TECHNICAL REPORT NUMBER 26

MILWAUKEE AREA ALTERNATIVE PRIMARY TRANSIT SYSTEM PLAN PREPARATION, TEST, AND EVALUATION

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Special acknowledgement is due Mr. Otto P. Dobnick, SEWRPC Senior Planner; Mr. David P. Jukins, SEWRPC Senior Engineer; Mr. Albert A. Beck, SEWRPC Senior Planner; and Mr. Robert E. Beglinger, SEWRPC Senior Engineer for their contributions to the preparation of this report.

Following the testing and evaluation of more than 50 alternative system plans, the Advisory Committee directed that two options—as depicted on the cover photographs—along with the base plan be presented for public reaction. One option would include bus-on-freeway rapid transit routes operated with high-capacity articulated motor buses, while the second option would initially include a light rail transit facility in Milwaukee's northwest corridor.

Photos courtesy of San Diego Transit and Siemens Corporation.

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Prepared by the
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This technical report, one in a series of four technical reports and one planning report documenting the findings of the Milwaukee area primary transit system alternatives analysis, conducted by the Regional Planning Commission, was financed through a joint planning grant from the U. S. Department of Transportation, Urban Mass Transportation Administration; the Wisconsin Department of Transportation; and Milwaukee County.

March 1982

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STATEMENT OF THE EXECUTIVE DIRECTOR

At the specific request of the Milwaukee County Executive, the Southeastern Wisconsin Regional Planning Commission in March 1979 undertook a study to determine the best means of providing rapid transit service within the greater Milwaukee area. The principal objectives of the study--termed in federal planning jargon a primary transit system alternatives analysis--were: 1) to identify those corridors within the greater Milwaukee area which can support fixed guideway transit facility development; and 2) to identify those transit modes which can best provide service within those corridors. These objectives required the Commission to reevaluate the feasibility of providing rapid transit service within the greater Milwaukee area by bus on freeway, bus on metered freeway, bus on reserved freeway lanes, bus on busway, and heavy rail rapid transit, as well as by light rail transit and commuter rail.

The design of any major element of an urban transportation system is a complex and difficult problem. The sheer size of the element to be designed alone presents a formidable obstacle. In addition, the complex pattern of interaction between the rapid, express, and local elements of the transit system, and between the transit system and the total transportation system in the Region, as well as between the total transportation system and existing and latent land use patterns, further complicates this difficult problem. Therefore, the design, test, and comparative evaluation of alternative rapid transit system plans under this study was an extensive and complex process. Under this study, however, these tasks were even more difficult than under most urban transportation planning studies for two reasons. First, a wide range of rapid transit modes had to be considered, most of which do not currently operate, or have never operated, within the Region. Second, a new approach, termed "alternative futures," was used for the first time in this transit planning effort. This approach attempts to deal with the uncertainties that currently exist about future conditions in the Region, which may be expected to significantly affect the need for and use of rapid transit facilities. Thus, a range of alternative system plans for each of the various rapid transit technologies had to be tested under a range of alternative future conditions in an attempt to identify those rapid transit facilities and services that could be expected to be viable under greatly varying future conditions. In order to evaluate each of the rapid transit modes under each of the sets of future conditions, a large number of alternative systems required examination. In all, the performance of 55 alternative rapid transit systems was simulated under this planning process.

This technical report documents—in considerable detail—the findings of the complex process by which the alternative primary transit system plans were designed, tested, and evaluated. For some of the transit modes—such as bus on freeway and heavy rail rapid transit—this study effort provides a needed periodic reexamination and reconsideration in light of changing conditions not only with respect to the existing and proposed land use patterns and the supporting transportation infrastructure and public attitudes toward investment in such facilities and services, but also with respect to factors which operate externally to the Region, such as lifestyles and the cost and availability of energy. For other transit modes—such as light rail transit and commuter rail—this study effort provides a first-time evaluation of their merits with respect to the provision of rapid transit service in the Milwaukee area. Through this process of alternative plan design, test, and evaluation, sufficient information and data have been collected and analyzed to permit identification of those corridors of travel demand within the Milwaukee area which can support specific primary transit modes under widely varying future conditions, and of those modes that can best provide rapid transit service in those corridors.

In many ways, the analyses documented within this technical report represent the heart of this elaborate and exhaustive study. It is the development of the alternative plans, as presented herein, which links together the various rapid transit technologies, the range of alternative future conditions, and the large assortment of detailed, yet vital, socioeconomic, land use, population, facility, and travel data assembled in the study. Similarly, it is the evaluation of each of these alternative plans against the adopted plan objectives, principles, and standards, as well as the comparison of the alternative plans against each other, which permits the sound selection of a recommended rapid transit system plan.

Respectfully submitted,

Kurt W. Bauer
Executive Director

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Chapter I

INTRODUCTION

System plan synthesis, or design, is a critical step in any primary transit system alternatives analysis. It is in the system design step of the alternatives analysis that the degree to which the system objectives can be met by alternative designs is determined. The provision of desired levels of service to existing and future land uses, the provision of increased levels of personal mobility by public transit, the reduction in transportation system congestion, and the modification of accessibility to influence desired patterns of land use development are in this step balanced against the economic, environmental, and social costs and impacts of primary transit system development and operation.

The design of any major element of an urban transportation system is a difficult task. The sheer size of the system to be designed presents a formidable obstacle to good design. The complex pattern of interaction among the components of the primary transit, total transit, and total transportation systems, as well as between these systems and the land use pattern, further compounds this difficulty. The fact that primary transit system development objectives must reflect the underlying value system of the resident population of the planning area makes the design of such a system even more difficult, since personal values concerning transportation in the Milwaukee area have been found to be diverse and often conflicting. Moreover, in the system plan design step, the primary transit facilities must be properly related to the existing transit and arterial highway facilities in order to provide, in effect, a single integrated transportation system, with the capacities and operation of its component parts carefully related to each other and to the existing and proposed land use patterns to be served.

Consideration must also be given in the primary transit plan design, test, and evaluation to those federal directives and regulations that may place constraints on the planning for, and implementation of, any recommended primary transit system. The U. S. Department of Transportation, Urban Mass Transportation Administration, requires that, in order for a study of primary transit systems that may include fixed guideway elements to be eligible for federal planning funds, and for the study recommendations to be subsequently eligible for federal capital assistance funds, that study must meet the requirements of an "alternatives analysis." [1] Based upon the findings and recommendations of such an "alternatives analysis"—the requirements of which this study is intended to meet—the U. S. Department of Transportation, Urban Mass Transportation Administration, will make available federal support for the provision of those primary transit facilities that are cost-effective. Such cost-effectiveness is determined by the degree to which a facility meets the transportation needs of the planning area, promotes its social, economic, environmental, and urban development goals, and supports national aims and objectives at the least cost of the alternatives considered.

Further constraints on the planning for rail primary transit systems in an "alternatives analysis" have also been set by the Urban Mass Transportation Administration.[2] These constraints require that for federal approval and subsequent funding of the recommendations of a primary transit plan that includes rail transit, the need for partially or fully grade-separated rail transit service must be shown clearly and convincingly; the proposed rail transit must be demonstrated to be, on balance, superior to other options in terms of ridership, capital and operating expenses, transportation service, and environmental, urban revitalization, and energy conservation objectives; the rail system must be approved and built in stages—one segment at a time; preference must be given to initial rail segments serving densely populated central portions of metropolitan areas, including central cities and

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[1] *See "Major Urban Mass Transportation Investments: Statement of Policy,"* *Federal Register*, *Volume 41, No. 185, September 22, 1976, pp. 41511-41514.*

[2] *See "Policy Toward Rail Transit,"* *Federal Register*, *Volume 43, No. 45, March 7, 1978, pp. 9128-9130.*

close-in suburbs; and localities proposing to build rail transit with federal assistance must be committed to the development and implementation of a program of local supportive policies and actions designed to enhance the proposed system's cost-effectiveness, patronage, and prospect for economic viability.

The regional air quality attainment and maintenance plan for southeastern Wisconsin, which is part of the federally required State Implementation Plan for air quality in Wisconsin, also places constraints on primary transit system planning. That plan recommends that long-term public transit service improvements be undertaken to promote increased use of transit and other high-occupancy vehicles in lieu of automobiles, thereby reducing vehicle miles of travel and air pollution emissions and contributing to the attainment of established ambient air quality objectives and standards.

The state-of-the-art of transportation system planning is such that in order to arrive at the best transportation system plan design, specific alternative plans initially representing a wide range of alternatives must be proposed, tested, and evaluated with respect to attainment of primary transit service objectives, with refinements being made in the plans in subsequent iterations. This approach requires the assimilation of large amounts of information, with the evaluation focusing on the degree to which each alternative plan meets the agreed-upon objectives.

PRIMARY TRANSIT PLAN DESIGN, TEST, AND EVALUATION IN THE MILWAUKEE AREA PRIMARY TRANSIT SYSTEM ALTERNATIVES ANALYSIS

The design, test, and evaluation of alternative system plans in the alternatives analysis for the Milwaukee area was more extensive than that required for most transportation studies. This is because the planning process was based not upon a single most probable forecast of future conditions, but rather upon the postulation of a number of alternative futures chosen to represent a range of future conditions which might occur over the plan design period. Using this approach, the performance of alternative system plans could be evaluated under a variety of possible future conditions. This evaluation could, in turn, serve to identify those primary transit system alternatives that perform well under a wide range of such conditions, and to differentiate these alternatives from those that perform well under only a few or a single set of future conditions. The alternative futures used in this planning process were selected to represent the probable extremes of a range of future conditions. The selection of these futures was based on the assumption that alternative system plans that perform well under the extremes of a range will also perform well at intermediate points in the range. In this way, "robust" system plans that could be expected to remain viable under greatly varying future conditions were identified.

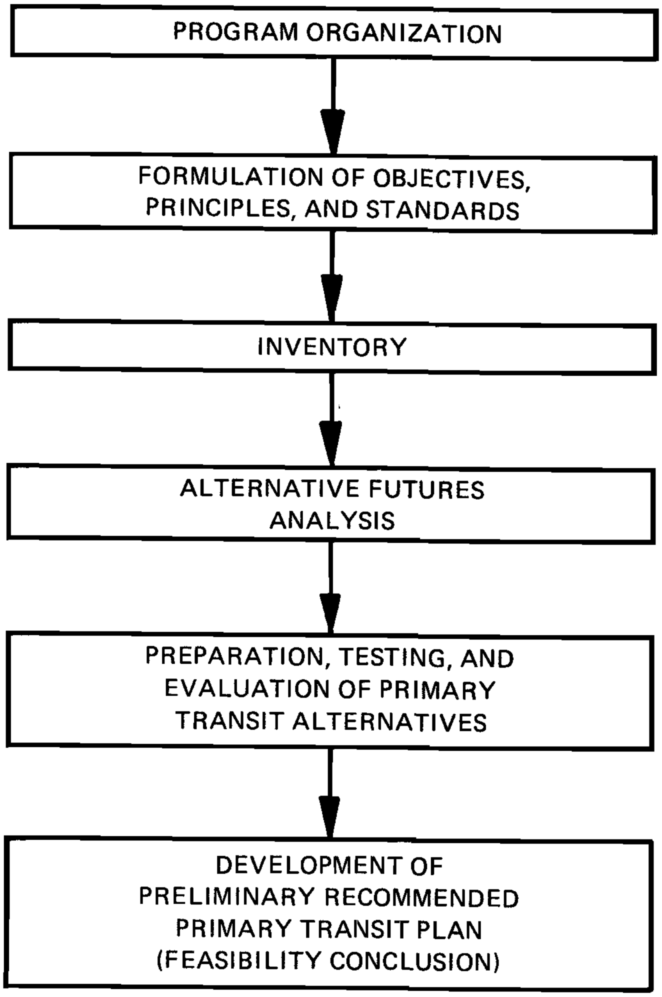
The Milwaukee area primary transit system alternatives analysis employed the six-step planning process shown in Figure 1. The first step of the planning process was program organization. Under this step, the work of the study was specified in more detail than set forth in the study prospectus. The next step was the formulation of primary transit system development objectives, principles, and standards to be used as a guide in the design, test, and evaluation of alternative primary transit systems. The third step was inventory—that is, the collection of pertinent planning and engineering data. The fourth step of the alternatives analysis was the conduct of the alternative futures analysis.

In the alternative futures analysis, four alternative futures representing the range of future conditions which may be reasonably expected to occur over the plan design period were developed. These futures were intended to reflect the effects of future changes in those factors which operate external to the Region, but which may be expected to affect regional growth and the degree of centralization and decentralization in the regional land use pattern.

The fifth step in the alternatives analysis was the design, test, and evaluation of alternative primary transit system plans for each of the four alternative futures identified in the alternative futures analysis. The sixth step was the development of a preliminary recommended primary transit system plan for the Milwaukee area. That plan was to consist of a "lower tier" and an "upper tier" of recommendations. Under this two-tier plan, recommendations placed in the lower tier are proposed for immediate implementation, while recommendations placed in the upper tier are not to be implemented for at least a decade. The upper tier consists of those elements that were found in the analyses to perform well only under some futures or a single future. The upper-tier recommendations are included in the plan to ensure that no action

Figure 1

THE MILWAUKEE AREA PRIMARY TRANSIT SYSTEM ALTERNATIVES ANALYSIS PLANNING PROCESS



Source: SEWRPC.

is taken that will preclude their possible implementation, while delaying their implementation until the certainty of their need is better established. The lower tier of the preliminary recommended primary transit plan consists of those elements of the alternative primary transit system plans that perform well under all or most alternative futures, and whose immediate incorporation into the existing transportation system is accordingly sound.

SCHEME OF PRESENTATION

This technical report sets forth the findings of the fifth and sixth steps in the alternatives analysis process: the design, test, and evaluation of alternative primary transit plans under each of the four alternative futures, and the development of the recommended primary transit system plan. Chapter II of the report describes the process used in the design, test, and evaluation of alternative primary transit system plans under each alternative future. The next four chapters of the report summarize the results of the design, test, and evaluation of the alternative plans considered under each of the four alternative futures, with one chapter being devoted to each future. Chapter VII presents the recommended plans for each of the four alternative futures, the conclusions concerning the feasibility of developing fixed guideway primary transit facilities in the Milwaukee area, and describes the recommended primary transit system plan for the Milwaukee area.

It should be noted that this technical report, together with its companion documents, SEWRPC Technical Report No. 23, Transit-Related Socioeconomic, Land Use, and Transportation Conditions and Trends in the Milwaukee Area; SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology; and SEWRPC Technical Report No. 25, Alternative Futures for Southeastern Wisconsin, is intended to document the procedures used in and data developed under, the alternative plans designed, tested, and evaluated under, and the decisions reached in the first phase of the primary transit system alternatives analysis for the Milwaukee area. The entire process is summarized, and the salient findings and recommendations set forth, in SEWRPC Planning Report No. 33, A Primary Transit System Plan for the Milwaukee Area, which serves as the principal product of the first phase of the alternatives analysis. Chapter VI of that report sets forth, in summary form, the findings of the primary transit plan design, test, and evaluation process and the recommended primary transit plan presented in greater detail in this technical report.

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Chapter II

METHODOLOGY FOR DESIGN, TEST, AND EVALUATION OF ALTERNATIVE PRIMARY TRANSIT SYSTEM PLANS

INTRODUCTION

The synthesis, or design, of a primary transit system for the Milwaukee area is the basic purpose of the Milwaukee area primary transit system alternatives analysis. It is also one of the most difficult as well as critical steps in the study. The sheer size of the system being planned, together with the complex pattern of interaction among the components of the system, between the primary transit system and the rest of the transit and transportation systems of the area, and between those transportation systems and the land use pattern, makes the design task a particularly difficult one. The need to design the plan to serve probable future, as well as existing, conditions in the Milwaukee area, conditions which may be significantly different from those which presently exist and influence primary transit needs—conditions relating to the size, characteristics, and spatial distribution of population and economic activity in the planning area, and to energy price and availability—further complicates this task. Finally, plan synthesis is as difficult as it is critical because it ultimately requires compromise among conflicting land use and transportation system development objectives.

To arrive at the best plan design, alternative primary transit system plans, initially representing the widest range of primary transit technology and network alternatives, were successively examined under the study, with each new iteration of plans providing a refinement of the previous iteration, based upon an evaluation of the plans with respect to attainment of the primary transit system development objectives adopted in the study.

The evaluation of alternative primary transit system plans necessarily involved the quantitative test of the alternative plans, and the preparation of estimates of the amount of travel each proposed primary transit system and the other elements of the total transportation system must carry. Without such quantitative estimates, the degree to which the plans meet certain objectives cannot be ascertained. Primary transit facilities and services affect traffic on the remainder of the transportation system, diverting persons and vehicles to or from other facilities and services. No primary transit system alternative plan can be soundly designed without knowing the probable extent of utilization of the proposed facilities and services, and the effects of this utilization on the remainder of the transportation system. In addition, it must be recognized that travel patterns in the Milwaukee area will change as existing land uses change and as new land uses are added to the regional complex. It is therefore essential that alternative primary transit plans be quantitatively tested. Such testing involves estimating future levels of travel demand for the alternative future land use patterns, and estimating the distribution of that future demand over the proposed primary transit facilities and services, and the transportation system as a whole. In this respect, the quantitative testing of alternative transit system plans provides the basis for the assessment of the engineering feasibility of alternative plans and of the degree to which each of the alternative plans meets the system development objectives.

This chapter identifies and describes the process of alternative primary transit system plan design, quantitative test, and evaluation that was used to arrive at a final recommended primary transit system plan under the Milwaukee area primary transit system alternatives analysis.

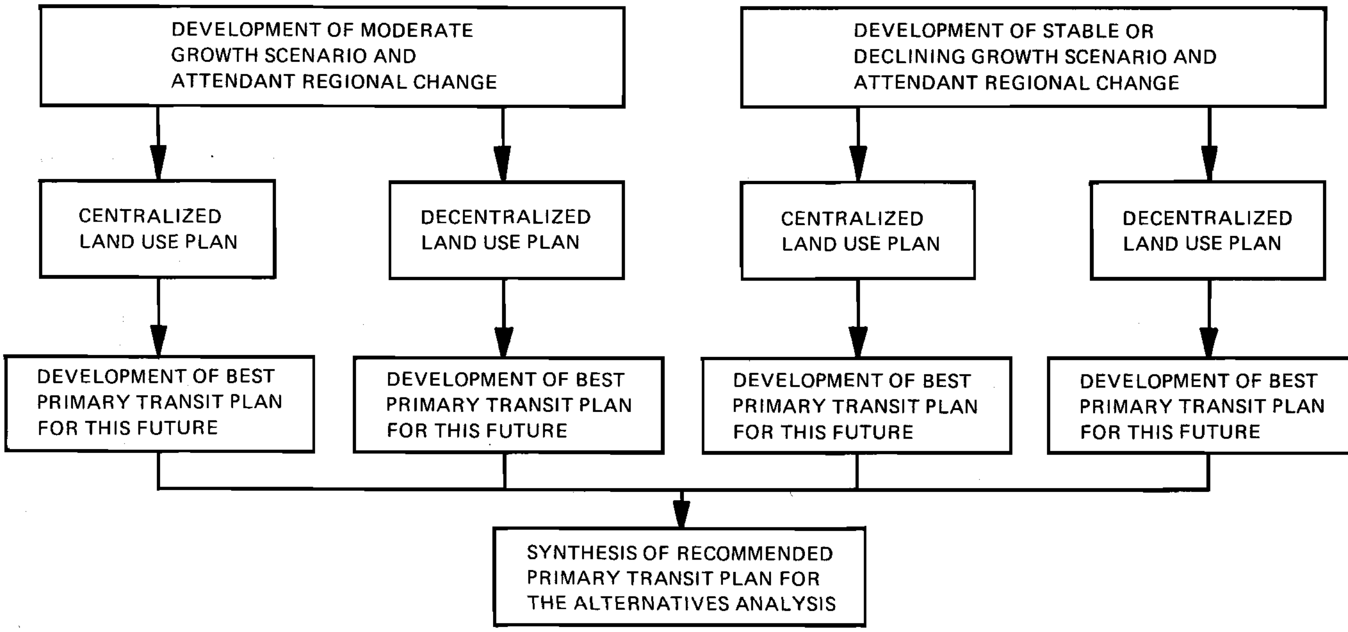
PRIMARY TRANSIT SYSTEM PLAN DESIGN, TEST, AND EVALUATION PROCESS

Under the alternative futures planning approach used in the alternatives analysis, four best primary transit system plans were developed, one for each of the four alternative futures postulated under the study (see Figure 2). The purpose of this approach was to permit the evaluation of the performance of alternative primary transit systems under a range of possible future conditions. In this way, primary transit system alternatives that may be expected to perform well under a wide range of future conditions could be identified and differentiated from those that may be expected to perform well only under a few or a single set of future conditions.

The final recommended primary transit system plan compiled from the alternatives was to consist of two tiers, a "lower tier" and an "upper tier."

Figure 2

SUMMARY OF PLANNING PROCESS OF THE PRIMARY TRANSIT SYSTEM ALTERNATIVES ANALYSIS



Source: SEWRPC.

The lower tier was to consist of those elements of the alternative primary transit system plans that the test and evaluation indicated would perform well under all or most alternative futures, and whose incorporation into the existing transportation system should therefore be sound in any case. The upper tier was to consist of those elements that the test and evaluation found would perform well only under some futures, or a single future. Recommendations placed in the lower tier are proposed for immediate implementation, while implementation of the recommendations placed in the upper tier proposed to be postponed until their need is better established over time. In this way, the recommended plan is intended to be a "robust" plan that will remain viable under greatly varying future conditions.

The design and test of alternative primary transit system plans for each of the primary transit technologies considered in this study was initiated under the most transit-oriented alternative future, or that future which may be expected to be accompanied by the greatest levels of primary and total transit use. This future envisions a combination of motor fuel cost and availability and levels and distribution of population and economic activity that will provide the most favorable environment for transit use compared with the other alternative futures. Because primary transit system alternatives determined to be infeasible under this most transit-oriented future may also be expected to be infeasible under other futures with conditions less conducive to transit use, these alternatives can be rejected without repeated testing and evaluation under other futures.

Primary transit system alternative plans were next tested under the alternative future least amenable to transit use. This future envisions a combination of motor fuel cost and availability and levels and distribution of population and economic activity that will provide the least favorable environment for transit use compared with the other alternative futures. The testing of transit alternative plans under those alternative futures that are the least oriented and the most oriented to transit use served to identify those options which have potential under the widest range of future conditions.

Following the design and test of alternative primary transit system plans under these two extremes of the range of future conditions in the Milwaukee area, the design and test of alternative transit system plans proceeded under the two remaining futures. These futures envision combinations of motor fuel cost and availability and levels and distributions of population and economic activity which may be expected to result in intermediate levels of transit use.

Figure 3 outlines the process used to develop the best primary transit system plan for each alternative future. As described above, the process involved the design, test, and evaluation of alternative primary transit system plans under each future. The process was divided into a number of steps intended to efficiently narrow down the number of technology and network alternatives to the most promising ones, rejecting unreasonable alternatives early in the process. Thus, under the process only the most promising alternatives received comprehensive evaluation and refinement.

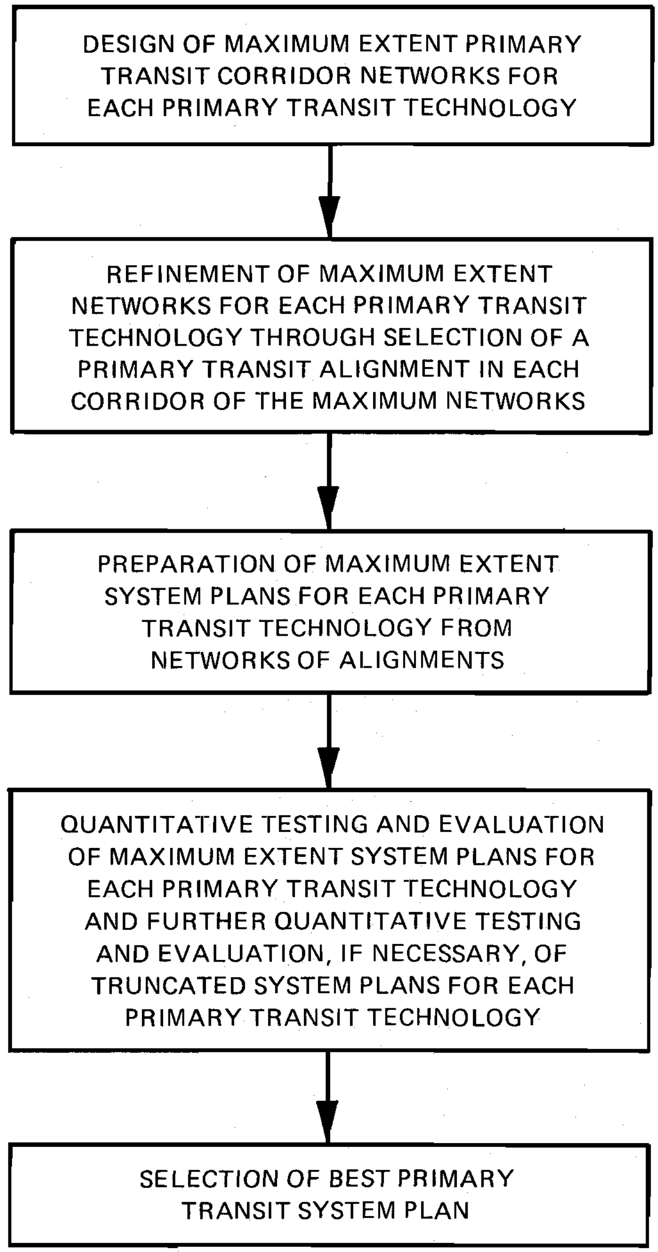
The first step in the plan design process conducted for each primary transit technology under each alternative future was the design of "maximum extent" primary transit system networks which encompass all logical corridors for primary transit service in the Milwaukee area. As set forth in the prospectus for the study, and as substantiated by the inventories of the state-of-the-art of primary transit technology[1] and of available rights-of-way for primary transit facility development[2] conducted under the study, seven primary transit technologies were considered for the Milwaukee area. These primary transit technologies consisted of a minimum baseline, or "do-nothing," alternative of motor bus operation in mixed traffic on freeways; a transportation systems management alternative of motor bus operation in mixed traffic on operationally controlled freeways, as recommended under the Commission's adopted long-range transportation system plan; motor bus operation on reserved freeway lanes; motor bus operation on busways; commuter rail transit; light rail transit; and heavy rail rapid transit.

[1] *See SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology.*

[2] *See Chapter VII of SEWRPC Technical Report No. 23, Transit-Related Socioeconomic, Land Use, and Transportation Conditions and Trends in the Milwaukee Area.*

Figure 3

PROCESS OF ALTERNATIVE PRIMARY TRANSIT SYSTEM PLAN DESIGN, TESTING, AND EVALUATION USED TO DEVELOP A BEST PRIMARY TRANSIT SYSTEM PLAN UNDER EACH ALTERNATIVE FUTURE



Source: SEWRPC.

Two of the three motor bus on freeway operation alternatives—motor bus operation on freeways in mixed traffic without operational control of the freeway system and motor bus operation on freeways on reserved lanes—were dismissed early in the study. Bus operation on freeways in mixed traffic without operational control was eliminated from further consideration in part because a freeway operational control system was already partially in place in the Milwaukee area and was achieving sufficient operational control on the Milwaukee area freeway system to increase operating speeds and improve traffic flow on its most congested segments. To plan further for the operation of buses in mixed traffic without operational control would have required an assumption that the existing freeway operational control system would be dismantled, and that the programmed installation of additional freeway ramp meters and the interconnection and central operational control of these ramp meters would not occur. Dismissal of the bus operation-on-freeway in mixed traffic without operational control alternative was also based in part on the fact that one of the purposes of considering bus-on-freeway operation alternatives in the study was to use such alternatives as a basis for the comparative evaluation of more capital-intensive exclusive guideway alternatives. Bus operation over operationally controlled freeways would present a more attractive low-capital investment alternative than bus operation on potentially congested freeways in mixed traffic. Such a comparative evaluation was required by the federal Urban Mass Transportation Administration in order to clearly identify the incremental benefits which can be derived from major capital investment in transit guideways.

These same basic reasons applied to the elimination from further consideration under this study of bus operation over reserved freeway lanes. Specifically, bus operation over operationally controlled freeways could provide the benefits of reserved lane freeway systems—preferential treatment and higher operating speeds for buses at relatively low cost; and a system for the operational control of area freeways was already partially in place in the Milwaukee area and achieving some degree of operational control. Furthermore, there were additional benefits attendant to the bus operation-on-operationally controlled freeway alternative. First, preferential treatment and higher freeway speeds for buses could be achieved with operational control without restricting freeway capacity for automobile travel to the same extent as would a reserved lane freeway system, and therefore without engendering as much diversion of automobile traffic from the freeway. Second, under the operational control alternative, the restriction on freeway traffic would occur in the same direction in which the improved bus service was provided. This would not be true where reserved freeway lanes are provided as contraflow lanes, and where, consequently, the automobile traffic restricted by the implementation of a reserved lane cannot be diverted to the bus service. Third, and perhaps even more importantly, reserved bus lanes could not be practically provided at a reasonable cost over the entire area freeway system, while freeway operational control could, and, in fact, would work best when applied systemwide. Reserved lanes cannot be practically provided systemwide in the Milwaukee area because of the location of the freeway-to-freeway interchange ramps and left-hand entrance and exit ramps on the freeway system. Developing freeway reserved lanes at these locations would entail significant construction costs. Fourth, operational control has a distinct safety advantage over contraflow reserved lanes in that it would not require buses to operate at high speeds with no physical separation between freeway traffic traveling in an opposite direction, as do contraflow reserved lanes.

The second step of the plan design process under each alternative future consisted of the refinement of the maximum extent corridor networks for each primary transit technology. Under this refinement, specific facility alignments in each primary transit corridor were investigated and the most cost-effective alignment identified. This step facilitated the preparation of capital costs attendant to each alternative system plan and provided the information needed to simulate accurately the operating characteristics of the alternative systems.

The third step in the plan design process was the preparation of maximum extent system plans for each primary transit technology under each alternative future by judicious combination of the selected alignments of each technology into a system plan. The fourth step in the plan design process was the quantitative test and evaluation of the extent to which the maximum system plan for each technology could be expected to meet the adopted primary transit system development objectives, principles, and standards under each of the alternative futures. Also part of this fourth step in the plan design process was the design, test, and evaluation, to the extent required, of further refined alternative primary transit system plans which truncated, or "cut back," the maximum extent system plans for each of the primary transit technologies. In order that the evaluation of these truncated plans could be more readily compared, motor bus-on-freeway primary transit routes were added to the truncated plans for each primary transit technology in those corridors where primary transit service by that technology was not provided, but was provided under the bus-on-freeway truncated plan.

The fifth and last step in the plan design process was the selection of a composite "best" primary transit system plan for each alternative future. As indicated in Figure 2, these "best" primary transit plans for the alternative futures constituted the basis for the synthesis of a recommended primary transit system plan for the Milwaukee area. The remainder of this chapter discusses in further detail each of the five steps in the process used in the design, test, and evaluation of alternative primary transit system plans under each alternative future.

Design of Maximum Networks

As already noted, the first step in the system plan design process was the synthesis for each alternative future of maximum extent networks for each primary transit technology. These networks were to serve all identified major corridors of demand for primary transit service in the Milwaukee area. Three maximum extent networks were initially synthesized: one for bus-on-freeway, one for commuter rail, and one for the fixed guideway alternatives of light rail rapid transit, heavy rail rapid transit, and busway. Only three maximum extent networks were synthesized because the bus-on-freeway primary transit network alternatives were necessarily limited in extent to existing and planned freeways, and the commuter rail networks were similarly necessarily limited to existing mainline railways. These maximum extent networks were initially identified in terms of general corridors, or sectors, within which primary transit service appeared to warrant consideration in the Milwaukee area. The remaining steps of the process to arrive at a best primary transit system plan for each alternative future involved successive refinement of these maximum extent networks, including the selection of specific alignments for the various primary transit modes within each corridor and the truncation, or "cutting back," of certain primary transit corridors if necessary to arrive at the best primary transit plan for each primary transit technology. This first step of the primary transit plan development process was particularly important because it established the maximum limits of primary transit development to be considered in the Milwaukee area for each transit technology under each alternative future.

The network, or spatial configuration, of the primary transit system plans has a significant impact on the costs and effectiveness of primary transit service, of the total transit system, and of the total transportation system. Primary transit service is intended to provide a high-speed and high-capacity alternative to other transit and to highway facilities in heavily traveled corridors. To accomplish this purpose, either an exclusive right-of-way is required in the corridor over which rapid transit service can be provided, or a freeway facility is required over which modified rapid transit service can be provided. As a practical matter, then, primary transit service cannot be ubiquitous in a planning area. Only those corridors characterized by high travel demands and/or by an availability of facilities or rights-of-way adaptable to the provision of primary transit service within reasonable costs and minimum disruption can be served by primary transit. These two factors—travel demand and right-of-way availability—therefore had to be explicitly considered in the design of maximum extent networks for each primary transit mode under each of the four alternative futures. It should be recognized, in this respect, that to a considerable extent, the design of primary transit networks to provide service in major travel corridors and over available rights-of-way is based on meeting the adopted primary transit system development objectives relating to economic efficiency, environmental quality, the provision of quick and convenient travel, and the minimization of urban disruption.

Major Travel Demands: A major consideration in the identification of any maximum extent primary transit network is the travel demand to be served. Only corridors of major travel demand will provide the level of ridership, and therefore direct benefits, necessary to justify the high costs of primary transit construction and operation. Heavily traveled corridors have a greater total market of travel from which primary transit can draw for its utilization, and certain characteristics of such corridors—principally arterial street and parking congestion—make them particularly attractive as potential locations for high-speed primary transit facilities. And importantly, greater reliance on transit for travel in densely traveled corridors can bring about significant secondary desirable impacts on arterial highway traffic congestion, motor fuel consumption, and air pollutant emissions, which add to the benefits of primary transit construction and operation. Moreover, primary transit may be the only feasible alternative in such corridors for the provision of reliable and adequate public transit service.

Corridors of major travel demand were identified through analysis of the location of existing and proposed major land use activity centers, or travel generators; through analysis of the concentration of existing and probable future travel desire lines; through analysis of the concentration of existing and probable future travel on the existing arterial street and highway and public transit systems; and through analysis of existing public transit routes of heavy ridership in the Milwaukee area. This identification of corridors of major travel demand was accomplished irrespective of primary transit mode.

An important consideration in the design of the maximum extent networks was the location of existing and proposed major land use activity centers in the Milwaukee area, including major retail and service centers; major industrial centers; major medical centers; major park and outdoor recreation areas; technical and vocational schools, colleges, and universities; intercity transportation terminals; and high-density residential areas. These centers and areas represent major concentrations of trip origins and destinations in the Milwaukee area. The provision of primary transit service to and between these major land use centers and areas may be expected to improve the transportation system of the Milwaukee area by alleviating peak loadings of travel on highway facilities serving these major travel concentrations, and could reduce the demand for land for automobile parking at these major centers.

Another important consideration in the design of the maximum extent networks was the existing and probable future concentration of travel desire lines in the Milwaukee area. A travel desire line is a straight line linking a trip origin to a trip destination, irrespective of existing or planned transportation facilities. Analysis of travel by desire lines provides a means for identifying the most efficient way in which travel demand can be served—namely, by directly linking origins to destinations. Major corridors of such travel desire lines in the Milwaukee area were identified by the use of "spider network analyses," in which all planning analysis areas within the Milwaukee area, irrespective of existing or planned transportation facilities, were directly connected, and existing and probable future travel demand over those connections analyzed. Those corridors lying along spider network links which carried the heaviest volumes of existing and probable future travel demand provided a focus of attention in the design of the maximum extent primary transit networks.

Yet another important consideration in the design of the maximum extent primary transit system networks was the future passenger volumes which may be expected on the Milwaukee area transportation system in the absence of any primary transit system improvement or expansion. Those parts of the area transportation system carrying the highest volumes of traffic—in particular, those parts of the arterial street system carrying high traffic volumes and experiencing traffic congestion—were used to help define corridors of heavy travel demand with potential for primary transit application. Corridors of future heavy travel demand identified in this manner, however, reflect the constraints of the location and capacity of the existing Milwaukee area transportation system.

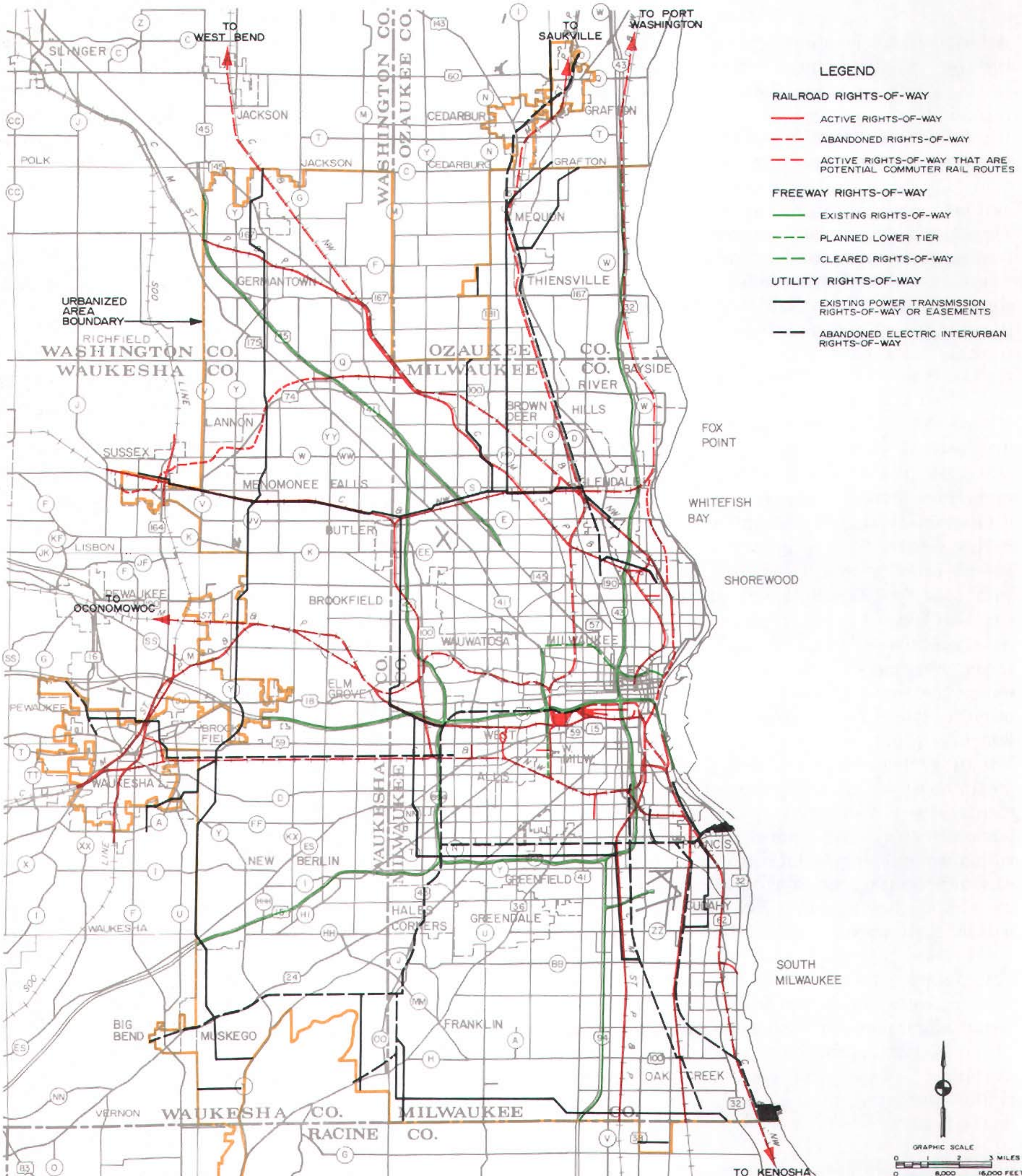
Another important consideration in the design of the maximum extent primary transit networks was the existing public transit routes with heavy ridership in the Milwaukee area. Consideration was thus given to the need to provide improved service along the currently most heavily traveled public transit routes in the Milwaukee area, particularly focusing on those routes whose efficiency of movement would substantially benefit from upgrading to primary transit service.

Availability of Rights-of-Way: The other major consideration in the design of the maximum extent primary transit system networks was the availability of potentially suitable rights-of-way for primary transit. The potential for the development of primary transit service in the Milwaukee area may be expected to be influenced by the extent to which alignments are available for primary transit development at a minimum of cost and disruption.

The potential availability of a number of rights-of-way for light rail, heavy rail, and motor bus-on-busway fixed guideway location, including active and abandoned railway rights-of-way, existing and cleared freeway rights-of-way, existing electric power transmission line rights-of-way, and abandoned electric interurban railway rights-of-way, as shown on Map 1, was investigated. Appropriately designed fixed guideway transit facilities can be developed over some of these rights-of-way at a minimum of cost and community disruption. The findings of this investigation are documented in Chapter VII of SEWRPC Technical Report No. 23, Transit-Related Socioeconomic, Land Use, and Transportation Conditions and Trends in the Milwaukee Area. Map 1 also indicates the potential location for future bus-on-freeway primary transit service in the Milwaukee area—specifically, existing freeways and freeways proposed to be constructed under the lower tier of the adopted long-range

Map 1

POTENTIALLY AVAILABLE PRIMARY TRANSIT RIGHTS-OF-WAY



The availability of alignments for primary transit fixed guideways within existing rights-of-way can affect the cost and practicality of alternative primary transit system configurations and alternative primary transit modes. Within the Milwaukee urbanized area there are a variety of rights-of-way which have the potential to readily accommodate primary transit guideways. These rights-of-way include for light rail, heavy rail, and motor bus guideways, abandoned electric interurban railway rights-of-way, electric power transmission line rights-of-way, freeway rights-of-way, and active and abandoned railway rights-of-way; for commuter rail lines, existing railway lines; and for motor bus, existing freeway lanes.

Source: SEWRPC.

regional transportation system plan. Potential rights-of-way for commuter rail primary transit are also shown on Map 1.

A potential for locating light rail and busway facilities on existing arterial street rights-of-way also exists. While such locations would not allow the provision of totally exclusive guideway primary transit service, with sufficient preferential treatment provided to the primary service, such locations should permit the operation of a light rail system or a bus system that provides a level of service somewhere between true primary, or rapid transit, and true secondary, or express transit, service over reserved street lanes. Such alignments, as shown on Map 2, include, but are not limited to, possible transit malls, particularly in the Milwaukee central business district, and the wider medians of arterial streets in the Milwaukee area.

Refinement of Maximum Networks

The second step of the plan design process consisted of the refinement of the initially delineated maximum extent primary transit networks for each primary transit technology under each alternative future. The refinement of each maximum extent primary transit network involved the selection of a specific alignment within each corridor for each type of guideway. The need for evaluation of alternative alignments, and selection of a preferred alignment, within the identified maximum extent network of primary transit corridors was only necessary for the primary transit technologies which required construction of fixed guideways. For these technologies of heavy rail, light rail, and motor bus on busway, several alternative alignments were investigated in each corridor. For the bus-on-freeway and commuter rail technologies, which use existing facilities for operation, this step was unnecessary, as alternative alignment options were not present, and the required alignments within each corridor could be readily identified.

Four factors, discussed at some length later in this section, were considered in the selection of a preferred alignment for each type of guideway alternative: construction cost; attendant community disruption; travel time advantage offered; and market potential, or the number of residents and jobs served.

It should be noted here that the selection of alignments within a corridor of each type of primary transit guideway can, at this stage in the planning process, be only preliminary. As indicated in Chapter I of SEWRPC Planning Report No. 33, A Primary Transit System Plan for the Milwaukee Area, more detailed engineering investigations of each alternative alignment must be undertaken in the second phase of the study. The preliminary selection of an alignment in the first phase of the study, is, however, a necessary step to allow the assessment at an adequate level of detail of the extent to which network plans meet the primary transit system development objectives adopted under the study.

The process of alignment evaluation and selection was based upon a limited number of key standards selected from those adopted under the study. These key standards were chosen to permit adequate identification of the major costs and benefits of the primary transit alternatives, while permitting the efficient screening of a large number of primary transit alternatives. The key factors assessed included the capital cost; travel time; community disruption; and the potential market expressed in terms of the number of residents and jobs in the service area.

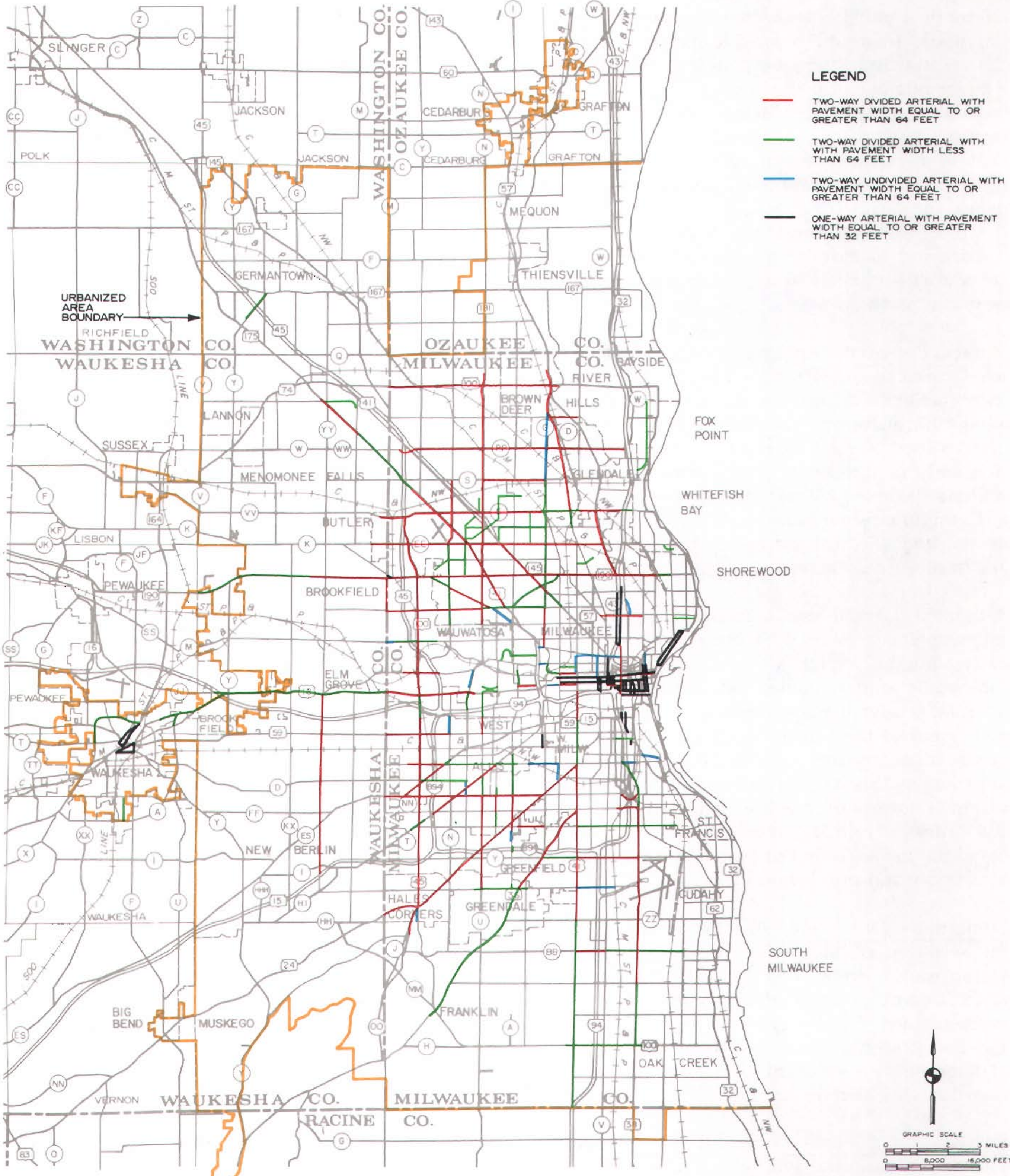
Cost of Primary Transit: An important consideration in the selection of the preferred facility alignments within each corridor was the capital cost. Inordinate capital costs made some alternatives infeasible, or decidedly inferior to others. The capital, or guideway construction, costs were initially assumed to be the only element costs which would differ significantly between alternative alignments within each corridor. The guideway construction costs assessed included the costs of constructing new facilities, or reconstructing or extending existing facilities, and of providing necessary traffic control and signaling systems and electrification facilities.

Estimates of the initial capital costs of constructing the alternative alignments were developed by applying average unit prices to each alternative alignment. The unit costs used are set forth in SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology. Information on the cost of upgrading existing rail facilities to conditions suitable for safe and efficient commuter rail operation is provided in Chapter VII of SEWRPC Technical Report No. 23, Transit-Related Socioeconomic, Land Use, and Transportation Conditions and Trends in the Milwaukee Area.

Travel Time: Another consideration in the selection of the preferred facility alignments within

Map 2

POTENTIALLY AVAILABLE RIGHTS-OF-WAY FOR LIGHT RAIL OR MOTOR BUS WITHOUT FULLY EXCLUSIVE GUIDEWAY



Light rail or motor bus transit service approaching primary levels can be provided at-grade on standard surface arterial streets if preferential treatment is provided. Specifically, either the existing lanes of the facilities must be reserved exclusively for transit use, or a portion of the right-of-way, such as the median, must be converted to exclusive transit use. In addition, some type of priority or preferential treatment should be provided at at-grade intersections. Shown on this map are those standard arterial facilities in the Milwaukee area with the greatest potential to accommodate such primary transit facilities—namely, those standard arterial streets with medians, and those standard arterial two-way streets of six or more lanes and one-way streets of three or more lanes.

Source: SEWRPC.

each corridor was an assessment of the increased accessibility and reduced travel times that the alternatives could be expected to provide to potential users. In order to provide improvement over the existing transit system, as well as to attract a larger number of transit riders and provide some secondary systemwide benefits, new primary transit facilities must offer a significant travel time advantage over existing secondary and tertiary transit services. In the selection of the preferred alignments for each of the primary transit alternatives, the travel times to the Milwaukee central business district and to certain other selected major travel generators attendant to each alternative alignment were compared.

Market Potential: Another consideration in the selection of the preferred facility alignments within each corridor was the size of the potential market along the alignment. Indicators of the potential market used were the size of the resident population and the number of jobs within a one-half-mile walking distance, a three-mile driving distance, or a 15-minute feeder bus travel time of the alignments, and the major travel generators that the alignments would serve.

Although it would have been desirable to forecast ridership for each primary transit alignment alternative in this sketch planning evaluation, such forecasting was precluded by the number of the alternative alignments examined at this stage. The assessment of the market potential was believed to be an adequate surrogate for full-scale simulation modeling at this stage of the planning process, providing a means of quickly identifying infeasible and inferior primary transit facility alignments based on an assessment of potential ridership, cost, disruption, and travel time advantage.

Community Disruption: Another consideration in the selection of the preferred facility alignments within each corridor was the potential disruption of existing neighborhood and community development entailed. Displacement of homes, businesses, and industries was considered to be a critical factor in determining the feasibility of alternative primary transit facility alignments.

Formulation of Maximum Extent System Plans

The third step in the synthesis of a primary transit system plan under each alternative future was the preparation of system plans of maximum extent for each primary transit technology under each alternative future. The first step in this synthesis of system plans involved the review and modification, as necessary, of the selected preferred alignments in combination for each fixed guideway primary transit technology. This was done to minimize any duplication in those selected alignments. The second step in this synthesis was the selection of facility locations and services for each transit technology, including the identification of routes, stations, and storage and maintenance facilities.

Test and Evaluation of Maximum Extent System Plans

The fourth step in the primary transit system plan synthesis process was the test and evaluation of the maximum extent system plans for each primary transit technology alternative: light rail transit, heavy rail rapid transit, commuter rail, motor bus on busway, and motor bus on controlled freeway in mixed traffic. This test and evaluation of the maximum extent alternative system plans for each mode under each alternative future provided the basis for the truncation of the maximum extent system plans into five "best" pure mode system plans for each alternative future—a bus on operationally controlled freeway plan, a commuter rail plan, a bus on busway plan, a light rail transit plan, and a heavy rail rapid transit plan. So that the evaluation of these truncated plans would be comparable in terms of the extent of service provided, bus-on-freeway routes were added to each truncated plan for each technology in each corridor where the truncated plan did not provide service, but the truncated bus-on-freeway plan did. These five truncated composite plans developed for each alternative future were subsequently tested, evaluated, and compared, and a best plan was selected for each alternative future. Subsequently, a recommended primary transit system plan of two tiers for the Milwaukee area was developed from the four best composite plans.

In order to facilitate consideration of all the factors that are important in plan evaluation and to facilitate the necessary participation by responsible public officials and concerned citizens in the plan evaluation process, it was necessary to quantitatively test each plan, evaluating each against the other alternative plans and the agreed-upon primary transit system development objectives and supporting standards. The following discussion is intended to set forth the process used to quantitatively test the alternative primary transit system plans synthesized under the Milwaukee area primary transit system alternatives analysis.

Alternative Primary Transit Plan Evaluation: The purpose of alternative primary transit system plan evaluation is to determine how well each alternative primary transit system plan achieves the primary transit system development objectives adopted under the study and, in so doing, identify the best plan to be recommended for implementation under the study.[3] The alternative primary transit system plans synthesized under the study were evaluated by comparing the ability of each alternative plan to meet key standards supporting selected system development objectives formulated under the study, and to satisfy the overriding considerations formulated under the study. This comparative assessment of alternative plans was made using supporting tables, figures, and maps. The plans were evaluated on an areawide basis as well as on a corridor basis, as necessary. In addition, a summary table, or matrix, of the evaluative information was prepared summarizing the degree to which each alternative plan meets each of the selected standards and related objectives.

The above-described methodology provided a comprehensive basis for the test and evaluation of each alternative plan considered. However, if both the evaluative information prepared under this approach and the summary table were found to be too large and cumbersome for practical use, three methods were to be used for reducing to a more manageable size the information developed concerning the satisfaction of objectives and standards by alternative plans. These methods were to be pursued successively, with each additional method being used only as necessary to arrive at a recommended plan. The first method was to simply reduce the size of the summary table by eliminating those standards which showed no significant difference in the degree of attainment by alternative plans, and by eliminating those alternative plans which under all standards were less desirable than other alternative plans. The reduced summary table was to be supported by an analysis of the key advantages and disadvantages of the remaining standards among the remaining alternative plans. The remaining alternatives were to be arranged in order of increasing cost, and the gains and losses that would result from the implementation of the increasingly more costly alternatives identified. This was the only method which was found necessary in the study for the reduction of evaluation data to a more manageable size.

The second method which was to be applied if necessary was a graphical approach, involving a comparison of the rankings of each alternative plan under each adopted standard. Under this approach, the study advisory committee was to rank each alternative plan against all other plans for its achievement of each standard. A figure was to be prepared with each standard listed along its top and showing each plan as a colored line connecting its ranking under each standard.

A third evaluation method, the rank-based expected value method, was also to be applied if necessary. This method, an adaptation of a method used in corporate and military decision-making, seeks to assign a numeric value to each alternative plan. This method simplifies the plan evaluation problem to one of rank ordering each alternative plan under each of the stated development objectives and then rank ordering the importance of each objective. It also involves explicit consideration of the uncertainty of plan implementation in the selection of the best plan. Specifically, the study advisory committee was to develop an ordering of plans by multiplying the rank-order value it would assign each plan under each development objective by the rank-order value it would assign to each primary transit system development objective, summing these products, and multiplying the result by the implementation probability of each plan.

QUANTITATIVE TESTING PROCEDURES IN PRIMARY TRANSIT PLAN EVALUATION

As already noted, comprehensive evaluation of alternative primary transit system plans involves the quantitative test of those plans. This requires the preparation of forecasts of travel on the primary transit system, on the total transit system, and on the total transportation system. Such quantitative testing of alternative primary transit system plans, accomplished through simulation of area travel and traffic, is essential to the design of an integrated primary transit and transportation system, a system in which the capacity and operation of the component parts are carefully related to one another and to existing and probable future travel demands. No primary transit facility or service can be soundly planned, designed, or implemented without the understanding of the transit systems obtained through travel simulation modeling of the distribution of existing and probable future travel patterns, not only over the proposed primary transit facilities and services but over the remainder of the transportation system as well.

[3] *See Chapter II of SEWRPC Planning Report No. 33, A Primary Transit System Plan for the Milwaukee Area.*

The simulation of travel and traffic is based on the premise that the magnitude and pattern of travel together is a stable function of the characteristics of the land use pattern and of the transportation system, with the term land use here referring to certain demographic, economic, and land use characteristics. In travel simulation modeling, those aspects of land use development and of the regional transportation system which affect the magnitude and pattern of travel demand are identified, quantified, and correlated with such travel through the analysis of detailed travel origin-and-destination survey data and land use and transportation system survey data. It has been demonstrated that the relationships between land use and the transportation system and travel so established remain reasonably stable over time, thus enabling the forecast of future travel patterns based upon a future land use pattern.

Given the necessary land use and transportation system data, the complete sequence of travel simulation occurs in four steps:

1. Trip generation, in which the total number of person trips generated in each subarea of the planning area for the time period under analysis is determined using relationships found to exist between land use and travel by analyses of the planning inventory data. The output from this step is the total number of person trip ends—that is, trips entering and leaving each subarea of the study area.

2. Trip distribution, in which the person trips generated in each subarea are linked with ends from other subareas, thereby defining the universe of person trips by point of origin and point of destination. The output from this step is the number of person trips made between each subarea pair.

3. Modal split, in which the number of person trips between each subarea pair is divided among the travel modes, primarily mass transit and automobile, the term automobile being defined to include vans in personal use. The automobile person trips are further converted to vehicle trips based upon automobile occupancy. The output of this step is the number of person trips made between each subarea pair by mass transit and the number of vehicle trips made between each subarea pair by automobile, including carpools and vanpools.

4. Traffic assignment, in which the intersubarea transit trips are assigned to the existing or proposed transit system network, and the intersubarea vehicle trips are assigned to the existing or proposed highway facility network. The output of this step is the number of people utilizing each route of the existing or proposed mass transit system and the number of vehicles utilizing each segment of the existing or proposed arterial street and highway system.

The end result of the four-step travel simulation process is a complete description of the use of an existing or proposed transportation system, highway, and transit system. Although the four steps set forth above provide a general description of the travel simulation modeling process, some variations are necessary and desirable for the various types of trips to be simulated. Thus, the simulation of travel demand is a complex procedure requiring application of a variety of mathematical and statistical techniques and consideration of all components of travel in an urban region.

A battery of travel simulation models was first used and developed on a regional scale in southeastern Wisconsin during the initial land use-transportation study conducted by the Commission in 1963. The development of the Commission's original design year 1990 regional transportation system plan was in part based upon quantitative analyses of the performance of alternative highway and transit systems permitted by the battery of travel simulation models developed to forecast average weekday travel for that study.

Between the completion of that initial regional land use-transportation planning effort in 1966 and the initiation of the major plan reevaluation effort in 1972, the emphasis on, and consequent need for, quantitative analysis of the performance of alternative transportation systems had increased, and significant advances in the state-of-the-art of travel simulation modeling had occurred. As a consequence, the Commission found it desirable to review and, as needed, refine the initial battery of traffic simulation models for use in the regional transportation plan reevaluation effort of 1972.

The first step in this review process consisted of an analysis of the adequacy of each individual model used in the initial study. The effectiveness of this analysis was greatly enhanced by the fact that major travel inventories were available for two points in time—1963 and 1972—thus permitting examination of the temporal stability of the traffic simulation models. The Commission's original travel simulation models, calibrated using 1963 home interview survey data, were shown through this testing, which used as input socioeconomic and land use survey data gathered in 1972, to accurately estimate travel in southeastern Wisconsin in 1972. This successful testing of the initial study procedures, a testing much more difficult than that typically used in transportation planning, should be regarded as an important validation of the accuracy of those procedures. However, although the adequacy of the initial study procedures was proven through this analysis, an investigation of newer modeling strategies was conducted and some of these strategies were incorporated into the travel simulation process for use in the plan reevaluation. A complete description of the initial study procedures can be found in SEWRPC Planning Report No. 7, The Regional Land Use-Transportation Study, Volume Two, Forecasts and Alternative Plans: 1990. A complete description of the analysis of the temporal stability of the initial study procedures and of the revised battery of travel simulation models used for the land use-transportation plan reevaluation effort is given in SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume Two, Alternative and Recommended Plans.

The travel simulation modeling to be conducted for the primary transit alternatives analysis will utilize the battery of travel simulation models developed under the regional land use-transportation plan reevaluation efforts completed in mid-1978. A review of advances in the state-of-the-art of travel simulation modeling since that time has indicated little practical refinement that should be incorporated into the travel simulation process.

CLASSIFICATION OF TRAVEL

An important consideration in the Commission's existing battery of travel simulation models is the classification of the different components of travel within the Region. Such classification of trips is necessary because different types of trips exhibit different characteristics and, as a consequence, require different simulation techniques. In addition, some of these types of trips represent very small proportions of total travel in an urban region: the classification of trips and the determination of the relative proportion of total travel they represent allow travel simulation modeling resources to be focused on those types of trips which represent the greater proportions of travel.

The first major distinction which can be drawn is between internal and external travel, as shown in Table 1. Internal trips are defined as those trips which have both ends within the Southeastern Wisconsin Region. External trips are defined as those trips which have one or both ends outside the Region. Travel internal to the Region accounted for over 96 percent of the vehicle trips and 97 percent of the person trips observed on an average weekday in 1972, and during peak travel periods accounted for even larger portions of total vehicle trips and person trips in the Region. Therefore, the primary emphasis in the Commission's simulation of average weekday travel has been, and the emphasis of modeling procedures in the Milwaukee area primary transit system alternatives analysis will be, on internal trips.

Among internal trips, further important distinctions can be made based upon mode of travel. The major transportation modes in southeastern Wisconsin include automobile, public transit, school bus, truck, and taxicab. In 1972 internal automobile travel accounted for nearly 86 percent of all internal person trips made in the Region on an average weekday; internal public transit accounted for an additional 4 percent; and internal school bus travel for an additional 3 percent. Heavy truck, light truck, and taxicab internal trips accounted for approximately 7 percent of all internal person trips made in the Region on an average weekday in 1972.

The trips made by internal public transit and automobile, which together accounted for 87 percent of total regional average weekday person trips, can be further classified by the type of living quarters of the persons making the trip—namely, households in the Region, group quarters in the Region, and households outside the Region. Group quarters are defined as dormitories, convents, homes for the aged, and similar group residences. Together, trips made by residents of group quarters and nonresidents accounted for slightly more than 1 percent of the total person trips made within the Region in 1972.

The primary emphasis of travel simulation modeling is accordingly focused on internal automobile and transit travel by residents of the Region who reside in households. These trips represent almost 86 percent of the total trips made within the Region on an average weekday. Importantly, such trips can be further classified according to the purpose of the trip—specifically, home-based work, home-based shopping, home-based other (excluding school), nonhome-based (excluding school), and all school trips. Home-based trips are defined as those trips having one end located at the residence of the tripmaker. The purpose of the home-

Table 1

TRIP CLASSIFICATION AND PLAN REEVALUATION TRAVEL SIMULATION PROCEDURE

Trip Classification					Simulation Procedure				
					Trip Generation				
Internal or External	Mode[a] of Travel	Type of Quarters	Trip Purpose	Percent of Total Trips	Production	Attraction	Trip Distribution	Modal Split	Traffic Assignment
Internal	Automobile, Transit Bus, and School Bus	Nongroup Quartered Residents	Home-Based Work	21.0	Cross-Classification Analysis	Multiple Regression Analysis	Gravity Model	Logit Analysis	Highway Using the Federal Highway Administration's Urban Transportation Planning Computer Programs
			Home-Based Shopping	13.4					
			Home-Based Other (excluding school)	30.5					
			Nonhome-Based (excluding school)	15.5	Multiple Regression Analysis				
			School	8.3	Average Factor		Existing Patterns	N/A	
		Group Quartered Residents	All	0.5					
		Nonresidents	All	0.6					Transit Using the Urban Mass Transportation Administration's Urban Transportation Planning System
	Heavy Truck	All	All	3.7	Multiple Regression Analysis		Fratar Model		
	Light Truck and Taxi	All	All	4.0					
External	All	All	All	2.5					

N/A Not Applicable.

[a]Not including the lesser modes of railroad, bicycle, motorcycle, air travel, water travel, and charter bus.

Source: SEWRPC.

based trip is determined by the nonhome end of the trip, either work, shopping, or other, with "other" representing an aggregation of personal business, medical-dental, social-eat-meal, and recreation trip purposes, as well as trips made solely to transport passengers. Nonhome-based trips are defined as those trips having neither end located at the place of residence of the tripmaker, and made for any purpose except school. Home-based and nonhome-based school trips must be considered separately because of the arbitrary constraints upon travel patterns imposed by school service-area boundaries. Trips to and from all schools—elementary, junior and senior high, and vocational and technical schools, and universities—represented approximately 8 percent of all person trips observed within the Region on an average weekday in 1972.

TRIP GENERATION

Basic Concepts

The first major step in the travel simulation process is trip generation, in which the total number of trip ends generated within each subarea of the study area is determined through the identification and quantification of relationships between travel and land use. Within trip generation, then, the travel data are expressed in terms of trip ends which may be conveniently represented as points in space with no regard to the direction, length, or duration of the trip. By convention, one end of each trip is termed the "production" end while the other end is termed the "attraction" end. For home-based trips, the production end is always considered to be the home end of the trip while the attraction end is always considered to be the nonhome end, irrespective of the actual direction of the trip. For nonhome-based trips, the production end is defined as the origin of the trip while the attraction end is defined as the destination.

Two sets of trip generation relationships are consequently developed. One set is developed for the production end of trips generated within the planning area and involves relating trip ends primarily to residential land uses. The other set is developed for the attraction end of trips generated within the planning area and involves relating trip ends primarily to nonresidential land uses.

There are four basic approaches to trip generation: factoring of existing trip patterns, land area trip analysis, regression analysis, and cross-classification analysis. The most basic approach to trip generation is the application of growth factors to existing travel patterns. Since the growth factor is applied to observed trip interchanges, this approach actually represents a combination of the trip generation and trip distribution steps. Usually this approach is used only for relatively small trip categories such as external trips, or for trip purposes for which trip distribution would be artificially constrained, such as school trips.

The second approach deals explicitly with land areas, and has as its objective the establishment of trip rates which reflect the character, location, and intensity of the land use. Trip rates, in terms of trips per acre, are determined for different kinds of land uses such as residential, commercial, and industrial. To forecast future trip generation, these rates are simply applied to the projected land use distribution in each zone.

The third approach involves the development of trip generation relationships using linear regression analysis. In this procedure, the dependent variable—the number of trips generated per zone or household—is determined by a linear combination of independent variables representing the land use and socioeconomic characteristics of the zone or household. To account for any nonlinear effects that an independent variable may have on the dependent variable, a monotonic transform such as a logarithmic or exponential transform may be made on an independent variable.

In cross-classification, the trip generation relationships are developed by establishing a multidimensional matrix. Each dimension of the matrix represents an independent or explanatory variable of tripmaking—such as household income, household size, or automobile availability—which is stratified into several classes. Values of the dependent variables—number of trips—are accumulated for each matrix cell from the household survey data, and the mean trip generation rate for that cell is determined. Thus, the value of each matrix cell represents the average trip production rate for households which possess the cell's independent variable characteristics. The model can then be applied to any geographic subarea of the Planning Region to obtain trip production estimates by linking the characteristics of the households within the subarea to the appropriate trip generation rate and summing the total number of trips made by all households residing in that area.

The selection of approaches to determine trip generation is dependent upon the type of trip to be simulated, the data available for calibration, and the particular needs and character of the study area.

Plan Reevaluation Trip Generation Procedures

As can be seen in Table 1, trip generation relationships were developed for the plan reevaluation effort through the use of: cross-classification analysis for major internal home-based trip productions; multiple regression analysis for major internal home-based trip attractions and for nonhome-based trip productions and attractions; average factoring of existing travel patterns for school trips, trips by persons in group quarters, and nonresident internal trips; and multiple regression analysis for truck and taxi trips and external trips.

Internal home-based trips by the residents of households in the Region constitute the vast majority of daily trips made within the Region. The production of these home-based trips was analyzed and forecast through the use of cross-classification analysis. Home-based trips were stratified into categories of home-based work, home-based shopping, and home-based other. As already mentioned, the home-based trip purposes of personal business, medical-dental, social-eat-meal, and recreation, as well as trips made solely to transport passengers, were combined into a single category—home-based other—as such trips were found in the 1972 travel survey and 1963 travel inventory to have reasonably similar trip production, attraction, and length characteristics. Within each trip purpose used in the modeling process, four category models were developed for forecasting future household trip production according to geographic location. These models are for the Milwaukee urban area, the Racine urban area, the Kenosha urban area, and all remaining areas within the Region (see Map 3). Separate models for these four areas were developed for each trip purpose because initial analyses based upon average values of household trip production as surveyed in 1963 and 1972 indicated substantial differences in tripmaking frequency between highly urbanized areas of the Region and the remaining areas of the Region, and between urban areas of different size within the Region.

An important consideration in the development of the trip production category models was the selection of the variables to be used to explain household trip frequency. Among the variables considered and investigated were automobile availability, household size, household income, structure type, neighborhood density, and stage in family life cycle. Household automobile availability and household size were selected as the independent variables to explain tripmaking in the trip generation model, since these variables exhibited a high correlation with tripmaking frequency, and explained most of the variation in household tripmaking as observed in the 1963 and 1972 surveys.[4]

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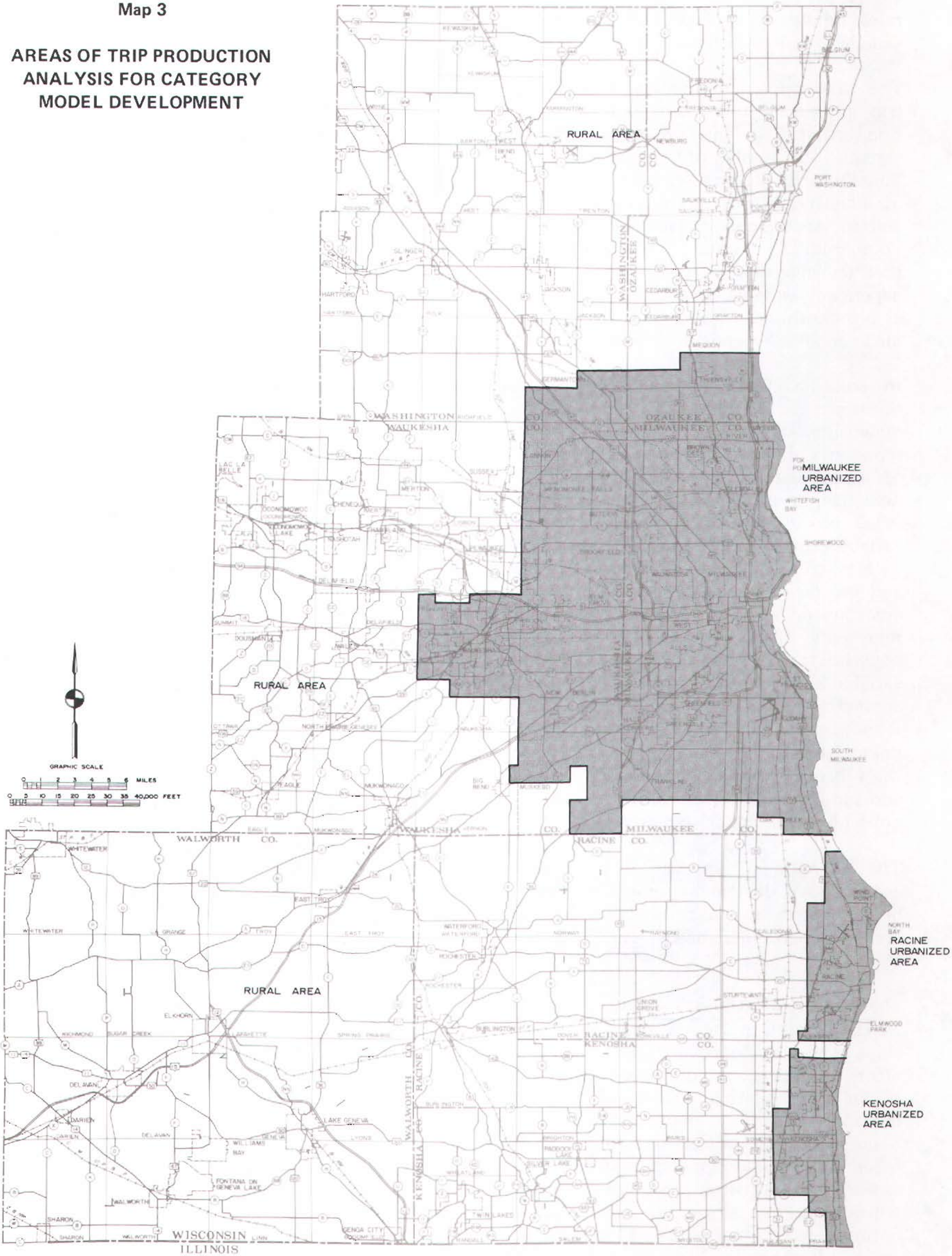
[4] *Under the Commission's existing pattern of travel simulation models, automobile availability is determined with a linear equation developed through multiple regression analyses. The model household automobile availability is a function of the independent variables of household income, household size, residential density, and transit accessibility. With regard to income and residential density, a logarithmic transformation was employed, reflecting the diminishing effects of these variables on automobile availability as they increase. Specifically: Number of automobiles available per household = 0.1106 (number of persons per household) + 0.4135 $\log_e$ (average household income) - 0.1210 $\log_e$ (number of households per developed gross residential acre) - 1.3 x 10^7 (transit accessibility) - 2.6425.*

Map 3

AREAS OF TRIP PRODUCTION ANALYSIS FOR CATEGORY MODEL DEVELOPMENT



Separate person trip production category models were developed for each urbanized area within the Region, as well as the rural area. This map delineates the area wherein each of the four models was calibrated for the year 1972.

Source: SEWRPC.

The category models calibrated for the Milwaukee, Racine, and Kenosha urban areas and the remaining area of the Region are presented by trip purpose in Figures 4 through 7. As shown in these figures, the trip generation rates vary, with the urban areas exhibiting generally higher tripmaking frequencies than the rest of the Region, as may be expected, particularly for nonwork trip purposes. Figures 4 through 7 also show the generally direct relationships that exist between the rate of household tripmaking and household automobile availability and household size.

The other set of trip end relationships developed in the trip generation process is for trip attractions, which are primarily a function of the nonresidential land use activity within the subareas of the Region. Person trip attraction relationships were developed through the calibration of four linear equations representing home-based work, home-based shopping, home-based other, and nonhome-based trip purposes. Relating home-based person trip attractions to employment, population, and land use, the equations were developed on a zonal basis using multiple regression analysis. The calibrated trip attraction equations are presented in Table 2.

The forecast of nonhome-based trip production by zone was accomplished through the use of multiple regression analysis. The production of nonhome-based trips cannot be simulated by zone with the cross-classification approach since neither end of the trip represents the place of residence of the tripmaker, although cross-classification can provide an estimate of total regional nonhome-based productions based on the total number of regional households and their characteristics. Under the assumption, therefore, that cross-classification would provide a better regional estimate of total future trip productions, the zonal totals derived from application of the regression equation were factored so that the sum of zones equaled the regional cross-classification estimate. The regression equation developed to allocate total productions to zones related the number of nonhome-based productions to the magnitude of the opportunity of making such a trip as expressed in terms of trip attractions. The calibrated equation is:

Number of nonhome-based productions
= 0.10 (number of home-based work attractions)
+ 0.06 (number of home-based other attractions)
+ 0.79 (number of nonhome-based attractions)
- 33.22

The generation of school trips was accomplished in the plan reevaluation effort through the extrapolation of existing trends. School trips constituted about 8 percent of the total person trips made within the Region in 1972. As already noted, the exclusion of all trips to or from all schools—elementary, junior high, senior high, vocational and technical, and college and university—from the other major internal trip production, attraction, and distribution analyses was necessary because of the limitations of the available trip distribution modeling procedures, which would inherently treat all schools as possible attractions, not being able to account for limitations imposed by school service boundaries. Growth factors were applied separately by mode: automobile, school bus, and mass transit. Population constituted the growth factor for automobile and school bus trips, which comprised less than 3 percent of all regional vehicle trips in 1972. Transit trips to or from schools accounted for approximately 31 percent of the transit person trips made within the Region in 1972. The growth factor for such trips was initially based upon population, and adjustments were made to those zones where significant changes in school enrollment or transit service were anticipated or planned. Such adjustments included school service boundary changes, new construction of educational institutions, and the improvement of transit services to larger universities.

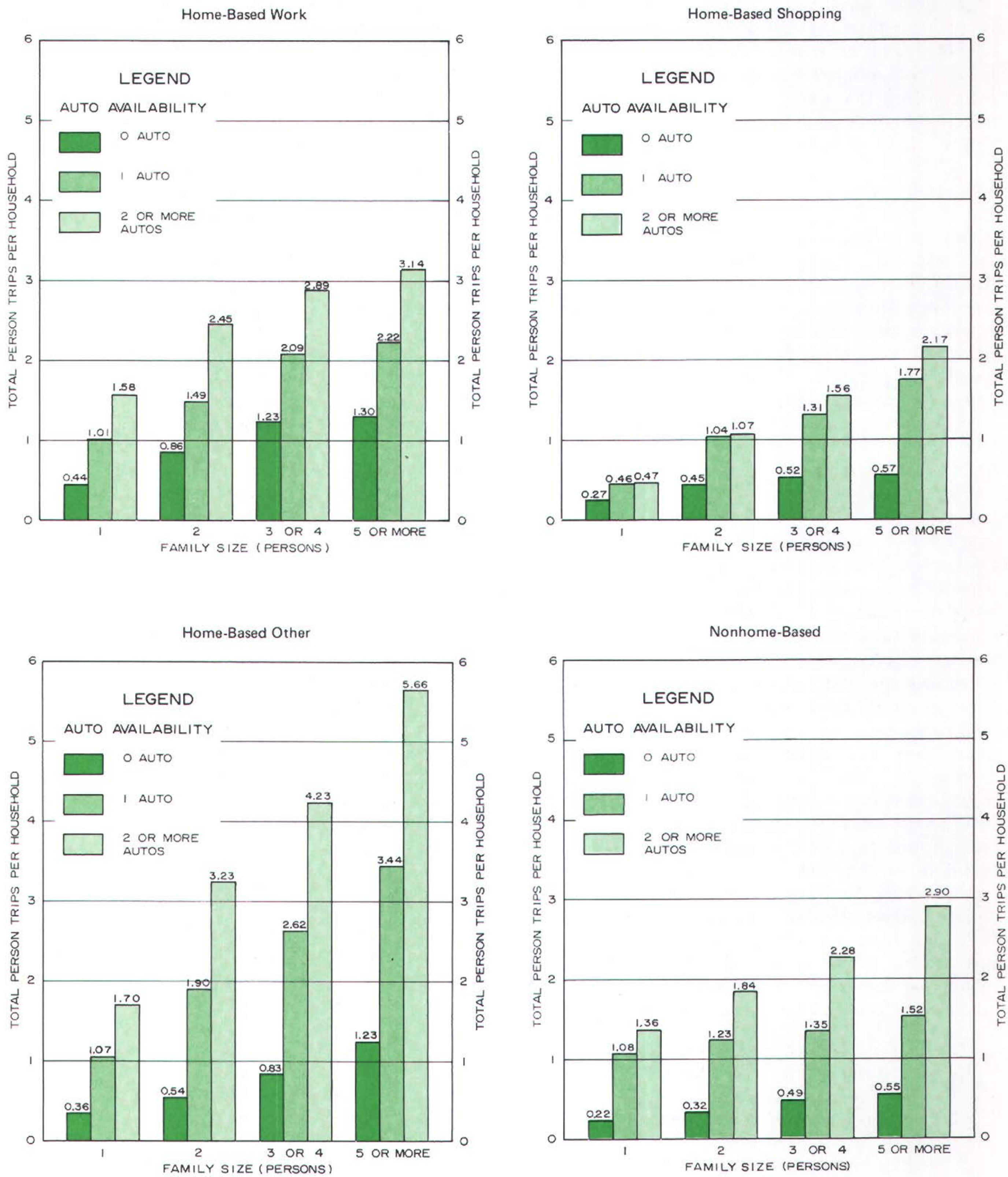
The generation of internal trips by persons residing in group quarters and nonresidents was accomplished by the application of uniform growth factors. The generation of truck and taxi trips was accomplished for the reevaluation effort using multiple regression analysis. Truck and taxi trip generation was determined to be best expressed on a zonal level as a function of employment, population, and retail and service land. The truck and taxi trip generation equation as derived from this analysis is:

Number of truck and taxi trip ends
= 160
+ 0.26 (total employment)
+ 0.15 (population)
+ 15.6 (net acres of retail and service land)

Since travel forecasts needed to be made according to weight classification—with light trucks being trucks weighing less than 8,000 pounds and medium and heavy trucks being trucks weighing more than 8,000 pounds in order that the air quality and noise implications of truck travel could be estimated, two additional truck trip generation equations were developed. These two equations—

Figure 4

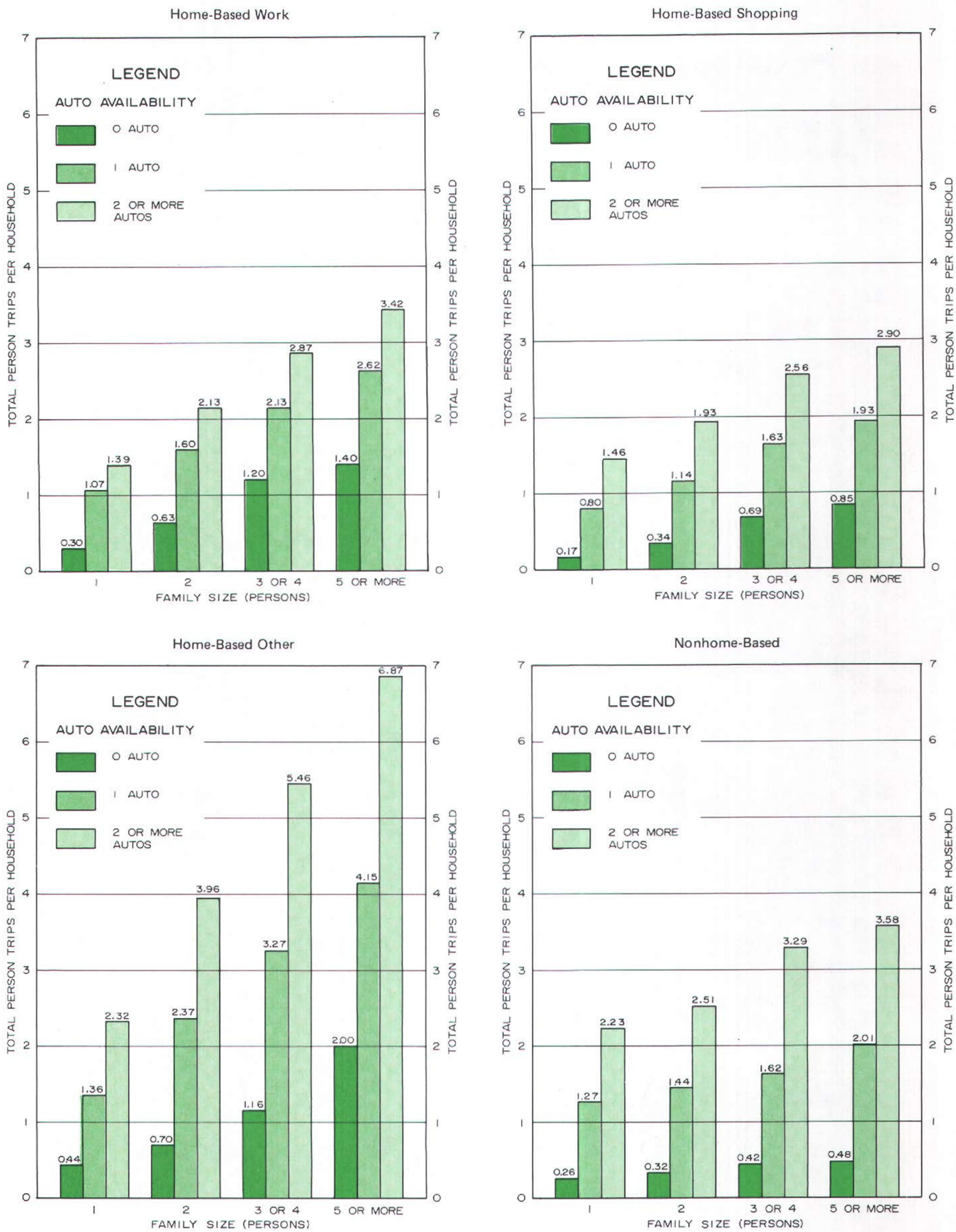
INTERNAL PERSON TRIP PRODUCTION CATEGORY MODELS: MILWAUKEE URBANIZING AREA



Source: SEWRPC.

Figure 5

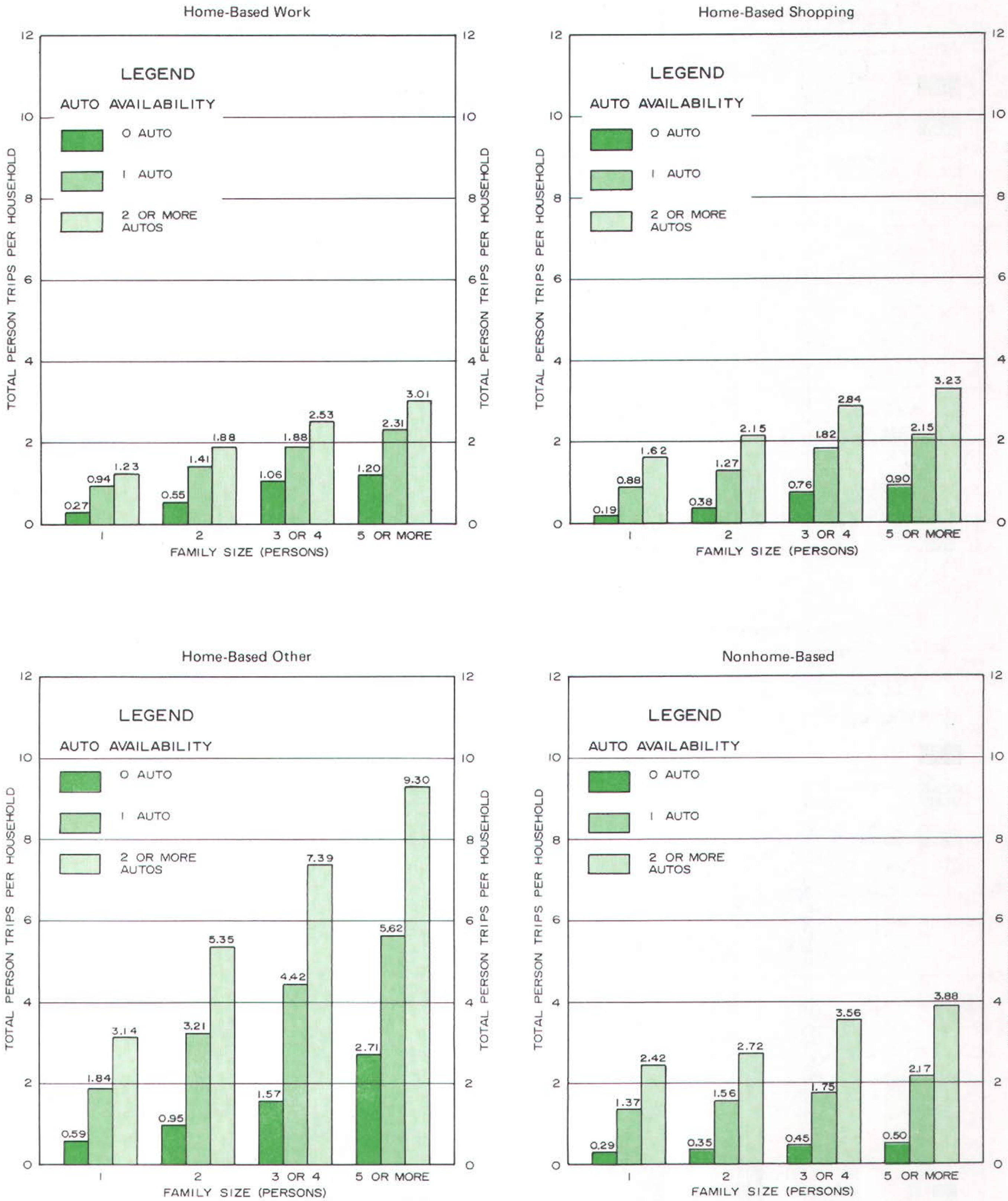
INTERNAL PERSON TRIP PRODUCTION CATEGORY MODELS: RACINE URBANIZING AREA



Source: SEWRPC.

Figure 6

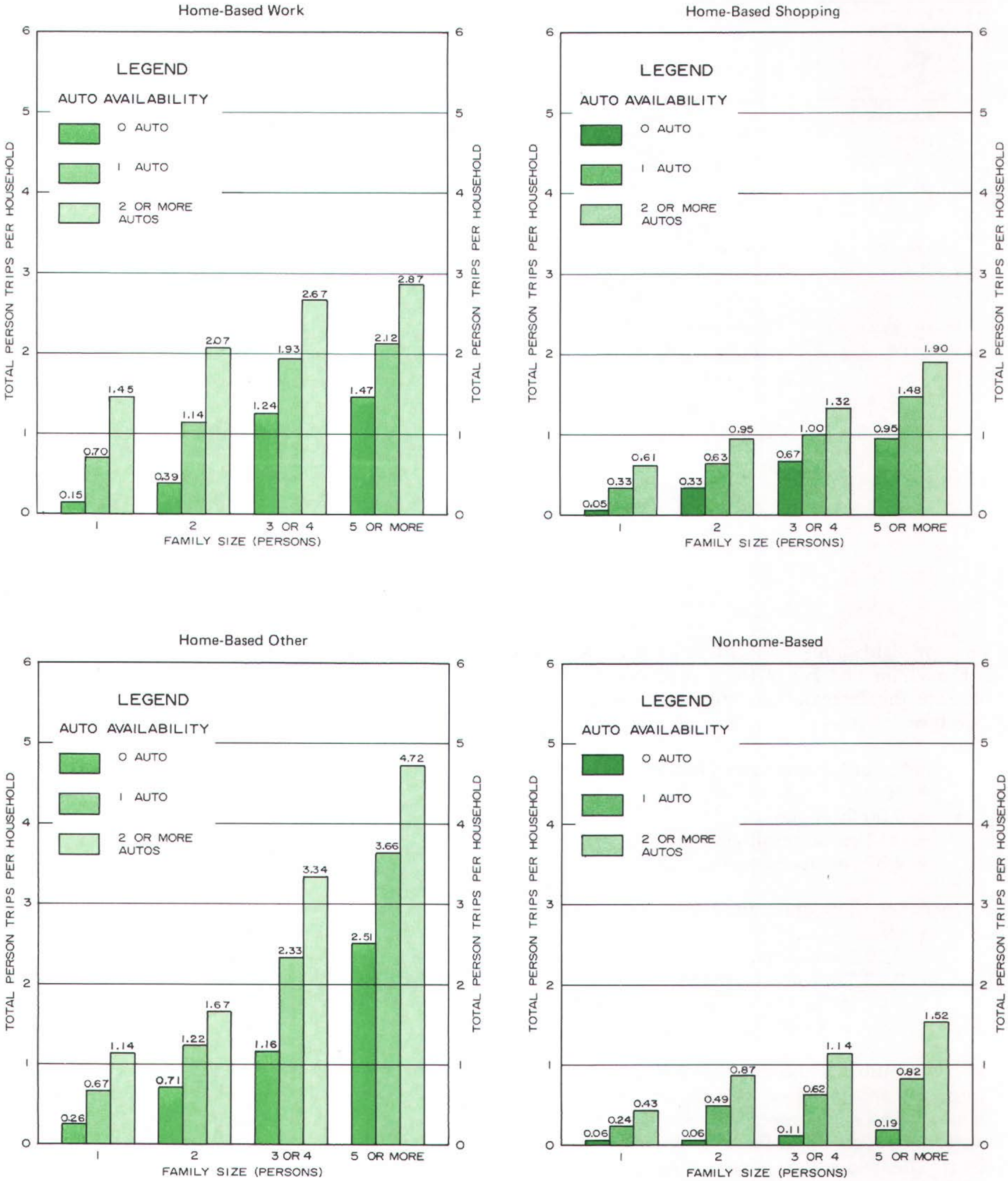
INTERNAL PERSON TRIP PRODUCTION CATEGORY MODELS: KENOSHA URBANIZING AREA



Source: SEWRPC.

Figure 7

INTERNAL PERSON TRIP PRODUCTION CATEGORY MODELS: RURAL AREA



Source: SEWRPC.

Table 2

TOTAL PERSON TRIP ATTRACTION EQUATIONS

Trip Purpose	Equation
Home-Based Work	Number of Trip Ends = 108.96 + 1.45 (Manufacturing Employment) + 1.48 (Retail Employment) + 1.88 (Governmental Employment) + 0.61 (All Other Employment)
Home-Based Shop	Number of Trip Ends = - 43.81 + 4.54 (Retail Employment) + 35.51 (Retail and Service Land)
Home-Based Other.	Number of Trip Ends = 199.68 + 2.17 (Retail Employment) + 1.88 (Governmental Employment) + 39.85 (Retail and Service Land) + 1.14 (Households)
Nonhome-Based	Number of Trip Ends = 14.64 + 0.11 (Manufacturing Employment) + 2.24 (Retail Employment) + 0.64 (Governmental Employment) + 0.09 (All Other Employment) + 25.74 (Retail and Service Land) + 0.43 (Households)

Source: SEWRPC.

one for light truck and taxi trips and the other for medium and heavy truck trips—were used to allocate the forecast total truck trips between the two types of trucks.

Number of light truck and taxi trip ends
= 46
+ 0.30 (households)
+ 0.11 (total employment)
+ 4.92 (retail and service land)

Number of medium and heavy truck trip ends
= 69
+ 0.19 (households)
+ 0.12 (total employment)
+ 3.67 (retail and service land, wholesale and manufacturing land)

The generation of the final trip category, external trips, was accomplished through the use of regression analysis. A number of regression equations were developed for defined external and internal areas. These equations related external trip generation to population and to the magnitude of residential, commercial, and industrial land use.

TRIP DISTRIBUTION

Basic Concepts

The second major step in the travel simulation process is trip distribution, in which the number of trips between zonal pair is determined. The input to this step is the number of trip ends produced by or attracted to each zone as determined in the trip generation step. Additional inputs such as the travel times between zones may also be required for calibration and application, depending on the type of trip distribution model used.

There are currently three types of trip distribution models in general use: growth factor models, the gravity model, and the opportunity model. Growth factor models calculate the number of trips between two zones for some projection year as a function of the number of trips observed between those two zones in the base year and some growth factor. As such, this is a combined trip generation-trip distribution model and is used for relatively small trip categories, which cannot be easily simulated using more sophisticated techniques. The most widely used growth factor model is the Fratar model, in which growth factors are applied to both the trip productions and attractions. A trip generation model must be used with the Fratar model to provide growth factors calculated as the ratio of design year productions and attractions to base year productions and attractions. Calibration of the Fratar model is necessary to ensure that the number of design year trips entering or leaving each zone matches the generated productions and attractions for that zone, respectively.

The gravity model is the most widely accepted and used trip distribution model. The basic premise of the gravity model is that the number of trips between two zones in the study area is a direct function of the number of trip ends in each zone and some inverse function of their spatial separation. This inverse function of spatial separation adjusts the relative attraction of each zone by the ability, desire, or need of the tripmaker to overcome the travel distance or travel time involved. Mathematically, the gravity model may be stated as follows:

$$T_{ij} = P_i \frac{\dfrac{A_j}{d_{ij}^{\,b}}}{\dfrac{A_1}{d_{i1}^{\,b}} + \dfrac{A_2}{d_{i2}^{\,b}} + \ldots + \dfrac{A_n}{d_{in}^{\,b}}}$$

where:

T_{ij} = trips produced in zone i and attracted to zone j,
P_i = trips produced by zone i,
A_j = trips attracted by zone j,
d_{ij} = the spatial separation between zones i and j, generally expressed in terms of door-to-door travel time,
b = an empirically determined exponent which expresses the average areawide effect of spatial separation between zones on trip interchange, and
n = the number of traffic analysis zones within the planning area.

The exponent b has been observed to vary with trip purpose, assuming values of about 3.0 for social trips, 2.0 for shopping trips, and 1.0 for work trips when spatial separation has been expressed as in-vehicle travel time. A decrease in the exponent implies that spatial separation is a less restrictive factor on a trip interchange, and it has been found that people generally are willing to travel farther for work purposes than for shopping or social function purposes. The exponent b also has been observed to increase as the separation increases, indicating that the effect of spatial separation increases as the separation itself increases. Moreover, the value of the exponent has been found to vary from urban area to urban area, particularly for nonwork-purpose trips.

As a consequence of the variance in the exponent b, it is necessary to develop and calibrate gravity models for each urban area under study, as well as for each trip purpose category considered. Moreover, since past experience has demonstrated that the exponent of travel time is not necessarily constant for all intervals of time and that travel patterns are affected by various social and economic characteristics of the travelers, it has become common practice to express the gravity model formula as follows:

$$T_{ij} = \frac{P_i A_j F_{ij} K_{ij}}{\sum_{j=1}^{n} A_j F_{ij} K_{ij}}$$

where:

F_{ij} = an empirically derived travel time friction factor which expresses the average areawide effect of spatial separation on trip interchange between zones which are t_{ij} minutes apart,
K_{ij} = an adjustment factor applied on a zone-to-zone basis to allow for the incorporation of the effect on travel patterns of social, economic, political, or historic characteristics not otherwise accounted for in the model formulation, and

T_{ij}, P_i, A_j, and n are as previously defined.

Through the use of the set of travel time friction factors to express the effect of spatial distribution on zonal trip interchange, the fact that the effect of spatial separation generally increases as the separation itself increases can be considered. Derived from the characteristics of the origin and destination zones, the zonal adjustment factor is essentially the ratio necessary to adjust the model so as to match computed travel patterns with the travel patterns observed between subareas of the Region in origin and destination surveys. This factor accounts quantitatively for the effects of biases which can generally be identified qualitatively through knowledge of the areas affected.

In order to apply the gravity model to forecast future travel patterns, it is necessary to calibrate the model to accurately reflect existing travel patterns and characteristics within a region. This calibration process actually determines the numerical values of the travel time friction factors and the zonal adjustment factors so that the gravity model accurately simulates the trip length characteristics determined in the travel inventory. These numerical values are assumed to remain constant over time, thereby providing a model which can be used to simulate the future trip interchange patterns, given future trip productions, attractions, and travel times between subareas of the Region.

Available evidence indicates that the assumption that the friction factors are stable over time is valid. The assumption of constant zonal adjustment factors is more difficult to justify, since social, economic, historic, or political effects or biases which exist in the base year may not exist in the future.

The final type of trip distribution model is the opportunity model, either the intervening opportunity model or the competing opportunity model. Although both of these models have a strong theoretical basis, the standardized procedures of these models for calibration, operation, or application are not as efficient or as well tested as those of the gravity model. Moreover, little research has been done to verify the ability of the opportunity model to either replicate existing travel patterns or remain stable over time. Consequently, while investigated, the opportunity model was not considered a viable alternative for the trip distribution step in the plan reevaluation effort.

Plan Reevaluation Trip Distribution Procedures

As noted above, the distribution of major internal person trips was accomplished in the reevaluation effort through use of the gravity model. Gravity models were calibrated for total internal automobile and transit person trips for home-based work, home-based shopping, home-based other, and nonhome-based trip purposes. Indicating the effect of spatial separation on trip interchanges observed in the 1972 travel surveys, the calibrated friction factors for each trip purpose are shown in Figure 8. As friction factors are relative, of greater importance than their absolute magnitudes is the slope of the smoothed friction factor curve. For this reason, the friction factor curves in Figure 8 were normalized and plotted on logarithmic scales to facilitate a comparison of trip purposes. As can be seen, the friction factor curve with the smallest negative slope is that for home-based work, indicating the lesser effects of spatial separation on the distribution of work trips as the travel time increases. Conversely, the curve for home-based shopping trips shows the greatest sensitivity to spatial separation as the travel time increases.

The distribution of both truck and taxi trips and external trips was accomplished through the use of the Fratar model.

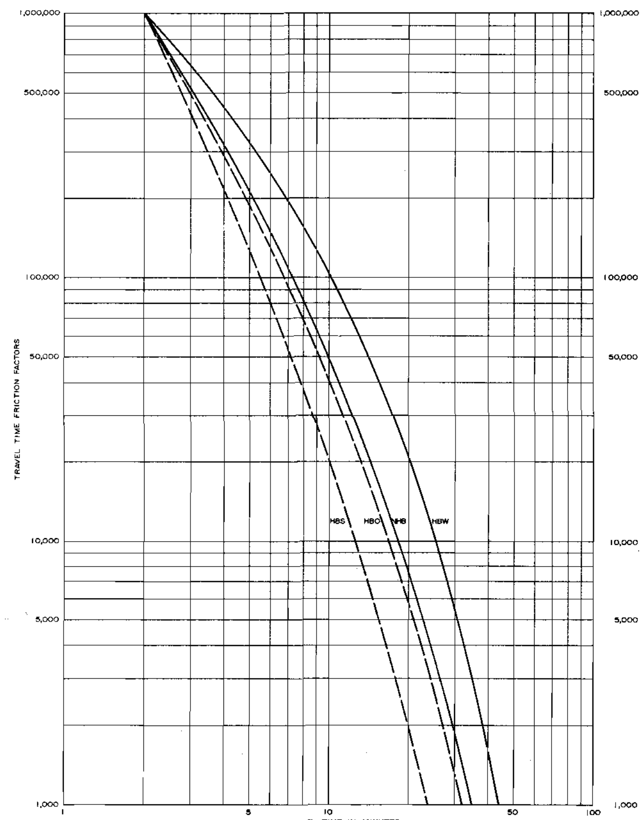
MODAL SPLIT

Basic Concepts

The third major step in the travel simulation process is modal split, in which the total number

Figure 8

TRAVEL TIME FRICTION FACTORS FOR INTERNAL TOTAL PERSON TRIPS IN THE REGION: 1972



Source: SEWRPC.

of trips is divided on the basis of travel mode used. Primarily, this step involves the division of internal person trips between the two major modes of travel, public transit and the private automobile. The determination of modal split is essentially an evaluation of the potential demand for public transit service. The aggregate demand for public transit service is determined by many individual decisions, and many factors operate to influence each individual choice concerning the use of public, as opposed to private, transportation. For analytical purposes, however, the factors affecting individual modal choice can be grouped into three categories: factors relating to the characteristics of the tripmaker, factors relating to the characteristics of the trip, and factors relating to the characteristics of the transportation system. The purpose of modal split modeling is to select from these three general categories those variables that best explain the choice of mode and which can be readily quantified.

The final phase of the modal split step is the application of an auto occupancy model which determines for each interchange the average number of persons per automobile trip. In this manner, automobile person trips are converted to automobile vehicle trips, which is the necessary input to the traffic assignment step of the travel simulation process.

Plan Reevaluation Modal Split Procedures

Modal split models for the plan reevaluation for the Milwaukee, Racine, and Kenosha urbanized areas were developed by trip purpose, with home-based work, home-based shopping, and other purpose trips being combined, and nonhome-based trips being considered separately. The method used to mathematically define the mode choice models was logit analysis, one of the three techniques that have been devised to calibrate disaggregate, behavioral, probabilistic models of mode choice. The use of logit analysis in the development of modal split or choice models is consistent with the economic theory of consumer behavior—specifically, that utility maximization establishes choice decisions.

The models formulated to simulate modal choice in the Milwaukee urbanized area are set forth in Figure 9. The models calibrated for home-based work and home-based shopping trip purposes and other purposes express the probability of mode choice as a function of household automobile availability, in-vehicle travel time, out-of-vehicle travel time, and out-of-pocket cost differences between automobile and transit modes. The nonhome-based mode choice model expresses the probability of mode choice as a function of in-vehicle travel time, out-of-vehicle travel time, and out-of-pocket cost differences between automobile and transit modes. Representing that part of door-to-door travel time which is spent outside a vehicle, out-of-vehicle time includes any walking or parking time attendant to automobile travel, and all walking, waiting, and transferring time associated with travel on public transit. In-vehicle time represents that part of door-to-door travel time spent inside the public transit vehicle or the automobile. A distinction was made in the mode choice model between the in-vehicle and out-of-vehicle portions of total travel time, as studies have shown that travelers find time spent walking, waiting, or transferring—that is, outside the vehicle—to be more inconvenient than time spent in the vehicle. The other transportation system variable considered, out-of-pocket cost, was intended to represent those costs of travel that

Figure 9

MODE CHOICE MODELS FOR PLAN REEVALUATION

Home-Based Work

$$P = \frac{e^{(-0.0162TC - 0.0301TI - 0.082TO)}}{e^{(-0.0162TC - 0.0301TI - 0.082TO)} + e^{(-0.0162HC - 0.0301HI - 0.082HO + 1.943A - 1.574)}}$$

Home-Based Shopping and Other

$$P = \frac{e^{(-0.0572TC - 0.0597TI - 0.1067TO)}}{e^{(0.0572TC - 0.0597TI - 0.1067TO)} + e^{(-0.0572HC - 0.0597HI - 0.1067HO + 2.3143A - 2.1219)}}$$

Nonhome-Based

$$P = \frac{e^{(-0.0345TC - 0.0277TI - 0.124TO)}}{e^{(-0.0345TC - 0.0277TI - 0.124TO)} + e^{(-0.0345HC - 0.0277HI - 0.124HO + 1.0305)}}$$

Where:

P = probability of transit use.
A = number of automobiles per household of trip made.
TC = transit cost.
TI = transit in-vehicle time.
TO = transit out-of-vehicle time.
HC = highway cost.
HI = highway in-vehicle time.
HO = highway out-of-vehicle time.

Source: SEWRPC.

individuals normally consider in their mode choice decision. Out-of-pocket costs for transit were considered to consist only of fares. Out-of-pocket costs associated with automobile travel consist of parking costs, motor fuel costs per vehicle mile, and a small proportion of routine maintenance costs (two cents per mile in 1972). In establishing a future cost of highway travel for use in the modal split step, out-of-pocket costs were assumed to be influenced principally by the change in motor fuel costs. Such change will be determined by the interaction of two factors: the price of motor fuel and automobile fuel efficiency as set forth in the alternative future scenarios. No significant real change in the cost of parking and routine maintenance was assumed.

The second major part of the modal split step is the determination of automobile occupancy. An auto occupancy model is required to convert auto person trips into auto vehicle trips by determining the proportion of persons in automobiles who are auto drivers. For the Commission's existing battery of travel simulation models, average automobile occupancies were calculated for all zone-to-zone interchanges by trip purpose based on the origin and destination survey, and these automobile occupancies were assumed to remain stable over time.

TRAFFIC ASSIGNMENT

The fourth and final major step in the traffic forecasting and analysis process is the assignment of the zonal trip interchanges arrived at in the trip distribution and modal split phases to specific routes of existing and proposed alternative transportation systems. The output of traffic assignment for the arterial street and highway system is a forecast of the number of vehicles per unit time expected to use each segment of the system by direction, complete with turning movements at intersections. The output of traffic assignment for the transit system is an estimate of the number of passengers per unit time expected to use each segment of the transit system by direction, complete with transfers at route intersections.

The assignment of traffic demand to the transportation system is accomplished separately for the highway and transit systems and in several steps. The first step in the assignment process involves the preparation of a matrix or table of both vehicle trip interchanges and transit passenger trip interchanges between all of the traffic analysis zones within the planning area, and the preparation of a complete and definitive description of the spatial location, capacity, and operating characteristics of the specific transportation system to be tested. For assignment of traffic demand to the highway system, 11 individual trip interchange tables which are direct outputs of the application of the modal split and trip distribution models must be combined to provide total zonal trip interchange volumes: the individual trip interchange tables for internal vehicle trips by automobile for each of the five trip purposes used in the modal split phase, for internal automobile and truck trips made by nonresidents of the Region, for automobile trips made by persons residing in group quarters, for external vehicle trips made by automobile, and for internal and external truck and taxi trips. For assignment of trips to the transit system, five individual trip interchange tables must be combined: the transit trip interchange tables for each of the four trip purposes derived from the modal split phase, and for school-purpose transit person trips.

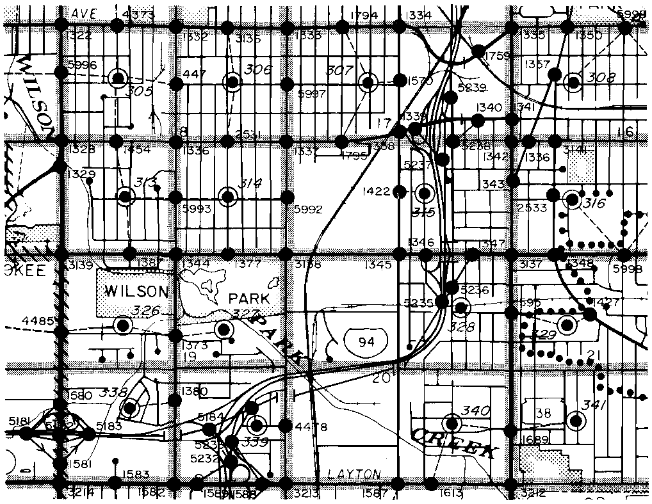
The definitive description of the highway and transit systems to be tested involves the preparation of highway and transit network maps and the collection, coding, and transfer to computer-usable form of data describing the location, capacity, and operating speeds of each link in the two networks so that the operation of the overall transportation system can be simulated. The preparation of the arterial street and highway network requires the assignment of node numbers to all intersections and to all access points in the system, with each segment between two nodes being defined as an arterial link (see Figure 10). Each arterial link in the network is thus defined by the node number pair describing its termini, and by attendant data pertinent to systems analysis, such as link capacity and operating speed. The preparation of the transit system network similarly requires the assignment of node numbers to all transfer and terminal points, with each section between two nodes being defined as a transit route link. Transit lines are then defined by the series of node numbers along a given transit route and the operating headways associated with that route. The transit network is more complex than the arterial network in that it has "artificial" links representing combination walk and wait times and combination auto travel and wait times for simulation of both walk and auto access to the transit system (see Figure 11).

It is necessary to "connect" both the highway and transit networks to the land uses served. This is done by the use of load nodes located at the centroids of the various traffic analysis zones and representing the points at which all trips originating from, and destined to, the zones enter or leave the transportation network. These load nodes are connected to the network access points by means of access or loading links. In the arterial street and highway network, the loading links represent collector streets, and in the transit network the links represent the means by which passengers go to or from the actual points of trip origin and destination and the transit stops. Once network maps have been prepared for the existing systems, highway and transit facility plan proposals for new facility construction or service expansion or the improvement of existing facilities and services can be readily tested by the insertion of new links into the network and the modification of the data describing the existing links in the network, respectively.

The second step in the assignment process involves the computation from the descriptions of the transportation networks of two sets of minimum time paths from each traffic analysis zone within the Region to all other such zones, one for automobile travel and one for transit travel. The

Figure 10

EXAMPLE OF HIGHWAY NETWORK MAP



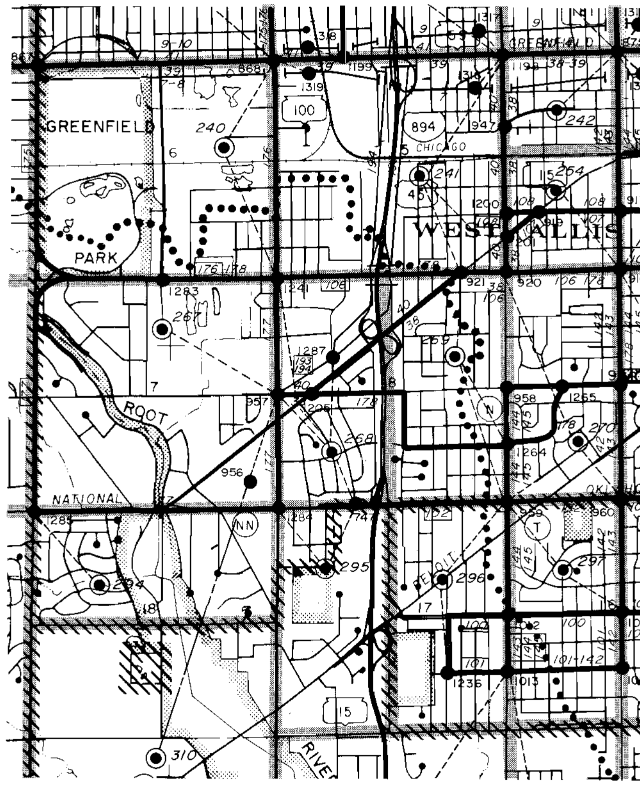
LEGEND

- 310 ZONE CENTROID AND NUMBER
- 1454 LINK NODE AND NUMBER
- FREEWAY/ARTERIAL LINK
- DIRECTIONAL LINK
- CENTROID CONNECTOR LINK
- TRAFFIC ANALYSIS ZONE BOUNDARY

Source: SEWRPC.

Figure 11

EXAMPLE OF TRANSIT NETWORK MAP



LEGEND

- 310 ZONE CENTROID AND NUMBER
- 875 LINK NODE AND NUMBER
- FREEWAY/EXPRESS TRANSIT LINK
- LOCAL TRANSIT LINK
- WALK/TRANSFER LINK
- AUTO CONNECTOR LINK
- 177 TRANSIT LINE NUMBER
- 176 TRANSIT LINE TERMINUS
- TRAFFIC ANALYSIS ZONE BOUNDARY

Source: SEWRPC.

minimum time paths are computed by systematically comparing travel time for all links in the system in successively outward steps from the starting node until the shortest time path to all nodes has been computed. As each node in the network is considered, travel times back to the starting node are accumulated and the immediately preceding node in the direction of travel is recorded to return to the centroid involved. Thus, the shortest travel time and route through the system between the starting node and all other nodes is systematically recorded and mapped. The resulting minimum time path routes are referred to as "trees" and represent the shortest door-to-door travel times between any two zones within the Region, including walk times at either end of the trip, wait and transfer times for transit trips, and park and unpark times for automobile trips.

In the next step, zone-to-zone trip volumes—that is, the matrix of average weekday trip interchange volumes created by the process of trip generation, trip distribution, and modal split—are assigned to all links—that is, to all individual route segments comprising the minimum time path for the various zonal trip interchanges. Thus, traffic volumes are accumulated on the links for all zonal interchanges, resulting in a complete assignment of traffic demand to the network. Since all of the trips are so assigned to the shortest time paths through the networks, some of the volumes on the individual links of the network may exceed the actual capacity of the transportation facilities being simulated, thus affecting the travel time used to initially determine the minimum time paths. The output of the assignment program at this stage is termed an "unrestrained" assignment. The ratios of the assigned volumes to the capacity of each link in the network are then calculated. The travel times are then reduced for those links having a volume-to-capacity ratio of less than one and increased for those links having a ratio greater than one. Minimum time paths are then recomputed, and the trip interchanges are reassigned on the basis of the revised minimum time path through the network. This iterative process is continued until the assigned volumes are observed to stabilize. Thus, the operating speed at which each segment of the transportation system can be traveled is modified to simulate the effect of increasing congestion in the system. The resulting capacity restraint serves to modify the unrestrained assignment volumes and provide a more realistic distribution of traffic over the system by simulating the manner in which vehicle operators will seek less congested arterial routes in tripmaking. Restrained assignments are not required for transit system capacity because additional transit capacity can be readily provided by the provision of additional transit vehicles and the attendant reduction of headways.

It should be noted that the traffic loadings determined using the above procedure are expressed in terms of 24-hour average weekday traffic volumes, which are comparable to the network capacities derived from the transportation system inventories conducted. These 24-hour average weekday traffic volumes can be converted to peak hourly volumes by the application of the appropriate factors shown in Tables 3 and 4.

Arterial Street and Highway and Local and Express Public Transit System Networks for Traffic Assignment

The future arterial street and highway system, which together with the alternative primary transit and supporting secondary and tertiary transit systems will constitute the assumed future surface transportation system of the Region to the plan design year 2000, must be defined in order to permit computer simulation model analyses of probable future travel and traffic conditions in the Region. The future arterial street and highway system was identified for the purposes of the study as the lower tier of the adopted long-range regional transportation system plan with but one exception: the Lake Freeway from Carferry Drive to Layton Avenue, a distance of 3.1 miles, was eliminated from the lower tier of the plan. This change was made consonant with the request of the Secretary of the Wisconsin Department of Transportation made in his adoption of the Commission's long-range regional transportation system plan in 1978 that, because of state funding constraints, this segment of freeway be placed in the upper tier of the plan.

The lower tier of the plan was used in the study to define the arterial street and highway element of the transportation system, because it represents the planned future state of the arterial highway element of the surface transportation system of the Region. The alternative primary transit system plans evaluated under this study, and the system ultimately recommended, logically should be developed within the context of the planned arterial street and highway system. Otherwise, the future level of service to be provided by the arterial street and highway system of the Milwaukee area may be underestimated, and the future attractiveness of public transit and, importantly, transit ridership may be overestimated. The arterial street and highway element of the lower tier of the Commission's adopted transportation system plan is documented in Chapter VI of SEWRPC Technical Report No. 23, Transit-Related Socioeconomic, Land Use, and Transportation Conditions and Trends in the Milwaukee Area, and in Chapter VIII of SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume Two, Alternative and Recommended Plans. The final recommended primary transit plan was also tested in relation to the existing, as opposed to the planned, arterial street system in order to provide an assessment of those improvements in the long-range arterial street and highway plans which could be deferred or avoided entirely based on the reduction of highway traffic congestion which may be expected to be achieved through implementation of the recommended primary transit system plan.

As shown on Map 4, the recommended lower-tier arterial street and highway system includes approximately 287 miles of freeway, 230 of which were open to traffic as of January 1, 1978. Less than one mile of new freeway is proposed to be added to the existing system in Milwaukee County under the lower tier of the plan: the "stub end" of the Stadium Freeway-South from National Avenue to Lincoln Avenue. Of the remaining 80 miles of freeway in Milwaukee County under the plan, five miles would be reconstructed for additional capacity, with the rest requiring no work or only resurfacing. The standard surface arterial street

Table 3

FACTORS TO CONVERT AVERAGE WEEKDAY HIGHWAY TRAVEL TO PEAK-PERIOD TRAVEL: 1972

Arterial Type	Proportion of Total Vehicle Travel on the Arterial Street and Highway System in the Peak Hour			
	Milwaukee Central Business District		Remainder of Region	
	Peak Hour Both Directions	Peak Hour Peak Direction	Peak Hour Both Directions	Peak Hour Peak Direction
Freeways.	0.080	0.040	0.080	0.048
Standard Surface Arterials. . . .	0.100	0.050	0.100	0.060

Source: SEWRPC.

Table 4

FACTORS TO CONVERT AVERAGE WEEKDAY TRANSIT TRAVEL TO PEAK-PERIOD TRAVEL: 1972

Trip Purpose	Proportion of Transit Person Travel by Period of Day			
	6 A.M. to 9 A.M. Morning	9 A.M. to 3 P.M. Midday	3 P.M. to 6 P.M. Evening	6 P.M. to 6 A.M. Night
Home Based Work	0.370	0.160	0.390	0.080
Home Based Shopping . . .	0.000	0.590	0.340	0.070
Home Based Other.	0.080	0.480	0.270	0.170
Nonhome Based	0.080	0.450	0.410	0.060
School.	0.420	0.190	0.390	0.000

Source: SEWRPC.

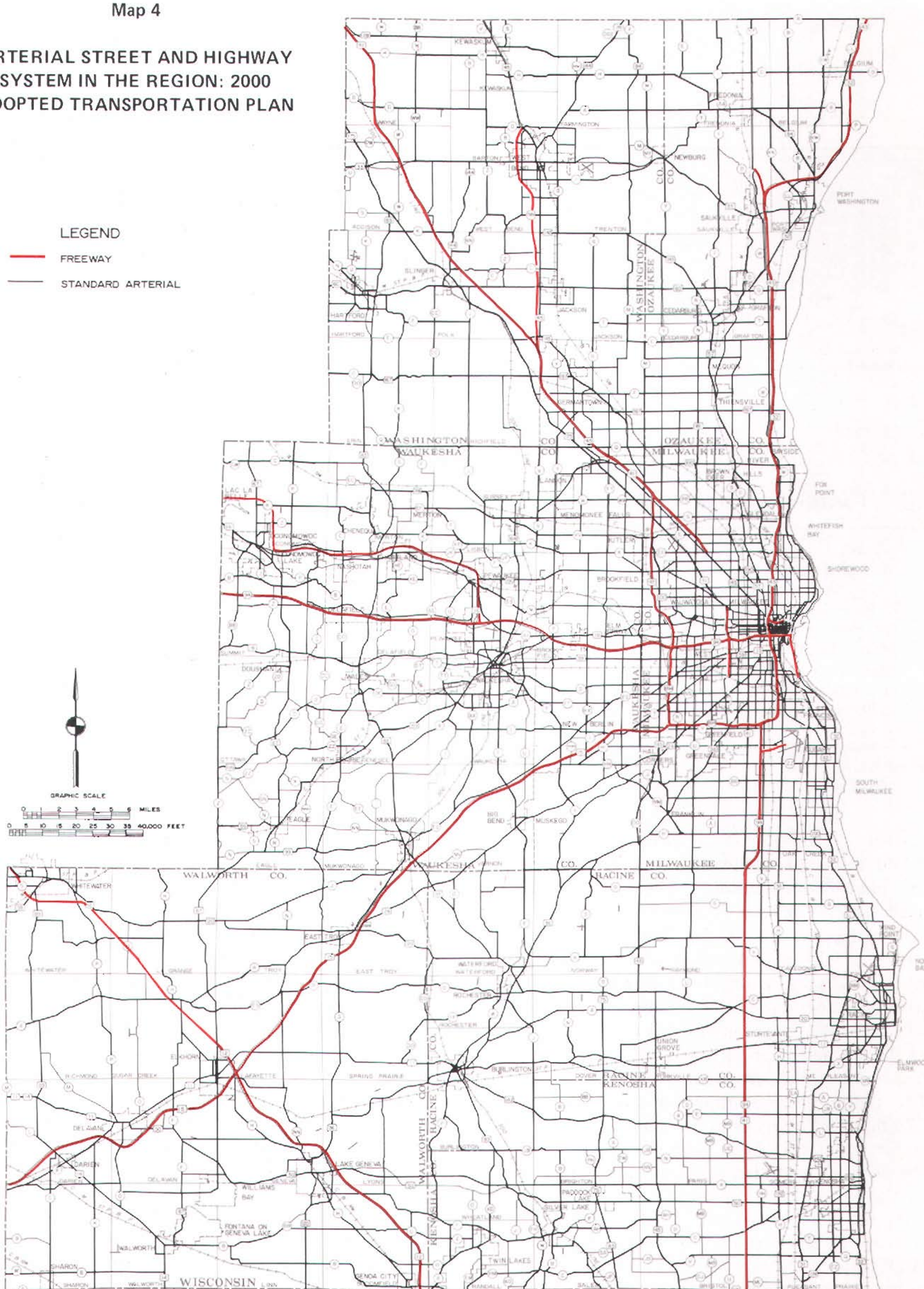
system of the Region is proposed to consist of 3,190 miles of facilities under the lower tier of the plan. Approximately 106 miles of new standard surface arterial facilities would be developed in the Region under the plan, only 12 miles of which would be developed in Milwaukee County. About 683 miles would be improved through reconstruction for additional capacity or through construction of a replacement facility. About one-third of the surface arterials proposed to be improved, or nearly 224 miles, are located in Milwaukee County. The recommended improvement of 144 of these 224 miles of arterials in Milwaukee County involves major street widening, with the remaining 80 miles requiring only minor capacity improvements, such as the reconstruction from rural to urban cross-sections. The remaining 2,401 miles of surface arterials in the Region, of which 454 miles are in Milwaukee County, would require only preservation, with 103 miles requiring no work, 1,418 miles requiring resurfacing, and 880 miles requiring reconstruction to the same capacity for structural reasons.

Related arterial street recommendations of the plan include curb parking restrictions and a freeway traffic management system. Under the lower tier of the plan, curb parking restrictions during peak travel hours are recommended to be instituted along 597 miles of major surface arterials in the Region. Nearly 380 miles of these surface streets are located in Milwaukee County, representing about 55 percent of the planned standard arterial street system in Milwaukee County. These restrictions would be reflected in the coding of the arterial street and highway simulation network. Currently, it is estimated that 140 miles of arterial streets in Milwaukee County have peak-hour curb parking restrictions.

An extensive freeway traffic management system was recommended under the lower tier of the plan, principally to permit a relatively high level of primary transit service to be provided through the operation of motor buses in mixed traffic on freeways. A freeway traffic management system was assumed to be incorporated into the arterial street

Map 4

ARTERIAL STREET AND HIGHWAY SYSTEM IN THE REGION: 2000 ADOPTED TRANSPORTATION PLAN



The future arterial street and highway system of the Milwaukee area and Region that was used in the traffic simulation modeling of alternative primary transit system plans under this study is the arterial street and highway element of the lower tier of the adopted long-range regional transportation system plan, with the exception of the Lake Freeway-South stub end treatment. Because of funding constraints, this freeway stub end treatment was placed in the upper tier of the plan in accordance with the request of the Secretary of the Wisconsin Department of Transportation in his adoption of the regional long-range plan. The lower tier of the arterial street and highway element of the adopted plan, with this one exception, then represents the planned future status of the Region's arterial street and highway system, and thus logically provides the context within which future primary transit system plans should be developed, tested, and evaluated under this study.

Source: SEWRPC.

and highway system under all the primary transit alternatives. The capital and operating costs of the freeway traffic management system, however, were only considered to be a part of the primary transit alternative which specifically proposed the institution of a freeway traffic management system to facilitate the provision of primary transit service via motor buses operating in mixed traffic on freeways.

Certain components of the public transit system are basic to each primary transit alternative to be examined under the study. Each primary transit system alternative proposes that local or tertiary service be extended throughout the developed urban area, and that secondary, or express, service be provided to those high-density residential areas or major travel generators not served by primary transit. Both of these proposals are consistent with the recommendations of the adopted long-range transportation system plan and the supporting system development and management objectives, principles, and standards.

MODIFICATIONS TO THE TRAVEL SIMULATION MODELS

As presently formulated, the Commission's battery of travel simulation models can directly consider the effect of certain changes in automobile operating costs on travel habits and patterns. The cost of operating an automobile is a direct input to the simulation of travel mode choice. Possible radical changes in automobile operating costs on trip generation and trip distribution cannot be considered, however, without some modification to the Commission's existing travel simulation models as well as to other such models which reflect the current state-of-the-art in transportation planning. Similarly, the effects of restrictions in fuel supply cannot be considered without some modification to the Commission's existing travel simulation models.

The extent of the modifications to the Commission's travel simulation models required to meet the needs of the alternatives analysis were determined by first considering the two future energy scenarios to be examined under the study—specifically with respect to the differences in automobile operation costs and opportunity for use between the two future scenarios and the conditions that existed in 1972, when the Commission's models were calibrated. One of the future scenarios to be considered under this study, called the moderate growth scenario, postulates a future characterized by higher fuel costs, higher energy use, and lower automobile fuel efficiency than those of the other future. Under this scenario, motor fuel costs are projected to increase to $2.30 per gallon, expressed in constant 1979 dollars—a 130 percent increase over the 1979 level of about $1.00 per gallon. Average automobile fuel efficiency is anticipated to increase to 27.5 miles per gallon. On the basis of fuel cost alone, the cost of operating an automobile is expected to rise to 8.4 cents per mile under this scenario. This represents a 3.4 cent, or 68 percent, increase, expressed in constant 1979 dollars, over the fuel cost of 5 cents per mile in 1972, the base year of the data used to calibrate the Commission's travel simulation models. The moderate growth scenario assumes an energy situation characterized by a decline in availability over the next 20 years and, importantly, a potential for major and continuing disruptions in motor fuel supply.

Under the stable or declining growth scenario, the cost of motor fuel is assumed to increase to $1.50 per gallon by the year 2000, expressed in 1979 dollars—a 50 percent increase over the 1979 level of about $1.00 per gallon. Automobile fuel efficiency is assumed to reach 32 miles per gallon by the year 2000 under this scenario. Consequently, the cost of automobile travel would be somewhat less than in the year 1972. On the basis of fuel cost alone, the cost of operating an automobile in the year 2000 under this scenario is assumed to be about 0.3 cent per mile less than the 5-cent-per-mile cost of 1972, the base year of the data used to calibrate the Commission's travel simulation models. This future assumes no major or continued disruption in motor fuel supply.

Thus, the Commission's travel simulation models required modification for use in the alternatives analysis only for application under the moderate growth scenario. For the testing of transit plans under the centralized land use plan of the moderate growth scenario, the Commission's existing battery of travel simulation models was modified to reflect a significant increase in automobile motor fuel cost and a significant restriction in automobile motor fuel availability. For the testing of transit plans under the decentralized land use plan of the moderate growth scenario, the Commission's existing travel simulation models were modified to reflect the effects of a significant increase in the cost of operating an automobile.

In making the necessary modifications to the Commission's battery of travel simulation models under the moderate growth scenario, the results of a survey conducted by the Regional Planning Commission in cooperation with the University of Wisconsin-Milwaukee following the 1973 oil embargo and subsequent motor fuel shortages were used as a guide. This survey was designed to determine actual past and probable future responses of households within the Region to increases in the cost of motor fuel and to restrictions in its supply. The survey findings, which provide valuable information about a phenomenon that was a subject of much speculation, were reported in SEWRPC Technical Report No. 15, Household Response to Motor Fuel Shortages and Higher Prices in Southeastern Wisconsin, published in August 1976.

The findings of this survey indicated that, under higher motor fuel prices and/or restricted motor fuel availability, households within the Region may be expected to make certain changes in average weekday travel patterns. For example, restricted motor fuel availability could be expected to significantly influence the choice of mode for travel to work, with a shift occurring to van and carpools and to transit. Furthermore, such a reduction in supply could be expected to reduce somewhat the number of trips made for shopping purposes, as well as to change the pattern of travel for shopping purposes. Based upon these survey findings, which are generally supported by other, similar studies conducted at the same time in other parts of the nation and by analyses of actual travel and traffic changes undertaken following the 1973 oil embargo, specific modifications to the Commission's travel demand forecasting procedures were made. These changes are similar to those made under the long-range transportation system plan reevaluation to evaluate the sensitivity of the recommended transportation system plan to motor fuel availability.

Trip Generation

The survey indicated that trip generation rates for all trip purposes except shopping could be expected to be reduced by less than 10 percent under conditions of increased motor fuel costs and/or restricted motor fuel availability. Accordingly, the household trip production model was modified for home-based shopping trips, reducing the generation rate for such trips from an average weekday level of 1.14 trips per household to a level of 0.87 trip per household (see Table 5).

Trip Distribution

The survey indicated that no significant changes in the pattern of work trips within the Region could be expected under conditions of higher fuel prices and/or restricted fuel availability. However, the survey did indicate that trip lengths for shopping could be expected to be reduced under such futures. Accordingly, the trip distribution model was adjusted by reducing the average trip length for home-based shopping trips from 11 minutes, or about four miles, to nine minutes, or about 2.3 miles. More importantly, the percentage of shopping trips that are 12 or more minutes in travel time duration was reduced from 33 percent to 15 percent of the total.

Table 5

HOME-BASED SHOPPING TRIP PRODUCTION RATES REFLECTING INCREASED MOTOR FUEL COST AND RESTRICTED AVAILABILITY

Trip Production Category		Average Weekday Trip Production Rate (Trips per Household)							
		Shopping Trips From 1972 Data				Shopping Trips Under Restricted Motor Fuel Availability or Increased Motor Fuel Price			
Auto Availability (Autos per Household)	Family Size (Persons per Household)	Urbanizing Areas			Rural Areas	Urbanizing Areas			Rural Areas
		Kenosha	Milwaukee	Racine		Kenosha	Milwaukee	Racine	
0	1	0.19	0.27	0.17	0.05	0.18	0.25	0.16	0.04
	2	0.38	0.45	0.34	0.33	0.36	0.42	0.32	0.29
	3 or 4	0.76	0.52	0.69	0.67	0.67	0.46	0.61	0.51
	5 or more	0.90	0.57	0.85	0.95	0.85	0.54	0.80	0.84
1	1	0.88	0.46	0.80	0.33	0.77	0.40	0.70	0.25
	2	1.27	1.04	1.14	0.63	1.12	0.92	1.00	0.48
	3 or 4	1.82	1.31	1.63	1.00	1.38	1.00	1.24	0.52
	5 or more	2.15	1.77	1.93	1.48	1.89	1.56	1.70	1.12
2 or more	1	1.62	0.47	1.46	0.61	1.33	0.40	1.20	0.39
	2	2.15	1.07	1.93	0.95	1.76	0.92	1.58	0.61
	3 or 4	2.84	1.56	2.56	1.32	1.82	1.00	1.64	0.63
	5 or more	3.23	2.17	2.90	1.90	2.65	1.78	2.38	1.22

Source: SEWRPC.

Modal Split and Auto Occupancy

The survey indicated that households within the Region could be expected to change their mode of travel in response to higher motor fuel prices and/or restricted fuel availability, with the shift being to carpools and mass transit. In order to reflect the shift to carpooling auto occupancy rates for home-based work trips were increased, with the rate of increase varying by the geographic area of trip production and by the trip length. The net modification was an increase in overall average auto occupancy from 1.1 to 1.2 persons per auto. In order to reflect the shift to transit under increased motor fuel costs, the cost of operating an automobile was increased by five to eight cents per mile, consistent with the alternative futures set forth in SEWRPC Technical Report No. 25, Alternative Futures for Southeastern Wisconsin. Also, under the centralized land use plan of the moderate growth future, which assumes that fuel rationing will occur in the future, the number of automobiles available to households is modified, this number being used in the mode choice model to indicate the bias of trips from households of high automobile availability to be made by automobile for all trip purposes. The modification assumes a reduction in automobile availability equal to the percentage reduction in motor fuel availability under the future, and is intended to reflect the decrease in automobile availability that would accompany decreased motor fuel availability.

Traffic Assignment

No changes were made in the traffic assignment model since the survey did not indicate that tripmakers would alter the manner in which they choose the path of travel between origins and destinations. The assignment model assumes that auto drivers will continue to choose routes that offer the shortest travel time.

SUMMARY

This chapter has identified and described the process of alternative primary transit system plan design, test, and evaluation that was used to arrive at a final recommended primary transit system plan under the Milwaukee area primary transit system alternatives analysis. Because this alternatives analysis was based on an alternative futures planning approach, it was possible to identify those primary transit facilities and services that performed well under a wide range of future conditions, and to differentiate them from those facilities and services that may be expected to work well under only a few or a single set of future conditions. As a result, the final recommended primary transit system plan was formulated to consist of two tiers: a lower tier and an upper tier. The lower tier was to consist of those primary transit facilities and services which were present in the best plans for all or most of the alternative futures, and whose incorporation into the existing transportation system should therefore be sound in any case. The upper tier was to consist of those primary transit facilities and services that were present in the best plans for only some futures, or for a single future. Recommendations placed in the lower tier were to be proposed for immediate implementation, while implementation of the recommendations placed in the upper tier was proposed to be postponed until their need was better established over time. In the interim, any available rights-of-way for such facilities could be preserved. In this way, the recommended plan was intended to be a "robust" plan that would remain viable under greatly varying future conditions.

A five-step process requiring the design, test, and evaluation of alternative primary transit systems under each future was used to develop the best primary transit system plan for each alternative future. The first step in the plan design process conducted for each primary transit technology under each alternative future was the design of maximum extent primary transit system networks which encompass all logical corridors for primary transit service in the Milwaukee area. These corridors are those characterized by heavy travel demands and/or by an availability of facilities or rights-of-way for primary transit use. The primary transit technologies for which such corridors were defined included motor bus operation in mixed traffic on operationally controlled freeways, as recommended under the Commission's adopted long-range transportation system plan; motor bus operation on busways; commuter rail transit; light rail transit; and heavy rail rapid transit. The second step of the plan design process under each alternative future consisted of the investigation of specific facility alignments for each technology in each primary transit corridor and the preliminary selection of the most cost-effective alignment. This step facilitated the preparation of capital costs attendant to each alternative system plan and provided the information needed to simulate accurately the operating characteristics of the alternative system plans. The third step was the design of maximum extent system plans from the combination of alignments selected for each technology and included the identification of routes and stations. The fourth step in the plan design process was the quantitative test and evaluation of the extent to which the maximum extent system plan for each technology could be expected to meet selected key primary transit system development objectives under each of the alternative futures. Also part of this fourth step was the design, test, and evaluation, to the extent required, of refined alternative primary transit system plans which truncated the maximum extent system plans for each of the primary transit technologies. The fifth and last step in the plan design process was the design of a composite "best" primary transit system plan for each alternative future, which in turn constituted the basis for the synthesis of the two-tier primary transit system plan recommended for the Milwaukee area.

This chapter has also described the quantitative methods to be used in the test of these primary transit alternative system plans. Such test requires the preparation of forecasts of travel on the primary transit system, on the total transit system, and on the total transportation system. The quantitative test of alternative primary transit system plans, accomplished through simulation of area travel and traffic, is essential to the design of an integrated primary transit and transportation system, a system in which the capacity and operation of the component parts are carefully related to one another and to existing and probable future travel demands.

The simulation of travel and traffic is based on the premise that the magnitude and pattern of travel together is a stable function of the characteristics of the land use pattern and of the transportation system, with the term land use here referring to certain demographic, economic, and land use characteristics. In travel simulation modeling, those aspects of land use development and of the regional transportation system which affect the magnitude and pattern of travel demand are identified, quantified, and correlated with such travel through the analysis of detailed travel origin-and-destination survey data and land use and transportation system survey data. It has been demonstrated that the relationships between land use and the transportation system and travel so established remain reasonably stable over time, thus enabling the forecast of future travel patterns based upon a future land use pattern.

Given the necessary land use and transportation system data, the complete sequence of travel simulation occurs in four steps:

1. Trip generation, in which the total number of person trips generated in each subarea of the planning area for the time period under analysis is determined using relationships found to exist between land use and travel by analyses of the planning inventory data. The output from this step is the total number of person trip ends—that is, trips entering and leaving each subarea of the study area.

2. Trip distribution, in which the person trips generated in each subarea are linked with ends from other subareas, thereby defining the universe of person trips by point of origin and point of destination. The output from this step is the number of person trips made between each subarea pair.

3. Modal split, in which the number of person trips between each subarea pair is divided among the travel modes, primary mass transit and automobile, the term automobile being defined to include vans in personal use. The automobile person trips are further converted to vehicle trips based upon automobile occupancy. The output of this step is the number of person trips made between each subarea pair by mass transit and the number of vehicle trips made between each subarea pair by automobile, including carpools and vanpools.

4. Traffic assignment, in which the intersubarea transit trips are assigned to the existing or proposed transit system network, and the intersubarea vehicle trips are assigned to the existing or proposed highway facility network. The output of this step is the number of people utilizing each route of the existing or proposed mass transit system and the number of vehicles utilizing each segment of the existing or proposed arterial street and highway system.

The end result of the four-step travel simulation process is a complete description of the use of an existing or proposed transportation system, highway, and transit system.

A battery of travel simulation models was first used and developed on a regional scale in southeastern Wisconsin during the initial land use-transportation study conducted by the Commission in 1963. Between the completion of that initial regional land use-transportation planning effort in 1966 and the initiation of the major plan reevaluation effort in 1972, the emphasis on, and consequent need for, quantitative analysis of the performance of alternative transportation systems had increased, and significant advances in the state-of-the-art of travel simulation modeling had occurred. As a consequence, the Commission found it desirable to review and, as needed, refine the initial battery of traffic simulation models for use in the regional transportation plan reevaluation effort of 1972. The Commission's original travel simulation models, calibrated using 1963 home interview survey data, were shown through this review to accurately estimate travel in southeastern Wisconsin in 1972. Although the adequacy of the initial study procedures was validated through this analysis, an investigation of newer modeling strategies was nevertheless conducted, and some of these strategies were incorporated into the travel simulation process for use in the plan reevaluation. The travel simulation modeling to be conducted for the primary transit system alternatives analysis will utilize the battery of travel simulation models developed under the regional land use-transportation plan reevaluation efforts completed in mid-1978. A review of advances in the state-of-the-art of travel simulation modeling since that time has indicated little practical refinement that should be incorporated into the travel simulation process.

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Chapter III

ALTERNATIVE PRIMARY TRANSIT SYSTEM PLAN COMPARISON AND EVALUATION FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN ALTERNATIVE FUTURE

INTRODUCTION

This study of primary transit system alternatives for the Milwaukee area uses an alternative futures approach to long-range primary transit system planning. In this approach, the uncertainty in key future conditions, particularly motor fuel cost and availability, economic conditions, population lifestyles and growth, and land use density and centralization, is explicitly dealt with through the development of a set of alternative futures which represent the range of possible future change in these conditions for the Southeastern Wisconsin Region. The purpose of the alternative futures approach is to identify those primary transit system options that perform well under a wide range of future conditions and which therefore can be recommended for implementation with a minimal amount of uncertainty concerning how well they will operate in the future.

Four alternative futures have been developed under this study, ranging from a future in which conditions are particularly optimistic for primary transit development and use to a future in which conditions are particularly pessimistic. Conditions in the optimistic future include moderate regional population and economic growth, a highly centralized land use pattern, continued real increases in energy cost, and some motor fuel availability problems. Conditions in the more pessimistic future include a slight decline in regional population, little regional economic growth, continued decentralization of urban development in the Region, and only minor real increases in energy cost which, when accompanied by increases in average automobile energy efficiency, lead to a decline in the future real cost of automobile travel. Between these two extremes, two other futures, representing intermediate combinations of these conditions, have been developed.

Alternative primary transit system plans must be tested and evaluated under each of the four alternative futures in order to permit development of a primary transit system plan which can function well under a wide range of possible future conditions in the Region. In addition, the alternative futures approach is intended to identify those alternative primary transit system options which work particularly well, but only under certain futures, so that it can be determined what actions should be recommended to avoid foreclosing important options for an uncertain future.

This chapter describes the formulation, testing, and evaluation of primary transit alternatives for the first of these four futures to be considered. This future has been developed to exemplify the most favorable, but reasonable, future conditions in the Region for transit system development and use. The future includes an increase in the cost of motor fuel and automobile travel, as well as a degree of uncertainty concerning motor fuel supply; a stabilization of population lifestyle trends, with only small future increases in female labor force participation and little change in household size; moderate economic growth in the Region consistent with historic trends as a result of an ability to effectively compete with other areas of the nation for economic growth; moderate population growth with no net in- or out-migration; and a centralized land use development pattern, with a return to the housing unit densities and population level in Milwaukee County which existed in 1970, when the county population was at its recorded peak. Any new urban development would occur primarily at medium density along the full periphery of and outward from existing urban centers. Salient aspects of this alternative future, which has been called the moderate growth scenario-centralized land use plan future, are summarized in Table 6. This alternative future is described in greater detail in a companion document to this report, SEWRPC Technical Report No. 25, Alternative Futures for Southeastern Wisconsin.

Alternative primary transit system plans for this future have been tested and evaluated according to the procedures described in the previous chapter of this report. The first step of the testing and evaluation process was the identification of a maximum network of corridors for each of the principal types of primary transit modes to be considered—specifically, commuter rail, bus-on-freeway modes, and fixed guideway modes. These networks were

Table 6

CHARACTERISTICS OF THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN ALTERNATIVE FUTURE

Key External Factors

Energy	Economic Conditions	Population Lifestyles
Oil price to converge with world oil price, which will increase at 5 percent annual rate to $72 per barrel in the year 2000 (1979 dollars) Petroleum-based motor fuel to increase to $2.30 per gallon by the year 2000 (1979 dollars) Assumes some potential for major and continuing disruptions in oil supply, causing the population to perceive for travel mode choice that their automobile is 25 percent less available for tripmaking Low degree of conservation in all sectors resulting in increase in energy use of 3 percent per year Automobile fuel efficiency of 27.5 miles per gallon	Region is considered to have relatively high attractiveness and competitiveness Per capita and household income increase envisioned as a result of attractiveness and competitiveness of Region, an increased proportion of the population being of work force age, and increased labor force participation	Female labor force participation increases to 50 to 55 percent and total labor force participation is 60 to 65 percent A continuation of below-replacement-level fertility rates during the next decade, followed by an increase to replacement level by the year 2000 Average household size stabilizes

Attendant Regional Change

Economic Activity of Region in the Year 2000	Population of Region in the Year 2000
1,016,000 jobs Manufacturing . . . . 32 percent Services . . . . 40 percent Other . . . . 28 percent Income of $29,600 per household in 1979 dollars (38 percent increase since 1970, or a 1.1 percent annual rate of increase) Income of $10,000 per capita in 1979 dollars (54 percent increase since 1970, or a 1.4 percent annual rate of increase)	2,219,300 persons 29.2 percent—0-19 years of age 58.5 percent—20-64 years of age 12.3 percent—65 years of age or older 739,400 households Average household size of 2.9 persons

Land Use Plan

Urban Growth and Density	Population Distribution		Employment Distribution	
Occurs primarily at medium residential density along the periphery of, and outward from, existing urban centers Existing developed portions of Milwaukee County generally maintain at least residential density of 1970	Milwaukee County		Milwaukee County	
	Population	1,049,600 persons	Employment	593,600 jobs
	Percent Change from 1970	- 0.4	Percent Change from 1970	16.2
	Percent Change from 1978	10.0	Percent Change from 1978	5.6
	Outlying County Population (Ozaukee, Washington, Waukesha)	677,600 persons	Outlying County Employment (Ozaukee, Washington, Waukesha)	231,400 jobs
	Percent Change from 1970	93.8	Percent Change from 1970	119.5
	Percent Change from 1978	52.8	Percent Change from 1978	63.6

Source: SEWRPC.

developed based upon an assessment of major existing and future travel demands in the Milwaukee area, and on a previous assessment of available rights-of-way, as documented in SEWRPC Technical Report No. 23, Transit-Related Socioeconomic, Land Use, and Transportation Conditions and Trends in the Milwaukee Area. The second step in this process was the refinement of the networks. In this step specific alignments were selected from among available alternatives for the location of proposed primary transit facilities within each corridor. Considerations in the refinement process included cost, travel time advantage, travel market potential, and community disruption. The refined networks were then subject to comprehensive test, evaluation, and comparison to establish the extent to which they meet the adopted primary transit system development objectives, principles, and standards, and to develop the best plan under this alternative future so identified.

DEVELOPMENT OF MAXIMUM PRIMARY TRANSIT SYSTEM NETWORKS

As already noted, the first step in the development, test, and evaluation of the primary transit system alternative plans was to establish the maximum extent of potential networks of services and facilities to be considered for each major type of primary transit mode under each alternative future. Accordingly, maximum networks were defined as general corridors for freeway-related motor bus modified rapid primary transit service; motor bus, light rail, and heavy rail guideways; and commuter rail service. The maximum networks were defined recognizing that the future spatial configuration of the area primary transit system, particularly one which requires fixed guideways, will have a significant impact upon both the costs and effectiveness of the secondary and tertiary, as well as the primary transit systems, and of the entire transportation system of the Milwaukee area. Only those corridors characterized by heavy travel demands or an availability of right-of-way or facility and attendant relatively low development cost and minimum disruption were initially included as part of each maximum network.

Service to Major Travel Demands

One of the two criteria used in defining the maximum extent of the primary transit networks considered under the study was travel demand. Only corridors of heavy travel demand can be expected to provide the levels of ridership necessary to justify the costs of primary transit system construction and operation. These corridors must have a large total market of travel to draw upon, and are usually characterized by automobile traffic and parking congestion which can make travel on high-speed primary transit systems particularly attractive. Only in such densely traveled corridors can a greater reliance on transit travel have important secondary impacts on highway congestion, motor fuel consumption, and air pollution.

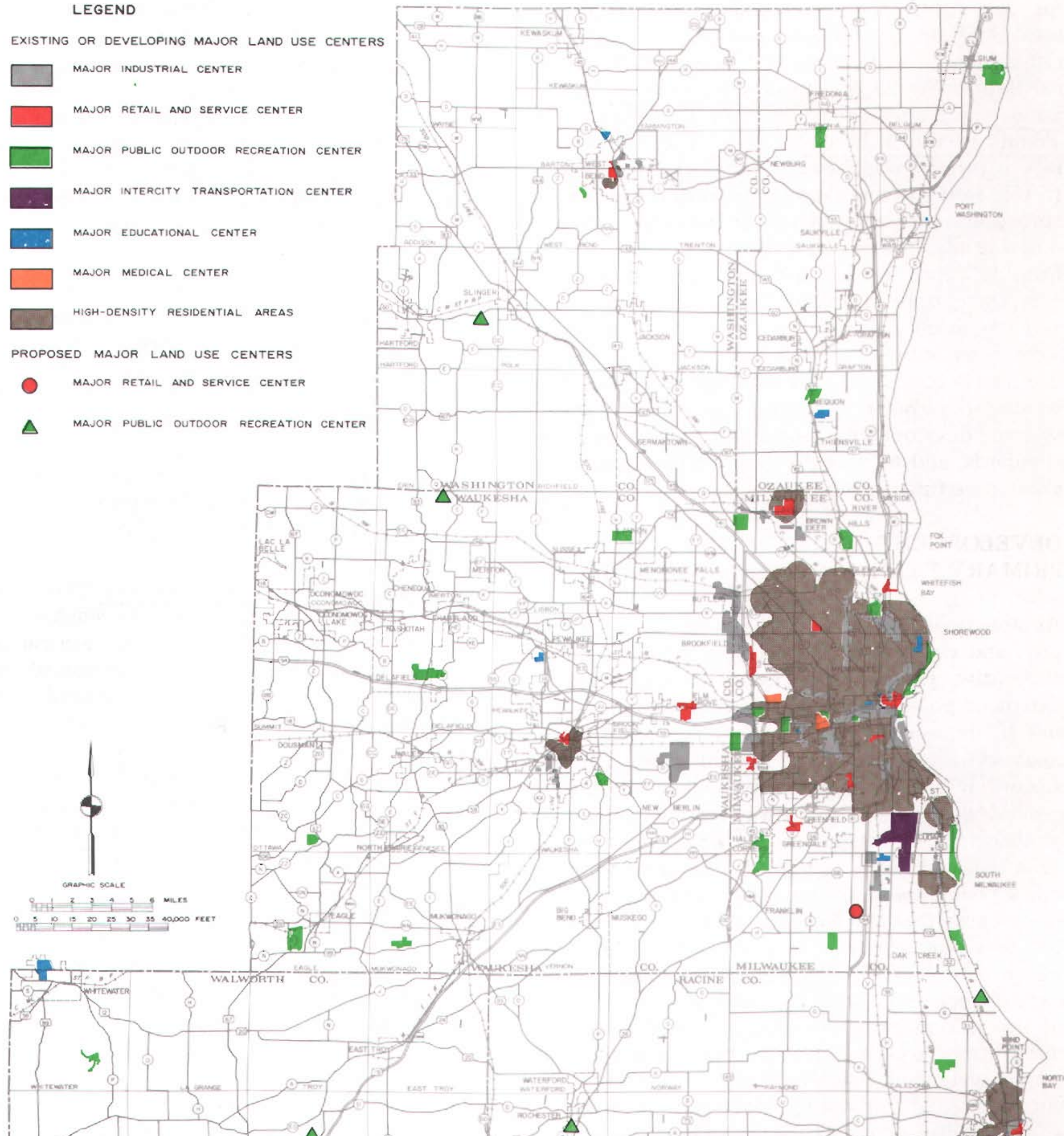
Corridors of major travel demand in the Milwaukee area under the moderate growth scenario-centralized land use plan were identified through analysis of the location of existing and proposed major trip generators; of existing and future travel desire lines in the Milwaukee area the impact of probable future travel demand on the Milwaukee area transportation system in the absence of any future transit improvement or expansion; and of existing transit routes of heavy ridership.

Major Land Use Activity Centers: The location of major travel corridors in the Milwaukee area and in the Southeastern Wisconsin Region can be identified, in part, through an examination of the existing and proposed location of major land use activity centers. These major, or regional, activity centers and areas include the larger retail and service centers, industrial centers, medical centers, universities, intercity transportation terminals, regional parks and outdoor recreation centers, and concentrations of high-density residential development. Travel to, from, and between these centers and areas may be expected to represent a fairly substantial portion, if not a majority, of the travel in the corridors of heavy travel demand within the Milwaukee urbanized area. The location of these major activity centers and areas is shown on Map 5.

Major retail and service centers are those commercial centers which have a regional service orientation. As of January 1980 there were 13 such major retail and service centers in the Region, 10 of which were located within the Milwaukee area. The centralized land use plan under the moderate growth scenario foresees the development of three additional retail service centers within the greater Milwaukee area—specifically in Oak Creek, West Bend, and Waukesha. As indicated in Table 7, the retail centers existing in the Milwaukee area in 1972 provided over 12 percent of the total regional

Map 5

EXISTING AND PROPOSED MAJOR LAND USE ACTIVITY CENTERS IN THE REGION UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



One of the considerations in the identification of potential fixed guideway alignments was the location of major land use activity centers in the Milwaukee area and in the Southeastern Wisconsin Region. Such major activity centers and areas include the larger retail and service centers, major industrial centers, intercity transportation terminals, regional parks, major medical centers, colleges and universities, and concentrations of high-density residential development. Shown on this map are the existing major land use centers as of 1980, as well as such major centers proposed for development by the year 2000 under the moderate growth scenario-centralized land use plan alternative future.

Source: SEWRPC.

Table 7

EXISTING AND PROPOSED MAJOR RETAIL AND SERVICE CENTERS IN THE REGION UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Major Retail and Service Centers[a]	Net Land Use Area[b] (acres)		Employment	
	1970	2000	1972	2000
Existing				
Milwaukee Area				
Bay Shore	28	28	5,600	5,700
Capitol Court	28	28	3,000	3,100
Mayfair	21	38	3,600	5,500
Milwaukee Central Business District	97	97	65,000	66,100
Mitchell Street	20	20	4,400	4,700
Northridge	- -	45	- -	4,500
Southgate	28	28	2,400	2,500
Southridge	25	43	2,700	4,500
West Allis-West	21	26	1,500	2,100
Brookfield Square	44	82	1,900	6,100
Subtotal	330	435	91,000	104,800
Other				
Kenosha Central Business District	29	29	2,400	2,400
Racine Central Business District	31	31	4,100	4,500
Elmwood Plaza[c]	18	- -	1,700	- -
Subtotal	78	60	8,200	6,900
Existing Total	390	495	99,200	111,700
Proposed				
Oak Creek	- -	30	- -	3,000
Waukesha Central Business District	- -	42	- -	3,100
West Bend Central Business District	- -	43	- -	6,200
Racine-West	- -	34	- -	3,500
Subtotal	- -	194	- -	15,800
Proposed Total	390	599	99,200	127,500
Neighborhood and Other Retail and Service Centers	6,127	6,571	205,900	307,500
Total	6,517	7,215	305,100	435,000

[a] *See Map 5.*

[b] *Includes only that land actually used for retail and service purposes.*

[c] *This center would be replaced by a proposed new center at the intersection of STH 11 and STH 31. Elmwood Plaza would remain as a community-level retail and service center.*

Source: SEWRPC.

employment and 30 percent of the commercial employment, while accounting for about 5 percent of the total retail and service land in the Region and less than one-fiftieth of 1 percent of the total area of the Region. The existing and proposed retail and service centers in the Milwaukee area are envisioned to provide over 11 percent of the year 2000 employment in the Region and 26 percent of the year 2000 commercial employment, while accounting for about 7 percent of the total future retail and service land in the Region and less than one-thirtieth of 1 percent of the total area of the Region.

Major industrial centers include the larger and more concentrated locations of manufacturing activities, wholesaling offices, and warehouse and storage areas within the Region. In 1970 the Region contained more than 10,000 acres of land devoted to industrial uses. Although this industrial development comprised only 0.6 percent of the total area of the Region, it accounted for almost 40 percent of the total regional employment. The 14 major industrial centers existing in the Milwaukee area in 1972 represented nearly 20 percent of total regional employment and 50 percent of the total regional industrial employment, while accounting for 33 percent of the total regional industrial lands and less than one-fifth of 1 percent of the total area of the Region. Under the moderate growth scenario-centralized land use plan, the 17 existing and proposed major industrial centers in the Milwaukee area are anticipated to provide nearly 19 percent of the total regional employment by the year 2000 and 49 percent of the regional industrial employment, while accounting for 36 percent of the regional industrial lands and less than one-half of 1 percent of the total land of the Region (see Table 8).

As major institutional centers, the major universities of the Milwaukee area are significant generators of travel. In 1972 the two major universities in the Milwaukee area—the University of Wisconsin-Milwaukee and Marquette University—represented the second and third largest concentrations of travel demand in the Milwaukee area, respectively. Only the Milwaukee central business district was a larger generator of travel demand of approximate equal land area—1.25 to 1.50 square miles.

Areas of high residential density in the Milwaukee area a also represent concentrations of travel demand. Over 40 percent of the trips made in the Region on an average weekday in 1972 were destined for a residence. Although they would represent nearly 40 percent of the households in the Region, high-density residential areas in the Milwaukee area in the year 2000 would account for less than 11 percent of the total residential land area of the Region under this alternative future, and only slightly more than 1 percent of the total land area of the Region.

Other major land use activity centers of areawide importance which primary transit should connect and serve include major medical centers, major park and outdoor recreation areas, county-operated technical and vocational schools, and intercity transportation terminals. The location of these land use activity centers and areas in the year 2000 are shown on Map 5. As shown on this map, the major concentrations of intensive land use activity are located primarily in central Milwaukee County.

Existing and Future Travel Desire Lines: The location of major travel corridors in the Milwaukee area can also be identified through an examination of the existing and probable future travel desire lines within the Milwaukee area and the Southeastern Wisconsin Region. A travel desire line is a direct, straight-line link between a trip origin and a trip destination, irrespective of the configuration of existing or proposed transportation facilities and services. To display the existing and future travel desire lines within the Region, a network was developed which as directly as possible connected the major subareas of the Region. Existing and future travel demand between the subareas of the Region were then assigned to that network. The amount of travel demand assigned to any segment of the network represented the sum of the volume of desired travel movement which may be expected between the subareas of the Region which are connected in a direct path by that segment. The pattern of travel desires in the Region was then shown on a map of the network on which the volume of desired travel on each of the segments of the network is graphically represented by the width of the segment.

Such a pattern of travel desire lines as they existed within the Region in 1972, the year of the Commission's last origin-and-destination survey, is shown on Map 6. The greatest volume of then-existing travel in the Region on an average weekday can be seen to occur between certain subareas of the Milwaukee area, and particularly between certain subareas of Milwaukee County. The greatest volume of travel desire lines in Milwaukee County occurs in the intensely developed areas of the City of Milwaukee, and is centered on the Milwaukee central business district. Major corridors of travel desire lines are evident in all landward directions radiating from the Milwaukee central business district. In addition, crosstown corridors are evident in an east-west direction north and south of the Milwaukee central business district, as well as in a north-south direction west of the central business district. Generally, the volume of travel in these major travel corridors declines with increasing distance from the Milwaukee central business district. Travel desire line volumes throughout the Region outside Milwaukee County are substantially less than those within Milwaukee County, the only exceptions being the volumes between Milwaukee County and eastern Waukesha County and in and between the Cities of Racine and Kenosha.

Table 8

EXISTING AND PROPOSED MAJOR INDUSTRIAL CENTERS IN THE REGION UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Major Industrial Centers[a]	Net Land Use Area[b] (acres)		Employment	
	1970	2000	1972	2000
Existing				
Milwaukee Area				
Cudahy-South Milwaukee	256	326	7,300	8,400
Milwaukee-Glendale	358	358	17,800	18,200
Milwaukee-Menomonee Valley East	398	396	18,600	19,000
Milwaukee-Menomonee Valley West	120	120	5,300	5,400
Milwaukee-Near North	123	123	15,000	15,300
Milwaukee-Near South	280	280	12,600	12,000
Milwaukee North	342	342	20,800	21,200
Milwaukee South	89	89	4,100	4,200
West Allis-East	220	220	9,300	9,500
West Allis-West	129	129	3,600	3,700
West Milwaukee	408	408	15,400	15,700
West Bend	83	314	3,800	7,100
Butler-Wauwatosa-Brookfield	375	375	14,600	14,900
New Berlin	174	524	3,500	8,500
Subtotal	3,355	4,006	151,700	163,100
Other				
Kenosha-East	214	214	11,600	11,600
Mt. Pleasant	162	575	3,500	9,400
Racine	273	273	12,500	12,800
Subtotal	649	1,062	27,600	33,800
Existing Total	4,004	5,068	179,300	196,900
Proposed				
Milwaukee-Granville	--	1,117	--	15,500
Oak Creek	--	678	--	8,800
Waukesha	--	460	--	8,000
Kenosha-West	--	313	--	4,500
Burlington	--	325	--	4,700
Subtotal	--	2,893	--	41,500
Proposed Total	4,004	7,961	179,300	238,400
Local and Other Industrial Centers	6,034	8,799	120,800	159,300
Total	10,038	16,710	300,100	397,700

[a] *See Map 5.*

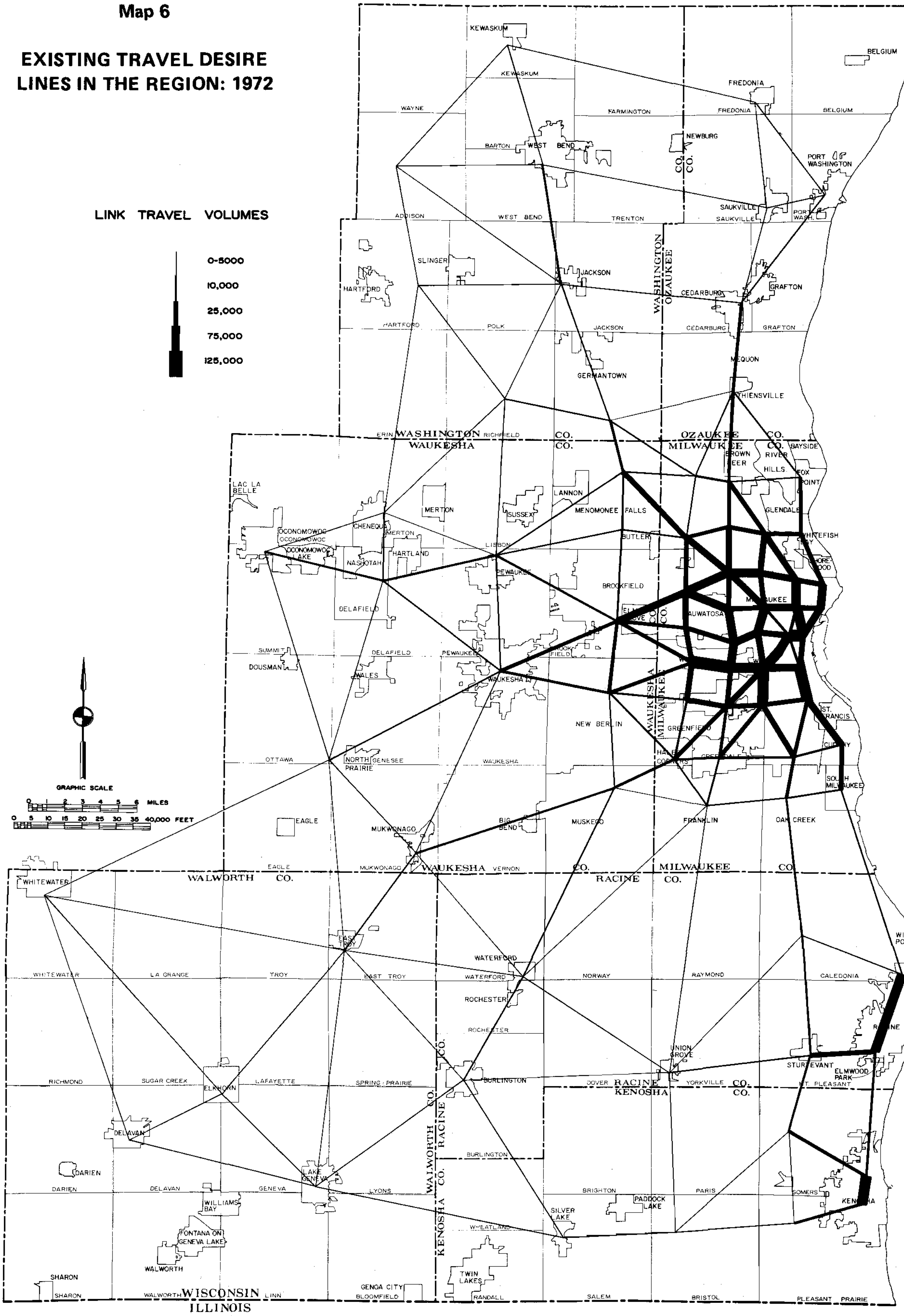
[b] *Includes only that land actually used for industrial purposes.*

Source: SEWRPC.

An examination of the volume of travel desires which may be expected to occur in the year 2000 under the moderate growth scenario-centralized land use plan alternative future indicates that the overall travel desire line pattern for the Region may be expected to continue to be concentrated in Milwaukee County, focusing on the City of Milwaukee and the Milwaukee central business district (see Map 7). The major corridors of travel desire lines radiating from the Milwaukee central business district to the southeast, southwest, north, and northeast may be expected to remain, as may the

Map 6

EXISTING TRAVEL DESIRE LINES IN THE REGION: 1972

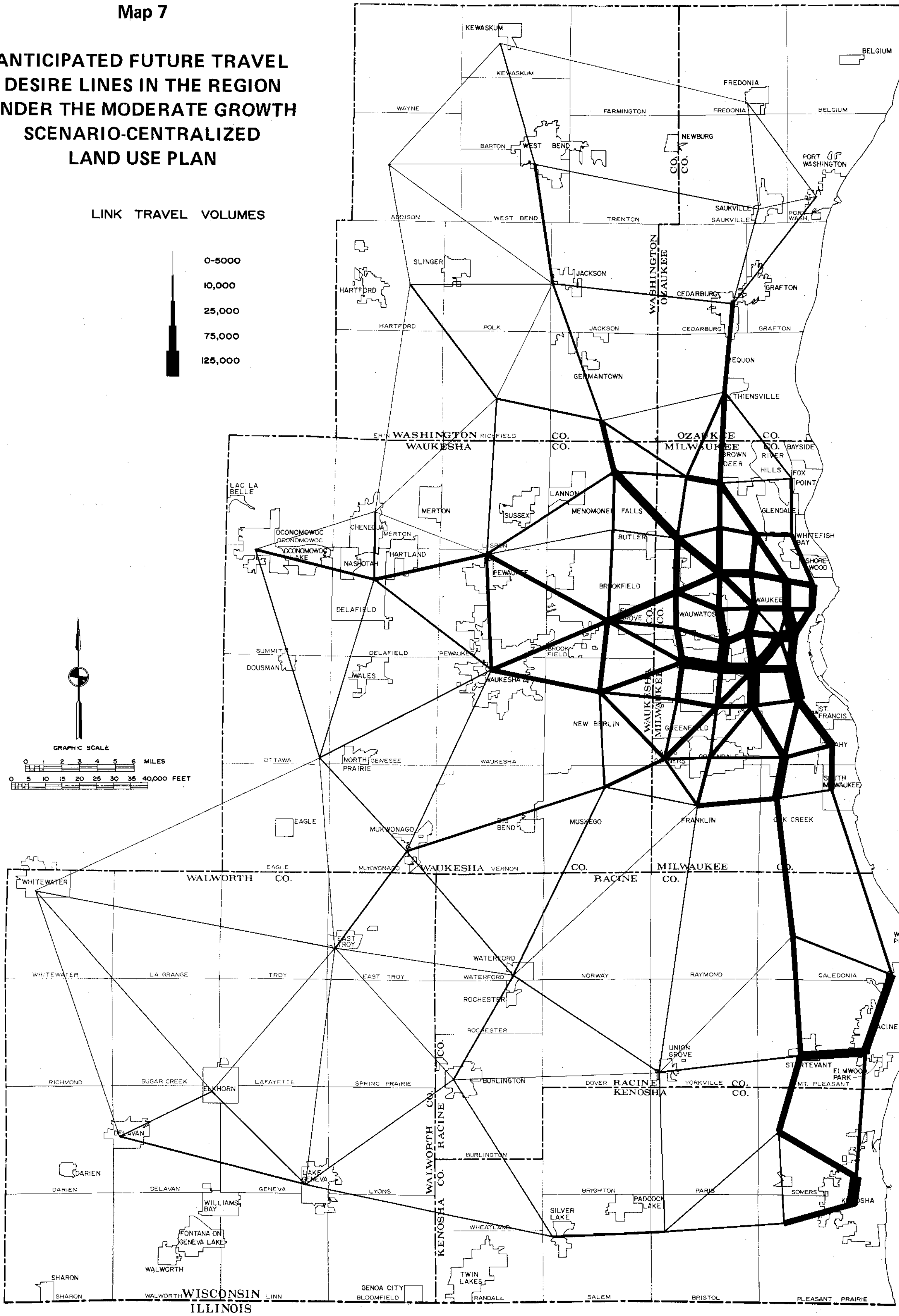


Another consideration in the identification of potential fixed guideway alignments was the location of major corridors of travel demand as indicated by existing travel desire lines within the Milwaukee area and the Southeastern Wisconsin Region. As indicated by the concentration of travel "desire lines" connecting person trips origins and destinations shown on this map, major corridors of travel demand occur in the more intensely developed areas of the City of Milwaukee, centered on the Milwaukee central business district. In general, the major corridors of travel demand radiate from the Milwaukee central business district in all landward directions. Significant corridors of travel demand also occur in the Racine and Kenosha areas of the Region.

Source: SEWRPC.

Map 7

ANTICIPATED FUTURE TRAVEL DESIRE LINES IN THE REGION UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



Another consideration in the identification of potential fixed guideway alignments was the probable future location of major corridors of travel demand as indicated by future travel desire lines. Under the moderate growth scenario-centralized land use plan alternative future, major corridors of travel demand as indicated by concentrations of travel "desire lines" connecting person trip origins and destinations may be expected to continue to be concentrated in Milwaukee County, focusing on downtown Milwaukee as do the existing travel desire lines (see Map 6). Travel volumes in most major corridors in the Milwaukee area may be expected to increase, especially those which extend toward the Brown Deer, Menomonee Falls, and Oak Creek suburban areas. In addition, travel in the Milwaukee-Racine-Kenosha corridor can be expected to increase significantly.

Source: SEWRPC.

crosstown corridors in an east-west direction north and south of the central business district, and in a north-south direction west of the central business district. Increases in travel desire line volumes may be expected in corridors radiating from the Milwaukee central business district into the southern portion of Milwaukee County, into Ozaukee County, and into northeastern Waukesha County. Outside Milwaukee County, travel desire lines within and between the Cities of Racine and Kenosha may be expected to continue to be significant. Travel desire line volumes between the City of Milwaukee and the Cities of Racine and Kenosha may also be expected to increase.

When considering only the heaviest 15 percent of travel desire line volumes, the resulting pattern is principally one of corridors radiating from the Milwaukee central business district, but also includes some crosstown corridors. As shown on Map 8, the network of the heaviest desire line volumes in 1972 shows major corridors radiating from the Milwaukee central business district in northeasterly, northerly, westerly, and southwesterly directions, and crosstown corridors north and west of the central business district. The network of the heaviest future travel desire lines expected to occur under this alternative future similarly displays major corridors of travel desire lines to the northeast and west of the Milwaukee central business district, and a major crosstown corridor west of the central business district. Major travel corridors northwest, south, and southeast of the Milwaukee central business district are also evident.

Future Travel Volumes: A third way in which major travel demand patterns can be identified is through consideration of the travel and traffic volumes which may be expected to occur on the future transportation system in the absence of any long-range primary transit system improvement or expansion. Those parts of the area transportation system carrying the highest volumes of traffic are corridors of heavy travel demand with potential for primary transit development. Those parts of the arterial street system both carrying high traffic volumes and experiencing traffic congestion are also corridors with a potential for primary transit development. Corridors of future heavy travel demand identified in this manner, however, necessarily reflect the constraints of the location and capacity of the existing Milwaukee area transportation system.

Future travel demand in southeastern Wisconsin under this alternative future was estimated through application of the travel simulation models decribed in Chapter II of this report. The unimproved transportation system to which the travel demand anticipated under this alternative future was assigned was a combination of the lower-tier arterial street and highway system of the adopted long-range regional transportation system plan which is described in Chapter II of this report, and the adopted short-range public transit system plan for the Milwaukee County Transit System combined with the existing Waukesha County-Milwaukee County commuter bus service operated by Wisconsin Coach Lines, Inc. The public transit system existing in Milwaukee County in 1979 and the Waukesha County-Milwaukee County commuter bus service are described in Chapter VI of SEWRPC Technical Report No. 23, Transit-Related Socioeconomic, Land Use, and Transportation Conditions and Trends in the Milwaukee Area.

The adopted short-range transit system plan for Milwaukee County differs from the existing transit system with respect to the primary transit element in that three new park-ride lots with "Freeway Flyer" service are to be added to the existing system; with respect to the secondary, or express, element in that three new peak-period routes are to be added to the existing system; and with respect to the tertiary, or local, transit element in that two new routes are to be added to the existing system, 15 existing routes are to be extended, about one-half of the existing routes are to be partially rerouted to improve connectivity and directness, and nearly one-third of the existing routes are to have headways reduced during off-peak time periods. These recommended improvements are anticipated to result in substantially more transit ridership at the end of five years than may be expected under a continuation of the existing transit route structure and level of service. It should be recognized, however, that the improvements recommended under this "base" or "no long-range transit improvement" system are the only improvements that are assumed to be made over the 20-year design period of this study.

Under this alternative future and this "base" or "no-long-range transit improvement" transportation system, a total of 5,664,400 person trips can be expected to be generated on an average weekday within the Region. As shown in Table 9, this represents an increase of about 27 percent over the approximately 4,460,400 person trips generated within the Region on an average weekday in 1972. The 27 percent increase in total person trips internal to the Region anticipated from 1972 to

Map 8

EXISTING AND FUTURE PATTERN OF THE MOST SUBSTANTIAL TRAVEL DESIRE LINES IN THE MILWAUKEE AREA: 1972 AND 2000

The location of major travel corridors in the Milwaukee area can be identified in part through an examination of the existing and probable future travel desire lines within the Milwaukee area. The pattern of travel desire lines which results from considering only the heaviest 15 percent of desire line volumes is principally one of corridors which radiate from downtown Milwaukee. Such a pattern is illustrated on this map, along with evidence of some crosstown corridors. Of special importance are the travel desire lines which occur for both the existing and future travel patterns.

Source: SEWRPC.

Table 9

COMPARISON OF THE DISTRIBUTION OF INTERNAL PERSON TRIPS IN THE REGION BY TRIP PURPOSE: 1972, ADOPTED REGIONAL LAND USE AND TRANSPORTATION SYSTEM PLANS, AND BASE PRIMARY TRANSIT SYSTEM PLAN FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Trip Purpose	Internal Person Trips Generated on an Average Weekday					
	Existing 1972		2000 Adopted Plan		Base Plan	
	Number of Trips	Percent of Total	Number of Trips	Percent of Total	Number of Trips	Percent of Total
Home-Based Work	1,055,500	23.7	1,364,600	23.7	1,385,300	24.5
Home-Based Shopping . . .	673,600	15.1	848,700	14.8	666,100	11.8
Home-Based Other	1,532,600	34.3	1,948,600	33.9	1,988,700	35.1
Nonhome Based.	779,800	17.5	1,001,300	17.4	1,036,600	18.3
School	418,900	9.4	587,700	10.2	587,700	10.3
Total	4,460,400	100.0	5,750,900	100.0	5,664,400	100.0

Source: SEWRPC.

Table 10

COMPARISON OF THE DISTRIBUTION OF INTERNAL PERSON TRIPS IN THE REGION BY MODE OF TRAVEL: 1972, ADOPTED REGIONAL LAND USE AND TRANSPORTATION SYSTEM PLANS, AND BASE PRIMARY TRANSIT SYSTEM PLAN FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Mode of Travel	Internal Person Trips Generated on an Average Weekday					
	Existing 1972		2000 Adopted Plan		Base Plan	
	Number of Trips	Percent of Total	Number of Trips	Percent of Total	Number of Trips	Percent of Total
Automobile Driver	2,884,700	64.7	3,764,100	65.5	3,690,100	65.1
Automobile Passenger . . .	1,217,900	27.3	1,363,200	23.7	1,318,300	23.3
Transit Passenger	184,200	4.1	335,000	5.8	367,400	6.5
School Bus Passenger	173,600	3.9	288,600	5.0	288,600	5.1
Total	4,460,400	100.0	5,750,900	100.0	5,664,400	100.0

Source: SEWRPC.

2000 compares with a 23 percent increase in population and a 36 percent increase in employment anticipated over the same period in the Region. The number of total trips and trips by purpose expected to be generated under this base transportation system is nearly the same as that expected under the adopted regional land use plan and transportation system plan, as both are based on the same population and employment levels and degree of land use centralization.

The distribution of person trips internal to the Region anticipated under this alternative future and base transportation system is summarized in Table 10 by mode of travel. Under this alternative future and base transportation system, 3,690,100 auto driver trips, 3,690,100 auto passenger trips, 367,400 transit passenger trips, and 288,600 school bus passenger trips may be expected to be generated in the Region. Most significant is the increase in transit passenger trips anticipated under this

Table 11

COMPARISON OF FACTORS WHICH AFFECT TRAVEL MODE CHOICE: 1972 AND 1979 CONDITIONS, ADOPTED REGIONAL LAND USE AND TRANSPORTATION SYSTEM PLANS, AND BASE PRIMARY TRANSIT SYSTEM PLAN FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Factor	Existing 1972	Existing 1979	2000 Adopted Plan	Base Plan
Motor Fuel				
Cost per Gallon (in 1979 dollars) . . .	$0.65 ($0.36 in 1972 dollars)	$1.00	$1.80 ($1.00 in 1972 dollars)	$2.30
Automobile Fuel Efficiency (miles per gallon).	12	14	27.5	27.5
Cost per Mile (in 1979 dollars).	$0.05 ($0.03 in 1972 dollars)	$0.07	$0.07 ($0.04 in 1972 dollars)	$0.08
Milwaukee Area Transit Fare (in 1979 dollars).	$0.90 ($0.50 in 1972 dollars)	$0.50	$0.90 ($0.50 in 1972 dollars)	$0.50
Regional Automobile Availability				
Total.	704,600	802,100	1,002,500	1,032,400
Average Number of Persons per Auto	2.6	2.2	2.2	2.1

Source: SEWRPC.

alternative future. Much of this difference is a result of the significantly greater attractiveness of public transit postulated under this future with respect to cost of travel.

As shown in Table 11, the public transit fare would be substantially lower under this alternative future and base transportation system than under either 1972 conditions or those conditions postulated in the adopted regional transportation system plan. Also, the cost of motor fuel per mile traveled by automobile would be somewhat higher. It was assumed under this future that the present transit fare in the Milwaukee area of $0.50 would not increase in real cost, but would increase only to offset the effects of general price inflation. Another factor contributing to this greater attractiveness of public transit for tripmaking is the improvements in off-peak transit service included in the adopted short-range transit plan for Milwaukee County. Finally, public transit use will increase under this alternative future because of its assumption that motor fuel supply will be uncertain and disrupted to the extent that the population will consider owned automobiles to be 25 percent less available for all home-based tripmaking.

The increase in transit passenger trips is anticipated to occur for all trip purposes except trips to and from school, as shown in Table 12. Substantial increases are expected to occur in trips for shopping and other nonwork or nonschool purposes. The increased use of public transit for such nonwork and nonschool trips represents a continuation of a trend experienced by the Milwaukee County Transit System over the last several years. It is anticipated that the increase in these trip purposes will be over three times greater than the increase in work trips. This represents a distribution of transit trips by trip purpose not experienced in the Milwaukee area since before World War II. However, of total person trips for work purposes over 9 percent, would be transit passenger trips, which is still more than the proportion of total trips anticipated to be made by transit for shopping and other nonwork- or nonschool-purpose trips.

The approximate doubling of transit use expected in the Milwaukee area over the 28-year period from 1972 to 2000 under this alternative future and base primary transit system, although substantial, apppears reasonable under this, the most optimistic future for transit use in the Milwaukee area, and

Table 12

COMPARISON OF THE DISTRIBUTION OF INTERNAL TRANSIT PASSENGER TRIPS IN THE MILWAUKEE AREA BY TRIP PURPOSE: 1972, ADOPTED REGIONAL LAND USE AND TRANSPORTATION SYSTEM PLANS, AND BASE PRIMARY TRANSIT SYSTEM PLAN FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

	Average Weekday Transit Passenger Trips					
	Existing 1972		2000 Adopted Plan		Base Plan	
Trip Purpose	Number of Trips	Percent of Total	Number of Trips	Percent of Total	Number of Trips	Percent of Total
Home-Based Work	70,100	39.4	123,000	41.8	102,100	31.2
Home-Based Shopping . . .	18,000	10.1	33,000	11.2	39,000	11.9
Home-Based Other	26,900	15.1	77,500	26.3	116,900	35.8
Nonhome Based.	12,600	7.1	9,800	3.3	17,500	5.4
School	50,200	28.3	51,300	17.4	51,300	15.7
Total	177,800	100.0	294,600	100.0	326,800	100.0

Source: SEWRPC.

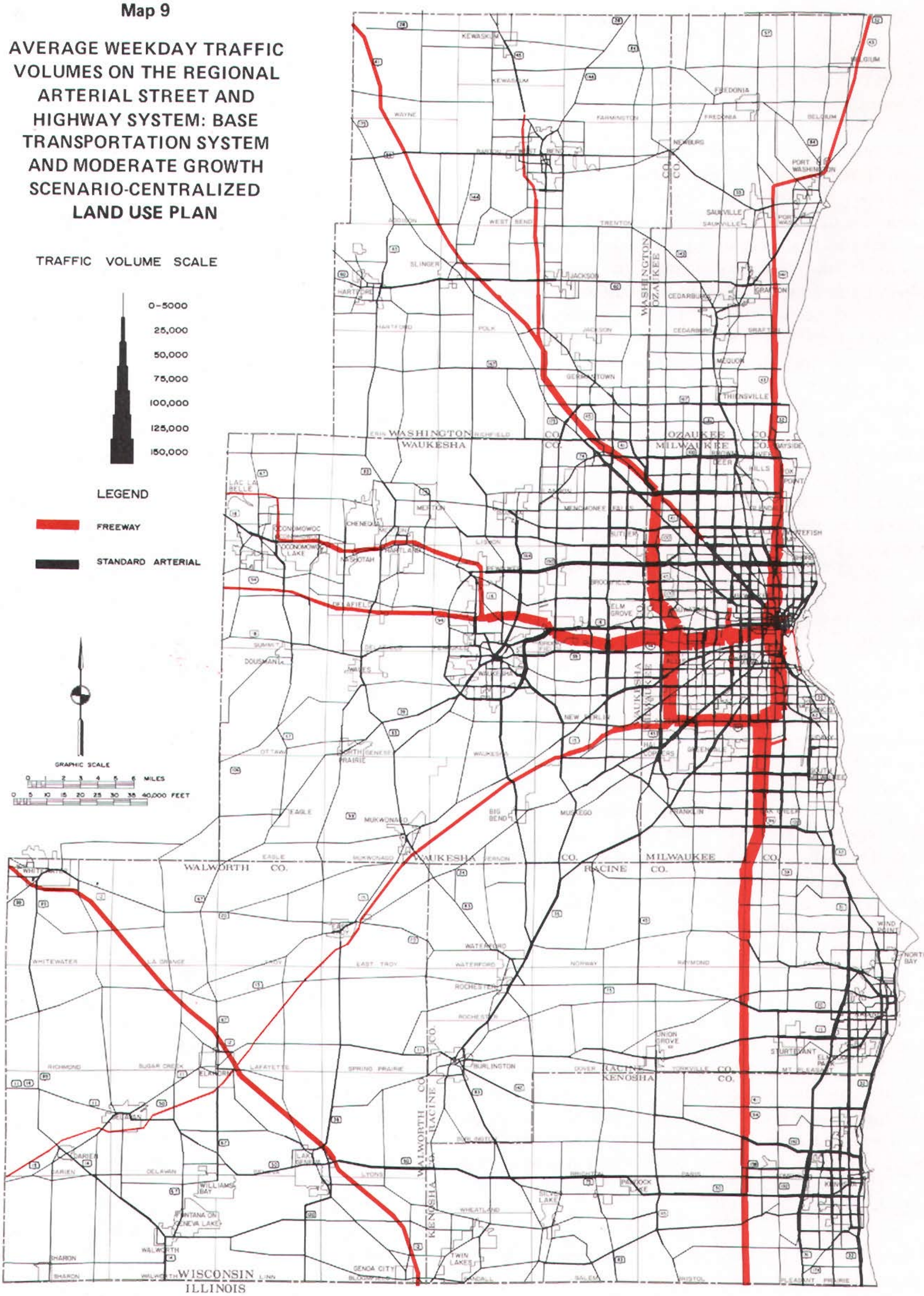
with implementation of the current five-year transit development program for the Milwaukee area. Under this future and program, transit fares would, in effect, be reduced by nearly one-half, while the cost of automobile travel per mile would increase by more than 60 percent. It is estimated that these changes in the cost of travel alone account for about 50 percent of the anticipated increase in transit ridership. The assumption under this future that motor fuel will experience periodic disruption, or that the supply will be rationed to the extent that households will perceive a 25 percent reduction in automobile availability for tripmaking, is also a factor in the forecast transit ridership increase, accounting for about 25 percent of that increase. The assumption that the total market for transit use in the Milwaukee area will increase substantially under this future as a result of an increase in the number of households and the number of jobs in Milwaukee County is yet another factor contributing to the forecast increase, accounting for about 10 percent. The route extensions and level of service improvements actually made in the Milwaukee area transit system since 1972, together with those proposed in the recommended five-year transit system development program for the Milwaukee area, account for about 15 percent of the increase.

The forecast ridership increase is consistent with recent trends in transit use in the Milwaukee area. Since public ownership of the system in 1975, when fares were stabilized and service improved, and since the cost of motor fuel and automobile travel began to increase substantially, transit ridership in the Milwaukee area has increased at an average annual rate of about 5 percent. The ridership increase expected under this alternative future from the year 1979 to the year 2000 represents a halving of that annual rate of increase. The increase in nonwork-purpose transit trips, or off-peak transit use, anticipated under this future represents a continuation of current trends in Milwaukee area transit use. In 1972 fewer than 50,000 transit trips were made in the Milwaukee area during the midday hours of 9:00 a.m. to 3:00 p.m., less than the number made during the morning peak hours of 6:00 a.m. to 9:00 a.m. A total of 54,000 midday transit trips were made in 1978, nearly 25 percent more than the number of trips made during the morning peak hours. Under this alternative future and base transit plan, it is expected that about 60 percent more transit trips will be made during the six-hour midday period than during the morning peak period. Transit trips made during the midday period are expected to increase from 1978 levels at an annual rate of about 3.4 percent, slightly more than the 2.5 percent annual rate of increase expected for total transit trips.

The resulting traffic volumes anticipated under this alternative future and base transportation system are shown on Map 9. The greatest traffic volumes are expected to occur on the freeway system, which will account for over 11.7 million vehicle miles

Map 9

AVERAGE WEEKDAY TRAFFIC VOLUMES ON THE REGIONAL ARTERIAL STREET AND HIGHWAY SYSTEM: BASE TRANSPORTATION SYSTEM AND MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



The average weekday traffic volumes anticipated on the regional arterial street and highway system in the year 2000 under the base transportation system and moderate growth scenario-centralized land use plan are shown on this map. The greatest traffic volumes may be expected to occur on the freeway system and, although freeways in the Region will constitute less than 9 percent of the arterial street and highway system in the year 2000, these facilities may be expected to carry over 40 percent of the arterial vehicle miles of travel. Of particular significance to transit planning are the standard surface arterial streets and highways which are expected to carry substantial average weekday traffic volumes in the year 2000. Such facilities are located principally in north-central and northwestern Milwaukee County, where there are no existing or planned freeways, as well as in and around the Cities of Racine and Kenosha.

Source: SEWRPC.

of travel in the Region on an average weekday. Although freeways in the Region will constitute less than 9 percent of the arterial street and highway system in the year 2000 under this future and base transportation system, these facilities may be expected to carry over 40 percent of the arterial vehicle miles of travel. The greatest freeway traffic volumes in the Region on an average weekday will occur in the Milwaukee area, and particularly in Milwaukee County. Within Milwaukee County, the heaviest concentration of travel volumes will occur on freeways emanating radially from the Milwaukee central business district, specifically to the north on the North-South Freeway (IH 43), to the west on the East-West Freeway (IH 94), and to the south on the North-South Freeway (IH 94). In addition, heavy freeway traffic volumes will occur in an east-west direction along the Airport Freeway (IH 894) south of the Milwaukee central business district, as well as in a north-south direction along the Zoo Freeway (USH 45 and IH 894) west of the City of Milwaukee. Generally, the volumes of travel on the radial freeways will decline with increasing distance away from the Milwaukee central business district.

Standard arterial streets and highways expected to carry substantial average weekday traffic volumes in the year 2000 are located principally in north-central and northwestern Milwaukee County, where there are no existing or planned freeways. A particularly heavily traveled arterial would be W. Capitol Drive extending in an east-west direction from the North-South Freeway (IH 43) to STH 164 in Waukesha County. Heavy traffic volumes are also expected to occur along stretches of W. Silver Spring Drive, W. Good Hope Road, and W. Brown Deer Road west of the North-South Freeway (IH 43) and east of the Fond du Lac Freeway (USH 41 and 45). Heavily used standard arterial streets radiating from the Milwaukee central business district may be expected to include W. Fond du Lac Avenue to the northwest and W. Bluemound Road (USH 18) and W. Wisconsin Avenue to the west. Substantial traffic volumes are also expected on N. and S. 27th Streets between W. Fond du Lac Avenue on the northwest side of the City of Milwaukee and the Airport Freeway (IH 894).

The relationship between the average weekday traffic volumes and the capacity of the arterial street and highway system in the Milwaukee area and the Region anticipated under this alternative future and base transportation system is shown on Map 10. The most severe traffic congestion may be anticipated to occur on the freeway system in the Milwaukee area, particularly on the East-West Freeway (IH 94), North-South Freeway (IH 94 and IH 43), and Zoo Freeway (IH 894 and USH 45). Primary transit improvement and expansion would be an alternative to providing any additional capacity for these congested arterials.

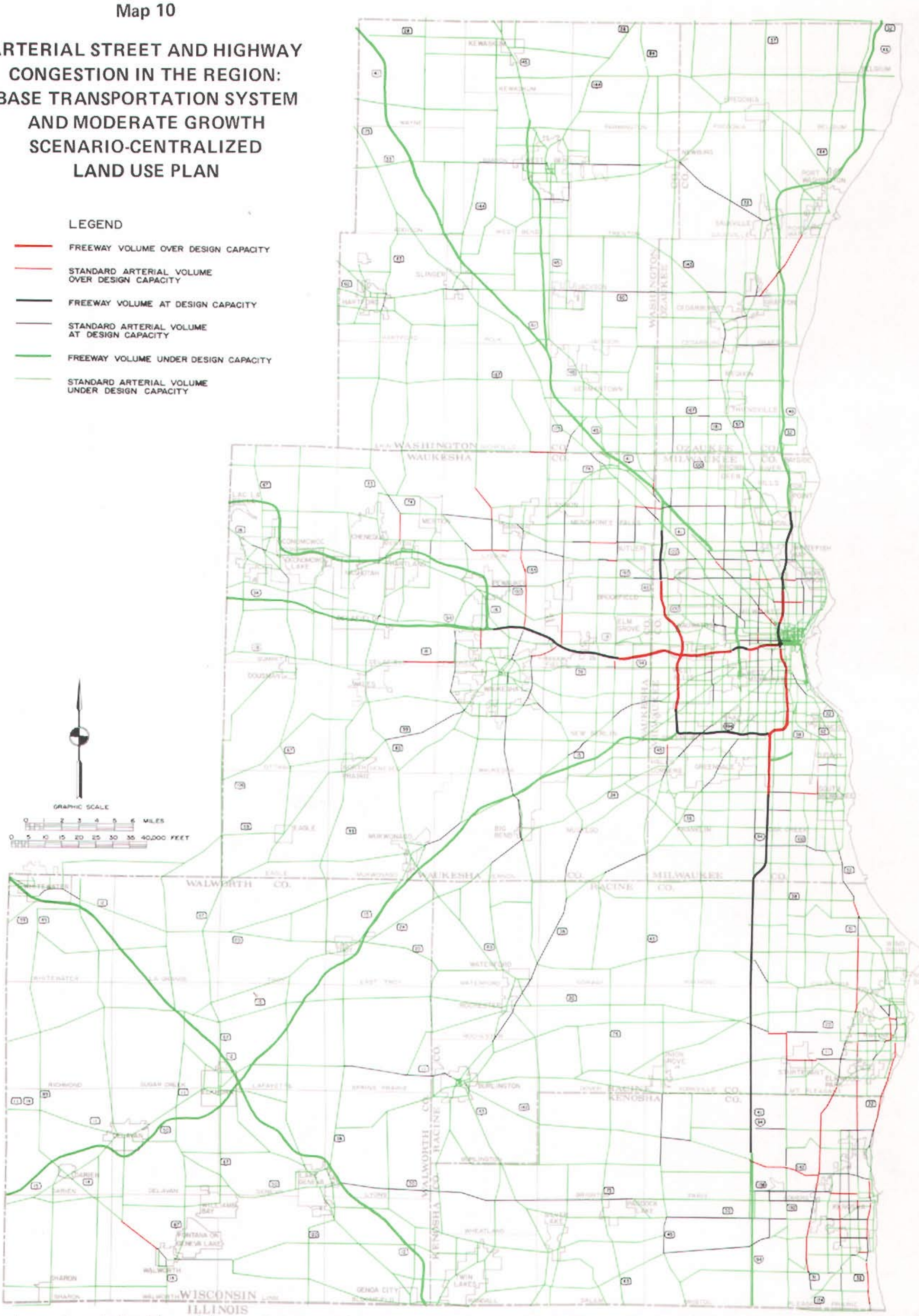
The future transit passenger volumes anticipated under this alternative future on the primary, secondary, and tertiary transit system elements of the base transportation system are shown on Map 11. The greatest volumes of transit passengers on an average weekday may be expected to occur in a radial pattern emanating from the Milwaukee central business district. Seven particularly high transit passenger volume corridors are focused on the downtown Milwaukee area and extend in all landward directions from the Milwaukee central business district. Specifically, the major corridors of transit ridership radiate from the Milwaukee central business district to the northeast, north, northwest, west, southwest, south, and southeast. In addition, major crosstown corridors are evident in an east-west direction north and south of the Milwaukee central business district as well as in a north-south direction west of the central business district.

Existing Transit Usage: The location of major travel corridors in the Milwaukee area can also be identified in part by the examination of the transit routes in the Milwaukee area which currently exhibit the highest levels of ridership. The most heavily used routes in the Milwaukee area were identified for this analysis through analyses of maximum load point passenger counts for public transit routes currently operated in Milwaukee County by the Milwaukee County Transit System. Maximum load point passenger counts establish the total number of passengers passing the point or points of greatest ridership on a transit route on an average weekday.

The maximum load point passenger count for each local transit route currently operated by the Milwaukee County Transit System in the summer of 1979 is indicated in Table 13. Those routes with maximum load counts in excess of 3,500 passengers per weekday, comprising about one-third of the local and express routes in the Milwaukee area, are shown on Map 12. Most of these routes of heavy ridership have significantly lower ridership and reduced frequency of bus service at their outer-

Map 10

ARTERIAL STREET AND HIGHWAY CONGESTION IN THE REGION: BASE TRANSPORTATION SYSTEM AND MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

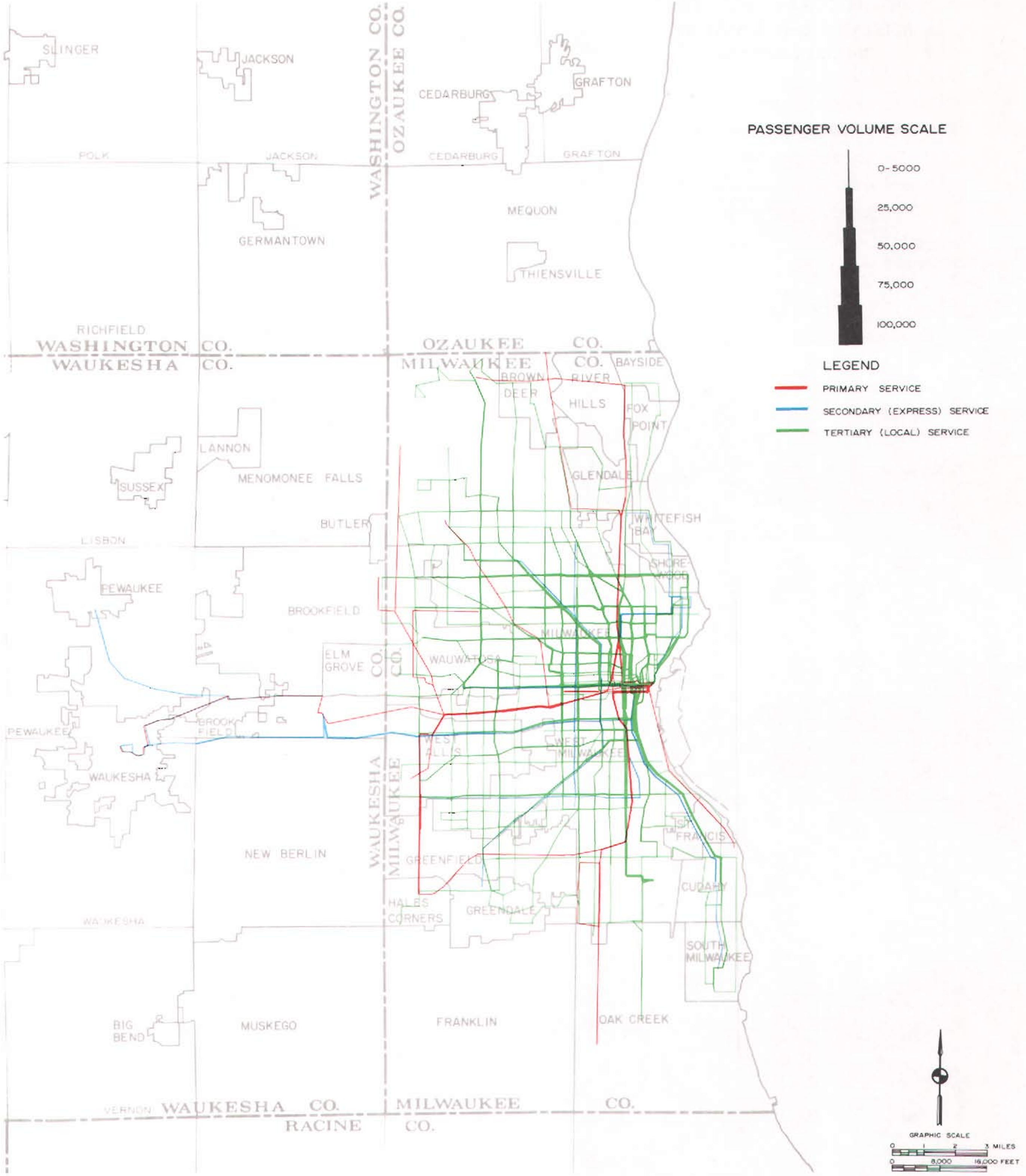


This map shows the relationship which may be expected between average weekday traffic volumes and the capacity of arterial street and highway system segments in the Milwaukee area and Southeastern Wisconsin Region under the base transportation system under the moderate growth scenario-centralized land use plan alternative future. The most severe traffic congestion may be anticipated to occur on the freeway system in the Milwaukee area, where most segments may be expected to be operating either at or over design capacity. A substantial number of standard surface arterial street and highway segments may also be expected to be operating at or over design capacity. Such segments are generally concentrated in the central area of Milwaukee County. An alternative to providing additional capacity for these congested arterials is the improvement and expansion of primary transit service.

Source: SEWRPC.

Map 11

TRANSIT PASSENGER VOLUMES ON THE MILWAUKEE AREA PUBLIC TRANSIT SYSTEM: BASE TRANSPORTATION SYSTEM AND MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



This map indicates the future transit passenger volumes which may be expected on the primary, secondary, and tertiary transit system elements of the base transportation system under the moderate growth scenario-centralized land use plan. Corridors of high transit passenger volumes are evident in all landward directions radiating from the Milwaukee central business district. In addition, there is evidence of major crosstown corridors which encircle the most highly developed section of Milwaukee on all three landward sides.

Source: SEWRPC.

Table 13

TOTAL DAILY PASSENGERS PASSING MAXIMUM LOAD POINTS ON AN AVERAGE WEEKDAY ON LOCAL AND EXPRESS TRANSIT ROUTES OPERATED BY THE MILWAUKEE COUNTY TRANSIT SYSTEM: SUMMER 1979

Route		Number of Passengers
Number	Name	
10	Wells Street	5,268
11	Vliet Street	2,362
11	Howell Avenue	2,261
12	12th Street	4,062
13	St. Paul Avenue	237
14	Holton Street	3,299
14	Mitchell Street	3,150
15	Oakland Avenue	3,722
15	Delaware Avenue	2,166
18	National Avenue	4,481
19	N. 3rd Street	6,330
19	Greenfield Avenue	951
19	S. 13th Street	3,641
20	S. 16th-S. 20th Streets	2,692
21	North Avenue	3,059
22	Center Street	2,188
23	Fond du Lac Avenue	5,246
27	N. 27th Street	4,709
27	S. 27th Street	3,566
30	Sherman Boulevard	10,761
30	Prospect Avenue	4,886
30	Jackson Street	5,082
31	Washington Avenue	2,881
35	N. 35th Street	3,000
35	S. 35th Street	2,334
51	Oklahoma Avenue	2,101
52	Clement Avenue	522
53	Lincoln Avenue	936
54	Mitchell Street	1,993
57	Walnut Street-Lisbon Avenue	1,845
58	Green Bay Avenue	477
60	Burleigh Street	1,666
62	Capitol Drive	4,673
64	Hales Corners	226
66	South Milwaukee	3,719
67	N. 76th Street	889
67	S. 84th Street	516
68	Port Washington Road	462
71	State Street	1,457
73	Keefe Avenue	87
76	N. 60th-S. 70th Street	1,567
76	S. 68th Street	669
76	S. 76th Street	762
80	N. 6th Street	2,969
80	S. 6th Street	1,984
82	Adler-Stevenson Streets	113
Total	--	121,967

Source: SEWRPC.

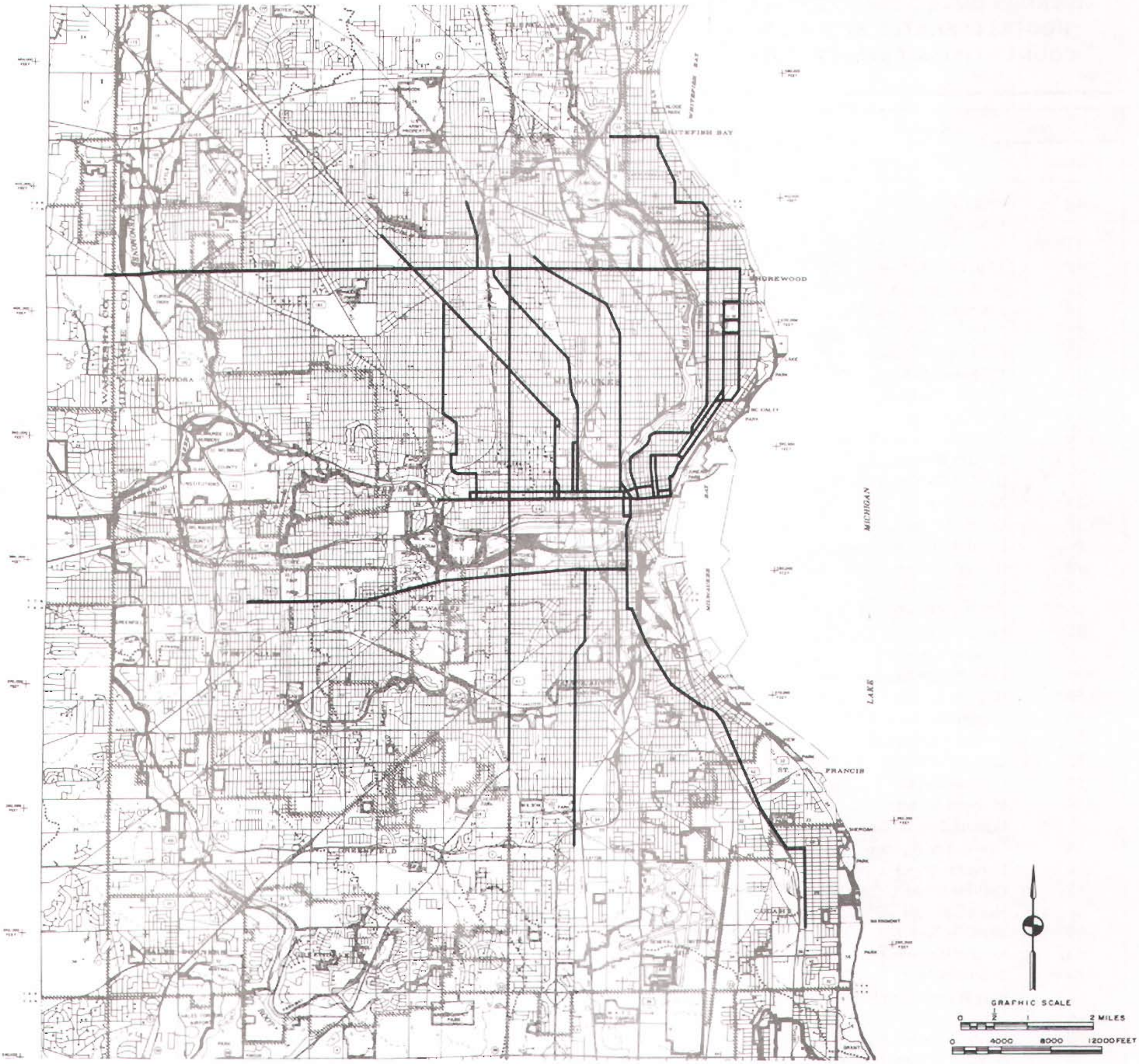
most reaches. Generally, at the beginning of these reaches there are turn-back points on the routes where at least one-half of the scheduled bus runs on the route reverse direction, or where the route splits into two or three branches over which scheduled runs are divided.

All but two of these segments of the 10 heaviest ridership routes radiate from the Milwaukee central business district. Of these 10 routes, Route 30—Sherman-Wisconsin—is by far the most heavily used route, with load point counts of about 11,000 passengers per average weekday west of the central business district, and almost 10,000 passengers per average weekday east of the central business district, if both of its branches east of the central business district are combined. Other high ridership routes beginning and ending at, or passing through, the Milwaukee central business district include: Route 10—Wells Street—to the west of the central business district; Route 12—12th Street—to the north; Route 15—Oakland Avenue—to the southeast and northeast; Route 18—National—to the southwest; Route 19—N. 3rd Street and S. 13th Street—to the north and south; Route 23—Fond du Lac Avenue—to the northwest; and Route 66—South Milwaukee—to the southeast. Crosstown routes of heavy ridership that do not enter the central business district include: Route 27—N. 27th Street and S. 27th Street—running north and southwest of the central business district; and Route 62—Capitol Drive—running east and west-north of the central business district.

These 10 routes can be combined to define seven potential primary transit corridors based on existing public transit use (see Map 13). Five of the corridors are focused on the Milwaukee central business district and extend outward in a northeasterly, northwesterly, westerly, southerly, and southeasterly direction. The sixth and seventh potential corridors are east-west and north-south crosstown corridors, located north and west of the central business district, respectively. Combined maximum load point counts for all transit routes operating in these seven corridors are presented in Table 14. The corridor with the highest combined maximum load point count is the northwest corridor, with a total volume of over 31,000 passenger trips on an average weekday recorded at maximum load points. There are four corridors with similar combined maximum load point counts for an average weekday: the west corridor, with a combined

Map 12

LOCATION OF MILWAUKEE COUNTY TRANSIT SYSTEM ROUTES OF HIGH RIDERSHIP BASED ON AVERAGE WEEKDAY MAXIMUM PASSENGER LOAD POINT COUNTS: SUMMER 1979



There are 10 routes in the Milwaukee County Transit System identified as carrying in excess of 3,500 passengers per weekday according to maximum passenger load point counts. At the outer end of most of these routes, at least one-half of the scheduled bus runs reverse direction or the route splits into two or more branches. However, the locations of the trunkline or "inner" portions of these high ridership routes are useful in identifying major travel corridors. Those portions of such high ridership routes are displayed on this map.

Source: Milwaukee County Transit System and SEWRPC.

count of nearly 17,000 passenger trips; the northeast corridor, with a combined count of about 14,000 passenger trips; the north-south crosstown corridor, with a combined count of approximately 14,000 passenger trips; and the south corridor, with a combined count of more than 11,000 passenger trips. Of the seven heavily used corridors, the corridors with the lowest combined maximum load counts are the southeast corridor, with 8,000 passenger trips, and the east-west crosstown corridor, with over 6,000 passenger trips. The northeast, northwest, and west corridors can probably be expected to experience greater combined maximum load point volumes during the other seasons of the year as trips to the University of Wisconsin-Milwaukee and Marquette University will be made along these corridors.

Conclusions for Major Travel Corridors: Corridors of major travel demand were identified under the moderate growth scenario-centralized land use plan alternative future based upon consideration of the location and intensity of existing and proposed major activity centers, travel desire lines, future traffic on a transit system in the Milwaukee area with no long-range improvements, and current public transit use in the Milwaukee area. Maps illustrating the results of each of the four analyses were prepared and overlayed to identify corridors which may be expected to be the most heavily utilized and which therefore present the best markets for potential primary transit service. Seven corridors of major travel demand, each approximately one to two miles wide and, together, totaling about 70 miles in length, were identified, as shown on Map 14. These corridors were intended to provide the basis for the development of maximum networks for the primary transit system alternatives. Only readily available existing rights-of-way or facilities which would present unique opportunities for primary transit service in terms of the cost and disruption associated with their development were considered for incorporation into the maximum design network as extensions of individual corridors of major travel demand.

The corridors of major travel demand so identified are: 1) a northeast corridor—a radial corridor extending from the Milwaukee central business district in a northeasterly direction into the Village of Shorewood; 2) a north corridor—a radial corridor extending from the Milwaukee central business district in a northerly direction into the City of Glendale; 3) a northwest corridor—a radial corridor extending from the Milwaukee central business district in a northwesterly direction to the Village of Menomonee Falls in Waukesha County; 4) a west corridor—a radial corridor extending from the Milwaukee central business district in a southwesterly direction to the Village of West Milwaukee and then westerly to the Cities of Brookfield and New Berlin in Waukesha County; 5) a southeast corridor—a radial corridor within the study area extending from the Milwaukee central business district in a southeasterly direction to the City of Cudahy; 6) a north-south crosstown corridor—a corridor located west of the Milwaukee central business district extending from the north side of the City of Milwaukee to the City of Greenfield and Village of Greendale; and 7) an east-west crosstown corridor—a corridor located north of the central business district extending from the Village of Shorewood to the western fringes of the City of Wauwatosa.

Availability of Rights-of-Way or Facilities

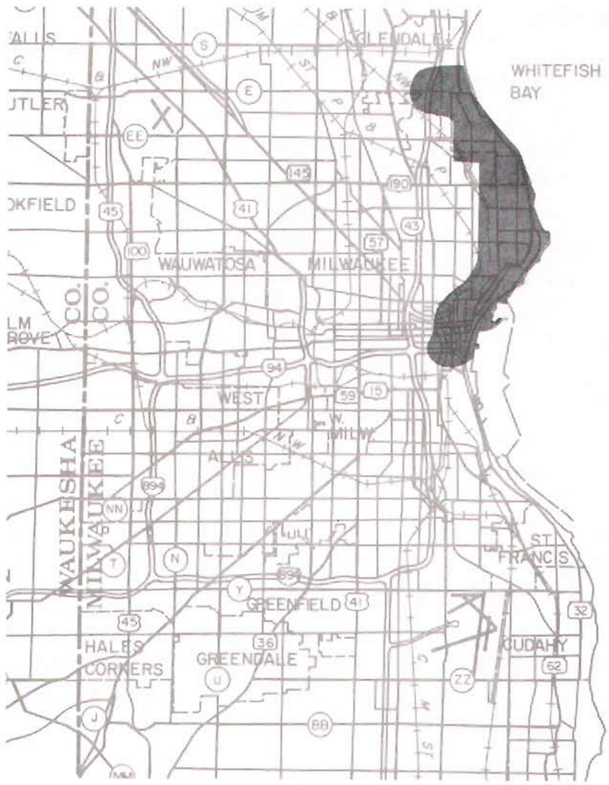
The availability of existing facilities or rights-of-way as appropriate for the convenient location of new primary transit facilities and services at a minimum of cost and disruption was also considered in the design of the maximum primary transit system networks. The suitable facilities readily available for the bus-on-freeway and commuter rail primary transit modes were considered separately from each other and from suitable rights-of-way for the motor bus, light rail transit, and heavy rail rapid transit fixed guideway modes. The bus-on-freeway modes require available freeway facilities in order to be developed at a minimum of cost and disruption and, similarly, the commuter rail mode requires available and suitable active railway lines in order to be developed at a minimum of cost and disruption. In addition, because the availability of existing facilities rather than rights-of-way—the latter of which would require the construction of new facilities—was considered for the bus-on-freeway and commuter rail modes, the examination of readily available facilities for these modes extended beyond the Milwaukee area to the entire seven-county Southeastern Wisconsin Region, which, in fact, comprises the entire commutershed for the greater Milwaukee area.

Available Facilities for Bus-on-Freeway Transit: Two bus-on-freeway alternatives were considered: a "no build" primary transit system alternative of motor bus on freeway in mixed traffic and a transportation system management primary transit system alternative of motor bus on operationally controlled freeways in mixed traffic. These two

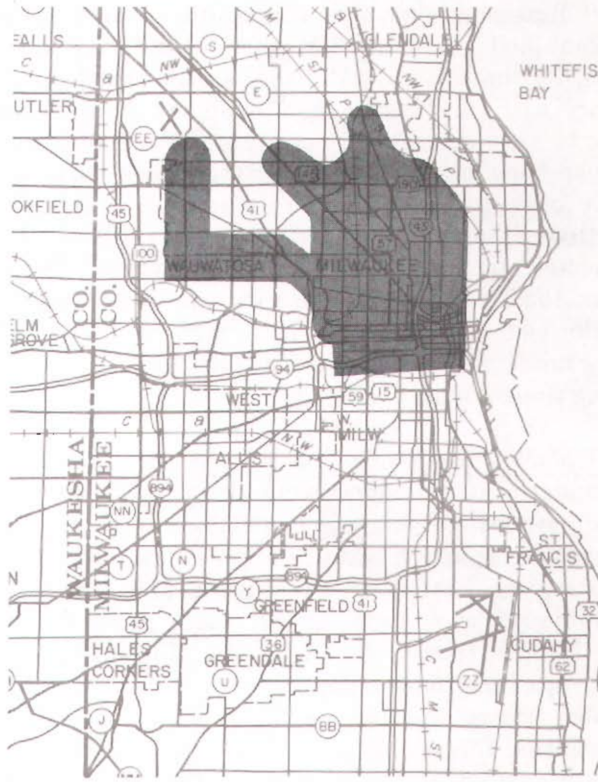
Map 13

CORRIDORS OF HIGH TRANSIT RIDERSHIP BASED ON EXISTING MAXIMUM PASSENGER LOAD POINT COUNTS: SUMMER 1979

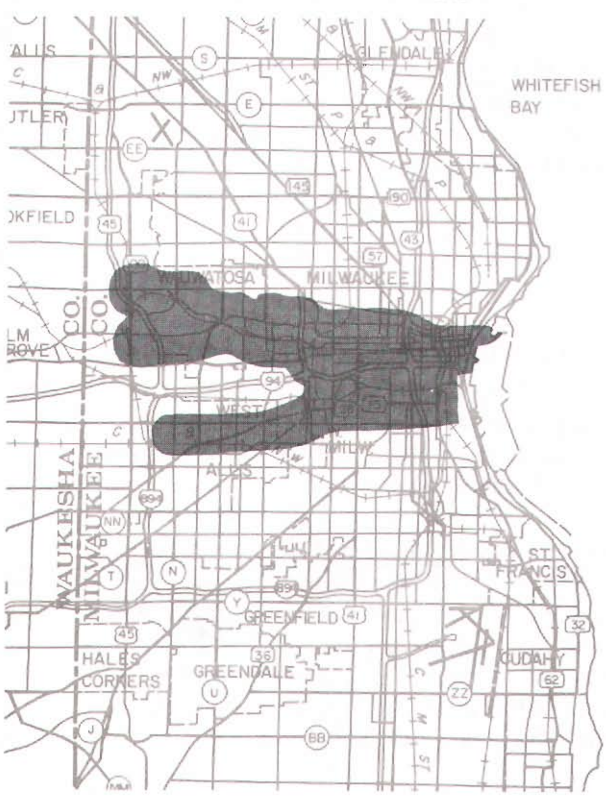
NORTHEAST TRANSIT CORRIDOR



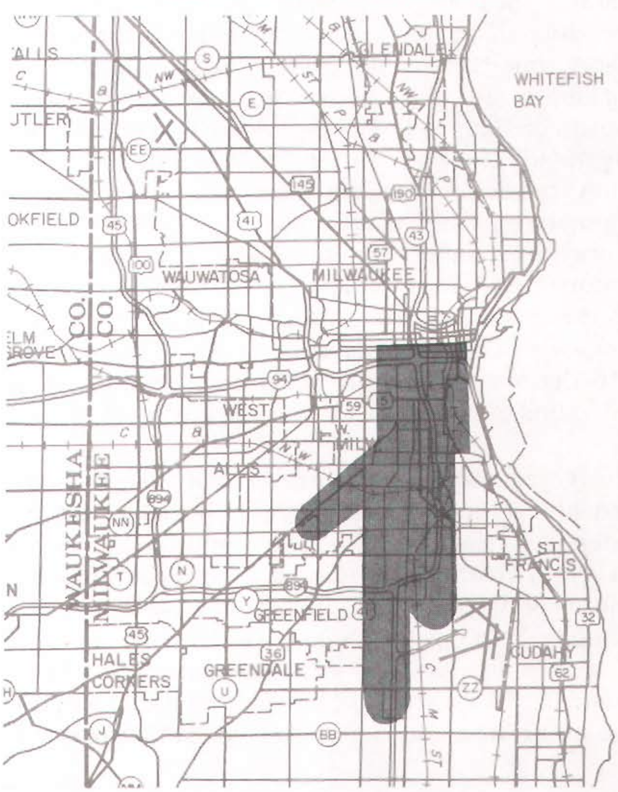
NORTHWEST TRANSIT CORRIDOR



WEST TRANSIT CORRIDOR

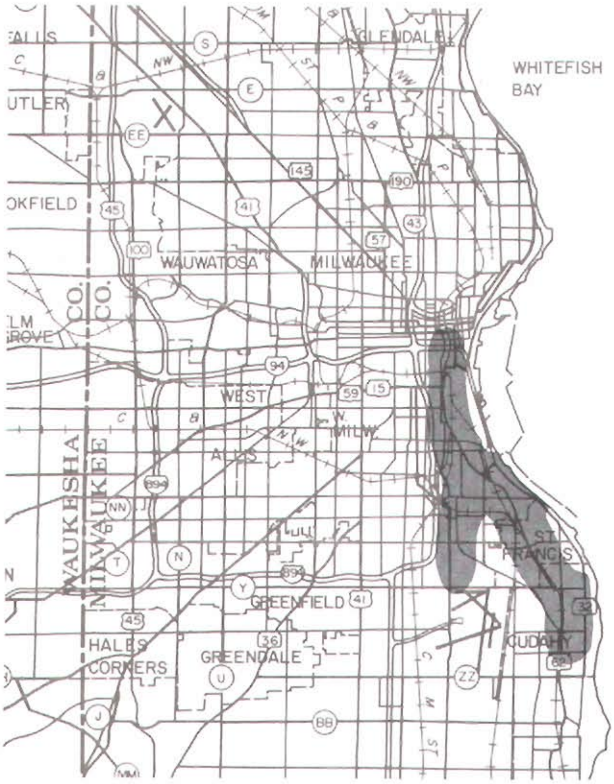


SOUTH TRANSIT CORRIDOR

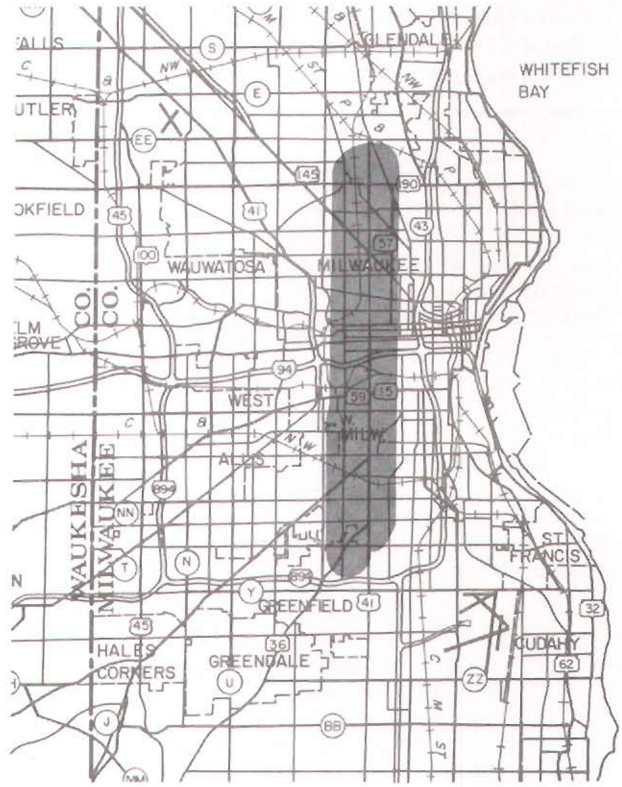


Map 13 (continued)

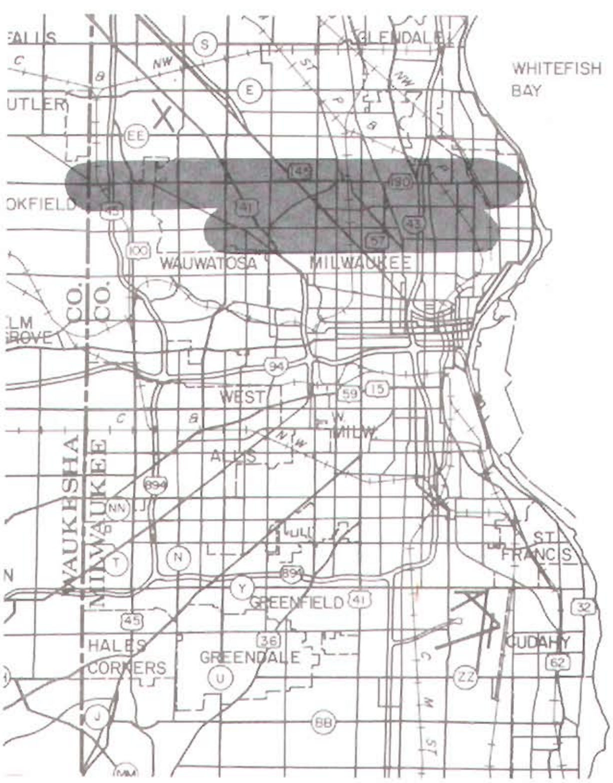
SOUTHEAST TRANSIT CORRIDOR

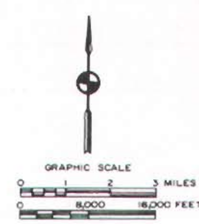


NORTH-SOUTH CROSSTOWN TRANSIT CORRIDOR



EAST-WEST CROSSTOWN TRANSIT CORRIDOR





The 10 highest ridership routes on the Milwaukee County Transit System as identified on Map 12 can be combined into groups which define seven potential primary transit corridors based on existing public transit use. Five of these corridors are focused on the Milwaukee central business district and extend outward in northeasterly, northwesterly, westerly, southerly, and southeasterly directions. In addition, two corridors are situated on a crosstown configuration located in an east-west direction north of the central business district and in a north-south direction west of the central business district.

Source: SEWRPC.

Table 14

COMBINED MAXIMUM LOAD POINT AVERAGE WEEKDAY PASSENGER VOLUMES FOR HIGH-RIDERSHIP CORRIDOR ROUTES OPERATED BY THE MILWAUKEE COUNTY TRANSIT SYSTEM: SUMMER 1979

Corridor	Maximum Load Point Volume
Northeast	
Route 15—Oakland Avenue	3,722
Route 30—Jackson Street	5,082
Route 30—Prospect Avenue	4,886
Total	13,690
Northwest	
Route 12—12th Street	4,062
Route 19—N. 3rd Street	6,330
Route 23—Fond du Lac Avenue	5,246
Route 30—Sherman Boulevard	10,761
Route 57—Walnut Street-Lisbon Avenue	1,845
Route 80—N. 6th Street	2,969
Total	31,213
West	
Route 10—Wells Street	5,268
Route 11—Vliet Street	2,362
Route 13—St. Paul Avenue	237
Route 18—National Avenue	4,481
Route 31—Washington Avenue	2,881
Route 71—State Street	1,957
Total	16,686
South	
Route 14—Holton Street	3,150
Route 19—S. 13th Street	3,641
Route 20—S. 16th-S. 20th Streets	2,692
Route 80—S. 6th Street	1,984
Total	11,467
Southeast	
Route 11—Howell Avenue	2,261
Route 15—Delaware Avenue	2,166
Route 66—South Milwaukee	3,719
Total	8,146
North-South Crosstown	
Route 27—N. 27th Street	4,709
Route 27—S. 27th Street	3,566
Route 35—N. 35th Street	3,000
Route 35—S. 35th Street	2,334
Total	13,609
East-West Crosstown	
Route 60—Burleigh Street	1,666
Route 62—Capitol Drive	4,673
Total	6,339

Source: SEWRPC.

alternatives have the potential to be developed at relatively minor cost and with a minimum of disruption on all existing freeways and freeways proposed to be constructed under the lower tier of the adopted long-range regional transportation system plan within the Milwaukee area, with the exception of the Lake Freeway "stub end" connection. These existing and planned lower-tier freeways are shown on Map 15.

Primary transit service under these alternatives would include no true rapid transit service—that is, transit service provided over exclusive, fully grade-separated fixed guideways. Rather, primary transit service would be of the modified rapid transit type—that is, would consist of the operation of motor buses in mixed traffic on freeways and, in the case of motor bus on operationally controlled freeways, operation in mixed traffic on a freeway system that provides preferential access to motor buses, but constrains access to the freeway system by other vehicles to ensure uninterrupted freeway traffic flow and operating speeds of at least 40 to 45 miles per hour (mph) on otherwise congested freeways, except for a one-mile stretch of the East-West Freeway (IH 94) west of the Stadium Interchange, which would have operating speeds of between 35 and 40 mph. Both types of primary transit service operated over freeways in mixed traffic could potentially be provided over a total of 239 miles of existing or committed freeways and 57 miles of planned lower-tier freeway in the Region.

A third type of motor bus primary transit has been shown to have some potential for provision over parts of the Milwaukee area freeway system—the operation of motor buses over reserved freeway lanes. Based upon the configuration and design of the Milwaukee area freeway system and the existing traffic volumes carried on that system, the segments of Milwaukee area freeways on which reserved bus lanes could be potentially developed include, in a contraflow direction, all freeway segments outside Milwaukee County and, within Milwaukee County, some segments of the North-South Freeway (IH 43 and IH 94), Airport Freeway (IH 894), Zoo Freeway (USH 45), and Fond du Lac Freeway (USH 41 and USH 45) between freeway-to-freeway interchanges. Normal flow reserved bus lanes could be readily provided only on segments of the Lake Freeway (IH 794), Fond du Lac Freeway (USH 41 and USH 45), and Rock Freeway (USH 15). Because the segments of the freeway system on which exclusive motor bus reserved lanes could be developed may not constitute an integrated system, any motor bus primary transit system using reserved lanes will need to operate in mixed traffic over those segments of the freeway system where reserved lanes cannot be provided. A reserved lane motor bus-on-freeway alternative can therefore be viewed as having the potential, like the other two motor bus-on-freeway alternatives, to be developed over the entire regional freeway system, with the understanding that parts of that system are to be operated in mixed traffic.

Available Facilities for Commuter Rail Transit: Facilities in the Milwaukee area and in the Region readily available for the development of commuter rail primary transit at a minimum of cost and disruption are limited to those active railway lines constructed to standards which permit the provision of appropriate high-speed passenger train operation. Such railway lines meet mainline railway engineering standards with respect to horizontal and vertical alignment and track condition, and, preferably, are of double-track rather than single-track construction. The six lines in the Milwaukee area and Region which meet these standards, and which connect the Milwaukee central business district and other major trip generators with areas of concentrated residential development, are shown on Map 16. These six railway lines, which have been determined to have good or excellent potential for commuter rail use based on consideration of the necessary costs of track rehabilitation, grade-crossing protection, and servicing and storage facilities, radiate from downtown Milwaukee to the communities of Port Washington, Saukville, West Bend, Oconomowoc, Kenosha, and Waukesha.

Available Rights-of-Way for Fixed Guideway Transit: A variety of existing rights-of-way within the Milwaukee area have been determined to be available to varying degrees for the construction of new exclusive fixed guideway facilities for motor buses, light rail transit, and heavy rail rapid transit at a minimum of cost and disruption. These potentially available rights-of-way include parts of active and abandoned railroad rights-of-way, existing and cleared freeway rights-of-way, existing electric power transmission rights-of-way, and abandoned electric interurban railway rights-of-way. In general, the active and abandoned railway rights-of-way and abandoned electric interurban rights-of-way provide the greatest number of readily available rights-of-way, or parts of rights-of-way.

Freeway medians, outside shoulders, and nonroadway portions of the Milwaukee area freeway system cannot readily be used over any substantial stretches, particularly in central Milwaukee County, as a location for fixed guideways for motor buses, light rail transit, or heavy rail rapid transit, as shown on Map 17. Major obstacles to such use include inadequate width available for guideway development, particularly in the median, but also in the freeway shoulders and nonroadway portion of the rights-of-way, and the crossing of the median, and particularly the freeway shoulders and nonroadway portion of the right-of-way, by freeway entrance and exit ramps.

There are, however, two freeway corridors in the Milwaukee area with excellent potential for fixed guideway primary transit development since they have been cleared in anticipation of freeway construction, and are presently part of freeways proposed for construction under the adopted regional transportation system plan, as shown on Map 17. These two portions of freeway segments are the Park Freeway-East and Stadium Freeway-South, both cleared for a distance of about one mile. In addition, there is one cleared freeway corridor in the Milwaukee area, the Park West Freeway between the North-South Freeway (IH 43) and N. Sherman Boulevard—a distance of approximately 2.2 miles in length—which is no longer recommended for construction but which could accommodate primary transit guideway development.

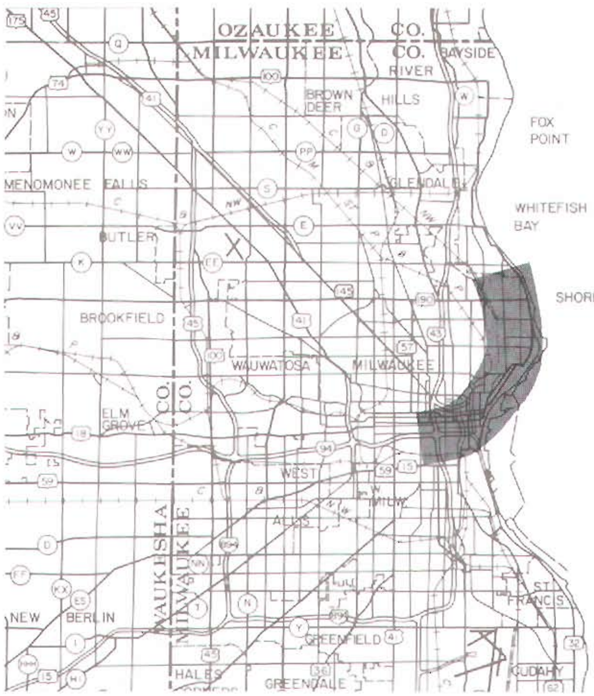
The development of this corridor for nontransportation uses, however, has been actively considered since the creation in 1977 of the Park West Redevelopment Task Force, a group of concerned citizens of the area formed by Congressman Henry S. Reuss (Fifth District, Wisconsin) in consultation with community group representatives, and state, Milwaukee County, and City of Milwaukee elected officials.

Major portions of active and abandoned railroad rights-of-way and abandoned electric interurban railway rights-of-way in the Milwaukee area have been identified as having good to excellent potential for the location of fixed guideway primary transit facilities, as shown on Map 17. These rights-of-way have sufficient horizontal and vertical clearance and adequate horizontal and vertical curvature for the location of primary transit fixed guideway facilities, permitting the ready development of at-grade exclusive busway, light rail transit, or heavy rail rapid transit facilities. Such rights-of-way consist of 18 separate segments totaling approximately 161 miles in length. There are some additional rights-of-way, also shown on Map 17, which have been identified as having only fair potential, as they would require grade separation or other

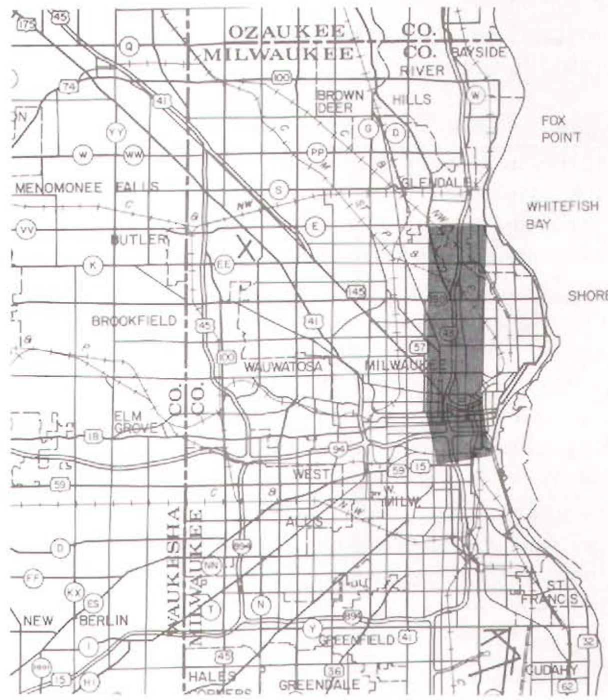
Map 14

CORRIDORS OF MAJOR TRAVEL DEMAND: MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

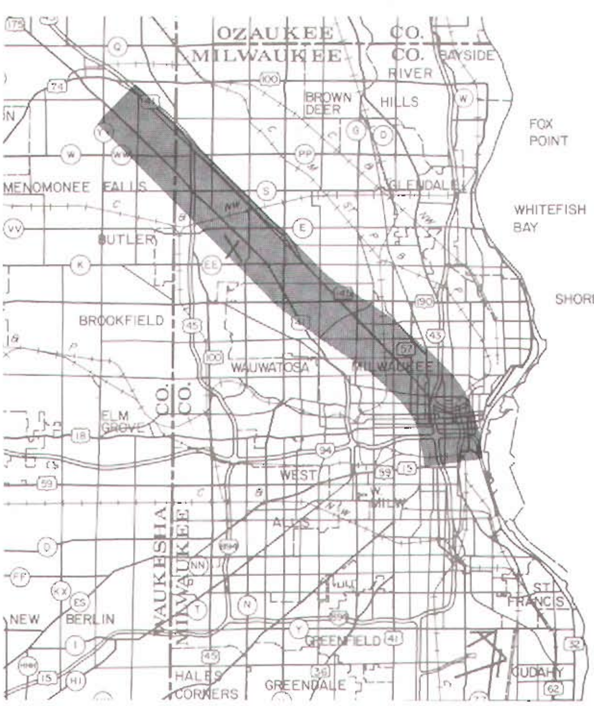
NORTHEAST CORRIDOR



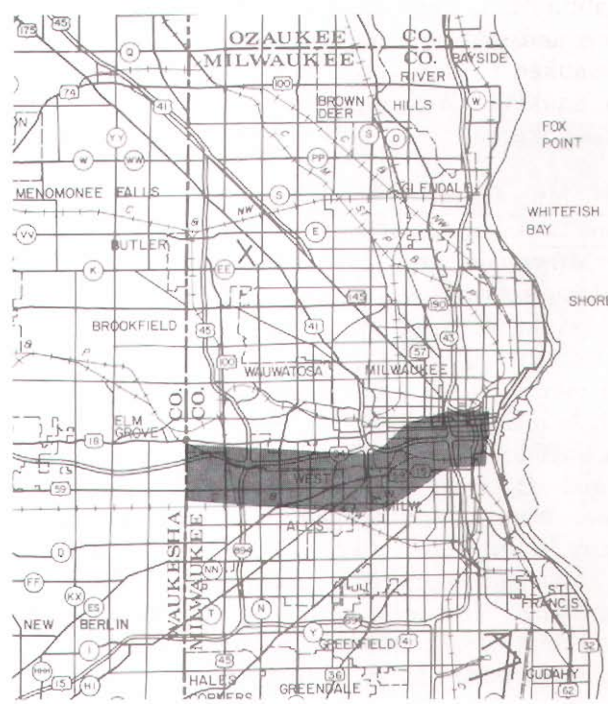
NORTH CORRIDOR



NORTHWEST CORRIDOR

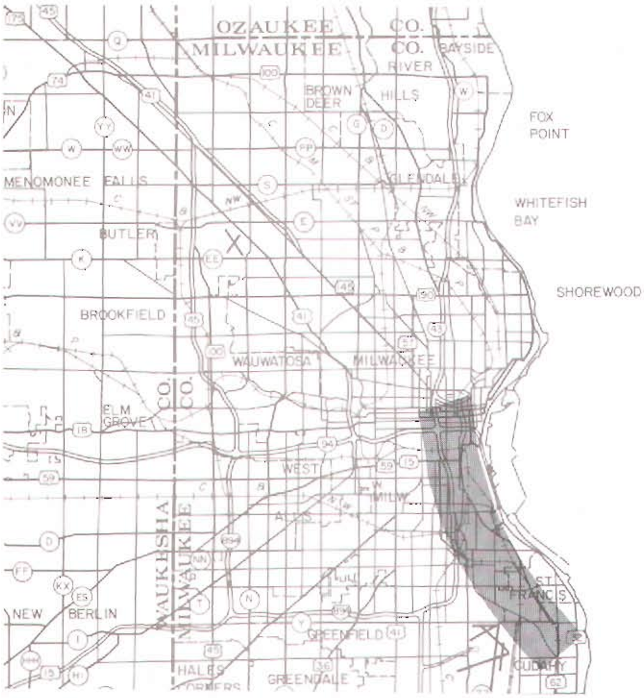


WEST CORRIDOR

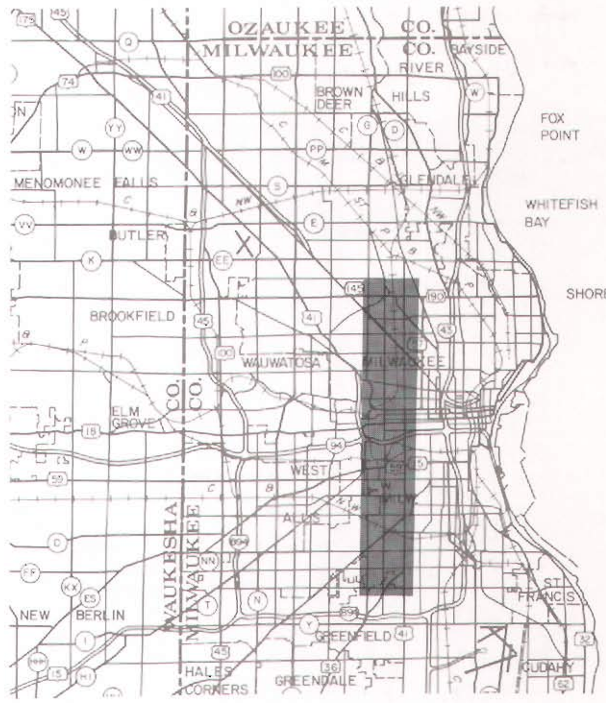


Map 14 (continued)

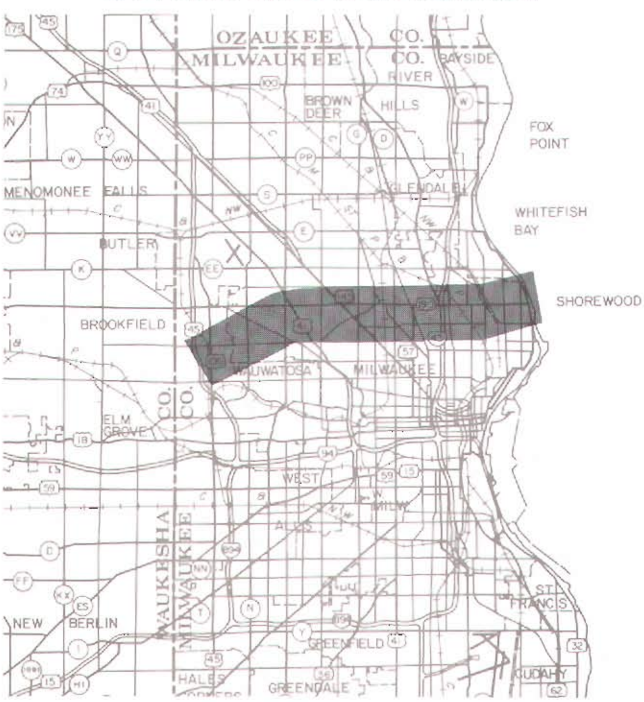
SOUTHEAST CORRIDOR

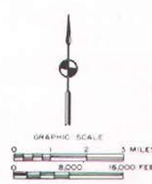


NORTH-SOUTH CROSSTOWN CORRIDOR



EAST-WEST CROSSTOWN CORRIDOR



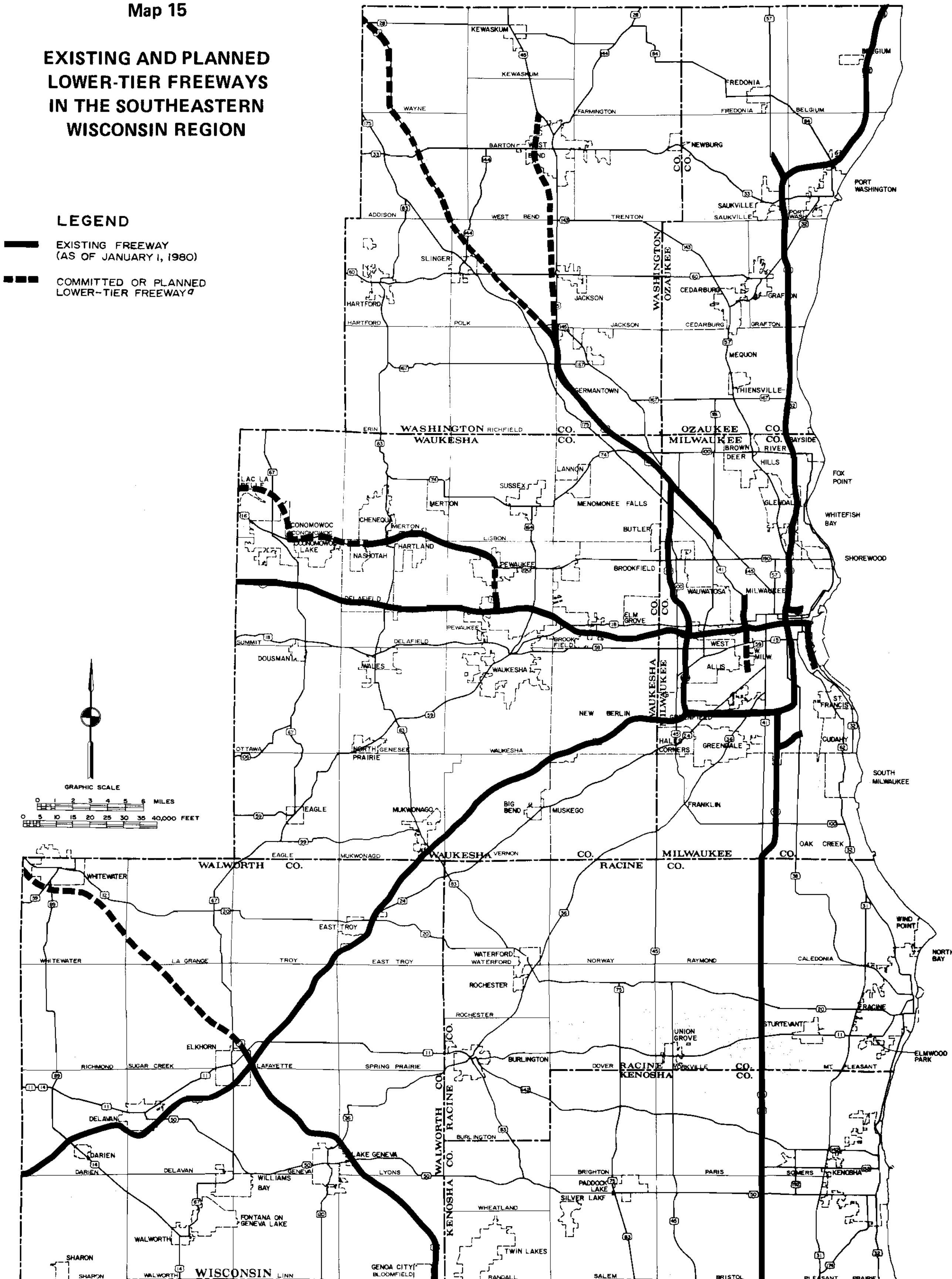


Seven corridors of major travel demand have been identified in the Milwaukee area for the moderate growth scenario-centralized land use plan. These corridors are intended to provide the basis for the development of maximum networks for each of the fixed guideway primary transit system alternatives. Five of these corridors originate in downtown Milwaukee and radiate in northeasterly, northerly, northwesterly, westerly, and southerly directions. In addition, there are two crosstown corridors: an east-west crosstown corridor north of the Milwaukee central business district and a north-south crosstown corridor west of the Milwaukee central business district. Each of these corridors is approximately one or two miles wide, and together they total about 70 miles in length.

Source: SEWRPC.

Map 15

EXISTING AND PLANNED LOWER-TIER FREEWAYS IN THE SOUTHEASTERN WISCONSIN REGION



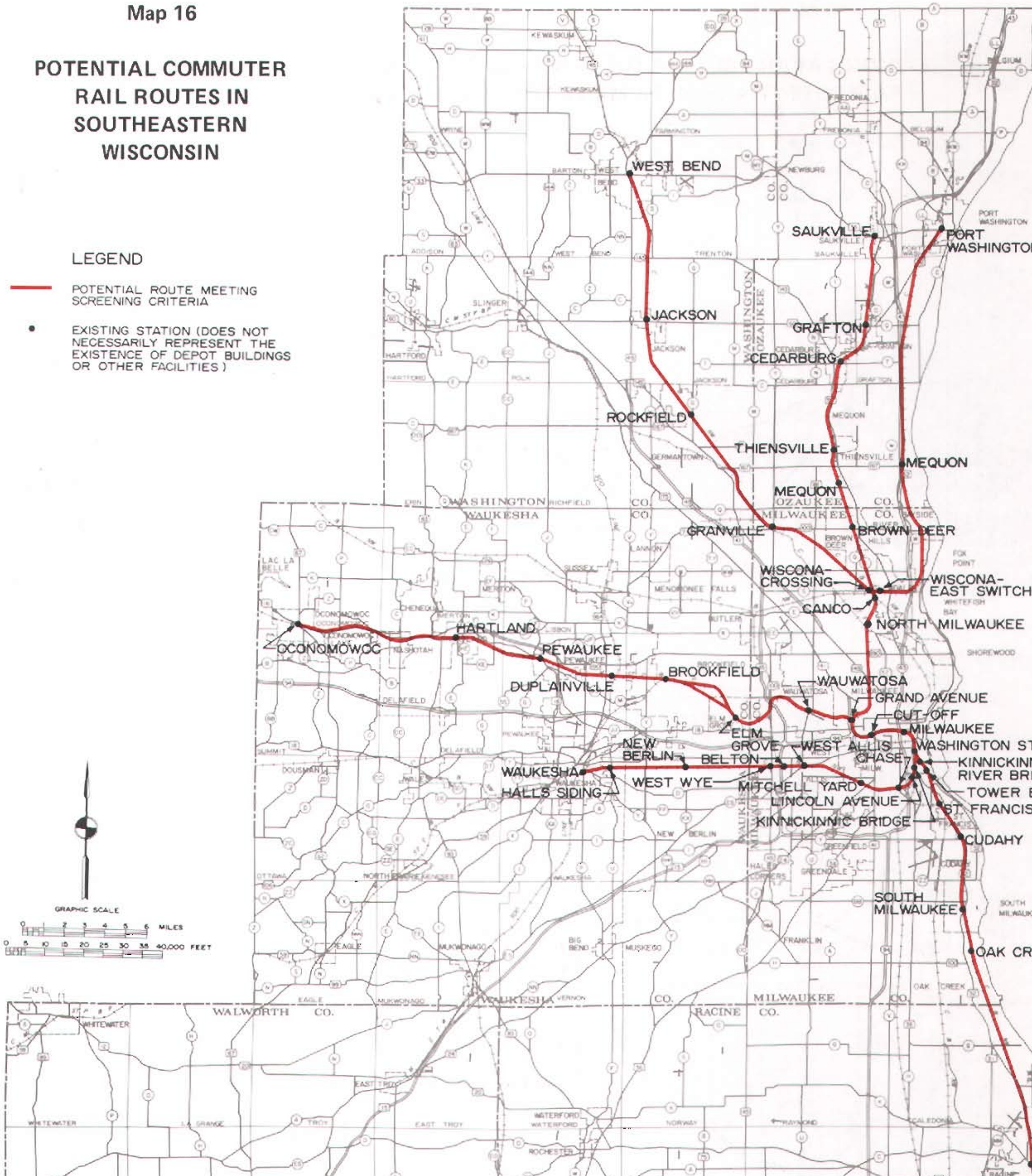
[a]Does not include the Lake Freeway-South between S. Carferry Drive and E. Layton Avenue because of the action of the Wisconsin Secretary of Transportation exempting approval of this facility from the State's action to adopt the regional transportation plan.

The existing freeway system as well as the planned lower-tier freeways in southeastern Wisconsin constitute the maximum extent network for the motor bus-on-freeway alternative, under which primary transit service would be provided by buses operating in mixed traffic on operationally controlled freeways. This alternative could utilize a total of about 239 miles of existing or committed freeways and approximatey 57 miles of planned lower-tier freeways in the Region.

Source: SEWRPC.

Map 16

POTENTIAL COMMUTER RAIL ROUTES IN SOUTHEASTERN WISCONSIN

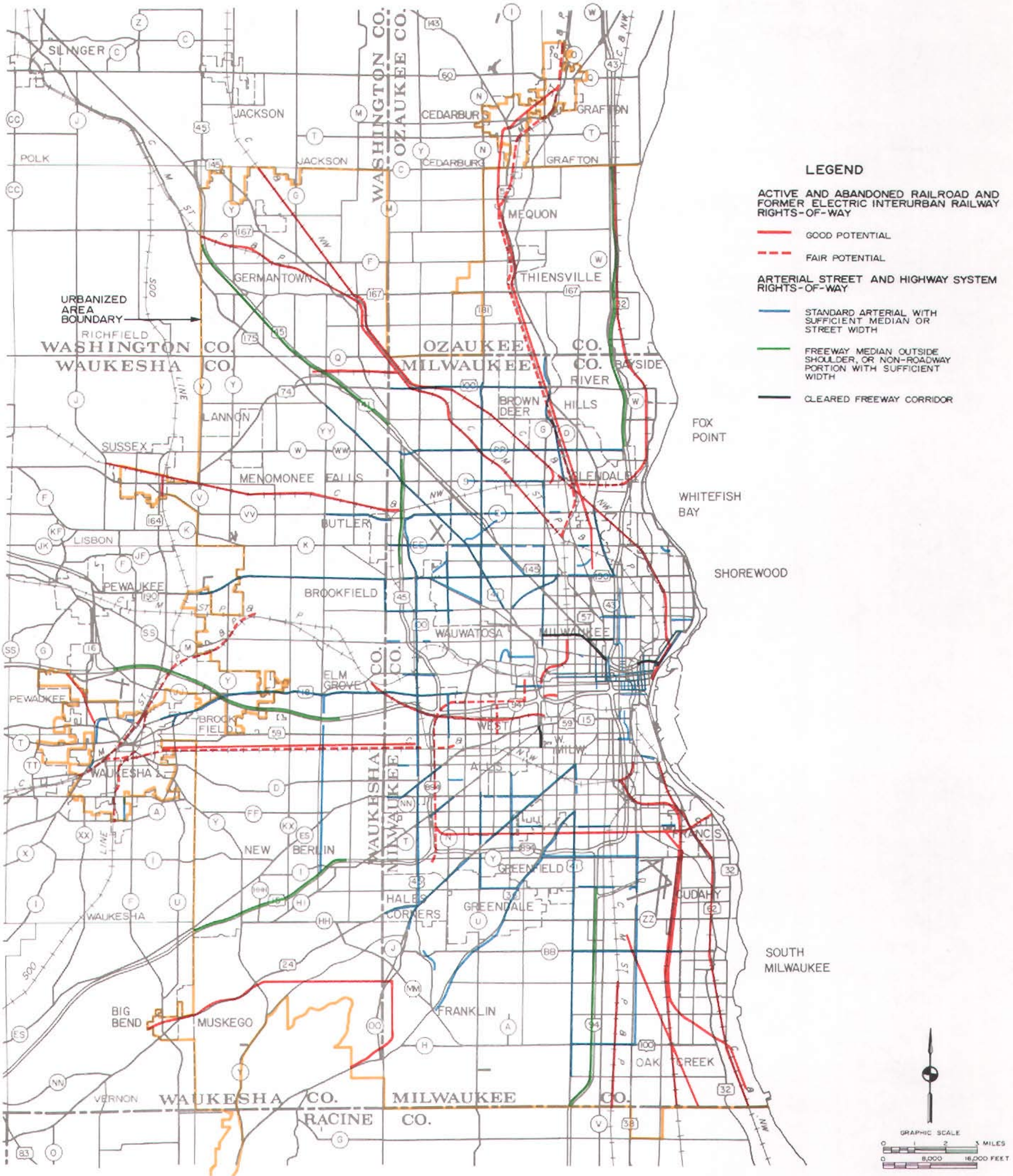


A total of six railway lines radiating out of downtown Milwaukee have potential for use in the provision of commuter rail service. These lines were identified on the basis of the existence of trackage constructed to mainline railway engineering standards, direct access to the Milwaukee central business district and other major trip generators, including concentrations of residential development, and the existence of double-track main lines. As illustrated on this map, the six lines extend from downtown Milwaukee to the communities of Port Washington, Saukville, West Bend, Oconomowoc, Kenosha, and Waukesha.

Source: SEWRPC.

Map 17

EXISTING AVAILABLE RIGHTS-OF-WAY IN THE MILWAUKEE AREA WITH GOOD OR FAIR POTENTIAL FOR PRIMARY TRANSIT FIXED GUIDEWAY DEVELOPMENT



The location of primary transit fixed guideways within existing rights-of-way can significantly reduce the cost of alternative system configurations. As shown on this map, there are a variety of rights-of-way within the Milwaukee area which have good or fair potential to accommodate fixed guideways. These rights-of-way include abandoned electric interurban railway rights-of-way, electric power transmission line rights-of-way, freeway rights-of-way, and active and abandoned railway rights-of-way. Light rail transit and Class B busway alignments also have the potential to be accommodated on certain standard surface arterial streets which possess sufficient median areas or cross-sectional widths.

Source: SEWRPC.

substantial work at certain locations in order to provide adequate horizontal clearances. Such rights-of-way consist of five separate segments totaling approximately 36 miles in length.

Other readily available rights-of-way with potential for light rail transit or motor bus guideway development include street boulevard medians or lanes. Such rights-of-way would not, however, be totally exclusive. Nevertheless, with sufficient preferential treatment these rights-of-way could permit motor bus or light rail transit to operate at levels approaching primary or rapid transit operation. Such rights-of-way, as shown on Map 17, include stretches of larger medians of arterial street boulevards and of the widest streets in the Milwaukee area, and consist of 57 separate segments totaling approximately 181 miles in length. These stretches of medians have sufficient width for development of a dual motor bus or light rail guideway, and the streets have sufficient width for light rail or motor bus guideway development in each direction while allowing for two lanes of moving motor vehicle traffic in each direction, provided that parking is prohibited.

Conclusions—Maximum Networks

The definition of the maximum potential network for each major type of primary transit technology is a particularly important step in any primary transit system alternatives analysis since it, in effect, establishes the maximum extent of primary transit development to be considered further in the study. The maximum potential network has been defined to include all reasonable possibilities for each major type of primary transit mode based upon consideration of the levels and patterns of existing and future travel demand in the Milwaukee area and the Region, and of the existing transportation facilities and rights-of-way readily available for primary transit use at minimum of construction cost and disruption.

Maximum Network for Fixed Guideway Technology: The maximum network of fixed guideway primary transit facilities for motor bus, light rail transit, and heavy rail rapid transit under the moderate growth scenario-centralized land use plan alternative future was defined to include seven corridors, as shown on Map 18. The network includes the seven defined corridors of major travel demand, and six extensions of those corridors. These extensions were included in the maximum potential network because of the availability of at least one existing right-of-way that could be developed at a minimum of cost and disruption. In addition, all the corridor extensions have been shown to have fairly substantial travel demand, although not necessarily among the highest in the Milwaukee area. In the next step of the primary transit system plan development process, alternative fixed guideway alignments within each of these corridors were developed and evaluated, and a preferred alignment within each corridor was selected.

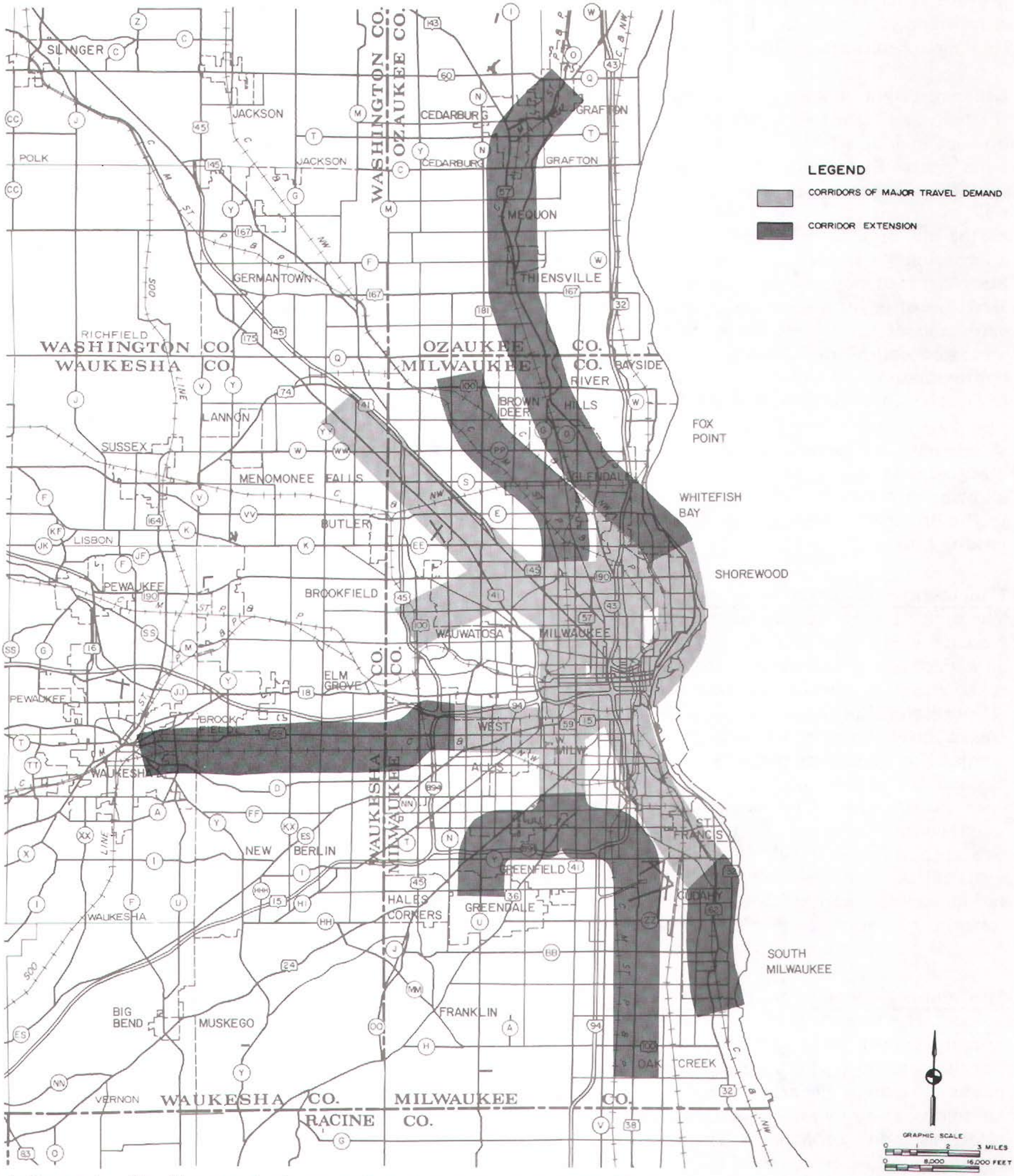
Maximum Network for Bus-on-Freeway Technology: Because all parts of the regional freeway system can accommodate some form of bus-on-freeway primary transit operation, the maximum network for the bus-on-freeway primary transit mode was defined to include all parts of the existing and planned lower-tier freeway system of the Region—except the Lake Freeway-South "stub end" completion—radiating from the Milwaukee central business district, as shown on Map 19. The only bus-on-freeway mode initially determined to warrant further consideration in the study for provision of primary transit service over this network was the bus on operationally controlled, or ramp-metered, freeway.

The bus-on-freeway in mixed traffic mode was eliminated from further consideration principally because a freeway operational control system is already partially in place and working in the Milwaukee area. To plan further for the operation of buses in mixed traffic without an operational control would require an assumption that the existing freeway operational control system would be dismantled. There were, as of 1979, 20 ramp meters installed at freeway entrance ramps, and four ramps to provide preferential access of buses to the freeway system, in operation in the Milwaukee area. The installation of additional ramp meters and the interconnection and central operational control of the ramp meters are recommended in the adopted regional transportation system plan, and these recommendations are programmed for implementation in the near future. The existing ramp meters have proven to be capable of achieving sufficient operational control to increase operating speeds and improve traffic flow on some of the most congested segments of the freeway system in the Milwaukee area.

Moreover, it must be recognized that one of the purposes of considering the bus-on-freeway transit alternative in this study is to use that alternative

Map 18

MAXIMUM FIXED GUIDEWAY NETWORK IN THE MILWAUKEE AREA, INCLUDING CORRIDOR EXTENSIONS FOR LIGHT RAIL TRANSIT, HEAVY RAIL RAPID TRANSIT, AND BUSWAY PRIMARY TRANSIT MODES

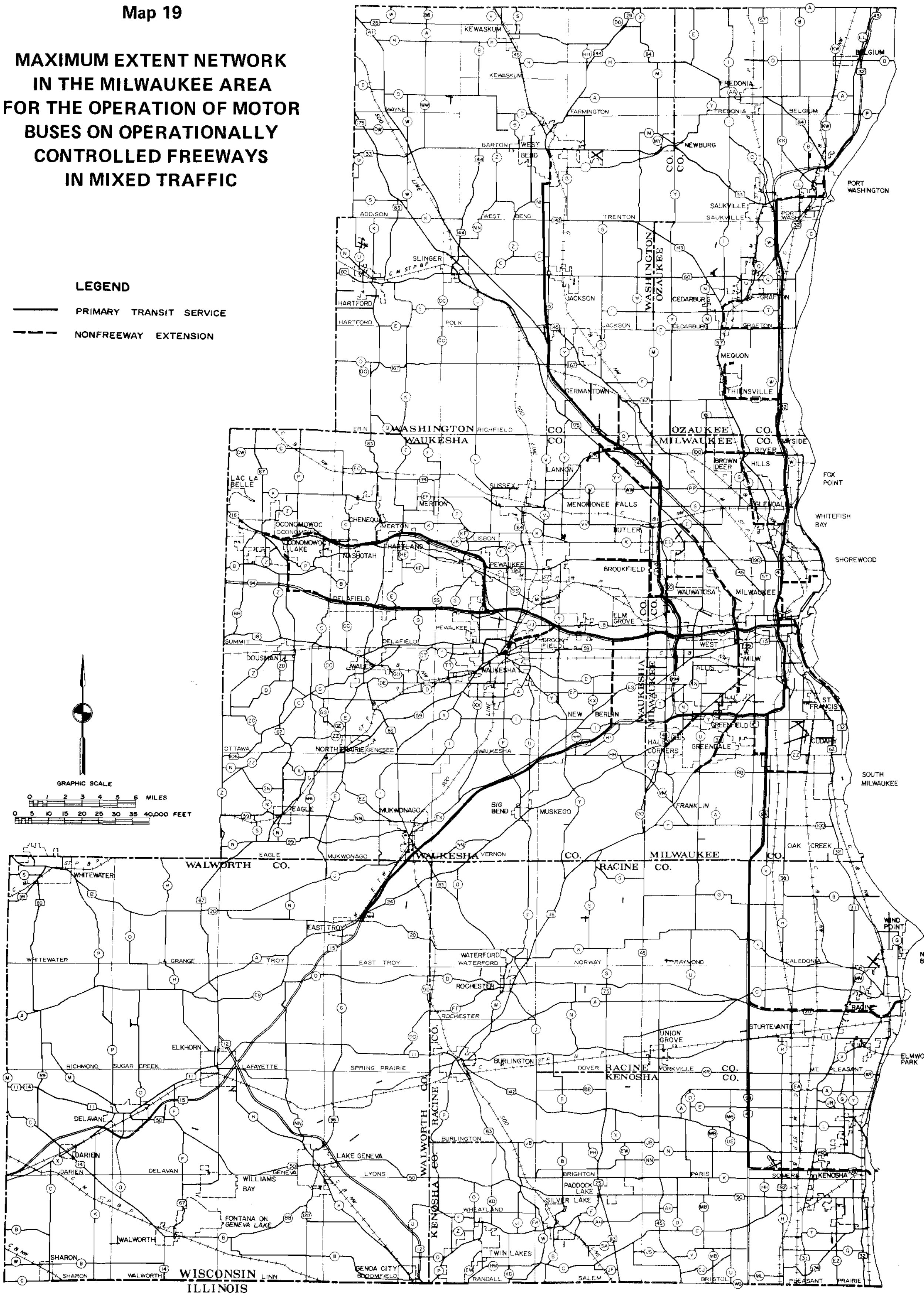


As illustrated on Map 14, a network of seven corridors of major travel demand was identified in the Milwaukee area. In addition, a set of six corridor extensions was identified which extends the reach of five of the seven corridors into outlying areas of the Region. These extensions have been included in the network of major corridors of travel demand because of the availability of at least one right-of-way in the corridor that offers a potential opportunity for fixed guideway development at a minimum of cost and disruption. Such corridor extensions permit the maximum network to reach the Village of Grafton to the north, the Granville area of the City of Milwaukee to the northwest, the City of Waukesha to the west, the Village of Greendale to the southwest, and the Cities of Oak Creek and South Milwaukee to the south.

Source: SEWRPC.

Map 19

MAXIMUM EXTENT NETWORK IN THE MILWAUKEE AREA FOR THE OPERATION OF MOTOR BUSES ON OPERATIONALLY CONTROLLED FREEWAYS IN MIXED TRAFFIC



The only bus-on-freeway mode to be considered further in this study as a means of providing primary transit service is the bus on operationally controlled, or ramp-metered, freeway mode, the operation of buses in mixed traffic and on reserved freeway lanes having been eliminated from further consideration following preliminary analysis. The maximum extent network for this primary transit mode is shown on this map and includes most segments of the existing and planned lower-tier freeway system in the Milwaukee area except the Lake Freeway-South "stub end" connection. Arterial streets and highways are utilized in areas not served by freeways in order to give the system access to a larger proportion of the Region's population and employment concentrations.

Source: SEWRPC.

as a basis for the comparative evaluation of more capital-intensive exclusive guideway alternatives. Such a comparison is, in fact, required by the federal Urban Mass Transportation Administration in order to clearly identify the incremental benefits which can be derived from major capital investment in transit guideways. Buses operating over operationally controlled freeways should present a more attractive low-capital investment alternative for this purpose than buses operating on potentially congested freeways in mixed traffic, and therefore provide a better basis for the comparative evaluation of more capital-intensive alternatives.

For the same basic reasons, the bus-over-reserved freeway lane mode has been eliminated from further consideration under this study. Buses operating over operationally controlled freeways can provide the benefits of reserved lane freeway systems of preferential access and higher operating speeds at relatively low cost, with the additional advantage that a system for the operational control of area freeways is already partially in place in the Milwaukee area and is achieving some degree of operational control. Furthermore, there are additional benefits attendant to the bus-on-operationally controlled freeways alternative over the bus-on-reserved freeway lane alternative. First, preferential treatment and higher freeway speeds for buses can be achieved with operational control without restricting freeway capacity for automobile travel to the same extent as would a reserved lane freeway system, and therefore without engendering as much diversion of automobile traffic from the freeway. Second, under the operational control alternative, the restriction on freeway traffic occurs in the same direction in which the improved bus service is provided. Some reserved freeway lanes are provided as contraflow lanes and, as a result, the freeway automobile traffic, which is restricted by the implementation of a reserved lane, cannot be diverted to the bus service. Third, and perhaps even more importantly, reserved bus lanes cannot be practically provided at low cost over the entire area freeway system, while freeway operational control can and, in fact, works best when it is applied systemwide. One reason why reserved lanes cannot be practically provided systemwide is the location of freeway-to-freeway interchanges and left-hand entrance and exit ramps on the Milwaukee area freeway system. To develop freeway reserved lanes at these locations would entail significant construction costs. Also, implementing reserved lanes on some segments of freeway in the Milwaukee area would cause significant volumes of freeway traffic to be diverted, both for normal flow and contraflow reserved lanes. Some segments of the Milwaukee area freeway system which would not permit development of reserved lanes at low cost and with reasonable disruption of automobile traffic include the East-West Freeway in Milwaukee County, parts of the Zoo and Airport Freeways, and the North-South Freeway near its interchange with the East-West Freeway in Milwaukee County. However, these segments of freeway are anticipated to be the most heavily congested freeways in the area in the future and will, therefore, most greatly affect transit travel times on freeways, and will most likely require the most intensive operation of motor buses. Fourth and lastly, operational control has a distinct safety advantage over contraflow reserved lane operation in that it does not require buses to operate at high speeds with no physical separation provided between freeway traffic traveling in an opposite direction, as do contraflow reserved lanes.

Maximum Network for Commuter Rail: The maximum network for commuter rail primary transit has been defined to include the six railway lines radiating from the Milwaukee central business district to Port Washington, Saukville, West Bend, Oconomowoc, Waukesha, and Kenosha, as shown on Map 16. Of the active railway lines in the Region, these six lines are constructed to standards permitting high-speed passenger train operation, and have good to excellent potential for such operation based on consideration of the costs of necessary track rehabilitation, grade-crossing protection, and storage and servicing facilities on each line. In addition, the lines are located to serve the Milwaukee central business district as well as other major trip generators, and to connect with residential areas.

Two of the seven corridors of major travel demand are located along the potential commuter rail routes in the west and southeast corridors from the central business district. Five of the corridors do not have potential commuter rail routes within them throughout their length and could not, therefore, have commuter rail service provided within them. However, potential commuter rail routes are located parallel and adjacent to two of these corridors, the radial north and northwest corridors, and within part of another corridor, the crosstown north-south corridor.

REFINEMENT OF THE FIXED GUIDEWAY MAXIMUM NETWORK

The second step in the development, test, and evaluation of the alternative primary transit system plans was the refinement of the maximum extent fixed guideway corridors for the light rail transit, heavy rail rapid transit, and bus-on-busway modes. In this step, an alignment was selected for each of the three modes within each corridor of the maximum corridor network.

Alignment Selection

Alternative alignments within each corridor of the maximum corridor network were developed to minimize capital costs and community disruption, while maximizing potential operating speeds and accessibility. To the extent possible, the alternative alignments were located along available rights-of-way using at-grade alignments with a minimum of grade separation. The alignments were selected to be as direct as possible in order to provide competitive travel times and, in order to maximize potential use by residents and workers in the Milwaukee area, were located to serve existing and proposed major activity centers and concentrations of residential development.

The capital costs for construction of each alternative mode on the alignment selected were estimated by determining the extent of the alignment to be at-grade, elevated, depressed, or in a subway. In addition, account was taken of the number and extent of over- or underpasses required for crossing watercourses, railroads, and streets and highways. Unit costs for each type of alignment and crossing are based upon the recent experience of other primary transit systems in the United States as documented in SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology. The capital costs considered were limited to construction costs, including grading, drainage, utility relocation, and guideway construction costs and electrification costs and signalization and communications systems costs, as appropriate. Costs were developed in 1979 dollars, the base year of the study from which all forecasts and projections were developed. All costs may be considered as actual local costs, because local wage and cost factors, as documented in Chapter VI of SEWRPC Technical Report No. 24, differ from national costs by less than 5 percent.

Right-of-way costs, although not expressed in dollar amounts, were quantitatively expressed for the evaluation in terms of the amount of right-of-way required, the amount and type of land to be acquired, and the amount and type of disruption entailed. Such expression is sufficient to permit comparison of the right-of-way needs of alternative alignments and selection on a preliminary basis of a preferred alignment. Other capital costs of developing a primary transit system were not considered at this point in the analyses because they would not significantly affect the selection of an alignment within a corridor, or would require information concerning the configuration and operation of an entire system, the cost of which can only be determined later in the analyses. Such costs consist of those for system support facilities, including vehicle storage and maintenance yards and end-of-line crossovers or turnarounds and stations, and vehicle costs. These costs, together with system operating and maintenance costs, were considered later in the evaluation of alternative system plans. Disruption, indicative of the remaining capital costs of developing a guideway attendant to right-of-way acquisition, was determined from Commission aerial photographs showing current land use.

The potential for the provision of quick travel over the alternative alignments was estimated by comparing corridor travel times along the alignment to the Milwaukee central business district and to other selected major trip generators along the alignments. The travel times were estimated from the performance characteristics for light rail transit, heavy rail rapid transit, and busway transit set forth in SEWRPC Technical Report No. 24. Travel time estimates were based upon the established acceleration and deceleration rates of the transit technology concerned, maximum operating speeds, average station dwell times, and station spacing. Maximum speed was, moreover, related to the degree of grade separation provided in an alignment.

It should be noted that the travel times presented assume that stops will be made by primary transit vehicles at all stations along an alignment. However, this will not necessarily be the case, particularly for the bus-on-busway mode. The station spacing used in the travel-time estimates for each mode, represent a typical station spacing for the mode, as set forth in Technical Report No. 24. Station spacings were assumed to vary with each fixed guideway technology and with the density and intensity of land use development in the corridor. For heavy rail rapid transit, stations were assumed to be located at approximately one-half-mile intervals in the Milwaukee central business district; at approximately one-mile intervals in other high-density urban areas; and at approximately two-mile intervals in medium-density urban areas. Stations for Class B light rail transit and busway modes were assumed to be located at approximately one-quarter-mile intervals in the Milwaukee central business district; at approximately one-half-mile intervals in other high-density urban areas; and at approximately one-mile intervals in medium-density urban areas. Station spacings for Class A light rail transit and busway alignments were assumed to be the same as those for Class B alignments except along grade-separated guideways located in high-density urban areas, where the stations were assumed to be spaced about one mile apart.

The accessibility to population and employment opportunities provided by an alignment was measured in terms of the probable future resident population and number of jobs located within a one-half-mile walking distance of the alignment, within a two-mile feeder bus distance, and within a three-mile driving distance. Based upon the evaluation of alternative alignments, one alignment in each corridor of the maximum corridor network was selected for each major mode: heavy rail rapid transit, light rail transit, and busway transit.

The alternative routes were located to meet the engineering design standards and requirements of each mode, specifically with respect to horizontal and vertical alignment and minimum guideway right-of-way widths. Because the controlling design standards for light rail and busway guideways are, for all practical purposes, identical, including, importantly, the flexibility in the need for grade separation, common alignments for these two modes were defined. Two types of light rail and busway alignment alternatives were defined: a Class A alignment, generally providing for full grade separation except in the Milwaukee central business district, and utilizing near ideal horizontal and vertical curvatures, thus permitting a higher level of service, and a Class B alignment, providing for minimum grade separation and permitting at-grade crossings with arterial streets and utilizing near maximum horizontal and vertical curvatures. Class B alignments would have the advantage of lower capital costs and disruption, and perhaps greater accessibility to corridor residents and jobs, but would have lower operating speeds.

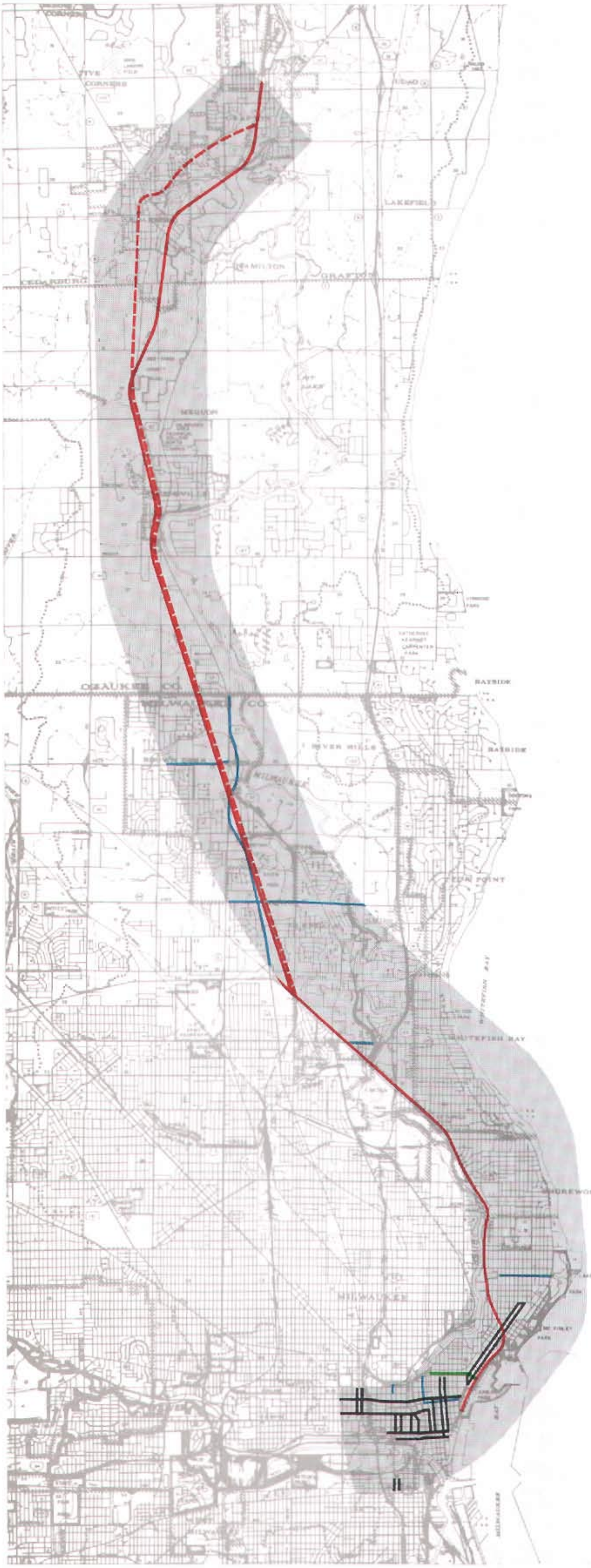
Fixed Guideway Alignments
in the Northeast Corridor

Available rights-of-way determined to have good potential for the location of at-grade primary transit guideways in the northeast corridor of the Milwaukee area are identified on Map 20. Also shown on Map 20 is the generalized existing land use pattern in the corridor and the location of major activity centers. Two alternative heavy rail rapid transit alignments and three light rail transit/busway alignments, one of which is a Class A alignment and two of which are Class B alignments, were defined for the corridor, as shown on Maps 21 and 22.

Heavy Rail Rapid Transit Alignments: Both alternative heavy rail alignments run from the Milwaukee central business district (CBD) to the Village of Grafton in Ozaukee County. In addition, both alignments are located primarily along active and abandoned railway and abandoned electric interurban railway rights-of-way north of E. Wisconsin Avenue. One alignment, Alternative 1H, 22.6 miles in length, would begin in downtown Milwaukee at N. 10th Street and W. Wisconsin Avenue and extend 1.3 miles in a subway to Lincoln Memorial Drive. Upon leaving the subway at Lincoln Memorial Drive, the line would be located on the right-of-way of the former Chicago & North Western (C&NW) lakefront main line between E. Mason Street and E. Bradford Avenue, a surface alignment for a distance of 1.9 miles. At E. Bradford Avenue, the alignment would be located along the right-of-way of the C&NW Capitol Drive spur track, a surface alignment, for a distance of 5.7 miles, leaving the right-of-way at W. Mill Road. At W. Mill Road the alignment would enter the right-of-way of the former Milwaukee Electric Lines-Milwaukee Northern Division interurban right-of-way, remaining along that right-of-way to Mequon Road (STH 167) in the Village of Thiensville as a surface alignment for a distance of 6.0 miles and as an elevated alignment between W. Churchill Place and W. Brown Deer Road in the Village of Brown Deer for 0.8 mile. The alignment over in this segment, however, would leave the interurban right-of-way immediately south of W. Good Hope Road and north of W. Donges Bay Road and enter the Chicago, Milwaukee, St. Paul & Pacific Railroad (Milwaukee Road's) Fifth Subdivision right-of-way in order to bypass two electric

Map 20

EXISTING AVAILABLE RIGHTS-OF-WAY IN THE NORTHEAST CORRIDOR WITH GOOD POTENTIAL FOR FIXED GUIDEWAY PRIMARY TRANSIT DEVELOPMENT



LEGEND

RAILWAY RIGHTS-OF-WAY

- ACTIVE AND ABANDONED RAILROAD
- FORMER INTERURBAN

ARTERIAL STREET RIGHTS-OF-WAY

- ARTERIAL WITH SUFFICIENT MEDIAN WIDTH
- ARTERIAL WITH SUFFICIENT STREET WIDTH

FREEWAY RIGHTS-OF-WAY

- CLEARED FREEWAY

GRAPHIC SCALE

0 ½ 1 2 MILES

0 4000 8000 12000 FEET

The northeast corridor is located between the City of Milwaukee central business district and the communities of Cedarburg and Grafton in Ozaukee County. This corridor contains many arterial street segments with good potential for fixed guideway development, many of which are concentrated in and around the Milwaukee central business district. The most prominent available existing rights-of-way other than street rights-of-way are the former Chicago & North Western Railway lakefront main line and the abandoned electric interurban railway between Milwaukee and Grafton.

Source: SEWRPC.

power transmission substation facilities which have been constructed on the former electric interurban railway right-of-way at these locations. The remaining 6.9 miles of the alignment, north of Mequon Road (STH 167), would be located in the right-of-way of the Milwaukee Road's Fifth Subdivision, terminating at Wisconsin Avenue in the Village of Grafton. Location along the Milwaukee Road's Fifth Subdivision right-of-way north of Mequon Road (STH 167) would provide the opportunity to utilize, for the most part, a surface alignment, whereas utilization of the interurban right-of-way, particularly between the Villages of Thiensville and Grafton, would require the removal of steel lattice electric power transmission towers located in the right-of-way in the Village of Thiensville, and the construction of elevated structures through the City of Cedarburg and the Village of Grafton. To facilitate the frequent street crossings between Mequon Road (STH 167) and W. Freistadt Road in the Village of Thiensville, a distance of 1.3 miles, and between Hamilton Road and a point north of Western Avenue in the City of Cedarburg, a distance of 0.8 mile, the alignment along the Milwaukee Road right-of-way would have to be located on an elevated structure.

Alternative 2H follows the same basic alignment as does 1H, differing, however, both in horizontal and vertical alignment between E. Capitol Drive and E. Kane Place. Specifically, the alignment would leave the former C&NW lakefront main line at E. Kane Place and enter a subway at N. Prospect Avenue, where it would remain in a subway along N. Maryland Avenue. At E. Capitol Drive the alignment would turn westerly in a subway section to the C&NW Capitol Drive spur track, where it would turn northwesterly and follow the alignment as in Alternative 1H. The total length of subway section from N. Prospect Avenue to the Capitol Drive spur track would be 3.4 miles. This alignment would provide more direct service to the University of Wisconsin-Milwaukee campus (UWM) lower east side area, the second largest existing trip attractor in the Milwaukee area. A subway alignment would be required because of the unavailability of other right-of-way options in the area. The total length of Alignment 2H is 23.2 miles.

Heavy Rail Rapid Transit Alignment Evaluation: As shown in Table 15, the capital cost of guideway construction for Alternative 1H is estimated at \$415.6 million in 1979 dollars, or an average cost of \$18.4 million per mile of dual guideway. Because of the additional subway construction entailed in Alternative 2H, the capital cost of the guideway construction would be about 12 percent greater per dual guideway mile than under Alternative 1H, averaging \$23.9 million per mile, for a total cost of \$554.5 million. A breakdown of guideway capital costs by segment of the heavy rail rapid transit alignments is shown in Table 16.

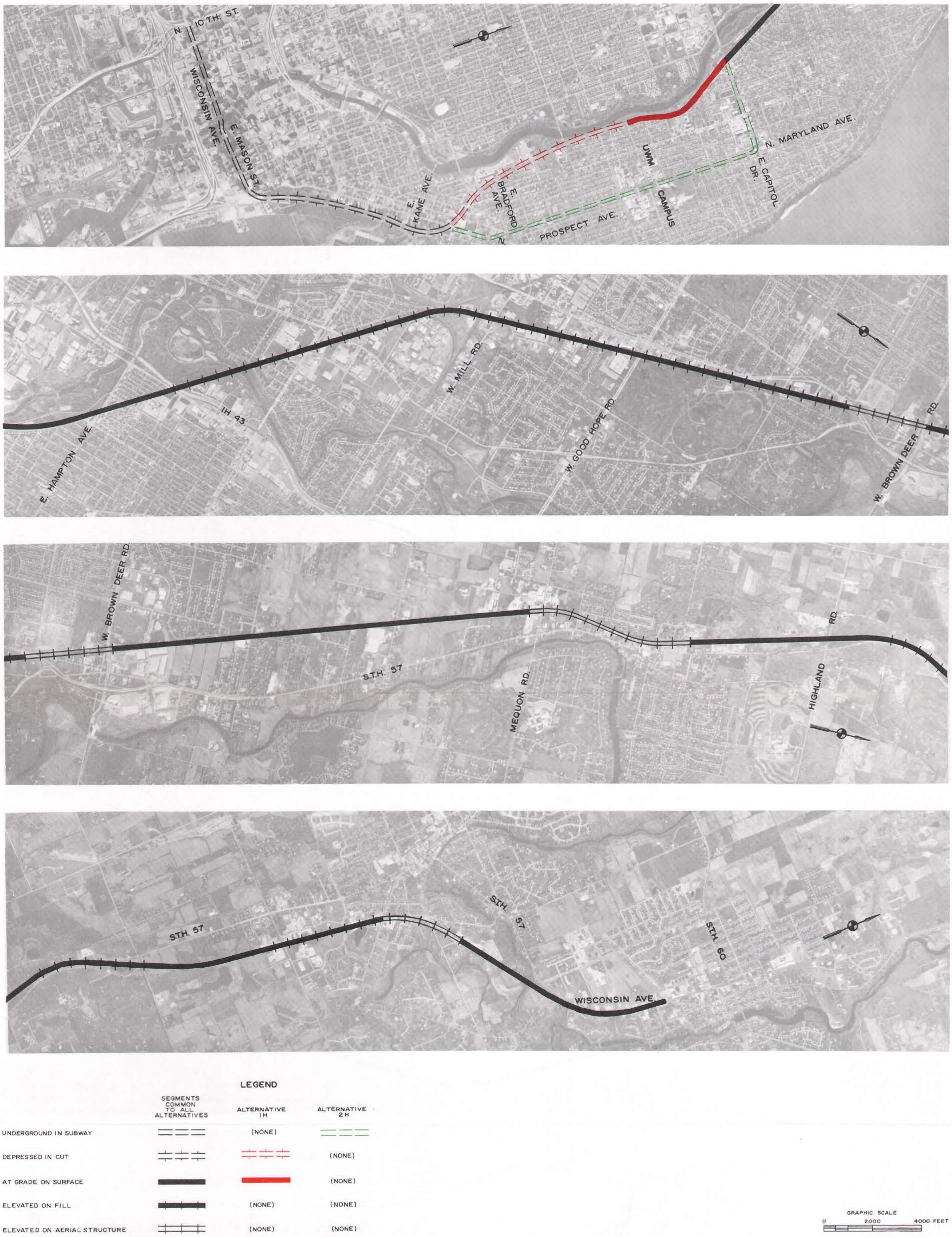
Alternative 1H would utilize a strip of land 22.6 miles in length, including 12.6 miles of active railway right-of-way, 1.9 miles of abandoned railway right-of-way owned by Milwaukee County, and 6.8 miles of former electric interurban railway right-of-way owned by the Wisconsin Electric Power Company. The remaining 1.3 miles of the alignment would be located directly beneath public street rights-of-way in the City of Milwaukee.

Because Alternative 1H utilizes active or abandoned railway rights-of-way for its entire length, the acquisition of residential or commercial structures should not be required. Alternative 2H would utilize a strip of land 18.5 miles in length, including 10.2 miles of active railway right-of-way; 1.5 miles of abandoned railway right-of-way owned by Milwaukee County; 6.8 miles of former electric interurban railway right-of-way owned by the Wisconsin Electric Power Company, and 0.4 mile of new right-of-way. The remaining 4.7 miles of the alignment would be located directly beneath public street rights-of-way in the City of Milwaukee. Because some new right-of-way would have to be acquired for Alternative 2H, some disruption would be entailed. The location of a portion of this alignment in a subway section between E. Capitol Drive and E. Kane Place along N. Maryland Avenue would require the acquisition of 0.4 mile of new right-of-way and the displacement of approximately 11 dwelling units and three commercial or industrial structures in order to provide adequate alignment for a high-speed heavy rail rapid transit alignment. In addition, both alternative alignments would require the relocation of wooden electric power transmission line poles along most of the 3.4 miles of former electric interurban railway right-of-way proposed to be used north of W. Brown Deer Road to Mequon Road (STH 167).

The estimated line-haul travel times between selected terminal locations of these heavy rail rapid transit alignments are summarized in Table 17. Alternative 1H would have a very small travel time advantage over Alternative 2H for trips originating north of W. Capitol Drive and having destinations within the Milwaukee central business district. The estimated line-haul travel time from downtown Milwaukee to the Village of Grafton varies by about

Map 21

HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE NORTHEAST CORRIDOR

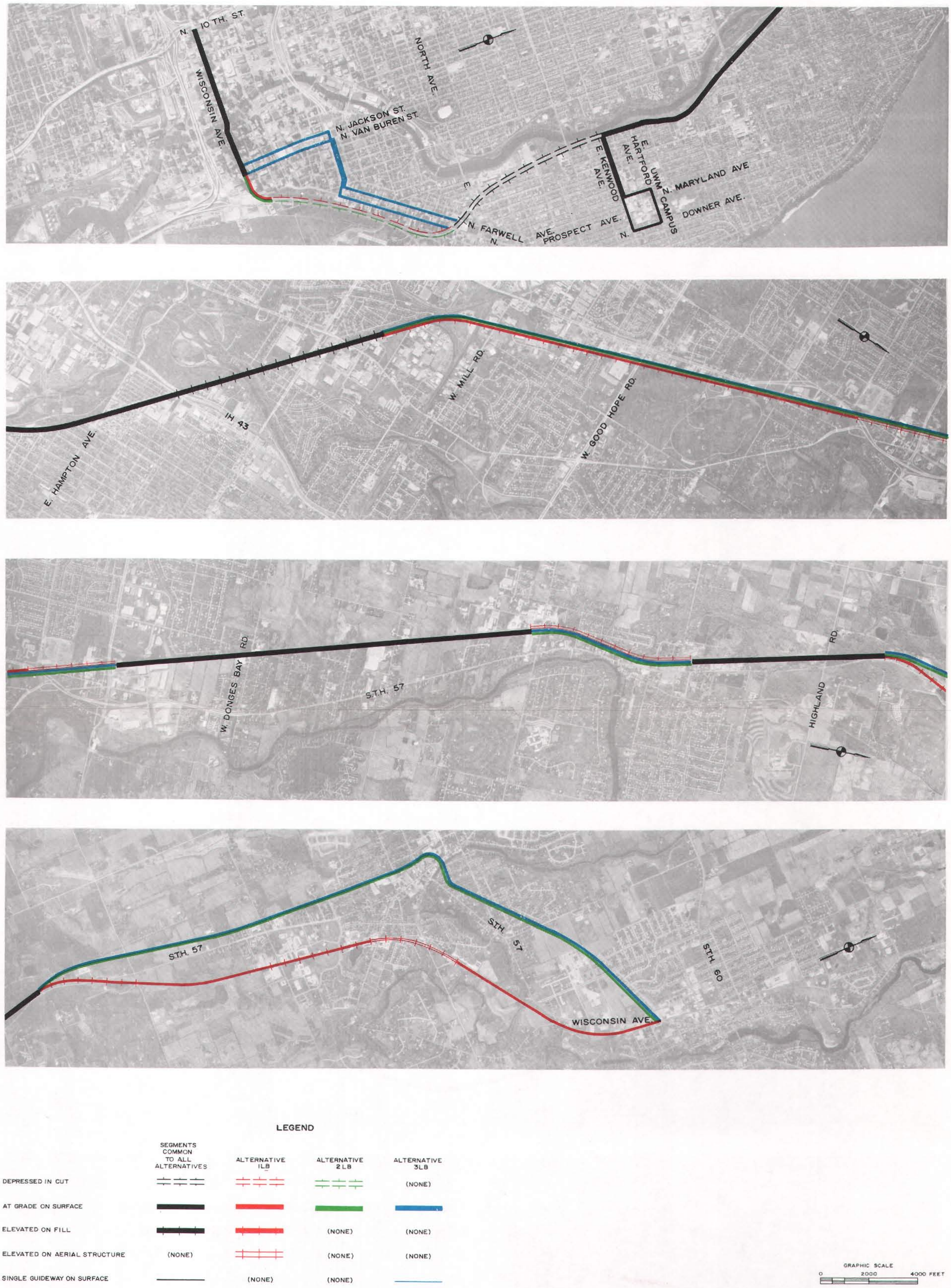


Two alternative fixed guideway alignments suitable for the provision of heavy rail rapid transit service were identified within the northeast corridor. The two alternative alignments are similar except in the near east side area of Milwaukee. Except for a subway beneath Wisconsin Avenue in downtown Milwaukee, the two alignments utilize primarily a combination of active and abandoned railway rights-of-way. In the area of Milwaukee's east side, Alternative 1H, the preferred alignment, utilizes a surface configuration along the Chicago & North Western Railway Capitol Drive spur track adjacent to the Milwaukee River. Alternative 2H utilizes a subway alignment beneath N. Maryland Avenue and E. Capitol Drive in order to directly serve the University of Wisconsin-Milwaukee campus.

Source: SEWRPC.

Map 22

LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE NORTHEAST CORRIDOR



Three alternative fixed guideway alignments suitable for the provision of light rail transit and busway service were identified within the northeast corridor. All three alternative alignments utilize a surface transit mall in downtown Milwaukee, are located on a combination of active and abandoned railway rights-of-way in most other areas, and include a spur to the University of Wisconsin-Milwaukee campus which consists of a one-way loop located on public street rights-of-way. On the near east side of Milwaukee, Alternatives 1LB and 2LB utilize the former Chicago & North Western Railway lakefront main line adjacent to Juneau Park, while Alternative 3LB, the preferred alignment, utilizes one-way pairs of arterial streets for its right-of-way. In addition, Alternative 1LB provides for a completely grade-separated, exclusive guideway outside the Milwaukee central business district, while Alternatives 2LB and 3LB are located almost entirely on the surface.

Source: SEWRPC.

Table 15

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE NORTHEAST CORRIDOR

Cost Element	Unit Cost	Alternative Alignment			
		Alignment 1H		Alignment 2H	
		Quantity	Total Cost	Quantity	Total Cost
Surface Construction					
At-Grade Construction	$ 3.3	10.2 miles	$ 33.4	9.1 miles	$ 29.8
Fill Construction.	$16.2	6.0 miles	97.2	6.0 miles	97.2
Cut Construction.	$20.3-$20.6	2.6 miles	53.7	0.9 mile	18.2
Total	- -	18.8 miles	$184.3	16.0 miles	$145.2
Grade-Separated Construction					
Aerial Construction	$16.1	2.5 miles	$ 40.6	2.5 miles	$ 40.6
Subway Construction	$39.8	1.3 miles	53.6	4.7 miles	188.8
Total	- -	3.8 miles	$ 94.2	7.2 miles	$229.4
Crossings					
Street and Highway					
At-Grade	$ - -	- -	$ - -	- -	$ - -
Overpasses	$ 0.3	15	4.5	14	4.2
Underpasses	$ 0.3	8	2.4	8	2.4
Railroad	$ - -	- -	- -	- -	- -
Watercourse	$ 0.3	4	1.2	4	1.2
Subtotal	- -	- -	$286.6	- -	$382.4
Engineering, Design, and Administration	15 percent	- -	$ 43.0	- -	$ 57.4
Contingencies	30 percent	- -	$ 86.0	- -	$114.7
Total Cost	- -	- -	$415.6	- -	$554.5

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

Table 16

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE NORTHEAST CORRIDOR

Segment	Alternative Alignment					
	Alignment 1H			Alignment 2H		
	Distance (miles)	Total Guideway Construction Cost (millions of dollars)	Average Unit Cost (millions of dollars per mile)	Distance (miles)	Total Guideway Construction Cost (millions of dollars)	Average Unit Cost (millions of dollars per mile)
N. 10th Street to N. Lincoln Memorial Drive . . .	1.3	$ 77.7	$59.8	1.3	$ 77.7	$59.8
N. Lincoln Memorial Drive to W. Silver Spring Drive.	6.5	119.4	18.4	7.1	258.3	36.4
W. Silver Spring Drive to Wisconsin Avenue, Grafton. . .	14.8	218.5	14.8	14.8	218.5	14.8
Total N. 10th Street to Wisconsin Avenue, Grafton . .	22.6	$415.6	$18.4	23.2	$554.5	$23.9

Source: SEWRPC.

Table 17

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE NORTHEAST CORRIDOR

Segment	Alternative Alignment							
	Alignment 1H				Alignment 2H			
	Distance (miles)	Average Speed (miles per hour)	Travel Time (minutes) Station-to-Station	Travel Time (minutes) Cumulative	Distance (miles)	Average Speed (miles per hour)	Travel Time (minutes) Station-to-Station	Travel Time (minutes) Cumulative
Milwaukee Central Business District (N. 10th Street and W. Wisconsin Avenue) to E. Kenwood Boulevard	3.9	33	7	- -	3.9	32	7	- -
E. Kenwood Boulevard to W. Silver Spring Drive.	3.9	38	6	13	4.5	38	7	14
W. Silver Spring Drive to the Village of Thiensville (W. Friestadt Road).	8.9	49	11	24	8.9	49	11	25
Village of Thiensville (W. Freistadt Road) to the Village of Grafton (Wisconsin Avenue) . . .	5.9	49	7	31	5.9	49	7	32

Source: SEWRPC.

1 minute, 31 minutes for Alternative 1H compared with 32 minutes for Alternative 2H. The UWM campus area, however, would be more accessible to the Milwaukee central business district and to northern Milwaukee and southern Ozaukee Counties under Alternative 2H. Both alignments would require seven minutes travel time from downtown Milwaukee to E. Kenwood Boulevard. Alternative 1H would require an additional travel time of approximately 4 minutes by feeder bus assuming no wait is required, and 12 minutes walking time, resulting in a total travel time from the Milwaukee central business district to the UWM campus area of between 11 and 19 minutes, compared with 7 minutes for Alternative 2H. The additional travel time entailed to and from the UWM campus area under Alternative 1H would mean that heavy rail rapid transit on this alignment would provide little or no travel time advantage over express bus service in mixed traffic from the UWM campus area to the Milwaukee central business district.

Alignments 1H and 2H are comparable in terms of accessibility to residents and jobs and service to major activity centers, except that Alternative 2H provides direct service to the UWM campus area. As indicated in Table 18, Alternative 1H would serve a total of 448,700 residents within a six-mile band along the alignment, compared with 452,100 residents for Alternative 2H. Alternative 2H would also serve a greater number of residents within walking distance, 96,900 people, compared with 90,000 people served under Alternative 1H. Alternative 1H would serve a greater number of jobs within walking distance, 86,500, compared with 83,400 for Alternative 2H.

Recommended Heavy Rail Rapid Transit Alignment: Based upon the foregoing preliminary assessment, Alternative 1H is the preferred heavy rail rapid transit alignment in the northeast corridor. It would provide service to approximately the same number of residents and jobs as would Alternative 2H, would provide travel times similar to those of Alternative 2H in the corridor to all locations except the UWM campus area, would result in a minimal disruption of residences and businesses, and would have lower construction costs.

At the request of the study advisory committee, a third alternative heavy rail alignment—Alternative 3H—was considered in the northeast corridor. This alignment would be about 16.1 miles in length. The northern end of the alignment would be located in the City of Mequon at Mequon Road (STH 167). From there south, the alignment would be located on the surface within the right-of-way of the C&NW Shoreline Subdivision through the City of Mequon, Village of Fox Point, and City of Glendale, a distance of about 8.5 miles, to Wiscona Junction, as shown on Map 23. From the junction, the alignment would follow the Capitol Drive spur track right-of-way on the surface for about 5.3 miles to approximately E. Belleview Place, where the alignment would cross the Milwaukee River on a major bridge and then enter the right-

Table 18

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE NORTHEAST CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Household Population Served: One-Half-Mile Walking Distance	Household Population Served: Two-Mile Driving Distance or 15-Minute Feeder Bus Travel Time	Household Population Served: Three-Mile Driving Distance	Number of Jobs Served (one-half-mile walking distance)
1H	90,000	335,900	448,700	86,500
2H	96,900	351,300	452,100	83,400

Source: SEWRPC.

of-way of the Milwaukee Road Chestnut Street Line. The alignment would remain along that right-of-way to E. Lloyd Street, being a surface alignment between E. Clarke Street and E. North Avenue, a distance of about 0.6 mile, and would be on elevated structure between E. North Avenue and E. Lloyd Street, a distance of about 0.3 mile. At E. Lloyd Street the alignment would continue on an elevated structure over N. Commerce Street, a distance of about 0.6 mile, to W. Walnut Street, where it would return to the Chestnut Street Line right-of-way and continue on an elevated structure for about 0.4 mile to W. McKinley Avenue. The remaining 0.3 mile of the alignment south of W. McKinley Avenue would be located on an elevated structure over N. 3rd Street, terminating at W. Kilbourn Avenue in the City of Milwaukee. Location of the alignment south of W. McKinley Avenue would be over N. 3rd Street, rather than over the Chestnut Street Line right-of-way, because the railroad right-of-way ends at W. Juneau Avenue, nearly 0.3 mile from W. Kilbourn Avenue. Extension of an alignment along the railway right-of-way south of W. Juneau Avenue to W. Kilbourn Avenue would require the removal of seven existing commercial or industrial structures located along the Milwaukee River.

The heavy rail alignment would have to be located principally on an elevated structure within or along the Chestnut Street Line railway right-of-way because of the presence of nearly 24 industrial sidings and of other railway trackage for yards and stations within this segment, and because of the intensive industrial development located immediately adjacent to the right-of-way. The elevated section would, for the most part, be located over E. Commerce Street adjacent to the right-of-way, rather than within the right-of-way itself. An elevated structure would preferably be constructed over a public street rather than over existing railway tracks because greater clearances are required over railway tracks for common carrier railway rolling stock. In addition, supports for a structure over railway tracks would require special design and positioning to accommodate the existing track layout.

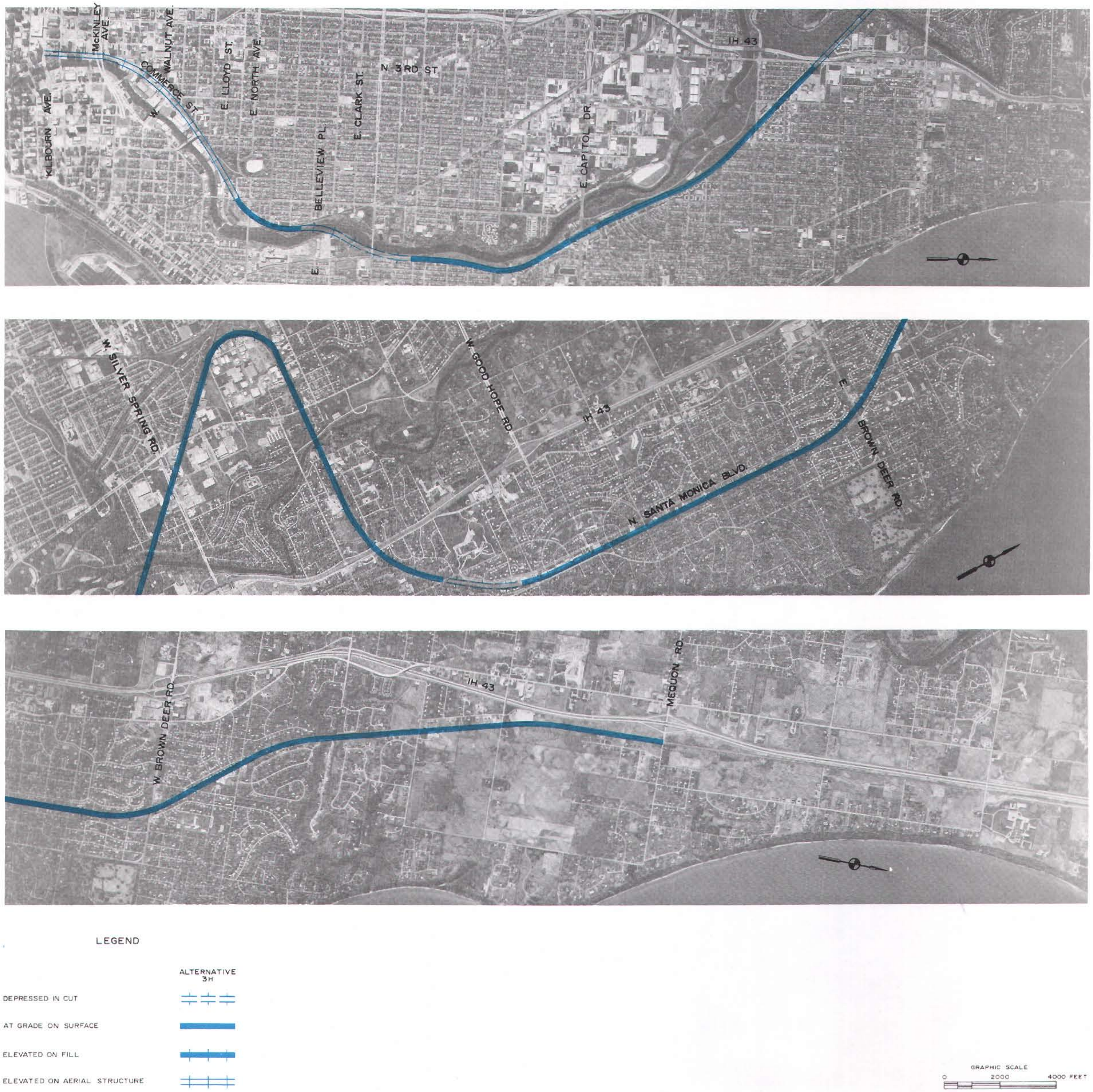
The alignment would be 16.1 miles in length, of which 15.1 miles would be located over existing railway right-of-way. About 0.7 mile of the alignment would be on elevated structure on railway right-of-way, and 14.4 miles would be located on a surface alignment on railway right-of-way. The remaining 1.0 mile of the alignment would be located on an elevated structure, with 0.9 mile of the alignment on public street right-of-way in the City of Milwaukee and the remainder on a skewed viaduct over the Milwaukee River. The capital cost of constructing a heavy rail rapid transit line on the alignment is estimated at $254.8 million, or $15.8 million per mile of dual guideway, as shown in Table 19. Table 20 summarizes the capital costs of major segments of the alignment.

A total of 74,400 residents and 60,200 jobs would be within walking distance of the alignment, 292,000 residents would be within a two-mile feeder bus distance, and 416,500 residents would be within a three-mile driving distance.

The estimated line-haul travel times for Alternative 3H between the City of Mequon and downtown Milwaukee are summarized in Table 21. It would provide travel times from the City of Mequon similar to those provided by Alternatives 1H and 2H, requiring a total of 23 minutes to traverse the alignment at an average speed of

Map 23

HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENT 3H IN THE NORTHEAST CORRIDOR



At the request of the study advisory committee, a third alternative heavy rail rapid transit alignment was considered in the northeast corridor. This alignment incorporates two major differences from Alternatives 1H and 2H, these being an elevated entrance into downtown Milwaukee along the west bank of the Milwaukee River, and the relocation of the guideway on an alignment through the Village of Fox Point. Following comparison of this alternative with the other heavy rail rapid transit alignments, it was recommended that Alternative 1H remain the preferred heavy rail rapid transit alignment in the northeast corridor.

Source: SEWRPC.

Table 19

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENT 3H IN THE NORTHEAST CORRIDOR

Cost Element	Alternative Alignment 3H		
	Unit Cost	Quantity	Total Cost
Surface Construction			
At-Grade Construction	$ 3.3-$ 3.4	8.8 miles	$ 29.1
Fill Construction	$16.1-$17.2	4.7 miles	76.8
Cut Construction	$21.6-$28.6	0.9 mile	22.9
Total	- -	14.4 miles	$128.8
Grade-Separated Construction			
Aerial Construction	$20.5	1.7 miles	$ 34.9
Subway Construction	$39.8	- -	- -
Total	- -	1.7 miles	$ 34.9
Crossings			
Street and Highway			
At-Grade	$ - -	- -	$ - -
Overpasses	$ 0.3	11	3.3
Underpasses	$ 0.3	13	3.9
Railroad	$ 0.3	1	0.3
Watercourse	$0.3-$4.0	3	4.6
Subtotal	- -	- -	$175.8
Engineering, Design, and Administration	15 percent	- -	$ 26.3
Contingencies	30 percent	- -	$ 52.7
Total Cost	- -	- -	$254.8

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

42 miles per hour (mph). Comparable line-haul travel times for Alternatives 1H and 2H for trips between Mequon Road (STH 167) in the City of Mequon and the eastern limits of the Milwaukee central business district at N. Lincoln Memorial Drive were estimated to be 20 minutes for Alternative 1H at an average speed of 44 mph and 21 minutes for Alternative 2H at an average speed of 44 mph. It should be noted that the circuity of the alignment required to make the connection between the Shoreline Subdivision and the Capitol Drive spur track without extensive disruption adds to the travel time. However, no option could be found to eliminate this circuity without requiring extensive subway construction. One option investigated would leave the Shoreline Subdivision and enter the right-of-way of the North-South Freeway (IH 43), running over this right-of-way for about 1.5 miles to the Capitol Drive spur track. However, there is insufficient freeway right-of-way to accommodate even an elevated structure. Another option would use the right-of-way of the former C&NW Whitefish Bay main line between the C&NW Shoreline Subdivision right-of-way and the C&NW Capitol Drive spur track right-of-way. This former railroad right-of-way, however, has since been developed for residential use, and its reuse for a transportation facility would entail extensive disruption.

Table 22 summarizes the results of the preliminary assessment of the capital cost, disruption, travel time, and accessibility to jobs and population of Alternative 3H, and Alternatives 1H and 2H. The estimated cost of Alternative 3H would be about the same as that of alignment 1H over the same segment from downtown Milwaukee to the City of

Table 20

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENT 3H IN THE NORTHEAST CORRIDOR

Segment	Alternative Alignment 3H		
	Distance (miles)	Total Guideway Construction Cost (millions of dollars)	Average Unit Cost (millions of dollars per mile)
W. Kilbourn Avenue to E. North Avenue.	1.6	$ 50.6	$31.6
E. North Avenue to W. Silver Spring Drive.	5.1	71.8	14.1
W. Silver Spring Drive to W. Brown Deer Road	6.2	102.8	16.5
W. Brown Deer Road to Mequon Road (STH 167). . .	3.2	29.6	9.2
Total W. Kilbourn Avenue to Mequon Road (STH 167). .	16.1	$254.8	$15.8

Source: SEWRPC.

Table 21

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENT 3H IN THE NORTHEAST CORRIDOR

Segment	Alternative Alignment 3H			
			Travel Time (minutes)	
	Distance (miles)	Average Speed (miles per hour)	Station-to-Station	Cumulative
W. Kilbourn Avenue to E. Kenwood Boulevard . . .	2.5	37	4	- -
E. Kenwood Boulevard to W. Silver Spring Drive. . . .	4.2	38	7	11
W. Silver Spring Drive to Mequon Road (STH 167). .	9.4	49	12	23

Source: SEWRPC.

Mequon. Its travel times would also be similar, as would its disruption. More population and employment, however, would be served between the City of Mequon and downtown Milwaukee by Alternative 2H. The disadvantage of Alternative 3H is principally that it would not permit ready extension of the line to existing and planned medium- and high-density urban areas in the Villages of Thiensville and Grafton and the City of Cedarburg in Ozaukee County. Also, Alternative 3H would have to enter the downtown area on an elevated structure, which may not be acceptable in terms of the urban design considerations involved. A subway from approximately W. McKinley Avenue to W. Wisconsin Avenue would add $35 million to the cost of the alternative. Thus, it is recommended that Alternative 1H remain the recommended heavy rail alignment within the northeast corridor, with the option to reconsider the alternative of switching over to the Chestnut Street Line right-of-way from the Capitol Drive spur track right-of-way at E. Belleview Place after preferred alignments have been selected in all other corridors, and the relationship of a line in the northeast corridor to the other lines required to form a heavy rail system for the Milwaukee area can be determined.

Light Rail Guideway/Busway Alignments: Three alternative light rail guideway/busway alignments were selected for analysis. All of the alternative alignments would originate in the Milwaukee central business district and terminate in the Village of Grafton in Ozaukee County. Each alignment would utilize a combination of active and abandoned railway and abandoned electric interurban railway rights-of-way, cleared freeway rights-of-way, and arterial street rights-of-way. One alignment, Alternative 1LB, 22.6 miles in length, would be very similar to heavy rail rapid transit Alternative 1H. It would be grade-separated along its length except along W. Wisconsin Avenue between N. 10th Street and N. Lincoln Memorial Drive, where it would be located on a surface in a transit mall for a distance of 1.3 miles.

Alternative 2LB would follow the same basic alignment as does Alternative 1LB except through the Villages of Cedarburg and Grafton, where it would remain on the former electric interurban railway right-of-way. This alternative would be grade-separated only at selected major street and highway crossings and at railway crossings. Alignment 2LB would deviate from the abandoned electric interurban railway right-of-way only at two locations, immediately south of W. Good Hope Road and immediately north of W. Donges Bay Road, where the alignment would use the Milwaukee Road's Fifth Subdivision right-of-way in order to bypass electric power transmission substation facilities which have been constructed on the right-of-way at these locations.

Alternative 3LB, 23.9 miles in length, would follow the same alignment followed by Alternative 2LB north of E. North Avenue, being located, specifically, on the rights-of-way of the former C&NW

Table 22

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE NORTHEAST CORRIDOR

Evaluation Criteria	Alternative Alignment		
	Alignment 1H	Alignment 2H	Alignment 3H
Capital Cost (guideway construction cost in millions of dollars)	$415.6 ($249.9 from City of Mequon to N. Lincoln Memorial Drive)	$554.5 ($388.8 from City of Mequon to N. Lincoln Memorial Drive)	$254.8
Community Disruption			
Type of Land Used (miles)			
Railroad and Former Interurban Right-of-Way	21.3	18.1	15.2
Public Street Right-of-Way	1.3	4.7	0.9
Newly Acquired Right-of-Way	- -	0.4	- -
Total	22.6	23.2	16.1
Structure Dislocation (number)			
Residential Buildings	- -	11	- -
Commercial or Industrial Buildings	- -	3	- -
Other Disruption	Relocation of wooden electric power transmission line poles along 3.4 miles of former interurban right-of-way		*None*
Travel Time (line-haul travel time in minutes to the Milwaukee CBD)	31 minutes from Village of Grafton (20 minutes from City of Mequon)	32 minutes from Village of Grafton (21 minutes from City of Mequon)	23 minutes from City of Mequon
Population Served			
One-Half-Mile Walking Distance			
Village of Grafton to N. Lincoln Memorial Drive	90,000	96,900	74,400
City of Mequon to N. Lincoln Memorial Drive	70,400	77,300	- -
Three-Mile Driving Distance			
Village of Grafton to N. Lincoln Memorial Drive	448,700	452,100	416,500
City of Mequon to N. Lincoln Memorial Drive	407,700	411,100	- -
Jobs Served			
One-Half-Mile Walking Distance			
Village of Grafton to N. Lincoln Memorial Drive	86,500	83,400	60,200
City of Mequon to N. Lincoln Memorial Drive	58,500	55,400	- -

Source: SEWRPC.

lakefront main line, the C&NW Capitol Drive spur track, and the former Milwaukee Electric Lines-Milwaukee Northern Division interurban right-of-way. The alignment between E. North Avenue and the Milwaukee central business district would, however, be different, being located along arterial street rights-of-way. Specifically, this portion of the alignment would be located in a transit mall along E. and W. Wisconsin Avenue between N. 10th Street and N. Van Buren Street, a distance of 1.1 miles. The line would then be located along N. Van Buren Street in a reserved lane, providing service in a northbound direction only for 0.7 mile. The southbound line would be located in a reserved lane on N. Jackson Street. After the line leaves N. Van Buren and N. Jackson Streets, the alignment would be located in the cleared right-of-way of the Park Freeway-East for 0.4 mile. The alignment would then enter and operate over N. Prospect Avenue in a reserved lane, providing service in a northbound direction only for 0.9 mile to the former C&NW lakefront main line. The southbound facility would be located in a reserved lane on N. Farwell Avenue. The remainder of the alignment of Alternative 3LB would be the same as alignment 2LB.

A fourth alternative alignment was investigated in an attempt to provide direct service to the UWM campus area. However, because of the lack of an available right-of-way, the only ways in which the required light rail transit/busway alignment could be developed would be through the use of an elevated or subway alignment for a distance of at least three miles; operation on the surface streets in mixed traffic or over reserved lanes; or operation over an acquired new right-of-way, requiring dislocation of homes, businesses, and industries. Direct service to the UWM campus area could be provided by operating over surface streets in mixed traffic or over reserved lanes via a spur from any of the three previous alignments. The spur would be used only by vehicles destined to, or originating from, the UWM campus area. One possible spur alignment would leave the C&NW Capitol Drive spur track right-of-way at E. Kenwood Boulevard, proceed along E. Kenwood Boulevard in mixed traffic west of N. Maryland Avenue and in a transit mall east of Maryland Avenue for a distance of 0.7 mile to the UWM campus, and, at N. Downer Avenue, follow a one-way loop along N. Downer, E. Hartford, and N. Maryland Avenues for 0.7 mile, returning to the fixed guideway located in the right-of-way of the C&NW Capitol Drive spur track along E. Kenwood Boulevard for a distance of 0.4 mile.

Light Rail Transit/Busway Alignment Evaluation: As indicated in Table 23, the capital cost of guideway construction for Alternative 1LB, the Class A alignment, is estimated at $350.3 million for a light rail transit system, or an average cost of $15.5 million per mile of dual guideway, and $276.3 million for a busway, or about $12.2 million per mile of dual guideway. The capital cost of guideway construction for the Class B alignments are lower. Specifically, the cost of constructing a dual guideway for light rail transit along Alignment 2LB is estimated at $222.0 million, or an average cost of $9.4 million per dual guideway mile, and for a busway, $143.1 million, or an average cost of $6.1 million per dual guideway mile. The capital cost of constructing Alternative 3LB is estimated to average $8.4 million per mile for light rail transit for a total cost of $202.1 million, and $4.9 million per mile for busway for a total cost of $118.9 million. A breakdown of guideway capital costs by segment of alternative light rail transit/busway alignment is shown in Table 24.

The capital cost for the UWM spur light rail guideway surface alignment is estimated at $8.8 million, and the cost for the busway alignment is estimated at $6.2 million, which includes only the cost of connecting ramps from the proposed busway alignment along the Capitol Drive spur track to the western end of E. Kenwood Boulevard.

Alternative 1LB would utilize a strip of land 22.6 miles in length, including 12.6 miles of active railway right-of-way, 1.9 miles of abandoned railway right-of-way owned by Milwaukee County, and 6.8 miles of former electric interurban railway right-of-way owned by the Wisconsin Electric Power Company. The remaining 1.3 miles of the alignment would utilize public street rights-of-way in the City of Milwaukee. Alternative 2LB would utilize 1.3 miles of public street rights-of-way in the City of Milwaukee and a total of 21.3 miles of railway rights-of-way, including 5.7 miles of active railway right-of-way, 13.7 miles of former electric interurban railway right-of-way owned by the Wisconsin Electric Power Company, and 1.9 miles of abandoned railway right-of-way owned by Milwaukee County. Alternative 3LB would utilize a total of 20.9 miles of railway right-of-way, including 5.7 miles of active railway right-of-way, 13.7 miles of former electric interurban railway right-of-way, and 1.5 miles of abandoned railway right-of-way owned by Milwaukee County. It would also use 0.4 mile of cleared freeway right-of-way and 2.6 miles of public street rights-of-way in the City of Milwaukee. The UWM spur alignment would be located on 1.4 miles of public street rights-of-way in the City of Milwaukee.

None of the three alignments or the UWM spur alignment would require the acquisition of any residential, commercial, or industrial structures. However, all three alignments which use the right-of-way of the former Milwaukee Electric Lines-Milwaukee Northern Division electric interurban railway line would require the relocation of wooden transmission line poles in place along most of the right-of-way north of W. Brown Deer Road to the City of Cedarburg.

Line-haul travel times for selected segments of the three light rail transit/busway alignments in the northeast corridor are summarized in Table 25. All

Table 23

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR LIGHT RAIL TRANSIT/BUSWAY FACILITIES IN THE NORTHEAST CORRIDOR

Cost Element	Unit Cost		Alternative Alignment											
			Alignment 1LB			Alignment 2LB			Alignment 3LB			UWM Spur Alignment		
				Total Cost			Total Cost			Total Cost			Total Cost	
	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway
Surface Construction														
At-Grade Construction	$ 3.1-$ 4.1	$ 0.8-$ 2.3	11.5 miles	$ 38.2	$ 14.1	19.2 miles	$ 64.1	$ 19.8	20.8 miles	$ 71.0	$ 22.1	1.4 miles	$4.5	$1.8
Fill Construction	$16.0-$16.2	$13.7-$14.7	6.0 miles	97.4	83.5	1.7 miles	27.6	24.2	1.8 miles	29.3	28.1	0.1 mile	1.6	2.5
Cut Construction	$22.0-$22.8	$19.4	2.4 miles	53.4	46.7	2.4 miles	53.0	46.7	1.3 miles	34.6	27.3	--	--	--
Total	--	--	19.9 miles	$189.0	$144.3	23.3 miles	$144.7	$ 90.7	23.9 miles	$134.9	$ 77.5	1.5 miles	$6.1	$4.3
Grade-Separated Construction														
Aerial Construction	$17.8-$19.4	$14.1-$17.2	2.7 miles	$ 44.5	$ 38.1	0.2 mile	$ 3.8	$ 3.5	--	$ --	$ --	--	$ --	$ --
Subway Construction	$ --	$ --	--	--	--	--	--	--	--	--	--	--	--	--
Total	--	--	2.7 miles	$ 44.5	$ 38.1	0.2 mile	$ 3.8	$ 3.5	--	$ --	$ --	--	$ --	$ --
Crossings														
Street and Highway														
At-Grade	$ --	$ --	19	$ --	$ --	50	$ --	$ --	75	$ --	$ --	10	$ --	$ --
Overpasses	$0.3	$0.3	15	4.5	4.5	7	2.1	2.1	7	2.1	2.1	--	--	--
Underpasses	$0.3	$0.3	8	2.4	2.4	3	0.9	0.9	3	0.9	0.9	--	--	--
Railroad	$0.3	$0.3	--	--	--	1	0.3	0.3	1	0.3	0.3	--	--	--
Watercourse	$0.3	$0.3	4	1.2	1.2	4	1.2	1.2	4	1.2	1.2	--	--	--
Subtotal	--	--	--	$241.6	$190.5	--	$153.0	$ 98.7	--	$139.4	$ 82.0	--	$6.1	$4.3
Engineering, Design, and Administration	15 percent	15 percent	--	$ 36.2	$ 28.6	--	$ 23.0	$ 14.8	--	$ 20.9	$ 12.3	--	$0.9	$0.6
Contingencies	30 percent	30 percent	--	$ 72.5	$ 57.2	--	$ 46.0	$ 29.6	--	$ 41.8	$ 24.6	--	$1.8	$1.3
Total Cost	--	--	--	$350.3	$276.3	--	$222.0	$143.1	--	$202.1	$118.9	--	$8.8	$6.2

NOTE: All costs are estimated in millions of 1979 dollars.
Source: SEWRPC.

Table 24

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE NORTHEAST CORRIDOR

Segment	Alternative Alignment																			
	Alignment 1LB					Alignment 2LB					Alignment 3LB					UWM Spur Alignment				
	Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)		Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)		Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)		Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)	
		Light Rail	Busway	Light Rail	Busway		Light Rail	Busway	Light Rail	Busway		Light Rail	Busway	Light Rail	Busway		Light Rail	Busway	Light Rail	Busway
N. 10th Street to N. Lincoln Memorial Drive	1.3	$ 7.3	$ 3.7	$ 5.6	$ 2.8	1.3	$ 7.3	$ 3.7	$ 5.6	$ 2.8	1.1[a]	$ 6.3	$ 3.2	$ 5.7	$ 2.9	--	$ --	$ --	$ --	$ --
N. Lincoln Memorial Drive to W. Silver Spring Drive	6.5	123.7	103.2	19.0	15.9	6.5	122.7	103.2	18.9	15.9	7.1[b]	103.8	79.5	14.6	11.2	1.5	8.8	6.2	5.9	4.1
W. Silver Spring Drive to Wisconsin Avenue, Grafton	14.8	219.3	169.4	14.8	11.4	15.7	92.0	36.2	5.8	2.3	15.7	92.0	36.2	5.8	2.3	--	--	--	--	--
Total N. 10th Street to Wisconsin Avenue, Grafton	22.6	$350.3	$276.3	$15.5	$12.2	23.5	$222.0	$143.1	$ 9.4	$ 6.1	23.9	$202.1	$118.9	$ 8.4	$ 4.9	1.5	$8.8	$6.2	$5.9	$4.1

[a] *The capital cost is estimated for the segment between N. 10th Street and N. Van Buren Street.*

[b] *The capital cost is estimated for the segment between N. Jackson Street and W. Silver Spring Drive.*

Source: SEWRPC.

three alternatives would provide similar overall travel times between the Village of Grafton and the Milwaukee central business district—specifically, between 50 and 53 minutes for light rail transit and 56 and 58 minutes for busways. It should be noted that if the station spacing of the light rail systems and busways of these alternatives approached that of heavy rail systems—specifically, an average spacing of one mile rather than one-half mile in high-density areas and two miles rather than one mile in medium-density areas—the travel times from the Village of Grafton to the Milwaukee central business district would approach 41 minutes for a light rail transit system and 43 minutes for a busway under Alternative 1LB, 43 minutes for a light rail transit system and 45 minutes for a busway under Alternative 2LB, and 44 minutes for a light rail transit system and 45 minutes for

Table 25

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE NORTHEAST CORRIDOR

Segment	Alternative Alignment														
	Alignment 1LB					Alignment 2LB					Alignment 3LB				
	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway) Station-to-Station	Cumulative	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway) Station-to-Station	Cumulative	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway) Station-to-Station	Cumulative
Milwaukee Central Business District (N. 10th Street and W. Wisconsin Avenue) to E. Kenwood Boulevard	3.9	Typical light rail/busway	18/16	13/15	- -	3.9	Typical light rail/busway	18/16	13/15	- -	4.3	Typical light rail/busway	16/14	16/18	- -
		Typical heavy rail	20/19	12/13	- -		Typical heavy rail	20/18	12/13	- -		Typical heavy rail	18/16	14/16	- -
E. Kenwood Boulevard to W. Silver Spring Drive	3.9	Typical light rail/busway	24/21	10/11	23/26	3.9	Typical light rail/busway	24/21	10/11	23/26	3.9	Typical light rail/busway	24/21	10/11	26/29
		Typical heavy rail	34/30	7/8	19/21		Typical heavy rail	31/29	7/8	19/21		Typical heavy rail	31/29	7/8	21/24
W. Silver Spring Drive to the Village of Thiensville (W. Freistadt Road)	8.9	Typical light rail/busway	34/30	16/18	39/44	8.9	Typical light rail/busway	32/30	17/18	40/44	8.9	Typical light rail/busway	32/30	17/18	43/47
		Typical heavy rail	39/39	14/14	33/35		Typical heavy rail	36/31	15/17	34/38		Typical heavy rail	36/31	15/17	36/41
Village of Thiensville (W. Freistadt Road) to the Village of Grafton (Wisconsin Avenue)	5.9	Typical light rail/busway	34/30	11/12	50/56	6.8	Typical light rail/busway	32/30	13/14	53/58	6.8	Typical light rail/busway	32/30	13/14	56/61
		Typical heavy rail	39/39	9/9	42/44		Typical heavy rail	36/31	11/13	45/51		Typical heavy rail	36/31	11/13	47/54

[a] *Assumes light rail and busway transit station spacing of approximately one-quarter mile in the Milwaukee central business district; one-half mile in other high-density urban areas unless the guideway is fully grade-separated, where one-mile spacing is assumed; and one mile in medium-density urban areas. The wider station spacing represents typical heavy rail station spacing of approximately one-half mile in the Milwaukee central business district; one mile in other high-density urban areas; and two miles in medium-density areas.*

[b] *The average speeds are based upon typical acceleration and deceleration rates; typical maximum operating speeds, which vary based on type, location, and degree of grade separation of right-of-way; assumed typical station spacing; and a typical station dwell time of 30 seconds. Preferential treatment has been assumed at all at-grade crossings. These typical light rail and busway transit characteristics were established in SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology. The result is average speeds of about 11 miles per hour in malls and other reserved guideways on street rights-of-way in the central business district; of from 20 to 30 miles per hour on reserved guideways in all other street rights-of-way; and of from 20 to 40 miles per hour on all other private rights-of-way. The variation in these average speeds is a result of variation in station spacing.*

Source: SEWRPC.

a busway under Alternative 3LB. The spur alignment to UWM would require 13 minutes to traverse by light rail and 17 minutes by bus, and about 4 minutes would be required to travel from the guideway alignment in the C&NW Capitol Drive spur track right-of-way at E. Kenwood Boulevard to the UWM campus area at E. Kenwood Boulevard and N. Maryland Avenue. Between 11 and 16 minutes would be added to any light rail or bus trip on any of the three corridor alignments—if transit vehicles operating between downtown Milwaukee and any of the suburban communities north of the UWM campus were routed over the UWM spur alignment.

Alternative Alignments 1LB, 2LB, and 3LB are comparable in terms of accessibility to residents and jobs and service to major activity centers. As shown in Table 26, Alternative 1LB would serve the fewest total residents, 448,700, compared with 484,000 for Alternative 2LB and 482,500 for Alternative 3LB, within a six-mile band around the align-

Table 26

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE NORTHEAST CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Household Population Served			Number of Jobs Served (one-half-mile walking distance)
	One-Half-Mile Walking Distance	15-Minute Feeder Bus Travel Time	Three-Mile Driving Distance	
1LB	90,100	335,900	448,700	86,500
2LB	92,800	337,700	484,000	88,300
3LB	98,700	344,700	482,500	90,500

Source: SEWRPC.

ment. Alternative 3LB would serve a greater number of residents within walking distance, 98,700, compared with 92,800 for Alternative 2LB and 90,100 for Alternative 1LB. Employment within walking distance would also be greatest for Alternative 3LB, 90,500 jobs, compared with 88,300 for Alternative 2LB and 86,500 for Alternative 1LB. Nearly 6,000 jobs and 12,000 residents would be within walking distance of the UWM spur alignment, which would also, importantly, provide a direct connection to the UWM campus.

Recommended Light Rail Transit/Busway Alignment: Based upon the foregoing preliminary assessment, Alternative 3LB is the preferred light rail/busway alignment in the northeast corridor. Both Alternatives 2LB and 3LB are substantially less costly than Alternative 1LB, while providing about the same travel times, amount of disruption, and access to jobs and population as Alternative 1LB. Alternative 3LB would be somewhat less costly than Alternative 2LB, and would provide somewhat greater access to jobs and population. It would require, however, use of existing arterial street lanes and a portion of the Park Freeway-East right-of-way.

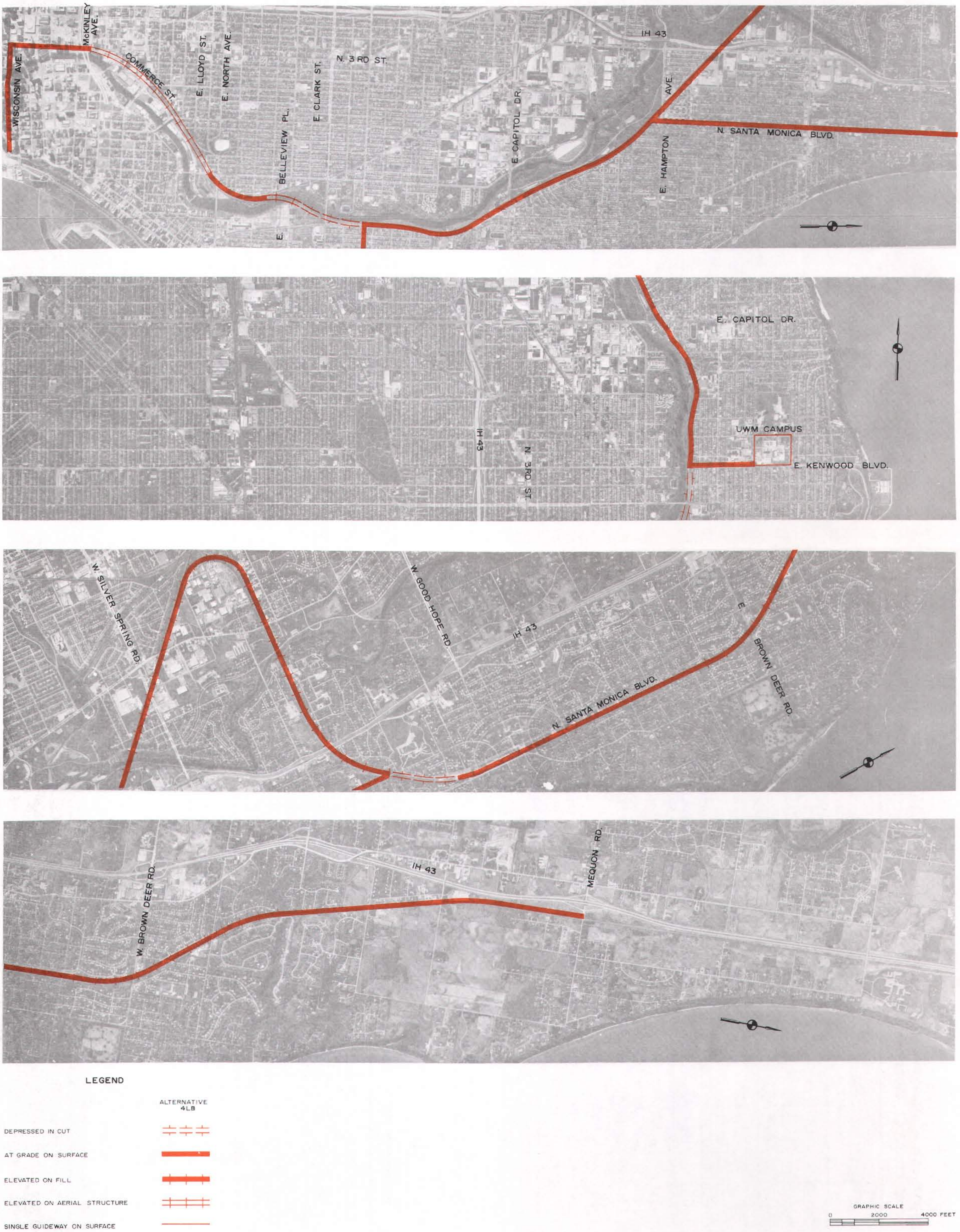
At the request of the study advisory Committee, a fourth alternative light rail transit/busway alignment—Alternative 4LB, was considered in the northeast corridor. This alignment would be very similar to heavy rail rapid transit Alternative 3H, as shown on Map 24. It would be grade-separated along most of its length except south of W. McKinley Avenue. Specifically, the alignment between W. McKinley and W. Wisconsin Avenues would be located on a surface alignment in a reserved lane for about 0.4 mile along N. 3rd Street. At W. Wisconsin Avenue the alignment would be located on a surface alignment in a transit mall to N. Lincoln Memorial Drive, a distance of 0.8 mile. The alignment would utilize a strip of land 16.9 miles in length, including 15.1 miles of existing railway right-of-way. Of this 15.1 miles of alignment, 0.7 mile would be located on an elevated structure and 14.4 miles would be located on a surface alignment. The remaining 1.8 miles of the alignment would utilize public street rights-of-way, 0.6 mile of which would be located on an elevated structure over public street rights-of-way in the City of Milwaukee, and 1.2 miles of which would be located on a surface alignment. Location of the alignment over 0.4 mile of public street right-of-way along N. 3rd Street, however, would require use of existing arterial street lanes, leaving only one lane of travel in each direction over this segment. Otherwise, the alignment would entail no disruption.

As shown in Table 27, the estimated capital cost of guideway construction is $243.4 million for light rail transit, or an average cost of $14.4 million per mile of dual guideway, and $190.8 million for a busway, or about $11.3 million per mile of dual guideway. Table 28 summarizes the capital cost of major segments of the alignment.

A total of 76,600 residents and 71,600 jobs would be within walking distance of this alignment; 293,100 residents would be within a two-mile feeder bus service; and 441,200 residents would be within a three-mile automobile drive. The estimated line-haul travel times for Alternative 4LB between the City of Mequon and N. Lincoln Memorial Drive in downtown Milwaukee are summarized in Table 29. A total of 39 minutes would be required to traverse the alignment at an average speed of 26 miles per hour (mph) for light rail transit. Bus transit would require 43 minutes at an average speed of 23 mph. Comparable line-haul travel times for the other three light rail transit/busway alternative alignments in the northeast cor-

Map 24

LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENT 4LB IN THE NORTHEAST CORRIDOR



At the request of the study advisory committee, a fourth alternative light rail transit and busway alignment was considered in the northeast corridor. This alternative differs from the other light rail transit and busway alternatives in that the entrance into the Milwaukee central business district would be along the west bank of the Milwaukee River instead of through the City of Milwaukee's east side. Also, the alignment through the communities of Thiensville, Cedarburg, and Grafton would be replaced with an alignment through the Village of Fox Point. In addition, an option was considered for utilization of the N. Santa Monica Boulevard right-of-way in order to reduce the circuity of Alternative 4LB. Following comparison of this alternative with the other light rail transit and busway alignments, it was recommended that Alternative 3LB remain the preferred light rail transit and busway alignment in the northeast corridor.

Source: SEWRPC.

Table 27

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENT 4LB IN THE NORTHEAST CORRIDOR

Cost Element	Unit Cost		Alternative Alignment 4LB		
				Total Cost	
	Light Rail	Busway	Quantity	Light Rail	Busway
Surface Construction					
At-Grade Construction	\$ 3.2-\$ 3.8	\$ 1.0-\$ 1.9	10.0 miles	\$ 33.3	\$ 13.7
Fill Construction	\$16.2-\$16.4	\$13.7-\$14.5	4.7 miles	76.3	65.5
Cut Construction	\$21.5-\$21.6	\$17.6-\$19.2	0.9 mile	19.4	16.5
Total	--	--	15.6 miles	\$129.0	\$ 95.7
Grade-Separated Construction					
Aerial Construction	\$20.5	\$18.3	1.3 miles	\$ 26.7	\$ 23.8
Subway Construction	\$ --	\$ --	--	--	--
Total	--	--	1.3 miles	\$ 26.7	\$ 23.8
Crossings					
Street and Highway					
At-Grade	\$ --	\$ --	--	\$ --	\$ --
Overpasses	\$ 0.3	\$ 0.3	11	3.3	3.3
Underpasses	\$ 0.3	\$ 0.3	13	3.9	3.9
Railroad	\$ 0.3	\$ 0.3	1	0.3	0.3
Watercourse	\$ 0.3-\$ 4.0	\$ 0.3-\$ 4.0	3	4.6	4.6
Subtotal	--	--	--	\$167.8	\$131.6
Engineering, Design, and Administration	15 percent	15 percent	--	\$ 25.2	\$ 19.7
Contingencies	30 percent	30 percent	--	\$ 50.4	\$ 39.5
Total Cost	--	--	--	\$243.4	\$190.8

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

ridor for trips between Mequon Road (STH 167) and N. Lincoln Memorial Drive in downtown Milwaukee were estimated to range between 30 and 38 minutes for light rail transit and 34 and 42 minutes for a busway.

It should be noted that the circuity of the alignment required to make the connection between the C&NW Shoreline Subdivision and the C&NW Capitol Drive spur track without significant disruption adds to the travel time. In addition, the alignment in this segment would need to be constructed on a costly fill section, adding about \$97.4 million to the capital cost for light rail transit and \$93.1 million for a busway. One option investigated to minimize this problem would leave the C&NW Shoreline Subdivision right-of-way and enter a public street right-of-way on a surface alignment at N. Santa Monica Boulevard in the Village of Fox Point, running over that Boulevard a distance of about 2.3 miles to the C&NW Capitol Drive spur track. The remaining 12.4 miles of the alignment, north of Santa Monica Boulevard and south of the connection at the Capitol Drive spur track, would be the same as in Alternative 4LB. The capital cost for a light rail alignment using this connection would be about 35 percent lower—\$158.2 million; and for a bus alignment would be 45 percent lower—\$105.1 million. This alignment would take 13 percent less time to traverse than would the alignment under Alternative 4LB, an

Table 28

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENT 4LB IN THE NORTHEAST CORRIDOR

Segment	Alternative Alignment 4LB				
	Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)	
		Light Rail	Busway	Light Rail	Busway
N. Lincoln Memorial Drive to E. Kilbourn Avenue	0.8	$ 4.4	$ 2.2	$ 5.5	$ 2.8
E. Kilbourn Avenue to E. Hampton Avenue	5.2	79.2	62.4	15.2	12.0
E. Hampton Avenue to Santa Monica Boulevard	4.5	97.4	93.1	21.6	20.7
Santa Monica Boulevard to Mequon Road (STH 167)	6.4	62.4	33.1	9.8	5.2
Total N. Lincoln Memorial Drive to Mequon Road (STH 167)	16.9	$243.4	$190.8	$14.4	$11.3

Source: SEWRPC.

Table 29

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENT 4LB IN THE NORTHEAST CORRIDOR

Segment	Alternative Alignment 4LB			
	Distance (miles)	Average Speed (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway)	
			Station-to-Station	Cumulative
N. Lincoln Memorial Drive to E. Kenwood Boulevard	3.3	19/17	10/12	- -
E. Kenwood Boulevard to W. Silver Spring Drive	4.2	23/21	11/12	21/24
W. Silver Spring Drive to Mequon Road (STH 167)	9.4	32/30	18/19	39/43

Source: SEWRPC.

average of 34 minutes at an average speed of 26 mph for light rail and 38 minutes at an average speed of 23 mph for a busway. This alternative would serve about 6 percent fewer residents within walking distance—71,600; and 8 percent fewer jobs within walking distance—65,700. Location of a dual light rail/busway guideway on a surface alignment on Santa Monica Boulevard would cause some disruption. It would require the widening of Santa Monica Boulevard for a distance of about 0.3 mile between E. Daphne Road and E. School Street in the Village of Fox Point in order to provide enough pavement width to accommodate both primary transit and automobile traffic. Additionally, location of at-grade primary transit between E. School Street and E. Hampton Road in a reserved lane for about 2.0 miles would require the use of existing arterial street lanes, leaving only one lane of travel in each direction over this segment.

Table 30 summarizes the results of the preliminary assessment of the capital cost, disruption, travel time, and accessibility to both jobs and population for Alternative 4LB. The best configuration of Alternative 4LB is the N. Santa Monica Boulevard connection between the C&NW Shoreline Subdivision and the Capitol Drive spur track rights-of-way. Otherwise, the cost of 4LB is significantly more than that of Alternatives 2LB and 3LB with no appreciable gain in travel time or accessibility to jobs or population. Moreover, Alternative 4LB requires that 0.3 mile of N. 3rd Street and 2.0 miles of N. Santa Monica Boulevard be reduced to one lane of moving traffic in each direction. Because of this, and the otherwise approximately equal capital costs, disruption, travel times, and accessibility, Alternative Alignment 3LB remains the preferred light rail/busway alignment in the northeast corridor.

Fixed Guideway Alignments
in the North Corridor

Available rights-of-way determined to have good potential for the location of primary transit guideways in the north corridor radiating from the central business district of the Milwaukee area are identified on Map 25. Also shown on Map 25 is the generalized existing land use pattern in the corridor and the location of major activity centers. Three alternative heavy rail rapid transit alignments and three light rail transit/busway alignments, one of which is a Class A alignment and two of which are Class B alignments, were identified in the corridor, as shown on Maps 26 and 27.

Heavy Rail Rapid Transit Alignments: All three alternative heavy rail alignments extend from the Milwaukee central business district to the City of Glendale in northern Milwaukee County. The alignments are located primarily along freeway rights-of-way, abandoned electric interurban railway rights-of-way, and public street rights-of-way. One alignment, Alternative 1H, 7.4 miles in length, would begin in downtown Milwaukee at N. Lincoln Memorial Drive and extend 1.3 miles in a subway beneath E. and W. Wisconsin Avenue to N. 11th Street. It would remain in a subway beneath N. 11th Street from W. Wisconsin Avenue to W. State Street, a distance of 0.4 mile, leave N. 11th Street for N. 12th Street at W. State Street, and remain beneath N. 12th Street to Reservoir Avenue in the City of Milwaukee, a distance of 0.8 mile. At Reservoir Avenue, the line would be located on a surface alignment for 0.2 mile. The remaining 4.7 miles of the alignment would be on elevated structure along the nonroadway portion of the North-South Freeway (IH 43) right-of-way between W. North Avenue and a point about 0.2 mile north of W. Silver Spring Drive.

Alternative 2H follows the same basic alignment as does Alternative 1H between N. Lincoln Memorial Drive and W. Capitol Drive. At W. Capitol Drive the alignment would leave the nonroadway portion of the North-South Freeway (IH 43), remaining on elevated structure along N. Green Bay Road for a distance of 2.1 miles. The total length of Alignment 2H is 7.2 miles.

Alternative 3H, 7.1 miles in length, would follow the same alignment followed by Alternatives 1H and 2H for 2.1 miles between E. Garfield Avenue and W. Capitol Drive, being located on elevated structure along the nonroadway portion of the North-South Freeway (IH 43). The alignment south of E. Garfield Avenue would, however, be located on a surface alignment adjacent to N. Halyard Avenue from E. Garfield Avenue to W. Brown Street, a distance of 0.2 mile, and then in a subway beneath N. 6th Street from W. Brown Street to W. Wisconsin Avenue, a distance of 1.3 miles. The line would then be located along W. and E. Wisconsin Avenue in a subway for 0.8 mile and terminate at N. Lincoln Memorial Drive. The northern remainder of the alignment would leave the North-South Freeway at W. Capitol Drive and be located on an elevated structure along W. Capitol Drive for 0.6 mile to N. 19th Place. The alignment would then turn north, remaining on elevated structure for 0.1 mile on new right-of-way between N. 19th Place and N. 20th Street to the beginning of the former Milwaukee Electric Lines-Northern Division electric interurban railway right-of-way at W. Fiebrantz Avenue. The remainder of Alternative 3H, 2.0 miles, would be located within the former electric interurban railway right-of-way to W. Silver Spring Drive in the City of Glendale. An elevated structure would be required along the right-of-way from W. Fiebrantz Avenue to W. Villard Avenue because of 10 public street and railroad crossings in this 1.4-mile stretch of right-of-way. The remaining 0.6 mile of this alternative alignment—between W. Villard Avenue and W. Silver Spring Drive—would be located on the former interurban right-of-way.

Table 30

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE NORTHEAST CORRIDOR

Evaluation Criteria	Alternative Alignment: Alignment 1LB Light Rail/Busway	Alignment 2LB Light Rail/Busway	Alignment 3LB Light Rail/Busway	Alignment 4LB Light Rail/Busway[a]	Light Rail/Busway Spur Alignment Light Rail/Busway
Capital Cost (guideway construction cost in millions of dollars)	$350.3/$276.3 ($253.7/$211.0 from City of Mequon to N. Lincoln Memorial Drive)	$222.0/$143.1 ($174.0/$130.0 from City of Mequon to N. Lincoln Memorial Drive)	$202.1/$118.9 ($155.1/$106.3 from City of Mequon to N. Lincoln Memorial Drive)	$243.4/$190.8 ($158.2/$105.1 Santa Monica Boulevard option)	$8.8/$6.2
Community Disruption					
Type of Land Use (miles)					
Railroad and Former Interurban Right-of-Way	21.3	22.2	20.9	15.1	0.1
Cleared Freeway Right-of-Way	--	--	0.4	--	--
Public Street Right-of-Way	1.3	1.3	2.6	1.8	1.4
Total	22.6	23.5	23.9	16.9	1.5
Structure Dislocation (number)					
Residential Buildings	--	--	--	--	--
Commercial or Industrial Buildings	--	--	--	--	--
Public Buildings	--	--	--	--	--
Other Disruption	Dislocation of wooden electric power transmission line poles along the former interurban right-of-way north of W. Brown Deer Road			N. 3rd Street to be reduced to one lane of traffic in each direction from W. McKinley Avenue to W. Wisconsin Avenue for 0.4 mile. Under Santa Monica Boulevard option, N. Santa Monica Boulevard to be widened for 0.3 mile from E. Daphne Road to E. School Street, and to be reduced to one lane of traffic in each direction for 2.0 miles between E. School Street and E. Hampton Road	--
Travel Time (line-haul travel time in minutes to the Milwaukee CBD)	50/56 (30/34 from City of Mequon to N. Lincoln Memorial Drive)	53/58 (31/36 from City of Mequon to N. Lincoln Memorial Drive)	56/61 (38/42 from City of Mequon to N. Lincoln Memorial Drive)	39/43 (34/38 Santa Monica Boulevard option)	13/17
Population Served					
One-Half-Mile Walking Distance					
Village of Grafton to N. Lincoln Memorial Drive	90,100	92,800	98,700	76,600/ 71,600 (Santa Monica Option)	.12,000
City of Mequon to N. Lincoln Memorial Drive	70,500	73,200	79,800	--	--
Three-Mile Driving Distance					
Village of Grafton to N. Lincoln Memorial Drive	448,700	484,000	482,500	441,200/405,300	50,000
City of Mequon to N. Lincoln Memorial Drive	407,700	443,000	445,500	--	--
Jobs Served					
One-Half-Mile Walking Distance					
Village of Grafton to N. Lincoln Memorial Drive	86,500	88,300	90,500	71,600/ 65,700	6,000
City of Mequon to N. Lincoln Memorial Drive	58,500	60,300	70,500	--	--

[a] *The time required to traverse the spur alignment only.*

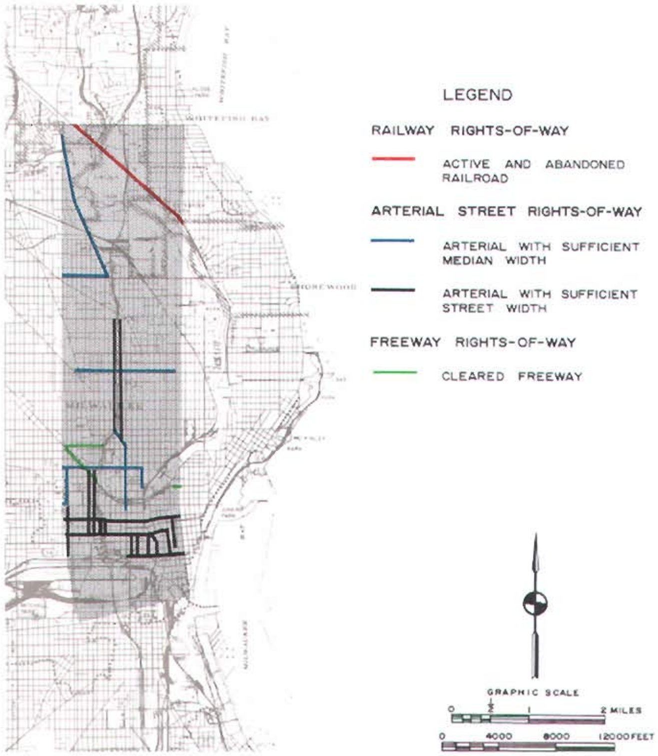
Source: SEWRPC.

Heavy Rail Rapid Transit Alignment Evaluation: As shown in Table 31, the capital cost of dual guideway construction for heavy rail rapid transit along Alternative Alignment 1H is estimated at $300.7 million in 1979 dollars, or an average cost of $40.6 million per mile. The cost of constructing a dual guideway along alignment 2H is estimated at $297.0 million, or an average cost of $41.2 million per mile. Because about one mile of Alternative 3H can be located on a surface alignment, the unit cost of guideway construction for this alternative was estimated to average $36.3 million per mile, for a total cost of $257.6 million.

As shown in Table 32, the largest capital expenditure would be required to locate a dual heavy rail guideway in the Milwaukee central business district area. The cost required to locate an alignment in a subway between N. Lincoln Memorial Drive and W. Brown Street was estimated to range from

Map 25

EXISTING AVAILABLE RIGHTS-OF-WAY IN THE NORTH CORRIDOR WITH GOOD POTENTIAL FOR FIXED GUIDEWAY PRIMARY TRANSIT DEVELOPMENT



The north corridor is located between the City of Milwaukee central business district and the Village of Glendale. This corridor contains a number of arterial street segments with good potential for fixed guideway development in the immediate vicinity of the Milwaukee central business district. In the area between the central business district and W. Capitol Drive, however, there is a marked lack of available rights-of-way as well as a lack of arterial street segments with good potential for the provision of primary transit fixed guideways.

Source: SEWRPC.

$127.8 million for Alternative 3H to $154.6 million for Alternatives 1H and 2H. Although the subway section represents about one-third of the total alignment lengths for each of the three alternatives, the capital cost required to construct it is nearly one-half of the cost required to construct the entire alignment.

Alternative 1H would utilize a strip of land 7.4 miles in length, including 4.7 miles of freeway right-of-way, 2.5 miles of subway beneath public street right-of-way in the City of Milwaukee, 0.1 mile of cleared freeway right-of-way, and 0.1 mile of newly acquired right-of-way. The new right-of-way is required where the alignment would leave N. 12th Street at Reservoir Avenue for the North-South Freeway (IH 43). The disruption entailed would consist of the displacement of six dwelling units in order to provide adequate alignment for a high-speed rapid transit alignment.

Alternative 2H would utilize a strip of land 7.2 miles in length, including 2.4 miles of freeway right-of-way, 0.1 mile of cleared freeway right-of-way, 0.1 mile of newly acquired right-of-way, and 4.6 miles of public street right-of-way, of which 2.5 miles would be in a subway and 2.1 miles would be on elevated structure. Alternative 2H would use the same right-of-way used by Alternative 1H, and thus the disruption of six dwelling units would be entailed.

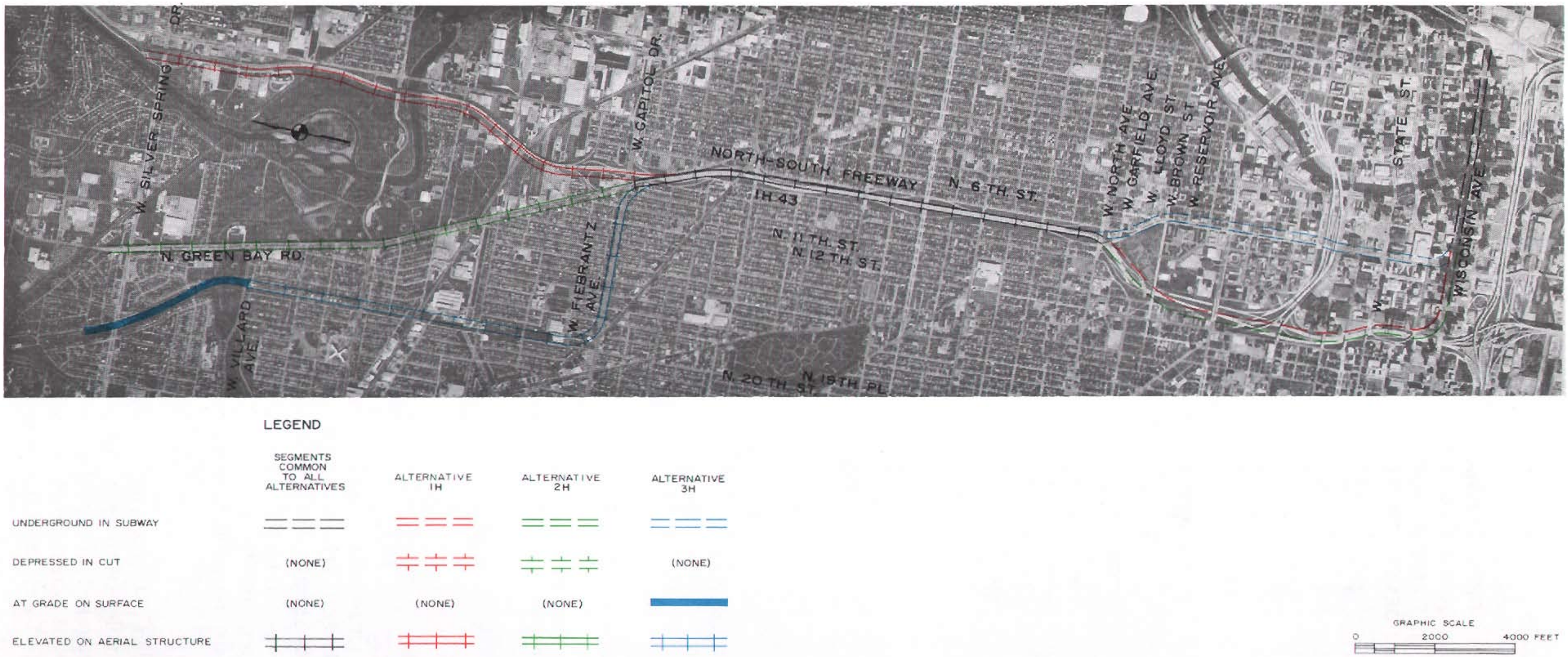
Alternative 3H would utilize a strip of land 7.1 miles in length, including 2.1 miles of freeway right-of-way, 2.0 miles of former electric interurban railway right-of-way now owned by the Wisconsin Electric Power Company, 2.7 miles of public street right-of-way in the City of Milwaukee, of which 2.1 miles would be in a subway and 0.6 mile would be on an elevated structure, and 0.1 mile of newly acquired right-of-way. It would also use 0.2 mile of vacant land between W. Brown Street and W. Garfield Avenue in the City of Milwaukee. The new right-of-way would have to be acquired for the elevated portion of the alignment between W. Capitol Drive and W. Fiebrantz Avenue adjacent to N. 19th Place. The displacement of approximately eight dwelling units and a church and library would be entailed. In addition, this alternative alignment would require the relocation of wooden transmission line poles along the former electric interurban railway right-of-way proposed to be used between W. Fiebrantz Avenue and W. Silver Spring Drive.

The estimated line-haul travel times between selected terminal locations of these heavy rail rapid transit alignments are summarized in Table 33. The three alignment alternatives would provide similar overall travel times between northern Milwaukee County and the Milwaukee central business district. The estimated line-haul travel time from downtown Milwaukee to W. Silver Spring Drive in northern Milwaukee County varies by only one minute, from 12 minutes for both Alternative 2H and Alternative 3H to 13 minutes for Alternative 1H.

The alignments are similar in terms of both accessibility to residents and jobs and service to major activity centers except that Alternative 1H pro-

Map 26

HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE NORTH CORRIDOR



Three alternative fixed guideway alignments suitable for the provision of heavy rail rapid transit service were identified within the north corridor. All three alternatives provide for a fully grade-separated, exclusive guideway which would require a subway for those alignment segments located under the near north side and central business district of Milwaukee. North of W. Lloyd Street all three alternative alignments are located principally on aerial structures either over the nonroadway portion of existing freeway rights-of-way or over arterial street rights-of-way. Following an evaluation and comparison of the three alignments, Alternative 3H was selected as the preferred alignment.

Source: SEWRPC.

Map 27

LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE NORTH CORRIDOR

LEGEND

	SEGMENTS COMMON TO ALL ALTERNATIVES	ALTERNATIVE 1LB	ALTERNATIVE 2LB	ALTERNATIVE 3LB
AT GRADE ON SURFACE				
ELEVATED ON AERIAL STRUCTURE	(NONE)		(NONE)	
SINGLE GUIDEWAY ON SURFACE	(NONE)	(NONE)		

GRAPHIC SCALE
0 2000 4000 FEET

Three alternative fixed guideway alignments suitable for the provision of light rail transit and busway service were identified within the north corridor. The three alternatives utilize a surface alignment along N. 6th Street to gain access to the transit mall along Wisconsin Avenue in downtown Milwaukee. North of W. Lloyd Street, Alternative 1LB provides for a fully grade-separated, exclusive guideway which would require an aerial structure over most of the remainder of its length. Alternatives 2LB and 3LB, however, are located almost entirely on the surface. To avoid the traffic congestion and complicated geometrics of the intersection at W. Capitol Drive and N. Green Bay Road, Alternative 2LB, the preferred alignment, would utilize W. Atkinson Avenue to bypass the area, while Alternative 3LB would utilize an aerial structure to pass over the area.

Source: SEWRPC.

Table 31

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE NORTH CORRIDOR

Cost Element	Unit Cost	Alternative Alignment					
		Alignment 1H		Alignment 2H		Alignment 3H	
		Quantity	Total Cost	Quantity	Total Cost	Quantity	Total Cost
Surface Construction							
At-Grade Construction	$ 3.2	- -	$ - -	- -	$ - -	0.6 mile	$ 1.9
Fill Construction	$16.4	- -	- -	- -	- -	0.1 mile	1.6
Cut Construction	$22.4-$22.7	0.2 mile	4.5	0.2 mile	4.5	0.1 mile	2.2
Total	- -	0.2 mile	$ 4.5	0.2 mile	$ 4.5	0.8 mile	$ 5.7
Grade-Separated Construction							
Aerial Construction	$20.5-$21.8	4.7 miles	$100.8	4.5 miles	$ 98.2	4.2 miles	$ 86.0
Subway Construction	$39.9-$40.7	2.5 miles	101.2	2.5 miles	101.2	2.1 miles	85.4
Total	- -	7.2 miles	$202.0	7.0 miles	$199.4	6.3 miles	$171.4
Crossings							
Street and Highway							
At-Grade	$ - -	- -	$ - -	- -	$ - -	- -	$ - -
Overpasses	$ - -	- -	- -	- -	- -	- -	- -
Underpasses	$ 0.3	3	0.9	3	0.9	1	0.3
Railroad	$ - -	- -	- -	- -	- -	- -	- -
Watercourse	$ 0.3	- -	- -	- -	- -	1	0.3
Subtotal	- -	- -	$207.4	- -	$204.8	- -	$177.7
Engineering, Design, and Administration	15 percent	- -	$ 31.1	- -	$ 30.7	- -	$ 26.6
Contingencies	30 percent	- -	$ 62.2	- -	$ 61.5	- -	$ 53.3
Total Cost	- -	- -	$300.7	- -	$297.0	- -	$257.6

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

Table 32

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE NORTH CORRIDOR

Segment	Alternative Alignment								
	Alignment 1H			Alignment 2H			Alignment 3H		
	Distance (miles)	Total Guideway Construction Cost (millions of dollars)	Average Unit Cost (millions of dollars per mile)	Distance (miles)	Total Guideway Construction Cost (millions of dollars)	Average Unit Cost (millions of dollars per mile)	Distance (miles)	Total Guideway Construction Cost (millions of dollars)	Average Unit Cost (millions of dollars per mile)
N. Lincoln Memorial Drive to E. Garfield Street	2.7	$154.6	$57.2	2.7	$154.6	$57.2	2.4	$127.8	$55.6
E. Garfield Street to W. Capitol Drive	2.4	74.6	31.1	2.4	75.9	31.7	2.0	62.4	29.7
W. Capitol Drive to W. Silver Spring Drive	2.3	71.5	31.1	2.1	66.5	31.7	2.7	67.4	24.9
Total N. Lincoln Memorial Drive to W. Silver Spring Drive	7.4	$300.7	$40.6	7.2	$297.0	$41.2	7.1	$257.6	$36.3

Source: SEWRPC.

Table 33

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE NORTH CORRIDOR

Segment	Alternative Alignment											
	Alignment 1H				Alignment 2H				Alignment 3H			
	Distance (miles)	Average Speed (miles per hour)	Travel Time (minutes) Station-to-Station	Travel Time (minutes) Cumulative	Distance (miles)	Average Speed (miles per hour)	Travel Time (minutes) Station-to-Station	Travel Time (minutes) Cumulative	Distance (miles)	Average Speed (miles per hour)	Travel Time (minutes) Station-to-Station	Travel Time (minutes) Cumulative
N. Lincoln Memorial Drive to W. Highland Boulevard	1.7	26	4	- -	1.7	26	4	- -	1.3	26	3	- -
W. Highland Boulevard to W. Capitol Drive	3.4	38	5	9	3.4	38	5	9	3.1	38	5	8
W. Capitol Drive to W. Silver Spring Drive	2.3	38	4	13	2.1	38	3	12	2.7	38	4	12

Source: SEWRPC.

Table 34

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE NORTH CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Household Population Served			Number of Jobs Served (one-half-mile walking distance)
	One-Half-Mile Walking Distance	15-Minute Feeder Bus Travel Time	Three-Mile Driving Distance	
1H	56,000	264,400	355,900	55,600
2H	56,500	282,800	391,300	57,000
3H	63,100	297,300	388,500	61,800

Source: SEWRPC.

vides direct service to the Bayshore Shopping Center, as shown in Table 34. Alternative 2H would serve a total of 391,300 residents within a six-mile band of the alignments, compared with 388,500 residents for Alternative 3H and 355,900 residents for Alternative 1H. Alternative 3H would serve the greatest number of residents within walking distance of the line, 63,100 people, compared with 56,000 people served under Alternative 1H and 56,500 people served under Alternative 2H. Alternative 3H would also serve the greatest number of jobs within walking distance—61,800, compared with 55,600 for Alternative 1H and 57,000 for Alternative 2H.

Recommended Heavy Rail Rapid Transit Alignment: Table 35 summarizes the results of the preliminary assessment of the cost, disruption, travel time, and market potential for each of the three heavy rail rapid transit alternative alignments in the north corridor. Alternative 3H is the preferred heavy rail rapid transit alignment in the north corridor because it is less costly than Alternatives 1H and 2H and would provide somewhat greater access to residents and jobs while offering about the same travel times. It would, however, require more disruption than would either Alternative 1H or 2H—specifically, four additional residential and public buildings—and the relocation of wooden electric power line poles along 2.0 miles of abandoned electric interurban railway right-of-way.

Light Rail Guideway/Busway Alignments: Three alternative light rail guideway/busway alignments were selected for analysis in the north corridor. All of the alignments would originate in the Milwaukee central business district and terminate in the City of Glendale in northern Milwaukee County. The alignments would utilize a combination of freeway right-of-way and arterial street right-of-way. One alignment, Alternative 1LB, 7.2 miles in length, would be very similar to heavy rail rapid transit Alternative Alignment 3H. It would be located on elevated structure for much of its length except

Table 35

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE NORTH CORRIDOR

Evaluation Criteria	Alternative Alignment		
	Alignment 1H	Alignment 2H	Alignment 3H
Capital Cost (guideway construction cost in millions of dollars)	$300.7	$297.0	$257.6
Community Disruption (miles)			
Type of Land Used			
Railroad and Former Interurban Right-of-Way	--	--	2.0
Existing Freeway Right-of-Way	4.7	2.4	2.1
Cleared Freeway Right-of-Way	0.1	0.1	--
Public Street Right-of-Way	2.5	4.6	2.7
Vacant Land	--	0.1	0.2
Newly Acquired Right-of-Way	0.1	--	0.1
Total	7.4	7.2	7.1
Structure Dislocation (number)			
Residential Buildings	6	6	8
Commercial or Industrial Buildings	--	--	--
Public Buildings	--	--	2
Other Disruption	None	None	Relocation of wooden electric power transmission poles along 2.0 miles of former interurban right-of-way
Travel Time (line-haul travel time in minutes to the Milwaukee CBD)	13	12	12
Population Served			
One-Half-Mile Walking Distance	56,000	56,500	63,100
Three-Mile Driving Distance	355,900	391,300	388,500
Jobs Served			
One-Half-Mile Walking Distance	55,600	57,000	61,800

Source: SEWRPC.

along W. and E. Wisconsin Avenue between N. 6th Street and N. Lincoln Memorial Drive, where it would be located on a surface alignment in a transit mall for about 0.9 mile, and along N. 6th Street between W. Wisconsin Avenue and W. Garfield Avenue, where it would be located on a public street right-of-way for 1.5 miles.

Alternative 2LB would follow the same alignment followed by Alternative 1LB for 2.4 miles between N. Lincoln Memorial Drive and N. 6th Street and W. Garfield Avenue. North of W. Garfield Avenue Alternative 2LB would continue to follow the general alignment of 1LB to W. Atkinson Avenue, but would operate adjacent to the North-South Freeway (IH 43) on the surface over N. 7th and N. 8th Streets in one-way guideways. Alternative 2LB would then be located on a surface alignment for 0.9 mile to W. Capitol Drive over W. Atkinson Avenue. At W. Capitol Drive the alignment would be located adjacent to N. 20th Street on newly acquired right-of-way for 0.1 mile to the former electric interurban railway right-of-way at W. Fiebrantz Avenue, and then on that right-of-way for 2.0 miles to W. Silver Spring Drive. It would be grade-separated only at railroad crossings. The total length of Alternative 2LB is 6.9 miles.

Alternative 3LB, 6.6 miles in length, would follow the same alignment followed by Alternative 2LB south of W. Keefe Avenue. North of W. Keefe Avenue the alignment would be located on an

Table 36

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR LIGHT RAIL TRANSIT/BUSWAY FACILITIES IN THE NORTH CORRIDOR

Cost Element	Unit Cost		Alternative Alignment								
			Alignment 1LB			Alignment 2LB			Alignment 3LB		
				Total Cost			Total Cost			Total Cost	
	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway
Surface Construction											
At-Grade Construction	$3.9-$4.6	$1.9-$3.8	2.9 miles	$ 11.4	$ 5.4	6.9 miles	$31.0	$15.9	5.8 miles	$26.6	$12.8
Fill Construction	$16.0	$14.0	0.1 mile	1.6	1.4	- -	- -	- -	- -	- -	- -
Cut Construction	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Total	- -	- -	3.0 miles	$ 13.0	$ 6.8	6.9 miles	$31.0	$15.9	5.8 miles	$26.6	$12.8
Grade-Separated Construction											
Aerial Construction	$19.9-$23.0	$17.5-$20.4	4.1 miles	$ 81.7	$ 71.6	- -	$ - -	$ - -	0.8 mile	$18.4	$16.3
Subway Construction	$ - -	$ - -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Total	- -	- -	4.1 miles	$ 81.7	$ 71.6	- -	$ - -	$ - -	0.8 mile	$45.0	$16.3
Crossings											
Street and Highway											
At-Grade	$ - -	$ - -	- -	$ - -	$ - -	- -	$ - -	$ - -	- -	$ - -	$ - -
Overpasses	$ - -	$ - -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Underpasses.	$ - -	$ - -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Railroad.	$ 0.3	$ 0.3	1	0.3	0.3	1	0.3	0.3	1	0.3	0.3
Watercourse.	$ 0.3	$ 0.3	1	0.3	0.3	1	0.3	0.3	1	0.3	0.3
Subtotal	- -	- -	- -	$ 95.3	$ 79.0	- -	$31.3	$16.5	- -	$45.6	$29.7
Engineering, Design, and Administration	- -	- -	- -	$ 14.3	$ 11.9	- -	$ 4.7	$ 2.5	- -	$ 6.8	$ 4.4
Contingencies	- -	- -	- -	$ 28.6	$ 23.8	- -	$ 9.4	$ 4.9	- -	$13.7	$ 8.9
Total Cost	- -	- -	- -	$138.2	$114.7	- -	$45.4	$23.9	- -	$66.1	$43.0

NOTE: All costs are estimated in millions of 1979 dollars.
Source: SEWRPC.

elevated structure along the nonroadway portion of the North-South Freeway (IH 43) for 0.2 mile to N. Green Bay Road, and then would remain on an elevated structure along N. Green Bay Road for 0.6 mile to W. Fiebrantz Avenue for a total distance of 0.8 mile. The remainder of the alignment, 1.9 miles, would be located on the surface in the median of N. Green Bay Road.

Light Rail Transit/Busway Alignment Evaluation: As indicated in Table 36, the capital cost of guideway construction for Alternative 1LB, the Class A light rail alignment, is estimated at $138.2 million for a light rail transit system, or an average cost of $19.5 million per mile of dual guideway, and $114.7 million for a busway, or about $16.2 million per mile of dual guideway. The capital costs for guideway construction for the Class B alignments are significantly lower. Specifically, the cost of constructing a dual guideway for light rail along Alignment 2LB is estimated at $45.4 million, or an average cost of $6.6 million per mile. The comparable cost of constructing a dual busway is $23.9 million, or an average cost of $3.5 million per mile. The capital cost of constructing Alternative 3LB is estimated at $10.0 million per mile for a light rail transit system, or a total cost of $66.1 million, and $6.5 million per mile for a busway, or a total cost of $43.0 million. A breakdown of guideway capital costs by segment of the alternative light rail/transit busway alignments is shown in Table 37.

Alternative 1LB would utilize a strip of land 7.1 miles in length, including 2.1 miles of freeway right-of-way, 2.0 miles of former electric interurban railway right-of-way owned by the Wisconsin Electric Power Company, about 0.2 mile of vacant land, and about 0.1 mile of newly acquired right-of-way along N. 19th Place between W. Capitol Drive and W. Fiebrantz Avenue. In addition, 2.7 miles of the alignment would utilize public street right-of-way in the City of Milwaukee. Alternative 2LB would utilize 4.8 miles of public street right-of-way in the City of Milwaukee and 2.0 miles of

Table 37

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE NORTH CORRIDOR

	Alternative Alignment														
	Alignment 1LB					Alignment 2LB					Alignment 3LB				
		Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)			Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)			Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)	
Segment	Distance (miles)	Light Rail	Busway	Light Rail	Busway	Distance (miles)	Light Rail	Busway	Light Rail	Busway	Distance (miles)	Light Rail	Busway	Light Rail	Busway
N. Lincoln Memorial Drive to E. Garfield Street	2.4	$ 14.5	$ 7.2	$ 6.0	$ 3.0	2.4	$14.5	$ 7.2	$6.0	$3.0	2.4	$14.5	$ 7.2	$ 6.0	$ 3.0
E. Garfield Street to W. Capitol Drive	2.0	57.3	50.7	28.6	25.4	2.4	18.8	9.3	7.8	3.9	2.1	26.7	21.5	12.7	10.2
W. Capitol Drive to W. Silver Spring Drive.	2.7	66.4	56.8	24.6	21.0	2.1	12.1	7.4	5.8	3.5	2.1	19.9	14.3	9.5	6.8
Total N. Lincoln Memorial Drive to W. Silver Spring Drive	7.1	$138.2	$114.7	$19.5	$16.2	6.9	$45.4	$23.9	$6.6	$3.5	6.6	$66.1	$43.0	$10.0	$ 6.5

Source: SEWRPC.

former electric interurban railway right-of-way owned by the Wisconsin Electric Power Company. Alternative 2LB would also require the acquisition of about 0.1 mile of new right-of-way along N. 19th Place from W. Capitol Drive to W. Fiebrantz Avenue. Alternative 3LB would utilize a total of 0.8 mile of freeway right-of-way and 5.8 miles of public street right-of-way in the City of Milwaukee.

Alternative 3LB would not require any land acquisition or the taking of any residential, commercial, or industrial structures. Alternatives 1LB and 2LB, however, would require some disruption. Alternative 1LB would require the displacement of approximately eight dwelling units and a church and library in order to provide adequate alignment for a high-speed Class A light rail transit/busway alignment. Alternative 2LB would require the displacement of five dwelling units. In addition, both Alternatives 1LB and 2LB would require the relocation of wooden electric power transmission line poles along 2.0 miles of former electric interurban railway right-of-way between W. Fiebrantz Avenue and W. Silver Spring Drive.

The estimated line-haul travel times for selected segments of the three light rail transit/busway alignments in the north corridor are summarized in Table 38. All three alignment alternatives would provide similar overall travel times between W. Silver Spring Drive in northern Milwaukee County and the Milwaukee central business district—specifically, between 21 and 24 minutes for the light rail mode and 23 and 27 minutes for the busway mode. The alignment with the shortest travel time would be Alternative 1LB.

The alternative alignments are comparable in terms of accessibility to residents and jobs and service to major activity centers. As shown in Table 39, Alternative 3LB would serve the greatest total number of residents within a six-mile band along the alignment, 391,300, compared with 388,500 for Alternative 1LB and 390,100 for Alternative 2LB. Alternatives 1LB and 2LB, however, would serve a greater number of residents within walking distance, 63,100 and 64,300, respectively, compared with 56,500 for Alternative 3LB. Employment served within walking distance is also greatest for Alternatives 1LB and 2LB, 61,800 and 63,000, respectively, compared with 57,000 for Alternative 3LB.

Recommended Light Rail Transit/Busway Alignment: Table 40 summarizes the results of the preliminary assessment of the capital cost, disruption, travel time, and accessibility to both jobs and population for each of the three light rail transit/busway alternative alignments in the north corridor. Alternative 2LB is the preferred alignment, although it requires the dislocation of five homes while Alternative 3LB requires no such disruption. Alternative 2LB, however, is the least costly alignment, provides travel times similar to those provided by the other alternatives, and provides the greatest accessibility by walking to jobs and population—about 10 percent more than provided by Alternative 3LB.

Fixed Guideway Alignments in the West Corridor

Available rights-of-way determined to have good potential for the location of primary transit guideways in the west corridor radiating from the central business district of the Milwaukee area are identi-

Table 38

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE NORTH CORRIDOR

Segment	Alternative Alignment											
	Alignment 1LB				Alignment 2LB				Alignment 3LB			
	Distance (miles)	Average Speed (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway)		Distance (miles)	Average Speed (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway)		Distance (miles)	Average Speed (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway)	
			Station-to-Station	Cumulative			Station-to-Station	Cumulative			Station-to-Station	Cumulative
N. Lincoln Memorial Drive to W. Highland Boulevard	1.3	11/11	7/7	- -	1.3	11/11	7/7	- -	1.3	11/11	7/7	- -
W. Highland Boulevard to W. Capitol Drive	3.1	20/18	9/10	16/17	3.5	18/15	12/14	19/21	3.2	17/15	11/13	18/20
W. Capitol Drive to W. Silver Spring Drive	2.7	31/27	5/6	21/23	2.1	23/19	5/6	24/27	2.1	22/19	6/7	24/27

Source: SEWRPC.

Table 39

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE NORTH CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Household Population Served			Number of Jobs Served (one-half-mile walking distance)
	One-Half-Mile Walking Distance	15-Minute Feeder Bus Travel Time	Three-Mile Driving Distance	
1LB	63,100	297,300	388,500	61,800
2LB	64,300	298,700	390,100	63,000
3LB	56,500	282,800	391,300	57,000

Source: SEWRPC.

fied on Map 28. Also shown on Map 28 are the generalized existing land use pattern in the corridor and the location of major activity centers. Two alternative heavy rail rapid transit alignments and two light rail transit/busway alignments, one a Class A alignment and the other a Class B alignment, were identified in the corridor, as shown on Maps 29 and 30. The alternative alignments were designed with the aid of the preliminary engineering analyses prepared for a high-speed busway in this corridor under the Milwaukee Area Transit Plan, prepared by the Milwaukee County Expressway and Transportation Commission in cooperation with the Commission in 1972. All of the alternative alignments utilize parts of the busway alignments developed under that study.

Heavy Rail Rapid Transit Alignments: Both alternative heavy rail alignments extend from the Milwaukee central business district to the City of Waukesha central business district. The alignments are located principally along active railway and former electric interurban railway rights-of-way west of N. 24th Street. East of N. 24th Street, the alignments are located along public street rights-of-way in the City of Milwaukee. One alignment, Alternative 1H, 18.5 miles in length, would begin in downtown Milwaukee at N. Lincoln Memorial Drive and extend 1.4 miles in a subway beneath E. and W. Wisconsin Avenue to N. 11th Street. Upon leaving the subway at N. 11th Street, the line would be located on an elevated structure over 0.1 mile of newly acquired right-of-way between N. 11th and N. 12th Streets. It would remain on an elevated structure for about 1.0 mile over W. Clybourn Street between N. 12th Street and N. 24th Street. At N. 24th Street, the alignment would cross the East-West Freeway, where it would be located on an elevated structure over the Milwaukee Road's First Subdivision main line for about 0.4 mile. The alignment would then enter the former electric interurban railway right-of-way at N. 30th Street on a surface alignment for about 0.5 mile to N. 38th Street.

Table 40

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE NORTH CORRIDOR

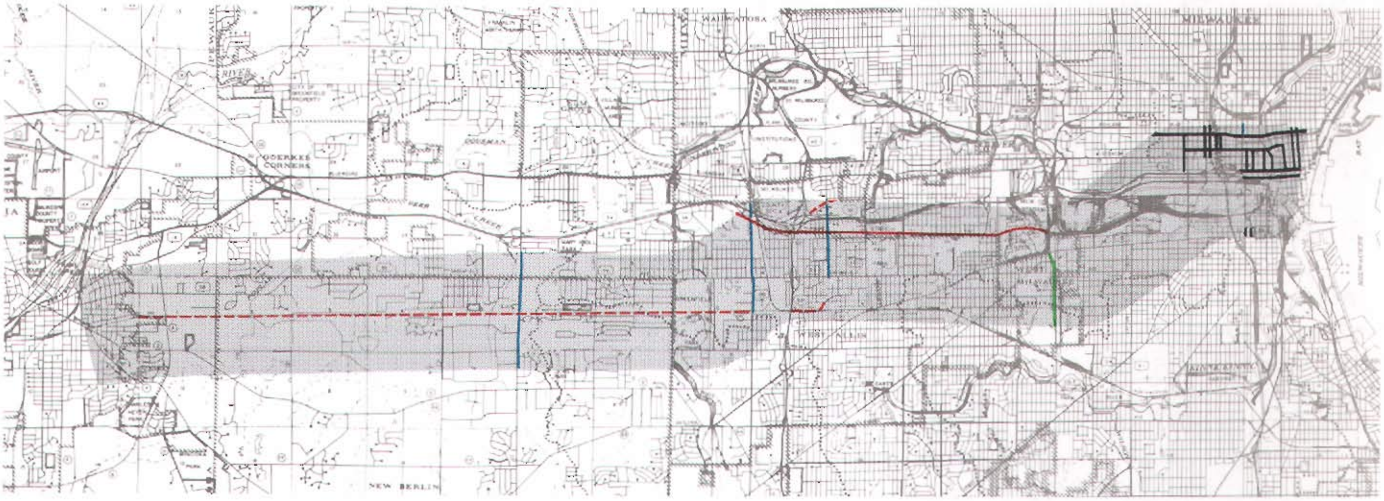
Evaluation Criteria	Alternative Alignment		
	Alignment 1LB Light Rail/Busway	Alignment 2LB Light Rail/Busway	Alignment 3LB Light Rail/Busway
Capital Cost (guideway construction cost in millions of dollars)	$138.2/$114.7	$45.4/$23.9	$66.1/$43.0
Community Disruption			
Type of Land Used (miles)			
Railroad and Former Interurban Right-of-Way	2.0	2.0	- -
Existing Freeway Right-of-Way	2.1	- -	0.8
Cleared Freeway Right-of-Way	0.0	- -	- -
Public Street Right-of-Way	2.7	4.8	5.8
Vacant Land	0.2	- -	- -
Newly Acquired Right-of-Way	0.1	0.1	- -
Total	7.1	6.9	6.6
Structure Dislocation (number)			
Residential Buildings	8	5	- -
Commercial or Industrial Buildings	- -	- -	- -
Public Buildings	2	- -	- -
Other Disruption	Relocation of wooden electric power transmission line poles along 2.0 miles of former interurban right-of-way		None
Travel Time (line-haul travel time in minutes to the Milwaukee CBD)	21/23	24/27	24/27
Population Served			
One-Half-Mile Walking Distance	63,100	64,300	56,500
Three-Mile Driving Distance	388,500	390,100	391,300
Jobs Served			
One-Half-Mile Walking Distance	61,800	63,000	57,000

Source: SEWRPC.

Upon leaving the former electric interurban railway right-of-way at N. 38th Street, the alignment would cross the Milwaukee Road railroad yards and a parking lot for Milwaukee County Stadium on an elevated structure for 0.8 mile to the Stadium Freeway (USH 41) and Chicago, Milwaukee, St. Paul & Pacific's (the Milwaukee Road's) Elm Grove Line. At the Stadium Freeway (USH 41) the alignment would enter the right-of-way of the Elm Grove Line, remaining along that right-of-way to S. 97th Street in the City of Milwaukee. The alignment along the Elm Grove Line would be elevated between the Stadium Freeway (USH 41) and S. 77th Street for about 1.5 miles, and on the surface between S. 77th Street and S. 97th Street for about 1.2 miles. The alignment would remain on the surface along the former electric interurban railway right-of-way between S. 97th Street and W. Washington Street, a distance of about 0.4 mile. The alignment would continue to be located within the right-of-way of the former electric interuban railway for about 0.8 mile on an elevated structure between W. Washington Street and W. Mitchell Street in the City of West Allis. At W. Mitchell Street it would continue along the right-of-way of the former Milwaukee Electric Lines-Watertown Division, remaining along that right-of-way to Lincoln Avenue in the City of Waukesha on a surface

Map 28

EXISTING AVAILABLE RIGHTS-OF-WAY IN THE WEST CORRIDOR WITH GOOD POTENTIAL FOR FIXED GUIDEWAY PRIMARY TRANSIT DEVELOPMENT



LEGEND

RAILWAY RIGHTS-OF-WAY

ACTIVE AND ABANDONED RAILROAD

FORMER INTERURBAN

ARTERIAL STREET RIGHTS-OF-WAY

ARTERIAL WITH SUFFICIENT MEDIAN WIDTH

ARTERIAL WITH SUFFICIENT STREET WIDTH

FREEWAY RIGHTS-OF-WAY

CLEARED FREEWAY

GRAPHIC SCALE

0 2 MILES

0 4000 8000 12000 FEET

The west corridor extends from the City of Milwaukee central business district in a southwesterly direction to the Village of West Milwaukee and then in a westerly direction to the City of Waukesha. This corridor contains a number of arterial street segments with good potential for fixed guideway development concentrated in and around the Milwaukee central business district. West of the central business district, the prominent existing rights-of-way are located along both active and abandoned railway rights-of-way, including the abandoned electric interurban railway right-of-way between Milwaukee and Waukesha.

Source: SEWRPC.

alignment for about 9.0 miles. The remaining 1.0 mile would be located on an aerial structure over Lincoln Avenue and E. Broadway, terminating at W. Main Street in downtown Waukesha.

Alternative 2H, 18.4 miles in length, would follow the same alignments followed by Alternative 1H between N. Lincoln Memorial Drive and N. 38th Street, and between S. 97th Street and W. Mitchell Street in the City of West Allis and the Waukesha central business district. Between S. 38th and S. 97th Streets, a distance of 3.5 miles, the alignment would be located largely on the right-of-way of the former Milwaukee Electric Lines-Local Rapid Transit Line interurban right-of-way. The alignment would be on elevated structure except between N. 61st Street and N. 68th Street and between S. 97th Street and the Elm Grove Line and W. Washington Street, where it would be located on the surface for about 0.8 mile. The alignment in this segment would leave the former electric interurban railway right-of-way only for a distance of about 0.2 mile in order to bypass an electric power substation; for about 0.1 mile between N. 68th and N. 69th Streets, the alignment would be elevated over W. O'Connor Street, and for about 0.1 mile between N. 69th and N. 70th Streets, it would be located on new right-of-way which would have to be acquired.

Heavy Rail Rapid Transit Alignment Evaluation: As shown in Table 41, the capital cost of guideway construction is estimated to be $327.4 million for Alternative 1H and $329.6 million for Alternative 2H. A breakdown of guideway capital costs by segment of the alternative heavy rail rapid transit alignments is shown in Table 42.

Alternative 1H would utilize a strip of land 18.5 miles in length, including 3.5 miles of active railway right-of-way; 10.7 miles of former electric interurban railway right-of-way owned by the Wisconsin Electric Power Company; and 3.8 miles of public street right-of-way in the Cities of Milwaukee and Waukesha, along which the facility would be in a subway for about 1.4 miles, and on an elevated structure for the remaining 2.4 miles. It would also cross the parking lot of the Milwaukee County Stadium for about 0.4 mile, and use about 0.1 mile of newly acquired right-of-way. The new right-of-way would be located over open lands presently owned by Marquette University; the alignment would leave the subway at N. 11th Street for the elevated structure along W. Clybourn Street.

Alternative 2H would utilize a strip of land 18.4 miles in length, including about 3.9 miles of public street right-of-way in the Cities of Milwaukee and Waukesha; and a total of 14.3 miles of railway rights-of-way, including 0.4 mile of active railway right-of-way and 13.9 miles of former electric interuban railway right-of-way owned by the Wisconsin Electric Power Company. It would also use about 0.2 mile of newly acquired right-of-way, 0.1 mile of which would consist of open lands presently owned by Marquette University and 0.1 mile of which would consist of vacant land between N. 69th and N. 70th Streets, where the alignment would leave W. O'Connor Street to enter the former electric interurban railway right-of-way. Both alternative alignments would require the relocation of some steel lattice electric transmission towers along the former electric interurban railway right-of-way between N. 97th Street and W. Mitchell Street. Neither of the two alternative alignments would require the taking of any residential, commercial, or industrial structures.

Line-haul travel times for selected segments of the two heavy rail rapid transit alignments in the west corridor are summarized in Table 43. Both alignment alternatives would provide similar overall travel times between the eastern limits of the City of Waukesha and the Milwaukee central business district—27 minutes for Alternative 1H compared with 28 minutes for Alternative 2H.

The two alternative alignments are comparable in terms of accessibility to residents and jobs and service to major activity centers. As shown in Table 44, Alternative 1H would serve fewer residents, 512,200, compared with 529,600 for Alternative 2H, within a six-mile band around the alignment. Both alignments would serve about the same number of residents within walking distance, 71,700 for Alternative 1H compared with 71,500 for Alternative 2H. However, Alternative 1H would serve the greatest number of jobs within walking distance, 90,800, compared with 82,700 for Alternative 2H.

Recommended Heavy Rail Rapid Transit Alignment: Table 45 summarizes the results of the preliminary assessment of the capital cost, community disruption, travel time, and accessibility to both jobs and population for each of the two heavy rail rapid transit alternative alignments.

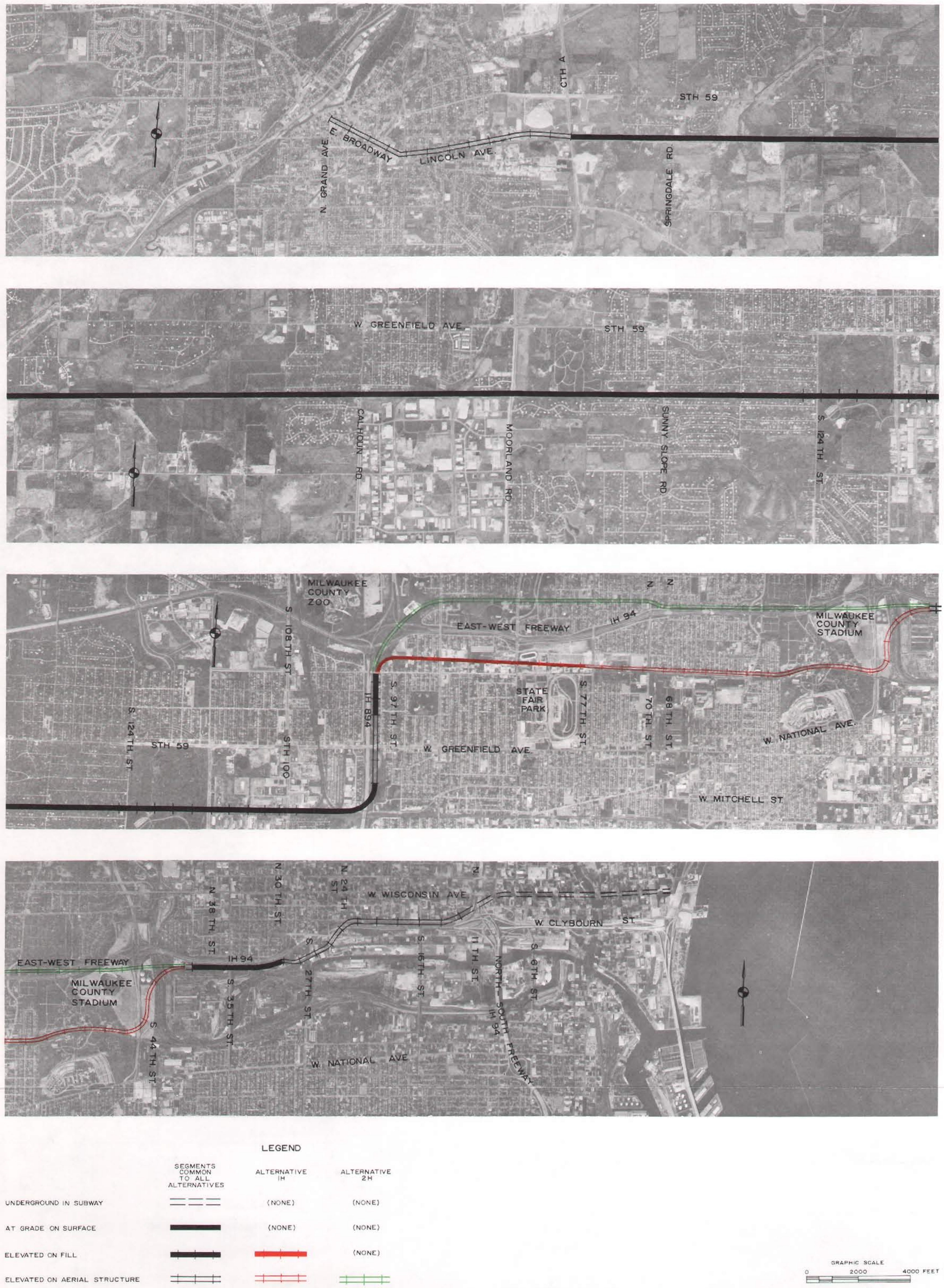
Alternative 1H is the preferred heavy rail rapid transit alignment in the west corridor because it would provide greater access to jobs within walking distance, while providing about the same travel times provided by Alternative 2H but at a somewhat lower capital cost.

Light Rail Transit/Busway Alignments: Two alternative light rail transit/busway alignments were selected for analysis in the west corridor. Both alignments would originate in the Milwaukee central business district and terminate at the City of Waukesha central business district. The alignments would utilize a combination of active railway right-of-way, former electric interurban railway right-of-way, and public street right-of-way.

One alignment, Alternative 1LB, is very similar to heavy rail rapid transit Alternative 1H. It has the same horizontal and vertical configuration along the approximately 13.0 miles of its length from Lincoln Avenue at the eastern limits of the City of Waukesha to the Milwaukee Road railroad yard at S. 44th Street. It differs only between N. Lincoln Memorial Drive and the Milwaukee Road railroad yards at S. 44th Street, and between Lincoln Avenue and W. Main Street in the City of Waukesha. More specifically, the alignment would be located on the surface in a transit mall for about 1.3 miles along E. and W. Wisconsin Avenue between N. Lincoln Memorial Drive and N. 10th Street. At N. 10th Street, the alignment would

Map 29

HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE WEST CORRIDOR



Two alternative fixed guideway alignments suitable for the provision of heavy rail rapid transit service were identified within the west corridor. Both alignments are similar, differing only in the area between Milwaukee County Stadium and the Milwaukee County Zoo. In this area, Alternative 1H, the preferred alignment, would utilize an existing railway right-of-way, while Alternative 2H would utilize a former electric interurban railway right-of-way. Both alignments provide for a fully grade-separated, exclusive guideway, and therefore require a subway in downtown Milwaukee and lengthy segments of aerial guideway in the remainder of Milwaukee County. In Waukesha County the alignments are located principally on the surface, although access to the City of Waukesha would necessitate an aerial structure.

Source: SEWRPC.

Map 30

LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE WEST CORRIDOR

Two alternative fixed guideway alignments suitable for the provision of light rail transit and busway service were identified within the west corridor. Both alignments are similar except in the area between N. 37th Street and the Milwaukee County Zoo, where Alternative 1LB would utilize an existing railway right-of-way and Alternative 2LB, the preferred alignment, would utilize a combination of former street railway and electric interurban railway rights-of-way. Both alignments require significant elevated segments in this area. Over the remainder of these alignments, the guideway would be generally located on the surface in a combination of transit mall, mixed traffic, reserved lane, and exclusive right-of-way configurations.

Source: SEWRPC.

Table 41

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE WEST CORRIDOR

Cost Element	Unit Cost	Alternative Alignment			
		Alignment 1H		Alignment 2H	
		Quantity	Total Cost	Quantity	Total Cost
Surface Construction					
At-Grade Construction	$ 3.2-$ 3.5	10.3 miles	$ 33.1	10.3 miles	$ 34.2
Fill Construction	$16.1-$16.4	0.8 mile	13.0	--	--
Cut Construction	$ --	--	--	--	--
Total	--	11.1 miles	$ 46.1	10.3 miles	$ 34.2
Grade-Separated Construction					
Aerial Construction	$19.0-$19.3	6.0 miles	$115.8	6.7 miles	$130.1
Subway Construction	$ --	1.4 miles	58.5	1.4 miles	58.5
Total	--	7.4 miles	$174.3	8.1 miles	$188.6
Crossings					
Street and Highway					
At-Grade	$--	--	$	--	$
Overpasses	$0.3	14	4.2	12	3.6
Underpasses.	--	--	--	--	--
Railroad.	$0.3	3	0.9	3	0.9
Watercourse.	$0.3	1	0.3	1	0.3
Subtotal	--	--	$225.8	--	$227.3
Engineering, Design, and Administration	15 percent	--	$ 33.9	--	$ 34.1
Contingencies	30 percent	--	$ 67.7	--	$ 68.2
Total Cost	--	--	$327.4	--	$329.6

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

remain on the surface in a reserved lane along W. Wisconsin Avenue for about 1.7 miles to W. Blue Mound Road. At W. Blue Mound Road the remaining part of this alignment to the Milwaukee Road railroad yards at S. 44th Street, a distance of 0.8 mile, would be located on an elevated structure. The alignment through and west of the Milwaukee Road railroad yards to Lincoln Avenue in the City of Waukesha would be the same alignment followed by Alternative 1H. The alignment would be located on a surface in mixed traffic along Lincoln Avenue and E. Broadway, a distance of about 1.1 miles, and in a transit mall along E. Broadway between N. East Avenue and W. Main Street, a distance of 0.3 mile.

Alternative 2LB follows the same alignment followed by heavy rail rapid transit Alternative 2H west of N. 92nd Street to Lincoln Avenue in the City of Waukesha, a distance of about 10.6 miles, and the same alignment followed by Alternative 1LB for a distance of 1.4 miles from Lincoln Avenue through the City of Waukesha to W. Main Street. The alignment east of N. 92nd Street would be located along the former electric interurban railway right-of-way to N. 52nd Street and W. Wisconsin Avenue, a distance of about 2.8 miles. The alignment would largely be on the surface except between N. 68th and N. 70th Streets, where it would leave the former electric interurban railway right-of-way on an elevated structure in order to

Table 42

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE WEST CORRIDOR

Segment	Alternative Alignment					
	Alignment 1H			Alignment 2H		
	Distance (miles)	Total Guideway Construction Cost (millions of dollars)	Average Unit Cost (millions of dollars per mile)	Distance (miles)	Total Guideway Construction Cost (millions of dollars)	Average Unit Cost (millions of dollars per mile)
N. Lincoln Memorial Drive to N. 11th Street	1.4	$ 84.8	$60.5	1.4	$ 84.8	$60.5
N. 11th Street to Milwaukee County Stadium . .	2.7	64.1	23.7	2.3	53.0	23.0
Milwaukee County Stadium to S. 108th Street (STH 100) . . .	4.6	94.1	24.6	4.9	107.4	25.3
S. 108th Street (STH 100) to Waukesha CTH A	8.0	42.3	8.8	8.0	42.3	8.8
Waukesha CTH A to W. Main Street	1.8	42.1	23.4	1.8	42.1	23.4
Total N. Lincoln Memorial Drive to Waukesha CTH A	18.5	$327.4	$17.7	18.4	$329.6	$17.9

Source: SEWRPC.

Table 43

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE WEST CORRIDOR

Segment	Alternative Alignment							
	Alignment 1H				Alignment 2H			
	Distance (miles)	Average Speed (miles per hour)	Travel Time (minutes) Station-to-Station	Travel Time (minutes) Cumulative	Distance (miles)	Average Speed (miles per hour)	Travel Time (minutes) Station-to-Station	Travel Time (minutes) Cumulative
N. Lincoln Memorial Drive to Milwaukee County Stadium	4.1	33	7	- -	3.7	33	7	- -
Milwaukee County Stadium to S. 108th Street (STH 100)	4.6	38	7	14	4.9	38	8	15
S. 108th Street (STH 100) to Waukesha CTH A	8.0	49	10	24	8.0	49	10	25
Waukesha CTH A to W. Main Street	1.8	36	3	27	1.8	36	3	28

Source: SEWRPC.

bypass a Wisconsin Electric Power Company electric transmission substation facility. The alignment in this segment would be located over W. O'Connor Street for a distance of 0.1 mile and over newly acquired right-of-way for about 0.1 mile. After the line leaves the former electric interurban railway right-of-way at N. 52nd Street, it would enter and operate over W. Wisconsin Avenue, including the Wisconsin Avenue viaduct, in a reserved lane to N. 10th Street, a distance of about 2.6 miles. The remaining 1.3 miles of the alignment would be located in a transit mall along W. and E. Wisconsin Avenue between N. 10th Street and N. Lincoln Memorial Drive.

Light Rail Transit/Busway Alignment Evaluation: As indicated in Table 46, the capital cost of guideway construction for Alternative 1LB, the Class A

Table 44

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE WEST CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Household Population Served			Number of Jobs Served (one-half-mile walking distance)
	One-Half-Mile Walking Distance	15-Minute Feeder Bus Travel Time	Three-Mile Driving Distance	
1H	71,700	343,400	512,200	90,800
2H	71,500	364,900	529,600	82,700

Source: SEWRPC.

Table 45

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE WEST CORRIDOR

Evaluation Criteria	Alternative Alignment	
	Alignment 1H	Alignment 2H
Capital Cost (guideway construction cost in millions of dollars)	$327.4	$329.6
Community Disruption		
Type of Land Used (miles)		
Railroad Right-of-Way	3.5	0.4
Former Interurban Right-of-Way	10.7	13.9
Public Street Right-of-Way	3.8	3.9
Public Land	0.4	- -
Newly Acquired Right-of-Way	0.1	0.2
Total	18.5	18.4
Structure Dislocation (number)		
Residential Buildings	- -	- -
Commercial or Industrial Buildings	- -	- -
Public Buildings	- -	- -
Other Disruption	Location of an aerial structure over a strip of land 0.4 mile in length owned by Milwaukee County, resulting in entail a small reduction in parking at Milwaukee County Stadium	- -
	Relocation of some steel electric power transmission towers along 0.8 mile of former interurban right-of-way between N. 97th and W. Mitchell Streets	
Travel Time (line-haul travel time in minutes to the Milwaukee CBD)	27	28
Population Served		
One-Half-Mile Walking Distance	71,700	71,500
Three-Mile Driving Distance	512,200	529,600
Jobs Served		
One-Half-Mile Walking Distance	90,800	82,700

Source: SEWRPC.

Table 46

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR LIGHT RAIL TRANSIT BUSWAY FACILITIES IN THE WEST CORIDOR

Cost Element	Unit Cost		Alternative Alignment					
			Alignment 1LB			Alignment 2LB		
				Total Cost			Total Cost	
	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway
Surface Construction								
At-Grade Construction	$ 3.2-$ 3.9	$ 0.8-$ 2.2	13.8 miles	$ 47.4	$ 20.0	17.7 miles	$ 63.3	$26.7
Fill Construction	$16.1-$16.4	$13.7-$16.9	1.2 miles	19.5	17.8	--	--	--
Cut Construction	$--	$--	--	--	--	--	--	--
Total	--	--	15.0 miles	$ 60.3	$ 37.8	17.7 miles	$ 63.3	$26.7
Grade-Separated Construction								
Aerial Construction	$19.0-$20.4	$16.8-$18.0	3.7 miles	$ 72.0	$ 63.4	1.0 mile	$ 19.1	$16.9
Subway Construction	$--	$--	--	--	--	--	--	--
Total	--	--	3.7 miles	$ 72.0	$ 63.4	1.0 mile	$ 19.1	$16.9
Crossings								
Street and Highway								
At-Grade	$--	$--	25.0	$ --	$ --	35.0	$ --	$ --
Overpasses	$0.3	$0.3	13.0	3.9	3.9	3.0	0.9	0.9
Underpasses	$--	$--	--	--	--	--	--	--
Railroad	$0.3	$0.3	3.0	0.9	0.9	3.0	0.9	0.9
Watercourse	$0.3	$0.3	1.0	0.3	0.3	2.0	0.6	0.6
Subtotal	--	--	--	$144.0	$106.3	--	$ 84.8	$46.0
Engineering, Design, and Administration	15 percent	15 percent	--	$ 21.6	$ 15.9	--	$ 12.7	$ 6.9
Contingencies	30 percent	30 percent	--	$ 43.2	$ 31.9	--	$ 25.4	$13.8
Total Cost	--	--	--	$208.8	$154.1	--	$122.9	$66.7

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

light rail/busway alignment, is estimated at $208.8 million for a light rail transit system, or an average unit cost of $11 million per mile of dual guideway, and about $154 million for a busway, or about $8 million per mile of dual guideway. The capital cost of guideway construction for the Class B alignment would be about 40 percent less, or about $123 million for a light rail transit system—an average cost of $6.6 million per mile of dual guideway. The comparable cost of constructing a dual busway is estimated at $67 million, or an average cost of $3.6 million per mile. A breakdown of guideway capital costs by segment of the alternative light rail/busway alignments is shown in Table 47.

Alternative 1LB would utilize a strip of land about 18.7 miles in length, including about 3.2 miles of active railway right-of-way and about 10.2 miles of former electric interurban railway right-of-way owned by the Wisconsin Electric Power Company. It would also use about 4.9 miles of public street right-of-way in the Cities of Milwaukee and Waukesha, over which the facility would be on a reserved lane surface alignment for about 3.0 miles, in mixed traffic for 1.4 miles in the City of Waukesha, and on an elevated structure for the remaining 0.5 mile. In addition, the alternative would use a strip of land about 0.4 mile in length used for parking at Milwaukee County Stadium.

Alternative Alignment 2LB would utilize about 5.4 miles of public street right-of-way in the City of Milwaukee and about 13.2 miles of former electric interurban railway right-of-way owned by the Wisconsin Electric Power Company. It would also require the acquisition of about 0.1 mile of new

Table 47

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE WEST CORRIDOR

Segment	Alternative Alignment									
	Alignment 1LB					Alignment 2LB				
	Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)		Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)	
		Light Rail	Busway	Light Rail	Busway		Light Rail	Busway	Light Rail	Busway
N. Lincoln Memorial Drive to N. 10th Street	1.3	$ 7.4	$ 4.1	$ 5.7	$ 3.2	1.3	$ 7.4	$ 4.1	$ 5.7	$3.2
N. 10th Street to Milwaukee County Stadium	3.0	48.3	39.4	16.1	13.1	3.2	18.0	9.3	5.6	2.9
Milwaukee County Stadium to S. 108th Street (STH 100)	4.6	102.6	91.0	22.3	19.8	4.4	48.7	35.9	11.0	8.1
S. 108th Street (STH 100) to Waukesha CTH A	8.0	40.9	15.0	5.1	1.9	8.0	39.3	12.7	4.9	1.6
Waukesha CTH A to W. Main Street	1.8	9.6	4.6	5.3	2.5	1.8	9.6	4.6	5.3	2.5
Total N. Lincoln Memorial Drive to Waukesha CTH A	18.7	$208.8	$154.1	$11.2	$ 8.2	18.7	$122.9	$66.7	$ 6.6	$3.6

Source: SEWRPC.

right-of-way between N. 69th and N. 70th Streets, where the alignment would leave W. O'Connor Street to re-enter the former electric interurban railway right-of-way. Additionally, location of a light rail/busway alignment over reserved lanes under Alternatives 1LB and 2LB would require use of W. Wisconsin Avenue. Specifically, Alternative 1LB would require the use of existing lanes on W. Wisconsin Avenue over a distance of about 1.7 miles between N. 10th and N. 38th Streets, leaving two lanes for motor vehicle traffic in each direction. Parking would have to be prohibited along this segment. Alternative 2LB would additionally require use of 0.4 mile of reserved lanes over arterial street rights-of-way from N. 38th Street to W. Blue Mound Road, leaving a total of three lanes for motor vehicle traffic. Both alternatives would require the relocation of some steel lattice electric transmission towers along the 0.8 mile of former interurban railway right-of-way between N. 97th and W. Mitchell Streets. Neither of the two alignments would require the disruption of any residential, industrial, or commercial structures.

Line-haul travel times between selected segments of the two light rail transit/busway alignments are summarized in Table 48. Alternative Alignment 1LB would provide faster travel times overall between the Waukesha central business district and downtown Milwaukee for a light rail transit system, 47 minutes compared with 51 minutes for Alternative 2LB. Comparable busway travel times are 51 minutes for Alternative 1LB and 58 minutes for Alternative 2LB. It should be noted that if the station spacing of the light rail transit systems and busways of these two alternatives approached that of heavy rail systems—specifically, an average spacing of one mile rather than one-half mile in high-density areas and two miles rather than one mile in medium-density areas—the travel times from the City of Waukesha to downtown Milwaukee would approach 42 minutes for a light rail transit system and 44 minutes for a busway under Alternative 1LB and 46 minutes for a light rail transit system and 51 minutes for a busway under Alternative 2LB.

The alignments are comparable in terms of accessibility to population and jobs and service to major activity centers. As shown in Table 49, Alternative 2LB would serve a greater number of residents within a six-mile band around the alignment and greater number of residents within walking distance, 537,900 and 84,900, respectively, compared with 535,100 and 83,700 for Alternative 1LB. However, Alternative 1LB would serve a greater number of jobs within walking distance, 88,900, compared with 79,600 for Alternative 2LB.

Table 48

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE WEST CORRIDOR

Segment	Alignment 1LB: Distance (miles)	Alignment 1LB: Station Spacing[a]	Alignment 1LB: Average Speed[b] (miles per hour—light rail/busway)	Alignment 1LB: Travel Time (minutes—light rail/busway) Station-to-Station	Alignment 1LB: Travel Time Cumulative	Alignment 2LB: Distance (miles)	Alignment 2LB: Station Spacing[a]	Alignment 2LB: Average Speed[b] (miles per hour—light rail/busway	Alignment 2LB: Travel Time (minutes—light rail/busway) Station-to-Station	Alignment 2LB: Travel Time Cumulative
N. Lincoln Memorial Drive to Milwaukee County Stadium . . .	4.3	Typical light rail/busway	18/17	14/15	- -	4.5	Typical light rail/busway	17/16	16/17	- -
		Typical heavy rail	20/18	13/14	- -		Typical heavy rail	19/18	14/15	- -
Milwaukee County Stadium to STH 100	4.6	Typical light rail/busway	28/25	10/11	24/26	4.4	Typical light rail/busway	24/20	11/13	27/30
		Typical heavy rail	32/30	9/9	22/23		Typical heavy rail	30/26	9/10	23/25
STH 100 to Waukesha CTH A. . .	8.0	Typical light rail/busway	32/30	15/16	39/42	8.0	Typical light rail/busway	30/26	16/19	43/49
		Typical heavy rail	39/39	12/12	34/35		Typical heavy rail	36/31	15/17	34/38
Waukesha CTH A to W. Main Street.	1.8	Typical light rail/busway	13/12	8/9	47/51	1.8	Typical light rail/busway	13/12	8/9	51/58
		Typical heavy rail	13/12	8/9	42/44		Typical heavy rail	13/12	8/9	46/51

[a] *Assumes light rail and busway transit typical station spacing of approximately one-quarter mile in the Milwaukee central business district; one-half mile in other high-density urban areas unless the guideway is fully grade-separated, where one-mile spacing is assumed; and one mile in medium-density urban areas. The wider station spacing represents typical heavy rail station spacing of approximately one-half mile in the Milwaukee central business district; one mile in other high-density urban areas; and two miles in medium-density areas.*

[b] *The average speeds are based upon typical acceleration and deceleration rates; typical maximum operating speeds, which vary based on type, location, and degree of grade separation of right-of-way; assumed typical station spacing; and a typical station dwell time of 30 seconds. Preferential treatment has been assumed at all at-grade crossings. These typical light rail and busway transit characteristics were established in SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology. The result is average speeds of about 11 miles per hour in malls and other reserved guideways on street rights-of-way in the central business district; of from 20 to 30 miles per hour on reserved guideways in all other street rights-of-way; and of from 20 to 40 miles per hour on all other private rights-of-way. The variation in these average speeds is a result of variation in average station spacing.*

Source: SEWRPC.

Table 49

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE WEST CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Household Population Served: One-Half-Mile Walking Distance	Household Population Served: 15-Minute Feeder Bus Travel Time	Household Population Served: Three-Mile Driving Distance	Number of Jobs Served (one-half-mile walking distance)
ILB	83,700	378,100	535,100	88,900
2LB	84,900	372,700	537,900	79,600

Source: SEWRPC.

Recommended Light Rail Transit/Busway Alignment: Table 50 summarizes the results of the preliminary assessment of the capital cost, disruption, travel time, and accessibility to both jobs and population for both of the light rail transit/busway alternative alignments in the west corridor. Alternative 2LB is the preferred alignment, although it serves about 11 percent fewer jobs than does Alternative 1LB. It does provide somewhat greater access to population, about the same amount of disruption, and importantly, would be about 40 percent less costly. It should be noted that the capital cost assumes the use of the Wisconsin Avenue viaduct. Even if the Wisconsin Avenue viaduct could not be used, the additional cost of providing an alternate connection on an aerial structure adjacent to

Table 50

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE WEST CORRIDOR

Evaluation Criteria	Alternative Alignment	
	Alignment 1LB	Alignment 2LB
	Light Rail/Busway	Light Rail/Busway
Capital Cost (guideway construction cost in millions of dollars)	$208.8/$154.1	$122.9/$66.7
Community Disruption		
Type of Land Used (miles)		
Railroad Right-of-Way.	3.2	- -
Former Interurban Right-of-Way.	10.2	13.2
Public Street Right-of-Way	4.9	5.4
Public Land.	0.4	- -
Newly Acquired Right-of-Way	- -	0.1
Total	18.7	18.7
Structure Dislocation (number)		
Residential Buildings	- -	- -
Commercial or Industrial Buildings	- -	- -
Public Buildings	- -	- -
Other Disruption	Location of alignment between N. 38th Street and N. 10th Street would require use of existing arterial street lanes, reducing the number of lanes to two in each direction	Location of alignment between N. 43rd Street and N. 10th Street would require use of existing street lanes, leaving a total of three lanes of travel between W. Blue Mound Road and N. 38th Street and a total of four lanes of travel on the remainder of the alignment to N. 10th Street
	- -	Location of an aerial structure over a strip of land 0.4 mile in length owned by Milwaukee County would entail a small reduction in parking at Milwaukee County Stadium
	Relocation of some street lattice electric transmission towers along 0.8 mile of interurban right-of-way between N. 97th and W. Mitchell Streets	
Travel Time (line-haul travel time in minutes to the Milwaukee CBD)	47/51	43/49
Population Served		
One-Half-Mile Walking Distance	83,700	84,900
Three-Mile Driving Distance	535,100	537,900
Jobs Served		
One-Half-Mile Walking Distance	88,900	79,600

Source: SEWRPC.

W. Blue Mound Road and S. 44th Street between W. Wisconsin Avenue and N. 38th Street and the former Milwaukee Electric Lines-Local Rapid Transit Line right-of-way would not be signficant.

At the request of the study advisory committee, a third alternative light rail transit/busway alignment—Alternative 3LB—was considered in the west corridor. This alignment would be very similar to light rail transit/busway Alternative 2LB, as shown on Map 31. It would follow the same alignment followed by Alternative 2LB between N. Lincoln Memorial Drive and N. 12th Street, about 1.5 miles. The alignment would then enter N. 12th Street, operating over reserved lanes between W. Wisconsin Avenue and W. Wells Street, about 0.1 mile. The alignment would then enter W. Wells Street, operating over reserved lanes to N. 35th Street—about 1.5 miles. It would then operate along W. Wells Street in mixed traffic for 0.2 mile between N. 35th Street and N. 37th Street. From there west, the alignment would cross the western portion of the Menomonee River Valley on a major bridge and then enter W. Wells Street at N. 44th Street, where it would be located on a surface alignment in mixed traffic for about 0.5 mile to N. 52nd Street. At N. 52nd Street the line would enter the former street railway right-of-way, being located at-grade over that right-of-way between W. Wells Street and the former Milwaukee Electric Lines interurban right-of-way, a distance of about 0.5 mile. The remaining 14.2 miles of the alignment west of N. 52nd Street to the City of Waukesha would be the same as that followed by Alternative 2LB.

The alignment would utilize a strip of land approximately 19.0 miles in length, including 12.7 miles of former electric interurban right-of-way, 0.5 mile of former street railway right-of-way, and 5.2 miles of public street right-of-way. Of the 5.2 miles of the alignment that would be located on the surface within public street rights-of-way, about 1.6 miles would be located on a transit mall, 1.8 miles would be located in mixed traffic, and 1.8 miles would be located in reserved lanes on W. Wisconsin Avenue between N. 10th Street and N. 12th Street, on N. 12th Street between W. Wisconsin Avenue and W. Wells Street, and on W. Wells Street between N. 12th Street and N. 35th Street. Use of this alignment would require the acquisition of about 0.6 mile of new right-of-way, 0.1 mile of which would be located between N. 69th Street and N. 70th Street, and 0.5 mile of which would be located between N. 37th and N. 44th Streets, where the alignment would cross the Menomonee River Valley on a major bridge. This last segment of new right-of-way would require bridge supports to be placed within a truck terminal area of the Miller Brewery site. It should be noted that the location of a light rail transit/busway alignment over reserved lanes along segments of W. Wisconsin Avenue, N. 12th Street, and W. Wells Street would require the use of two existing arterial street lanes, leaving at least two lanes for motor vehicle traffic in each direction, assuming parking is prohibited.

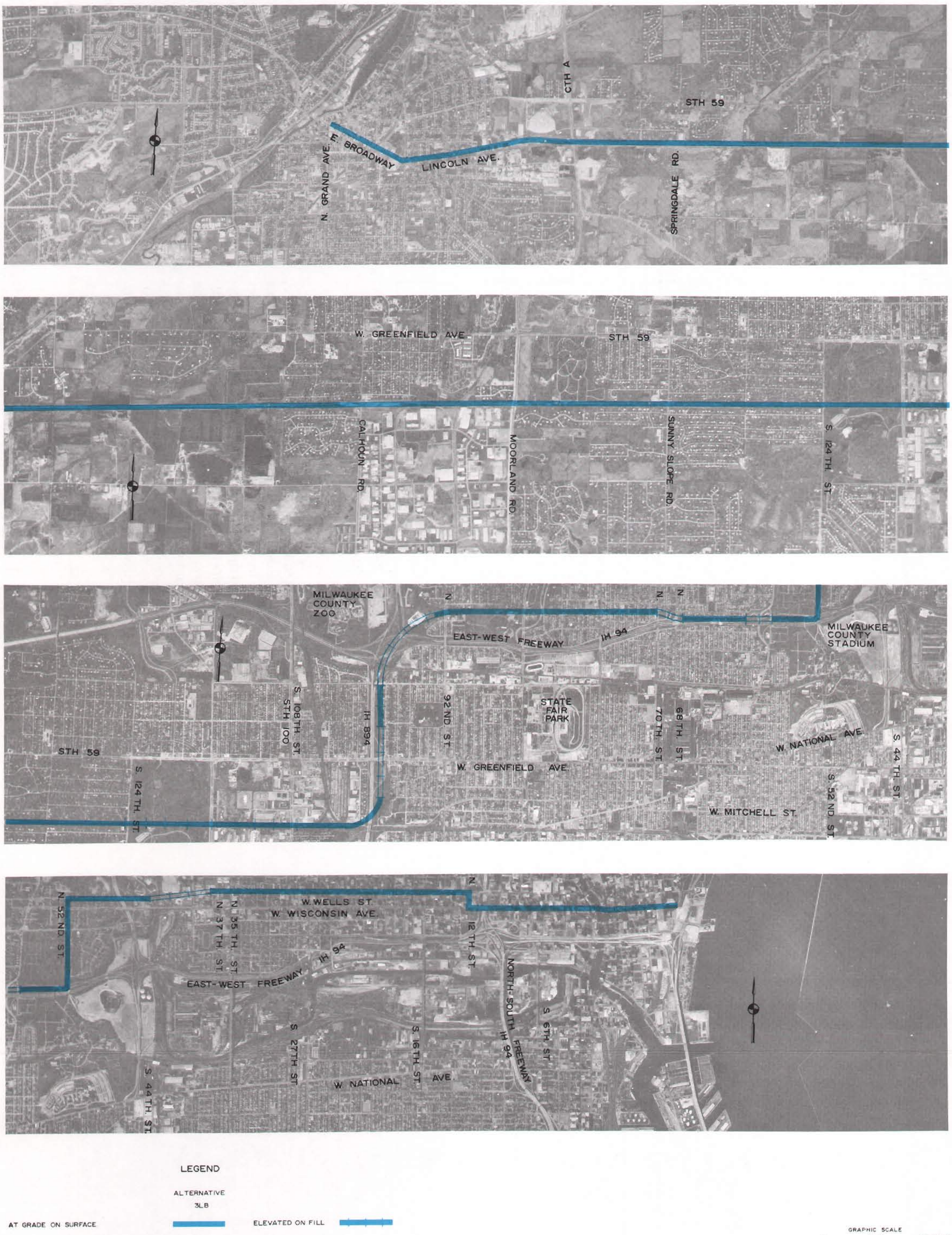
As shown in Table 51, the estimated capital cost of guideway construction is $137 million for a light rail transit system, or an average cost of $7 million per mile of dual guideway, and $78 million a busway, or $4 million per mile of dual guideway. Table 52 summarizes the capital cost of major segments of the alignment.

A total of 86,800 residents and 80,100 jobs would be located within walking distance of the alignment; 375,400 residents would be located within a two-mile feeder bus service range; and 541,000 residents would be located within a three-mile automobile driving range. The estimated line-haul travel times for Alternative 3LB between the City of Waukesha and N. Lincoln Memorial Drive in downtown Milwaukee are summarized in Table 53. A total of 53 minutes would be required to traverse the alignment at an average speed of 22 mph on a light rail transit system. Bus transit would require 61 minutes at an average speed of 19 mph.

Table 54 summarizes the results of the preliminary assessment of the capital cost, disruption, travel time, and accessibility to both jobs and population for Alternative 3LB. The cost of Alternative 3LB is significantly greater than that of Alternative 2LB with no appreciable change in travel time or accessibility to jobs or population. It should be noted that about 70 percent of the increase in the cost of Alternative 3LB over 2LB can be attributed to the cost of constructing a new major bridge facility over the Menomonee River Valley between N. 37th Street and N. 44th Street at W. Wells Street. In addition, it must be pointed out that even if the Wisconsin Avenue viaduct could not support a light rail/busway alignment, a new bridge constructed at this location could be expected to be less costly than if constructed at Wells Street, because the Menomonee River Valley is narrower at Wisconsin Avenue. It is recommended that Alternative 2LB remain the preferred alignment because of its lower cost if it can utilize the existing Wisconsin Avenue viaduct.

Map 31

LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENT 3LB IN THE WEST CORRIDOR



At the request of the study advisory committee, a third alternative light rail transit and busway alignment was considered in the west corridor. Alternative 3LB differs from Alternative 2LB (see Map 30) only in that access to the Milwaukee central business district would be provided over W. Wells Street between N. 52nd Street and N. 12th Street, instead of over W. Wisconsin Avenue. This alternative would require the construction of a viaduct between N. 37th Street and N. 44th Street. Following consideration of this alternative, it was recommended that Alternative 2LB remain the preferred alignment.

Source: SEWRPC.

Table 51

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENT 3LB IN THE WEST CORRIDOR

Cost Element	Unit Cost		Alternative Alignment 3LB		
				Total Cost	
	Light Rail	Busway	Quantity	Light Rail	Busway
Surface Construction					
At-Grade Construction	$ 3.2-$ 3.9	$ 0.8-$ 2.2	17.5 miles	$ 62.5	$25.1
Fill Construction	$16.1-$16.4	$13.7-$16.9	- -	- -	- -
Cut Construction	$ - -	$ - -	- -	- -	- -
Total	- -	- -	17.5 miles	$ 62.5	$25.1
Grade-Separated Construction					
Aerial Construction	$19.0-$20.4	$16.8-$18.0	1.5 miles	$ 29.3	$25.9
Subway Construction	$ - -	$ - -	- -	- -	- -
Total	- -	- -	1.5 miles	$ 29.3	$25.9
Crossings					
Street and Highway					
At-Grade	$- -	$- -	39	$ - -	$ - -
Overpasses	$0.3	0.3	3	0.9	0.9
Underpasses	$- -	- -	- -	- -	- -
Railroad	$0.3	0.3	3	0.9	0.9
Watercourse	$0.3	0.3	2	0.6	0.6
Subtotal	- -	- -	- -	$ 94.2	$53.4
Engineering, Design, and Administration	15 percent	15 percent	- -	$ 14.1	$ 8.0
Contingencies	30 percent	30 percent	- -	$ 28.3	$16.1
Total Cost	- -	- -	- -	$136.6	$77.5

NOTE: *All costs are estimated in millions of 1979 dollars.*

Source: SEWRPC.

At the request of the study advisory committee, a fourth alternative light rail transit/busway—a spur alignment—was designed that would provide direct service to major activity centers in the City of Wauwatosa—specifically, the Milwaukee County Institutions and the Mayfair Shopping Center area. The spur alignment, as shown on Map 32, would leave Alternative 2LB, the preferred alignment, in the west corridor, along the former electric interurban railway right-of-way at N. Glenview Avenue, proceed along N. Glenview Avenue in the median for a distance of about 0.3 mile to W. Blue Mound Road, and then operate in mixed traffic over W. Glenview Avenue for about 0.2 mile between W. Blue Mound Road and W. Wisconsin Avenue. It would then turn in a westerly direction and operate over W. Wisconsin Avenue in mixed traffic to the eastern edge of the Milwaukee County Institutions at about N. Windsor Avenue, a distance of about 0.1 mile. Upon leaving W. Wisconsin Avenue at N. Windsor Avenue, the alignment would parallel W. Wisconsin Avenue on open lands owned by Milwaukee County to N. Pleasant View Street, a distance of about 0.1 mile. Remaining on open land owned by Milwaukee County, the alignment would then parallel N. Pleasant View Street for about 0.3 mile to an existing access road to the County Institutions, where it would turn in a westerly direction and operate in the median of that access road for about 0.3 mile. It would continue to operate on the surface over open lands in a westerly direction to the Zoo Freeway (USH 45), and proceed in a northerly direction, paralleling the Zoo Freeway to Underwood Parkway, a total dis-

Table 52

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENT 3LB IN THE WEST CORRIDOR

Segment	Alternative Alignment 3LB				
	Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)	
		Light Rail	Busway	Light Rail	Busway
N. Lincoln Memorial Drive to N. 10th Street	1.3	$ 7.4	$ 4.1	$ 5.7	$3.2
N. 10th Street to Milwaukee County Stadium	3.5	21.8	20.2	9.0	5.8
Milwaukee County Stadium to S. 108th Street (STH 100)	4.4	48.7	35.9	11.0	8.1
S. 108th Street (STH 100) to Waukesha CTH A	8.0	39.3	12.7	4.9	1.6
Waukesha CTH A to W. Main Street	1.8	9.6	4.6	5.3	2.5
Total N. Lincoln Memorial Drive to Waukesha CTH A	19.0	$136.6	$77.5	$ 7.2	$4.1

Source: SEWRPC.

Table 53

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENT 3LB IN THE WEST CORRIDOR

Segment	Alternative Alignment 3LB			
	Distance (miles)	Average Speed (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway)	
			Station-to-Station	Cumulative
N. Lincoln Memorial Drive to Milwaukee County Stadium	4.8	16/14	18/20	--
Milwaukee County Stadium to STH 100	4.4	24/20	11/13	29/33
STH 100 to Waukesha CTH A	8.0	30/26	16/19	45/52
Waukesha CTH A to W. Main Street	1.8	13/12	8/9	53/61

Source: SEWRPC.

tance of about 1.5 miles. At Underwood Parkway the line would be located on an elevated structure to N. Mayfair Road (STH 100), a distance of about 0.2 mile. It would then enter and operate on the surface within the median of N. Mayfair Road (STH 100) in a northerly direction for about 0.3 mile to W. Clarke Street. Upon leaving N. Mayfair Road (STH 100) at W. Clarke Street, the alignment would turn to the east and parallel N. Mayfair Road over a portion of the Mayfair Mall Shopping Center parking lot, terminating southwest of the shopping center mall complex and northeast of the intersection of N. Mayfair Road and W. North Avenue.

Table 54

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE WEST CORRIDOR

Evaluation Criteria	Alternative Alignment		
	Alignment 1LB	Alignment 2LB	Alignment 3LB
	Light Rail/Busway	Light Rail/Busway	Light Rail/Busway
Capital Cost (guideway construction cost in millions of dollars)	$208.8/$154.1	$122.9/$66.7	$136.6/$77.5
Community Disruption			
Type of Land Used (miles)			
Railroad Right-of-Way	3.2	--	--
Former Interurban Right-of-Way	10.2	13.2	13.2
Public Street Right-of-Way	4.9	5.4	5.2
Public Land	0.4	--	--
Newly Acquired Right-of-Way	--	0.1	0.6
Total	18.7	18.7	19.0
Structure Dislocation (number)			
Residential Buildings	--	--	--
Commercial or Industrial Buildings	--	--	--
Public Buildings	--	--	--
Other Disruption	Location of alignment between N. 38th and N. 10th Streets would require use of existing arterial street lanes, reducing the number of lanes to two in each direction Location of an aerial structure over a strip of land 0.4 mile in length owned by Milwaukee County would entail a small reduction in parking at Milwaukee County Stadium	Location of alignment between N. 43rd and N. 10th Streets would require the use of existing street lanes, leaving a total of three lanes of travel between W. Blue Mound Road and N. 38th Street and a total of four lanes of travel on the remainder of the alignment to N. 10th Street	Location of alignment between N. 10th and N. 12th Streets on W. Wisconsin Avenue, between W. Wisconsin Avenue and W. Wells Street on N. 12th Street, and between N. 12th and N. 35th Streets on W. Wells Street would require the use of two existing street lanes, leaving two lanes of travel in each direction on these facilities
	Location of some steel lattice electric transmission towers along 0.8 mile of interurban right-of-way between N. 97th and W. Mitchell Streets		
Travel Time (line-haul travel time in minutes to the Milwaukee CBD)	47/51	51/58	53/61
Population Served			
One-Half-Mile Walking Distance	83,700	84,900	86,800
Three-Mile Driving Distance	535,100	537,900	541,000
Jobs Served			
One-Half-Mile Walking Distance	88,900	79,600	80,100

Source: SEWRPC.

At-grade primary transit system development within the median area of N. Mayfair Road would have an impact on the traffic-carrying capacity of its intersection with W. North Avenue—specifically, disrupting left-turn traffic on both approaches to the intersection. It must be recognized, however, that transit provides more efficient "person per lane" movement and, therefore, should be given preference for use of a portion of the existing right-of-way. There are strategies available that would minimize this problem at the intersection, including redesign of the existing special left-turn lane, use of the track lane for left-turn movements, and modifications to existing motor vehicle traffic control devices. It should be apparent, however, that any light rail or busway guideway designed for using street right-of-way and any proposed priority treatments would require detailed traffic engineering studies in a later phase of this study, so that impacts on motor vehicle traffic resulting from intersection modification can be appropriately treated.

Map 32

LIGHT RAIL TRANSIT/BUSWAY WAUWATOSA SPUR ALIGNMENT IN THE WEST CORRIDOR

At the request of the study advisory committee, a spur was located to provide direct service to major activity centers in the City of Wauwatosa such as the Milwaukee County Institutions and the Mayfair Mall Shopping Center area. This spur alignment would leave the Alternative 2LB alignment at N. Glenview Avenue and utilize public street rights-of-way to the Milwaukee County Institution grounds before continuing to the Mayfair Mall Shopping Center. Following consideration of this alignment, it was recommended that the spur be incorporated into the maximum extent system for light rail transit and busways.

Source: SEWRPC.

The alignment would utilize a strip of land approximately 3.4 miles in length, including 0.9 mile of public street right-of-way, 0.3 mile of public access road serving the Milwaukee County Medical Complex, 2.1 miles of open land owned by Milwaukee County located within the Milwaukee County Institutional grounds, and 0.1 mile of newly acquired right-of-way. The new right-of-way would be required where the alignment enters the parking lot of the Mayfair Mall Center. No disruption of residential, business, or commercial structures would be entailed along this alignment.

As shown in Table 55, the estimated capital cost of guideway construction for this alternative is \$21 million for a light rail transit system, or an average cost of about \$6 million per mile of dual guideway, and \$10 million for a busway, or about \$3 million per mile of dual guideway. Table 56 summarizes the capital cost of major segments of the alignment.

Nearly 19,000 jobs and 9,000 residents would be within walking distance of the Wauwatosa Spur Alignment, which would also, importantly, pro-

Table 55

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR LIGHT RAIL TRANSIT/BUSWAY WAUWATOSA SPUR ALIGNMENT IN THE WEST CORRIDOR

Cost Element	Unit Cost		Wauwatosa Spur Alignment		
				Total Cost	
	Light Rail	Busway	Quantity	Light Rail	Busway
Surface Construction					
At-Grade Construction	$3.2-$5.3	$0.8-$1.7	3.2 miles	$11.2	$3.8
Fill Construction	$ --	$ --	--	--	--
Cut Construction	$ --	$ --	--	--	--
Total	--	--	3.2 miles	$11.2	$3.8
Grade-Separated Construction					
Aerial Construction	$16.0	$14.0	0.2 mile	$ 3.3	$2.8
Subway Construction	$ --	$ --	--	--	--
Total	--	--	0.2 mile	$ 3.3	$2.8
Crossings					
Street and Highway					
At-Grade	$ --	$ --	13	$ --	$--
Overpasses	$ --	$ 0.3	1	0.3	0.3
Underpasses	$ --	$ --	--	--	--
Railroad	$ --	$ --	--	--	--
Watercourse	$ --	$ --	--	--	--
Subtotal	--	--	--	$14.8	$6.9
Engineering, Design, and Administration	15 percent	15 percent	--	$ 2.2	$1.0
Contingencies	30 percent	30 percent	--	$ 4.4	$2.0
Total Cost	--	--	--	$21.4	$9.9

Source: SEWRPC.

vide a direct connection to the Milwaukee County Medical Complex and the Mayfair Mall Shopping Center. Additionally, about 123,000 residents would be located within a two-mile feeder bus service range and more than 225,000 residents would be located within a three-mile driving range.

The estimated line-haul travel times for the spur alignment are summarized in Table 57. The spur alignment to the Mayfair Mall Shopping Center would require about 8 minutes to traverse by both light rail vehicle and bus.

Table 58 summarizes the results of the preliminary assessment of the capital cost, disruption, travel time, and accessibility to both jobs and population for the Wauwatosa Spur Alignment. The spur, which, as already noted, would provide a direct connection to the Milwaukee County Institutions and the Mayfair Mall Shopping Center, would add about 17 percent, or $21 million, to the cost of the light rail alternative, and about 15 percent, or $10 million, to the cost of the busway. Importantly, it would provide nearly 25 percent greater access to jobs and about 15 percent greater access to population within walking distance. Additionally, it would provide a connection to the east-west crosstown alignment, facilitating trips made between eastern Waukesha and western Milwaukee Counties and the UWM/lower east side and W. Capitol Drive areas. As a consequence, it is recommended that the Wauwatosa spur be part of the maximum extent system for light rail transit and busways under this alternative future.

Table 56

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY WAUWATOSA SPUR ALIGNMENT IN THE WEST CORRIDOR

Segment	Alternative Alignment 3LB				
	Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)	
		Light Rail	Busway	Light Rail	Busway
N. Glenview Avenue and W. Hawthorne Avenue to the Milwaukee County Medical Complex	1.3	$ 7.4	$3.0	$5.7	$2.3
Milwaukee County Medical Complex to W. Watertown Plank Road	0.6	3.3	1.2	5.5	2.0
W. Watertown Plank Road to the Mayfair Shopping Center.	1.5	10.7	5.7	7.1	3.8
Total N. Glenview Avenue to the Mayfair Shopping Center	3.4	$21.4	$9.9	$6.3	$2.9

Source: SEWRPC.

Table 57

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY WAUWATOSA SPUR ALIGNMENT IN THE WEST CORRIDOR

Segment	Alternative Alignment 3LB			
	Distance (miles)	Average Speed (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway)	
			Station-to-Station	Cumulative
N. Glenview Avenue and W. Hawthorne Avenue to the Milwaukee County Medical Complex	1.3	20/18	4/4	- -
Milwaukee County Medical Complex to W. Watertown Plank Road	0.6	30/28	1/1	5/5
W. Watertown Plank Road to the Mayfair Shopping Center.	1.5	30/27	3/3	8/8

Source: SEWRPC.

Fixed Guideway Alignments in the Northwest Corridor

Available rights-of-way determined to have good potential for the location of primary transit guideways in the northwest corridor radiating from the central business district of the Milwaukee area are identified on Map 33. Also shown on Map 33 are the generalized existing land use pattern in the corridor and the location of major activity centers. Two alternative heavy rail rapid transit alignments and three light rail transit/busway alignments, one of which is a Class A alignment and two of which are Class B alignments, were identified in the corridor, as shown on Maps 34 and 35.

Table 58

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR THE LIGHT RAIL TRANSIT/BUSWAY WAUWATOSA SPUR ALIGNMENT IN THE WEST CORRIDOR

Evaluation Criteria	Wauwatosa Spur Alignment
	Light Rail/Busway
Capital Cost (guideway construction cost in millions of dollars)	$21.4/$9.9
Community Disruption	
Type of Land Used (miles)	
Railroad Right-of-Way	- -
Former Interurban Right-of-Way	- -
Public Street Right-of-Way	0.9
Public Land[a]	2.4
Newly Acquired Right-of-Way	0.1
Total	3.4
Structure Dislocation (number)	
Residential Buildings	- -
Commercial or Industrial Buildings	- -
Public Buildings	- -
Other Disruption	None
Travel Time (line-haul travel time in minutes between Mayfair Shopping Center and the former interurban right-of-way at N. Glenview Avenue)	8/8
Population Served	
One-Half-Mile Walking Distance	9,000
Three-Mile Driving Distance	225,000
Jobs Served	
One-Half-Mile Walking Distance	19,000

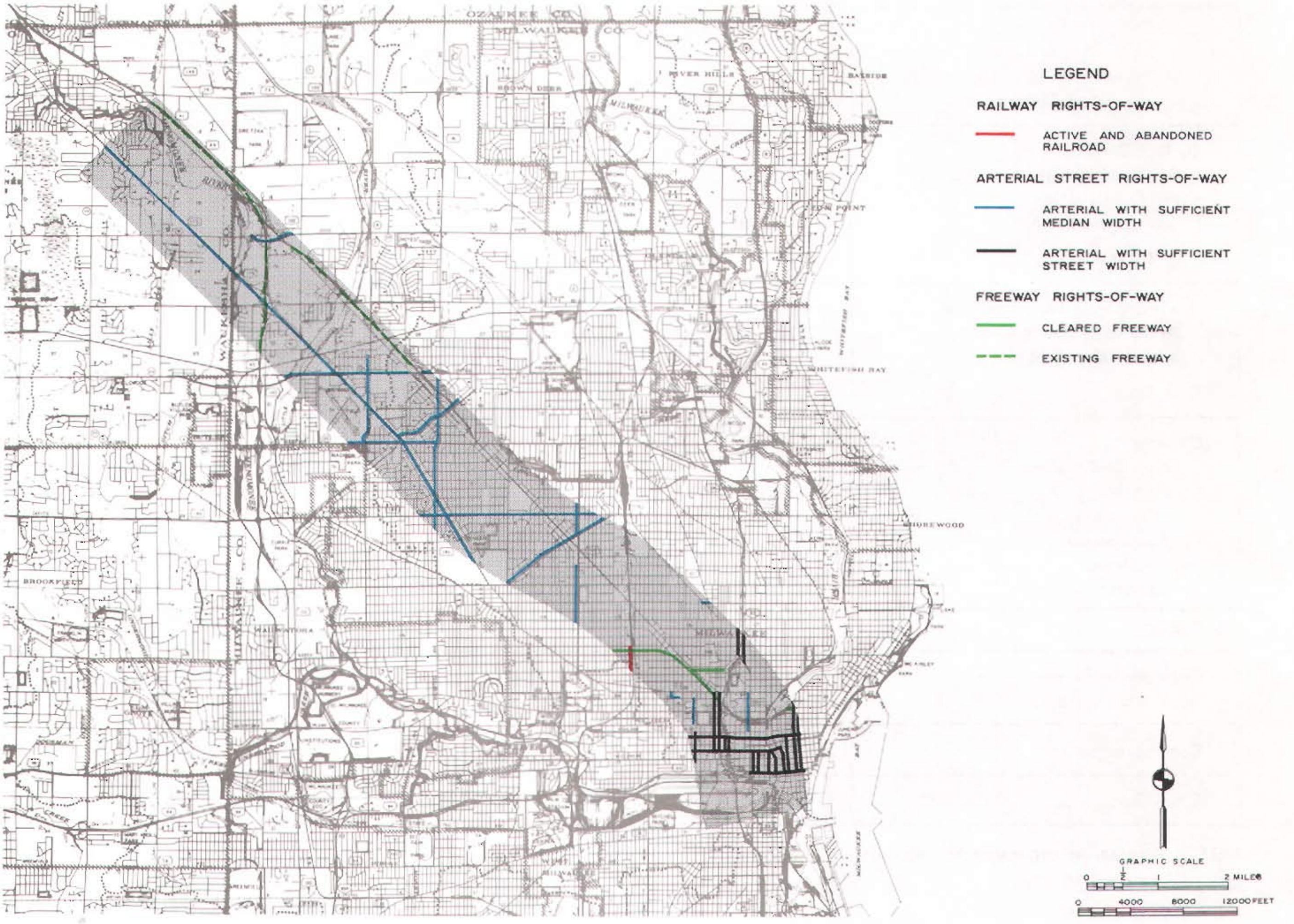
[a] *Includes 0.3 mile of private access road located within land owned by Milwaukee County and used for access to Milwaukee County Institutions.*

Source: SEWRPC.

Heavy Rail Rapid Transit Alignments: Both alternative heavy rail alignments extend from the Milwaukee central business district to the Village of Menomonee Falls in northeastern Waukesha County. The alignments are located primarily along freeway rights-of-way and public street rights-of-way. One alignment, Alternative 1H, approximately 15.8 miles in length, would begin in downtown Milwaukee at N. Lincoln Memorial Drive and extend 0.9 mile in a subway beneath E. and W. Wisconsin Avenue to N. 6th Street. It would remain in a subway beneath N. 6th Street from W. Wisconsin Avenue to W. Brown Street for a distance of about 1.2 miles. The line would then be located on a surface alignment adjacent to W. Brown Street between N. 6th Street and the North-South Freeway (IH 43), a distance of about 0.3 mile. From here, the alignment would enter the cleared right-of-way of the Park West Freeway on an elevated structure to N. Sherman Boulevard, a distance of about 2.3 miles. It would remain on an elevated structure over the median of N. Sherman Boulevard and W. Fond du Lac Avenue for about 3.3 miles. At N. 68th Street the alignment would enter the nonroadway portion of the Fond du Lac Freeway (STH 145) right-of-way, remaining along that right-of-way to N. Pilgrim Road in the Village of Menomonee Falls. The alignment would be elevated between N. 68th Street and W. Silver Spring Drive, a distance of about 1.3 mile; between Little Menomonee River Parkway Drive and N. 102nd Street, a distance of about 0.3 mile; and again over the

Map 33

EXISTING AVAILABLE RIGHTS-OF-WAY IN THE NORTHWEST CORRIDOR WITH GOOD POTENTIAL FOR FIXED GUIDEWAY PRIMARY TRANSIT DEVELOPMENT



The northwest corridor is located between the City of Milwaukee central business district and the Village of Menomonee Falls. This corridor contains many arterial street segments with good potential for fixed guideway location. In addition, a cleared freeway right-of-way exists in the corridor on the City of Milwaukee's near north side.

Source: SEWRPC.

W. Good Hope Road Interchange, a distance of about 0.2 mile. The remaining 6.0 miles of the alignment between W. Silver Spring Drive and Little Menomonee River Parkway Drive, S. 102nd Street and S. 109th Street, and W. Juniper Street to N. Pilgrim Road in the Village of Menomonee Falls would be located on the surface.

Alternative 2H, approximately 15.4 miles in length, would follow the same alignment followed by Alternative 1H for about 6.5 miles between N. Lincoln Memorial Drive and W. Capitol Drive in the City of Milwaukee. North of W. Capitol Drive, the remaining 8.9 miles of the alignment would be located on elevated structure over public street rights-of-way—more specifically, over W. Capitol Drive between W. Fond du Lac Avenue and W. Appleton Avenue, a distance of about 1.4 miles, and over W. Appleton Avenue between W. Capitol Drive in the City of Milwaukee and N. Pilgrim Road in the Village of Menomonee Falls, a distance of about 7.5 miles.

Table 59

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE NORTHWEST CORRIDOR

Cost Element	Unit Cost	Alternative Alignment			
		Alignment 1H		Alignment 2H	
		Quantity	Total Cost	Quantity	Total Cost
Surface Construction					
At-Grade Construction	$ 3.5	6.0 miles	$ 21.0	--	$ --
Fill Construction	--	--	--	--	--
Cut Construction	$22.0	0.3 mile	6.6	0.3 mile	6.6
Total	$ --	6.3 miles	$ 27.6	0.3 mile	$ 6.6
Grade-Separated Construction					
Aerial Construction	$16.0-$19.9	7.4 miles	$145.2	13.0 miles	$239.5
Subway Construction	$40.6	2.1 miles	85.3	2.1 miles	85.3
Total	$ --	9.5 miles	$230.5	15.1 miles	$324.8
Crossings					
Street and Highway					
At-Grade	$ --	--	$ --	--	$ --
Overpasses	$ 0.3	7	2.1	--	--
Underpasses	$ 0.3	3	0.9	--	--
Railroad	$ 0.3	1	0.3	--	--
Watercourse	$ 0.3	1	0.3	--	--
Subtotal	$ --	--	$261.7	--	$331.4
Engineering, Design, and Administration	15 percent	--	$ 39.2	--	$ 49.7
Contingencies	30 percent	--	$ 78.5	--	$ 99.4
Total Cost	--	--	$379.4	--	$480.5

NOTE: All costs are estimated in millions of 1979 dollars.

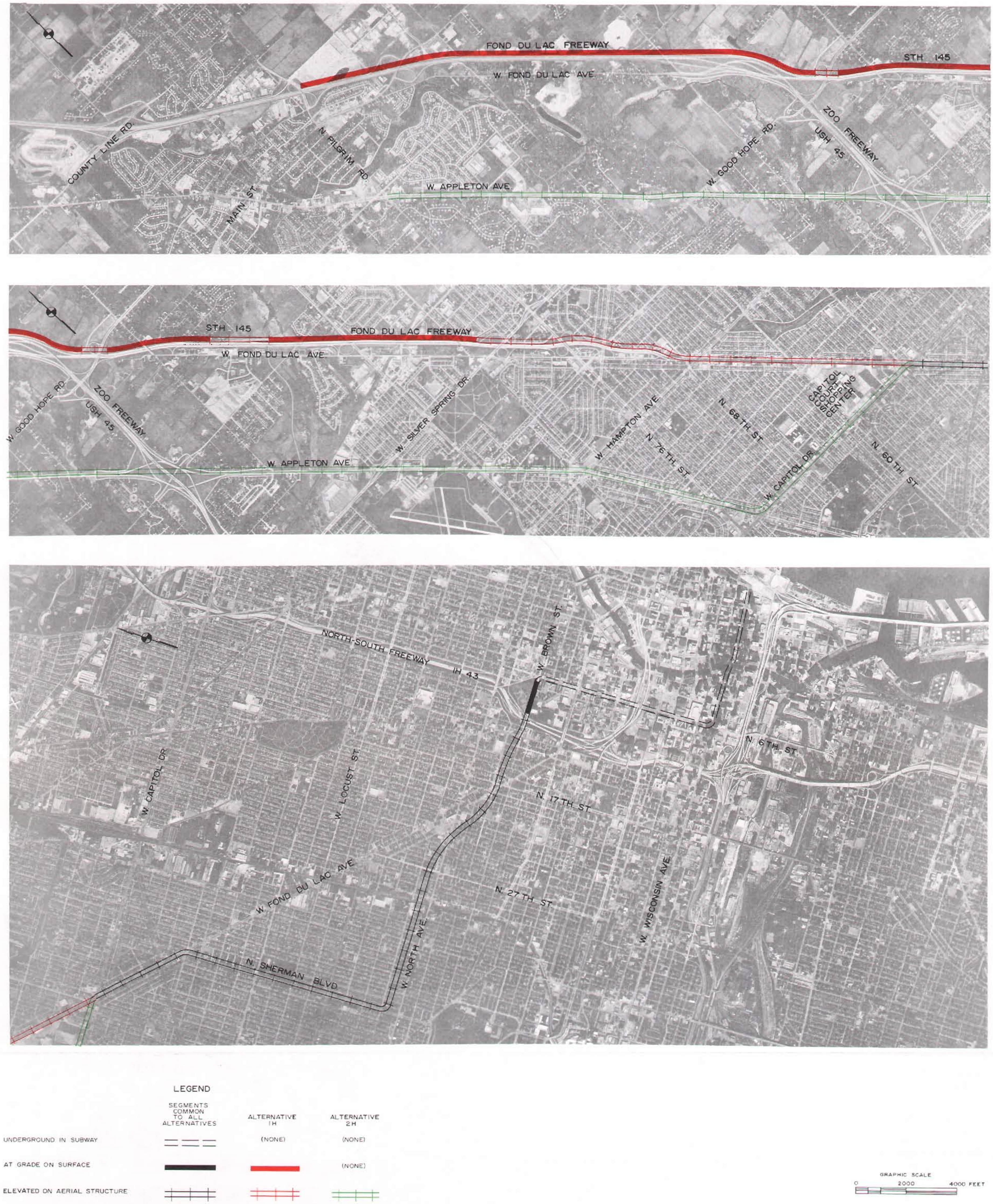
Source: SEWRPC.

Heavy Rail Rapid Transit Alignment Evaluation: As shown in Table 59, the capital cost of dual guideway construction for heavy rail rapid transit along Alternative Alignment 1H is estimated to total $379 million in 1979 dollars, or an average cost of $24 million per mile. The cost of constructing a dual guideway along Alignment 2H is estimated at $480 million, or an average cost of $31 million per mile. A breakdown of guideway capital costs by segment of the heavy rail rapid transit alignments is shown in Table 60.

Alternative 1H would utilize a strip of land about 15.8 miles in length, including about 7.8 miles of existing freeway right-of-way, 5.4 miles of public street right-of-way, 0.3 mile of public land adjacent to W. Brown Street, and about 2.3 miles of cleared right-of-way of the Park West Freeway. Of the public street right-of-way used, the transit facility would be in a subway for a distance of about 2.1 miles, and on an elevated structure for the remaining 3.3 miles. Alternative 2H would utilize a strip of land about 15.4 miles in length, including 2.3 miles of cleared freeway right-of-way and 12.8 miles of public street right-of-way, of which the facility would be in a subway for about 2.1 miles, and on an elevated structure for about 10.7 miles. It would also use about 0.3 mile of publicly owned land adjacent to W. Brown Street between N. 6th Street and the North-South Freeway (IH 43). Neither of the two alternative alignments would require the taking of any residential, commercial, or industrial structures.

Map 34

HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE NORTHWEST CORRIDOR

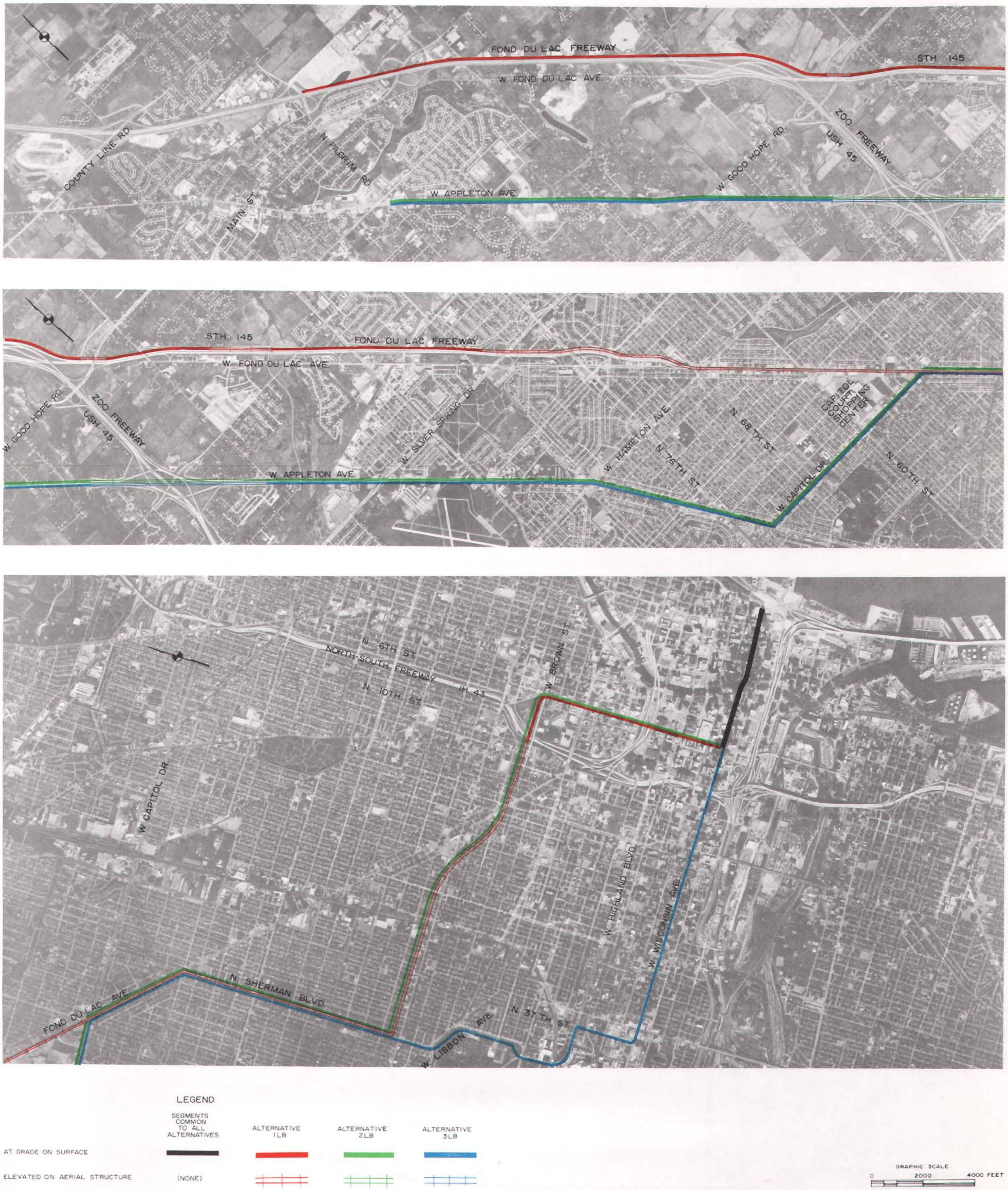


Two alternative fixed guideway alignments suitable for the provision of heavy rail rapid transit service were identified within the northwest corridor. The two alternative alignments are similar, and would utilize the same alignment between the Milwaukee central business district and the Capitol Court Shopping Center area, where the alternatives diverge to follow two somewhat parallel alignments in a northwesterly direction to the Village of Menomonee Falls. Except for a subway beneath Wisconsin Avenue and N. 6th Street in downtown Milwaukee, the common alignment for the alternatives to the Capitol Court Shopping Center would be located on elevated structure. Northwest of the Capitol Court Shopping Center area, Alternative 1H, the preferred alignment, would utilized a combination of elevated structure and surface alignment within the right-of-way of W. Fond du Lac Avenue and the Fond du Lac Freeway (STH 145), while Alternative 2H would utilize an elevated structure located entirely within the right-of-way of W. Appleton Avenue and W. Capitol Drive.

Source: SEWRPC.

Map 35

LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE NORTHWEST CORRIDOR



Three alternative fixed guideway alignments suitable for the provision of light rail transit/busway service were identified within the northwest corridor. All three alternative alignments would utilize a surface transit mall in downtown Milwaukee. Alternative 1LB would utilize the right-of-way of the proposed Park West Freeway as well as the existing Fond du Lac Freeway to reach the Menomonee Falls area along an alignment that is elevated over most of its length. Alternatives 2LB and 3LB would be located entirely on the surface and extend into Menomonee Falls over the right-of-way of W. Appleton Avenue. Alternative 2LB, the preferred alignment, would utilize the right-of-way of the proposed Park West Freeway in the more intensively developed areas of the City of Milwaukee, while Alternative 3LB would be located in the median area of W. Wisconsin Avenue and through Washington Park.

Source: SEWRPC.

Table 60

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE NORTHWEST CORRIDOR

Segment	Alignment 1H Distance (miles)	Alignment 1H Total Guideway Construction Cost (millions of dollars)	Alignment 1H Average Unit Cost (millions of dollars per mile)	Alignment 2H Distance (miles)	Alignment 2H Total Guideway Construction Cost (millions of dollars)	Alignment 2H Average Unit Cost (millions of dollars per mile)
Milwaukee Central Business District (N. Lincoln Memorial Drive) to N. Sherman Boulevard	4.7	$201.3	$42.8	4.7	$201.3	$42.8
N. Sherman Boulevard to N. Silver Spring Drive	4.7	132.7	28.2	5.8	165.2	28.5
N. Silver Spring Drive to the Village of Menomonee Falls (N. Pilgrim Road)	6.4	45.4	7.1	4.9	114.0	23.3
Total Milwaukee Central Business District (N. Lincoln Memorial Drive) to the Village of Menomonee Falls (N. Pilgrim Road)	15.8	$379.4	$24.0	15.4	$480.5	$31.2

Source: SEWRPC.

Table 61

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE NORTHWEST CORRIDOR

Segment	Alignment 1H Distance (miles)	Alignment 1H Average Speed (miles per hour)	Alignment 1H Travel Time (minutes) Station-to-Station	Alignment 1H Travel Time (minutes) Cumulative	Alignment 2H Distance (miles)	Alignment 2H Average Speed (miles per hour)	Alignment 2H Travel Time (minutes) Station-to-Station	Alignment 2H Travel Time (minutes) Cumulative
Milwaukee Central Business District (N. Lincoln Memorial Drive and E. Wisconsin Avenue) to N. Sherman Boulevard	4.7	35	8	- -	4.7	35	8	- -
N. Sherman Boulevard to W. Silver Spring Drive	4.7	38	7	15	5.8	38	9	17
W. Silver Spring Drive to Village of Menomonee Falls (N. Pilgrim Road)	6.4	49	8	23	4.9	49	6	23

Source: SEWRPC.

Line-haul travel times between selected segments of the two heavy rail rapid transit alignments are summarized in Table 61. The overall travel times between the Village of Menomonee Falls and the Milwaukee central business district would be the same for both alternatives, about 23 minutes.

The two alternative alignments are comparable in terms of accessibility to residents and jobs and service to major activity centers. As shown in Table 62, Alternative 1H would serve fewer total residents within a six-mile band centered on the alignment, 521,300, compared with 592,600 for Alternative 2H. Alignment 2H would serve a slightly greater number of residents within walking distance, 113,500, compared with 111,100 for Alternative 1H. Employment served within walking distance is also somewhat greater for Alignment 2H, 77,000 jobs, compared with 75,500 for Alternative 1H.

Table 62

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE NORTHWEST CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Household Population Served			Number of Jobs Served (one-half-mile walking distance)
	One-Half-Mile Walking Distance	15-Minute Feeder Bus Travel Time	Three-Mile Driving Distance	
1H	111,100	446,000	521,300	75,500
2H	113,500	449,300	592,600	77,000

Source: SEWRPC.

Recommended Heavy Rail Rapid Transit Alignment: Table 63 summarizes the results of the preliminary assessment of the capital cost, community disruption, travel time, and accessibility to both jobs and population for each of the heavy rail rapid transit alternative alignments. Alternative 1H is the preferred heavy rail rapid transit alignment in the northwest corridor. It would provide service to the same number of residents and jobs within walking distance while providing the same travel times provided under Alternative 2H, yet would require fewer financial resources for construction.

Light Rail Transit/Busway Alignments: Three alternative light rail transit/busway alignments were selected for analysis in the northwest corridor. All three of these alignments would originate in the Milwaukee central business district and terminate in the Village of Menomonee Falls in Waukesha County. The alignments would utilize a combination of existing and cleared freeway rights-of-way and public street rights-of-way.

One alignment, Alternative 1LB, approximately 15.8 miles in length, would be quite similar to heavy rail rapid transit Alternative 1H. It would have the same horizontal and vertical configuration along approximately 13.7 miles of its length from N. 6th Street and W. Brown Street to N. Pilgrim Road in the Village of Menomonee Falls. It would differ from the heavy rail rapid transit alignment only between N. Lincoln Memorial Drive and W. Brown Street, where it would be located on the surface in a transit mall for about 0.9 mile along E. and W. Wisconsin Avenue between N. Lincoln Memorial Drive and N. 6th Street; and along N. 6th Street between W. Wisconsin Avenue and W. Brown Street, a distance of 1.2 miles, where it would be located within a public street right-of-way.

Alternative 2LB would follow the same alignment followed by heavy rail rapid transit Alternative 2H, but would be located on a surface alignment except between N. 111th Street and S. 118th Street, where it would be located on elevated structure for about 0.4 mile in a median over W. Appleton Avenue.

Alternative 3LB, approximately 15.4 miles in length, would follow the same alignment followed by Alternative 2LB north of the cleared right-of-way of the Park West Freeway and N. Sherman Boulevard, utilizing a surface alignment on public street rights-of-way for about 10.7 miles. The alignment south of the Park West Freeway cleared right-of-way would be located on the surface in the median of N. Sherman Boulevard for 0.2 mile to W. Lisbon Avenue. It would remain on a surface alignment through Washington Park, being located adjacent to W. Lisbon Avenue and N. 40th Street for about 0.7 mile. It would then enter the median of W. Highland Boulevard on a surface alignment for about 0.4 mile to N. 37th Street. The line would be located on a surface alignment in mixed traffic on N. 37th Street between W. Highland Boulevard and W. Wisconsin Avenue, about 0.4 mile.[1] Leaving N. 37th Street, the alignment would enter and operate over W. Wisconsin Avenue on reserved lanes to N. 10th Street, a distance of about 1.7 miles. The remaining 1.3 miles of the alignment would be located in a transit mall along W. and E. Wisconsin Avenue between N. 10th Street and N. Lincoln

[1] *For a distance of one block—between W. State Street and W. Highland Boulevard—N. 37th Street has a right-of-way width of 60 feet and a roadway width of only 30 feet.*

Table 63

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE NORTHWEST CORRIDOR

Evaluation Criteria	Alternative Alignment	
	Alignment 1H	Alignment 2H
Capital Cost (guideway construction cost in millions of dollars)	$379.4	$480.5
Community Disruption		
Type of Land Used (miles)		
Railroad and Former Interurban Right-of-Way	- -	- -
Existing Freeway Right-of-Way	7.8	- -
Cleared Freeway Right-of-Way	2.3	2.3
Public Street Right-of-Way	5.4	12.8
Public Land	0.3	0.3
Newly Acquired Right-of-Way	- -	- -
Total	15.8	15.4
Structure Dislocation (number)		
Residential Buildings	- -	- -
Commercial or Industrial Buildings	- -	- -
Public Buildings	- -	- -
Other Disruption	None	None
Travel Time (line-haul travel time in minutes to the Milwaukee CBD)	23	23
Population Served		
One-Half-Mile Walking Distance	111,100	113,500
Three-Mile Driving Distance	521,300	592,600
Jobs Served		
One-Half-Mile Walking Distance	75,500	77,000

Source: SEWRPC.

Memorial Drive. An optional routing for Alternative 3LB between the Washington Park area and downtown Milwaukee would be along W. Highland Boulevard east of N. 32nd Street instead of along W. Wisconsin Avenue. Although W. Highland Boulevard would provide a wide right-of-way and median area for guideway location in addition to less motor vehicle traffic, the W. Wisconsin Avenue alignment was selected because it would directly serve a larger number of major traffic generators, including Marquette University.

Light Rail Transit/Busway Alignment Evaluation: As indicated in Table 64, the capital cost of guideway construction for Alternative 1LB, the Class A light rail/busway alignment, is estimated at $266 million for a light rail transit system, or an average unit cost of $17 million per mile of dual guideway, and about $211 million for a busway, or about $13 million per mile of dual guideway. The capital cost of guideway construction for the Class B alignments would be significantly lower. Specifically, the cost of constructing a dual guideway for light rail transit along Alignment 2LB is estimated at $84 million, or an average cost of $5 million per mile. The comparable cost of constructing a dual busway is about $44 million, or an average cost of $3 million per mile. The capital cost of constructing Alternative 3LB is estimated to average $5 million per mile for a light rail transit system, or a total cost of about $83 million, and about $3 million per mile for a busway, or a total cost of about $44 million. A breakdown of guideway capital costs by segment of alternative light rail transit/busway alignment is shown in Table 65.

Table 64

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR LIGHT RAIL TRANSIT/BUSWAY FACILITIES IN THE NORTHWEST CORRIDOR

Cost Element	Unit Cost		Alternative Alignment									
			Alignment 1LB			Alignment 2LB			Alignment 3LB			
			Quantity	Total Cost		Quantity	Total Cost		Quantity	Total Cost		
	Light Rail	Busway		Light Rail	Busway		Light Rail	Busway		Light Rail	Busway	
Surface Construction												
At-Grade Construction	$2.7-$3.9	$0.9-$2.4	8.2 miles	$ 28.7	$ 10.3	15.0 miles	$50.2	$24.3	15.0 miles	$49.9	$23.7	
Fill Construction	$19.7	$14.0	0.3 mile	5.9	4.2	--	--	--	--	--	--	
Cut Construction	--	--	--	--	--	--	--	--	--	--	--	
Total	$ --	$ --	8.5 miles	$ 34.6	$ 14.5	15.0 miles	$50.2	$23.8	15.0 miles	$49.9	$23.7	
Grade-Separated Construction												
Aerial Construction	$15.5-$20.4	$14.0-$18.0	7.3 miles	$145.1	$127.7	0.4 mile	$ 6.2	$ 5.6	0.4 mile	$ 6.2	$ 5.6	
Subway Construction	--	--	--	--	--	--	--	--	--	--	--	
Total	$ --	$ --	7.3 miles	$145.1	$127.7	0.4 mile	$ 6.2	$ 5.6	0.4 mile	$ 6.2	$ 5.6	
Crossings												
Street and Highway												
At-Grade	$ --	$ --	--	$ --	$ --	--	$ --	$ --	--	$ --	$ --	
Overpasses	$ 0.3	$ 0.3	7	2.1	2.1	1	0.3	0.3	--	0.0	0.0	
Underpasses	$ 0.3	$ 0.3	3	0.9	0.9	--	0.0	0.0	--	0.0	0.0	
Railroad	$ 0.3	$ 0.3	1	0.3	0.3	2	0.6	0.6	2	0.6	0.6	
Watercourse	$ 0.3	$ 0.3	1	0.3	0.3	1	0.3	0.3	1	0.3	0.3	
Subtotal	$ --	$ --	--	$183.3	$145.8	--	$57.6	$30.6	--	$57.0	$30.2	
Engineering, Design, and Administration	15 percent	15 percent	--	$ 27.5	$ 21.9	--	$ 8.6	$ 4.6	--	$ 8.6	$ 4.5	
Contingencies	30 percent	30 percent	--	$ 55.0	$ 43.7	--	$17.3	$ 9.2	--	$17.1	$ 9.1	
Total Cost	--	--	--	$265.8	$211.4	--	$83.5	$44.4	--	$82.7	$43.8	

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

Table 65

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE NORTHWEST CORRIDOR

Segment	Alternative Alignment														
	Alignment 1LB					Alignment 2LB					Alignment 3LB				
	Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)		Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)		Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)	
		Light Rail	Busway	Light Rail	Busway		Light Rail	Busway	Light Rail	Busway		Light Rail	Busway	Light Rail	Busway
Milwaukee Central Business District (N. Lincoln Memorial Drive) to N. Sherman Boulevard	4.7	$ 89.3	$ 71.8	$19.0	$15.3	4.7	$28.1	$13.1	$6.0	$2.8	4.7	$27.3	$12.5	$5.8	$2.6
N. Sherman Boulevard to W. Silver Spring Drive	4.7	132.7	116.7	28.2	24.8	5.8	26.1	16.7	4.5	2.9	5.8	26.1	16.7	4.5	2.9
W. Silver Spring Drive to the Village of Menomonee Falls (N. Pilgrim Road)	6.4	43.8	22.9	6.8	3.6	4.9	29.3	14.6	6.0	3.0	4.9	29.3	14.6	6.0	3.0
Total Milwaukee Central Business District (N. Lincoln Memorial Drive) to the Village of Menomonee Falls (N. Pilgrim Road)	15.8	$265.8	$211.4	$16.8	$13.4	15.4	$83.5	$44.4	$5.4	$2.9	15.4	$82.7	$43.8	$5.4	$2.8

Source: SEWRPC.

Alternative 1LB would utilize a strip of land about 15.8 miles in length, including 7.8 miles of existing freeway right-of-way and 5.4 miles of public street right-of-way in the City of Milwaukee, along which the facility would be on a surface alignment for about 2.1 miles and on an elevated structure for the remaining 3.3 miles. Of the 2.1 miles of the alignment that would be located on the surface within public street right-of-way, about 1.0 mile would be located within a median, 0.9 mile would be located in a transit mall, and 0.2 mile would be located in a reserved lane on N. 6th Street between W. State Street and W. Wisconsin Avenue. In addition, the alignment would use about 0.3 mile of public land and about 2.3 miles of the Park West Freeway cleared right-of-way.

Alternative 2LB would utilize a strip of land about 15.4 miles in length, including a strip of parkland 0.3 mile in length, 2.3 miles of cleared freeway right-of-way, and 12.8 miles of public street right-of-way, along which the facility would be located in a transit mall for a distance of about 0.9 mile, within a median for about 11.7 miles, and in a reserved lane on N. 6th Street between W. State Street and W. Wisconsin Avenue for the remaining 0.2 mile. It should be noted that the location of a light rail transit/busway alignment over reserved lanes between W. State Street and W. Wisconsin Avenue along N. 6th Street under both Alternatives 1LB and 2LB would require the use of two existing arterial street lanes, leaving two lanes for motor vehicle traffic in each direction, and would require the prohibition of parking along both sides of the street.

Alternative 3LB would utilize a strip of land about 15.4 miles in length, including about 0.7 mile of parkland and 14.7 miles of public street right-of-way, over which the facility would be in a transit mall for 1.3 miles, within a median for 11.3 miles, in mixed traffic for 0.4 mile, and in a reserved lane between N. 36th Street and N. 10th Street along W. Wisconsin Avenue for the remaining 1.7 miles. Location of a light rail transit/busway in a reserved lane along W. Wisconsin Avenue between N. 36th Street and N. 10th Street would leave two lanes of travel for motor traffic in each direction, and would require the prohibition of parking along this segment since the use of the curb lane in each direction would be required to maintain the two travel lanes in each direction. None of the three light rail transit/busway alignments would require the disruption of any residential, industrial, or commercial structures.

Line-haul travel times between selected segments of the three light rail transit/busway alignments are summarized in Table 66. Light rail transit under Alternative 1LB would provide about 16 percent faster travel times overall between the Village of Menomonee Falls and downtown Milwaukee, 35 minutes, compared with 42 minutes for Alternative 2LB and 43 minutes for Alternative 3LB. Comparable busway travel times are 37 minutes for Alternative 1LB, 47 minutes for Alternative 2LB, and 48 minutes for Alternative 3LB. It should be noted that if the station spacing of the light rail transit systems and busways of these alternatives approached that of heavy rail systems—specifically, an average spacing of one mile rather than one-half mile in high-density areas and two miles rather than one mile in medium-density areas—the travel times from the Village of Menomonee Falls to downtown Milwaukee would approach 33 minutes for both a light transit system and a busway under Alternative 1LB, 35 minutes for a light rail transit system and 37 minutes for a busway under Alternative 2LB, and 37 minutes for a light rail transit system and 38 minutes for a busway under Alternative 3LB.

The alignments are comparable in terms of accessibility to population and jobs and service to major activity centers. As shown in Table 67, Alternative 2LB would serve the greatest number of residents within a six-mile band around the alignment, 592,600, compared with 575,600 for Alternative 3LB and 521,300 for Alternative 1LB. Alternative 3LB would serve the greatest number of residents within walking distance, 114,600, compared with 113,500 for Alternative 2LB and 111,100 for Alternative 1LB. Alternative 2LB would serve the greatest number of jobs within walking distance, 77,000, compared with 75,500 for Alternative 1LB and 74,100 for Alternative 3LB.

Recommended Light Rail Transit/Busway Alignment: Table 68 summarizes the results of the preliminary assessment of the capital cost, disruption, travel time, and accessibility to both jobs and population for each of the light rail transit/busway alternative alignments in the northwest corridor. Alternative 2LB is the preferred alignment in the northwest corridor. While both Alternatives 2LB and 3LB are substantially less costly than Alternative 1LB, Alternative 2LB provides about the same travel time to downtown Milwaukee provided by Alternative 3LB, while serving a greater population within a three-mile driving distance of the align-

Table 66

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE NORTHWEST CORRIDOR

	Alternative Alignment														
	Alignment 1LB					Alignment 2LB					Alignment 3LB				
				Travel Time (minutes—light rail/busway)					Travel Time (minutes—light rail/busway)					Travel Time (minutes—light rail/busway)	
Segment	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Station-to-Station	Cumulative	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Station-to-Station	Cumulative	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Station-to-Station	Cumulative
Milwaukee Central Business District (N. Lincoln Memorial Drive and E. Wisconsin Avenue) to N. Sherman Boulevard	4.7	Typical light rail/busway	20/19	14/15	--	4.7	Typical light rail/busway	18/16	16/18	--	4.7	Typical light rail/busway	16/15	17/19	--
		Typical heavy rail	20/20	14/14	--		Typical heavy rail	20/19	14/15	--		Typical heavy rail	18/17	16/16	--
N. Sherman Boulevard to W. Silver Spring Drive	4.7	Typical light rail/busway	32/30	9/9	23/24	5.8	Typical light rail/busway	22/19	16/18	32/36	5.8	Typical light rail/busway	22/19	16/18	33/37
		Typical heavy rail	32/30	9/9	23/23		Typical heavy rail	30/26	12/13	26/28		Typical heavy rail	28/26	12/13	28/29
W. Silver Spring Drive to the Village of Menomonee Falls (N. Pilgrim Road)	6.4	Typical light rail/busway	32/30	12/13	35/37	4.9	Typical light rail/busway	28/26	10/11	42/47	4.9	Typical light rail/busway	28/26	10/11	43/48
		Typical heavy rail	39/39	10/10	33/33		Typical heavy rail	36/32	9/9	35/37		Typical heavy rail	33/32	9/9	37/38

[a] *Assumes light rail and busway transit station spacing of approximately one-quarter mile in the Milwaukee central business district; one-half mile in other high-density urban areas unless the guideway is fully grade-separated, where one-mile spacing is assumed; and one mile in medium-density urban areas. The wider station spacing represents typical heavy rail station spacing of approximately one-half mile in the Milwaukee central business district; one mile in other high-density urban areas; and two miles in medium-density areas.*

[b] *The average speeds are based upon typical acceleration and deceleration rates; typical maximum operating speeds, which vary based on type, location, and degree of grade separation of right-of-way; assumed typical station spacing; and a typical station dwell time of 30 seconds. Preferential treatment has been assumed at all at-grade crossings. These typical light rail and busway transit characteristics were established in SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology. The result is average speeds of about 11 miles per hour in malls and other reserved guideways on street rights-of-way in the central business district; of from 20 to 30 miles per hour on reserved guideways in all other street rights-of-way; and of from 20 to 40 miles per hour on all other private rights-of-way. The variation in these average speeds is a result of variation in station spacing.*

Source: SEWRPC.

Table 67

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE NORTHWEST CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

	Household Population Served			
Alternative	One-Half-Mile Walking Distance	15-Minute Feeder Bus Travel Time	Three-Mile Driving Distance	Number of Jobs Served (one-half-mile walking distance)
1LB	111,100	446,000	521,300	75,500
2LB	113,500	449,300	592,600	77,000
3LB	114,600	447,900	575,600	74,100

Source: SEWRPC.

ment, as well as more jobs within a one-half-mile walking distance.

At the request of the study advisory committee, three alternatives to the use of the cleared Park West Freeway right-of-way at the southern portion of the preferred alignment were considered in the northwest corridor. These alignments would instead use either W. Fond du Lac Avenue, W. Highland Avenue, or W. Lisbon and W. Walnut Avenues.

The alternative connection principally using W. Fond du Lac Avenue would leave the preferred alignment Alternative 2LB at N. 6th Street and

Table 68

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE NORTHWEST CORRIDOR

Evaluation Criteria	Alternative Alignment		
	Alignment 1LB Light Rail/Busway	Alignment 2LB Light Rail/Busway	Alignment 3LB Light Rail/Busway
Capital Cost (guideway construction cost in millions of dollars)	$265.8/$211.4	$83.5/$44.4	$82.7/$43.8
Community Disruption			
Type of Land Used (miles)			
Railroad and Former Interurban Right-of-Way	--	--	--
Existing Freeway Right-of-Way	7.8	--	--
Cleared Freeway Right-of-Way	2.3	2.3	--
Public Street Right-of-Way	5.4	12.8	14.7
Public Land	0.3	0.3	0.7
Newly Acquired Right-of-Way	--	--	--
Total	15.8	15.4	15.4
Structure Dislocation (number)			
Residential Buildings	--	--	--
Commercial or Industrial Buildings	--	--	--
Public Buildings	--	--	--
Other Disruption	Location of an alignment over reserved lanes on N. 6th Street would require the use of two existing street lanes, reducing the number of lanes to two in each direction between W. State Street and W. Wisconsin Avenue. Parking would be prohibited along this segment		Location of an alignment between N. 36th Street and N. 10th Street over W. Wisconsin Avenue would require the use of existing arterial street lanes, reducing the number of lanes to two in each direction. Parking would be prohibited along this segment
Travel Time (line-haul travel time in minutes to the Milwaukee CBD)	35/37	42/47	43/48
Population Served			
One-Half-Mile Walking Distance	111,100	113,500	114,600
Three-Mile Driving Distance	521,300	592,600	575,600
Jobs Served			
One-Half-Mile Walking Distance	75,500	77,000	74,100

Source: SEWRPC.

W. Walnut Street and proceed along W. Walnut Street in the median to W. Fond du Lac Avenue for about 0.4 mile. It would enter and operate over W. Fond du Lac Avenue for about 2.7 miles to N. Sherman Boulevard. The alignment in this segment would be required to operate in mixed traffic on W. Fond du Lac Avenue for about 2.1 miles between W. Walnut Street and N. 35th Street, and then to operate in the median of Fond du Lac Avenue between N. 35th Street and N. Sherman Boulevard, about 0.6 mile. The alignment would then return to that of Alternative 2LB, using the median of W. Fond du Lac Avenue, W. Capitol Drive, and W. Appleton Avenue to N. Pilgrim Road in the Village of Menomonee Falls.

A major disadvantage of this alternative alignment is that it would require light rail vehicles and motor buses to operate in mixed traffic over W. Fond du Lac Avenue between W. Walnut Street and N. 35th Street. This segment of W. Fond du Lac Avenue has a roadway of only 50 feet in width, sufficient for two lanes of moving traffic in each direction with parking prohibited. With the exception of most of its signalized intersection approaches, parking is currently permitted over this entire stretch of W. Fond du Lac Avenue, which is abutted almost entirely by retail and service land uses. There is little potential for any widening of this segment of W. Fond du Lac Avenue without entailing urban disruption except between W. Walnut Street and

N. 20th Street. Existing right-of-way along this segment of W. Fond du Lac Avenue is fully used by the existing sidewalks and roadway, and adjacent buildings have little or no setback from the sidewalks. Between N. 28th and N. 35th Streets, there is some underutilization of adjacent lands which may permit some street widening without a large amount of disruption. Most signalized intersections along this stretch of W. Fond du Lac Avenue are currently experiencing traffic congestion during peak travel hours, including the W. Fond du Lac Avenue intersections with N. 17th Street, N. 27th Street, N. 28th Street, W. Locust Street, W. Burleigh Street, and N. 35th Street. The impacts of mixed traffic transit operation on this segment of W. Fond du Lac Avenue would include not only delay to transit, with slower travel times and unreliability, but also disruption, particularly of left-turn and cross traffic, as well as of through traffic. As a consequence, use of W. Fond du Lac Avenue as an alternative alignment in the northwest corridor is not recommended.[2]

A second alternative to use of the Park West Freeway right-of-way for the light rail transit/busway alignment in the southern portion of the northwest corridor would be an alignment located along W. Walnut Street and W. Lisbon Avenue between N. 6th Street and N. Sherman Boulevard. This alignment would leave the preferred alignment Alternative 2LB at N. 6th Street and W. Walnut Street, proceeding within the median of W. Walnut Street to N. 24th Street, a distance of about 1.2 miles. It would then enter and operate over W. Lisbon Avenue for about 1.0 mile to N. Sherman Boulevard. The alignment in this segment would operate in the median of W. Lisbon Avenue between N. 24th Street and N. 30th Street for about 0.4 mile, and in mixed traffic for about 0.6 mile between N. 30th Street and N. Sherman Boulevard.

The major disadvantage of this alternative is the same as that of the Fond du Lac alternative. Mixed traffic transit operation would be required on W. Lisbon Avenue between W. Walnut Street and N. Sherman Boulevard. This stretch of W. Lisbon Avenue has a roadway ranging in width from 50 to 54 feet, with the exception of the segment between N. 39th and N. 41st Streets, which has a 62-foot-wide roadway. Parking is currently permitted on this entire stretch of W. Lisbon Avenue, which is abutted almost entirely by retail and service land uses. Traffic congestion during the morning and evening peak hours presently occurs at the W. Lisbon Avenue intersection with N. 35th Street. This alignment, although not desirable, would be preferable to the use of W. Fond du Lac Avenue in the northwest corridor.[3]

A third possible connection would be similar to the portion of Alternative 3LB between N. 6th Street and N. Sherman Boulevard, except that it would utilize W. Highland Boulevard instead of W. Wisconsin Avenue between N. 6th Street and Washington Park and N. Sherman Boulevard. Specifically, the alignment would leave W. Wisconsin Avenue at N. 16th Street, and proceed along N. 16th Street in a reserved lane in a northbound direction to W. State Street. The southbound facility would be located in a reserved lane over N. 17th Street. At W. State Street, the N. 16th Street northbound reserved lane facility and N. 17th Street southbound reserved lane facility would enter the median of N. 17th Street to W. Highland Boulevard, and would proceed along W. Highland Boulevard to Washington Park, where it would be located on parkland to N. Sherman Boulevard—a distance of about 2.6 miles.

Because this alignment would be located largely in a median or over reserved lanes, it would be reasonable to expect that the cost of guideway construction would not differ appreciably from that Alternative 3LB. Additionally, access to jobs and employment and line-haul travel time to downtown Milwaukee would not be expected to differ appreciably. Thus, either Wisconsin Avenue or Highland Boulevard could be used as a connection in the northwest corridor. It should be noted, however, that location of a light rail transit/busway alignment over W. Wisconsin Avenue would permit direct access to more major activity centers, including Deaconess Hospital, Milwaukee Children's Hos-

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[2] *The attractiveness of various fixed guideway development alternatives in the northwest corridor may be affected by the possible widening of W. Fond du Lac and W. Lisbon Avenues. Recommendations for such widening may result from the findings of the Milwaukee Northwest Side/Ozaukee County transportation improvement study, which is expected to be completed in mid-1981.*

[3] *Ibid.*

pital, Milwaukee County Medical Complex, and Marquette University. It may be concluded, therefore, that, as an alternative to the Park West Freeway, the best configuration for an alternative southern portion connection in the northwest corridor is the Wisconsin Avenue connection between N. 6th Street and N. Sherman Boulevard, or Alternative 3LB. This alternative connection should be selected as the preferred alternative in this corridor if it is determined that the use of the Park West Freeway cleared right-of-way is not desirable.

In addition to considering alternatives to the use of the Park West Freeway corridor, the Committee requested that the Fond du Lac Freeway right-of-way be investigated as a location for the alignment at the northern end of the corridor as an alternative to the median of W. Appleton Avenue. However, such location would be possible only north of W. Silver Spring Drive. South of W. Silver Spring Drive there is insufficient horizontal clearance to locate an at-grade guideway in the median, shoulder or nonroadway portion of the Fond du Lac Freeway. Thus, the northern portion of the alignment would have to remain in the median of Appleton Avenue between W. Capitol Drive and N. 91st Street, a distance of about 1.9 miles. The line would then enter the median of N. 91st Street and proceed along N. 91st Street for about 1.2 miles to the Fond du Lac Freeway (STH 145), where it would enter the nonroadway portion of its right-of-way, remaining along that right-of-way to N. Pilgrim Road in the Village of Menomonee Falls. The alignment would be elevated between Little Menomonee River Parkway and N. 102nd Street, a distance of about 0.3 mile, and again over the W. Good Hope Road Interchange, a distance of about 0.2 mile. The remaining 4.8 miles of the alignment between N. 102nd Street and N. 109th Street and from W. Juniper Street to N. Pilgrim Road would be located on the surface.

The estimated capital cost of guideway construction of the Fond du Lac alternative between N. 91st Street and N. Pilgrim Road is $39 million for a light rail transit system, or an average cost of $6 million per mile of dual guideway, and $20 million for a busway, or about $3 million per mile of dual guideway. The comparable cost of guideway construction in the median of W. Appleton Avenue between N. 91st Street and N. Pilgrim Road is $26 million for a light rail transit system, or an average cost of $6 million per mile of dual guideway, and $13 million for a busway, or about $3 million per mile of dual guideway.

A total of 25,000 residents and 9,000 jobs would be located within walking distance of the Fond du Lac alignment; 101,400 residents would be located within a two-mile feeder bus service range; and 140,900 residents would be located within a three-mile automobile driving range. The Appleton Avenue alignment would serve about 26,300 residents and 8,600 jobs within walking distance; 121,200 residents within a two-mile feeder bus service range; and 131,600 residents within a three-mile automobile driving range.

A total of 14 minutes would be required for light rail transit to traverse this segment of the Fond du Lac alignment at an average speed of 28 miles per hour (mph), while bus transit would require about 15 minutes at an average speed of about 26 mph. It would take about 9 minutes for light rail transit to traverse the segment of the Appleton Avenue alternative between N. 91st Street and N. Pilgrim Road at an average speed of 28 mph. Bus transit would require about 10 minutes at an average speed of 26 mph.

The cost of the Fond du Lac alternative is somewhat greater than that of the Appleton Avenue alternative with no appreciable difference in accessibility to jobs or population. The Fond du Lac Alternative would also entail about 35 percent longer travel times. It is therefore recommended that the preferred alignment remain that in the median of W. Appleton Avenue under the preferred alternative in the northwest corridor.

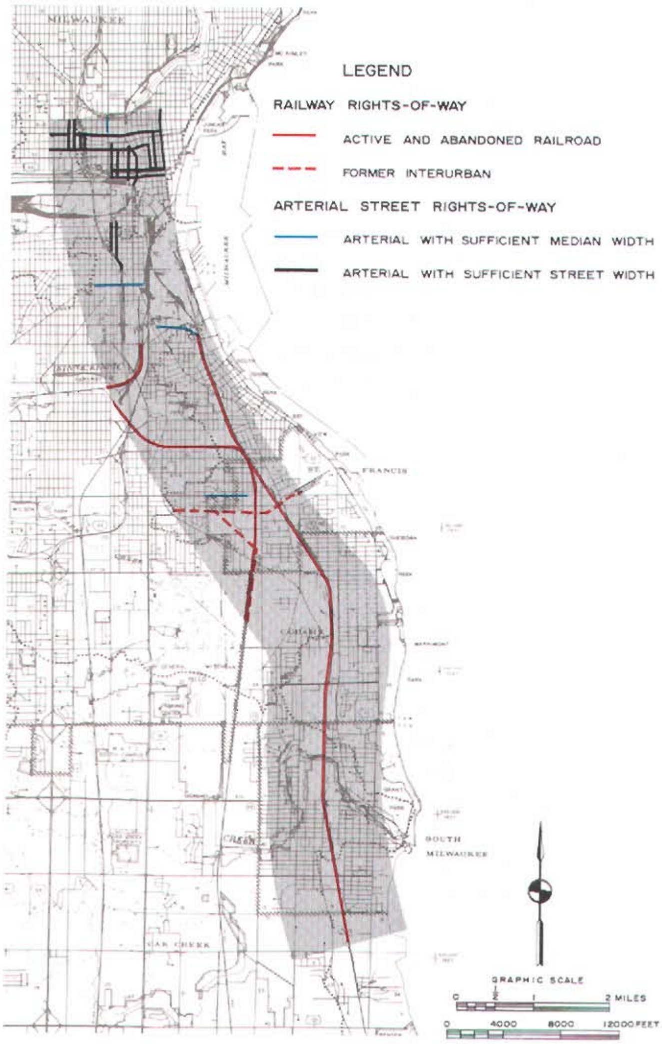
Fixed Guideway Alignments in the Southeast Corridor

Available rights-of-way determined to have good potential for the location of primary transit guideways in the southeast corridor radiating from the central business district of the Milwaukee area are identified on Map 36. Also shown on Map 36 are the generalized existing land use pattern in the corridor and the location of major activity centers. Two alternative heavy rail rapid transit alignments and three light rail transit/busway alignments, one of which is a Class A alignment and two of which are Class B alignments, were identified in the corridor, as shown on Maps 37 and 38.

Heavy Rail Rapid Transit Alignments: Both alternative heavy rail alignments extend from the Milwaukee central business district to the City of South Milwaukee in southeastern Milwaukee County. The alignments are located primarily along active railroad rights-of-way south of E. Linus

Map 36

EXISTING AVAILABLE RIGHTS-OF-WAY IN THE SOUTHEAST CORRIDOR WITH GOOD POTENTIAL FOR FIXED GUIDEWAY PRIMARY TRANSIT DEVELOPMENT



The southeast corridor is located between the City of Milwaukee central business district and the City of South Milwaukee. This corridor contains many arterial street segments with good potential for fixed guideway development in and around the Milwaukee central business district, but almost none within the remainder of the corridor. South of E. and W. Lincoln Avenue, there are both active and abandoned railroad rights-of-way with good potential for fixed guideway development.

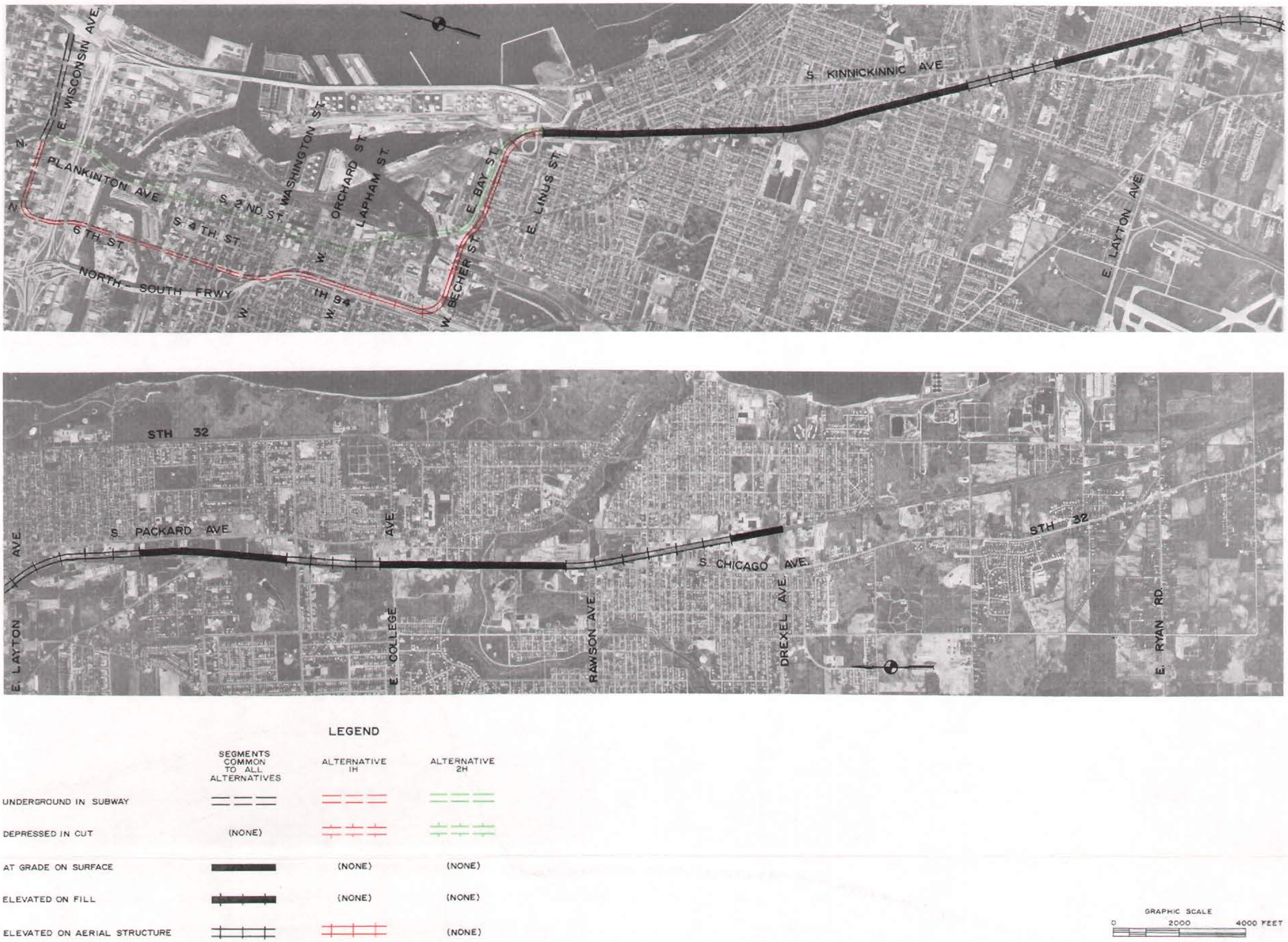
Source: SEWRPC.

Street in the City of Milwaukee. North of E. Linus Street the alignments are located along public street rights-of-way in the City of Milwaukee. One alignment, Alternative 1H, 11.9 miles in length, would begin in downtown Milwaukee at N. Lincoln Memorial Drive and extend 0.9 mile in a subway beneath E. and W. Wisconsin Avenue to N. 6th Street. It would remain in a subway beneath N. and S. 6th Street from W. Wisconsin Avenue to approximately W. Washington Street, a distance of about 1.5 miles, leave S. 6th Avenue for W. Polcyn Street at W. Washington Street, and remain beneath W. Polcyn Street to S. 4th Street, a distance of about 0.2 mile. At S. 4th Street the line would be located on a surface alignment along the nonroadway portion of the North-South Freeway (IH 43) right-of-way for about 0.2 mile to E. Orchard Street, then on an elevated structure over S. 4th Street between E. Orchard Street and W. Becher Street, a distance of about 0.6 mile. It would remain on an elevated structure for about 1.2 miles over W. Becher Street between S. 4th Street and S. Kinnickinnic Avenue and over the median of E. and S. Bay Street between S. Kinnickinnic Avenue and E. Linus Street. At E. Linus Street the alignment would enter the right-of-way of the Chicago & North Western Railway's Kenosha Subdivision main line, remaining within that right-of-way to E. Drexel Avenue in the City of South Milwaukee. The alignment would be elevated between E. Crawford Avenue and S. Barland Road, a distance of 0.5 mile, between E. Layton Avenue and E. Edgerton Avenue, a distance of 0.6 mile, between E. Ladish Avenue and E. Birchwood Avenue, a distance of 0.2 mile, and between E. Rawson Avenue and W. Menomonee Avenue, a distance of 0.9 mile. The remaining 5.1 miles of the alignment would be located on the surface within the railroad right-of-way.

Alternative 2H, approximately 11.0 miles in length, would follow the same alignment followed by Alternative 1H for about 7.4 miles from E. Linus Street in the City of Milwaukee to E. Drexel Avenue in the City of South Milwaukee. North of E. Linus Street, the remaining 3.6 miles of the alignment would be located in a subway beneath public street rights-of-way—more specifically, beneath E. and S. Bay Street between E. Linus Street and S. Kinnickinnic Avenue, a distance of about 0.8 mile; on new right-of-way for a distance of 0.1 mile between W. Lapham Street and S. 2nd Street; beneath S. Kinnickinnic Avenue between E. Bay Street and W. Lapham Street, a distance of about 0.4 mile; and beneath S. 2nd Street and N. Plankinton Avenue for a distance of about 1.7 miles to W. Wisconsin Avenue and beneath W. Wisconsin Avenue between N. Plankinton Avenue and N. Lincoln Memorial Drive, a distance of 0.6 mile.

Map 37

HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE SOUTHEAST CORRIDOR

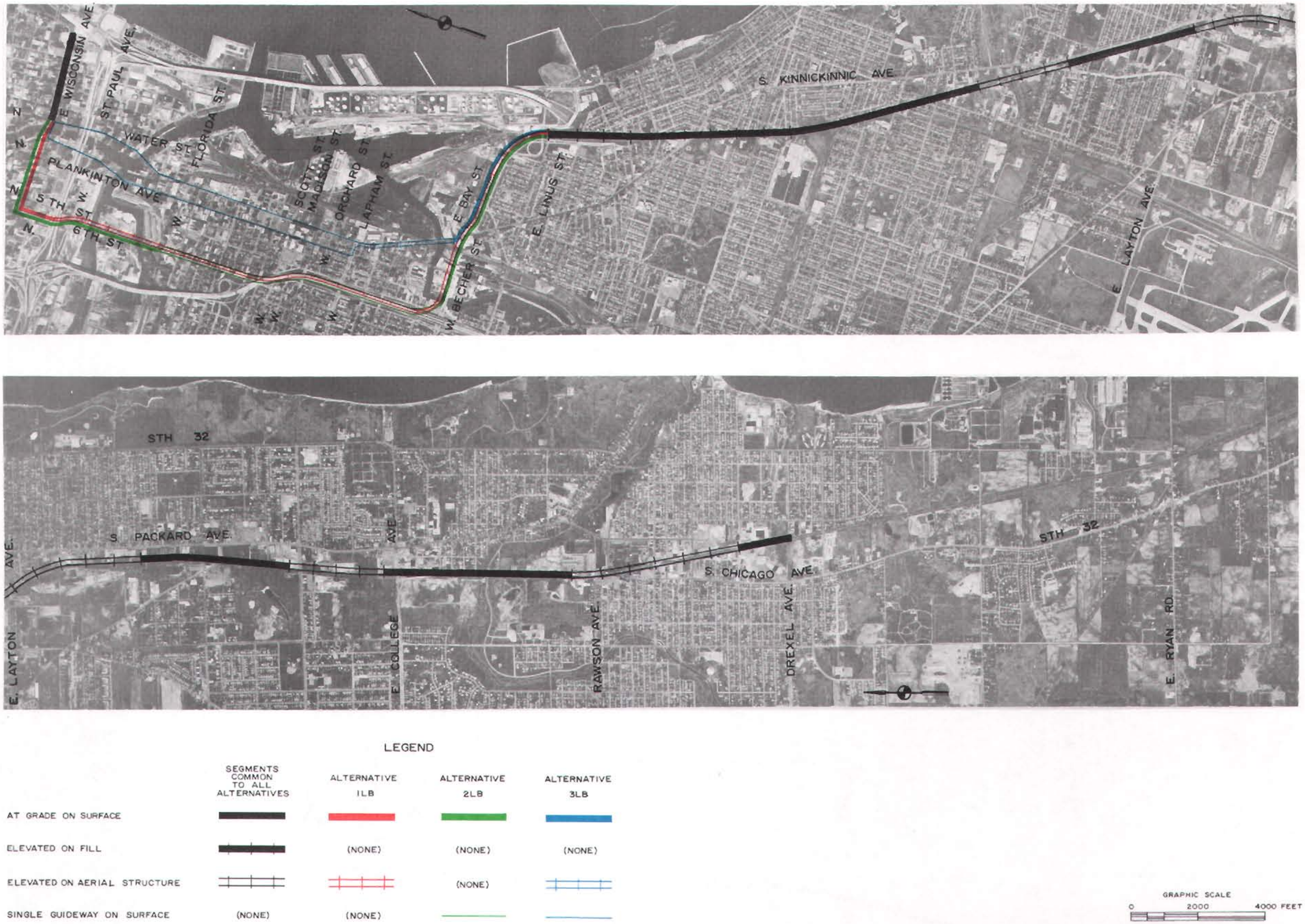


Two alternative fixed guideway alignments suitable for the provision of heavy rail rapid transit service were identified within the southeast corridor. The two alignments are similar except in the area of the City of Milwaukee's near south side. In this area, Alternative 1H, the preferred alignment, would be located primarily in a subway beneath S. 5th and S. 6th Streets, while Alternative 2H would be located in a subway beneath S. 1st Street and S. Kinnickinnic Avenue. South of E. Lincoln Avenue, both alternative alignments would be located principally on the right-of-way of the Chicago & North Western Railway's Kenosha Subdivision.

Source: SEWRPC.

Map 38

LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE SOUTHEAST CORRIDOR



Three alternative fixed guideway alignments suitable for the provision of light rail transit and busway service were identified within the southeast corridor. All three alternative alignments would utilize a surface transit mall in downtown Milwaukee along E. and W. Wisconsin Avenue. Alternative 1LB would gain access to downtown Milwaukee along S. 6th Street and would be located on an elevated structure for provision of a completed grade-separated, exclusive guideway immediately outside the Milwaukee central business district. Alternative 2LB, the preferred alignment, and Alternative 3LB would be located principally on the surface, with Alternative 2LB gaining access to downtown Milwaukee over S. 6th Street and Alternative 3LB gaining access to downtown Milwaukee over S. 1st and 2nd Streets.

Source: SEWRPC.

Table 69

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE SOUTHEAST CORRIDOR

Cost Element	Unit Cost	Alternative Alignment			
		Alignment 1H		Alignment 2H	
		Quantity	Total Cost	Quantity	Total Cost
Surface Construction					
At-Grade Construction	$3.2-$3.3	4.0 miles	$ 13.2	4.0 miles	$ 13.2
Fill Construction	$17.9	1.1 miles	19.7	1.1 miles	19.7
Cut Construction	$21.0-$22.0	0.2 mile	4.4	- -	- -
Total	- -	5.3 miles	$ 37.3	5.1 miles	$ 32.9
Grade-Separated Construction					
Aerial Construction	$16.2-$20.4	4.0 miles	$ 76.9	2.3 miles	$ 43.7
Subway Construction	$36.8-$38.1	2.6 miles	92.9	3.6 miles	133.7
Total	- -	6.6 miles	$169.8	5.9 miles	$177.4
Crossings					
Street and Highway					
At-Grade	$ - -	- -	$ - -	- -	$ - -
Overpasses	$ 0.3	7	2.1	7	2.1
Underpasses	$ 0.3	4	1.2	4	1.2
Railroad	$ 0.3				
Watercourse	$ 0.3	1	0.3	1	0.3
Subtotal	- -	- -	$210.7	- -	$213.9
Engineering, Design, and Administration	15 percent	- -	$ 31.6	- -	$ 32.1
Contingencies	30 percent	- -	$ 63.2	- -	$ 64.2
Total Cost	- -	- -	$305.5	- -	$310.2

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

Heavy Rail Rapid Transit Alignment Evaluation: As shown in Table 69, the capital cost of dual guideway construction for heavy rail rapid transit along Alternative Alignment 1H is estimated to total $306 million in 1979 dollars, or an average cost of $26 million per mile. The cost of constructing a dual guideway along Alignment 2H is estimated to total $310 million, or an average cost of $28 million per mile. A breakdown of guideway capital costs by segment of the heavy rail rapid transit alignments is shown in Table 70.

Alternative 1H would utilize a strip of land about 11.9 miles in length, including approximately 7.4 miles of active railroad right-of-way, 4.3 miles of public street right-of-way in the City of Milwaukee, and 0.2 mile of existing freeway right-of-way. Of the public street right-of-way used, the transit facility would be in a subway for about 2.5 miles, and on an elevated structure for the remaining 1.8 miles. The only disruption under this alternative would be attendant to the location of an elevated structure over E. Becher Street between S. 1st Street and S. Kinnickinnic Avenue, which would require the use of one arterial street lane, leaving a total of three lanes of travel for motor vehicle traffic.

Alternative 2H would utilize a strip of land approximately 11.0 miles in length, including 7.4 miles of active railway right-of-way, 3.5 miles of public street right-of-way, of which the facility would

Table 70

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE SOUTHEAST CORRIDOR

Segment	Alternative Alignment					
	Alignment 1H			Alignment 2H		
	Distance (miles)	Total Guideway Construction Cost (millions of dollars)	Average Unit Cost (millions of dollars per mile)	Distance (miles)	Total Guideway Construction Cost (millions of dollars)	Average Unit Cost (millions of dollars per mile)
Milwaukee Central Business District (N. Lincoln Memorial Drive) to W. Canal Street	1.7	$ 86.6	$54.1	0.9	$ 49.7	$55.2
W. Canal Street to the City of St. Francis (E. Crawford Avenue)	4.7	138.3	29.4	4.6	179.9	39.1
City of St. Francis (E. Crawford Avenue) to the City of Cudahy (E. Grange Avenue)	2.5	39.7	15.9	2.5	39.7	15.9
City of Cudahy (E. Grange Avenue) to the City of South Milwaukee (E. Drexel Avenue)	3.0	40.9	13.6	3.0	40.9	13.6
Total Milwaukee Central Business District (N. Lincoln Memorial Drive) to the City of South Milwaukee (E. Drexel Avenue)	11.9	$305.5	$25.7	11.0	$310.2	$28.2

Source: SEWRPC.

be in a subway for the entire distance, and about 0.1 mile of new right-of-way. The new right-of-way would be required where the alignment would leave S. Kinnickinnic Avenue at W. Lapham Street for S. 2nd Street. The displacement of three residential structures and two commercial or industrial structures would be entailed.

Line-haul travel times between selected segments of the two heavy rail rapid transit alignments are summarized in Table 71. Alternative 2H would have a small travel time advantage for trips originating north of E. Crawford Avenue in the City of St. Francis and having destinations within the Milwaukee central business district. The estimated line-haul travel time of the two alternatives from downtown Milwaukee to the City of South Milwaukee varies by about two minutes—17 minutes for Alternative 2H and 19 minutes for Alternative 1H.

The two alternative alignments are comparable in terms of accessibility to residents and jobs and service to major activity centers. As shown in Table 72, Alternative 2H would serve fewer total residents within a six-mile band around the alignment, 336,500, compared with 349,200 for Alternative 1H. Alignment 1H would also serve a greater number of residents within walking distance, 69,200, compared with 62,700 for Alternative 2H. In addition, Alternative 1H would serve a greater number of jobs within walking distance, 75,400, compared with 64,400 for Alternative 2H.

Recommended Heavy Rail Rapid Transit Alignment: Table 73 summarizes the results of the preliminary assessment of the capital cost, community disruption, travel time, and accessibility to both jobs and population for each of the heavy rail rapid transit alignments. Alternative 1H is the preferred alignment in the southeast corridor because it is less costly, would provide about 10 percent greater access to population and jobs within walking distance, would provide about the same travel times to downtown Milwaukee provided by Alternative 2H, and would not require any disruption of residential or commercial structures. It would, however, require that the number of travel lanes along W. Becher Street between S. 1st Street and S. Kinnickinnic Avenue be reduced to three for a distance of about 0.2 mile.

Light Rail Transit/Busway Alignments: Three alternative light rail transit/busway alignments were selected for analysis in the southeast corridor. All three of the alternative alignments would originate

Table 71

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE SOUTHEAST CORRIDOR

Segment	Alignment 1H Distance (miles)	Alignment 1H Average Speed (miles per hour)	Alignment 1H Travel Time (minutes) Station-to-Station	Alignment 1H Travel Time (minutes) Cumulative	Alignment 2H Distance (miles)	Alignment 2H Average Speed (miles per hour)	Alignment 2H Travel Time (minutes) Station-to-Station	Alignment 2H Travel Time (minutes) Cumulative
Milwaukee Central Business District (N. Lincoln Memorial Drive) to the City of St. Francis (E. Crawford Avenue)	6.4	34	11	--	5.5	36	9	--
City of St. Francis (E. Crawford Avenue) to the City of Cudahy (E. Grange Avenue)	2.5	40	4	15	2.5	40	4	13
City of Cudahy (E. Grange Avenue) to the City of South Milwaukee (E. Drexel Avenue)	3.0	45	4	19	3.0	45	4	17

Source: SEWRPC.

Table 72

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE SOUTHEAST CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Household Population Served: One-Half-Mile Walking Distance	Household Population Served: 15-Minute Feeder Bus Travel Time	Household Population Served: Three-Mile Driving Distance	Number of Jobs Served (one-half-mile walking distance)
1H	69,200	260,300	349,200	75,400
2H	62,700	227,200	336,500	64,400

Source: SEWRPC.

in the Milwaukee central business district and terminate in the City of South Milwaukee in southeastern Milwaukee County. The alignments would utilize a combination of active railway and public street rights-of-way.

One alignment, Alternative 1LB, approximately 11.9 miles in length, would be very similar to heavy rail rapid transit Alternative 1H. It would have the same horizontal and vertical configuration along approximately 9.2 miles of its length from W. Orchard Street to E. Drexel Avenue in the City of South Milwaukee. It would differ from the heavy rail rapid transit alignment only between N. Lincoln Memorial Drive and W. Orchard Street, where it would be located on the surface in a transit mall for 0.9 mile along E. and W. Wisconsin Avenue between N. Lincoln Memorial Drive and N. 6th Street; and along N. 6th Street between W. Wisconsin Avenue and W. St. Paul Avenue, where the alignment would be located within public street right-of-way in reserved lanes for 0.3 mile. The remaining 1.5 miles of the alignment between W. St. Paul Avenue and W. Orchard Street would be located on an elevated structure, of which 0.6 mile would be located over new right-of-way between W. St. Paul Avenue and W. Florida Street.

Alternative 2LB, approximately 12.0 miles in length, would follow the same basic alignment followed by Alternative 1LB south of E. Linus Street for a distance of about 7.4 miles. It would, however, be grade-separated only at selected major street and highway crossings and at those locations where an at-grade guideway could not be provided within the right-of-way. North of E. Linus Street, the alignment would be located on the surface within the median of S. and E. Bay Street for a distance of 0.9 mile to S. Kinnickinnic Avenue. At S. Kinnickinnic Avenue the alignment would be

Table 73

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE SOUTHEAST CORRIDOR

Evaluation Criteria	Alternative Alignment	
	Alignment 1H	Alignment 2H
Capital Cost (guideway construction cost in millions of dollars)	$305.5	$310.2
Community Disruption		
Type of Land Used (miles)		
Railroad Right-of-Way	7.4	7.4
Existing Freeway Right-of-Way	0.2	--
Cleared Freeway Right-of-Way	--	--
Public Street Right-of-Way	4.3	3.5
Vacant Land	--	--
Newly Acquired Right-of-Way	--	0.1
Total	11.9	11.0
Structure Dislocation (number)		
Residential Buildings	--	3
Commercial or Industrial Buildings	--	2
Public Buildings	--	--
Other Disruption	Location of an aerial structure over W. Becher Street between S. 1st Street and S. Kinnickinnic Avenue would require the use of one existing arterial street lane, reducing the number of travel lanes to a total of three for a distance of about 0.2 mile	None
Travel Time (line-haul travel time in minutes to the Milwaukee CBD)	19	17
Population Served		
One-Half-Mile Walking Distance	69,200	62,700
Three-Mile Driving Distance	349,200	336,500
Jobs Served		
One-Half-Mile Walking Distance	75,400	64,400

Source: SEWRPC.

located on an elevated structure over W. Becher Street for 0.2 mile to S. 1st Street, from where it would be located on the surface to S. 4th Street, a distance of about 0.2 mile. The line would then be located in reserved lanes along S. 4th Street between W. Becher Street and W. Madison Street, along W. Polcyn Street between W. Madison Street and W. Scott Street, along S. 5th Street between W. Washington Street and W. Virginia Street, and along S. Alexander Lane between W. Virginia and W. Florida Streets, providing service in a northbound direction for a distance of about 1.5 miles. The southbound facility would be located along S. 6th Street between W. Virginia Street and W. Elgin Street, along W. Baroga Street between W. Elgin Street and W. Madison Street, and along S. 5th Street between W. Madison Street and W. Becher Street. After the line leaves the one-way guideways along S. 5th Street and S. 6th Street at W. Florida Street, it would be located in mixed traffic over the S. 6th Street viaduct for 0.6 mile to W. St. Paul Avenue. The remaining 1.2 miles would follow the same alignment between W. St. Paul Avenue and N. Lincoln Memorial Drive used in Alternative 1LB.

Alternative 3LB, approximately 11.3 miles in length, would follow the same alignment followed by Alternative 2LB east of S. Kinnickinnic Avenue and south of E. Bay Street to the City of South Milwaukee, a distance of about 8.3 miles. The alignment north of E. Bay Street would be located on an elevated structure over S. Kinnickinnic Avenue to W. Lapham Street, a distance of about 0.6 mile. An elevated alignment was chosen because location of fixed guideway alignment in either reserved lanes or mixed traffic along this segment would limit lane width to less than 12 feet, and, thus, truck traffic would be unable to service industries along this segment. The alignment would enter the median of W. Lapham Street on the surface for about 0.1 mile to S. 2nd Street, from where it would be located in reserved lanes for about 1.3 miles to W. St. Paul Avenue. It would remain in a reserved lane along N. Plankinton Avenue between W. St. Paul Avenue and W. Wisconsin Avenue, a distance of 0.4 mile, providing service in a northbound direction only. The southbound facility would be located in a reserved lane on N. Water Street between W. Wisconsin Avenue and E. Pittsburgh, a distance of 0.6 mile, and along S. 1st Street between E. Pittsburgh and W. Lapham Street, a distance of about 1.1 miles. After the line leaves N. Plankinton Street and N. Water Street, it would be located in a transit mall along W. Wisconsin Avenue to N. Lincoln Memorial Drive, a distance of about 0.6 mile.

Light Rail Transit/Busway Alignment Evaluation: As indicated in Table 74, the capital cost of guideway construction for Alternative 1LB, the Class A light rail/busway alignment, is estimated at $215 million for a light rail transit system, or an average unit cost of $18 million per mile of dual guideway, and $178 million for a busway, or about $15 million per mile of dual guideway. The capital costs for guideway construction for the Class B alignments would be significantly lower. Specifically, the cost of constructing a dual guideway for light rail transit along Alignment 2LB is estimated at $139 million, or an average cost of about $12 million per mile. The comparable cost of constructing a dual busway is about $97 million, or an average cost of $8 million per mile. The capital cost of constructing Alternative 3LB is estimated to average $13 million per mile for a light rail transit system, or a total cost of about $148 million, and about $10 million per mile for a busway, or a total cost of about $108 million. A breakdown of guideway capital costs by segment of the alternative light rail transit/busway alignments is shown in Table 75.

Alternative 1LB would utilize a strip of land about 11.9 miles in length, including approximately 7.4 miles of active railroad right-of-way and 3.9 miles of public street right-of-way in the City of Milwaukee, along which the facility would be located on a surface alignment for about 1.2 miles and on an elevated structure for the remaining 2.7 miles. Of the 1.2 miles of the alignment that would be located on the surface within public street right-of-way, about 0.9 mile would be located in a transit mall and 0.3 mile would be located in a reserved lane on N. 6th Street between W. St. Paul Avenue and W. Wisconsin Avenue. This alignment would also require the acquisition of about 0.6 mile of new right-of-way adjacent to the 6th Street viaduct, land presently used by the Chicago, Milwaukee, St. Paul & Pacific (Milwaukee Road) railroad. Additionally, location of an elevated structure over W. Becher Street between S. 1st Street and S. Kinnickinnic Avenue would require use of about 0.2 mile of one arterial street lane, reducing the total number of travel lanes to three.

Alternative 2LB would utilize about 7.4 miles of active railway right-of-way and 6.1 miles of public street right-of-way. Of the 6.1 miles of public street right-of-way, 0.9 mile would be in a transit mall, 0.9 mile would be in a median, 0.6 mile would be in mixed traffic, 3.5 miles would be in a reserved lane, and 0.2 mile would be on an elevated structure. Location of an alignment on an elevated structure over W. Becher Street between S. 1st Street and S. Kinnickinnic Avenue would require the use of one arterial street lane, leaving a total of three lanes for motor vehicle traffic or parking. Additionally, location of an alignment in reserved lanes along N. 6th Street between W. Wisconsin Avenue and W. St. Paul Avenue and along W. Becher Street between S. 1st and S. 5th Streets would require the use of two arterial street lanes, leaving two lanes of travel in each direction for motor vehicle traffic or parking. Reserved lanes along S. 4th Street and S. 5th Street between W. Becher and W. Madison Streets and along W. Polcyn and W. Baroga Streets would require the use of one arterial street lane, leaving two lanes for motor traffic with parking prohibited.

Alternative 3LB would utilize about 7.4 miles of active railway right-of-way and 5.6 miles of public

Table 74

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR LIGHT RAIL TRANSIT/BUSWAY FACILITIES IN THE SOUTHEAST CORRIDOR

Cost Element	Unit Cost		Alternative Alignment								
			Alignment 1LB			Alignment 2LB			Alignment 3LB		
				Total Cost			Total Cost			Total Cost	
	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway
Surface Construction											
At-Grade Construction	$3.2-$4.0	$0.8-$2.3	5.2 miles	$ 17.5	$ 7.4	8.7 miles	$ 35.0	$13.2	7.7 miles	$ 31.7	$ 12.2
Fill Construction	$16.5	$14.1	1.1 miles	18.2	15.6	1.1 miles	18.2	15.6	1.1 miles	18.2	15.6
Cut Construction	--	--	--	--	--	--	--	--	--	--	--
Total	$ --	$ --	6.3 miles	$ 35.7	$ 23.0	9.8 miles	$ 53.2	$28.8	8.8 miles	$ 49.9	$ 27.8
Grade-Separated Construction											
Aerial Construction	$16.2-$20.4	$14.0-$18.0	5.6 miles	$109.0	$ 96.1	2.1 miles	$ 41.1	$36.1	2.5 miles	$ 49.0	$ 43.1
Subway Construction	--	--	--	--	--	--	--	--	--	--	--
Total	$ --	$ --	5.6 miles	$109.0	$ 96.1	2.1 miles	$ 41.1	$36.1	2.5 miles	$ 49.0	$ 43.1
Crossings											
Street and Highway											
At-Grade	$ --	$ --	18	$ --	$ --	60	$ --	$ --	63	$ --	$ --
Overpasses	$ 0.3	$ 0.3	7	2.1	2.1	5	1.5	1.5	5	1.5	1.5
Underpasses.	$ 0.3	$ 0.3	4	1.2	1.2	--	--	--	--	--	--
Railroad.	$ 0.3	$ 0.3	1	0.3	0.3	--	--	--	--	--	--
Watercourse.	$0.3-$0.7	$0.3-$0.7	1	0.3	0.3	1	0.3	0.3	3	1.7	1.7
Subtotal	$ --	$ --	--	$148.6	$122.7	--	$ 96.1	$66.7	--	$102.1	$ 74.1
Engineering, Design, and Administration	15 percent	15 percent	--	$ 22.2	$ 18.4	--	$ 14.4	$10.0	--	$ 15.3	$ 11.1
Contingencies	30 percent	30 percent	--	$ 44.5	$ 36.8	--	$ 28.8	$20.0	--	$ 30.6	$ 22.3
Total Cost	--	--	--	$215.3	$177.9	--	$139.3	$96.7	--	$148.0	$107.5

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

street right-of-way. Of the 5.6 miles of public street right-of-way, 0.6 mile would be in a transit mall, 1.0 mile would be in a median, 3.4 miles would be in a reserved lane, and 6.0 miles would be on an elevated structure. Location of an elevated structure over S. Kinnickinnic Avenue between E. Bay Street and W. Lapham Street would require the use of one arterial street lane, leaving a total of three lanes for motor vehicle traffic or parking. Additionally, location of a transit facility in reserved lanes along S. 2nd Street and Plankinton Avenue in a northbound direction and along S. 1st and N. Water Streets in a southbound direction would require the use of one arterial street lane on each of these facilities, leaving two lanes for motor vehicle traffic or parking in each direction along S. 1st Street, S. 2nd Street, N. Water Street, and Plankinton Avenue between W. Wisconsin Avenue and W. Lapham Street.

Line-haul travel times between selected segments of the three light rail transit/busway alignments are summarized in Table 76. Light rail transit under Alternative 1LB would provide somewhat faster travel times overall between the City of South Milwaukee and downtown Milwaukee, 29 minutes, compared with 35 minutes for Alternative 2LB and 31 minutes for Alternative 3LB. Comparable busway travel times are 33 minutes for Alternative 1LB, 38 minutes for Alternative 2LB, and 34 minutes for Alternative 3LB. It should be noted that if the station spacing of the light rail transit systems and busways of these alternatives approached that of heavy rail systems—specifically, an average spacing of one mile rather than one-half mile in high-density areas and two miles rather than one mile in medium-density areas—the travel times from the City of South Milwaukee to downtown Milwaukee would approach 25 minutes for

Table 75

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE SOUTHEAST CORRIDOR

Segment	Alternative Alignment														
	Alignment 1LB					Alignment 2LB					Alignment 3LB				
	Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)		Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)		Distance (miles)	Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)	
		Light Rail	Busway	Light Rail	Busway		Light Rail	Busway	Light Rail	Busway		Light Rail	Busway	Light Rail	Busway
Milwaukee Central Business District (N. Lincoln Memorial Drive) to W. St. Paul Avenue	1.3	$ 6.4	$ 3.8	$ 4.9	$ 2.9	1.3	$ 6.4	$ 3.8	$ 4.0	$2.4	1.2	$ 10.9	$ 4.9	$ 9.1	$ 4.1
W. St. Paul Avenue to the City of St. Francis (E. Crawford Avenue)	5.1	128.2	111.0	27.3	23.6	5.1	60.9	40.6	15.8	11.5	4.6	65.2	50.3	14.2	10.9
City of St. Francis (E. Crawford Avenue) to the City of Cudahy (E. Grange Avenue)	2.5	40.0	31.9	15.6	12.8	2.5	32.2	23.0	12.9	9.2	2.5	32.2	23.0	12.9	9.2
City of Cudahy (E. Grange Avenue) to the City of South Milwaukee (E. Drexel Avenue)	3.0	40.7	31.2	13.6	10.4	3.0	39.7	29.3	13.2	9.8	3.0	39.7	29.3	13.2	9.8
Total Milwaukee Central Business District (N. Lincoln Memorial Drive) to the City of South Milwaukee (E. Drexel Avenue)	11.9	$215.3	$177.9	$18.2	$15.1	11.9	$139.3	$96.7	$11.7	$ 8.2	11.3	$148.0	$107.5	$13.1	$ 9.5

Source: SEWRPC.

Table 76

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE SOUTHEAST CORRIDOR

Segment	Alternative Alignment														
	Alignment 1LB					Alignment 2LB					Alignment 3LB				
	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway)		Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway)		Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway)	
				Station-to-Station	Cumulative				Station-to-Station	Cumulative				Station-to-Station	Cumulative
Milwaukee Central Business District (N. Lincoln Memorial Drive) to the City of St. Francis (E. Crawford Avenue)	6.4	Typical light rail/busway	22/19	17/20	--	6.4	Typical light rail/busway	17/16	22/24	--	5.8	Typical light rail/busway	19/17	18/20	--
		Typical heavy rail	24/24	16/16	--		Typical heavy rail	20/19	19/20	--		Typical heavy rail	22/20	16/17	--
City of St. Francis (E. Crawford Avenue) to the City of Cudahy (E. Grange Avenue)	2.5	Typical light rail/busway	25/25	6/6	23/26	2.5	Typical light rail/busway	25/21	6/7	28/31	2.5	Typical light rail/busway	25/21	6/7	24/27
		Typical heavy rail	37/33	4/5	20/21		Typical heavy rail	30/30	5/5	24/25		Typical heavy rail	30/30	5/5	21/22
City of Cudahy (E. Grange Avenue) to the City of South Milwaukee (E. Drexel Avenue)	3.0	Typical light rail/busway	30/26	6/7	29/33	3.0	Typical light rail/busway	26/26	7/7	35/38	3.0	Typical light rail/busway	26/26	7/7	31/34
		Typical heavy rail	36/36	5/5	25/26		Typical heavy rail	35/30	5/6	29/31		Typical heavy rail	35/30	5/6	26/28

[a] *Assumes light rail and busway transit station spacing of approximately one-quarter mile in the Milwaukee central business district; one-half mile in other high-density urban areas unless the guideway is fully grade-separated, where one-mile spacing is assumed; and one mile in medium-density urban areas. The wider station spacing represents typical heavy rail station spacing of approximately one-half mile in the Milwaukee central business district; one mile in other high-density urban areas; and two miles in medium-density areas.*

[b] *The average speeds are based upon typical acceleration and deceleration rates; typical maximum operating speeds, which vary based on type, location, and degree of grade separation of right-of-way; assumed typical station spacing; and a typical station dwell time of 30 seconds. Preferential treatment has been assumed at all at-grade crossings. These typical light rail and busway transit characteristics were established in SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology. The result is average speeds of about 11 miles per hour in malls and other reserved guideways on street rights-of-way in the central business district; of from 20 to 30 miles per hour on reserved guideways in all other street rights-of-way; and of from 20 to 40 miles per hour on all other private rights-of-way. The variation in these average speeds is a result of variation in station spacing.*

Source: SEWRPC.

Table 77

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE SOUTHEAST CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Household Population Served			Number of Jobs Served (one-half-mile walking distance)
	One-Half-Mile Walking Distance	15-Minute Feeder Bus Travel Time	Three-Mile Driving Distance	
1LB	69,200	260,300	349,200	75,400
2LB	69,200	260,300	349,200	75,400
3LB	62,700	227,200	336,500	64,400

Source: SEWRPC.

a light rail transit system and 26 minutes for a busway under Alternative 1LB, 29 minutes for a light rail transit system and 31 minutes for a busway under Alternative 2LB, and 26 minutes for a light rail transit system and 28 minutes for a busway under Alternative 3LB.

The alignments are comparable in terms of accessibility to population and jobs and service to major activity centers. As shown in Table 77, Alternative 3LB would serve the fewest total residents within a six-mile band around the alignment, 336,500, compared with 349,200 for both Alternatives 1LB and 2LB. Alignments 1LB and 2LB would also serve a greater number of residents within walking distance, 69,200, compared with 62,700 for Alternative 3LB. Moreover, Alternatives 1LB and 2LB would serve a greater number of jobs within walking distance, 75,400, compared with 64,400 for Alternative 3LB.

Recommended Light Rail Transit/Busway Alignment: Table 78 summarizes the results of the preliminary assessment of the capital cost, community disruption, travel time, and accessibility to both jobs and population for each of the light rail transit/busway alignments. Alternative 2LB is the preferred light rail/busway alignment in the southeast corridor. Alternative 2LB is substantially less costly than Alternative 1LB, while providing equal access to population and jobs. Alternative 2LB does, however, call for a reduction in the amount of pavement width available to traffic on about 3.4 miles of streets, 0.2 mile of which will have, as a result, fewer than two lanes available for traffic or parking in each direction. Alternative 2LB and Alternative 3LB have about the same cost, but Alternative 2LB provides over 10 percent greater walking access to jobs and population. All three alternatives provide about equal travel times to downtown Milwaukee, with Alternative 1LB being about 10 percent faster.

At the request of the study advisory committee, a fourth alternative light rail transit/busway alignment—Alternative 4LB—was considered in the southeast corridor. As shown on Map 39, the key feature of this alternative is the location of a portion of the alignment over the completed segment of the Lake Freeway-South, which crosses the entrance to the Milwaukee inner harbor on the Daniel Hoan Memorial Bridge. This segment of freeway, unlike other freeway facilities in the Milwaukee area, can readily accommodate a fixed guideway primary transit facility within its existing roadway for two reasons. First, its physical configuration, including the configuration of its interchanges, permits development of a primary transit facility without substantial reconstruction. Second, existing and anticipated future traffic volumes on this segment of the freeway—specifically, 17,000 and 25,000 vehicles per average weekday in the years 1977 and 2000, respectively—would enable one existing freeway lane to be used in each direction without the creation of traffic congestion or the significant diversion of automobile or truck traffic from the freeway.

This fourth alternative light rail/busway alignment would be located on the surface in a transit mall for about 1.2 miles along E. and W. Wisconsin Avenue between N. 10th Street and N. Marshall Street. The alignment would then proceed in a southerly direction to W. Michigan Street along a strip of land about 0.1 mile in length currently owned by the Milwaukee County Park Commission and formerly used as the right-of-way for N. Marshall Street. It would then enter the pub-

Table 78

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE SOUTHEAST CORRIDOR

<table>
<tr><th rowspan="3">Evaluation Criteria</th><th colspan="3">Alternative Alignment</th></tr>
<tr><th>Alignment 1LB</th><th>Alignment 2LB</th><th>Alignment 3LB</th></tr>
<tr><th>Light Rail/Busway</th><th>Light Rail/Busway</th><th>Light Rail/Busway</th></tr>
<tr><td>Capital Cost (guideway construction cost in millions of dollars)</td><td>$215.3/$177.9</td><td>$139.3/$96.7</td><td>$148.0/$107.5</td></tr>
<tr><td>Community Disruption
Type of Land Used (miles)
Railroad and Former Interurban Right-of-Way</td><td>7.4</td><td>7.4</td><td>7.4</td></tr>
<tr><td>Existing Freeway Right-of-Way</td><td>- -</td><td>- -</td><td>- -</td></tr>
<tr><td>Cleared Freeway Right-of-Way</td><td>- -</td><td>- -</td><td>- -</td></tr>
<tr><td>Public Street Right-of-Way</td><td>3.9</td><td>6.1[a]</td><td>5.6[b]</td></tr>
<tr><td>Vacant Land</td><td>- -</td><td>- -</td><td>- -</td></tr>
<tr><td>Newly Acquired Right-of-Way</td><td>0.6</td><td>- -</td><td>- -</td></tr>
<tr><td>Total</td><td>11.9</td><td>13.5</td><td>13.0</td></tr>
<tr><td>Structure Dislocation (number)
Residential Buildings</td><td>- -</td><td>- -</td><td>- -</td></tr>
<tr><td>Commercial or Industrial Buildings</td><td>- -</td><td>- -</td><td>- -</td></tr>
<tr><td>Public Buildings</td><td>- -</td><td>- -</td><td>- -</td></tr>
<tr><td rowspan="2">Other Disruption</td><td colspan="2">Location of an alignment on an elevated structure over W. Becher Street between S. 1st Street and S. Kinnickinnic Avenue would require the use of one arterial street lane, leaving a total of three travel lanes. Additionally, location of an alignment on N. 6th Street in a reserved lane would require the use of two arterial street lanes and the prohibition of parking, leaving two lanes of travel in each direction</td><td rowspan="2">Location of an elevated structure over S. Kinnickinnic Avenue between E. Bay Street and W. Lapham Street would require the use of one arterial street lane, leaving two lanes of travel in each direction, with parking prohibited. Additionally, location of a transit facility in reserved lanes along S. 2nd Street and N. Plankinton Avenue in a northbound direction would require the use of one arterial street lane, leaving two lanes of travel S. 2nd Street in each direction and three lanes along N. Plankinton Avenue. Location of reserved lanes along S. 1st and N. Water Streets in a southbound direction would require the use of one arterial street lane, leaving two lanes of travel in each direction on both S. 1st and N. Water Streets. with parking prohibited</td></tr>
<tr><td></td><td>Location of an alignment in a reserved lane along W. Becher Street between S. 1st and S. 5th Streets would require the use of two arterial street lanes, leaving two lanes of travel in each direction. Reserved lanes along S. 4th and S. 5th Streets between W. Washington and Virginia Streets and along W. Polcyn and W. Baroga Streets would require the use of one arterial street lane and the prohibition of parking, leaving two lanes of travel in each direction</td></tr>
<tr><td>Travel Time (line-haul travel time in minutes to the Milwaukee CBD)</td><td>29/33</td><td>33/36</td><td>31/34</td></tr>
<tr><td>Population Served
One-Half-Mile Walking Distance
Three-Mile Driving Distance</td><td>69,200
349,200</td><td>69,200
349,200</td><td>62,700
336,500</td></tr>
<tr><td>Jobs Served
One-Half-Mile Walking Distance</td><td>75,400</td><td>75,400</td><td>64,400</td></tr>
</table>

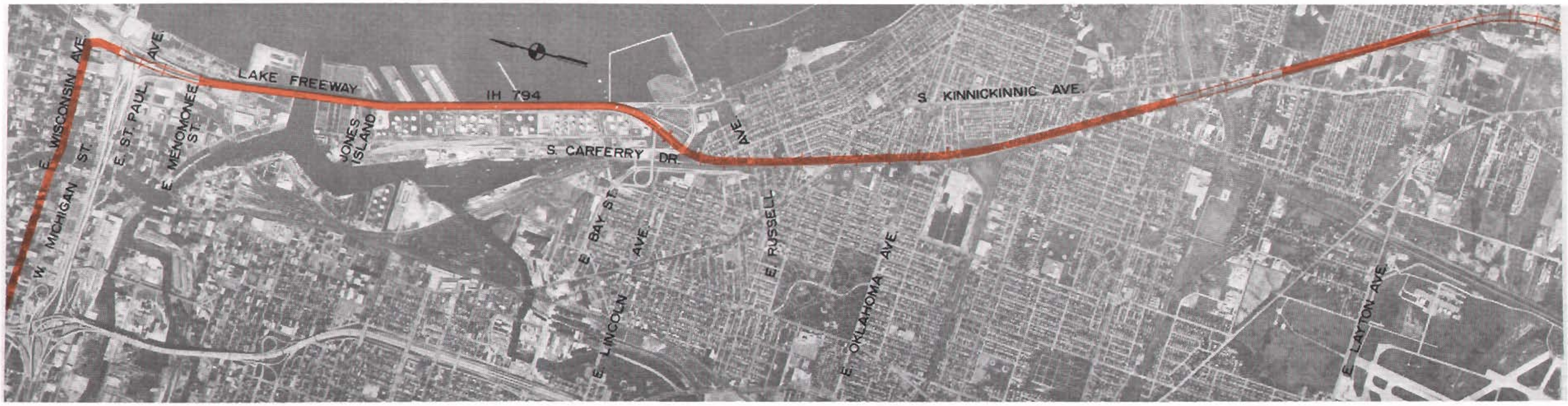
[a] *Includes two one-way guideways 1.5 miles in length.*

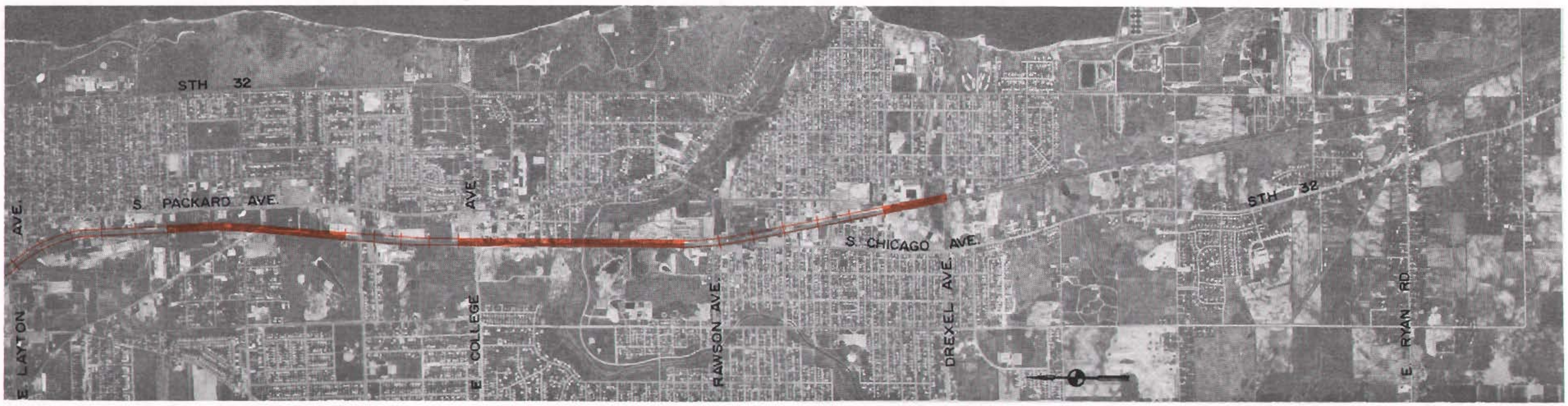
[b] *Includes two one-way guideways 1.7 miles in length.*

Source: SEWRPC.

Map 39

LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENT 4LB IN THE SOUTHEAST CORRIDOR





LEGEND

ALTERNATIVE 4LB

AT GRADE ON SURFACE

ELEVATED ON FILL

ELEVATED ON AERIAL STRUCTURE

GRAPHIC SCALE

0 2000 4000 FEET

At the request of the study advisory committee, a fourth alternative light rail transit and busway alignment was considered in the southeast corridor. Alternative 4LB would be located on the surface in a transit mall along E. and W. Wisconsin Avenue, and would utilize the existing structure of the Daniel Hoan Memorial Bridge and the Lake Freeway (IH 794) over the Milwaukee inner harbor and Jones Island area to gain access to the Bayview area of Milwaukee's south side. The alignment would then extend to the City of South Milwaukee along the Chicago & North Western Railway Kenosha Subdivision right-of-way on a combination of elevated and surface alignments. After consideration of Alternative 4LB, it was recommended that Alternative 2LB remain the preferred alignment for light rail transit and busways in the southeast corridor.

Source: SEWRPC.

licly owned right-of-way presently dedicated to the construction of the Lake Freeway-North Interchange to E. Menomonee Street, a distance of 0.4 mile, over an aerial structure. At W. St. Paul Avenue, the alignment would enter an elevated structure over publicly owned right-of-way presently dedicated to the construction of the Lake Freeway-North Interchange to E. Menomonee Street, a distance of about 0.3 mile. The line would then enter and operate over the existing Lake Freeway on reserved lanes for about 1.8 miles to E. Lincoln Avenue. Leaving the existing Lake Freeway facility at E. Lincoln Avenue, the alignment would be located on available right-of-way along an extension of the freeway on a fill for about 0.3 mile to E. Russell Avenue, from where it would be located within the right-of-way of the C&NW Kenosha Subdivision right-of-way. The busway alignment would be different for a distance of about 0.2 mile between E. Bay Street and S. Carferry Drive. In the southbound direction it would operate in mixed traffic over the existing freeway exit ramp to S. Carferry Drive. The northbound facility would operate in mixed traffic along S. Carferry Drive between the freeway exit and entrance ramps, enter the freeway entrance ramp, and operate in mixed traffic to a point about 0.1 mile north of E. Lincoln Avenue, a distance of about 0.3 mile. The alignment south of S. Carferry Drive would be located along an extension of the Lake Freeway on available right-of-way for about 0.3 mile to E. Russell Avenue. The alignment along the remaining 7.3 miles south of E. Russell Avenue to the City of South Milwaukee would be identical to that in Alternatives 2LB and 3LB, being located within the C&NW Kenosha Subdivision right-of-way.

The light rail alignment would utilize a strip of land approximately 11.2 miles in length, including about 7.3 miles of active railroad right-of-way, 1.8 miles of existing freeway right-of-way, and 1.2 miles of public street right-of-way on which the facility would be located in a transit mall. It would also use about 0.9 mile of vacant land, 0.5 mile of which is cleared right-of-way for the extension of the Lake Freeway, 0.1 mile of which is located between W. Wisconsin Avenue and W. Michigan Street and owned by the Milwaukee County Park Commission, and 0.3 mile of which is located between S. Carferry Drive and the C&NW Kenosha Subdivision and owned by the City of Milwaukee. The busway alignment would utilize a strip of land about 11.4 miles in length, including about 7.3 miles of active railway right-of-way, 1.9 miles of existing freeway right-of-way, and 1.3 miles of public street right-of-way. Of the 1.3 miles of alignment on public street right-of-way, 1.2 miles would be located in a transit mall and 0.1 mile would be in mixed traffic. The alignment would also use about 0.9 mile of vacant land, 0.5 mile of which is cleared right-of-way for the extension of the Lake Freeway, 0.1 mile of which is located between E. Wisconsin Avenue and E. Michigan Street and owned by the Milwaukee County Park Commission, and 0.3 mile of which is owned by the City of Milwaukee. It should be noted that the location of a light rail transit/busway alignment on reserved lanes over the Lake Freeway would require the use of two freeway lanes, leaving two lanes for motor vehicle traffic and a paved shoulder in each direction.

As shown in Table 79, the capital cost of guideway construction is estimated at $136 million for a light rail transit system, or an average cost of $12 million per mile of dual guideway, and about $93 million for a busway, or about $8 million per mile of dual guideway. Table 80 summarizes the capital costs of major segments of the alignment.

A total of 59,000 residents and 53,200 jobs would be located within walking distance of the alignment; 229,300 residents would be located within a two-mile feeder bus service range; and 323,800 residents would be located within a three-mile automobile driving range.

The estimated line-haul travel times for Alternative 4LB between the City of South Milwaukee and downtown Milwaukee are summarized in Table 81. Light rail transit would take a total of 29 minutes to traverse the alignment at an average speed of 23 mph, and bus transit would take about 32 minutes at an average speed of 20 mph.

Table 82 summarizes the results of the preliminary assessment of the capital cost, disruption, travel time, and accessibility to both jobs and population for each of the light rail transit/busway alternatives. Alternative 4LB would cost about $3 to $12 million less than would the Class B light rail and busway alignment alternatives in the corridor. Its overall travel times between downtown Milwaukee and the City of South Milwaukee would be about two to six minutes shorter than those for the other Class B light rail/busway alignment alternatives. Additionally, it would entail no use of lanes on standard arterial streets, utilizing two available lanes of the Lake Freeway. The disadvantage of Alternative 4LB is that it would not serve the near south side of the City of Milwaukee as well as would Alternatives 2LB and 3LB. Specifically, it

Table 79

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENT 4LB IN THE SOUTHEAST CORRIDOR

Cost Element	Unit Cost		Alternative Alignment 4LB			
			Light Rail		Busway	
	Light Rail	Busway	Quantity	Total Cost	Quantity	Total Cost
Surface Construction						
At-Grade Construction	$ 3.1-$ 5.7	$ 0.6-$ 3.2	7.8 miles	$ 28.9	8.1 miles	$ 9.3
Fill Construction	$16.5-$17.0	$14.2-$15.0	1.2 miles	19.9	1.1 miles	15.9
Cut Construction	--	--	--	--	--	--
Total	$ --	$ --	8.9 miles	$ 48.8	9.2 miles	$24.9
Grade-Separated Construction						
Aerial Construction	$16.2-$20.4	$14.0-$18.0	2.2 miles	$ 42.8	2.2 miles	$37.5
Subway Construction	--	--	--	--	--	--
Total	$ --	$ --	2.2 miles	$ 42.8	2.2 miles	$37.5
Crossings						
Street and Highway						
At-Grade	$ --	$ --	21	$ --	23	$ --
Overpasses	$ 0.3	$ 0.3	6	1.8	5	1.5
Underpasses	$ 0.3	$ 0.3	--	0.0	--	0.0
Railroad	$ 0.3	$ 0.3	--	0.0	--	0.0
Watercourse	$ 0.3	$ 0.3	1	0.3	1	0.3
Subtotal	$ --	$ --	--	$ 93.7	--	$64.2
Engineering, Design, and Administration	15 percent	15 percent	--	$ 14.0	--	$ 9.6
Contingencies	30 percent	30 percent	--	$ 28.0	--	$19.2
Total Cost	--	--	--	$135.7	--	$93.0

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

would serve about 15 percent fewer residents and about 30 percent fewer jobs within walking distance of the alignment than would Alternative 2LB. Thus, it is recommended that Alternative 2LB remain the preferred alignment in the southeast corridor since it would provide greater access to population and jobs within walking distance than would Alternative 4LB, while requiring a similar cost.

Fixed Guideway Alignments in the East-West Crosstown Corridor

Available rights-of-way determined to have good potential for the location of primary transit fixed guideways in the east-west crosstown corridor are identified on Map 40. Also shown on Map 40 are the generalized existing land use pattern in the corridor and the location of major activity centers. Unlike the first five corridors for which fixed guideway alignments have been identified, the east-west crosstown corridor does not serve the Milwaukee central business district. Instead, this corridor serves travel demands that extend across the Milwaukee area along a two-mile-wide band located approximately three miles north of the central business district. In general, the east-west crosstown corridor extends in a westerly direction from the University of Wisconsin-Milwaukee campus and the Village of Shorewood in eastern Milwaukee County to the City of Wauwatosa in western Mil-

Table 80

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENT 4LB IN THE SOUTHEAST CORRIDOR

Segment	Alternative Alignment 4LB					
	Distance (miles)		Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)	
	Light Rail	Busway	Light Rail	Busway	Light Rail	Busway
Milwaukee Central Business District (N. 10th Street and W. Wisconsin Avenue) to W. St. Paul Avenue	1.4	1.4	$ 11.0	$ 6.4	$ 7.8	$4.6
W. St. Paul Avenue to the City of St. Francis (E. Crawford Avenue).	4.3	4.5	52.8	34.3	12.2	7.8
City of St. Francis (E. Crawford Avenue) to the City of Cudahy (E. Grange Avenue). .	2.5	2.5	32.2	23.0	12.9	9.2
City of Cudahy (E. Grange Avenue) to the City of South Milwaukee (E. Drexel Avenue)	3.0	3.0	39.7	29.3	13.2	9.8
Total Milwaukee Central Business District (N. 10th Street and W. Wisconsin Avenue) to the City of South Milwaukee (E. Drexel Avenue)	11.2	11.4	$135.7	$93.0	$12.1	$8.2

Source: SEWRPC.

Table 81

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENT 4LB IN THE SOUTHEAST CORRIDOR

Segment	Alternative Alignment 4LB			
	Distance (miles) Light Rail/Busway	Average Speed (miles per hour—light rail/busway)	Travel Time (minutes—light rail/busway)	
			Station-to-Station	Cumulative
Milwaukee Central Business District (N. 10th Street and W. Wisconsin Avenue) to the City of St. Francis (E. Crawford Avenue)	5.7/5.9	21/20	16/18	- -
City of St. Francis (E. Crawford Avenue) to the City of Cudahy (E. Grange Avenue).	2.5/2.5	25/21	6/7	22/25
City of Cudahy (E. Grange Avenue) to the City of South Milwaukee (E. Drexel Avenue)	3.0/3.0	26/26	7/7	29/32

Source: SEWRPC.

Table 82

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE SOUTHEAST CORRIDOR

Evaluation Criteria	Alternative Alignment			
	Alignment 1LB	Alignment 2LB	Alignment 3LB	Alignment 4LB
	Light Rail/Busway	Light Rail/Busway	Light Rail/Busway	Light Rail/Busway
Capital Cost (guideway construction cost in millions of dollars)	$215.3/$177.9	$139.3/$96.7	$148.0/$107.5	$135.7/$9.3
Community Disruption				
Type of Land Used (miles)				
Railroad and Former Interurban Right-of-Way	7.4	7.4	7.4	7.3/7.3
Existing Freeway Right-of-Way	- -	- -	- -	1.8/1.9
Cleared Freeway Right-of-Way	- -	- -	- -	0.6/0.5
Public Street Right-of-Way	3.9	6.1[a]	5.6[b]	1.2/1.3
Public Land	- -	- -	- -	0.4/0.4
Newly Acquired Right-of-Way	0.6	- -	- -	- -
Total	11.9	13.5	13.0	11.2/11.4
Structure Dislocation				
Residential Buildings	- -	- -	- -	- -
Commercial or Industrial Buildings	- -	- -	- -	- -
Public Buildings	- -	- -	- -	- -
Other Disruption	Location of an alignment on an elevated structure over W. Becher Street between S. 1st Street and S. Kinnickinnic Avenue would require the use of one arterial street lane, leaving a total of three travel lanes. Additionally, location of an alignment on N. 6th Street in a reserved lane would require the use of two arterial street lanes and the prohibition of parking, leaving two lanes of travel in direction		Location of an elevated structure over S. Kinnickinnic Avenue between E. Bay Street and W. Lapham Street would require the use of one arterial street lane, leaving two lanes of travel in each direction, with parking prohibited. Additionally, location of a transit facility in reserved lanes along S. 2nd Street and N. Plankinton Avenue in a northbound direction would require the use of one arterial street lane, leaving two lanes of travel along S. 2nd Street in each direction and three lanes along N. Plankton Avenue. Location of reserved lanes along S. 1st and W. Water Streets in a southbound direction would require the use of one arterial street lane, leaving two lanes of travel in each direction on both S. 1st and N. Water Streets, with parking prohibited	Location of an alignment in reserved lanes along the Lake Freeway facility would require the use of two freeway lanes for about 1.8 miles, leaving two lanes of travel and a breakdown lane in each direction
		Location of an alignment in a reserved lane along W. Becher Street between S. 1st and S. 5th Streets would require the use of two arterial street lanes, leaving two lanes of travel in each direction. Reserved lanes along S. 4th and S. 5th Streets between W. Washington and Virginia Streets and along W. Polcyn and W. Baroga Streets would require the use of one arterial street lane and the prohibition of parking, leaving two lanes of travel in each direction		
Travel Time (line-haul travel time in minutes to the Milwaukee CBD)	29/33	33/36	31/34	29/32
Population Served				
One-Half-Mile Walking Distance	69,200	69,200	62,700	59,000
Three-Mile Driving Distance	349,200	349,200	336,500	323,800
Jobs Served				
One-Half-Mile Walking Distance	75,400	75,400	64,400	53,200

[a] *Includes two one-way guideways 1.5 miles in length.*

[b] *Includes two one-way guideways 1.7 miles in length.*

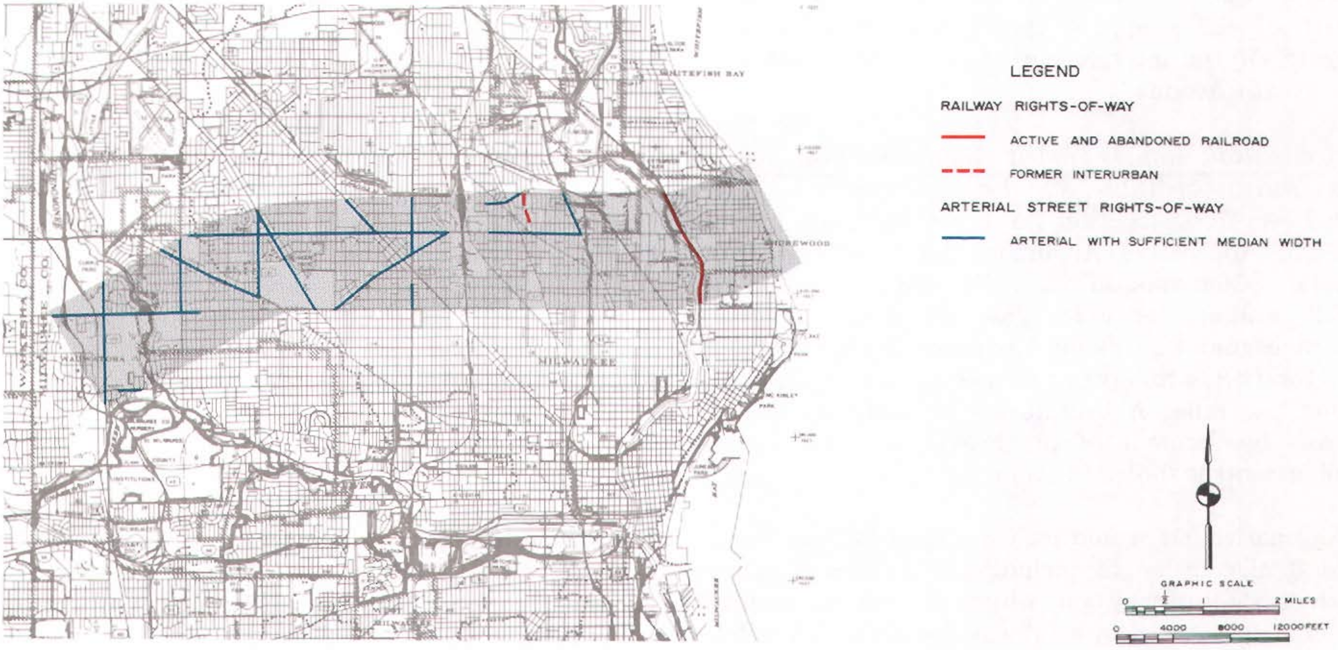
Source: SEWRPC.

waukee County. Two alternative heavy rail rapid transit alignments and four light rail transit/busway alignments, two which are Class A alignments and two which are Class B alignments, were identified in the corridor, as shown on Maps 41 and 42.

Heavy Rail Rapid Transit Alignments: Both alternative heavy rail rapid transit alignments terminate at the University of Wisconsin-Milwaukee campus at the eastern end of the corridor, and at the Mayfair Mall Shopping Center—located near the intersection of N. Mayfair Road and W. North Avenue in the City of Wauwatosa—at the western end of the corridor. The two alignments are located principally on public arterial street rights-of-way within the Village of Shorewood, the City of Milwaukee, and the City of Wauwatosa. One alignment, Alternative 1H, about 11.1 miles in length, would begin at the intersection of N. Maryland Avenue and E. Kenwood Boulevard and extend in a northerly direction 0.9 mile in a subway beneath N. Maryland Avenue. It would then curve in a westerly direction on newly acquired right-of-way onto E. Capitol Drive, remaining in a subway beneath E. and W. Capitol Drive to N. Estabrook Parkway, a distance of about 0.8 mile. Upon leaving the subway at N. Estabrook Parkway, the guideway would be located on an elevated structure cen-

Map 40

EXISTING AVAILABLE RIGHTS-OF-WAY IN THE EAST-WEST CROSSTOWN CORRIDOR WITH GOOD POTENTIAL FOR FIXED GUIDEWAY PRIMARY TRANSIT DEVELOPMENT



The east-west crosstown corridor is located along an axis between the Village of Shorewood on Lake Michigan and the City of Wauwatosa on the Waukesha County line. This corridor contains many arterial street segments with good potential for fixed guideway development west of the N. 33rd Street railway corridor. East of this railway corridor there are only a few such rights-of-way. Within this corridor there are virtually no active or abandoned railway rights-of-way that are aligned in the same general direction as the corridor.

Source: SEWRPC.

tered in the median of E. and W. Capitol Drive to W. Grantosa Drive, a distance of about 7.3 miles. In the segment, between N. Maryland Avenue and W. Grantosa Drive the fixed guideway would pass underneath the Chicago & North Western Capitol Drive spur track in the subway, and over the Milwaukee Road Chestnut Street line and Fifth Subdivision railroad main line, as well as the North-South Freeway (IH 43), on an elevated structure. At W. Grantosa Drive, the elevated alignment would enter Grantosa Parkway and continue to N. Mayfair Road (STH 100), a distance of about 0.4 mile. The alignment would then continue on an aerial structure over N. Mayfair Road in a southerly direction to W. Center Street, a distance of 1.3 miles. Upon leaving Mayfair Road at W. Center Street, the alignment would turn to the east and parallel N. Mayfair Road over a portion of the Mayfair Mall Shopping Center parking lot. The western terminal of this alignment would be located over the parking lot southwest of the shopping center mall complex and northeast of the intersection of N. Mayfair Road and W. North Avenue.

Alternative 2H, about 10.0 miles in length, would follow the same alignment followed by Alternative 1H east of N. 35th Street for about 4.7 miles. West of N. 35th Street the alignment would be located on elevated structure over W. Roosevelt Drive from N. 35th Street to N. 60th and W. Burleigh Streets, a distance of about 1.9 miles. At N. 60th Street, the aerial alignment would utilize the right-of-way of W. Burleigh Street as far west as N. Colonial Drive, a distance of about 2.3 miles. The elevated guideway would then leave W. Burleigh Street and proceed in a southwesterly direction for 1.2 miles to the Mayfair Mall Shopping Center parking lot. The right-of-way for this segment would be located on a combination of public and private lands—specifically, on property of

Mount Mary College, over the Menomonee River Parkway, on the Blue Mound Golf and Country Club property, and on the Mayfair Shopping Center parking lot. The western terminal of this alignment would be located over the parking lot southeast of the shopping center mall complex, but north of the intersection of N. 104th Street and W. North Avenue.

Heavy Rail Rapid Transit Alignment Evaluation: As shown in Table 83, the capital cost of dual guideway construction for heavy rail rapid transit along Alternative Alignment 1H is estimated to total $364 million in 1979 dollars, or about $33 million per mile. The cost of constructing a dual guideway along Alignment 2H is estimated to total $334 million, or an average cost of $33 million per mile. A breakdown of guideway capital costs by segment of the heavy rail rapid transit alignments is shown in Table 84.

Alternative 1H would utilize a strip of land about 11.1 miles in length, including 10.1 miles of public street right-of-way on which the transit facility would be located in a subway for about 1.5 miles, and on an elevated structure for the remaining 8.6 miles. It would also use about 0.4 mile of publicly owned parkland adjacent to W. Grantosa Drive in the City of Wauwatosa, and about 0.6 mile of newly acquired right-of-way. The new right-of-way would be located between N. Oakland Avenue and E. Beverly Road and would require the taking of approximately 11 dwelling units and three commercial or industrial structures in order to provide adequate alignment for a high-speed heavy rail rapid transit system. In addition, new right-of-way would be required for a distance of about 0.4 mile where the alignment crosses the parking lot of the Mayfair Mall Shopping Center.

Alternative 2H would utilize a strip of land about 10.1 miles in length, including 8.7 miles of public street right-of-way on which the facility would be located in a subway for about 1.5 miles, and on an elevated structure for about 7.2 miles. It would also use about 0.6 mile of publicly owned parkland located adjacent to the Menomonee River Parkway between W. Tower View Road and W. Center Street. Additionally, it would require the use of about 0.8 mile of new right-of-way. Of this 0.8 mile, 0.2 mile would consist of residential, commercial, and industrial land located between N. Oakland Avenue and E. Beverly Road, 0.3 mile would consist of open lands owned by the Blue Mound Golf and Country Club, 0.2 mile would be located on the eastern portion of the Mayfair Mall Shopping Center parking lot, and 0.1 mile would consist of open lands owned by Mount Mary College. This alternative would require the taking of the same 11 residential structures and three commercial or industrial structures that would have to be taken under Alternative 1H.

Line-haul travel times between selected segments of the two heavy rail rapid transit alignments are summarized in Table 85. Alternative 2H would require more travel time for trips between N. 35th Street and the Mayfair Mall Shopping Center. The estimated line-haul travel times from the University of Wisconsin-Milwaukee campus, the eastern terminus of the alignment, to the Mayfair Mall Shopping Center, at the western terminus, vary by about two minutes, 17 minutes for Alternative 1H and 15 minutes for Alternative 2H.

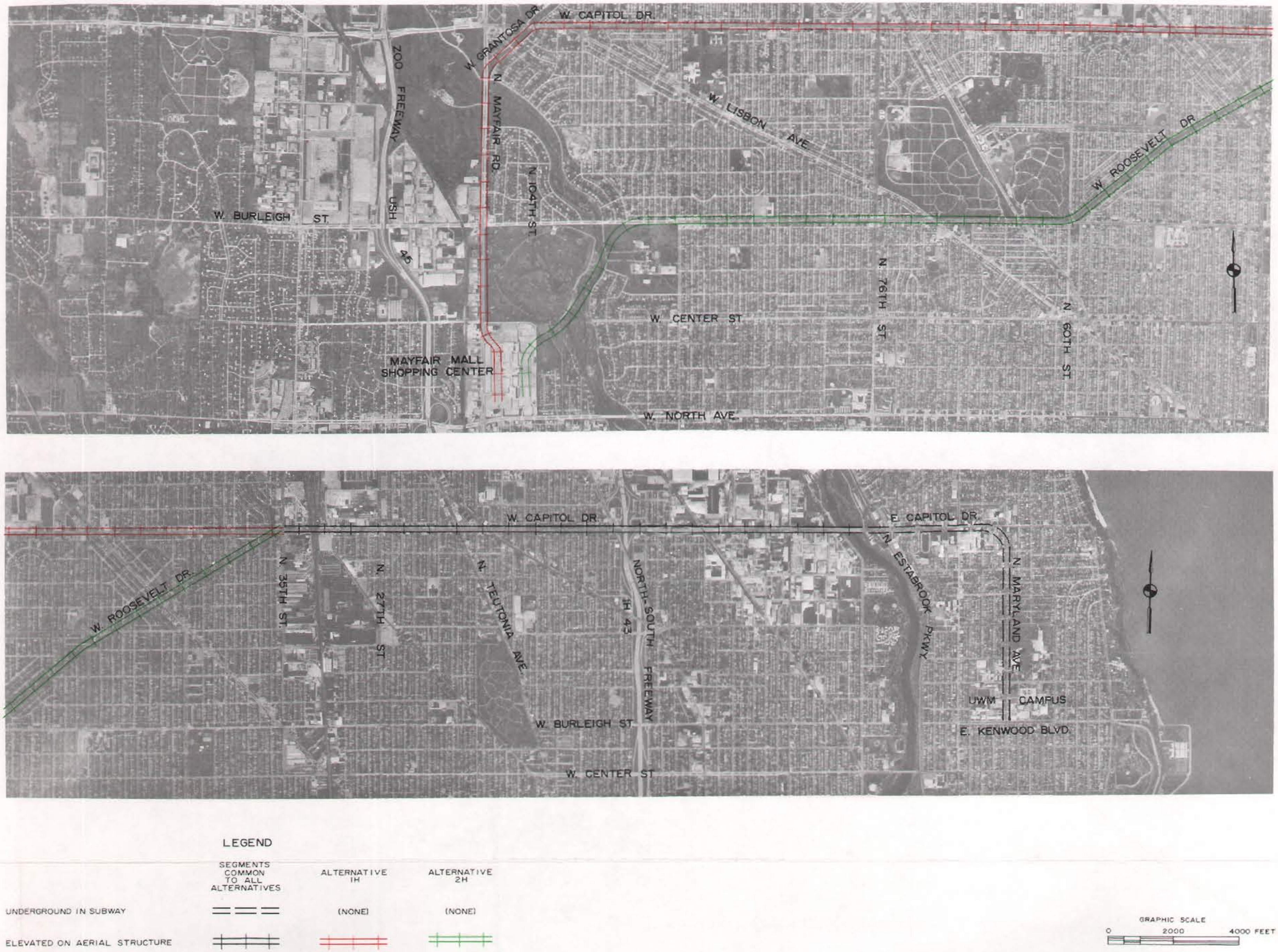
The two alternative alignments are comparable in terms of accessibility to residents and jobs and service to major activity centers. As shown in Table 86, Alternative 2H would serve a greater number of residents within a six-mile band around the alignment, approximately 455,800, compared with 433,900 for Alternative 1H. Alternative 2H would serve only slightly more residents within walking distance, 80,100, compared with 78,800 for Alternative 1H. However, Alternative 1H would serve a greater number of jobs within walking distance, 66,000, compared with 57,600 for Alternative 2H.

Recommended Heavy Rail Rapid Transit Alignment: Table 87 summarizes the results of the preliminary assessment of the capital cost, community disruption, travel time, and accessibility to both jobs and population for each of the heavy rail rapid transit alignments. Alternative 1H is the preferred heavy rail rapid transit alignment in the east-west corridor. It would provide about 15 percent greater access to jobs. Its travel times and access to population are similar to those of Alternative 2H, and its guideway construction cost is only about 8 percent greater.

Light Rail Transit/Busway Alignments: Four light rail transit/busway alignments were identified in this corridor, two of which are Class A alignments and two of which are a Class B alignments. All four alignments are similar to the alignments selected for the heavy rail rapid transit mode within the east-west crosstown corridor. The alignments would utilize a combination of active railway and public street rights-of-way. One alignment, Alternative 1LB, is very similar to heavy rail rapid transit

Map 41

HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE EAST-WEST CROSSTOWN CORRIDOR

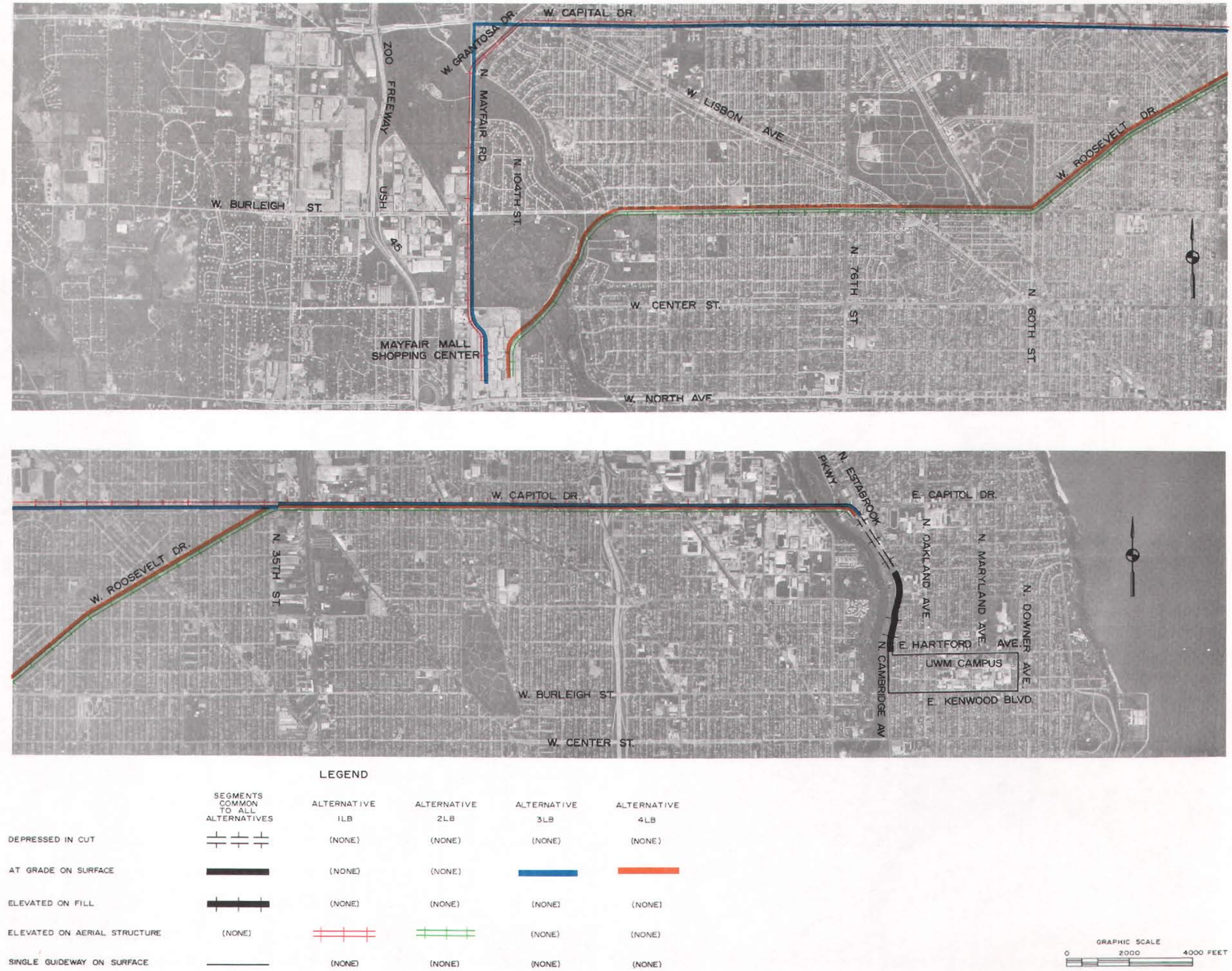


Two alternative fixed guideway alignments suitable for the provision of heavy rail rapid transit service were identified within the east-west crosstown corridor. The two alternatives would utilize a common alignment between the University of Wisconsin-Milwaukee campus and the intersection of N. 35th Street and W. Capitol Drive. This common segment would be located on an elevated structure except on that portion of the line east of the Milwaukee River, which would be located in a subway. West of N. 35th Street, Alternative 1H, the preferred alignment, would be located above W. Capitol Drive and N. Mayfair Road, terminating on the west side of the Mayfair Mall Shopping Center. Alternative 2H would be located above W. Roosevelt Drive and W. Burleigh Street, terminating on the east side of the Mayfair Mall Shopping Center. These two segments would be located entirely on elevated structures, providing a completely grade-separated, exclusive guideway.

Source: SEWRPC.

Map 42

LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE EAST-WEST CROSSTOWN CORRIDOR



Four alternative fixed guideway alignments suitable for the provision of light rail transit and busway service were identified within the east-west crosstown corridor. All four alignments would gain access to the University of Wisconsin-Milwaukee campus through use of the Chicago & North Western Railway Capitol Drive spur track and a one-way loop extending over city streets between the Capitol Drive spur track right-of-way and N. Downer Avenue. Alternatives 1LB and 2LB would provide a completely grade-separated, exclusive guideway through use of an elevated structure over W. Capitol Drive and N. Mayfair Road, and W. Roosevelt Drive and W. Burleigh Street, respectively. Alternatives 3LB and 4LB would be located almost entirely on the surface. Alternative 3LB, the preferred alignment, would be located in the median area of W. Capitol Drive and N. Mayfair Road, while Alternative 4LB would be located in the median area of W. Roosevelt Drive and W. Burleigh Street.

Source: SEWRPC.

Table 83

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE EAST-WEST CROSSTOWN CORRIDOR

Cost Element	Unit Cost	Alternative Alignment: Alignment 1H Quantity	Alignment 1H Total Cost	Alignment 2H Quantity	Alignment 2H Total Cost
Surface Construction					
At-Grade Construction	$ --	--	$ --	--	$ --
Fill Construction.	--	--	--	--	--
Cut Construction.	--	--	--	--	--
Total	$ --	--	$ --	--	$ --
Grade-Separated Construction					
Aerial Construction	$19.8	9.4 miles	$186.6	8.4 miles	$166.1
Subway Construction	37.9	1.7 miles	64.4	1.7 miles	64.4
Total	$ --	11.1 miles	$251.0	10.0 miles	$230.5
Crossings					
Street and Highway					
At-Grade	$ --	--	$ --	--	$ --
Overpasses	--	--	--	--	--
Underpasses	--	--	--	--	--
Railroad	--	--	--	--	--
Watercourse	--	--	--	--	--
Subtotal	$ --	--	$251.0	--	$230.5
Engineering, Design, and Administration	15 percent	--	$ 37.6	--	$ 34.6
Contingencies	30 percent	--	$ 75.3	--	$ 69.2
Total Cost	--	--	$363.9	--	$334.3

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

Table 84

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE EAST-WEST CROSSTOWN CORRIDOR

Segment	Alignment 1H Distance (miles)	Alignment 1H Total Guideway Construction Cost (millions of dollars)	Alignment 1H Average Unit Cost (millions of dollars per mile)	Alignment 2H Distance (miles)	Alignment 2H Total Guideway Construction Cost (millions of dollars)	Alignment 2H Average Unit Cost (millions of dollars per mile)
University of Wisconsin-Milwaukee (E. Kenwood Boulevard) N. Estabrook Parkway	1.7	$ 93.4	$54.9	1.7	$ 93.4	$54.9
N. Estabrook Parkway to N. 35th Street	3.0	87.0	29.0	3.0	87.0	29.0
N. 35th Street to N. 92nd Street.	3.6	105.1	29.2	3.9	112.8	28.9
N. 92nd Street to W. North Avenue (Mayfair Mall Shopping Center)	2.8	78.4	28.0	1.5	41.1	27.4
Total E. Kenwood Boulevard to W. North Avenue.	11.1	$363.9	$32.8	10.1	$334.3	$33.1

Source: SEWRPC.

Table 85

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE EAST-WEST CROSSTOWN CORRIDOR

Segment	Alternative Alignment							
	Alignment 1H				Alignment 2H			
	Distance (miles)	Average Speed (miles per hour)	Travel Time (minutes) Station-to-Station	Travel Time (minutes) Cumulative	Distance (miles)	Average Speed (miles per hour)	Travel Time (minutes) Station-to-Station	Travel Time (minutes) Cumulative
University of Wisconsin-Milwaukee to N. 35th Street and W. Capitol Drive. .	4.7	38	7	- -	4.7	38	7	- -
N. 35th Street to the Mayfair Mall Shopping Center (STH 100 and North Avenue)	6.4	38	10	17	5.4	38	8	15

Source: SEWRPC.

Table 86

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE EAST-WEST CROSSTOWN CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Household Population Served			Number of Jobs Served (one-half-mile walking distance)
	One-Half-Mile Walking Distance	15-Minute Feeder Bus Travel Time	Three-Mile Driving Distance	
1H	78,800	327,000	433,900	66,000
2H	80,100	314,900	455,800	57,600

Source: SEWRPC.

Alternative 1H. It has the same horizontal and vertical configuration along approximately 9.7 miles of its length between E. Pinedale Court and the Mayfair Mall Shopping Center in the City of Wauwatosa. It differs south of E. Pinedale Court, where the light rail alignment would be located on the surface within the Chicago & North Western Capitol Drive spur track right-of-way for about 0.8 mile to E. Kenwood Boulevard. In order to provide direct access to the University of Wisconsin-Milwaukee campus, the guideway would be located in the configuration of a one-way loop—necessary because of narrow street widths in the vicinity of the campus—and would operate in a clockwise direction along E. Hartford Avenue, N. Downer Avenue, and E. Kenwood Boulevard. The guideway would operate in mixed traffic on both E. Hartford Avenue and E. Kenwood Boulevard between N. Cambridge and N. Oakland Avenues; in a transit mall with layover areas on both E. Hartford Avenue and E. Kenwood Boulevard between N. Oakland and N. Downer Avenues; and in a reserved lane on N. Downer Avenue between E. Hartford Avenue and E. Kenwood Boulevard. The loop guideway would total 1.6 miles in length.

Alternative 2LB follows the same alignment followed by Alternative 1LB for 5.7 miles between the UWM campus and W. Capitol Drive and N. 35th Street. West of N. 35th Street, the alignment would be located on an elevated structure over W. Roosevelt Drive from N. 35th Street to N. 60th and W. Burleigh Streets, a distance of about 1.9 miles. At N. 60th Street the alignment would be elevated over the median of W. Burleigh Street to N. Colonial Drive, a distance of about 2.3 miles. Upon leaving W. Burleigh Street, the alignment would remain on an elevated structure over newly acquired right-of-way for 0.6 mile and over parkland for a distance of 0.6 mile, terminating at the Mayfair Mall Shopping Center parking lot. The total length of Alignment 2LB is about 11.1 miles.

Table 87

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE EAST-WEST CROSSTOWN CORRIDOR

Evaluation Criteria	Alternative Alignment	
	Alignment 1H	Alignment 2H
Capital Cost (guideway construction cost in millions of dollars)	$363.9	$334.3
Community Disruption		
Type of Land Used (miles)		
Railroad and Former Interurban Right-of-Way	--	--
Existing Freeway Right-of-Way	--	--
Cleared Freeway Right-of-Way	--	--
Public Street Right-of-Way	10.1	8.5
Public Land	0.4	0.6
Newly Acquired Right-of-Way	0.6	0.8
Total	11.1	10.1
Structure Dislocation (number)		
Residential Buildings	11	11
Commercial or Industrial Buildings	3	3
Public Buildings	--	--
Other Disruption	--	--
Travel Time (minutes)	17	15
Population Served		
One-Half-Mile Walking Distance	78,800	80,100
Three-Mile Driving Distance	433,900	455,800
Jobs Served		
One-Half-Mile Walking Distance	66,000	57,600

Source: SEWRPC.

Alternative 3LB, 12.1 miles in length, would follow the same horizontal and vertical alignment followed by Alternative 1LB south of E. Pinedale Court to the UWM campus, a distance of about 2.6 miles. The remaining 9.5 miles of the alignment—between E. Pinedale Court and the Mayfair Mall Shopping Center—would follow almost the same horizontal configuration followed by Alternative 1LB, but would differ with respect to vertical configuration. North of E. Pinedale Court the alignment would be located on the surface within the right-of-way of the Capitol Drive spur track for about 0.1 mile to E. Capitol Drive. It would then be located in reserved lanes along E. and W. Capitol Drive to N. Green Bay Road, a distance of about 1.4 miles. The remaining 8.0 miles of the alignment west of N. Green Bay Road would be located principally in the median of W. Capitol Drive and N. Mayfair Road except between W. Hopkins Street and N. 35th Street, where it would be located in reserved lanes for about 0.2 mile; and south of W. Center Street, where, for about 0.4 mile, it would be located on the surface within the limits of the Mayfair Mall Shopping Center parking lot. In the vicinity of W. Capitol Drive and N. Mayfair Road, Alternative 3LB would turn from W. Capitol Drive directly south onto N. Mayfair Road without utilizing W. Grantosa Parkway, as would Alternative 1LB.

Alternative 4LB, about 11.1 miles in length, would follow the same alignment followed by Alternative 3LB east of N. 35th Street to the UWM campus, a distance of about 5.7 miles. West of N. 35th Street, Alternative 4LB would follow the same general alignment followed by Alternative 2LB, but would be located on the surface within public street rights-of-way. Specifically, it would

Table 88

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR LIGHT RAIL TRANSIT/BUSWAY FACILITIES IN THE EAST-WEST CROSSTOWN CORRIDOR

	Alternative Alignment														
			Alignment 1LB			Alignment 2LB			Alignment 3LB			Alignment 4LB		
	Unit Cost			Total Cost			Total Cost			Total Cost			Total Cost	
Cost Element	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway
Surface Construction														
At-Grade Construction	$3.6-$3.9	$1.6-$1.8	2.2 miles	$ 8.1	$ 3.9	2.2 miles	$ 8.1	$ 3.9	11.6 miles	$45.1	$19.9	10.6 miles	$40.3	$17.8
Fill Construction	$16.0	$13.7	0.3 mile	4.8	4.1	0.3 mile	4.8	4.1	0.3 mile	4.8	4.1	0.3 mile	4.8	4.1
Cut Construction	$22.4	$19.2	- -	- -	- -	- -	- -	- -	0.2 mile	4.5	3.8	0.2 mile	4.5	3.8
Total	- -	- -	2.5 miles	$ 12.9	$ 8.0	2.5 miles	$ 12.9	$ 8.0	12.1 miles	$54.4	$27.8	11.1 miles	$49.6	$25.7
Grade-Separated Construction														
Aerial Construction	$19.8	$17.5	9.6 miles	$190.6	$168.0	8.6 miles	$170.4	$150.2	- -	$ - -	$ - -	- -	$ - -	$ - -
Subway Construction	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Total	$ - -	$ - -	9.6 miles	$190.6	$168.0	8.6 miles	$170.4	$150.2	- -	$ - -	$ - -	- -	$ - -	$ - -
Crossings														
Street and Highway														
At-Grade	$ - -	$ - -	20	$ - -	$ - -	20	$ - -	$ - -	125	$ - -	$ - -	118	$ - -	$ - -
Overpasses	$ - -	$ - -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Underpasses	$ - -	$ - -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Railroad	$ - -	$ - -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Watercourse	$ 0.3	$ 0.3	- -	- -	- -	- -	- -	- -	1	0.3	0.3	1	0.3	0.3
Subtotal	$ - -	- -	- -	$203.5	$176.0	- -	$183.3	$158.2	- -	$54.7	$28.1	- -	$49.9	$26.0
Engineering, Design, and Administration	15 percent	15 percent	- -	$ 30.5	$ 26.4	- -	$ 27.5	$ 23.7	- -	$ 8.2	$ 4.2	- -	$ 7.5	$ 3.9
Contingencies	30 percent	30 percent	- -	$ 61.0	$ 52.8	- -	$ 55.0	$ 47.5	- -	$16.4	$ 8.4	- -	$15.0	$ 7.8
Total Cost	- -	- -	- -	$295.0	$255.2	- -	$265.8	$229.4	- -	$79.3	$40.7	- -	$72.4	$37.7

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

be located in the median of W. Roosevelt Drive between W. Capitol Drive and W. Burleigh Street, a distance of about 1.9 miles; in reserved lanes on W. Burleigh Street between N. 60th and N. 92nd Streets, a distance of about 2.0 miles; and in the median of Burleigh Street from N. 92nd Street to N. Colonia Drive, a distance of about 0.3 mile. West of N. Colonial Drive, the alignment would be located on newly acquired right-of-way for a distance of about 0.6 mile and over parkland for a distance of about 0.6 mile.

Light Rail Transit/Busway Alignment Evaluation: As indicated in Table 88, the capital costs of guideway construction for the Class A light rail transit alignments are similar, about $295 million for Alternative 1LB and $266 million for Alternative 2LB, or an average cost of about $24 million per mile. The comparable cost of constructing a Class A dual busway is $255 million for Alternative 1LB and $229 million for Alternative 2LB, or an average cost of about $21 million per mile for both of these alternatives. The capital costs of constructing the Class B alignments are significantly lower. Specifically, the dual Class B guideway for light rail transit along Alignment 3LB would cost about $79 million, or an average cost of $6 million per mile. The comparable cost for a dual Class B busway is about $41 million, or an average cost of $3 million per mile. The capital cost of constructing Alternative 4LB is estimated at $6 million per mile for a light rail transit system, or a total of $72 million, and about $3 million per mile for a busway, or a total of about $38 million. A breakdown of guideway capital costs by segment of the alternative light rail/busway alignments is given in Table 89.

Alternative 1LB would utilize a strip of land about 12.1 miles in length, including 0.9 mile of active railway right-of-way and 10.4 miles of public street right-of-way in the Cities of Milwaukee and Wauwatosa. Of the 10.4 miles on public street right-of-way, 1.6 miles would be on a surface alignment and 8.8 miles would be on an elevated structure. Of the 1.6 miles of the alignment that would be located on the surface within public street rights-of-way, about 1.0 mile would be located in a transit mall, 0.4 mile would operate in mixed traffic, and about 0.2 mile would be in a reserved lane on N. Downer Street between E. Kenwood Boulevard and E. Hartford Avenue. The line would also operate over a strip of parkland for about 0.4 mile and over new right-of-way presently used for parking at the Mayfair Mall Shopping Center for about 0.4 mile.

Table 89

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE EAST-WEST CROSSTOWN CORRIDOR

	Alternative Alignment																			
	Alignment 1LB					Alignment 2LB					Alignment 3LB					Alignment 4LB				
		Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)			Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)			Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)			Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)	
Segment	Distance (miles)	Light Rail	Busway	Light Rail	Busway	Distance (miles)	Light Rail	Busway	Light Rail	Busway	Distance (miles)	Light Rail	Busway	Light Rail	Busway	Distance (miles)	Light Rail	Busway	Light Rail	Busway
University of Wisconsin-Milwaukee (E. Kenwood Boulevard) to N. Estabrook Parkway	2.7	$ 18.7	$ 11.6	$ 6.9	$ 4.3	2.7	$ 18.7	$ 11.6	$ 6.9	$ 4.3	2.7	$18.7	$11.6	$6.9	$4.3	2.7	$18.7	$11.6	$6.9	$4.3
N. Estabrook Parkway to N. 35th Street	3.0	92.6	81.8	30.9	27.3	3.0	92.6	81.8	30.9	27.3	3.0	23.5	13.5	7.8	4.5	3.0	23.5	13.5	7.8	4.5
N. 35th Street to N. 92nd Street.	3.6	102.5	90.5	28.5	25.1	3.9	112.8	99.5	28.9	25.5	3.6	21.2	9.4	5.9	2.6	3.9	21.9	9.7	5.6	2.5
N. 92nd Street to W. North Avenue (Mayfair Mall Shopping Center)	2.8	81.2	71.3	29.0	25.5	1.5	41.7	36.5	27.8	24.3	2.8	15.9	6.2	5.7	2.2	1.5	8.3	2.9	5.5	1.9
Total University of Wisconsin-Milwaukee (E. Kenwood Boulevard) to W. North Avenue) Mayfair Mall Shopping Center)	12.1	$295.0	$255.2	$24.4	$21.1	11.1	$265.8	$229.4	$23.9	$20.7	12.1	$78.9	$40.7	$6.5	$3.4	11.1	$72.4	$37.7	$6.5	$3.4

Source: SEWRPC.

Alternative 2LB would utilize a strip of land about 11.1 miles in length, including about 0.9 mile of active railway right-of-way, 9.0 miles of public street right-of-way, 0.6 mile of parkland, and 0.6 mile of new right-of-way. Of the 9.0 miles that would be on public street right-of-way, 1.6 miles would be on a surface alignment and 7.4 miles would be on an elevated structure above the street. Of the 1.6 miles of the alignment that would be located on the surface within public street right-of-way, about 1.0 mile would be located in a transit mall, 0.4 mile would operate in mixed traffic, and about 0.2 mile would be located in a reserved lane. The 0.6-mile strip of parkland that would be used is located along the Menomonee River Parkway in the City of Wauwatosa. Of the 0.6 mile of new right-of-way that would be acquired, 0.3 mile is presently owned by the Blue Mound Golf and Country Club and 0.3 mile is presently used for parking at the Mayfair Mall Shopping Center.

Alternative 3LB would utilize a strip of land about 12.1 miles in length, including about 0.9 mile of active railway right-of-way, 10.8 miles of public street right-of-way, and 0.4 mile of newly acquired right-of-way. Along the public street right-of-way, the facility would be located in transit malls for about 1.0 mile, within arterial street medians for about 7.6 miles, and in reserved lanes for about 1.8 miles. The facility would operate over arterial streets in mixed traffic for about 0.4 mile. The 0.4 mile of new right-of-way that would be acquired is presently used for parking at the Mayfair Mall Shopping Center.

Alternative 4LB would utilize a strip of land about 11.1 miles in length, including 9.0 miles of public street right-of-way, about 0.9 mile of active railway right-of-way, 0.6 mile of parkland, and 0.6 mile of new right-of-way. Of the 9.0 miles of public street right-of-way, about 3.8 miles would be located within a median, about 1.0 mile would be located in transit malls, about 3.8 miles would be located in reserved lanes, and about 0.4 mile would operate in mixed traffic. The new right-of-way would be the same as that required under Alternative 2LB.

It should be noted that, under all four alternatives, location of a one-way light rail transit/busway alignment in a reserved lane along N. Downer Street for 0.2 mile between E. Kenwood Boulevard and E. Hartford Avenue would require the use of one arterial street lane, leaving two lanes for motor vehicle traffic in each direction assuming parking is prohibited. Additionally, location of a transit facility in reserved lanes along E. and W. Capitol Drive between the C&NW Capitol Drive spur track and N. Green Bay Road and between W. Hopkins and N. 35th Streets under both Alternative Alignments 3LB and 4LB, and along W. Burleigh Street between N. 60th Street and N. 92nd Street under Alternative 4LB only, would require the use of two arterial street lanes and the existing median, leaving two lanes for motor vehicle traffic or parking in each direction. None of the four alignments would require the disruption of any residential, commercial, or industrial structures.

Line-haul travel times between selected segments of the four light rail transit/busway alignments are summarized in Table 90. The Class A alignments would provide about 17 percent faster travel times overall between the University of Wisconsin-Milwaukee campus area and the City of Wauwatosa at N. Mayfair Road (STH 100) and W. North Avenue, 29 and 27 minutes for Alternatives 1LB and 2LB, respectively, compared with 35 minutes for Alternative 3LB and 33 minutes for Alternative 4LB. Comparable busway travel times are 31 and 29 minutes for Alternatives 1LB and 2LB, respectively, and 39 minutes for Alternative 3LB and 37 minutes for Alternative 4LB. It should be noted that if the station spacing of the light rail transit systems and busways of these alternatives approached that of heavy rail systems—specifically, an average spacing of one mile rather than one-half mile in high-density areas and two miles rather than one mile in medium-density areas—the travel times would approximate 28 minutes for a light rail transit system and 30 minutes for a busway under Alternative 1LB, 26 minutes for a light rail transit system and 28 minutes for a busway under Alternative 2LB, 31 minutes for a light rail transit system and 32 minutes for a busway under Alternative 3LB, and 28 minutes for a light rail transit system and 30 minutes for a busway under Alternative 4LB.

The alignments are comparable in terms of accessibility to population and jobs and service to major activity centers. All four alignments directly serve the University campus area and the Mayfair Mall Shopping Center. Alternatives 1LB and 3LB would also serve the Capitol Court Shopping Center. As shown in Table 91, Alternatives 2LB and 4LB would serve a greater number of residents within a six-mile band centered on the alignment, 463,600, compared with 439,400 for Alternatives 1LB and 3LB. Alternatives 2LB and 4LB would also serve a greater number of residents within walking distance, 80,900, compared with 79,600 for Alternatives 1LB and 3LB. However, Alternatives 1LB and 3LB would serve about 15 percent more jobs within walking distance, 65,800, compared with 57,300 for Alternatives 2LB and 4LB.

Recommended Light Rail Transit/Busway Alignment: Table 92 summarizes the results of the preliminary assessment of the capital cost, disruption, travel time, and accessibility to both jobs and population for each of the light rail transit/busway alternative alignments in the east-west crosstown corridor. Alternative 3LB is the preferred alignment. Alternatives 3LB and 4LB, the Class B alignments, have about one-fourth the cost of Alternatives 1LB and 2LB, although they would entail about 20 percent longer travel times. Compared with Alternative 4LB, Alternative 3LB is about 10 percent more costly but provides over 15 percent greater access to jobs. In addition, Alternative 3LB would require that the pavement width available to automobile traffic be reduced on 1.8 miles of streets, compared with 3.8 miles under Alternative 4LB.

Fixed Guideway Alignments in the North-South Crosstown Corridor

Available rights-of-way determined to have good potential for the location of primary transit fixed guideways in the north-south crosstown corridor are identified on Map 43. Also shown on Map 43 are the generalized existing land use pattern in the corridor and the location of major activity centers. Unlike five of the seven corridors for which fixed guideway alignments have been identified, the north-south crosstown corridor does not serve the Milwaukee central business district. Instead, this corridor serves travel demands across the Milwaukee area along a two-mile-wide band located approximately two miles west of the central business district. In general, the north-south crosstown corridor extends in a southerly direction from the intersection of N. 35th Street and W. Silver Spring Drive to the S. 35th Street overpass at the Airport Freeway (IH 894) in the City of Greenfield. Three extensions of this corridor are possible along existing rights-of-way with good potential for use as fixed guideway alignments. One such extension extends from the north end of the corridor at N. 35th Street and W. Silver Spring Drive in a northwesterly direction to the vicinity of the Northridge Shopping Center. The other two extend from the south end of the corridor. One of these extensions extends in a southwesterly direction to the Village of Greendale. The other extends in a southeasterly direction to the City of Oak Creek. Two alternative heavy rail rapid transit alignments and four light rail transit/busway alignments, two of which are Class A alignments and two of which are Class B alignments, were identified in the corridor, as shown on Maps 44 and 45.

Heavy Rail Rapid Transit Alignments: Both alternative heavy rail rapid transit alignments terminate on the north at the Northridge Shopping Center—

Table 90

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE EAST-WEST CROSSTOWN CORRIDOR

	Alternative Alignment																			
	Alignment 1LB					Alignment 2LB					Alignment 3LB					Alignment 4LB				
				Travel Time (minutes—light rail/busway)					Travel Time (minutes—light rail/busway)					Travel Time (minutes—light rail/busway)					Travel Time (minutes—light rail/busway)	
Segment	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Station-to-Station	Cumulative	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Station-to-Station	Cumulative	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Station-to-Station	Cumulative	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Station-to-Station	Cumulative
University of Wisconsin-Milwaukee (E. Kenwood Boulevard) to N. 35th Street and W. Capitol Drive	5.7	Typical light rail/ busway	20/19	17/18	- -	5.7	Typical light rail/ busway	20/19	17/18	- -	5.7	Typical light rail/ busway	19/17	18/20	- -	5.7	Typical light rail/ busway	19/17	18/20	- -
		Typical heavy rail	21/20	16/17	- -		Typical heavy rail	21/20	16/17	- -		Typical heavy rail	20/19	17/18	- -		Typical heavy rail	20/19	17/18	- -
N. 35th Street and W. Capitol Drive to the Mayfair Mall Shopping Center (STH 100 and W. North Avenue) . .	6.4	Typical light rail/ busway	32/30	12/13	29/31	5.4	Typical light rail/ busway	32/30	10/11	27/29	6.4	Typical light rail/ busway	22/20	17/19	35/39	5.4	Typical light rail/ busway	22/19	15/17	33/37
		Typical heavy rail	32/30	12/13	28/30		Typical heavy rail	32/30	10/11	26/28		Typical heavy rail	28/26	14/14	31/32		Typical heavy rail	29/27	11/12	28/30

[a] *Assumes light rail and busway transit typical station spacing is approximately one-fourth mile in the Milwaukee central business district; one-half mile in other high-density urban areas, unless the guideway is fully grade-separated, where one-mile spacing is assumed; and one mile in medium-density urban areas. The wider station spacing represents typical heavy rail station spacing of approximately one-half mile in the Milwaukee central business district; one mile in other high-density urban areas; and two miles in other medium-density areas.*

Source: SEWRPC.

[b] *The average speeds are based upon typical acceleration and deceleration rates; typical maximum operating speeds—which vary based on type, location, and degree of grade separation of right-of-way; assumed typical station spacing; and a typical station dwell-time of 30 seconds. Preferential treatment has been assumed at all at-grade crossings. These typical light rail and busway transit characteristics were established in SEWRPC Technical report No. 24, State-of-the-Art of Primary Transit System Technology. The result is average speeds of about 11 miles per hour in malls and other street rights-of-way; and from 20 to 40 miles per hour on all other private rights-of-way. (The variation in these average speeds is a result of variation in station spacing.)*

Table 91

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE EAST-WEST CROSSTOWN CORRIDOR

Alternative	Household Population Served			Number of Jobs Served (one-half-mile walking distance)
	One-Half-Mile Walking Distance	15-Minute Feeder Bus Travel Time	Three-Mile Driving Distance	
1LB	79,600	335,800	439,400	65,800
2LB	80,900	323,700	463,600	57,300
3LB	79,600	335,800	439,400	65,800
4LB	80,900	323,700	463,600	57,300

Source: SEWRPC.

specifically, southeast of the shopping center mall complex and northwest of the intersection of N. 76th Street and W. Brown Deer Road at the northern end of the northwesterly extension of the N. 35th Street corridor. At the southern end of the N. 35th Street corridor proper the alignment splits into two branches, the west branch terminating at the Southridge Shopping Center at S. 76th Street and W. Grange Avenue and the east branch terminating at E. Ryan Road in the City of Oak Creek. Both alignments utilize a combination of active railroad right-of-way, former electric interurban railway right-of-way, cleared freeway right-of-way, and public street right-of-way in the communities of Milwaukee, West Milwaukee, Greenfield, Greendale, and Oak Creek.

Beginning at the Northridge Shopping Center, the two alignments would both be located on an aerial structure over the shopping center parking lot and on fill over newly acquired right-of-way to W. Brown Deer Road just west of N. 76th Street, a total distance of 0.9 mile. South of W. Brown Deer Road the two alignments would use different rights-of-way to the intersection of N. Sherman Boulevard and W. Custer Avenue, a distance of 4.6 miles for Alternative 1H and 5.2 miles for Alternative 2H. Alternative 1H would be located on elevated structure over the median of N. 76th Street and at-grade along the Milwaukee Road's Twelfth Subdivision right-of-way. Alternative 2H would be located on both an elevated structure and fill along the Chicago & North Western Air Line Subdivision and on fill along the eastern edge of the Havenwoods area.

At W. Custer Avenue, the two alternatives would again share a common alignment for about 4.0 miles on an elevated structure above the median of N. Sherman Boulevard. At W. Lloyd Street, the common alignment would enter Washington Park and follow the eastern perimeter of that park for about 0.5 mile on an elevated structure, then would be located in a subway for 0.5 mile under Washington Park and W. Highland Boulevard before continuing on fill within the Milwaukee Road Fifth Subdivision right-of-way. The common alignment would then continue for about 1.8 miles to W. National Avenue, crossing the Menomonee River Valley on a viaduct located on an alignment which utilizes a combination of private and public lands, including a privately owned parking lot, N. 42nd Street, a privately owned truck terminal, the Milwaukee Road Blue Mound yard, the Milwaukee County Stadium parking lot, and the eastern perimeter of the U. S. Veterans Administration Center grounds. This stretch of common alignment would pass over W. State Street, the Milwaukee Road Fifth Subdivision trackage, and N. 42nd Street; underneath the W. Wisconsin Avenue viaduct; over the Milwaukee Road Blue Mound yard and N. 44th Street; underneath the East-West Freeway (IH 94); and over the Stadium Freeway (USH 41), the Milwaukee Road Elm Grove Line, and W. National Avenue.

Alternatives 1H and 2H would again share a common alignment between W. National Avenue and W. Lincoln Avenue, a distance of about 1.2 miles, utilizing the right-of-way cleared for the Stadium Freeway-South. Immediately south of the Chicago & North Western New Line Subdivision trackage, Alternatives 1H and 2H would separate to follow different alignments. Alternative 1H would follow the alignment of the proposed Stadium Freeway-South to W. Plainfield Avenue, a distance of about 2.5 miles, continuing in a southerly direction on newly acquired right-of-way and parkland from the

Table 92

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE EAST-WEST CROSSTOWN CORRIDOR

Evaluation Criteria	Alternative Alignment			
	Alignment 1LB	Alignment 2LB	Alignment 3LB	Alignment 4LB
	Light Rail/Busway	Light Rail/Busway	Light Rail/Busway	Light Rail/Busway
Capital Cost (guideway construction cost in millions of dollars)	$295.0/$255.2	$265.8/$229.4	$79.3/$40.7	$72.4/$37.7
Community Disruption				
Type of Land Used (miles)				
Railroad and Former Interurban Right-of-Way	0.9	0.9	0.9	0.9
Existing Freeway Right-of-Way	- -	- -	- -	- -
Cleared Freeway Right-of-Way	- -	- -	- -	- -
Public Street Right-of-Way	10.4	9.0	10.8	9.0
Public Land	0.4	0.6	0.0	0.6
Newly Acquired Right-of-Way	0.4	0.6	0.4	0.6
Total	12.1	11.1	12.1	11.1
Structure Dislocation (number)				
Residential Buildings	- -	- -	- -	- -
Commercial or Industrial Buildings	- -	- -	- -	- -
Public Buildings	- -	- -	- -	- -
Other Disruption	Location of an alignment in a reserved lane along N. Downer Street for 0.2 mile between E. Kenwood Boulevard and E. Hartford Avenue would require the use of one arterial street lane, leaving two lanes for motor vehicle traffic in each direction, with parking prohibited			
			Location of a transit facility in reserved lanes along E. and W. Capitol Drive between the C&NW spur track and N. Green Bay Road, and between W. Hopkins and N. 35th Streets, would require the use of 1.6 miles of two arterial street lanes, leaving two lanes for motor vehicle traffic or parking in each direction	
				Location of an alignment along W. Burleigh Street between N. 60th and N. 92nd Streets would require the use of two arterial street lanes, leaving two lanes for motor vehicle traffic or parking in each direction
Travel Time (minutes)	29/31	27/29	35/39	33/37
Population Served				
One-Half-Mile Walking Distance	79,600	80,900	79,600	80,900
Three-Mile Driving Distance	439,400	463,600	439,400	463,600
Jobs Served				
One-Half-Mile Walking Distance	65,800	57,300	65,800	57,300

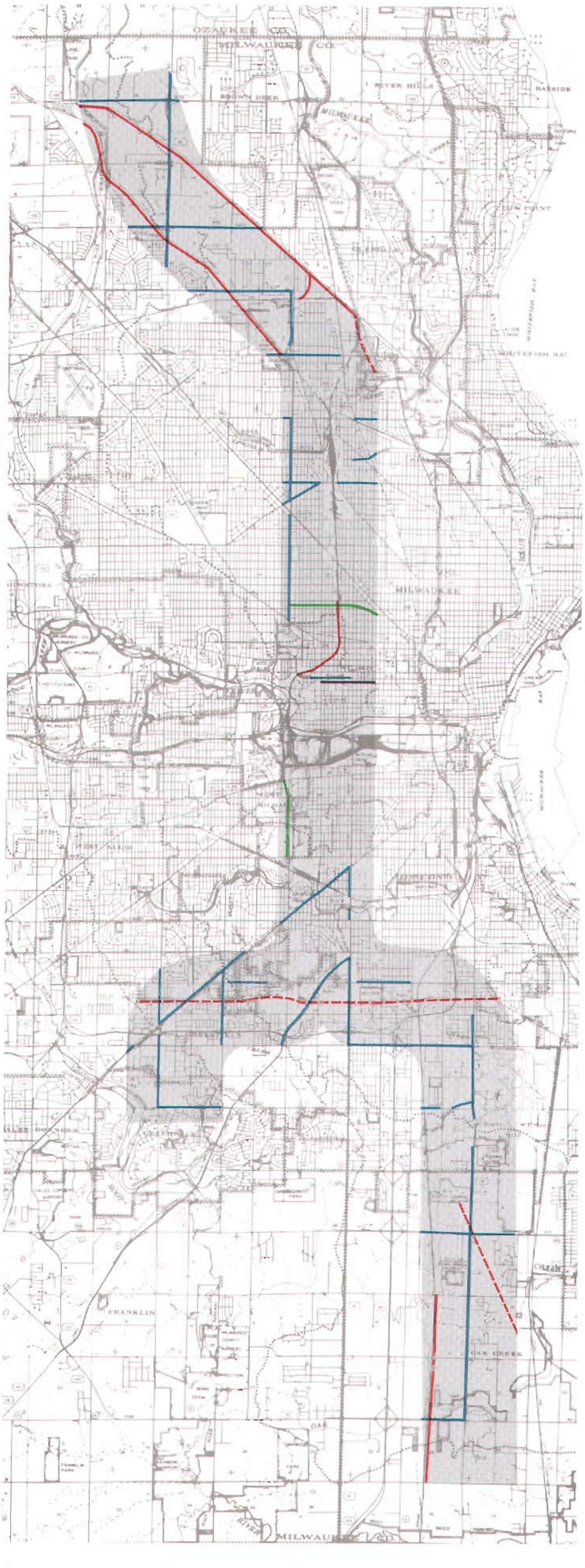
Source: SEWRPC.

New Line Subdivision on fill to just west of S. 43rd Street, then on elevated structure over S. 43rd Street, and on elevated structure and fill east of S. 43rd Street to the former Milwaukee Electric Lines-Lakeside Belt Line right-of-way. Here, Alternative 1H would split into two branches, the Greendale branch, about 3.6 miles in length, and the Oak Creek branch, about 9.5 miles in length.

The Greendale branch would proceed in a westerly direction along the Lakeside Belt Line right-of-way in cut and on fill. At W. Forest Home Avenue the alignment would proceed on an elevated structure over W. Forest Home Avenue and then south over S. 76th Street to the Southridge Shopping Center. The southwest terminal of this branch alignment would be located over the parking lot

Map 43

EXISTING AVAILABLE RIGHTS-OF-WAY IN THE NORTH-SOUTH CROSSTOWN CORRIDOR WITH GOOD POTENTIAL FOR FIXED GUIDEWAY PRIMARY TRANSIT DEVELOPMENT



LEGEND

RAILWAY RIGHTS-OF-WAY

ACTIVE AND ABANDONED RAILROAD

FORMER INTERURBAN

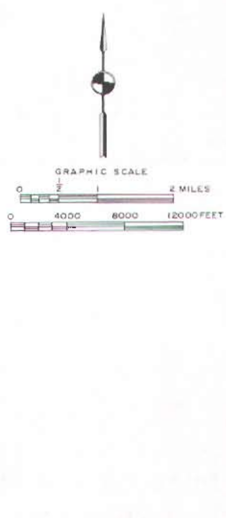
ARTERIAL STREET RIGHTS-OF-WAY

ARTERIAL WITH SUFFICIENT MEDIAN WIDTH

ARTERIAL WITH SUFFICIENT STREET WIDTH

FREEWAY RIGHTS-OF-WAY

CLEARED FREEWAY



The north-south crosstown corridor is located along an axis between the Northridge Shopping Center on the north and the Southridge Shopping Center on the south. This corridor contains only scattered short segments of rights-of-way with good potential for fixed guideway location, most of which are arterial street rights-of-way. Noteworthy are the cleared freeway rights-of-way intended for the construction of the Park West Freeway and the Stadium Freeway-South.

Source: SEWRPC.

west of the shopping center mall complex and east of S. 76th Street.

The Oak Creek branch of Alternative 1H would proceed in an easterly direction along the Lakeside Belt Line right-of-way on a combination of elevated structure, cut, and fill as far as S. 2nd Street. Here, the alignment would curve in a southerly direction onto the S. Howell Avenue right-of-way, and enter a subway from an aerial structure at E. Van Norman Avenue, two blocks north of E. Layton Avenue. At E. Layton Avenue the alignment would continue east of S. Howell Avenue in cut and in a subway underneath the access roads and runways serving General Mitchell Field. Approximately 0.5 mile north of E. College Avenue the alignment would again enter S. Howell Avenue, and would proceed on an elevated structure to a terminus at the intersection of S. Howell Avenue and E. Ryan Road.

Alternative 2H, unlike Alternative 1H, would split into its Greendale and Oak Creek branches immediately south of the Chicago & North Western New Line Subdivision trackage at S. 43rd Street. The Greendale branch would proceed in a southwesterly direction for a distance of about 7.1 miles, and the Oak Creek branch would proceed in a southeasterly direction for about 11.4 miles. The Greendale branch would be located almost entirely on elevated structure over public streets and highways. Its alignment would proceed south over S. 43rd Street, then southwest over W. Forest Home Avenue, and then south over S. 76th Street. The terminus of this branch alignment would be located over the parking lot west of the shopping center mall complex and east of S. 76th Street.

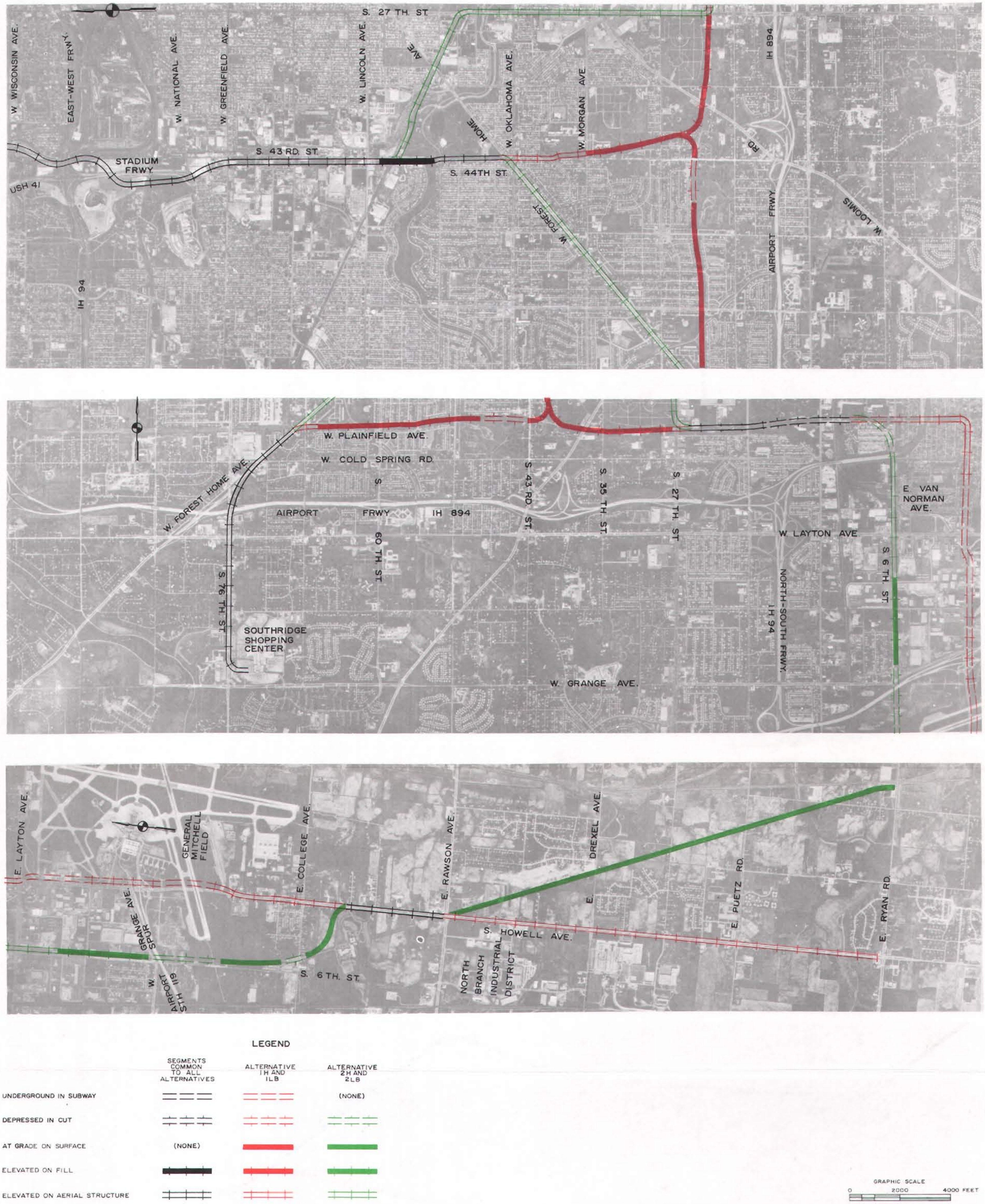
The Oak Creek branch of Alternative 2H would proceed in a southeasterly direction from S. 43rd Street almost entirely on elevated structure along the northern edge of Jackson Park, then directly over the Chicago & North Western New Line Subdivision trackage as far as S. 27th Street, and then southerly over the median of S. 27th Street to the former Milwaukee Electric Lines-Lakeside Belt Line right-of-way. The alignment would then follow the former Lakeside Belt Line right-of-way in cut and on fill before turning south onto rights-of-way of the former Chicago, North Shore & Milwaukee (North Shore Line) and The Milwaukee Electric Railway & Light Company interurban railways. The former North Shore Line right-of-way would be utilized as far south as W. College Avenue, where the alignment would curve easterly to an elevated alignment over S. Howell Avenue in order to bypass the Milwaukee Area Technical College South Campus. At the intersection of N. Howell Avenue and W. Rawson Road, the alignment would again utilize the former North Shore Line right-of-way to a southerly terminus at E. Ryan Road, adjacent to the Chicago & North Western New Line Subdivision trackage.

Heavy Rail Rapid Transit Alignment Evaluation: As shown in Table 93, the capital cost of dual guideway construction for heavy rail rapid transit along Alternative Alignment 1H is estimated to total $756 million in 1979 dollars, or about $26 million per mile. The cost of constructing a dual guideway along Alignment 2H is estimated to total $737 million, or an average cost of $24 million per mile. A breakdown of guideway capital costs by segment of the heavy rail rapid transit alignments is provided in Table 94.

Alternative 1H would utilize a strip of land about 29.3 miles in length, including about 2.9 miles of active mainline railway right-of-way, 4.6 miles of former electric interurban railway right-of-way presently owned by the Wisconsin Electric Power Company, and 1.2 miles of cleared freeway right-of-way along the Stadium Freeway-South corridor. It would also use about 13.2 miles of public street right-of-way, on which the transit facility would be located in a subway beneath the street for about 0.5 mile and on an elevated structure above the street for 12.7 miles. It would cross the parking lot of the Milwaukee County Stadium for about 0.4 mile, and would use about 1.6 miles of parkland and 1.4 miles of land along the western edge of General Mitchell Field. Additionally, it would require the use of about 4.0 miles of new right-of-way, including 2.0 miles of open land in the Northridge Shopping Center area as well as adjacent to S. 43rd Street south of W. Oklahoma Avenue; 0.5 mile of residential land south of W. Howard Avenue and at W. Howell Avenue where the alignment would cross the Lakeside Belt Line right-of-way; 0.4 mile of industrial land, 0.2 mile of which is located within an active scrap yard at N. 43rd Street and W. Lincoln Avenue and 0.2 mile of which is located within an inactive truck terminal located at N. 42nd Street and W. Blue Mound Road; and 1.1 miles of parking lots, including a parking lot of the Miller Brewing Company for about 0.5 mile and parking lots of the Northridge and Southridge Shopping Centers for 0.4 mile and 0.2 mile, respectively. The new right-of-way would require the taking of 26 residential structures, all

Map 44

HEAVY RAIL RAPID TRANSIT AND CLASS A LIGHT RAIL TRANSIT/BUSWAY
ALTERNATIVE ALIGNMENTS IN THE NORTH-SOUTH CROSSTOWN CORRIDOR

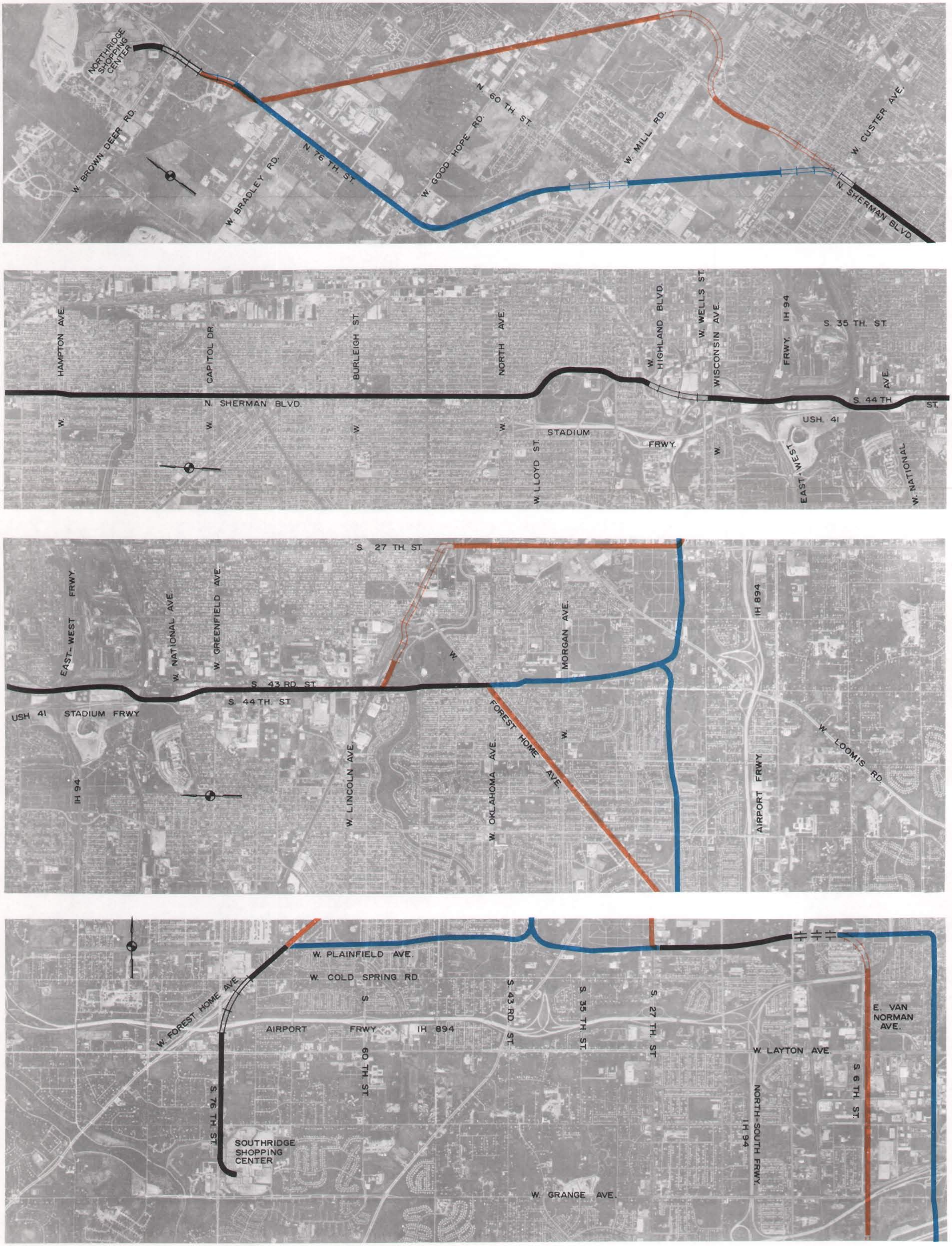


Two alternative fixed guideway alignments suitable for the provision of heavy rail rapid transit service or Class A light rail transit/busway service were identified within the north-south crosstown corridor. The preferred alignment for heavy rail transit consists of Alternative 2H between the Northridge Shopping Center and S. 6th Street, including the branch to the Southridge Shopping Center in the Village of Greendale. Southeast of S. 6th Street, the preferred alignment for heavy rail transit is Alternative 1H, which would serve not only General Mitchell Field but also the Oak Creek North Branch Industrial District. The preferred alignment for light rail transit is a Class B alignment, Alternative 3LB, which is shown on Map 45.

Source: SEWRPC.

Map 45

CLASS B LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE NORTH-SOUTH CROSSTOWN CORRIDOR



Two alternative fixed guideway alignments suitable for the provision of Class B light rail transit/busway service were identified within the north-south crosstown corridor. Between W. Silver Spring Drive and the Jackson Park area on the City of Milwaukee's south side, Alternative 3LB, the preferred alignment, and 4LB would utilize a common alignment, generally located along N. Sherman Boulevard and S. 43rd Street. The principal differences between these two alternatives are in the alignments at the far north end of the corridor and along each of the two branches on the south side of Milwaukee County.

Source: SEWRPC.

Table 93

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE NORTH-SOUTH CROSSTOWN CORRIDOR

		Alternative Alignment			
		Alignment 1H		Alignment 2H	
Cost Element	Unit Cost	Quantity	Total Cost	Quantity	Total Cost
Surface Construction					
At-Grade Construction	$ 3.2-$ 3.3	2.0 miles	$ 6.5	4.7 miles	$ 15.5
Fill Construction.	$16.0-$17.7	4.2 miles	69.6	4.8 miles	96.1
Cut Construction.	$20.6-$21.3	1.7 miles	35.7	1.4 miles	30.7
Total	- -	7.9 miles	$111.8	10.9 miles	$142.3
Grade-Separated Construction					
Aerial Construction	$16.0-$19.6	20.1 miles	$359.7	19.3 miles	$342.0
Subway Construction	$34.2-$35.6	1.3 miles	45.2	0.5 mile	17.8
Total	- -	21.4 miles	$404.9	19.8 miles	$359.8
Crossings					
Street and Highway					
At-Grade	$ - -	- -	$ - -	- -	$ - -
Overpasses	$ 0.3	5	1.5	10	3.0
Underpasses	$ 0.3	7	2.1	8	2.4
Railroad	$ 0.3	3	0.9	2	0.6
Watercourse	$ 0.3	1	0.3	1	0.3
Subtotal	- -	- -	$521.5	- -	$508.4
Engineering, Design, and Administration	15 percent	- -	$ 78.2	- -	$ 76.3
Contingencies	30 percent	- -	$156.4	- -	$152.6
Total Cost	- -	- -	$756.1	- -	$737.3

Source: SEWRPC.

near the intersection of W. Howell Avenue and the Lakeside Belt Line right-of-way.

Alternative 2H would utilize a strip of land about 30.7 miles in length, including 1.2 miles of cleared freeway right-of-way, 4.4 miles of active mainline railway right-of-way, and 7.1 miles of former electric interurban right-of-way—1.2 miles which is owned by the Wisconsin Electric Power Company and 5.9 miles which is owned by Milwaukee County. It would also use about 11.0 miles of public street right-of-way, on which the transit facility would be located in a subway for about 0.3 mile and on an elevated structure for the remaining 10.7 miles. It would also cross the parking lot of the Milwaukee County Stadium for 0.4 mile, and would use about 2.3 miles of parkland and about 4.3 miles of newly acquired right-of-way. The new right-of-way would include about 1.8 miles of open or vacant land, 0.9 mile of developed commercial land and industrial land, and 0.5 mile of vacant land owned by the Milwaukee Area Technical College. In addition, new right-of-way would be required where the alignment would cross a parking lot of the Miller Brewing Company for about 0.5 mile, and parking lots of the Northridge and Southridge Shopping Centers for distances of 0.4 mile and 0.2 mile, respectively. Location of a transit facility on the 0.4 mile of commercial and industrial land located at W. Plainfield Avenue and S. 6th Street would entail the displacement of approximately five commercial or industrial structures.

Line-haul travel times between selected segments of the two heavy rail rapid transit alignments are summarized in Table 95. The alternatives would provide similar overall travel times between the

Table 94

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE NORTH-SOUTH CROSSTOWN CORRIDOR

	Alternative Alignment					
	Alignment 1H			Alignment 2H		
Segment	Distance (miles)	Total Guideway Construction Cost (millions of dollars)	Average Unit Cost (millions of dollars per mile)	Distance (miles)	Total Guideway Construction Cost (millions of dollars)	Average Unit Cost (millions of dollars per mile)
N. 76th Street and W. Brown Deer Road (Northridge Shopping Center) to W. Silver Spring Drive	5.2	$ 92.1	$17.7	5.8	$125.7	$21.7
W. Silver Spring Drive to W. Wisconsin Avenue	5.9	178.2	30.2	5.9	178.2	30.2
W. Wisconsin Avenue to S. 43rd Street and W. Howard Avenue (Cherokee Park)	4.7	129.9	27.6	2.6[a]	77.2	29.7
S. 43rd Street and W. Howard Avenue (Cherokee Park) to S. 76th Street and W. Grange Avenue (Southridge Shopping Center)	3.8	86.6	22.8	4.8[b]	113.5	23.6
S. 43rd Street and W. Howard Avenue (Cherokee Park) to the City of Oak Creek (E. Ryan Road)	9.7	269.3	27.8	11.6[c]	242.7	20.9
Total N. 76th Street and W. Brown Deer Road to S. 76th Street and W. Grange Avenue and the City of Oak Creek	29.3	$756.1	$25.8	30.7	$737.3	$24.0

[a]*Construction cost was estimated for the segment between W. Wisconsin Avenue and W. Cleveland Avenue.*

[b]*Construction cost for the west, or Greendale, branch of the alignment was estimated for the segment between W. Cleveland Avenue and the intersection of S. 76th Street and W. Grange Avenue.*

[c]*Construction cost for the east, or Oak Creek, branch of the alignment was estimated for the segment between W. Cleveland Avenue and the City of Oak Creek.*

Source: SEWRPC.

northern terminus of the alignments at the Northridge Shopping Center to the southern termini at the Southridge Shopping Center in the City of Greendale and at E. Ryan Road in the City of Oak Creek. The estimated line-haul travel times between the Northridge and Southridge Shopping Centers are 28 minutes for Alternative 1H and 27 minutes for Alternative 2H. The estimated travel times to the City of Oak Creek at E. Ryan Road are 36 minutes and 37 minutes for Alternatives 1H and 2H, respectively.

The alignments are comparable in terms of accessibility to population and jobs and service to major activity centers, but Alternative 1H would better serve General Mitchell Field and the Oak Creek Industrial Park. Both alignments would directly serve the Northridge and Southridge Shopping Centers. As shown in Table 96, Alternative 1H would serve a greater number of residents within a six-mile band centered on the alignment, 876,000, compared with 814,600 for Alternative 2H. Alternative 2H would serve a larger number of residents within walking distance, 150,600, compared with 139,700 for Alternative 1H. Alternative 2H would also serve about 9 percent more jobs within walking distance, 92,500, compared with 84,600 for Alternative 1H.

Recommended Heavy Rail Rapid Transit Alignment: Table 97 summarizes the results of the preliminary assessment of the capital cost, community disruption, travel time, and accessibility to both jobs and population for each of the heavy rail rapid transit alignments. Alternative 2H is the preferred heavy rail rapid transit alignment in the north-south corridor, outside of its Oak Creek branch

Table 95

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE HEAVY RAIL RAPID TRANSIT ALTERNATIVE ALIGNMENTS IN THE NORTH-SOUTH CROSSTOWN CORRIDOR

Segment	Alternative Alignment							
	Alignment 1H				Alignment 2H			
	Distance (miles)	Average Speed (miles per hour)	Travel Time (minutes) Station-to-Station	Travel Time (minutes) Cumulative	Distance (miles)	Average Speed (miles per hour)	Travel Time (minutes) Station-to-Station	Travel Time (minutes) Cumulative
N. 76th Street and W. Brown Deer Road to W. Silver Spring Drive	5.2	46	7	- -	5.8	46	8	- -
W. Silver Spring Drive to W. Wisconsin Avenue	5.9	38	9	16	5.9	38	9	17
W. Wisconsin Avenue to S. 43rd Street and W. Howard Avenue (Cherokee Park)	4.7	40	7	23	2.6[a]	38	4	21
S. 43rd Street and W. Howard Avenue (Cherokee Park) to S. 76th Street and W. Grange Avenue (Southridge Shopping Center)	3.8	49	5	28	4.8[b]	45	6	27
S. 43rd Street and W. Howard Avenue (Cherokee Park) to the City of Oak Creek (E. Ryan Road)	9.7	45	13	36	11.6[c]	44	16	37

[a] *Travel times were estimated for the segment between W. Wisconsin Avenue and W. Cleveland Avenue.*

[b] *Travel times for the west, or Greendale, branch of the alignment were estimated for the segment between W. Cleveland Avenue and the intersection of S. 76th Street and W. Grange Avenue.*

[c] *Travel times for the east, or Oak Creek, branch of the alignment were estimated for the segment between W. Cleveland Avenue and the City of Oak Creek.*

Source: SEWRPC.

Table 96

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE NORTH-SOUTH CROSSTOWN CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Household Population Served			Number of Jobs Served (one-half-mile walking distance)
	One-Half-Mile Walking Distance	15-Minute Feeder Bus Travel Time	Three-Mile Driving Distance	
1H	139,700	658,200	876,000	84,600
2H	150,600	630,700	814,600	92,500

Source: SEWRPC.

south of the Lakeside Belt Line right-of-way. Otherwise, it is the lower-cost alternative, its travel times are similar to those of Alternative 1H, and it would provide about 9 percent greater access to jobs and population within walking distance. South of the Lakeside Belt Line right-of-way, Alternative 1H, although requiring about $20 million more in guideway construction costs, would better serve General Mitchell Field and the Oak Creek Industrial Park, and is the preferred alignment.

Light Rail Transit/Busway Alignments: Four light rail transit/busway alignments were identified in this corridor, two of which are Class A alignment and two of which are Class B alignments. All four alignments are similar to the alignments identified for the heavy rail rapid transit mode within the north-south crosstown corridor. The Class A light rail transit/busway alignments, Alternative 1LB and 2LB, which, by definition, must be either identical to Alternatives Alignments 1H and 2H, respectively.

Table 97

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE HEAVY RAIL RAPID TRANSIT ALIGNMENTS IN THE NORTH-SOUTH CROSSTOWN CORRIDOR

Evaluation Criteria	Alternative Alignment	
	Alignment 1H	Alignment 2H
Capital Cost (guideway construction cost in millions of dollars)	$756.1	$737.3
Community Disruption		
Type of Land Used (miles)		
Railroad and Former Interurban Right-of-Way	7.5	11.5
Existing Freeway Right-of-Way	- -	- -
Cleared Freeway Right-of-Way	1.2	1.2
Public Street Right-of-Way	13.2	11.0
Public Land	3.4	2.7
Newly Acquired Right-of-Way	4.0	4.3
Total	29.3	30.7
Structure Dislocation (number)		
Residential Buildings	26	- -
Commercial or Industrial Buildings	- -	5
Public Buildings	- -	- -
Other Disruption	None	None
Travel Time (minutes)	28 to Southridge 36 to the City of Oak Creek	27 to Southridge 37 to the City of Oak Creek
Population Served		
One-Half-Mile Walking Distance	139,700	150,600
Three-Mile Driving Distance	876,000	814,600
Jobs Served		
One-Half-Mile Walking Distance	84,600	92,500

Source: SEWRPC.

Alternatives 3LB and 4LB, both Class B alignments, follow alignments almost identical to those of Alternatives 1H and 1LB and Alternatives 2H and 2LB, respectively. The major differences between the Class B alignments and the Class A alignments are in the vertical alignment. The Class B light rail transit/busway alignments are located predominantly on the surface while the Class A light rail transit/busway and heavy rail rapid transit alignments are located on fully grade-separated, exclusive rights-of-way.

There are three differences in horizontal alignment that distinguish Alternatives 3LB and 4LB. First, the alignment of Alternative 3LB would remain in the median of N. 76th Street beyond W. Bradley Road. Second, the alignment of Alternatives 3LB and 4LB between the W. Wisconsin Avenue viaduct and W. National Avenue would utilize the right-of-way of N. and S. 44th Street to cross the Menomonee River Valley instead of the alignment selected for Alternatives 1LB/1H and 2LB/2H. To accomplish such a crossing of the western edge of the Menomonee River Valley on existing right-of-way, the entire 1.2-mile length of N. and S. 44th Street between W. National Avenue and W. Wells Street would be closed to motor vehicle traffic and dedicated for use as a transit right-of-way. The use of 44th Street would enable three existing grade separations to be utilized which would otherwise have to be newly constructed. The light rail vehicles or buses could also be operated in mixed traffic over this 1.2-mile stretch of N. and S. 44th Street. The third and last horizontal alignment difference occurs on the Oak Creek branch of Alternative 3LB between Van Norman Avenue and a point located approximately 0.5 mile north of College Avenue, a distance of 1.6 miles. Instead of being located in a cut and subway adjacent to and east of S. Howell Avenue, the alignment would be situated at-grade in the median area of S. Howell Avenue. The existing motor vehicle underpasses beneath the main east-west runway of General Mitchell Field would be utilized for this alignment.

Several elevated structures would be required for Alternatives 3LB and 4LB as a result of topography or the need to effect a grade-separated crossing of mainline railway tracks. Both Class B alignments would require aerial structures at the following four locations: 1) immediately west of N. 76th Street at W. Brown Deer Road because of topography as well as nearby freeway entrance ramps from N. 76th Street; 2) at the intersection of N. Sherman Boulevard and W. Silver Spring Drive, as a result of the grade-separated arterial interchange, and the need for a grade-separated crossing of the Milwaukee Road Twelfth Subdivision trackage; 3) between W. Highland Boulevard and W. Wells Street because of the topography of the Menomonee River Valley; and 4) near S. 76th Street and W. Forest Home Avenue because of freeway entrance and exit ramps to and from W. Forest Home Avenue as well as the interchange with the Airport Freeway (IH 894). Alternative 3LB would require an elevated structure at N. 60th Street and W. Mill Road in order to carry the guideway over the intersection, which is depressed under the railroad overpass at this location. Two more elevated structures would be required along the Alternative 4LB alignment, one to carry the fixed guideway over various Chicago & North Western tracks in the vicinity of N. 40th Street and W. Mill Road, and the other to provide an alignment for the Oak Creek branch between S. 35th and S. 27th Streets, where no other reasonable or available right-of-way presently exists.

Light Rail Transit/Busway Alignment Evaluation: As indicated in Table 98, the capital costs of guideway construction for the Class A light rail transit alignments are similar, estimated to total $756 million for Alternative 1LB and $737 million for Alternative 2LB, or an average cost of about $25 million per mile for both of these alternatives. The comparable cost of constructing a Class A busway is $658 million for Alternative 1LB and $635 million for Alternative 2LB, or an average cost of $22 million per mile for both of these alternatives. The capital costs of constructing the Class B alignments are significantly lower. The cost of constructing a Class B guideway for light rail transit along Alternative Alignment 3LB is estimated to total $204 million, or an average cost of $7 million per mile. The comparable cost of constructing a Class B busway is $123 million, or an average cost of about $4 million per mile. The capital cost of constructing Alternative 4LB is estimated to average $9 million per mile for a light rail transit system, or a total of $286 million, and about $7 million per mile for busway, or a total of $199 million. A breakdown of guideway capital costs by segment of the four alternative light rail transit/busway alignments is given in Table 99.

Alternative 1LB would utilize a strip of land about 29.3 miles in length, including about 2.9 miles of active mainline railway right-of-way, 4.6 miles of former electric interurban railway right-of-way presently owned by the Wisconsin Electric Power Company, and 1.2 miles of cleared freeway right-of-way along the Stadium Freeway-South corridor. It would also use about 13.2 miles of public street right-of-way, on which the transit facility would be located in a subway for about 0.5 mile and on an elevated structure for the remaining 12.7 miles. It would also cross the parking lot of the Milwaukee County Stadium for a distance of about 0.4 mile, and would use about 1.6 miles of parkland and 1.4 miles of land along the western edge of General Mitchell Field. Additionally, it would require the use of about 4.0 miles of new right-of-way, including 2.0 miles of open land in the Northridge Shopping Center area as well as adjacent to S. 43rd Street south of W. Oklahoma Avenue; 0.5 mile of residential land south of W. Howard Avenue and at W. Howell Avenue where the alignment crosses the Lakeside Belt Line right-of-way; 0.4 mile of industrial land, 0.2 mile of which is located within an active scrap yard at N. 43rd Street and W. Lincoln Avenue, and 0.2 mile of which is located within an inactive truck terminal at N. 42nd Street and W. Blue Mound Road; and 1.1 miles of parking lots, including a parking lot of Miller Brewing Company for about 0.5 mile, and parking lots of the Northridge and Southridge Shopping Centers for 0.4 mile and 0.2 mile, respectively. The new right-of-way would require the taking of 26 residential structures, all near the intersection of W. Howell Avenue and the Lakeside Belt Line right-of-way.

Alternative 2LB would utilize a strip of land about 30.7 miles in length, including 1.2 miles of cleared freeway right-of-way, 4.4 miles of active mainline railway right-of-way, and 7.1 miles of former elec-

Table 98

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR LIGHT RAIL TRANSIT/BUSWAY FACILITIES IN THE NORTH-SOUTH CROSSTOWN CORRIDOR

			Alternative Alignment											
			Alignment 1LB			Alignment 2LB			Alignment 3LB			Alignment 4LB		
	Unit Cost			Total Cost			Total Cost			Total Cost			Total Cost	
Cost Element	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway	Quantity	Light Rail	Busway
Surface Construction														
At-Grade Construction	$ 3.6-$ 3.9	$ 1.6-$ 1.8	2.0 miles	$ 6.3	$ 2.8	4.7 miles	$ 15.5	$ 7.0	26.7 miles	$ 90.6	$ 39.9	24.4 miles	$ 84.2	$ 37.0
Fill Construction	$16.2-$20.0	$14.1-$17.0	4.2 miles	69.6	59.2	4.8 miles	96.1	81.7	--	--	--	1.0 mile	16.2	13.8
Cut Construction	$20.5-$21.6	$17.4-$17.9	1.7 miles	35.9	30.5	1.5 miles	30.7	26.1	0.3 mile	6.5	5.5	1.1 miles	23.9	20.3
Total	--	--	7.9 miles	$111.8	$ 92.5	10.9 miles	$142.3	$114.8	27.0 miles	$ 97.1	$ 45.4	26.5 miles	$124.3	$ 71.1
Grade-Separated Construction														
Aerial Construction	$17.6-$17.8	$15.5-$16.0	20.1 miles	$359.7	$316.5	19.3 miles	$342.0	$300.9	2.3 miles	$ 40.9	$ 36.8	3.7 miles	$ 68.3	$ 61.5
Subway Construction	$34.8-$35.6	$30.6-$31.4	1.3 miles	45.2	39.8	0.5 mile	17.8	15.7	--	--	--	--	--	--
Total	--	--	21.4 miles	$404.9	$356.3	19.8 miles	$359.8	$316.6	2.3 miles	$ 40.9	$ 36.8	3.7 miles	$ 68.3	$ 61.5
Crossings														
Street and Highway														
At-Grade	$ --	$ --	--	$ --	$ --	20	$ --	$ --	126	$ --	$ --	120	$ --	$ --
Overpasses	$ 0.3	$ 0.3	5	1.5	1.5	10	3.0	3.0	1	0.3	0.3	2	0.6	0.6
Underpasses.	$ 0.3	$ 0.3	7	2.1	2.1	8	2.4	2.4	--	--	--	6	1.8	1.8
Railroad.	$ 0.3	$ 0.3	3	0.9	0.9	2	0.6	0.6	3	0.9	0.9	2	0.6	0.6
Watercourse.	$ 0.3	$ 0.3	1	0.3	0.3	1	0.3	0.3	4	1.2	1.2	5	1.5	1.5
Subtotal	--	--	--	$521.5	$453.6	--	$508.4	$437.7	--	$140.4	$ 84.6	--	$197.1	$137.1
Engineering, Design, and Administration	15 percent	15 percent	--	$ 78.2	$ 68.0	--	$ 76.3	$ 65.6	--	$ 21.1	$ 12.7	--	$ 29.6	$ 20.5
Contingencies	30 percent	30 percent	--	$156.4	$136.0	--	$152.6	$131.3	--	$ 42.2	$ 25.4	--	$ 59.1	$ 41.0
Total	--	--	--	$756.1	$657.7	--	$737.3	$634.6	--	$203.7	$122.7	--	$285.8	$198.6

NOTE: All costs are estimated in millions of 1979 dollars.

Source: SEWRPC.

Table 99

ESTIMATED FIXED GUIDEWAY CONSTRUCTION COSTS FOR SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE NORTH-SOUTH CROSSTOWN CORRIDOR

	Alternative Alignment																			
	Alignment 1LB					Alignment 2LB					Alignment 3LB					Alignment 4LB				
		Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)			Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)			Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)			Total Guideway Construction Cost (millions of dollars)		Average Unit Cost (millions of dollars per mile)	
Segment	Distance (miles)	Light Rail	Busway	Light Rail	Busway	Distance (miles)	Light Rail	Busway	Light Rail	Busway	Distance (miles)	Light Rail	Busway	Light Rail	Busway	Distance (miles)	Light Rail	Busway	Light Rail	Busway
N. 76th Street and W. Brown Deer Road to W. Silver Spring Drive. . . .	5.2	$ 90.3	$ 78.5	$17.4	$15.0	5.8	$125.1	$107.6	$21.6	$18.6	5.2	$ 40.6	$ 24.4	$7.8	$4.7	5.8	$ 65.5	$ 45.5	$11.3	$7.8
W. Silver Spring Drive to W. Wisconsin Avenue	5.9	178.2	155.0	30.2	26.3	5.9	178.2	155.0	30.2	26.3	5.9	57.1	34.4	9.7	5.8	5.9	60.0	41.7	10.2	7.1
W. Wisconsin Avenue to S. 43rd Street and W. Howard Avenue (Cherokee Park)	4.7	129.8	112.9	27.6	24.1	2.6[a]	72.6	61.4	27.9	23.6	4.7	24.8	14.9	5.3	3.2	2.5[a]	14.4	10.0	5.8	4.0
S. 43rd Street and W. Howard Avenue (Cherokee Park) to S. 76th Street and W. Grange Avenue (Southridge Shopping Center)	3.8	86.7	75.4	22.8	19.8	4.8[b]	113.2	97.4	23.6	20.3	3.8	25.5	15.4	6.7	4.0	4.7[b]	30.2	21.0	6.4	4.5
S. 43rd Street and W. Howard Avenue (Cherokee Park) to the City of Oak Creek (E. Ryan Road)	9.7	271.1	235.8	27.9	24.3	11.6[c]	248.2	213.2	21.4	18.4	9.7	55.7	33.6	5.7	3.5	11.5[c]	115.7	80.4	10.1	7.0
Total N. 76th Street and W. Brown Deer Road to S. 76th Street and W. Grange Avenue and the City of Oak Creek . . .	29.3	$756.1	$657.7	$25.8	$22.4	30.7	$737.3	$634.6	$24.0	$20.7	29.3	$203.7	$122.7	$7.0	$4.2	30.3	$285.8	$198.6	$ 9.4	$6.6

[a]Construction cost was estimated for the segment between W. Wisconsin Avenue and W. Cleveland Avenue.

[b]Construction cost for the west, or Greendale, branch of the alignment was estimated for the segment between W. Cleveland Avenue and the intersection of S. 76th Street and W. Grange Avenue.

[c]Construction cost for the east, or Oak Creek, branch of the alignment was estimated for the segment between W. Cleveland Avenue and the City of Oak Creek.

Source: SEWRPC.

tric interurban right-of-way. Of the 7.1 miles of former electric interurban right-of-way, 1.2 miles are owned by the Wisconsin Electric Power Company and 5.9 miles are owned by Milwaukee County. It would also use about 11.0 miles of public street right-of-way, on which the transit facility would be located in a subway for about 0.3 mile and on an elevated structure for 10.7 miles. In addition, it would also cross the parking lot of Milwaukee County Stadium for about 0.4 mile, and would use about 2.0 miles of parkland and about 4.6 miles of newly acquired right-of-way. The new right-of-way would include about 2.6 miles of open or vacant land, 0.4 mile of developed commercial land and industrial land, and 0.5 mile of vacant land owned by the Milwaukee Area Technical College. In addition, new right-of-way would be required where the alignment would cross the parking lot of Miller Brewing Company for about 0.5 mile, and parking lots of the Northridge and Southridge Shopping Centers for 0.4 mile and 0.2 mile, respectively. Location of a transit facility on the 0.4 mile of commercial and industrial land located at W. Plainfield Avenue and S. 6th Street would entail the displacement of approximately five commercial or industrial structures.

Alternative 3LB would utilize a strip of land about 29.3 miles in length, including 2.9 miles of active mainline railway right-of-way and 4.8 miles of former electric interurban railway right-of-way owned by the Wisconsin Electric Power Company. It would also use about 16.2 miles of public street right-of-way, of which the transit facility would be located within arterial street medians for 14.0 miles, in reserved lanes for 0.8 mile, on an elevated structure for 0.2 mile, and on existing public street right-of-way which would be dedicated to the exclusive use of light rail transit for 1.2 miles. The alignment would also use about 1.0 mile of publicly owned parkland and 1.2 miles of vacant land owned by Milwaukee County for use as freeway right-of-way. About 3.2 miles of newly acquired right-of-way which is privately owned at the present time would be required, including 1.5 miles of undeveloped or vacant land, 0.3 mile of developed residential land, 0.5 mile which is currently used as a parking lot by Miller Brewing Company, and 0.3 mile of industrial land. In addition, new right-of-way would be required where the alignment crosses the parking lot of the Northridge Shopping Center for about 0.4 mile and where it crosses the Southridge Shopping Center parking lot for about 0.2 mile.

Alternative 4LB would utilize a strip of land about 30.4 miles in length, including 4.1 miles of active mainline railway right-of-way and 1.3 miles of former electric interurban railway right-of-way owned by the Wisconsin Electric Power Company. It would also use about 12.2 miles of public street right-of-way, of which the transit facility would be located within arterial street medians for 9.8 miles, in reserved lanes for 0.6 mile, on an aerial structure for 0.6 mile, and on existing public street right-of-way which would be dedicated to the exclusive use of light rail transit for 1.2 miles. The alignment would also use about 2.0 miles of publicly owned parkland and 7.1 miles of vacant land owned by Milwaukee County for use as intact transportation corridors. About 3.7 miles of newly acquired right-of-way which is privately owned at the present time would be required, including 1.6 miles of undeveloped or vacant land, 0.5 mile of land which is currently used as a parking lot by Miller Brewing Company, 0.3 mile of industrial land, 0.2 mile of developed commercial land, and 0.5 mile of cleared land on two separate parcels owned by the Milwaukee Area Technical College. In addition, new right-of-way would be required where the alignment crosses the parking lot of the Northridge Shopping Center for about 0.4 mile and where it crosses the Southridge Shopping Center parking lot for about 0.2 mile.

It should be noted that location of an at-grade dual guideway on the surface of S. 43rd Street under Alternatives 3LB and 4LB would require the use of two arterial street lanes, leaving two lanes for motor vehicle traffic in each direction assuming parking is prohibited. Such a reserved lane configuration would be required over a distance of about 0.8 mile for Alternative 3LB and 0.5 mile for Alternative 4LB. Alternative 3LB would also require the taking of one lane in each direction of S. Howell Avenue for approximately 0.3 mile where the highway passes beneath the main east-west runway of General Mitchell Field. This would leave one lane for moving traffic in each direction plus an emergency stopping lane in each direction.

Line-haul travel times between selected locations of the four light rail transit/busway alignments are summarized in Table 100. The times required to travel over the light rail transit/busway alternative alignments are all somewhat similar. The travel time for the Class A Alignment for Alternative 1LB is 6 to 7 percent shorter—depending on the mode—over the entire length of the corridor than the

Table 100

AVERAGE LINE-HAUL TRAVEL TIMES BETWEEN SELECTED SEGMENTS OF THE LIGHT RAIL TRANSIT/BUSWAY ALTERNATIVE ALIGNMENTS IN THE NORTH-SOUTH CROSSTOWN CORRIDOR

	Alternative Alignment																			
	Alignment 1LB					Alignment 2LB					Alignment 3LB					Alignment 4LB				
				Travel Time (minutes—light rail/busway)					Travel Time (minutes—light rail/busway)					Travel Time (minutes—light rail/busway)					Travel Time (minutes—light rail/busway)	
Segment	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Station-to-Station	Cumulative	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Station-to-Station	Cumulative	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Station-to-Station	Cumulative	Distance (miles)	Station Spacing[a]	Average Speed[b] (miles per hour—light rail/busway)	Station-to-Station	Cumulative
N. 76th Street and W. Brown Deer Road to W. Silver Spring Drive.	5.2	Typical light rail/ busway	30/28	10/11	--	5.8	Typical light rail/ busway	29/27	12/13	--	5.2	Typical light rail/ busway	28/26	11/12	--	5.8	Typical light rail/ busway	29/27	12/13	--
		Typical heavy rail	37/37	8/8	--		Typical heavy rail	37/36	9/10	--		Typical heavy rail	35/32	9/10	--		Typical heavy rail	34/32	10/11	--
W. Silver Spring Drive to W. Wisconsin Avenue	5.9	Typical light rail/ busway	23/21	15/17	25/28	5.9	Typical light rail/ busway	23/21	15/17	27/30	5.9	Typical light rail/ busway	23/20	15/18	26/30	5.9	Typical light rail/ busway	22/20	16/18	29/31
		Typical heavy rail	32/30	11/12	19/20		Typical heavy rail	32/30	11/12	20/22		Typical heavy rail	29/27	12/13	21/23		Typical heavy rail	29/27	12/13	22/24
W. Wisconsin Avenue to S. 43rd Street and W. Howard Avenue (Cherokee Park)	4.7	Typical light rail/ busway	25/22	11/13	36/41	2.6[c]	Typical light rail/ busway	23/21	7/8	34/38	4.7	Typical light rail/ busway	24/21	12/13	38/43	2.5[c]	Typical light rail/ busway	22/20	7/8	35/38
		Typical heavy rail	33/32	8/9	27/29		Typical heavy rail	32/30	5/5	25/27		Typical heavy rail	31/29	9/10	30/33		Typical heavy rail	30/28	5/6	27/30
S. 43rd Street and W. Howard Avenue (Cherokee Park) to S. 76th Street and W. Grange Avenue (Southridge Shopping Center)	3.8	Typical light rail/ busway	32/30	7/8	43/49	4.8[d]	Typical light rail/ busway	28/26	10/11	44/49	3.8	Typical light rail/ busway	30/27	8/9	46/52	4.7[d]	Typical light rail/ busway	27/25	10/11	45/49
		Typical heavy rail	39/39	6/6	33/35		Typical heavy rail	36/35	8/8	33/35		Typical heavy rail	35/33	6/7	36/40		Typical heavy rail	32/30	9/9	36/39
S. 43rd Street and W. Howard Avenue (Cherokee Park) to the City of Oak Creek (E. Ryan Road) . .	9.7	Typical light rail/ busway	29/26	20/22	56/63	4.6[e]	Typical light rail/ busway	27/25	26/28	60/66	9.7	Typical light rail/ busway	26/24	22/24	60/67	11.5[e]	Typical light rail/ busway	26/24	27/29	62/67
		Typical heavy rail	37/35	16/16	43/45		Typical heavy rail	35/34	20/20	45/47		Typical heavy rail	32/30	18/19	48/52		Typical heavy rail	33/31	21/22	48/52

[a] *Assumes light rail and busway transit station spacing of approximately one-quarter mile in the Milwaukee central business district; one-half mile in other high-density urban areas unless the guideway is fully grade-separated, where one-mile spacing is ssumed; and one mile in medium-density urban areas. The wider station spacing represents typical heavy rail station spacing of approximately one-half mile in the Milwaukee central business district; one mile in other high-density urban areas; and two miles in medium-density areas.*

[b] *The average speeds are based upon typical acceleration and deceleration rates; typical maximum operating speeds, which vary based on type, location, and degree of grade separation of right-of-way; assumed typical station spacing; and a typical station well time of 30 seconds. Preferential treatment has been assumed at all at-grade crossings. These typical light rail and busway transit characteristics were established in SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Techology. The result is average speeds of about 11 miles per hour in malls and other reserved guideways on street rights-of-way in the central business district; of from 20 to 30 miles per hour on reserved guideways in all other street rights-of-way; and of from 20 to 40 miles per hour on all other private rights-of-way. The variation in these average speeds is a result of variation in station spacing.*

[c] *Travel times are estimated for the segment between W. Wisconsin Avenue and W. Cleveland Avenue.*

[d] *Travel times for the west, or Greendale, branch of the alignment were estimated for the segment between W. Cleveland Avenue and N. 76th Street and W. Grange Avenue.*

[e] *Travel times for the east, or Oak Creek, branch of the alignment was estimated for the segment between W. Cleveland Avenue and E. Ryan Road in the City of Oak Creek.*

Source: SEWRPC.

Table 101

HOUSEHOLD POPULATION AND EMPLOYMENT SERVED BY LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE NORTH-SOUTH CROSSTOWN CORRIDOR UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Household Population Served			Number of Jobs Served (one-half-mile walking distance)
	One-Half-Mile Walking Distance	15-Minute Feeder Bus Travel Time	Three-Mile Driving Distance	
1LB	139,700	658,200	876,000	84,600
2LB	150,600	630,700	814,600	92,500
3LB	139,700	658,200	876,000	84,600
4LB	150,600	630,700	814,600	92,500

Source: SEWRPC.

travel time for the Class B alignment for Alternative 3LB. The Class A alignment for Alternative 2LB, however, has a travel time advantage over the Class B alignment for Alternative 4LB which varies by less than 3 percent. Comparable travel times between the Northridge and Southridge Shopping Centers for the light rail transit mode are 43 and 46 minutes for Alternatives 1LB and 3LB, respectively, and 44 and 45 minutes for Alternatives 2LB and 4LB. Between the Northridge Shopping Center and the City of Oak Creek, the light rail transit alignments have a total travel time of 56 and 60 minutes for Alternatives 1LB and 3LB, respectively, and 60 and 62 minutes for Alternatives 2LB and 4LB. Comparable travel times for the busway mode between the Northridge and Southridge Shopping Centers are 49 and 52 minutes for Alternatives 1LB and 3LB, respectively, and 49 minutes for both Alternatives 2LB and 4LB. Between the Northridge Shopping Center and the City of Oak Creek, the busway alignments have a total travel time of 63 and 67 minutes for Alternatives 1LB and 3LB, respectively, and 66 and 67 minutes for Alternatives 2LB and 4LB. It should be noted that if the station spacing of the light rail transit and busway alignments of these four alternatives was designed to replicate the station spacings of heavy rail rapid transit systems, total travel times would be shortened significantly. Specifically, the station spacings would be changed from 0.5 mile to 1.0 mile in high-density areas, and from 1.0 mile to 2.0 miles in medium-density areas. This would result in reductions in travel times of 20 to 25 percent for the light rail transit alignments—to about 34 minutes to Southridge and 45 minutes to Oak Creek, and of 20 to 29 percent for the busway alignments—to about 37 minutes to Southridge and 50 minutes to Oak Creek.

The alternative alignments are quite similar in terms of accessibility to population and employment. As shown in Table 101, Alternatives 1LB and 3LB would serve the greatest number of residents within a six-mile band centered on the alignment, 876,000, compared with 814,600 for Alternatives 2LB and 4LB. Alternatives 2LB and 4LB serve a larger number of residents within walking distance, 150,600, compared with 139,700 for Alternatives 1LB and 3LB. Alternatives 2LB and 4LB would in addition serve about 9 percent more jobs within walking distance, 92,500, compared with 84,600 for Alternatives 1LB and 3LB. With respect to serving major activity centers, Alternatives 2LB and 4LB would serve the Southgate and Point Loomis Shopping Centers. Alternative 1LB and 3LB would directly serve the industrial areas in the City of Oak Creek and General Mitchell Field. All four alignments would serve the Northridge and Southridge Shopping Centers, as well as Milwaukee County Stadium and the industrial areas in the Village of West Milwaukee.

Recommended Light Rail Transit/Busway Alignment: Table 102 summarizes the results of the preliminary assessment of the capital cost, disruption, travel time, and accessibility to both employment and population for each of the light rail transit/busway alternative alignments in the north-south crosstown corridor. Alternative 3LB is the preferred alignment in the north-south crosstown corridor. Alternatives 3LB and 4LB both have about one-third the cost of Alternatives 1LB and 2LB, with no significant loss of travel time. Compared with Alternative 4LB, Alternative 3LB is almost 30 percent less costly while serving only about 7 percent less population and about 9 percent fewer jobs within walking distance. Alterna-

Table 102

SUMMARY OF PRELIMINARY EVALUATION IMPACTS FOR ALTERNATIVE LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS IN THE NORTH-SOUTH CROSSTOWN CORRIDOR

Evaluation Criteria	Alternative Alignment			
	Alignment 1LB	Alignment 2LB	Alignment 3LB	Alignment 4LB
	Light Rail/Busway	Light Rail/Busway	Light Rail/Busway	Light Rail/Busway
Capital Cost (guideway construction cost in millions of dollars)	$756.1/$657.1	$737.3/$634.6	$203.7/$122.7	$285.8/$198.6
Community Disruption				
Type of Land Used (miles)				
Railroad and Former Interurban Right-of-Way	7.5	11.5	7.7	11.3
Cleared Freeway Right-of-Way	1.2	1.2	1.2	1.2
Public Street Right-of-Way	13.2	11.0	16.2	12.2
Public Land	3.4	2.7	1.0	2.0
Newly Acquired Right-of-Way	4.0	4.3	3.2	3.7
Total	29.3	30.7	29.3	30.4
Structure Dislocation (number)				
Residential Buildings	26	--	--	--
Commercial or Industrial Buildings	--	5	--	--
Public Buildings	--	--	--	--
Other Disruption	None	None	Location of alignment in reserved lanes would require the taking of two lanes on S. 43rd Street for 0.8 mile, leaving two lanes in each direction with parking prohibited. Also, one lane in each direction on S. Howell Avenue for 0.3 mile would be taken, leaving one moving traffic lane in each direction	Location of alignment in reserved lanes would require the taking of two lanes on S. 43rd Street for 0.5 mile, leaving two lanes in each direction with parking prohibited
Travel Time minutes)				
Northridge-Greendale	43/49	44/49	46/52	44/49
Northridge-Oak Creek	56/63	60/66	60/67	60/67
Population Served				
One-Half-Mile Walking Distance	139,700	150,600	139,700	150,600
Three-Mile Driving Distance	876,000	814,600	876,000	814,600
Jobs Served				
One-Half-Mile Walking Distance	84,600	92,500	84,600	92,500

Source: SEWRPC.

tive 3LB does, however, serve about 8 percent more population within driving distance. In addition, Alternative 3LB has a distinct advantage over Alternative 4LB in that its alignment directly serves General Mitchell Field.

Formation of Maximum Extent System Plans for Fixed Guideway Technologies

The third step in the development, test, and evaluation of the alternative primary transit system plans under the moderate growth scenario-centralized land use plan alternative future was the design of maximum extent light rail transit/busway and heavy rail rapid transit system plans, accomplished by judiciously combining the seven alignments selected for each of the three fixed guideway modes—busway, light rail transit, and heavy rail rapid transit—within each of the seven general corridors of maximum extent. Four guidelines were used in this synthesis of maximum extent system plans for each mode.

The first guideline was to retain, to the extent possible, each of the seven preferred alignments for each of the three modes in the system plans for that mode. These alignments were found to be

Table 103

SUMMARY OF PREFERRED HEAVY RAIL RAPID TRANSIT ALIGNMENTS
FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Characteristic	Corridor[a]						
	Northeast	North	West	Northwest	Southeast	East-West Crosstown	North-South Crosstown
Alternative Alignment	1H	3H	1H	1H	1H	1H	2H[c]
Total Length (miles)	22.6	7.1	18.5	15.8	11.9	11.1	30.6
On Surface	18.8	0.8	11.1	6.3	5.3	- -	6.0
In Subway	1.3	2.1	1.4	2.1	2.6	1.7	1.3
On Elevated Structure	2.5	4.2	6.0	7.4	4.0	9.4	23.3
Capital Cost[b] (millions of dollars)	$520.4	$257.6	$327.4	$379.4	$305.5	$363.9	$800.7
Total Travel Time (minutes)	31	12	27	23	19	17	37
Population Served Within One-Half-Mile Walking Distance	90,000	63,100	71,700	111,100	69,200	78,800	148,700
Population Served Within Three-Mile Driving Distance	448,700	388,500	512,200	521,300	349,200	433,900	817,800
Employment Served Within One-Half-Mile Walking Distance	86,500	61,800	90,800	75,500	75,400	66,000	95,600

[a] *Information presented within this table relates to each of the individual corridors only, and does not constitute systemwide information. These data, therefore, cannot be summed without incorporating some duplication.*

[b] *For guideway construction only; does not include the cost of right-of-way and vehicle acquisition or station and maintenance facility construction.*

[c] *South of the Lakeside Belt Line right-of-way in the Oak Creek corridor extension, Alternative Alignment 1H was selected as the preferred alignment.*

Source: SEWRPC.

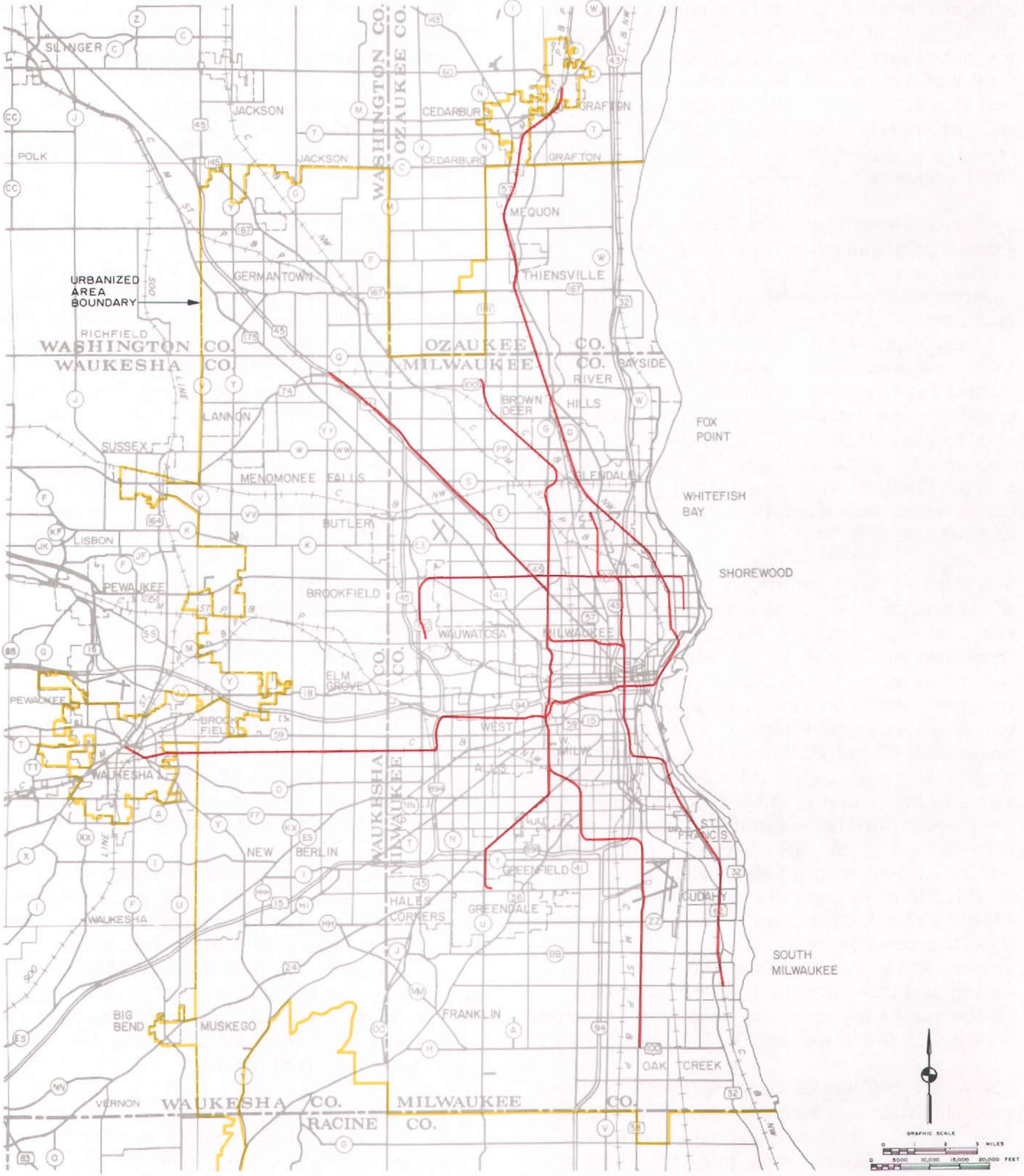
superior to other alignments concerned in terms of construction cost, urban disruption, population and employment served, and travel time. The second guideline was to minimize the cost and disruption attendant to connecting the recommended alignments, particularly through the Milwaukee central business district. The preferred alignments were to be connected into a system in such a way as to minimize the number of different alignments entering the central business district and to eliminate the need for extensive turnaround and storage facilities in that district. The third guideline was to minimize any duplication of alignments in the corridors. In the application of this guideline, consideration was given both to eliminating one or more of any duplicative segments of the preferred alignments in each corridor, and to substituting a single new alignment for one or more duplicative segments. The fourth guideline was to serve as many major land use activity centers as practicable while providing an overall high level of accessibility to high- and medium-density residential areas.

Maximum Extent System Plan for Heavy Rail Rapid Transit: Of the seven preferred alignments for heavy rail rapid transit, five radiate from the central business district and two would be crosstown alignments. One of these preferred alignments—that in the north-south crosstown corridor—would divide into two branches on the south side of Milwaukee County. These preferred alignments have a total length of 113.5 miles, of which 4.1 miles are common to more than one preferred alignment. These seven preferred alignments are summarized in Table 103 and shown on Map 46. Map 46 illustrates that without some modification of the alignments, dead-end terminals would exist in proximity to other alignments, and there would be duplication of some segments of alignment.

Accordingly, seven modifications were made to the preferred alignments to assist in obtaining an efficient system plan. The first modification is the relocation of that segment of the northwest corridor alignment between W. Keefe Avenue and W. Capitol Drive. In order to accommodate

Map 46

PREFERRED HEAVY RAIL RAPID TRANSIT ALIGNMENTS FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



A total of seven preferred alignments suitable for the provision of heavy rail rapid transit were identified within the Milwaukee area. Of these seven alignments, five radiate from the City of Milwaukee central business district, while two are of a crosstown configuration. One alignment—that in the north-south crosstown corridor—would divide into two branches on the south side of Milwaukee County. The preferred alignments that reach into the Village of Grafton, the City of Waukesha, the Village of Greendale, the City of Oak Creek, and the City of South Milwaukee are based on the extension of corridors of high travel demand along existing and potentially available rights-of-way. The seven preferred alignments have a continued length of 113.5 miles, of which 4.1 miles, or about 4 percent, are common to more than one alignment.

Source: SEWRPC.

a common transfer station between the alignments in the northwest and east-west crosstown corridors and provide additional vehicle routing flexibility, this segment of the northwest corridor alignment was substituted with alignments over N. Sherman Boulevard between W. Keefe Avenue and W. Melvina Street, and over W. Capitol Drive between N. 45th and N. 50th Streets. This modification would also eliminate a duplicative segment of fixed guideway.

The second modification is the relocation of that segment of alignment in the north-south crosstown corridor between the East-West Freeway (IH 94) and the Stadium Freeway (USH 41). In order to accommodate a common transfer station between the alignments in the west and north-south crosstown corridors and provide additional vehicle routing flexibility, this segment of the north-south crosstown corridor alignment was substituted with an alignment identical to that in the west corridor between the north and south limits of the Milwaukee County Stadium parking lot. This modification would also eliminate a duplicative segment of fixed guideway.

The third modification involves the rearrangement of the alignment segments in the north, northwest, and southeast corridors that are located in the immediate vicinity of N. 6th Street and W. Wisconsin Avenue. As originally envisioned, these preferred alignments turn from a subway located underneath N. 6th Street to a subway located underneath E. and W. Wisconsin Avenue. In order to provide a more logical interconnection of alignments in the central business district, as well as to more easily provide for through routing of vehicles between corridors, this alignment configuration was substituted with a tangent alignment beneath N. 6th Street through the entire central business district. This modification would also eliminate both the possible need for vehicle layover, turnaround, and storage tracks in the central business district and the community disruption attendant to the curved alignments necessary for transition between N. 6th Street and W. Wisconsin Avenue.

The fourth modification provides for a more direct routing in what may be considered a south corridor from General Mitchell Field to downtown Milwaukee. This modification joins the Oak Creek branch alignment to the preferred alignment in the southeast corridor instead of the preferred alignment in the north-south crosstown corridor. A new segment of alignment would be required along S. Howell Avenue, S. Chase Avenue, and S. 4th Street, connecting with the preferred alignment of the southeast corridor at S. 4th Street and W. Rogers Street. This modification eliminates a duplicative portion of the Oak Creek branch alignment between the junction adjacent to S. 43rd Street and immediately south of the Chicago & North Western Railway New Line Subdivision and the intersection of S. Howell and E. Plainfield Avenues.

The fifth modification provides for the extension of the preferred alignment in the north-south corridor from W. Silver Spring Drive to the Chicago & North Western Railway Capitol Drive spur track along the former Milwaukee Electric Lines-Milwaukee Northern Division electric interurban railway right-of-way. That segment of the preferred alignment to the Village of Grafton which is located north of the Capitol Drive spur track would be connected to and become part of the preferred alignment in the north corridor. This modification would also eliminate a duplicative portion of the northeast corridor alignment located adjacent to the Capitol Drive spur track north of Capitol Drive.

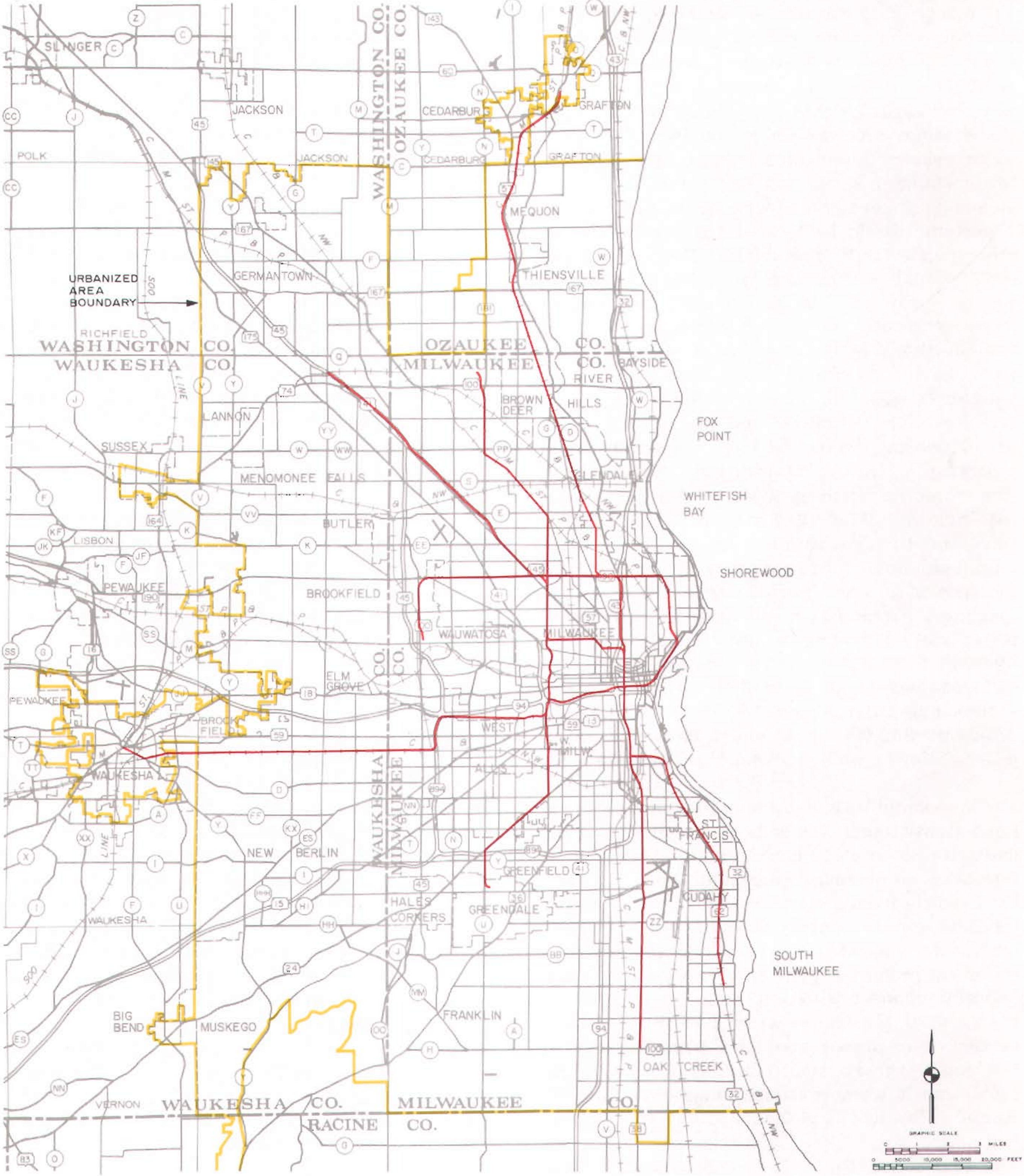
The sixth modification is the interconnection of the preferred alignments in the east-west crosstown and northeast corridors in the vicinity of E. Capitol Drive and N. Estabrook Parkway. This modification permits the through routing of vehicles between the two alignments, resulting in a reduction in the number of terminals for the maximum extent network. In addition, this modification eliminates that segment of alignment in the east-west crosstown corridor between N. Estabrook Parkway and E. Kenwood Boulevard.

The seventh modification is the relocation of the preferred alignment in the north-south crosstown corridor between the Northridge Shopping Center and W. Silver Spring Drive approximately one and one-half miles to the west. Because of this relocation, the new preferred alignment would be located on the Milwaukee Road Twelfth Subdivision right-of-way and on N. Wauwatosa Avenue, thus effecting a better spacing of the lines.

The resulting maximum extent system plan for heavy rail rapid transit is shown on Map 47. This maximum network would consist of about 103.7 miles of guideway. Of this total, about 21.6 miles, or 21 percent, would be located along active mainline railway rights-of-way; about 20.2 miles, or 19 percent, would be located along former electric

Map 47

MAXIMUM EXTENT HEAVY RAIL RAPID TRANSIT NETWORK FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



The maximum extent heavy rail rapid transit network for the moderate growth scenario-centralized land use plan alternative future was developed from the seven preferred alignments, with modifications made as necessary to provide an efficient system plan. The modifications were intended to eliminate duplicative routings, facilitate common stations where two or more alignments cross in the same general vicinity, and provide for a more direct routing in certain corridors. As shown on this map, the maximum network for heavy rail rapid transit would consist of about 103.7 miles of guideway, of which about 55.5 miles, or 54 percent of the fixed guideway, would be located on elevated structures, about 6.7 miles, or 6 percent, would be located in subways, and about 41.5 miles, or 40 percent, would be located on at-grade, exclusive rights-of-way.

Source: SEWRPC.

interurban railway rights-of-way presently owned by the Wisconsin Electric Power Company; about 1.9 miles, or 2 percent, would be located along abandoned mainline railway rights-of-way; and about 13.6 miles, or 13 percent, would be located along both active and cleared freeway rights-of-way, the cleared right-of-way being located along the Stadium Freeway-South and Park West Freeway corridors. About 39.2 miles, or 38 percent of this maximum extent system, would be located on public street rights-of-way; about 3.9 miles, or 4 percent, would be located on rights-of-way on other public lands; and about 3.3 miles, or 3 percent, would be located on new rights-of-way which would have to be acquired from private property owners. Of the total maximum extent system, about 55.5 miles, or 54 percent of the fixed guideway, would be located on elevated structures; about 6.7 miles, or 6 percent, would be located in subways; and about 41.5 miles, or 40 percent, would be located on fully grade-separated, exclusive rights-of-way. Urban disruption would be relatively low, the new right-of-way requiring the taking of only eight residential structures and two institutional structures, as well as a limited amount of private parking areas and traffic lanes on selected arterial streets. Altogether, the maximum extent heavy rail rapid transit network under this alternative future would serve about 494,000 residents within a one-half-mile walking distance and about 1 million residents within a three-mile driving distance. In addition, a total of about 340,000 jobs would be served within a one-half-mile walking distance of the alignment.

The maximum extent system for the heavy rail rapid transit mode would be operated as four primary transit routes. Each primary transit route represents an organized geographical path followed by a vehicle from a starting terminal to a finishing terminal on a regularly scheduled basis. These routes were selected from the maximum extent system of preferred alignments because they would logically connect different areas in and around the City of Milwaukee as well as major activity centers. For purposes of this planning process, the four primary transit routes for heavy rail rapid transit were arbitrarily numbered Route 1, Route 2, Route 3, and Route 4.

The first route, Route 1, would total 31.7 miles in length and extend from the City of Waukesha through the Cities of New Berlin and West Allis into the City of Milwaukee central business district. The route would then turn in a northeasterly direction, passing near the University of Wisconsin-Milwaukee campus before turning again in a westerly direction across the northern section of the City of Milwaukee, terminating at the Mayfair Mall Shopping Center in the City of Wauwatosa.

The second route, Route 2, would total 31.7 miles in length and would operate in a general north-south direction between the Village of Grafton and the City of Oak Creek. Route B would serve the Cities of Cedarburg, Mequon, and Glendale, and the Villages of Thiensville and Brown Deer, in addition to the Milwaukee central business district.

The third route, Route 3, would total 26.1 miles in length and would cross the Milwaukee urbanized area in a general northwest-southeast direction. The terminals of this route would be located in the Village of Menomonee Falls and the City of South Milwaukee, and the route would serve the Cities of St. Francis and Cudahy, as well as the Milwaukee central business district.

The fourth route, Route 4, would total 18.2 miles in length and would connect the northwest side of the City of Milwaukee with the Village of Greendale along a north-south crosstown alignment. Route 4 would also serve the Village of West Milwaukee and the City of Greenfield. The four routes are described in summary form in Table 104 and are shown on Map 48.

Maximum Extent System Plans for Light Rail Transit and Busways: Of the seven preferred alignments identified for the combination light rail transit and busway maximum extent system, five would radiate from the central business district and two would be crosstown alignments. One of these preferred alignments—that in the north-south crosstown corridor—would divide into two branches on the south side of Milwaukee County. These preferred alignments have a total length of 119.7 miles, of which 9.3 miles are common to more than one preferred alignment. These seven preferred alignments are summarized in Table 105 and shown on Map 49. The map illustrates that, without some modification of the alignments, dead-end terminals would exist in proximity to other alignments, and there would be duplication of some segments of alignment.

Accordingly, five modifications were made to the preferred alignments to assist in obtaining an efficient system plan. The first modification is the relocation of that segment in the northwest corridor alignment between W. Keefe Avenue and W. Capitol Drive. In order to accommodate a common transfer station between the alignments in the northwest and east-west crosstown corridors and provide additional vehicle routing flexibility, this segment of the northwest corridor alignment was substituted with alignments on N. Sherman Boulevard between W. Keefe Avenue and W. Capitol Drive, and on W. Capitol Drive between N. Sherman Boulevard and W. Fond du Lac Avenue. This modification would also eliminate a duplicative segment of fixed guideway.

The second modification is the relocation of that segment of alignment in the west corridor between N. 37th Street and N. Mitchell Boulevard. In order to accommodate a common transfer station between the alignments in the west and north-south crosstown corridors and provide additional vehicle routing flexibility, this segment of the west corridor alignment was substituted with an alignment that turns off W. Wisconsin Avenue at N. 38th Street and is located on an elevated structure over W. Blue Mound Road between N. 38th Street and N. 44th Street, where a connection is made with the preferred north-south crosstown corridor. This segment of the relocated alignment would require that W. Blue Mound Road between N. 38th and N. 39th Streets be closed to motor vehicle traffic and dedicated for use as a transit right-of-way. The relocated segment of alignment would follow the same alignment selected for the north-south crosstown corridor for about 0.6 mile to a location adjacent to the Milwaukee County Stadium parking lot. Here, the relocated alignment would enter an elevated structure to pass over the Stadium parking lot, as well as over the Stadium Freeway (USH 41) and the East-West Freeway (IH 94), before connecting with the original preferred alignment of the west corridor at N. Mitchell Boulevard immediately north of the East-West Freeway.

The third modification provides for a more direct routing in what may be considered a south corridor from General Mitchell Field to downtown Milwaukee. This modification joins the Oak Creek branch alignment to the preferred alignment in the southeast corridor instead of to the preferred alignment in the north-south crosstown corridor. A new segment of alignment would be required along S. Howell Avenue, S. Chase Avenue, and a one-way pair of arterial streets—S. 4th and S. 5th Streets—connecting with the preferred alignment of the southeast corridor at W. Rogers Street. This modification eliminates a duplicative portion of the Oak Creek branch alignment between the junction of the two branches near S. 41st Street and W. Plainfield Avenue and the location at which the Lakeside Belt Line right-of-way crosses S. Howell Avenue.

The fourth modification eliminates a duplicative segment of the preferred alignment in the northwest corridor between the intersection of N. 37th Street and W. Wisconsin Avenue and the intersection of W. Highland Boulevard and W. Juneau Avenue. Routing of vehicles in this area would be over the relocated preferred alignment in the west corridor between N. 38th and N. 44th Streets, and over the preferred alignment in the north-south crosstown corridor between W. Blue Mound Road and W. Highland Boulevard. This modification coincides with the second alignment modification—the relocation of that segment of alignment in the west corridor between N. 37th Street and N. Mitchell Boulevard—and necessitates the construction of an east-to-north connection at the intersection of N. 44th Street and W. Blue Mound Road.

The fifth alignment modification provides for the extension of the preferred alignment in the north corridor from W. Silver Spring Drive to the Chicago & North Western Railway Capitol Drive spur track along the former Milwaukee Electric Lines-Milwaukee Northern Division electric interurban railway right-of-way. That segment of the preferred alignment to the Village of Grafton which is located north of the Capitol Drive spur track would be connected to and become part of the preferred alignment in the north corridor. This modification would also eliminate a duplicative portion of the northeast corridor alignment located adjacent to the Capitol Drive spur track north of E. Capitol Drive.

The maximum extent light rail transit and busway system includes the UWM spur configuration as described for the preferred alignment for the east-west crosstown corridor. Such a configuration would better allow the use of the UWM spur as a terminal and turnaround facility for different routes and would better fit into the existing street pattern in the area.

The maximum extent system plan for the light rail transit and busway modes is shown on Map 50. This maximum network would consist of about 104.5 miles of guideway. Of this total, 11.7 miles, or 11 percent, would be located along active main-line railway rights-of-way; about 31.4 miles, or 30 percent, would be located along former electric

Table 104

SUMMARY OF PRIMARY TRANSIT SYSTEM ROUTES FOR HEAVY RAIL RAPID TRANSIT IN THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Characteristic	Route Designation[a]			
	1	2	3	4
Route Description	Waukesha-Milwaukee Central Business District-UWM	Grafton-Milwaukee Central Business District-Oak Creek	Menomonee Falls-Milwaukee Central Business District-South Milwaukee	Northridge-Southridge
Total Length (miles)	31.7	31.7	26.1	18.2
On Surface	14.6	12.5	11.7	3.0
In Subway	1.4	3.7	3.7	0.5
On Elevated Structure	15.7	15.5	10.7	14.7
Capital Cost[b] (millions of dollars)	$684.5	$750.3	$579.3	$493.6
Population Served Within One-Half-Mile Walking Distance	146,300	124,200	178,400	115,100
Population Served Within Three-Mile Driving Distance	963,000	570,500	765,400	661,700
Employment Served Within One-Half-Mile Walking Distance	129,000	91,400	95,000	76,100

[a] *Information presented within this table relates only to each of the primary transit system rates that are part of the maximum extent heavy rail rapid transit system. These data do not constitute aggregate systemwide information and therefore should not be summed for such purposes.*

[b] *For guideway construction only; does not include the cost of right-of-way and vehicle acquisition or station and maintenance facility construction.*

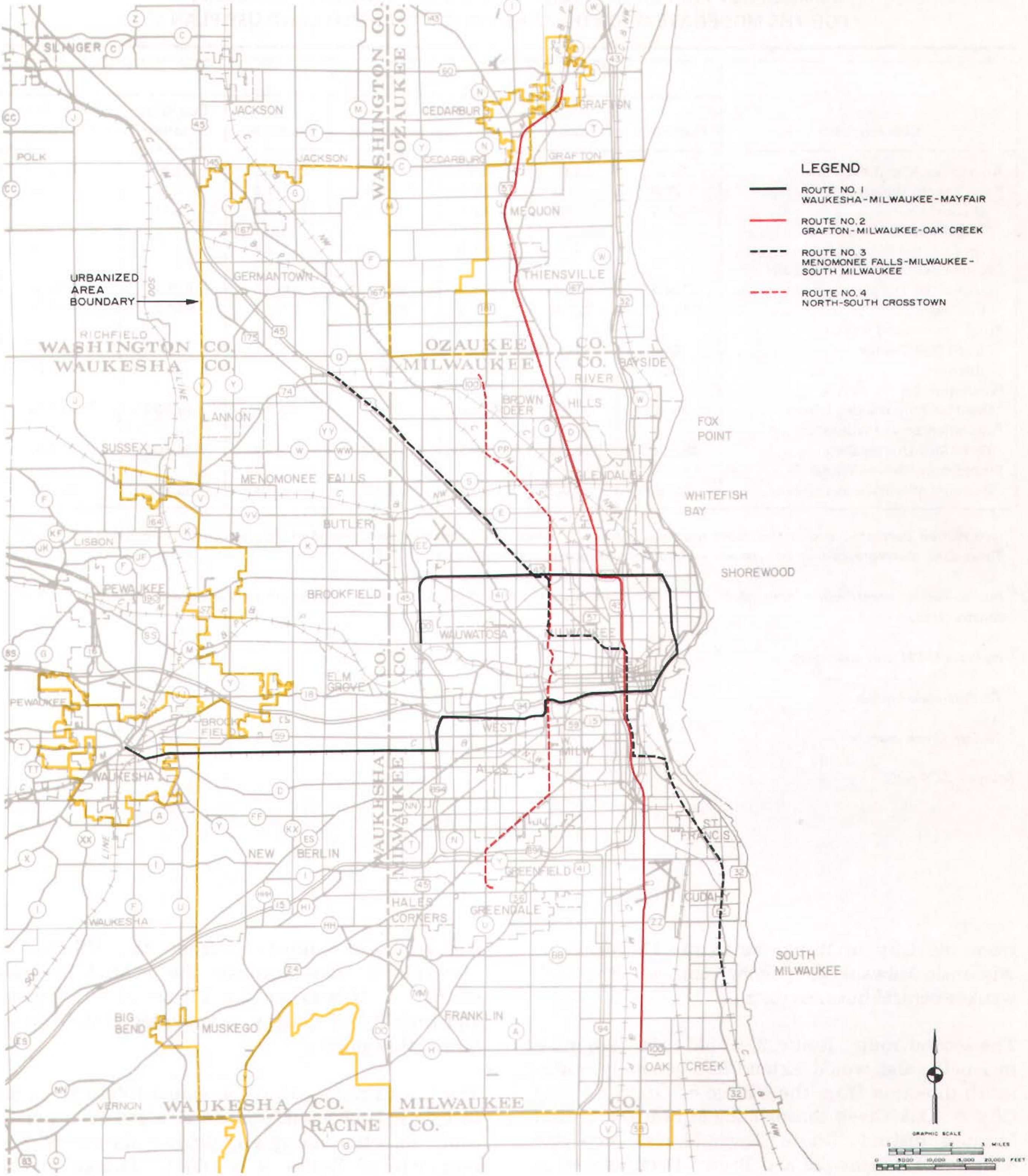
Source: SEWRPC.

interurban railway rights-of-way presently owned by the Wisconsin Electric Power Company; about 0.5 mile, or less than 1 percent, would be located along abandoned mainline railway rights-of-way; and 1.6 miles, or nearly 2 percent, would be located along the cleared freeway rights-of-way of the Stadium Freeway-South and Park Freeway-East corridors. About 51.7 miles, or 49 percent of this maximum extent system, would be located on the rights-of-way of existing public streets and highways. Of this total, 33.8 miles, or 65 percent, would be located in the median areas of public street and highway rights-of-way; 11.2 miles, or 22 percent, would be located in reserved lanes on public streets; 2.2 miles, or 4 percent, would consist of operation in mixed traffic; 2.0 miles, or 4 percent, would be located in transit malls; 1.2 miles, or 2 percent, would be located over dedicated street right-of-way; and 1.3 miles, or 3 percent, would be located on an elevated structure above public streets. The maximum network would require the use of other public lands for a total distance of 3.6 miles, or 3 percent of the maximum extent system, as well as the acquisition of about 4.1 miles of new right-of-way which is privately owned, or 4 percent of the system. Of the total maximum extent system, about 96.7 miles, or 92 percent of the fixed guideway, would be located on the surface, and about 7.8 miles, or 8 percent, would be located on elevated structures. There would be no segments of fixed guideway located in subways. Total urban disruption would be relatively low, the new right-of-way requiring the taking of only five residential structures as well as some private parking areas and traffic and parking lanes on selected arterial streets. Altogether, the maximum extent light rail transit/busway network under this alternative future would serve about 508,000 residents within a one-half-mile walking distance and about 1 million residents within a three-mile driving distance. In addition, a total of about 347,900 jobs would be served within a one-half-mile walking distance of the alignment.

The maximum extent system for the light rail transit and busway modes could be operated as five primary transit routes. The first route, Route 1, would total 23.2 miles in length and would extend

Map 48

HEAVY RAIL RAPID TRANSIT PRIMARY TRANSIT SYSTEM ROUTES FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



For purposes of primary transit system plan test and evaluation, the maximum extent system for the heavy rail rapid transit mode was assumed to be operated as four primary transit routes. The first route would total 31.7 miles in length and extend from the City of Waukesha through the City of Milwaukee central business district, passing near the University of Wisconsin-Milwaukee campus, and terminating in the City of Wauwatosa. The second route would also total 31.7 miles in length and would operate in a general north-south direction between the Village of Grafton and the City of Oak Creek, also passing through the City of Milwaukee central business district. The third route would total 26.1 miles in length and would operate in a general northwest-southeast direction between the Village of Menomonee Falls and the City of South Milwaukee, and it, too, would pass through the City of Milwaukee central business district. The fourth route would total 18.2 miles in length and would run in a north-south direction about two to three miles west of downtown Milwaukee between the northwest side of the City of Milwaukee and the Village of Greendale, functioning as a crosstown route.

Source: SEWRPC.

Table 105

SUMMARY OF PREFERRED LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS
FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Characteristic	Corridor[a]						
	Northeast	North	West	Northwest	Southeast	East-West Crosstown	North-South Crosstown
Alternative Alignment	3LB	2LB	2LB	3LB	2LB	3LB	3LB
Total Length (miles)	25.4[c]	6.9	18.7	15.4	11.9	12.1	29.3
On Surface	25.4[c]	6.9	17.7	15.0	9.8	12.1	27.0
In Subway	--	--	--	--	--	--	--
On Elevated Structure	--	--	1.0	0.4	2.1	--	2.3
Capital Cost[b] (millions of dollars)							
Light Rail Transit	$264.1[c]	$45.4	$122.9	$82.7	$139.3	$79.3	$203.7
Busway	$155.3[c]	$23.9	$ 66.7	$43.8	$ 96.7	$40.7	$122.7
Total Travel Time (minutes)							
Light Rail Transit	54	24	51	43	35	35	46[d]/60[e]
Busway	59	27	58	48	38	39	52[d]/67[e]
Population Served Within One-Half-Mile Walking Distance	98,700	64,300	84,900	114,600	69,200	79,600	139,700
Population Served Within Three-Mile Driving Distance	482,500	390,100	537,900	575,600	349,200	439,400	876,000
Employment Served Within One-Half-Mile Walking Distance	90,500	63,000	79,600	74,100	75,400	65,800	84,600

[a] *Information presented within this table relates to each of the individual corridors only, and does not constitute systemwide information. These data, therefore, cannot be summed without incorporating some duplication.*

[b] *For guideway construction only; does not include the cost of right-of-way and vehicle acquisition or station and maintenance facility construction.*

[c] *Includes UWM spur alignment.*

[d] *To Greendale branch.*

[e] *To Oak Creek branch.*

Source: SEWRPC.

from the City of Waukesha to the University of Wisconsin-Milwaukee, passing through the Milwaukee central business district.

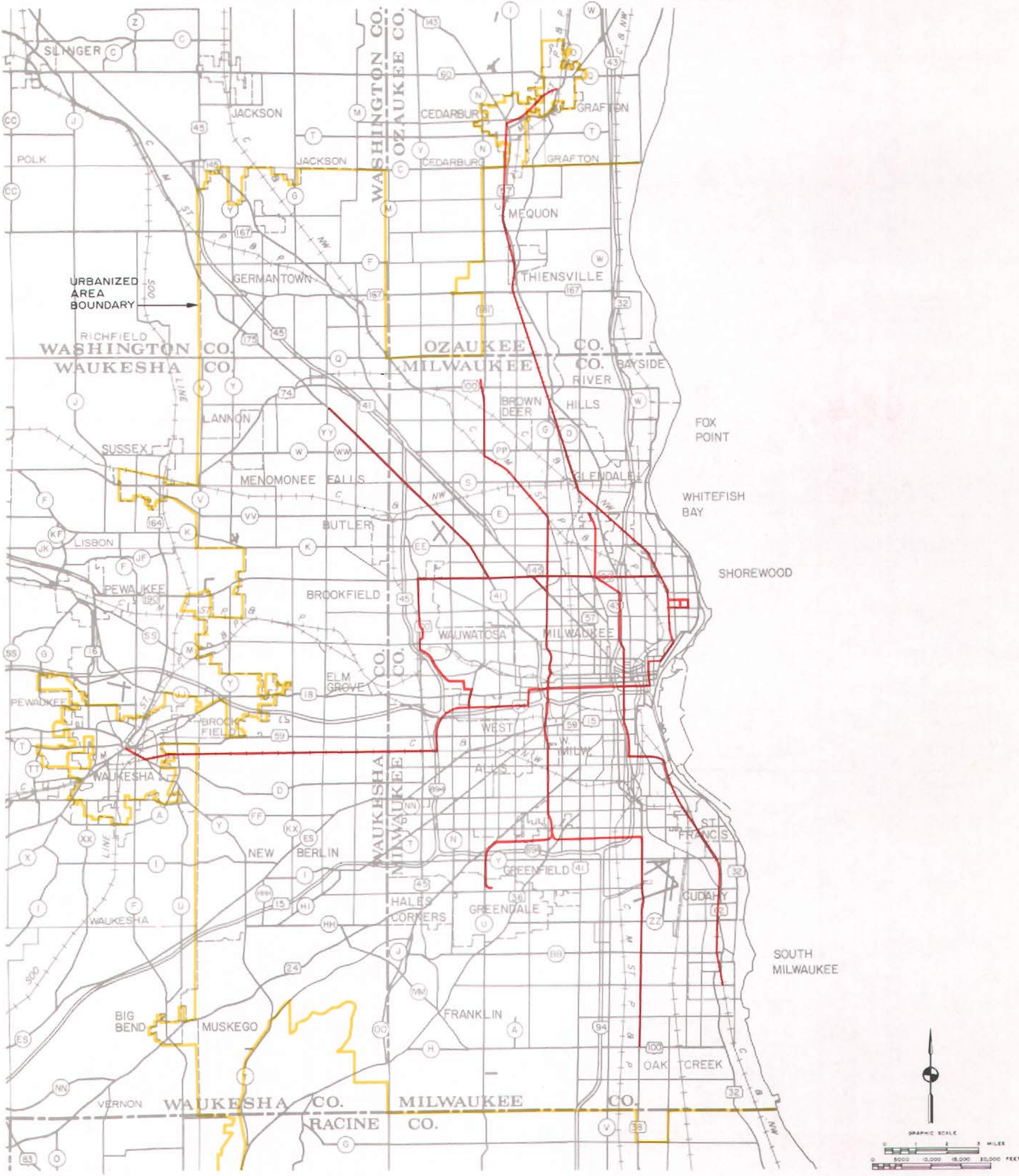
The second route, Route 2, would total 32.8 miles in length, and would extend in a generally north-south direction from the Village of Grafton to the City of Oak Creek through the Milwaukee central business district. Route 2 would also serve the Villages of Thiensville and Brown Deer, as well as the Cities of Mequon and Glendale.

The third route, Route 3, would total 26.3 miles in length, and would extend in a generally north-west-southeast direction from the Village of Menomonee Falls through the central business district of Milwaukee, the Village of St. Francis, and the City of Cudahy, terminating in the City of South Milwaukee.

The fourth route, Route 4, would total 19.7 miles in length, and would extend in a generally north-south direction along a crosstown alignment. The terminals of Route 4 would be located at the Northridge and Southridge Shopping Centers, and the route would serve the Villages of Greendale and West Milwaukee and the City of Greenfield, in addition to the City of Milwaukee.

Map 49

PREFERRED LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

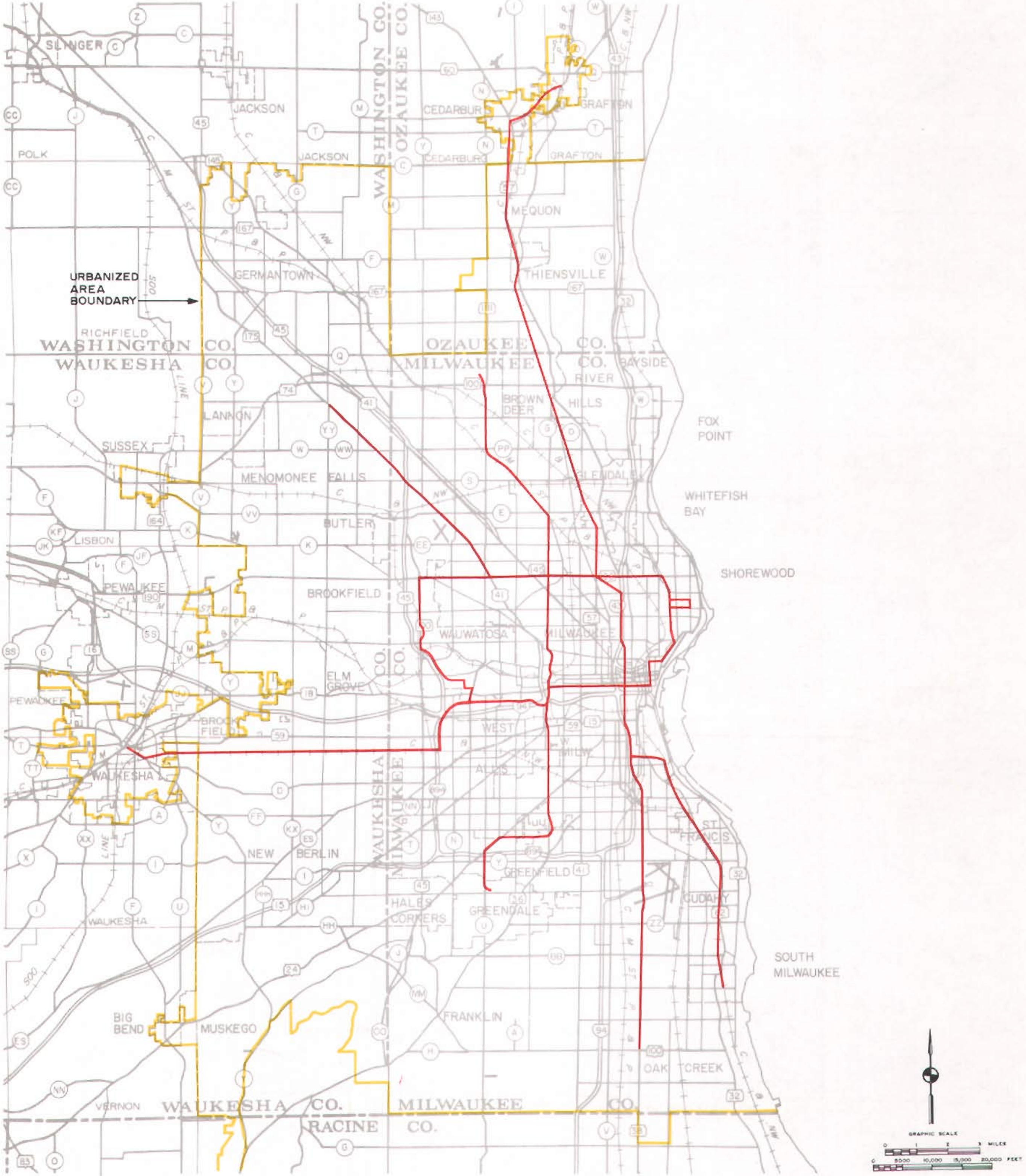


A total of seven preferred alignments suitable for the provision of light rail transit and busway service were identified within the Milwaukee area. Of these seven alignments, five radiate from the City of Milwaukee central business district, and two are of a crosstown configuration. One alignment—that in the north-south crosstown corridor—would divide into two branches on the south side of Milwaukee County. The preferred alignments that reach into the Village of Grafton, the City of Waukesha, the Village of Greendale, the City of Oak Creek, and the City of South Milwaukee are based on the extension of corridors of high travel demand along existing and potentially available rights-of-way. The seven preferred alignments have a combined length of 119.7 miles, of which 9.3 miles, or about 8 percent, are common to more than one alignment.

Source: SEWRPC.

Map 50

MAXIMUM EXTENT LIGHT RAIL TRANSIT/BUSWAY NETWORK FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



The maximum extent light rail transit and busway network for the moderate growth scenario-centralized land use plan alternative future was developed from the seven preferred alignments, with modifications made as necessary to provide an efficient system plan. The modifications were intended to eliminate duplicative routings, facilitate common stations where two or more alignments cross in the same general vicinity, and provide for a more direct routing in certain corridors. As shown on this map, the maximum network for light rail transit and busway service would consist of about 104.5 miles of guideway, of which 96.7 miles, or 92 percent, would be located on the surface, and about 7.8 miles, or about 8 percent, would be located on elevated structures. There would be no segments of guideway located in subways.

Source: SEWRPC.

The fifth and last route, Route 5, would total 24.8 miles in length, and would serve the Cities of Milwaukee and Wauwatosa. The overall configuration of Route 5 would be that of a loop which primarily serves the most intensely developed areas of the City of Milwaukee as well as the University of Wisconsin-Milwaukee campus area and the central business district of the City of Milwaukee. The five routes are summarized in Table 106 and illustrated on Map 51.

Summary of Maximum Network Design for Fixed Guideway Technologies: The third step in the development, test, and evaluation of alternative primary transit system plans under the moderate growth scenario-centralized land use plan alternative future involved the synthesis of maximum extent system plans for the three primary transit modes which require the construction of fixed guideway facilities. These three primary transit modes are heavy rail rapid transit, light rail transit, and busways. The maximum extent system for heavy rail rapid transit consists of four routes totaling about 108 one-way route miles in length and operating over 103.7 miles of fixed guideway. The system would have a capital cost of $2,269 million, not including the cost of right-of-way acquisition, vehicle acquisition, and station and maintenance facility construction. The population living within a one-half-mile walking distance of the system would total about 494,000, while the population served within a three-mile driving distance would total about 1 million. A total of 340,000 jobs would be served within a one-half-mile walking distance of this system.

The maximum extent system plan for light rail transit and busways consists of five routes totaling about 127 one-way route miles in length operating over 104.5 miles of fixed guideway. The capital cost of this system is about $773.8 million for the light rail transit system and $466.5 million for the busway system, not including the cost of right-of-way acquisition, vehicle acquisition, and station and maintenance facility construction. The population served within a one-half-mile walking distance of the system would total about 508,000, while the population served within a three-mile driving distance would total about 1 million. A total of about 347,900 jobs would be served within a one-half-mile walking distance of this system.

The configurations of the heavy rail rapid transit maximum extent network and the light rail transit/busway maximum extent network are very similar. The major difference between the two maximum extent networks is that the light rail transit/busway system includes a spur to the University of Wisconsin-Milwaukee campus area, as well as a spur to the Milwaukee County Institutions grounds, which serve to create a closed loop in the system. These two fixed guideway segments are not contained within the heavy rail rapid transit system. The heavy rail rapid transit system, however, does include a fixed guideway along the cleared right-of-way for the Park West Freeway, a segment which is not included in the light rail transit/busway system. There are also several minor differences in the location of the alignments constituting the heavy rail rapid transit and the light rail transit/busway networks which are attributable to the specific design attributes of each of the technologies. These differences are related primarily to the horizontal and vertical alignment requirements of each of the technologies, and are therefore evident in intensely developed areas, at junctions and terminals, and at locations where mainline horizontal curves are necessary.

These two maximum extent networks, together with the maximum networks defined for the bus-on-freeway and commuter rail modes, constitute the basis for further primary transit system plan test and evaluation under the moderate growth scenario-centralized land use plan alternative future. Further test and evaluation efforts, including traffic simulation model studies, are intended to define the "best plan" for each mode under this future by identifying those services and facilities which should be cut back or deleted. The best truncated system plans for each of the primary transit modes will then be combined into a best plan for the moderate growth scenario-centralized land use plan alternative future.

EVALUATION OF ALTERNATIVE PRIMARY TRANSIT SYSTEM PLANS

The fourth step in the process of designing a primary transit system plan for the Milwaukee area under this study consisted of the test and evaluation of each of the maximum extent system plans for each of the five modes under each of the four alternative futures. Based upon this initial test and evaluation, "best" systems for each mode under each future were developed. These best systems represent truncated versions of the maximum extent systems from which facilities and services indicated by the test and evaluation process to be unproductive were deleted. The findings of this

Table 106

SUMMARY OF PRIMARY TRANSIT SYSTEM ROUTES FOR LIGHT RAIL TRANSIT AND BUSWAYS IN THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Characteristic	Route Designation[a]				
	1	2	3	4	5
Route Description	Waukesha-Milwaukee Central Business District-UWM	Grafton-Milwaukee Central Business District-Oak Creek	Menomonee Falls-Milwaukee Central Business District-South Milwaukee	Northridge-Southridge	UWM-County Institutions Grounds-UWM
Total Length (miles)	23.2	32.8	26.3	19.7	24.8
On Surface	20.8	32.8	22.5	17.2	23.1
On Exclusive Right-of-Way	13.4	17.3	5.9	9.0	6.9
In Median Area	- -	9.2	12.0	8.2	8.6
In Reserved Lanes	4.0	5.7	4.0	- -	5.4
Mixed Traffic Operation	1.4	0.6	0.6	- -	0.5
In Transit Mall	2.0	- -	- -	- -	1.7
In Subway	- -	- -	- -	- -	- -
On Elevated Structure	2.4	- -	3.8	2.5	1.7
Capital Cost[b] (millions of dollars)					
Light Rail Transit	$204.0	$178.7	$244.7	$150.8	$217.9
Busway	$129.9	$ 96.7	$161.8	$ 92.2	$141.4
Population Served Within One-Half-Mile Walking Distance	96,300	124,200	170,700	115,000	136,200
Population Served Within Three-Mile Driving Distance	605,300	570,500	630,800	661,700	557,300
Employment Served Within One-Half-Mile Walking Distance	84,900	91,400	100,000	76,100	134,500

[a] *Information presented within this table relates only to each of the primary transit system routes that are part of the maximum extent heavy rail rapid transit system. These data do not constitute aggregate systemwide information and therefore should not be summed for such purposes.*

[b] *For guideway construction only; does not include the cost of right-of-way and vehicle acquisition or station and maintenance facility construction.*

Source: SEWRPC.

initial test and evaluation under the moderate growth scenario-centralized land use plan alternative future are summarized in this section, and the five "best" plans for this alternative future, one for each potential Milwaukee area primary transit mode—bus-on-freeway, commuter rail, light rail transit, heavy rail rapid transit, and bus on busways—are described.

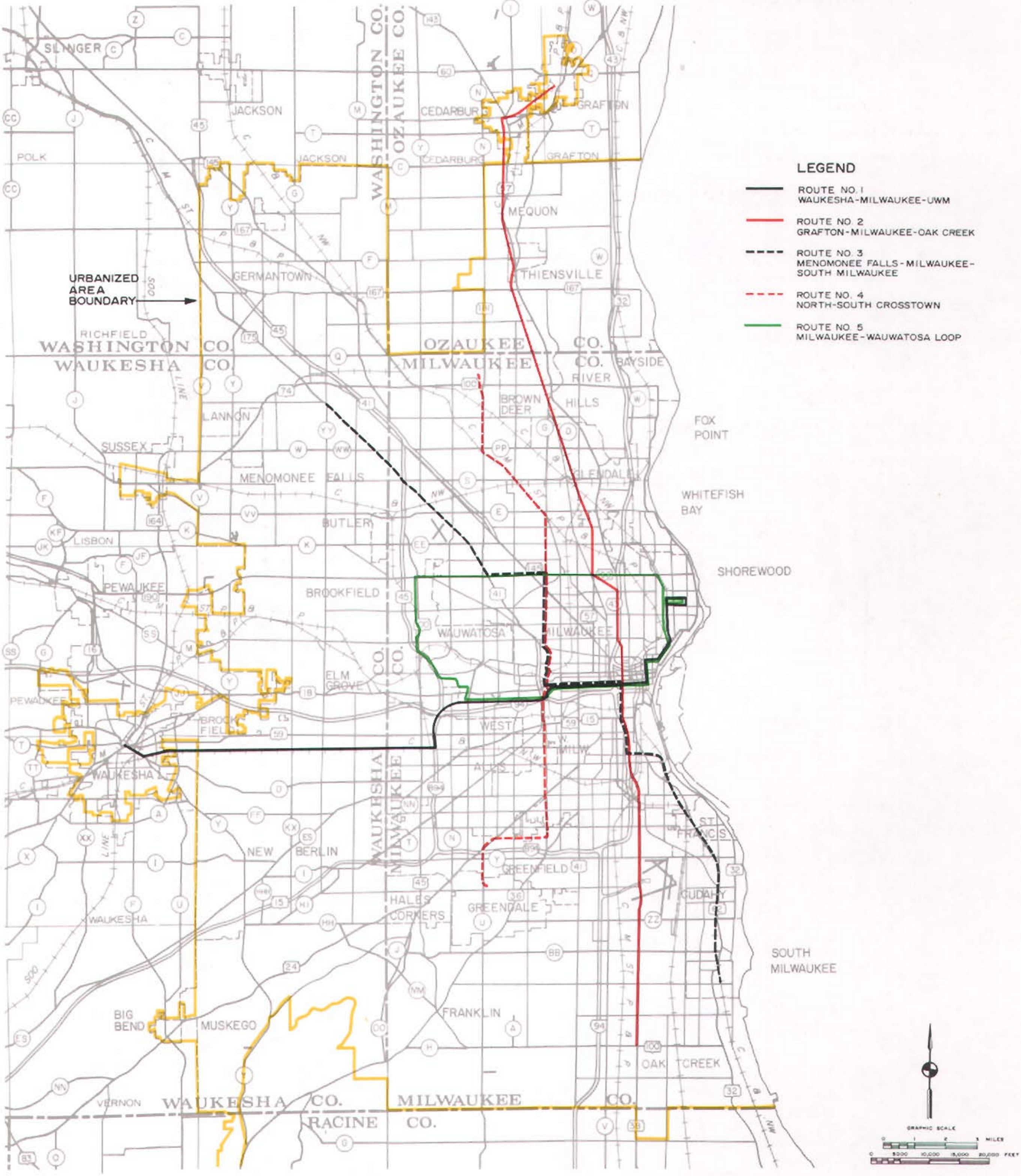
Because the plans initially considered were intended to be maximum extent plans which proposed to extend service beyond reasonably warranted limits, the initial evaluation of the plans was confined to a few selected, basic measures of the service provided, the potential utilization, and the costs entailed—measures which consisted of a small, but important, subset of the primary transit system development objectives and standards adopted under the study. In the next step of the process of designing a recommended plan, the "best" plans for each of the different primary transit modes were compared, and a "best" overall plan for each alternative future identified. This set of plans was then subject to further test and evaluation using a more comprehensive set of evaluative measures.

Evaluation of Maximum Extent Bus-on-Freeway System Plan

One of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is that of buses operating over operationally controlled freeways. The maximum extent system plan developed for this technology is summarized with respect to its coverage, stations, routes, and operation on Map 52 and in Tables 107 through 109. Map 53 and Tables 110 and 111 provide comparable information for the base, or benchmark, plan used in the study. The base plan envisions no long-range primary transit improvements in the Milwaukee area and is composed, in effect, of the existing Milwaukee area transit system, incorporating into that system, however, those short-range improvements recommended in the adopted Milwaukee County five-year transit improvement plan.

Map 51

LIGHT RAIL TRANSIT/BUSWAY PRIMARY TRANSIT SYSTEM ROUTES FOR THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

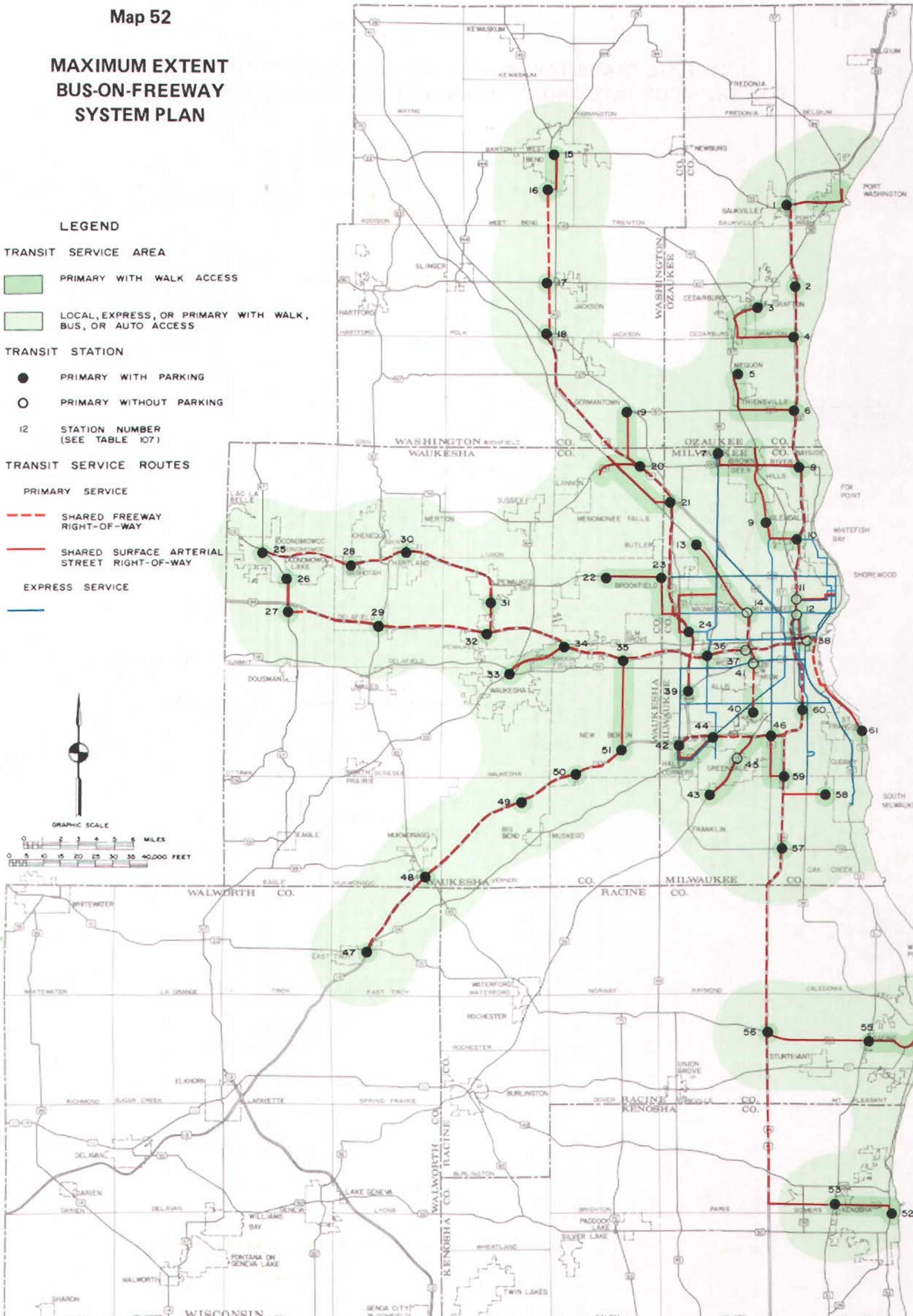


For purposes of primary transit system test and evaluation, the maximum extent system for the light rail transit and busway modes was assumed to be operated as five primary transit routes. The first route would total 23.2 miles in length and extend from the City of Waukesha through the City of Milwaukee central business district, and terminate at the University of Wisconsin-Milwaukee campus. The second route would total 32.8 miles in length and would operate in a general north-south direction between the Village of Grafton and the City of Oak Creek, also passing through the City of Milwaukee central business district. The third route would total 26.3 miles in length and would operate in a general northwest-southeast direction between the Village of Menomonee Falls and the City of South Milwaukee, and it, too, would pass through the City of Milwaukee central business district. The fourth route would total 19.7 miles in length and would run in a north-south direction about two to three miles west of downtown Milwaukee between the northwest side of the City of Milwaukee and the Village of Greendale, functioning as a crosstown route. The fifth route would total 24.8 miles in length, and would form a loop connecting much of the City of Milwaukee's north side as well as the City of Wauwatosa with the University of Wisconsin-Milwaukee campus and downtown Milwaukee.

Source: SEWRPC.

Map 52

MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN



The bus-on-freeway maximum extent system plan would provide for a significant expansion of the existing primary transit service in the Milwaukee area. Under this plan, bus-on-freeway service would be increased within Milwaukee County, and would be extended well beyond existing and future limits of the Milwaukee urbanized area. Also, all bus-on-freeway service under the maximum extent plan would be provided throughout the day, including midday and evening time periods, and would be operated at headways of no more than 30 minutes in the peak direction during peak periods and 60 minutes otherwise. Altogether, 31 bus-on-freeway routes, totaling 1,218 miles in length and using 61 primary transit stations, would be operated under this maximum extent plan. This compares with the 11 bus-on-freeway routes operated in 1980 during peak periods from only 19 primary transit stations. The 31 bus-on-freeway routes would be operated using high-capacity, articulated buses over existing and proposed freeways between outlying park-ride lots and the Milwaukee central business district (CBD). Most of these routes would have a limited number of intermediate stops which would connect with feeder/distributor express and local bus service in order to permit access to major travel generators other than the Milwaukee CBD.

The maximum extent bus-on-freeway system plan also provides for complementary expansion and improvement of the Milwaukee area express and local transit system. Nine additional express or limited stop routes would be provided, and the local transit system would be extended into all contiguous areas of urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County.

Source: SEWRPC.

Table 107

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (buses per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning		Midday		Afternoon		Evening	
										In	Out	In	Out	In	Out	In	Out
1	IH 43 and STH 33	Village of Saukville	Proposed	Yes	300	1	--	47	44	3	3	2	2	4	5	2	2
2	IH 43 and CTH Q	Town of Grafton	Proposed	Yes	275	1	1	40	37	3	3	2	2	4	5	2	2
3	S. 1st Avenue and Wisconsin Avenue	Village of Grafton	Proposed	Yes	100	1	1	51	48	2	2	1	1	2	4	1	1
4	IH 43 and CTH C	Town of Grafton	Existing	Yes	150	1	--	37	34	2	2	1	1	2	4	1	1
5	Cedarburg Road and Highland Road	City of Mequon	Existing	Yes	200	1	1	46	43	3	2	1	1	4	6	1	1
6	IH 43 and Mequon Road	City of Mequon	Proposed	Yes	300	1	1	32	29	3	2	1	1	4	6	1	1
7	N. 76th Street and W. Brown Deer Road	City of Milwaukee	Proposed	Yes	175	1	5	38	35	6	3	3	3	3	7	2	2
8	IH 43 and Brown Deer Road	Village of River Hills	Existing	Yes	30	1	2	28	25	6	3	3	3	3	7	2	2
9	N. Teutonia Avenue and W. Florist Avenue	City of Milwaukee	Proposed	Yes	100	1	1	42	39	4	3	1	1	3	5	1	1
10	IH 43 and W. Silver Spring Drive	Village of Glendale	Existing	Yes	200	4	7	22	19	16	12	7	7	15	24	7	7
11	IH 43 and W. Locust Street	City of Milwaukee	Proposed	Yes	--	3	4	16	14	6	3	3	3	3	7	2	2
12	IH 43 and W. North Avenue	City of Milwaukee	Proposed	Yes	--	5	4	13	12	22	15	10	10	18	31	9	9
13	W. Appleton Avenue and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	180	1	1	37	34	6	6	3	3	7	7	2	2
14	W. North Avenue and W. Lisbon Avenue	City of Milwaukee	Proposed	Yes	--	1	3	21	18	6	6	3	3	7	7	2	2
15	W. Main Street and W. Washington Street	City of West Bend	Proposed	Yes	80	1	--	83	78	2	2	1	1	2	3	1	1
16	S. Main Street and W. Paradise Drive	City of West Bend	Proposed	Yes	200	1	--	75	70	2	2	1	1	2	3	1	1
17	USH 45 and STH 60	Town of Polk	Proposed	Yes	120	1	--	66	61	2	2	1	1	2	3	1	1
18	USH 45 and USH 145	Town of Polk	Proposed	Yes	160	1	--	57	52	2	2	1	1	2	3	1	1
19	Pilgrim Road and Mequon Road	Village of Germantown	Proposed	Yes	170	1	1	46	41	2	2	1	1	2	2	1	1
20	USH 41 and Main Street	Village of Menomonee Falls	Proposed	Yes	200	2	1	40	35	4	4	2	2	4	5	2	2
21	N. 107th Street and W. Good Hope Road	City of Milwaukee	Proposed	Yes	175	1	3	38	33	3	2	1	1	4	4	1	1
22	N. Calhoun Road and W. Capitol Drive	City of Brookfield	Proposed	Yes	225	1	1	40	35	4	3	2	2	3	7	2	2
23	N. 124th Street and W. Capitol Drive	City of Wauwatosa	Proposed	Yes	250	1	3	35	30	4	3	2	2	3	7	2	2
24	USH 45 and W. Watertown Plank Road	City of Wauwatosa	Existing	Yes	350	2	2	28	24	5	5	4	4	5	5	4	4
25	S. Main Street and E. Wisconsin Avenue	City of Oconomowoc	Proposed	Yes	90	1	--	71	67	2	2	2	2	2	3	2	2
26	E. Summit Avenue and Pabst Road	City of Oconomowoc	Proposed	Yes	50	1	--	64	60	3	3	2	2	3	3	2	2
27	Summit Avenue and Delafield Road	Town of Summit	Existing	Yes	50	1	--	59	55	3	3	2	2	3	3	2	2
28	Lakeland Road and STH 16	Village of Nashotah	Existing	Yes	90	1	--	63	59	2	2	2	2	2	3	2	2
29	STH 83 and IH 94	City of Delafield	Proposed	Yes	125	1	--	50	46	3	3	2	2	3	3	2	2
30	Merton Avenue and STH 16	Village of Hartland	Proposed	Yes	125	1	--	56	52	2	2	2	2	2	3	2	2
31	Main Street and USH 16	Village of Pewaukee	Proposed	Yes	160	1	1	46	42	2	2	2	2	2	3	2	2
32	Grandview Boulevard and IH 94	City of Waukesha	Proposed	Yes	220	1	1	43	39	3	3	2	2	3	3	2	2
33	N. Barstow Street and W. Main Street	City of Waukesha	Proposed	Yes	90	1	1	44	40	3	3	1	1	3	4	1	1
34	N. Barker Road and W. Blue Mound Road	Town of Brookfield	Existing	Yes	300	1	1	34	30	3	3	1	1	3	4	1	1
35	N. Moorland Road and IH 94	City of Brookfield	Proposed	Yes	170	3	2	30	26	9	7	7	7	7	11	6	6
36	N. 84th Street and IH 94	City of Milwaukee	Proposed	Yes	400	9	2	22	18	25	21	13	13	23	33	13	13
37	Cemetery Access Road and IH 94	City of Milwaukee	Proposed	Yes	--	1	--	20	16	5	5	4	4	5	5	4	4
38	N. 3rd Street and W. Wisconsin Avenue	City of Milwaukee	Existing	Yes	--	29	23	--	--	110	79	61	61	104	162	52	52
39	USH 45 and W. National Avenue	City of West Allis	Proposed	Yes	350	1	4	24	20	5	2	2	2	2	10	2	2
40	S. 43rd Street and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	150	1	1	30	27	3	3	2	2	3	3	2	2

Table 107 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
41	S. 44th Street and W. National Avenue. . . .	Village of West Milwaukee	Proposed	Yes	--	1	2	20	17	3	3	2	2	3	3	2	2
42	S. 108th Street and STH 15.	City of Greenfield	Existing	Yes	400	1	3	30	27	4	3	2	2	3	7	2	2
43	W. Loomis Road and W. Rawson Avenue	City of Franklin	Proposed	Yes	225	1	1	37	33	4	3	2	2	3	6	2	2
44	S. 76th Street and W. Cold Spring Road . . .	City of Greenfield	Proposed	Yes	300	1	2	29	26	3	2	2	2	2	8	2	2
45	W. Loomis Road and W. Grange Avenue.	Village of Greendale	Proposed	Yes	--	1	2	29	26	4	3	2	2	3	7	2	2
46	S. 27th Street and IH 894.	City of Milwaukee	Proposed	Yes	350	1	3	25	22	3	3	2	2	3	6	2	2
47	STH 15 and STH 20	Town of East Troy	Proposed	Yes	80	1	--	74	70	4	2	2	2	2	5	2	2
48	STH 83 and STH 15	Town of Mukwonago	Existing	Yes	170	1	--	65	61	4	2	2	2	2	5	2	2
49	CTH F and STH 15.	Town of Vernon	Existing	Yes	120	1	--	55	51	4	2	2	2	2	5	2	2
50	Racine Avenue and STH 15	City of New Berlin	Existing	Yes	200	1	--	49	45	4	2	2	2	2	5	2	2
51	S. Moorland Road and STH 15	City of New Berlin	Proposed	Yes	140	1	2	43	39	4	2	2	2	2	5	2	2
52	6th Avenue and 56th Street.	City of Kenosha	Existing	Yes	100	1	6	72	69	4	2	4	4	6	8	2	2
53	STH 31 and 52nd Avenue.	City of Kenosha	Proposed	Yes	500	1	1	58	55	4	2	4	4	6	8	2	2
54	Wisconsin Avenue and 6th Street.	City of Racine	Proposed	Yes	100	1	8	66	63	5	2	4	4	8	10	2	2
55	STH 31 and 12th Street . .	Town of Mt. Pleasant	Proposed	Yes	500	1	1	54	51	5	2	4	4	8	10	2	2
56	IH 94 and STH 20	Town of Mt. Pleasant	Proposed	Yes	400	1	--	44	41	5	2	4	4	8	10	2	2
57	IH 94 and Ryan Road . . .	City of Oak Creek	Proposed	Yes	350	1	2	30	27	5	2	4	4	3	7	2	2
58	Nicholson Avenue and E. Rawson Avenue	City of Oak Creek	Proposed	Yes	300	1	1	31	28	5	3	2	2	3	6	2	2
59	IH 94 and W. College Avenue.	City of Milwaukee	Existing	Yes	450	4	4	26	23	11	6	8	8	16	20	4	4
60	IH 94 and W. Holt Avenue	City of Milwaukee	Existing	Yes	240	1	3	21	20	5	5	3	3	8	8	2	2
61	S. Lake Drive and E. Lunham Avenue	City of Cudahy	Proposed	Yes	250	1	--	28	27	4	3	2	2	5	5	2	2

Source: SEWRPC.

Under the maximum extent bus-on-freeway plan, buses would operate in primary transit service primarily over existing and proposed freeways between outlying park-ride lots and the Milwaukee central business district (CBD). Bus routes from park-ride lots in Milwaukee County to the CBD would be operated with a very limited number of intermediate stops as necessary to connect and coordinate with feeder express and local bus service, thus providing access to major travel generators other than the Milwaukee CBD. From the west, intermediate stops would be located at S. Moorland Road and at S. 84th Street; from the north, intermediate stops would be located at W. Silver Spring Drive and at W. North Avenue; and from the south, an intermediate stop would be located at W. Oklahoma Avenue. Primary transit bus routes originating at locations outside Milwaukee County but within the existing or future Milwaukee urbanized area would generally serve two outlying park-ride lots prior to proceeding essentially nonstop to the Milwaukee CBD. Primary transit bus routes originating at locations outside the Milwaukee urbanized area would have stops at two to five outlying park-ride lots prior to proceeding essentially nonstop to the CBD. The park-ride lots would be located, to the extent practicable, within or near freeway interchanges to minimize travel times. Within the Milwaukee CBD, all primary transit bus routes would operate over E. and W. Wisconsin Avenue for about two miles, with stops every one-quarter mile.

The Milwaukee area freeways over which buses would operate in primary transit service would be operationally controlled during peak travel periods. All freeway entrance ramps in the Milwaukee urbanized area would be ramp metered to restrain automobile and truck access to the freeways during peak travel periods. The ramp meters

Table 108

PRIMARY TRANSIT ROUTES FOR THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN

Route Number	Route Stops: Station Number	Route Stops: Location	One-Way Route Fare to Downtown Milwaukee
1—Port Washington	1	IH 43 and STH 33	$1.80
	2	IH 43 and CTH Q	1.60
	10	IH 43 and W. Silver Spring Drive	0.60
	12	IH 43 and W. North Avenue	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
2—Cedarburg	3	S. 1st Avenue and Wisconsin Avenue	$1.60
	4	IH 43 and CTH C	1.40
	10	IH 43 and W. Silver Spring Drive	0.60
	12	IH 43 and W. North Avenue	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
3—Mequon	5	Cedarburg Road and Highland Road	$1.20
	6	IH 43 and Mequon Road	1.00
	10	IH 43 and W. Silver Spring Road	0.60
	12	IH 43 and W. North Avenue	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
4—Brown Deer	7	N. 76th Street and W. Brown Deer Road	$0.60
	8	IH 43 and W. Brown Deer Road	0.60
	11	IH 43 and W. Locust Street	0.60
	12	IH 43 and W. North Avenue	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
5—River Hills	- -	STH 57 and W. County Line Road	$0.60
	9	N. Teutonia Avenue and W. Florist Avenue	0.60
	10	IH 43 and W. Silver Spring Drive	0.60
	12	IH 43 and W. North Avenue	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
6—Northwest Side	13	W. Appleton Avenue and W. Silver Spring Drive	$0.60
	14	W. North Avenue and W. Lisbon Avenue	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
7—Wauwatosa	- -	W. Lisbon Avenue and W. Burleigh Street	$0.60
	24	USH 45 and W. Watertown Plank Road	0.60
	37	Cemetery Access Road and IH 94	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
8—West Bend	15	S. Main Street and W. Washington Avenue	$2.20
	16	S. Main Street and Paradise Drive	2.20
	17	USH 45 and STH 60	1.80
	18	USH 45 and USH 145	1.60
	20	USH 41 and Main Street	1.00
	36	N. 84th Street and IH 94	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
9—Germantown	19	N. Pilgrim Road and W. Mequon Road	$1.20
	36	N. 84th Street and IH 94	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
10—Menomonee Falls	20	STH 74 and USH 41	$0.60
	36	N. 84th Street and IH 94	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
11—Menomonee Falls	21	STH 175 and Good Hope Road	$0.60
	36	N. 84th Street and IH 94	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -

Table 108 (continued)

Route Number	Route Stops: Station Number	Route Stops: Location	One-Way Route Fare to Downtown Milwaukee
12—Brookfield	22	N. Calhoun Road and W. Capitol Drive.	$1.00
	23	N. 124th Street and W. Capitol Drive.	0.60
	36	N. 84th Street and IH 94.	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
13—Milwaukee County Institutions/UWM	24	USH 45 and W. Watertown Plank Road	$0.60
	11	IH 43 and W. Locust Street	0.60
	- -	University of Wisconsin-Milwaukee Campus	- -
14—Oconomowoc/Pewaukee	25	S. Main Street and E. Wisconsin Avenue	$2.00
	28	Lakeland Road and STH 16	1.80
	30	Merton Avenue and STH 16.	1.60
	31	Main Street and USH 16	1.40
	35	N. Moorland Road and IH 94	1.00
	36	N. 84th Street and IH 94.	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
15—Oconomowoc/Delafield	26	E. Summit Avenue and Pabst Road.	$2.00
	27	Summit Avenue and Delafield Road	2.00
	29	STH 33 and IH 94	1.80
	32	Grandview Boulevard and IH 94	1.40
	35	N. Moorland Road and IH 94	1.00
	36	N. 84th Street and IH 94.	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
16—Waukesha	33	N. Barstow Street and W. Main Street	$1.20
	34	N. Barker Road and W. Blue Mound Road.	1.20
	36	N. 84th Street and IH 94.	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
17—East Troy	47	STH 15 and STH 20	$2.00
	48	STH 83 and STH 15	1.80
	49	CTH F and STH 15.	1.40
	50	Racine Avenue and STH 15	1.20
	51	S. Moorland Road and STH 15	1.00
	35	N. Moorland Road and IH 94	1.00
	36	N. 84th Street and IH 94.	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
18—Hales Corners	42	S. 108th Street and STH 15	$0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
19—Greenfield	44	S. 76th Street and W. Cold Spring Road	$0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
20—West Allis	39	USH 45 and W. National Avenue	$0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
21—Stadium	40	S. 43rd Street and W. Morgan Avenue	$0.60
	41	S. 44th Street and W. National Avenue.	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
22—Franklin	43	W. Loomis Road and W. Rawson Avenue	$0.60
	45	W. Loomis Road and W. Grange Avenue	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -
23—Kenosha	52	6th Avenue and 56th Street	$2.00
	53	STH 31 and 52nd Avenue	1.80
	59	IH 94 and W. College Avenue	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	- -

Table 108 (continued)

Route Number	Route Stops: Station Number	Route Stops: Location	One-Way Route Fare to Downtown Milwaukee
24—Racine	54	Wisconsin Avenue and 6th Street	$1.60
	55	STH 31 and 12th Street	1.40
	56	IH 94 and STH 20	1.20
	59	IH 94 and W. College Avenue	0.60
	38	N. 3rd Street and W. Wisconsin Avenue	--
25—Oak Creek	57	IH 94 and Ryan Road	$0.60
	38	N. 3rd Street and W. Wisconsin Avenue	--
26—Oak Creek	58	Nicholson Avenue and E. Rawson Avenue	$0.60
	38	N. 3rd Street and W. Wisconsin Avenue	--
27—South Side/UWM	46	College Avenue and IH 94	$0.60
	11	IH 43 and W. Locust Street	0.60
	--	University of Wisconsin-Milwaukee Campus	--
28—South Side/College Avenue	46	College Avenue and IH 94	$0.60
	38	N. 3rd Street and W. Wisconsin Avenue	--
29—South Side/IH 894	46	S. 27th Street and IH 894	$0.60
	38	N. 3rd Street and W. Wisconsin Avenue	--
30—South Side/Holt Avenue	60	IH 94 and W. Holt Avenue	$0.60
	38	N. 3rd Street and W. Wisconsin Avenue	--
31—Cudahy	61	S. Lake Drive and E. Lunham Avenue	$0.60
	38	N. 3rd Street and W. Wisconsin Avenue	--

Source: SEWRPC.

would be operated through a central control system which would continuously measure traffic volumes on those portions of the freeway system needed for transit service through an interconnected series of traffic sensing devices. As traffic volumes approached the levels beyond which operating speeds would decrease, fewer automobiles and trucks would be permitted to enter the freeway system. Sufficient constraint would be exercised to ensure uninterrupted traffic flow and operating speeds of at least 40 to 45 miles per hour (mph) on otherwise congested freeways, except for a less than one-mile stretch of the East-West Freeway (IH 94) west of the Stadium Interchange, which would have operating speeds of between 35 and 40 mph.

High-capacity, articulated buses would be used to provide this primary transit service. The carrying capacity of the articulated bus was assumed to be 67 passengers, the seating capacity of these vehicles, as standees would be undesirable under the high-speed operation in mixed traffic contemplated and the relatively long trip lengths involved. The top speed of the vehicle would approximate 55 mph, and the acceleration and deceleration rates would approximate 2.0 miles per hour per second and 2.5 miles per hour per second, respectively. These buses would be inferior to conventional buses only with respect to acceleration rate, which would be about 20 percent slower than that of conventional buses.

Under the maximum extent bus-on-freeway system plan, primary transit service in the Milwaukee area and in the Region would be substantially expanded, with such service operating well beyond the future boundary of the Milwaukee urbanized area. Service would be extended north to the communities of Thiensville, Cedarburg, Grafton, Saukville, and Port Washington in Ozaukee County; northwest to the communities of Germantown, Jackson, and West

Table 109

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Bus-on-Freeway Plan
Primary Element		
Exclusive Guideway Miles		
Subway	- -	- -
Elevated	- -	- -
At-Grade	- -	- -
Total	- -	- -
Shared Guideway Miles		
Freeways	51.5	163.6
Surface Arterial Streets	49.5	81.9
Total	101.0	245.5
Route Miles	449	1,218
Vehicle Miles	8,900	49,500
Vehicle Hours	460	2,020
Vehicles Required	78	221
Express and Local Elements		
Route Miles	1,306	1,823
Vehicle Miles	85,900	103,600
Vehicle Hours	6,520	7,590
Vehicles Required	823	875
Total System		
Route Miles	1,755	3,041
Vehicle Miles	94,800	153,100
Vehicle Hours	6,980	9,610
Vehicles Required	901	1,096

Source: SEWRPC.

Bend in Washington County; west to the communities of Menomonee Falls, Brookfield, Pewaukee, Hartland, Nashotah, and Oconomowoc in Waukesha County; southwest to the communities of Mukwonago in Waukesha County and East Troy in Walworth County; and south to the Cities of Racine in Racine County and Kenosha in Kenosha County.

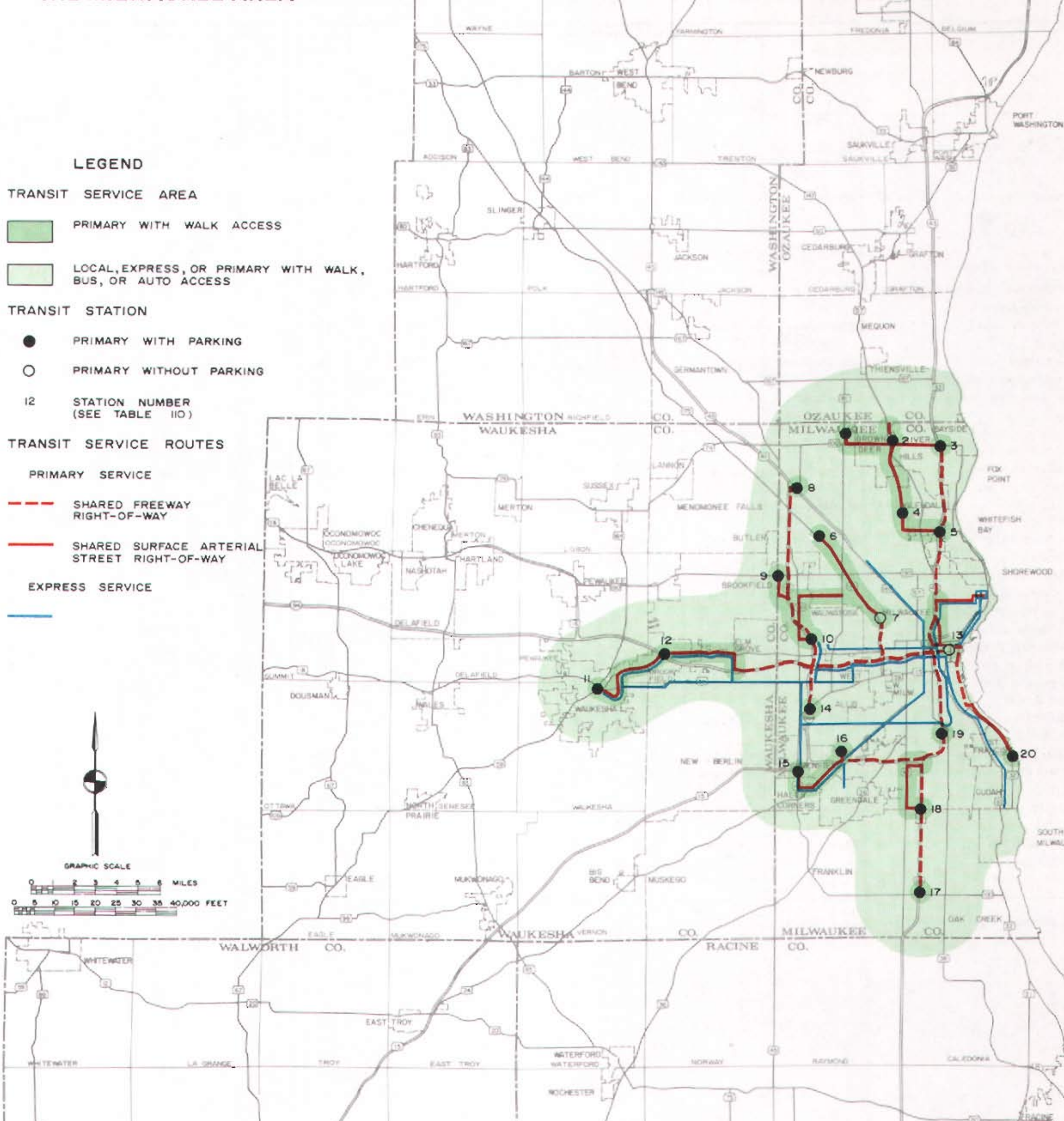
The bus-on-freeway plan would provide for 60 primary transit stations or stops outside the Milwaukee CBD, 53 with park-ride lots. Twenty-six of these stations would be within Milwaukee County, 20 of which would have park-ride lots. The bus-on-freeway plan would thus increase the total number of stations in the Region outside the Milwaukee CBD by 41 and the number of stations with park-ride lots in the Region outside the CBD by 36. Of this increase, eight stations—four with park-ride lots—would be in Milwaukee County.

Considerations in the location and sizing of stations included the location and concentration of future urban development; the logical spacing of stations based upon observed walking, driving, and local bus access distances to present "Freeway Flyer" stations; the potential for direct walking, feeder/distributor bus, or motor vehicle access; the availability of existing park-ride and park-and-pool lots; the provision for stations in local land use plans; the availability of existing right-of-way for station development or expansion with a minimum of disruption; and public transit utilization forecasts for each potential station. Furthermore, the number of route miles of primary transit service would be increased by nearly 200 percent over the number anticipated in the base plan, from about 450 miles to more than 1,200 miles. The number of bus miles of primary transit service would be increased by a factor of over five. A significant part of this increase in primary transit service would result from the extension of primary service into off-peak travel periods, as indicated in Tables 112 and 113.

The maximum extent bus-on-freeway system plan also envisions complementary expansion and improvement of the Milwaukee area express and local transit system. Five additional express or limited-stop routes would be provided over the seven routes included in the base plan—only three of which were in operation in 1980. Eleven of the express routes would operate in a coordinated manner with the expanded bus-on-freeway primary transit system. The local transit system in the Milwaukee area would be extended under the bus-on-freeway plan into all contiguous areas of urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County. Service would be expanded during the off-peak midday, and particularly evening, travel periods. In total, the number of express and local service route miles operated would increase by 40 percent over the number anticipated in the base plan, from 1,306 to 1,823 miles; and the number of express and

Map 53

BASE SYSTEM PLAN FOR THE MILWAUKEE AREA



The base system plan envisions no long-range primary transit improvements in the Milwaukee area, and is composed of the existing Milwaukee area transit system and those short-range improvements recommended in the adopted Milwaukee County five-year transit improvement plan. The base system plan is intended to provide benchmark information against which the maximum extent plans can be evaluated. The base plan provides for 16 bus-on-freeway routes totaling 449 miles in length, of which 11 routes existed in 1980. The base plan provides for seven express bus routes—four more than existed in 1980—and envisions little expansion of local service beyond that existing in 1980 within central Milwaukee County.

Source: SEWRPC.

Table 110

CHARACTERISTICS OF TRANSIT STATIONS FOR THE BASE SYSTEM PLAN

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	N. 76th Street and W. Brown Deer Road . . .	City of Milwaukee	Existing[a]	Yes	150	1	3	38	- -	10	3	- -	- -	3	12	- -	- -
2	N. Green Bay Road and W. Brown Deer Road . . .	Village of Brown Deer	Existing[a]	Yes	140	2	- -	32	- -	10	3	- -	- -	3	12	- -	- -
3	IH 43 and W. Brown Deer Road . . .	Village of River Hills	Existing	Yes	500	1	1	25	24	10	3	4	4	3	12	- -	- -
4	N. Teutonia Avenue and W. Florist Avenue	City of Milwaukee	Existing[a]	Yes	80	1	1	30	- -	4	- -	- -	- -	- -	6	- -	- -
5	IH 43 and W. Silver Spring Drive. . .	Village of Glendale	Existing	Yes	200	2	6	22	19	8	2	4	4	3	12	- -	- -
6	W. Appleton Avenue and W. Silver Spring Drive. . .	City of Milwaukee	Proposed	Yes	150	1	1	37	- -	6	2	- -	- -	4	6	- -	- -
7	W. North Avenue and W. Lisbon Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	21	- -	6	2	- -	- -	4	6	- -	- -
8	N. 107th Street and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	200	1	- -	36	- -	3	2	- -	- -	2	3	- -	- -
9	N. 124th Street and W. Capitol Drive	City of Wauwatosa	Existing[a]	Yes	350	1	1	33	- -	6	2	- -	- -	3	7	- -	- -
10	USH 45 and W. Watertown Plank Road	City of Wauwatosa	Existing	Yes	270	1	2	26	- -	4	- -	- -	- -	- -	11	- -	- -
11	N. Clinton Street and W. Madison Street.	City of Waukesha	Existing	Yes	70	1	1	52	- -	3	- -	- -	- -	- -	3	- -	- -
12	N. Barker Road and W. Blue Mound Road . . .	Town of Brookfield	Existing	Yes	220	1	- -	38	- -	3	- -	- -	- -	- -	3	- -	- -
13	N. 3rd Street and W. Wisconsin Avenue . . .	City of Milwaukee	Existing	Yes	- -	16	21	- -	- -	76	25	4	4	32	93	- -	- -
14	S. 108th Street and W. Cleveland Avenue . . .	City of West Allis	Existing[a]	Yes	400	1	3	29	- -	6	3	- -	- -	4	6	- -	- -
15	S. 108th Street and STH 15	City of Greenfield	Existing	Yes	360	1	2	30	- -	4	2	- -	- -	3	5	- -	- -
16	S. 76th Street and W. Cold Spring Road . . .	City of Greenfield	Existing[a]	Yes	320	1	1	29	- -	5	3	- -	- -	3	5	- -	- -
17	IH 94 and W. Ryan Road .	City of Oak Creek	Proposed	Yes	100	1	- -	30	- -	3	- -	- -	- -	- -	3	- -	- -
18	IH 94 and W. College Avenue.	City of Milwaukee	Existing	Yes	325	1	2	26	- -	5	- -	- -	- -	- -	7	- -	- -
19	IH 94 and W. Holt Avenue	City of Milwaukee	Existing	Yes	240	1	2	21	- -	5	3	- -	- -	3	5	- -	- -
20	S. Lake Drive and E. Lunham Avenue	City of Cudahy	Proposed	Yes	225	1	- -	28	- -	4	3	- -	- -	3	5	- -	- -

[a]*Station is part of a privately owned shopping center parking lot.*

Source: SEWRPC.

local service bus miles operated would increase by 21 percent over the number envisioned in the base plan, from 85,900 to 103,600 bus miles on an average weekday. The express and local transit services would continue to be provided by conventional buses.

Transit Utilization: Under the maximum extent bus-on-freeway system plan and the moderate growth scenario-centralized land use plan alternative future, about 390,000 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 114 and 115. About 77,000, or 20 percent, of these transit trips may be expected to utilize the primary transit system for all or a portion of the trip. Thus, the maximum extent bus-on-freeway plan envisions that about 9 percent of the total of 4.4 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that about 2 percent will be made using primary transit. About 61,000, or 19 percent, more transit trips may be expected to

Table 111

PRIMARY TRANSIT ROUTES FOR THE BASE SYSTEM PLAN

Route Number	Route Stops: Station Number	Route Stops: Location	One-Way Route Fare to Downtown Milwaukee
1—Northridge	1	N. 76th Street and W. Brown Deer Road.	$0.60
	2	N. Green Bay Road and W. Brown Deer Road. . . .	0.60
	3	IH 43 and W. Brown Deer Road.	0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -
2—Brown Deer	2	N. Green Bay Road and W. Brown Deer Road. . . .	$0.60
	4	N. Teutonia Avenue and W. Florist Avenue	0.60
	5	IH 43 and W. Silver Spring Drive	0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -
3—Timmerman Field	6	W. Appleton Avenue and W. Silver Spring Drive . .	$0.60
	7	W. North Avenue and W. Lisbon Avenue.	0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -
4—Northwest Side	8	N. 107th Street and W. Good Hope Road	$0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -
5—Wauwatosa/Brookfield	9	N. 124th Street and W. Capitol Drive.	$0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -
6—Milwaukee County Institutions	10	USH 45 and W. Watertown Plank Road	$0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -
7—UBUS-Wauwatosa	10	USH 45 and W. Watertown Plank Road	$0.60
	- -	University of Wisconsin-Milwaukee Campus.	- -
8—Waukesha	11	N. Clinton Street and W. Madison Street.	$1.25
	12	N. Barker Road and W. Blue Mound Road.	1.15
	13	N. 3rd Street and W. Wisconsin Avenue	- -
9—West Allis	14	S. 108th Street and W. Cleveland Avenue	$0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -
10—Hales Corners	15	S. 108th Street and STH 15	$0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -
11—Greenfield	16	S. 76th Street and W. Cold Spring Road	$0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -
12—Oak Creek	17	IH 94 and W. Ryan Road	$0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -
13—South	18	IH 94 and W. College Avenue	$0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -
14—South-UWM	18	IH 94 and W. College Avenue	$0.60
	- -	University of Wisconsin-Milwaukee Campus.	- -
15—South Side/Holt Avenue	19	IH 94 and W. Holt Avenue.	$0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -
16—Cudahy	20	S. Lake Drive and E. Lunham Avenue	$0.60
	13	N. 3rd Street and W. Wisconsin Avenue	- -

Source: SEWRPC.

Table 112

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	1,218	1,197	1,218	1,141	1,218
Vehicle Miles	11,000	15,100	15,500	7,900	49,500
Vehicle Hours	470	580	660	310	2,020
Vehicles Required	158	97	221	78	221
Express and Local					
Route Miles.	1,823	1,749	1,823	1,640	1,823
Vehicle Miles	22,800	30,700	29,700	20,400	103,600
Vehicle Hours	1,700	2,220	2,270	1,400	7,590
Vehicles Required	688	363	875	211	875
Total System					
Route Miles.	3,041	2,946	3,041	2,787	3,041
Vehicle Miles	33,800	45,800	45,200	28,300	153,100
Vehicle Hours	2,170	2,800	2,930	1,710	9,610
Vehicles Required	846	460	1,096	289	1,096

Source: SEWRPC.

Table 113

TIME-OF-DAY OPERATION OF THE BASE SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	449	45	449	- -	449
Vehicle Miles	3,900	500	4,500	- -	8,900
Vehicle Hours	200	20	240	- -	460
Vehicles Required	67	4	78	- -	78
Express and Local					
Route Miles.	1,206	1,067	1,224	953	1,224
Vehicle Miles	18,900	25,300	26,300	15,400	85,900
Vehicle Hours	1,470	1,820	2,110	1,120	6,520
Vehicles Required	611	297	823	162	823
Total System					
Route Miles.	1,655	1,112	1,673	953	1,673
Vehicle Miles	22,800	25,800	30,800	15,400	94,800
Vehicle Hours	1,670	1,840	2,350	1,120	6,980
Vehicles Required	678	301	901	162	901

Source: SEWRPC.

Table 114

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Maximum Extent Bus-on-Freeway Plan		
	Total Person Trips[a]	Transit Trips		Total Person Trips[a]	Transit Trips	
		Number	Percent of Total Trips		Number	Percent of Total Trips
Home-Based Work	1,112,900	102,100	9.2	1,109,900	117,400	10.6
Home-Based Shopping . .	512,400	39,000	7.6	511,500	49,400	9.7
Home-Based Other	1,502,200	116,900	7.8	1,497,300	151,800	10.1
Nonhome Based.	837,100	17,500	2.1	833,600	18,000	2.2
School	465,300	51,300	11.0	465,300	51,300	11.0
Total	4,429,900	326,800	7.4	4,417,600	387,900	8.8

[a]The difference in the total person trips generated under the bus-on-freeway maximum extent plan and the total trips generated under base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been found to be correlated with increased automobile ownership, and greater automobile ownership has been found to be correlated with increased trip generation. The Commission travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.

Source: SEWRPC.

Table 115

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Time of Day	Base Plan				Maximum Extent Bus-on-Freeway Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	6,800	45.3	70,200	21.5	16,300	21.3	78,900	20.3
Midday	100	0.7	112,800	34.5	23,600	30.8	138,000	35.6
Afternoon . .	8,100	54.0	111,400	34.1	28,600	37.3	130,100	33.5
Evening. . . .	- -	- -	32,400	9.9	8,100	10.6	41,900	10.8
Total	15,000	100.0	326,800	100.0	76,600	100.0	387,900	100.0

Source: SEWRPC.

be made under this plan than under the base plan. Nearly all of this increased transit use would be on the primary transit system element of the plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent bus-on-freeway system plan and the base system plan are summarized in Table 116. The costs shown include all construction costs, plus the cost of right-of-way acquisition and the acquisition and replacement of vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 116.

The total capital cost of the base plan is estimated at $233 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain the existing service to the year 2000. About $22 million, or 10 percent of the total capital cost, would be required for the primary transit element.

Table 116

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Bus-on-Freeway Plan
Guideway Development[b]	$ --	$ 14,326,000
Station Development[c]	2,893,700	25,907,700
Vehicle Storage and Maintenance Facility Development[c]	24,775,000	30,150,000
Vehicle Acquisition and Replacement[d]	205,660,000	286,060,000
Total	$233,328,700	$356,443,700

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent bus-on-freeway plan would be implemented incrementally from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 to 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes for the bus-on-freeway plan the implementation cost of the proposed freeway operational control system in the Milwaukee area, which has an estimated useful life of 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—12 acres under the base plan and 78 acres under the maximum extent bus-on-freeway plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of the acquisition and replacement as necessary over the 20-year design period of all buses used in the system. Both plans assume the availability of a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years.*

Source: SEWRPC.

The total capital cost of the maximum extent bus-on-freeway plan is estimated at $356 million. About $14 million, or about 4 percent of this cost, would be required to implement a freeway operational control system in the Milwaukee urbanized area. About $286 million would be incurred in the purchase of new and replacement of existing transit vehicles—$85 million of which would be for the purchase of 356 articulated buses, and $201 million of which would be for the purchase of 1,433 conventional buses. The remaining $56 million would be required to construct park-ride stations and to expand bus storage and maintenance facilities. About $132 million, or 37 percent of the total capital cost of the plan, would be required for its primary transit element.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent bus-on-freeway plan can be expected to approximate $71 million. The remaining $285 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal and the federal shares are estimated to total $47 million and $186 million, respectively.

Table 117 presents the annual operating and maintenance costs and farebox revenues anticipated for the design year of the base and bus-on-freeway maximum extent plans. Under the base plan, operating and maintenance costs may be expected to approximate $60 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent bus-on-freeway plan would increase the total operating and maintenance costs for the Milwaukee area in the year 2000 by $38 million to a total cost of $98 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $4.3 million under the base plan, and $28.5 million under the maximum extent bus-on-freeway plan. Primary transit system operating and maintenance costs would thus represent about

Table 117

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Bus-on-Freeway Plan
Ridership		
Primary Element	3,825,000	19,530,000
Total System	94,250,000	199,800,000
Operating and Maintenance Cost		
Primary Element	$ 4,305,500	$ 28,502,600
Total System	60,313,100	98,013,700
Operating and Maintenance Cost per Passenger		
Primary Element	$1.12	$1.46
Systemwide Average	0.63	0.89
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.12	$0.09
Total System	0.15	0.14
Farebox Revenue		
Primary Element	$ 2,423,200	$ 15,362,400
Total System	37,114,800	52,300,700
Operating Deficit		
Primary Element	$ 1,882,300	$ 13,140,200
Total System	23,198,300	45,713,000
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	56	54
Total System	62	53
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 941,150	$ 6,570,100
Total System	11,599,150	22,856,500
State (72 percent of nonfederal share of operating deficit)		
Primary Element	677,628	4,730,472
Total System	8,351,388	16,456,680
Local		
Primary Element	263,522	1,839,628
Total System	3,247,762	6,399,820
Local Operating Deficit per Ride		
Primary Element	$0.07	$0.09
Total System	0.03	0.06

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, about equal to the $11.6 million required to provide 50 percent federal funding of the operating deficits under the base plan, but substantially less than the $22.9 million required to provide such funding under the maximum extent bus-on-freeway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

7 percent of the total operating costs expected in the design year for the base plan, and about 30 percent of the total operating costs expected in the design year for the maximum extent bus-on-freeway plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.63. For the maximum extent bus-on-freeway plan, the average cost per passenger may be expected to approach $0.89—$0.26, or 40 percent, more than the base plan cost. The average operating cost per passenger mile, however, would be slightly less under the maximum extent bus-on-freeway plan alternative—$0.14, compared with $0.15 for the base plan. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.12 and $0.12, respectively, and for the maximum extent bus-on-freeway plan $1.46 and $0.09, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $37 million, expressed in 1979 dollars, compared with $52 million under the maximum extent bus-on-freeway plan. Under the maximum extent bus-on-freeway alternative, the primary transit element could be expected to generate about 7 percent, or $2.4 million, of the total revenue, compared with 29 percent, or $15.4 million, for the base plan. Under both the base and maximum extent bus-on-freeway plans, the current fares are assumed to increase with general price inflation. The fare under both plans would thus remain at $0.50 per ride, expressed in constant 1979 dollars, for local and express bus service. Similarly, the primary service fare would remain at $0.60 within Milwaukee County, and would increase with distance from Milwaukee County to between $1.00 and $1.40 at the outer limits of the future urbanized area, and to between $1.80 and $2.20 at the extreme limits of service under the maximum extent plan routes.

The operating deficit in the year 2000 for the maximum extent bus-on-freeway plan would be about $46 million, expressed in 1979 dollars, requiring a subsidy of about $0.41 per passenger. This compares with the base system plan deficit of about $23 million, or $0.24 per passenger. Farebox revenues would cover about 53 percent of the operating costs under the maximum extent bus-on-freeway plan, and 62 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has in the past funded up to 72 percent of the nonfederal share.[3] The annual local share of the public funding requirement in the year 2000 would be about $6.4 million for the bus-on-freeway maximum extent system and $3.2 million for the base system.

Development of Truncated Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent bus-on-freeway system plan are summarized in Table 118. The maximum extent bus-on-freeway system plan has higher capital costs and greater operating deficits, both in total and on a per passenger basis, than does the base plan. In addition, farebox revenues under the maximum extent bus-on-freeway system plan cover a smaller proportion of operating costs in the plan design year than do such revenues under the base plan.

Most of the increases in the cost and decreases in the cost-effectiveness of the maximum extent bus-on-freeway system plan can be attributed to the overextension of service envisioned in this plan.[4] Under the maximum extent plan, primary transit service would be extended into large areas of the Region not now served. In addition, it would be expanded into an all-day operation, and it would be provided with headways of no more than 30 minutes during the peak travel periods in the peak direction and of no more than 60 minutes otherwise. Thus, the primary transit service proposed would be a true transit service, available for tripmaking of all purposes. The cost-effectiveness of the less productive routes on which bus-on-freeway service would be extended can be iden-

Table 118

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Bus-on-Freeway Plan
Ridership		
In Design Year	94,250,000	109,800,000
To Design Year	1,485,900,000	1,607,900,000
Capital Cost		
Total to Design Year	$ 233,328,700	$ 356,443,700
To Design Year per Passenger	0.160	0.220
To Design Year After Accounting for Useful Life Beyond Design Year	148,842,000	221,249,800
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.100	0.140
Operating Cost		
Percent Met by Farebox Revenues in Design Year	62	53
Operating Deficit in Design Year	$ 23,198,300	$ 45,713,000
Operating Deficit per Passenger in Design Year	0.250	0.420
Operating Deficit to Design Year	430,900,000	611,020,000
Operating Deficit to Design Year per Passenger	0.290	0.380
Total Cost		
To Design Year	$ 664,228,700	$ 967,463,700
Federal Share	402,112,960	590,664,960
Nonfederal Share	262,115,740	376,798,740
To Design Year per Passenger	0.450	0.600
Federal Share	0.270	0.370
Nonfederal Share	0.180	0.230
To Design Year After Accounting for Useful Life Beyond Design Year	579,742,000	832,269,800
Federal Share	334,523,600	482,509,840
Nonfederal Share	245,218,400	349,759,960
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.390	0.520
Federal Share	0.225	0.300
Nonfederal Share	0.165	0.220

Source: SEWRPC.

[3] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, about equal to the $11.6 million required to provide 50 percent federal funding of the operating deficits under the base plan, but substantially less than the $22.9 million required to provide such funding under the maximum extent bus-on-freeway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

[4] *The extension of local and express service under the maximum extent bus-on-freeway plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express and local service included in each maximum extent primary transit system plan is basically in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules were modified, however, to coordinate properly the secondary and tertiary service proposed to be provided with the primary service under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered and should, therefore, not affect a comparison of those alternatives.*

Table 119

OPERATING COST-EFFECTIVENESS OF BUS-ON-FREEWAY ROUTES OF THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicles Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
1—Port Washington	63,500	$ 3,000	2,700	$ 6,200	49
2—Cedarburg	37,000	1,800	1,300	2,800	62
3—Mequon	30,800	1,500	1,400	3,100	47
4—Brown Deer	44,800	2,100	1,600	3,600	59
5—River Hills	18,500	900	1,500	3,400	26
6—Northwest Side	41,400	2,000	1,600	3,500	56
7—Wauwatosa	6,900	300	1,500	3,400	10
8—West Bend	47,200	2,300	2,100	4,700	48
9—Germantown	27,200	1,300	1,200	2,800	46
10—Menomonee Falls	14,400	700	1,200	2,700	26
11—Menomonee Falls	46,600	2,200	1,400	3,200	71
12—Brookfield	32,200	1,600	1,300	3,000	52
13—Milwaukee County Institutions/UWM	1,200	100	700	1,600	4
14—Oconomowoc/Pewaukee	39,900	1,900	2,200	4,900	39
15—Oconomowoc/Delafield	27,800	1,300	2,000	4,400	30
16—Waukesha	41,900	2,000	1,200	2,700	76
17—East Troy	50,400	2,400	2,700	6,100	40
18—Hales Corners	28,800	1,400	1,300	3,000	46
19—Greenfield	18,400	900	1,000	2,400	37
20—West Allis	23,700	1,100	1,000	2,300	50
21—Stadium	7,500	400	600	1,500	25
22—Franklin	21,300	1,000	1,100	2,600	39
23—Kenosha	236,600	11,300	5,300	12,100	94
24—Racine	241,300	11,600	4,900	11,200	104
25—Oak Creek/Ryan Road	41,600	2,000	1,700	3,800	52
26—Oak Creek/Rawson Avenue	22,500	1,100	1,300	2,900	38
27—South Side/UWM	2,200	100	600	1,400	7
28—South Side/College Avenue	5,200	200	300	600	42
29—South Side/IH 894	14,200	700	900	2,000	34
30—South Side/Holt Avenue	15,000	700	900	2,100	34
31—Cudahy	9,900	500	800	1,800	26
Total	1,259,900	$60,400	49,300	$111,800	54

Source: SEWRPC.

tified through a determination of what proportion of the operating costs of the routes may be expected to be recovered through farebox revenues. As shown in Table 119, only 9 of the 31 routes under the maximum extent plan are expected to meet more than one-half of their operating costs through farebox revenues.

To reduce operating deficits and increase the proportion of primary transit operating costs met by farebox revenues, it was necessary to truncate the bus-on-freeway maximum extent plan. In order to do so while maintaining a framework of true primary transit service in the Milwaukee area, and, importantly, to assure reasonable comparability between all primary transit alternatives tested, this truncation was limited to reductions in the extent of service provided. Nevertheless, those bus-on-freeway facilities and services which could be reasonably cost-effective if the time periods and frequency of service offered were reduced were identified so that these reduced services could be considered for addition to the "best" primary transit system plan for this future as "specialized" transit service.[5]

Accordingly, with the objective of reducing bus-on-freeway operating deficits by increasing the proportion of bus-on-freeway operating costs met by farebox revenues to at least 50 percent, the maximum extent bus-on-freeway system plan was truncated as set forth in Table 120 and presented on Map 54. Each bus-on-freeway route for which farebox revenues were not expected to approach 50 percent of operating costs on an all-day and minimum frequency basis was cut back. However, those routes which could be expected to meet 50 percent of their operating costs through farebox revenues with a cutback in time periods or frequency of service were identified for consideration later in the study, and are summarized in Table 120.

Evaluation of Maximum
Extent Commuter Rail Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is commuter rail. The maximum extent system plan developed for this technology is summarized with respect to its coverage, stations, routes, and operation on Map 55 and in Tables 121 through 124. Under this plan, all primary transit service would be provided by a commuter rail system operating diesel-electric locomotives pushing or pulling trains ranging in length from one to six bi-level gallery coaches. Each coach would have a capacity of 157 passengers, the seating capacity of these vehicles, as standees would be undesirable given the interior design of the coaches and the relatively long passenger trip lengths.

Primary transit service under the maximum extent commuter rail plan would be extended well beyond the limits of the future Milwaukee urbanized area. However, in Milwaukee County service would not be much more extensive than current "Freeway Flyer" service. Passenger trains providing the commuter rail primary transit service would operate on six routes, all of which would terminate at Milwaukee Union Station located at S. 5th Street and W. St. Paul on the southern fringe of the Milwaukee central business district (CBD). Collector-distributor bus service would connect the station to all parts of the Milwaukee CBD at six-minute headways along a routing centered on E. and W. Wisconsin Avenue between N. 6th Street and N. Prospect Avenue. Two of the six commuter rail routes would extend north from the passenger station into Ozaukee County, one terminating in the City of Port Washington and the other terminating in the Village of Saukville. One route would extend to the northwest and terminate in the City of West Bend in Washington County. Two routes would extend west into Waukesha County, one route terminating in the Village of Oconomowoc and the other terminating in the City of Waukesha. The sixth route would extend south to the Cities of Racine and Kenosha.

A total of 43 stops would be made on the routes, 33 of which would be provided with park-ride lots. Seventeen, or about 40 percent, of the stops would

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[5] *Reductions in time periods of service and increases in the headways operated have the potential to affect primary transit cost-effectiveness significantly. Under this future, the off-peak-time period operations of bus-on-freeway service are less cost-effective than the peak-time-period operations. Accordingly, limiting bus-on-freeway service to the peak travel periods may be expected to increase the proportion of bus-on-freeway operating costs met by farebox revenues only slightly, because it is only reasonable to expect that, under such a peak-period-only operation, travel on the bus-on-freeway system in the afternoon peak period will be reduced to the primarily work- and school-related travel generated during the morning peak period.*

To reduce the frequency of service, maximum headways in the peak periods and the peak direction were increased from 30 to 60 minutes with only a relatively small reduction in transit use and a substantial reduction in operating cost. The decrease in ridership would result from the attendant increase in wait time for transit service. First wait times under this study were assumed to approximate one-half of the headway up to a maximum of 10 minutes. Consequently, increases in maximum headway would not affect this wait time. However, all subsequent wait times, which are attendant to transfers, were estimated at one-half of the headway with no upper limit. It should be noted that, by not permitting headways greater than 60 minutes, it is assumed that any decrease in operating costs possible through further headway increases would result in ridership and revenue reductions and a subsequent stabilization or decline in the proportion of operating costs recovered from farebox revenues. The ridership reductions would result from the inconvenient schedule.

be within Milwaukee County, eight of which would be provided with park-ride lots. Considerations in the location and sizing of stations included the location and concentration of future urban development; the logical spacing of stations based upon commuter rail performance requirements and observed access distances to primary transit stations; the potential for direct walking, feeder/distributor bus, and motor vehicle access; the historical location of railway stations and their present condition and use; the availability of right-of-way for station development and expansion with a minimum of disruption; and public transit utilization forecasts for each potential station. On the average, one stop would be made every 3.6 miles on the six routes of the maximum extent commuter rail system, average speeds on the routes would be about 31 miles per hour, and service headways would be 30 minutes in the peak periods and peak direction and 60 minutes otherwise. The schedule of trains would be such that a maximum waiting time of 30 minutes during all periods would be required for transferring between trains in the downtown terminal. Trains would consist of a locomotive and one or two coaches except on the route to the Cities of Racine and Kenosha, over which trains of six coaches would be used during the peak periods.

The maximum extent commuter rail system plan also envisions complementary expansion and improvement of the Milwaukee area express and local transit system, similar to that anticipated in the maximum extent bus-on-freeway system plan. Five additional express or limited-stop routes would be provided over the seven routes included in the base plan—only three of which were in operation in 1980. Eight of these routes would operate in a coordinated manner with the commuter rail primary transit system. The local transit system in the Milwaukee area would be extended into all contiguous areas of urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County. Service would be expanded during the off-peak midday, and particularly evening, travel periods. In total, the number of express and local service route miles operated would increase by 42 percent over the number anticipated in base plan, from 1,306 to 1,853 miles; and the number of express and local service bus miles operated would increase by 41 percent over the number envisioned in base plan, from 85,900 to 121,500 bus miles on an average weekday. The express and local transit services would continue to be provided by conventional buses.

Transit Utilization: Under the maximum extent commuter rail system plan and moderate growth scenario-centralized land use plan alternative future, about 372,000 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 125 and 126. About 31,700, or 9 percent, of these transit trips may be expected to utilize the primary transit system for all or a portion of the trip. Thus, the maximum extent commuter rail system plan envisions that about 8 percent of the total of 4.4 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that about 1 percent will be made using primary transit. About 55,000, or 17 percent, more transit trips may be expected to be made under this plan than under the base plan. About 30 percent of this increased transit use would be on the primary transit system element of the plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent commuter rail system plan and the base system plan are summarized in Table 127. The costs shown include all track rehabilitation and construction costs, plus the cost of locomotive, passenger coach, and supporting bus acquisition and replacement, as needed, over the plan design period. Most capital items required to implement the plan would have useful lives beyond the 20-year plan design period, a factor not reflected in the plan capital cost requirement shown in Table 127 for the plan design period.

The total capital cost of the base plan is estimated at \$233 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain the existing service to the year 2000. About \$22 million, or 10 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent commuter rail plan is estimated at \$402 million. About 36 percent of the total cost, or \$145 million, would be required for the primary transit element of the plan.

Table 120

RECOMMENDED CHANGES IN THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Recommended Change
5—River Hills	Route to be cut back to Station 10 at the North-South Freeway (IH 43) and W. Silver Spring Drive
7—Wauwatosa	Feeder loop on route operating over W. Burleigh Street and S. 108th Street to Station 24 at the Zoo Freeway (USH 45) and W. Watertown Plank Road to be truncated. Express route serving Station 24 would be cut back to N. Glenview Avenue
9—Germantown and 10—Menomonee Falls 11—Menomonee Falls	Routes to be combined
13—Milwaukee County Institutions/UWM	Route to be eliminated
15—Oconomowoc/Delafield	Route to be cut back to Waukesha, at Station 32 at the East-West Freeway (IH 94) and Grandview Boulevard
17—East Troy	Route to be truncated from East Troy to Mukwonago but retained for consideration as addition to final plan, with service limited to peak periods and possibly at increased headways
19—Greenfield	Express route serving Station 44 at S. 76th Street and W. Cold Spring Road to W. Howard Avenue to be cut back
21—Stadium	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly at increased headways
22—Franklin and 29—South Side/IH 894	Routes to be combined
27—South Side/UWM	Route to be eliminated
31—Cudahy	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways

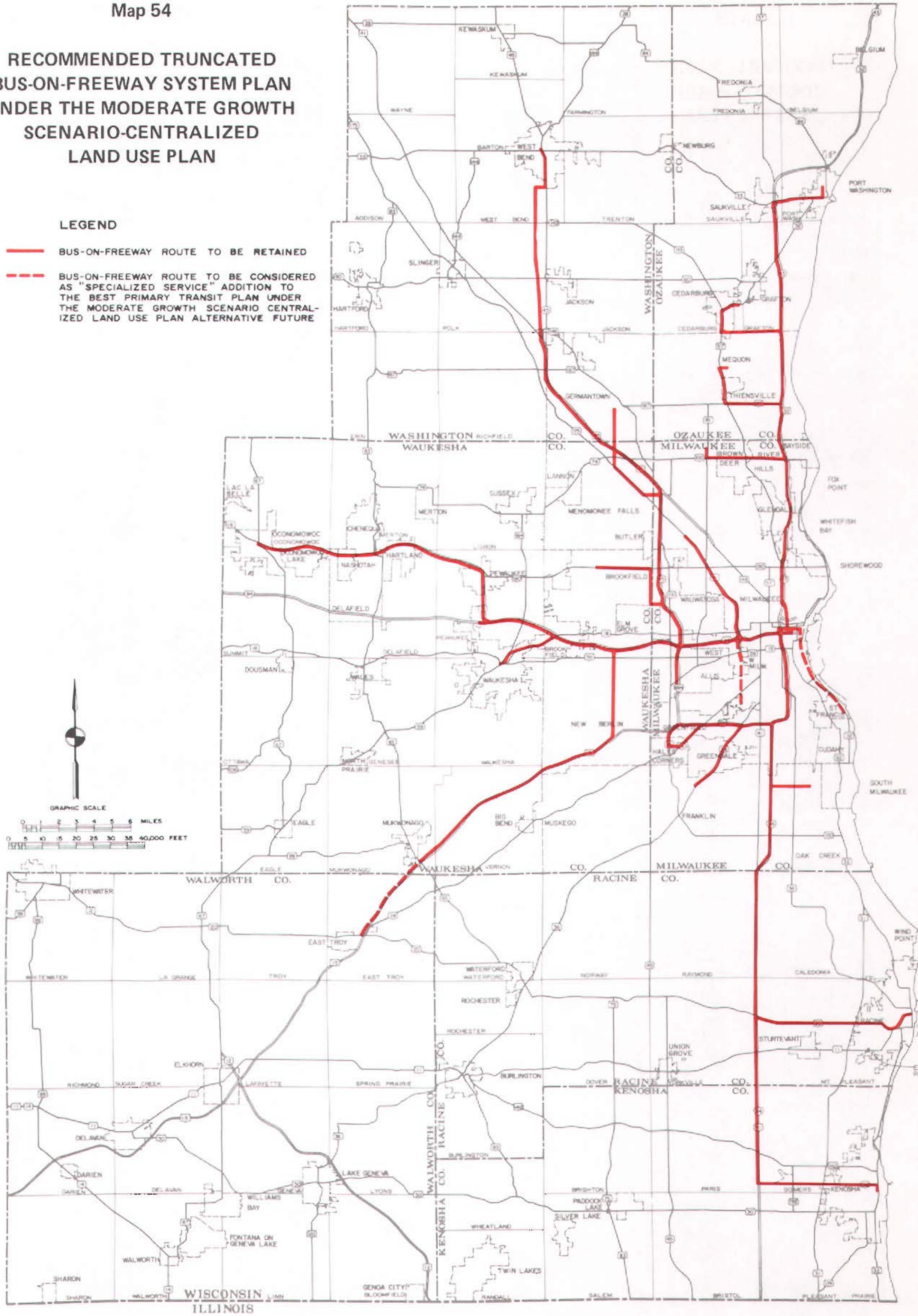
Source: SEWRPC.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent commuter rail plan can be expected to approximate $80 million. The remaining $322 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal and the federal shares are estimated to total $47 million and $186 million, respectively.

Table 128 presents the annual operating and maintenance costs and farebox revenues anticipated for the design year of the base and maximum extent commuter rail plans. Under the base plan, operating and maintenance costs may be expected to approximate $60 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent commuter rail plan would increase the total operating and maintenance costs by $41 million, to a total cost of $101 million. The cost of operating and maintaining the primary

Map 54

RECOMMENDED TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

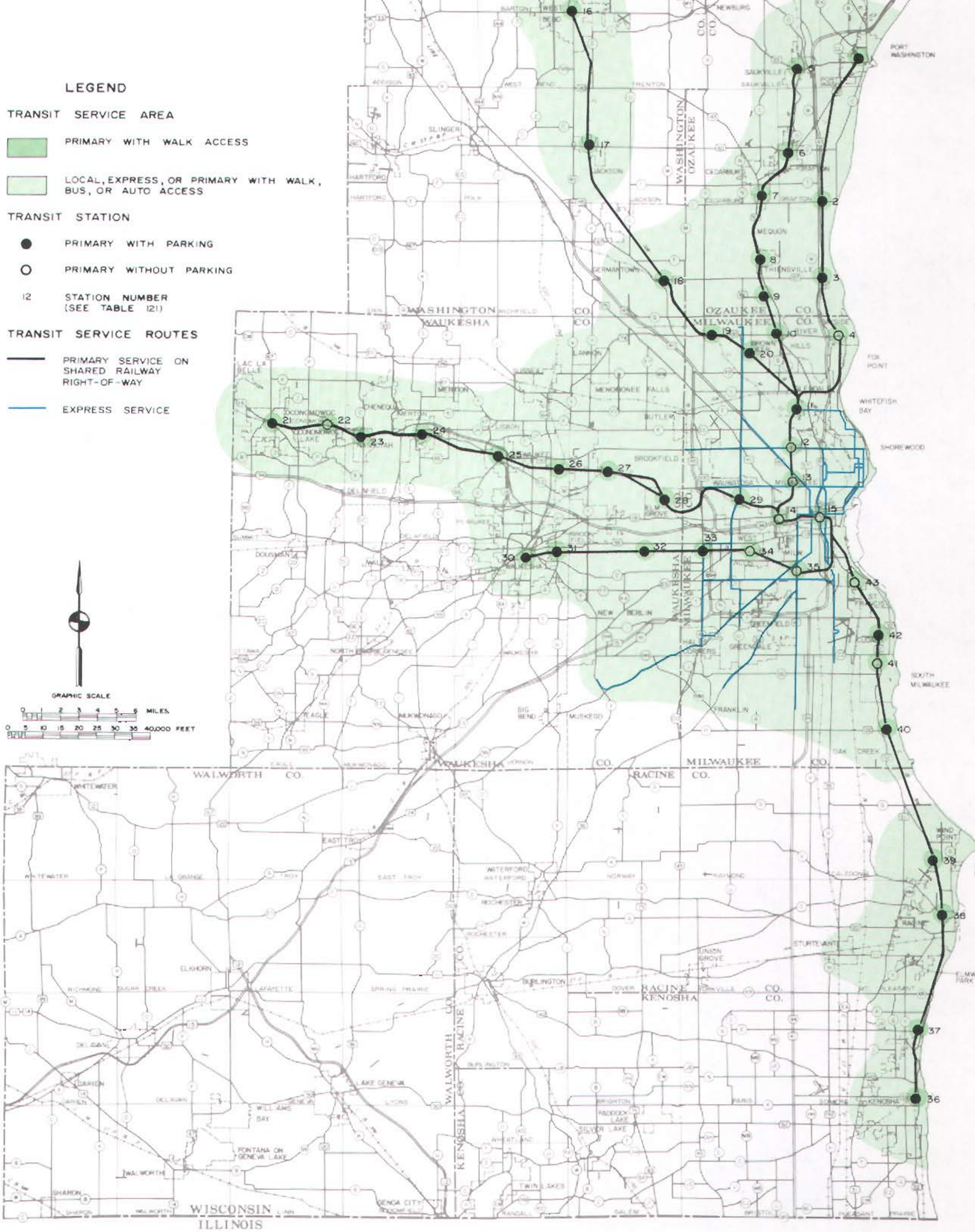


The maximum extent bus-on-freeway system plan shown on Map 52 was truncated with the objective of maximizing the number of bus-on-freeway primary transit routes for which at least 50 percent of the operating costs could be met with farebox revenues. A total of 25 of the 31 routes in the maximum extent plan, totaling 1,118 route miles in length, were recommended to be retained in the truncated plan. Four of the six routes recommended to be omitted from the truncated plan were recommended to be considered for addition to the final "best" plan recommended for this future as specialized peak-period-only service.

Source: SEWRPC.

Map 55

MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN



The maximum extent commuter rail system plan would provide a significant expansion of primary transit service outside Milwaukee County, but not within Milwaukee County. Under the maximum extent commuter rail plan, primary transit service would be provided by passenger trains on six railway routes emanating from the Milwaukee central business district which have largely double-track mainline railway trackage, and which extend to other major travel generators. The commuter rail service would operate throughout the day. Headways would not exceed 30 minutes during the peak periods in the peak direction and 60 minutes otherwise under the maximum extent plan.

The maximum extent commuter rail system plan also provides for complementary expansion and improvement of the Milwaukee area express and local transit system. Nine additional express bus routes would be provided over the three routes which were actually in operation in 1980. The local transit system under the plan would be extended into all contiguous areas of urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County.

Source: SEWRPC.

Table 121

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (trains per period)							
										Morning		Midday		Afternoon		Evening	
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	*Connecting* Express or Local Routes	Peak	Off-Peak	In	Out	In	Out	In	Out	In	Out
1	N. Maple Street and W. Grand Avenue	City of Port Washington	Proposed	Yes	210	1	--	55	55	6	3	6	6	3	6	4	4
2	IH 43 and CTH C	Town of Grafton	Proposed	Yes	75	1	--	44	44	6	3	6	6	3	6	4	4
3	IH 43 and Mequon Road	City of Mequon	Proposed	Yes	150	1	1	38	38	6	3	6	6	3	6	4	4
4	Rexleigh Drive and E. Brown Deer Road	Village of Bayside	Proposed	Yes	--	1	2	32	32	6	3	6	6	3	6	4	4
5	Railroad Street and Dekora Street	Village of Saukville	Proposed	Yes	100	1	--	58	58	6	3	6	6	3	6	4	4
6	11th Avenue and North Street	Village of Grafton	Proposed	Yes	260	1	1	51	51	6	3	6	6	3	6	4	4
7	Cardinal Avenue and Pioneer Road	City of Cedarburg	Proposed	Yes	325	1	1	44	44	6	3	6	6	3	6	4	4
8	Main Street and Friestadt Road	Village of Thiensville	Proposed	Yes	170	1	1	39	39	6	3	6	6	3	6	4	4
9	Baehr Road and Donges Bay Road	City of Mequon	Proposed	Yes	150	1	1	34	34	6	3	6	6	3	6	4	4
10	Deerbrook Trail and W. Brown Deer Road	Village of Brown Deer	Proposed	Yes	125	1	1	29	29	6	3	6	6	3	6	4	4
11	N. Teutonia Avenue and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	200	3	2	22	22	18	9	18	18	9	18	12	12
12	N. 34th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	--	3	2	17	17	18	9	18	18	9	18	12	12
13	N. 30th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	--	3	2	13	13	18	9	18	18	9	18	12	12
14	N. 44th Street and W. Blue Mound Road	City of Milwaukee	Proposed	Yes	--	4	1	6	6	24	12	24	24	12	24	16	16
15	N. 5th Street and W. St. Paul Avenue	City of Milwaukee	Existing	Yes	--	6	3	--	--	36	18	36	36	18	36	24	24
16	Island Drive and E. Washington Street	City of West Bend	Proposed	Yes	175	1	--	64	64	6	3	6	6	3	6	4	4
17	N. Center Street and Main Street	Village of Jackson	Proposed	Yes	230	1	--	53	53	6	3	6	6	3	6	4	4
18	S. Country Aire Drive and Mequon Road	Village of Germantown	Proposed	Yes	175	1	1	42	42	6	3	6	6	3	6	4	4
19	N. 107th Street and W. Brown Deer Road	City of Milwaukee	Proposed	Yes	100	1	2	35	35	6	3	6	6	3	6	4	4
20	N. 68th Street and W. Bradley Road	City of Milwaukee	Proposed	Yes	100	1	1	29	29	6	3	6	6	3	6	4	4
21	S. Main Street and Collins Street	City of Oconomowoc	Proposed	Yes	130	1	--	62	62	6	3	6	6	3	6	4	4
22	Sawyer Road and USH 16	Town of Oconomowoc	Proposed	Yes	--	1	--	55	55	6	3	6	6	3	6	4	4
23	Lakeland Road and CTH PP	Village of Nashotah	Proposed	Yes	80	1	--	50	50	6	3	6	6	3	6	4	4
24	Cottonwood Avenue and Pawling Avenue	Village of Hartland	Proposed	Yes	160	1	--	45	45	6	3	6	6	3	6	4	4
25	W. Wisconsin Avenue and Capitol Drive	Village of Pewaukee	Proposed	Yes	225	1	1	38	38	6	3	6	6	3	6	4	4
26	Duplainville Road and Marjean Lane	Town of Pewaukee	Proposed	Yes	250	1	1	32	32	6	3	6	6	3	6	4	4
27	N. Brookfield Road and River Road	City of Brookfield	Proposed	Yes	125	1	1	27	27	6	3	6	6	3	6	4	4
28	Legion Drive and Watertown Plank Road	Village of Elm Grove	Proposed	Yes	120	1	1	19	19	6	3	6	6	3	6	4	4
29	N. 75th Street and W. State Street	City of Wauwatosa	Proposed	Yes	50	1	4	12	12	6	3	6	6	3	6	4	4
30	N. Barstow Street and Cutler Street	City of Waukesha	Proposed	Yes	175	1	1	46	46	6	3	6	6	3	6	4	4
31	Pearl Street and CTH A	Town of Waukesha	Proposed	Yes	250	1	--	40	40	6	3	6	6	3	6	4	4
32	S. Moorland Road and Honey Lane	City of New Berlin	Proposed	Yes	75	1	2	33	33	6	3	6	6	3	6	4	4
33	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	75	1	4	26	26	6	3	6	6	3	6	4	4
34	S. 70th Street and Dickinson Street	City of Milwaukee	Proposed	Yes	--	1	1	19	19	6	3	6	6	3	6	4	4
35	S. 27th Street and W. Dakota Street	City of Milwaukee	Proposed	Yes	--	1	4	12	12	6	3	6	6	3	6	4	4
36	14th Avenue and 54th Street	City of Kenosha	Existing	Yes	125	1	1	63	63	6	3	6	6	3	6	4	4
37	STH 32 and CTH E	Town of Somers	Proposed	Yes	400	1	1	57	57	6	3	6	6	3	6	4	4
38	Memorial Drive and State Street	City of Racine	Proposed	Yes	150	1	1	45	45	6	3	6	6	3	6	4	4
39	STH 32 and Three Mile Road	Town of Caledonia	Proposed	Yes	450	1	1	39	39	6	3	6	6	3	6	4	4
40	5th Avenue and E. Ryan Road	City of Oak Creek	Proposed	Yes	200	1	2	29	29	6	3	6	6	3	6	4	4
41	13th Avenue and E. Rawson Avenue	City of South Milwaukee	Proposed	Yes	--	1	2	22	22	6	3	6	6	3	6	4	4
42	Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	120	1	2	18	18	6	3	6	6	3	6	4	4
43	Brust Avenue and E. Oklahoma Avenue	City of Milwaukee	Proposed	Yes	--	1	2	10	10	6	3	6	6	3	6	4	4

Source: SEWRPC.

Table 122

PRIMARY TRANSIT ROUTES FOR THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN

Route Number	Route Stops		One-Way Route Fare to Downtown Milwaukee
	Station Number	Location	
1—Milwaukee-Port Washington	1	N. Maple Street and W. Grand Avenue	$1.80
	2	IH 43 and CTH C	1.40
	3	IH 43 and Mequon Road	1.00
	4	Rexleigh Drive and E. Brown Deer Road	0.60
	11	N. Teutonia Avenue and W. Silver Spring Drive	0.60
	12	N. 34th Street and W. Capitol Drive	0.60
	13	N. 30th Street and W. North Avenue	0.60
	14	N. 44th Street and W. Blue Mound Road	0.60
	15	N. 5th Street and W. St. Paul Avenue	- -
2—Milwaukee-Saukville	5	Railroad Street and Dekora Street	$1.80
	6	11th Avenue and North Street	1.60
	7	Cardinal Avenue and Pioneer Road	1.40
	8	Main Street and Freistadt Road	1.20
	9	Baehr Road and Donges Bay Road	1.00
	10	Deerbrook Trail and W. Brown Deer Road	0.60
	11	N. Teutonia Avenue and W. Silver Spring Drive	0.60
	12	N. 34th Street and W. Capitol Drive	0.60
	13	N. 30th Street and W. North Avenue	0.60
	14	N. 44th Street and W. Blue Mound Road	0.60
	15	N. 5th Street and W. St. Paul Avenue	- -
3—Milwaukee-West Bend	16	Island Drive and E. Washington Street	$2.20
	17	N. Center Street and Main Street	1.80
	18	S. County Aire Drive and Mequon Road	1.20
	19	N. 107th Street and W. Brown Deer Road	0.60
	20	N. 68th Street and W. Bradley Road	0.60
	11	N. Teutonia Avenue and W. Silver Spring Drive	0.60
	12	N. 34th Street and W. Capitol Drive	0.60
	13	N. 30th Street and W. North Avenue	0.60
	14	N. 44th Street and W. Blue Mound Road	0.60
	15	N. 5th Street and W. St. Paul Avenue	- -
4—Milwaukee-Oconomowoc	21	S. Main Street and Collins Street	$2.00
	22	Sawyer Road and USH 16	1.80
	23	Lakeland Road and CTH PP	1.80
	24	Cottonwood Avenue and Pawling Avenue	1.60
	25	W. Wisconsin Avenue and Capitol Drive	1.40
	26	Duplainville Road and Marjean Lane	1.20
	27	N. Brookfield Road and River Road	1.20
	28	Legion Drive and Watertown Plank Road	1.00
	29	N. 75th Street and W. State Street	0.60
	14	N. 44th Street and W. Blue Mound Road	0.60
	15	N. 5th Street and W. St. Paul Avenue	- -
5—Milwaukee-Waukesha	30	N. Barstow Street and Cutler Street	$1.20
	31	Pearl Street and CTH A	1.20
	32	S. Moorland Road and Honey Lane	1.00
	33	S. 108th Street and Manor Park Drive	0.60
	34	S. 70th Street and Dickinson Street	0.60
	35	S. 27th Street and W. Dakota Street	0.60
	15	N. 5th Street and W. St. Paul Avenue	- -
6—Milwaukee-Kenosha	36	14th Avenue and 54th Street	$2.00
	37	STH 32 and CTH E	1.80
	38	Memorial Drive and State Street	1.60
	39	STH 32 and Three Mile Road	1.20
	40	5th Avenue and E. Ryan Road	0.60
	41	13th Avenue and E. Rawson Avenue	0.60
	42	Whitnall Avenue and E. Grange Avenue	0.60
	43	Brust Avenue and E. Oklahoma Avenue	0.60
	15	N. 5th Street and W. St. Paul Avenue	- -

Source: SEWRPC.

Table 123

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Commuter Rail Plan
Primary Element		
Exclusive Guideway Miles		
Subway	--	--
Elevated	--	--
At-Grade	--	--
Total	--	--
Shared Guideway Miles		
Freeways	51.5	--
Surface Arterial Streets	49.5	--
Total	101.0	157.3[a]
Route Miles	449	354
Vehicle Miles	8,900	13,100
Vehicle Hours	460	420
Vehicles Required	78	90
Trains Required	--	36
Express and Local Elements		
Route Miles	1,306	1,853
Vehicle Miles	85,900	121,500
Vehicle Hours	6,520	8,710
Vehicles Required	823	1,023
Total System		
Route Miles	1,755	2,207
Vehicle Miles	94,800	134,600
Vehicle Hours	6,980	9,130
Vehicles Required	901	1,113
Trains Required	--	36

[a] *Although commuter rail operation is designated in this table as being over an exclusive guideway, commuter trains in fact operate over railway trackage also utilized by freight trains.*

Source: SEWRPC.

transit system in the design year may be expected to approximate $4.3 million under the base plan, and $20 million under the maximum extent commuter rail plan. Primary transit system operating and maintenance costs would thus represent 7 percent of the total operating costs expected in the design year for the base plan, and 20 percent of the total operating costs expected in the design year for the maximum extent commuter rail system plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.63. For the maximum extent commuter rail plan, the average cost per passenger may be expected to approach $0.94—$0.31, or about 50 percent, more than the base plan cost. The average operating cost per passenger mile, however, would be only slightly greater under the maximum extent commuter rail plan—$0.16, compared with $0.15 under the base plan. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.12 and $0.12, respectively, and for the maximum extent commuter rail plan would be $2.52 and $0.13, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $37 million, expressed in 1979 dollars, compared with $49 million under the maximum extent commuter rail plan. Under the commuter rail alternative, the primary transit element may be expected to generate about 17 percent, or $8.5 million, of the total revenues compared with 7 percent, or $2.4 million, under the base plan. Under both the base and maximum extent commuter rail plans, current fares are assumed to increase with general price inflation. The fare under both plans would thus remain at $0.50 per ride, expressed in constant 1979 dollars, for local and express bus service. Similarly, the primary service fare would remain at $0.60 within Milwaukee County, and would increase with distance from Milwaukee County to between $1.20 and $1.60 at the outer limits of the future urbanized area, and to between $1.20 and $2.20 at the extreme limits of service under the maximum extent plan routes.

The operating deficit in the year 2000 for the maximum extent commuter rail plan would be about $52 million, expressed in 1979 dollars, requiring a subsidy of about $0.48 per passenger. This compares with the base system plan deficit of about $23 million, or $0.24 per passenger. Farebox revenues would cover about 49 percent of the operating costs under the maximum extent commuter rail plan and 62 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has in the past funded up to 72 percent of the non-

Table 124

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	354	354	354	354	354
Vehicle Miles	3,900	3,400	4,100	1,700	13,100
Vehicle Hours	130	110	130	50	420
Vehicles (coaches) Required.	90	27	90	21	90
Trains Required	36	18	36	18	36
Express and Local					
Route Miles.	1,853	1,775	1,853	1,672	1,853
Vehicle Miles	26,000	36,800	36,500	22,200	121,500
Vehicle Hours	1,920	2,490	2,710	1,590	8,710
Vehicles Required	761	409	1,023	237	1,023
Total System					
Route Miles.	2,207	2,129	2,207	2,026	2,207
Vehicle Miles	29,900	40,200	40,600	23,900	134,600
Vehicle Hours	2,050	2,600	2,840	1,640	9,130
Vehicles Required	851	436	1,113	258	1,113
Trains Required	36	18	36	18	36

Source: SEWRPC.

Table 125

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Maximum Extent Commuter Rail Plan		
		Transit Trips			Transit Trips	
	Total Person Trips	Number	Percent of Total Trips	Total Person Trips	Number	Percent of Total Trips
Home-Based Work	1,112,900	102,100	9.2	1,111,100	110,300	9.9
Home-Based Shopping . .	512,400	39,000	7.6	511,700	48,100	9.4
Home-Based Other	1,502,200	116,900	7.8	1,499,400	144,700	9.7
Nonhome Based.	837,100	17,500	2.1	834,400	17,700	2.1
School	465,300	51,300	11.0	465,300	51,300	11.0
Total	4,429,900	326,800	7.4	4,421,900	372,100	8.4

Source: SEWRPC.

Table 126

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Time of Day	Base Plan				Maximum Extent Commuter Rail Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	6,800	45.3	70,200	21.5	6,300	19.9	75,600	20.3
Midday	100	0.7	112,800	34.5	10,500	33.1	132,600	35.6
Afternoon . .	8,100	54.0	111,400	34.1	11,000	34.7	125,000	33.6
Evening. . . .	- -	- -	32,400	9.9	3,900	12.3	38,900	10.5
Total	15,000	100.0	326,800	100.0	31,700	100.0	372,100	100.0

Source: SEWRPC.

Table 127

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Commuter Rail Plan
Guideway Development	$ - -	$ 34,536,900[d]
Station Development[b]	2,893,700	17,040,400
Vehicle Storage and Maintenance Facility Development[b]	24,775,000	37,139,800
Vehicle Acquisition and Replacement[c].	205,660,000	313,135,000
Total	$233,328,700	$401,852,100

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent commuter rail plan would be implemented incrementally from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 to 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—12 acres under the base plan and 58 acres under the maximum extent commuter rail plan. Right-of-way is assumed to have a life of 100 years. The useful life of stations is estimated at 30 years.*

[c] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses and commuter rail coaches and locomotives. Both plans assume a fleet of 640 buses with an average age of 10 years in 1980. Buses have an average useful life of 12 years. Commuter rail coaches and locomotives have an estimated useful life of 30 years.*

[d] *The cost of fixed guideway development for the provision of commuter rail service does not account for trade rehabilitation work proposed by the Milwaukee Road for the 1980 and 1981 work seasons. Should this work be completed, the total cost of guideway development could be reduced by $12,274,000 to $22,262,900.*

Source: SEWRPC.

Table 128

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Commuter Rail Plan
Ridership		
Primary Element	3,825,000	8,083,500
Total System	94,250,000	106,800,000
Operating and Maintenance Cost		
Primary Element	$ 4,305,500	$ 20,397,500
Total System	60,313,100	100,735,900
Operating and Maintenance Cost per Passenger		
Primary Element	$1.12	$2.52
Systemwide Average	0.63	0.94
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.12	$0.13
Total System	0.15	0.16
Farebox Revenue		
Primary Element	$ 2,423,200	$ 8,450,900
Total System	37,114,800	49,128,300
Operating Deficit		
Primary Element	$ 1,882,300	$ 11,946,600
Total System	23,198,300	51,607,600
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	56	41
Total System	62	49
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 941,150	$ 5,973,300
Total System	11,599,150	25,803,800
State (72 percent of nonfederal share of operating deficit)		
Primary Element	677,628	4,300,776
Total System	8,351,388	18,578,736
Local		
Primary Element	263,522	1,672,524
Total System	3,247,762	7,225,064
Local Operating Deficit per Ride		
Primary Element	$0.07	$0.21
Total System	0.03	0.07

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, about equal to the $11.6 million required to provide 50 percent federal funding of the operating deficits under the base plan, but substantially less than the $25.8 million required to provide such funding under the maximum extent commuter rail plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

federal share.[6] The annual local share of the public funding requirement in the year 2000 would be about $7.2 million for the maximum extent commuter rail plan. The local funding requirement for the base system would be somewhat less—$3.2 million.

Development of Truncated Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent commuter rail system plan are summarized in Table 129. The maximum extent commuter rail system plan has higher capital costs and greater operating deficits, both in total and on a per passenger basis, than does the base plan. In addition, farebox revenues under the maximum extent commuter rail system plan cover a smaller proportion of operating costs in the plan design year than do such revenues under the base plan.

Most of the increases in the cost and decreases in the cost-effectiveness of the maximum extent commuter rail system plan can be attributed to the overextension of service envisioned in this plan.[7]

[6] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, about equal to the $11.6 million required to provide 50 percent federal funding of the operating deficits under the base plan, but substantially less than the $25.8 million required to provide such funding under the maximum extent commuter rail plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

[7] *The extension of local and express service under the maximum extent commuter rail plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express and local service included in each maximum extent primary transit system plan is basically in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules were modified, however, to coordinate properly the secondary and tertiary service proposed to be provided with the primary service under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered and should, therefore, not affect a comparison of those alternatives.*

Table 129

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Commuter Rail Plan
Ridership		
In Design Year	94,250,000	106,800,000
To Design Year	1,485,900,000	1,605,300,000
Capital Cost		
Total to Design Year	$ 233,328,700	$ 401,852,100
To Design Year per Passenger	0.160	0.250
To Design Year After Accounting for Useful Life Beyond Design Year	148,842,000	210,245,300
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.100	0.130
Operating Cost		
Percent Met by Farebox Revenues in Design Year	62	49
Operating Deficit in Design Year	$ 23,198,300	$ 51,607,600
Operating Deficit per Passenger in Design Year	0.250	0.480
Operating Deficit to Design Year	430,900,000	658,170,000
Operating Deficit to Design Year per Passenger	0.290	0.410
Total Cost		
To Design Year	$ 664,228,700	$1,060,022,100
Federal Share	402,112,960	650,566,680
Nonfederal Share	262,115,740	409,455,420
To Design Year per Passenger	0.450	0.660
Federal Share	0.270	0.400
Nonfederal Share	0.180	0.260
To Design Year After Accounting for Useful Life Beyond Design Year	579,742,000	868,415,300
Federal Share	334,523,600	497,281,240
Nonfederal Share	245,218,400	371,134,060
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.390	0.540
Federal Share	0.225	0.310
Nonfederal Share	0.165	0.230

Source: SEWRPC.

Under the maximum extent plan, primary transit service would be extended into large areas of the Region not now served. In addition, it would be expanded into an all-day operation, and it would be provided with headways of no more than 30 minutes during the peak travel periods in the peak direction and of no more than 60 minutes otherwise. Thus, the primary transit service proposed would be a true transit service, available for tripmaking of all purposes. The cost-effectiveness of the less productive routes on which commuter rail service would be extended can be identified through a determination of what proportion of the operating costs may be expected to be recovered through farebox revenues. As shown in Table 130, only the route to the Cities of Racine and Kenosha can be expected to meet one-half of its operating costs through farebox revenues. None of the other routes are expected to meet as much as 36 percent of operating costs from farebox revenues.

To reduce operating deficits and increase the proportion of primary transit operating costs met by farebox revenues to at least 50 percent, it was necessary to truncate the maximum extent commuter rail plan. In order to do so while maintaining a framework of true primary transit service in the Milwaukee area, and, importantly, to assure reasonable comparability between all primary transit alternatives tested, this truncation was limited to reductions in the number and extent of commuter rail routes provided. Nevertheless, those commuter rail facilities and services which could be reasonably cost-effective if the time periods and frequency of service offered were reduced were identified so that these reduced services could be considered for addition to the "best" primary transit system plan for this future as "specialized" transit service.[8]

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[8]*Reductions in the time periods of service and increases in the headways operated have the potential to affect primary transit cost-effectiveness significantly. The off-peak-time period operations of commuter rail service under this future are generally less cost-effective than the peak-time-period operations. Accordingly, limiting commuter rail service to the peak travel periods may be expected to increase the proportion of commuter rail operating costs met by farebox revenues, even though under peak-period-only operation, travel on the commuter rail system may be expected to be reduced to the primarily work- and school-related travel generated during the morning peak period.*

To reduce the frequency of service, maximum headways in the peak periods and the peak direction were increased from 30 to 60 minutes with only a relatively small reduction in transit use and a substantial reduction in operating cost. The decrease in ridership would result from the attendant increase in wait time for transit service. First wait times under this study were assumed to approximate one-half of the headway up to a maximum of 10 minutes. Consequently, increases in maximum headway would not affect this wait time. However, all subsequent wait times, which are attendant to transfers, were estimated at one-half of the headway with no upper limit. It should be noted that, by not permitting headways greater than 60 minutes, it is assumed that any decrease in operating costs possible through further headway increases would result in ridership and revenue reductions and a subsequent stabilization or decline in the proportion of operating costs recovered from farebox revenues. The ridership reductions would result from the inconvenient schedule.

Table 130

OPERATING COST-EFFECTIVENESS OF COMMUTER RAIL ROUTES OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Average Weekday Operating Costs and Farebox Revenues				
	Passenger Miles of Travel	Farebox Revenue	Vehicle Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
Kenosha and Racine . . .	326,000	$18,200	5,500	$33,500	54
Oconomowoc	66,900	3,700	1,700	10,600	35
Saukville	66,800	3,700	1,800	11,100	34
Waukesha	38,000	2,100	1,100	6,500	33
Port Washington.	39,600	2,200	1,100	6,800	32
West Bend	56,600	3,200	1,900	11,400	28
Total	594,000	$33,100	13,100	$79,900	41

Source: SEWRPC.

Table 131

CAPITAL COST-EFFECTIVENESS OF COMMUTER RAIL STRETCHES OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Stretch	Route	Passenger Miles of Travel on Average Weekday	Capital Cost Over Plan Design Period	Capital Cost Over Plan Design Period per Passenger Mile on an Average Weekday
Milwaukee-Kenosha.	Kenosha[a]	324,060	$46,681,300	$144
Grand Avenue-Oconomowoc . . .	Oconomowoc	60,960	16,663,600	273
Milwaukee-Grand Avenue	All	21,320	5,981,100	281
Grand Avenue-Canco	West Bend, Saukville, and Port Washington	36,540	11,450,400	313
Canco-West Bend	West Bend	36,800	14,706,200	400
Canco-Port Washington.	Port Washington	24,780	10,554,600	426
Canco-Saukville	Saukville	40,140	18,774,700	467
Washington Street-Waukesha . . .	Waukesha	38,980	19,875,200	510

[a] *The Waukesha route also operates for a short 1.6-mile segment from Washington Street to Milwaukee along this 33.1-mile stretch from Kenosha to Milwaukee.*

Source: SEWRPC.

Because it can be assumed that elimination of either the Saukville or Port Washington route to the north, and either the Oconomowoc or Waukesha route to the west, would serve to increase the operating cost-effectiveness of the remaining route in each of these corridors sufficiently to allow them to be part of the truncated plan, the capital cost-effectiveness of each of these routes and the operating and capital cost-effectiveness of each segment of these routes was investigated as part of the truncation of the maximum extent commuter rail system plan. The less cost-effective capital cost elements of these four routes were identified through consideration of the total capital cost requirements, over the plan design period, of travel per passenger mile in the plan design year on the major segments of the routes of the maximum extent system plan. As summarized in Table 131, the route to Kenosha was found to be by far the most cost-effective in terms of capital cost. The route to Oconomowoc was found to be the next most cost-effective, principally because of its limited track rehabilitation needs over the plan design period. The remaining routes, including the routes to Port Washington and Saukville, were found to be of similar capital cost-effectiveness with the exception of the route to Waukesha, which was found to be the least cost-effective because of its extensive track rehabilitation needs.

Another consideration in the maximum extent commuter rail plan truncation was the operating and capital costs per passenger and passenger mile carried on segments of the system. Table 132 summarizes the capital and operating costs, and passenger volumes and passenger miles carried, for the major segments of the maximum extent commuter rail transit system, and provides a ranking of the segments in terms of operating cost per passenger mile and capital cost per passenger mile. Map 56 identifies the major segments of the primary transit element of the plan. Figure 12 illustrates the ranking of the segments in terms of operating cost per passenger mile. Those segments having higher-than-average operating costs per passenger mile are identified, as are those segments on which farebox revenues may be expected to recover less than one-half of the operating costs, based on passenger miles carried. Figure 13 displays the ranking of segments in terms of capital cost per passenger mile. Maps 51 and 58 show those segments which may be expected to have higher-than-average operating costs and capital costs per passenger mile, respectively, as well as the degree to which such average costs are exceeded.

In any consideration of this segment-by-segment cost-effectiveness information, it is important to recognize that the outer ends of each route can carry no through traffic except by interface with a different mode such as a feeder/distributor bus. Therefore, along with the displayed measures of segment cost-effectiveness, consideration must be given to the passenger volume which the outer segment contributes to the total route volume in comparison with the contribution of the other segments of the route and, in particular, to the volume which would be provided at another potential outer segment. Such passenger volume data are provided in Table 132. Consideration should also be given to the magnitude of the reduction in capital and operating costs that would result from eliminating any given segment, and to the potential for the passenger volume along the eliminated segment to continue to use the system by driving or using a feeder/distributor bus to the new end-of-route.

Based upon the systemwide capital and operating cost-effectiveness evaluation, and the route and segment cost-effectiveness evaluation indicating the weakest elements of the system, the Kenosha and Oconomowoc routes and the stretch of the Saukville route to Grafton of the maximum extent commuter rail system were retained under this future, to provide a truncated plan as presented in Table 133 and on Map 59.

Evaluation of Maximum Extent Light Rail System Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is light rail transit. The maximum extent system plan developed for this technology is summarized with respect to its coverage, stations, routes, and operation on Maps 60 and 61 and in Tables 134 through 136. Under this plan, all primary transit service would be provided by a light rail transit system operating a fleet of 200 electrically propelled, bidirectional, single-articulated light rail vehicles.

Primary transit service under the maximum extent light rail transit system plan would be provided over five routes, which together would represent a substantial expansion over existing primary transit service. One route, Route 1, would extend from the City of Waukesha to the University of Wisconsin-Milwaukee, passing through the Milwaukee central business district. The second route, Route 2, would extend in a generally north-south direction from the Village of Grafton to the City of Oak Creek through the Milwaukee central business district, and would also serve the Villages of Thiensville and Brown Deer and the Cities of Mequon and Glendale. The third route, Route 3, would extend in a generally northwesterly-southeasterly direction from the Village of Menomonee Falls through the central business district of Milwaukee and the Cities of St. Francis and Cudahy, terminating in the City of South Milwaukee. The fourth route, Route 4, would extend in a generally north-south direction along a crosstown alignment. The terminals of Route 4 would be located at the Northridge and Southridge Shopping Centers, and the route would serve the Villages of Greendale and West Milwaukee and the City of Greenfield in addition to the City of Milwaukee. The fifth and last route, Route 5, would operate in a loop primarily serving the most intensively developed areas of the City of Milwaukee as well as the University of Wisconsin-Milwaukee campus area and the central business district of the City of Milwaukee.

Table 132

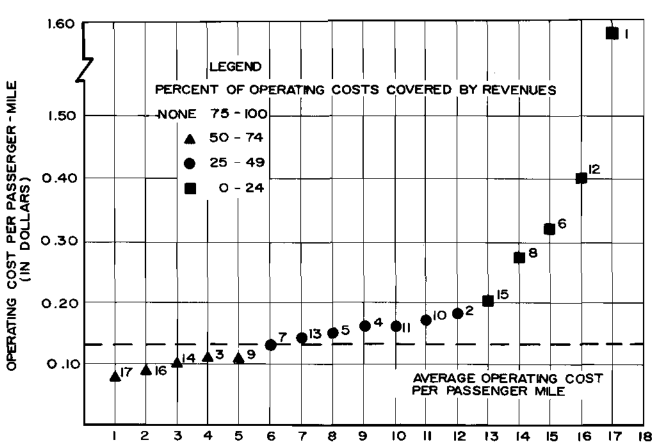
COST-EFFECTIVENESS ANALYSIS OF SEGMENTS OF THE PRIMARY ELEMENT OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Segment	Transit Ridership: Average Weekday Passenger Volume: Range	Average	Passenger Miles	Average Weekday Operating Cost in Design Year	Total Capital Cost Over Design Period	Average Weekday Operating Cost-Effectivensss in Design Year: Cost per Passenger Miles	Rank	Total Capital Cost-Effectiveness Over the Design Period: Cost per Passenger Mile	Rank
1. Saukville-Grafton.	450-450	450	1,100	$ 1,770	$ 4,074,200	$1.61	17	$3,703	17
2. Grafton-Brown Deer	1,070-3,180	2,190	22,950	4,230	11,042,100	0.18	12	481	12
3. Brown Deer-Canco	3,830-3,830	3,830	16,090	1,690	3,658,400	0.11	4	227	4
4. Canco-Grand Avenue.	5,530-9,290	7,830	36,540	5,780	11,450,400	0.16	9	313	10
5. Grand Avenue-Milwaukee	8,520-8,520	8,520	21,320	3,230	5,981,100	0.15	8	281	9
6. West Bend-Granville	580-1,820	1,020	19,820	6,390	10,752,100	0.32	15	542	13
7. Granville-Canco.	2,250-2,650	2,500	16,980	2,240	3,954,100	0.13	6	233	5
8. Port Washington-Brown Deer . . .	690-1,290	860	13,010	3,520	7,678,100	0.27	14	590	14
9. Brown Deer-Canco	2,030-2,030	2,030	11,770	1,350	2,876,500	0.11	4	244	6
10. Waukesha-STH 100.	1,560-2,080	1,920	17,660	3,030	10,570,300	0.17	11	599	14
11. STH 100-Washington Street. . . .	1,660-2,410	2,030	21,320	3,460	9,304,900	0.16	9	436	11
12. Oconomowoc-Pewaukee.	500-1,160	830	10,200	4,050	6,521,000	0.40	16	639	16
13. Pewaukee-Brookfield.	1,970-2,800	2,350	14,540	2,040	3,960,400	0.14	7	272	7
14. Brookfield-Grand Avenue	2,970-3,530	3,230	36,220	3,690	6,182,200	0.10	3	171	3
15. Kenosha-Racine.	4,220-5,750	5,180	52,840	10,330	14,380,900	0.20	13	272	7
16. Racine-South Milwaukee	9,630-12,750	11,520	154,370	13,570	18,962,800	0.09	2	123	2
17. South Milwaukee-Milwaukee . . .	10,690-13,570	12,300	116,850	9,620	13,337,600	0.08	1	114	1

Source: SEWRPC.

Figure 12

RANK ORDERING OF OPERATING COSTS PER PASSENGER MILE COST-EFFECTIVENESS OF SEGMENTS OF THE PRIMARY ELEMENT OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

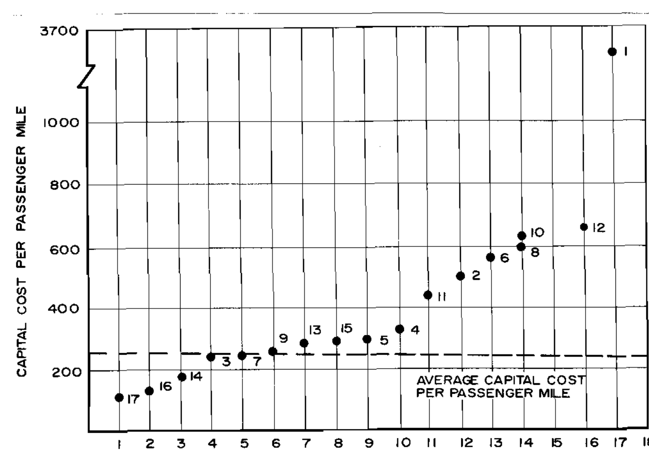


NOTE: NUMBERS ADJACENT TO POINTS ON GRAPH REFER TO COMMUTER RAIL SYSTEM SEGMENTS. (SEE TABLE 132)

Source: SEWRPC.

Figure 13

RANK ORDERING OF CAPITAL COSTS PER PASSENGER MILE COST-EFFECTIVENESS OF SEGMENTS OF THE PRIMARY ELEMENT OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

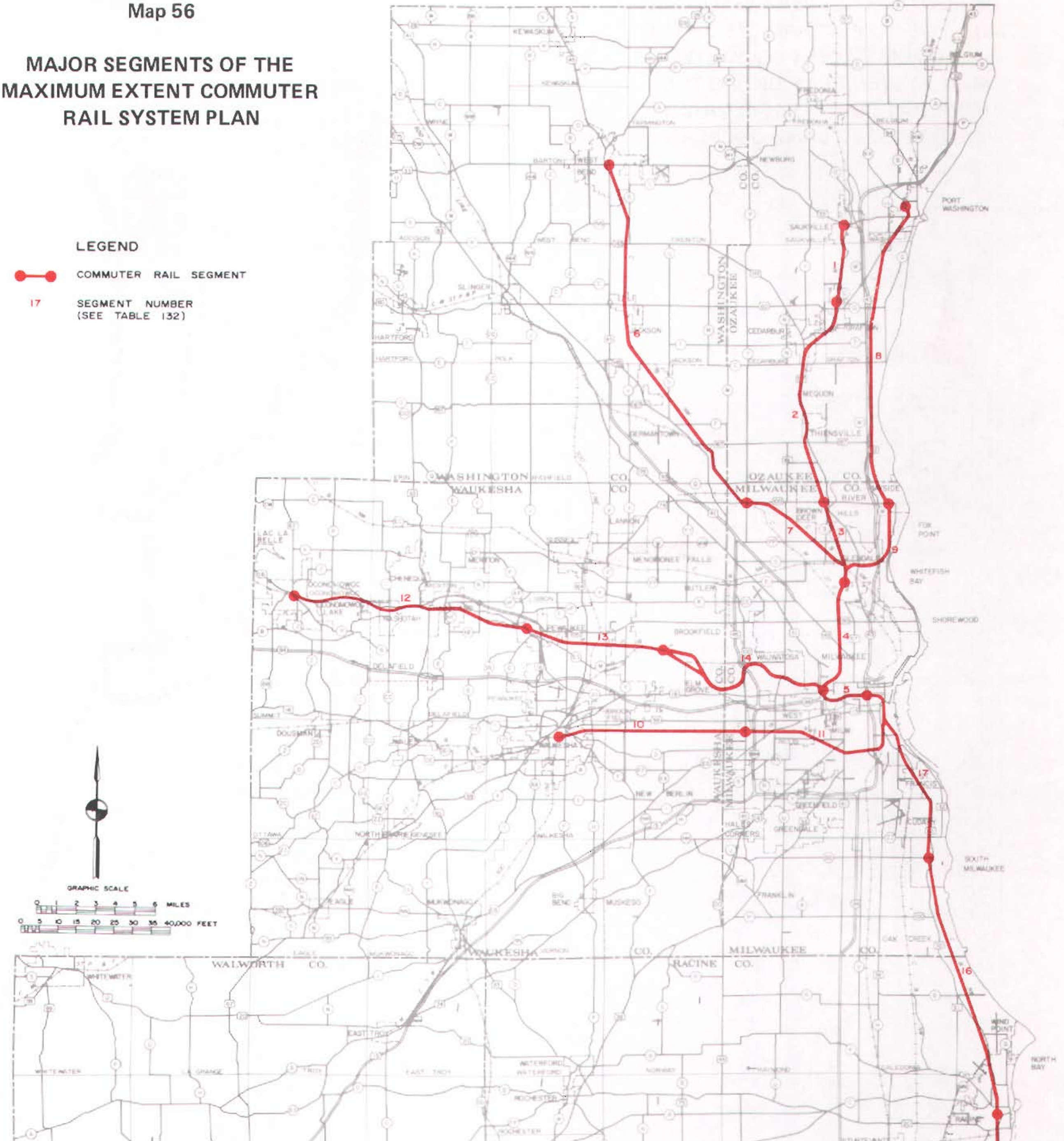


NOTE: NUMBERS ADJACENT TO POINTS ON GRAPH REFER TO COMMUTER RAIL SYSTEM SEGMENTS. (SEE TABLE 132)

Source: SEWRPC.

Map 56

MAJOR SEGMENTS OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN

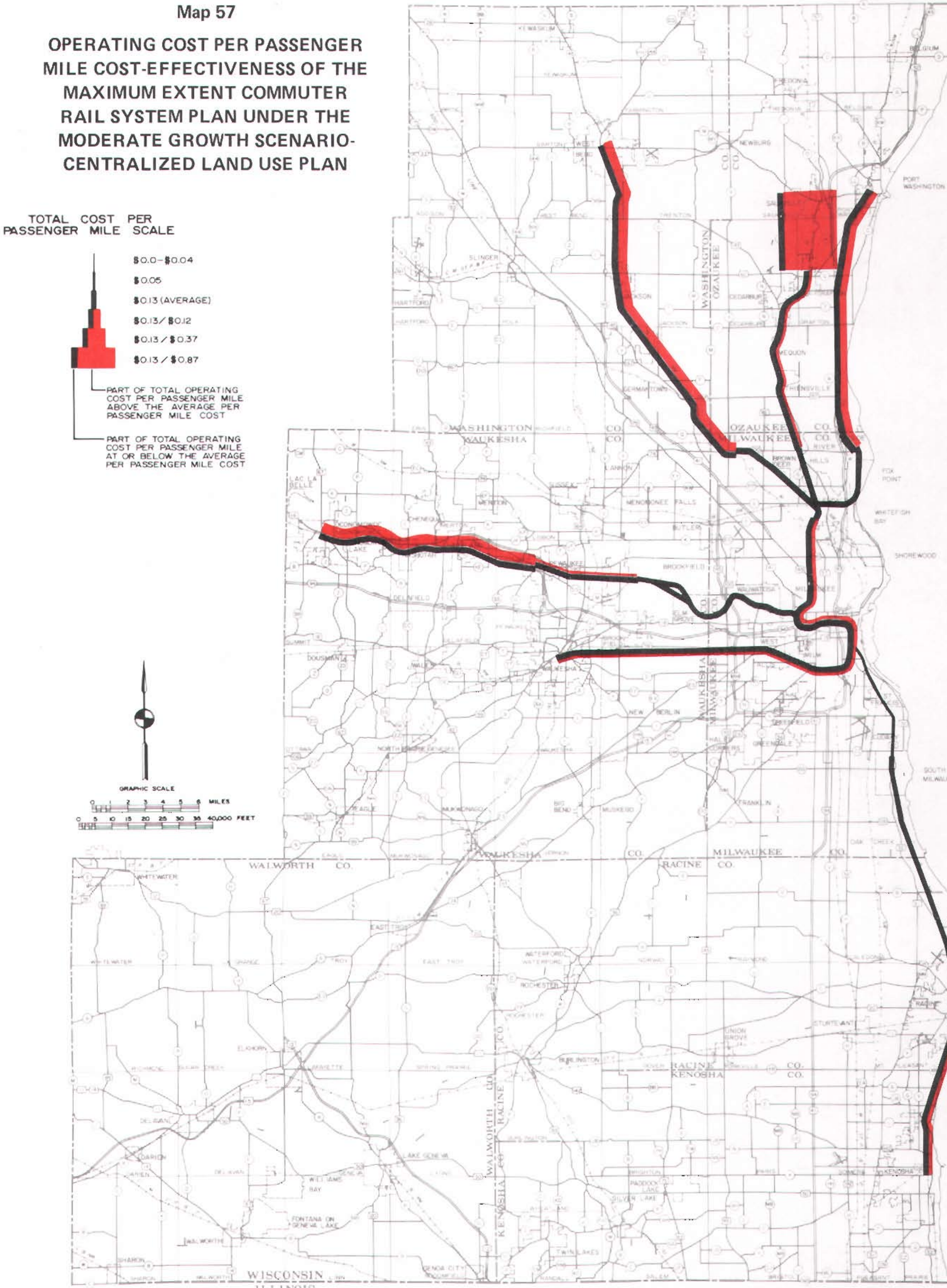


As shown on this map, the primary element of the maximum extent commuter rail network has been divided into 17 segments. These segments facilitate the identification of the less productive operating and capital cost elements of the primary transit system. The limits of these segments are defined so as to provide a logical end point should a particular route be truncated.

Source: SEWRPC.

Map 57

OPERATING COST PER PASSENGER MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

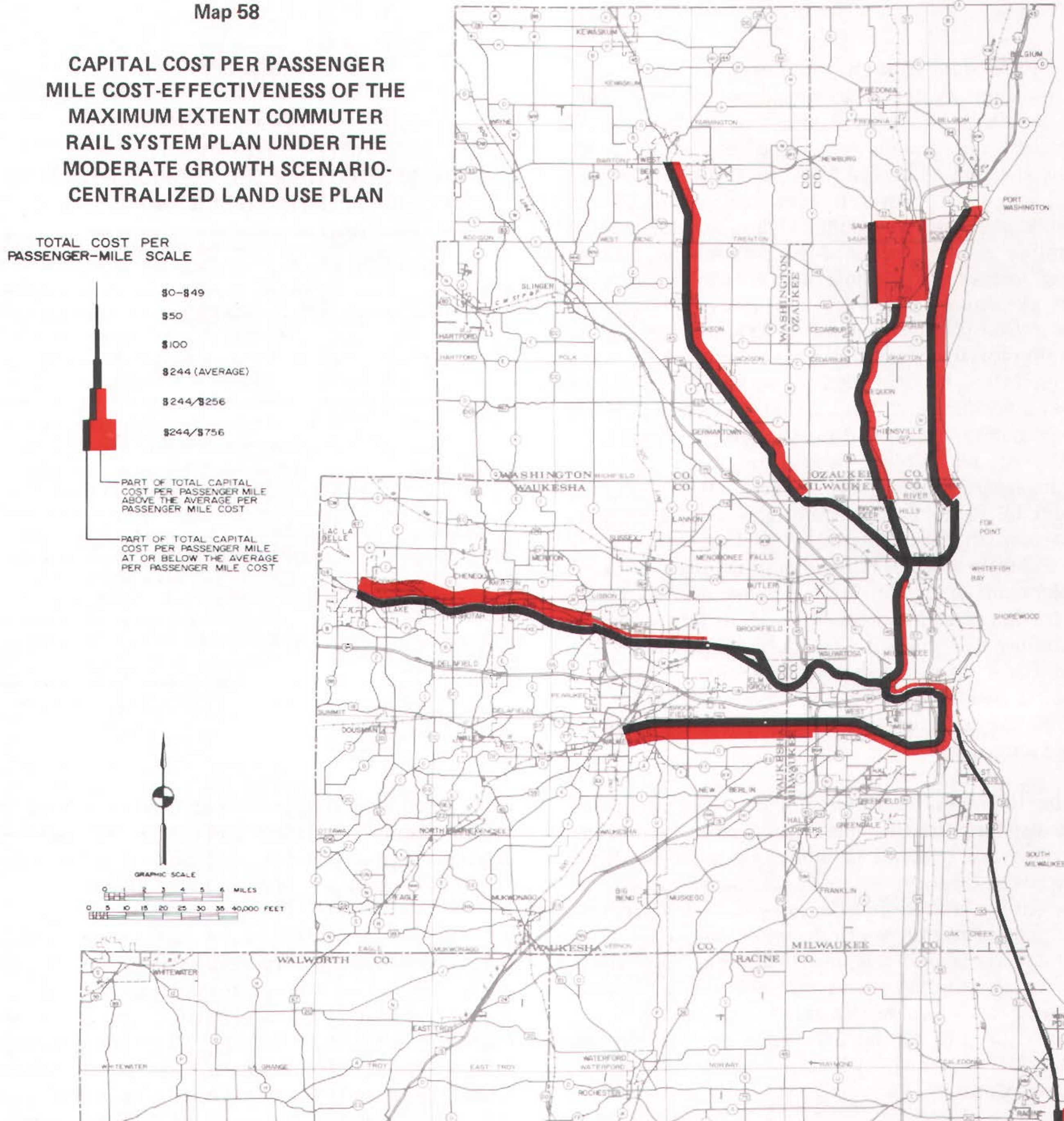


An important basis for the identification of the less productive elements of the maximum extent commuter rail system plan is the ranking of the system segments in terms of operating cost per passenger mile. Those system segments having higher-than-average operating costs per passenger mile were identified as candidates for either elimination or service reduction. As shown on this map, such segments are typically located at the ends of primary transit routes and in low-density suburban residential areas outside Milwaukee County. It is important to recognize that, because the outer ends of each route carry no through traffic, except through connection with a different mode such as feeder/distributor bus, they suffer by comparison with inner segments of a route. Therefore, other factors must also be considered in the system truncated process, such as passenger volumes.

Source: SEWRPC.

Map 58

CAPITAL COST PER PASSENGER MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



Another important basis for the identification of the less productive elements of the maximum extent commuter rail system plan is the ranking of the system segments in terms of capital cost per passenger mile. Those system segments having higher-than-average capital costs per passenger mile were identified as candidates for either elimination or service reduction. As shown on this map, such segments are typically located at the ends of primary transit routes and in low-density suburban residential areas outside Milwaukee County. Again, it is important to recognize that because the outer ends of each route carry no through traffic, except through connection with a different mode such as feeder/distributor bus, they suffer by comparison with inner segments of a route. Therefore, other factors must also be considered in the system truncation process, such as passenger volumes.

Source: SEWRPC.

The total dual guideway mileage of this maximum extent system plan would be approximately 104.5 miles. About 96.5 miles, or 92 percent, of the light rail system would be located at-grade, while the remaining 8.0 miles, or 8 percent, would be located on elevated structure. Right-of-way requirements would include 11.9 miles along active mainline railway rights-of-way; about 31.4 miles along former electric interurban railway rights-of-way presently owned by the Wisconsin Electric Power Company; about 0.5 mile along abandoned mainline railway rights-of-way; and 1.6 miles along cleared freeway right-of-way of the Stadium Freeway-South and Park Freeway-East corridors. The majority of the light rail guideway—about 51.7 miles, or 49 percent—would be located within public street rights-of-way, over which the facilities would be located in reserved lanes for 11.2 miles, in a median for 33.8 miles, in transit malls for 2.0 miles, in a street right-of-way wholly dedicated to light rail operation for 1.2 miles, in mixed traffic for 2.2 miles, and on elevated structure for the remaining 1.3 miles. Other public lands would be used for a total distance of 3.6 miles. A 3.8-mile strip of private lands, along which a total of five residential structures are located, would have to be acquired.

Under this maximum extent light rail system plan, 162 primary transit stations or stops would be provided, of which 143 would be located within Milwaukee County. All of these stations would be of a simple, functional design with a low or high level platform with waiting shelter, benches, waste receptacles, public telephone, lighting, newspaper and other vending machines, and posted transit schedule and fare information. Park-ride lots are planned at 28 of the 162 light rail transit stations, 19 of which will be located within Milwaukee County.

On the average, one stop would be made about every 0.6 mile on the five routes. Typical stops would be spaced one-quarter mile apart in the central business district of the City of Milwaukee, one-half mile apart in areas of high-density development, and one mile apart in areas of medium-density development. Average speeds on the five routes would be about 20 miles per hour. Headways in the peak periods would range from 7 to 20 minutes, with all service being provided by two articulated vehicle trains. In the off-peak periods, headways would range from 10 to 20 minutes during the midday period, and 15 to 20 minutes during the evening, with all routes operating with single-articulated vehicles. During the peak periods, each light rail vehicle would carry a maximum of 68 seated passengers and up to 79 standees. During off-peak periods, each vehicle would carry 68 seated passengers and up to 24 standees.

Table 133

RECOMMENDED CHANGES IN THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Recommended Change
Port Washington	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
West Bend	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
Waukesha	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
Saukville	Route to be cut back from Saukville to Grafton

Source: SEWRPC.

The maximum extent light rail transit system plan also envisions complementary expansion and improvement of the Milwaukee area local and express transit system elements. As under the maximum extent plans for all other potential primary transit technologies, local transit service would be extended under this light rail transit plan into all contiguous areas of urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County. Also, local transit service would be expanded during the off-peak travel periods, particularly in the evening. Express transit service under this light rail plan would be provided over five transit routes, all of which are designed to complement the maximum extent light rail system plan, serving some areas not directly served by the primary light rail transit system. In total, the number of express and local service route miles operated would increase by 27 percent over the number anticipated in the base plan, from 1,302 to 1,660 miles. The number of express and local ser-

Map 59

RECOMMENDED TRUNCATED COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

LEGEND

COMMUTER RAIL ROUTE TO BE RETAINED

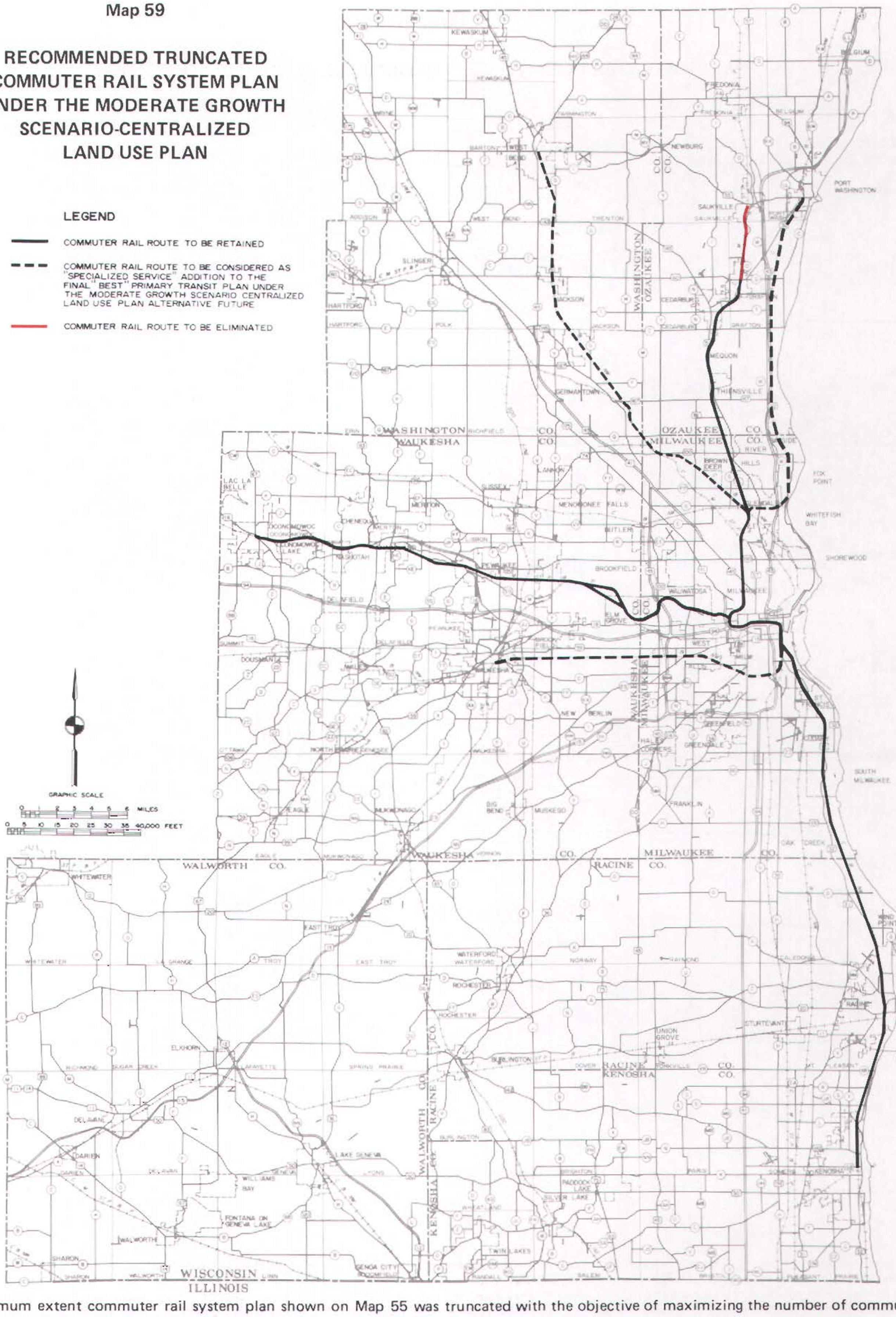
COMMUTER RAIL ROUTE TO BE CONSIDERED AS "SPECIALIZED SERVICE" ADDITION TO THE FINAL "BEST" PRIMARY TRANSIT PLAN UNDER THE MODERATE GROWTH SCENARIO CENTRALIZED LAND USE PLAN ALTERNATIVE FUTURE

COMMUTER RAIL ROUTE TO BE ELIMINATED

GRAPHIC SCALE

0 1 2 3 4 5 6 MILES

0 5 10 15 20 25 30 35 40,000 FEET

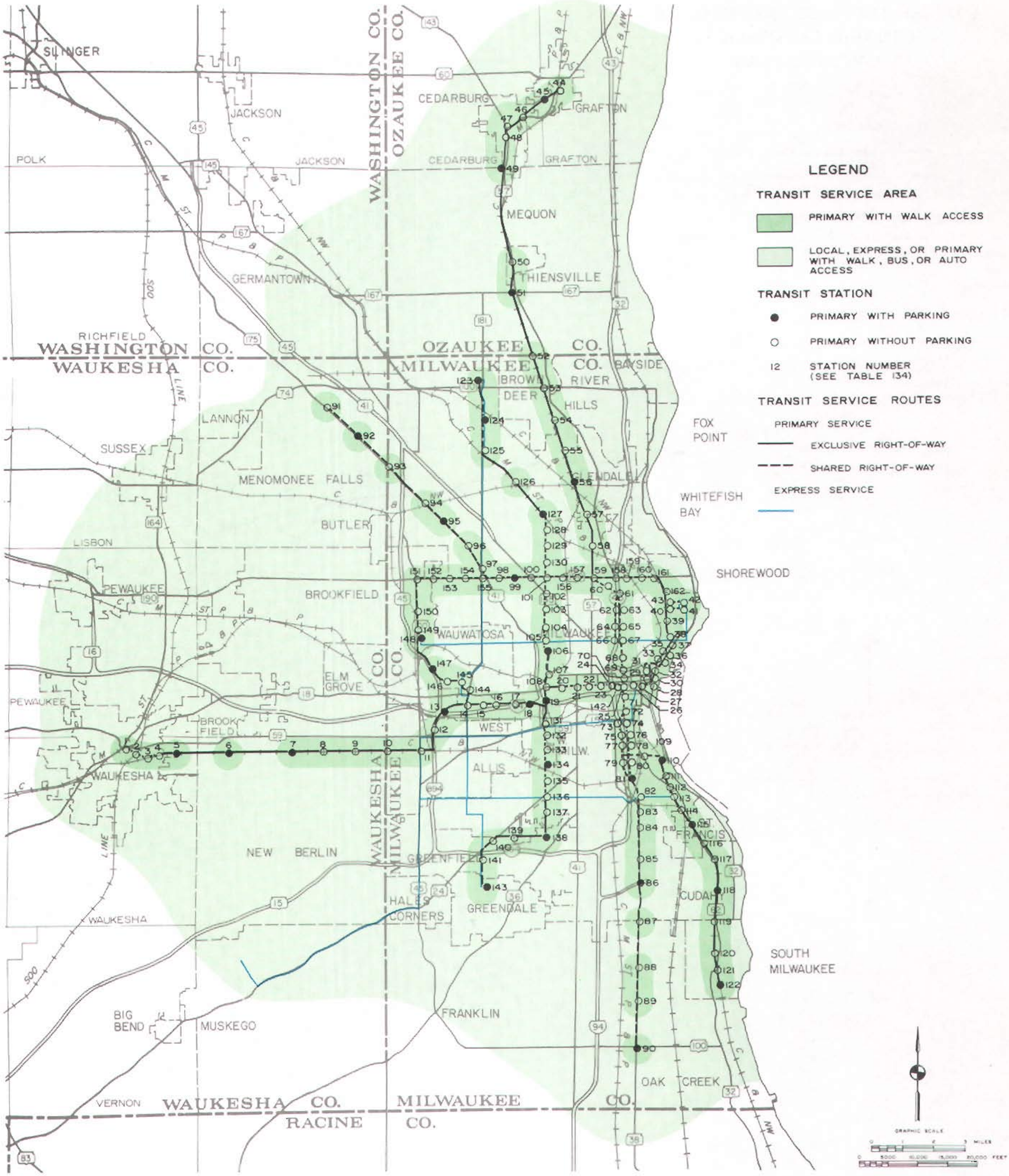


The maximum extent commuter rail system plan shown on Map 55 was truncated with the objective of maximizing the number of commuter rail routes for which at least 50 percent of the operating costs could be met with farebox revenues. A total of three of the six routes in the maximum extent plan, totaling 177 route miles in length, were recommended to be retained in the truncated plan. However, the three routes omitted from the truncated commuter rail plan were recommended to be considered for addition to the final "best" plan recommended for this future as specialized peak-period-only service.

Source: SEWRPC.

Map 60

MAXIMUM EXTENT LIGHT RAIL TRANSIT (AND BUSWAY) SYSTEM PLAN

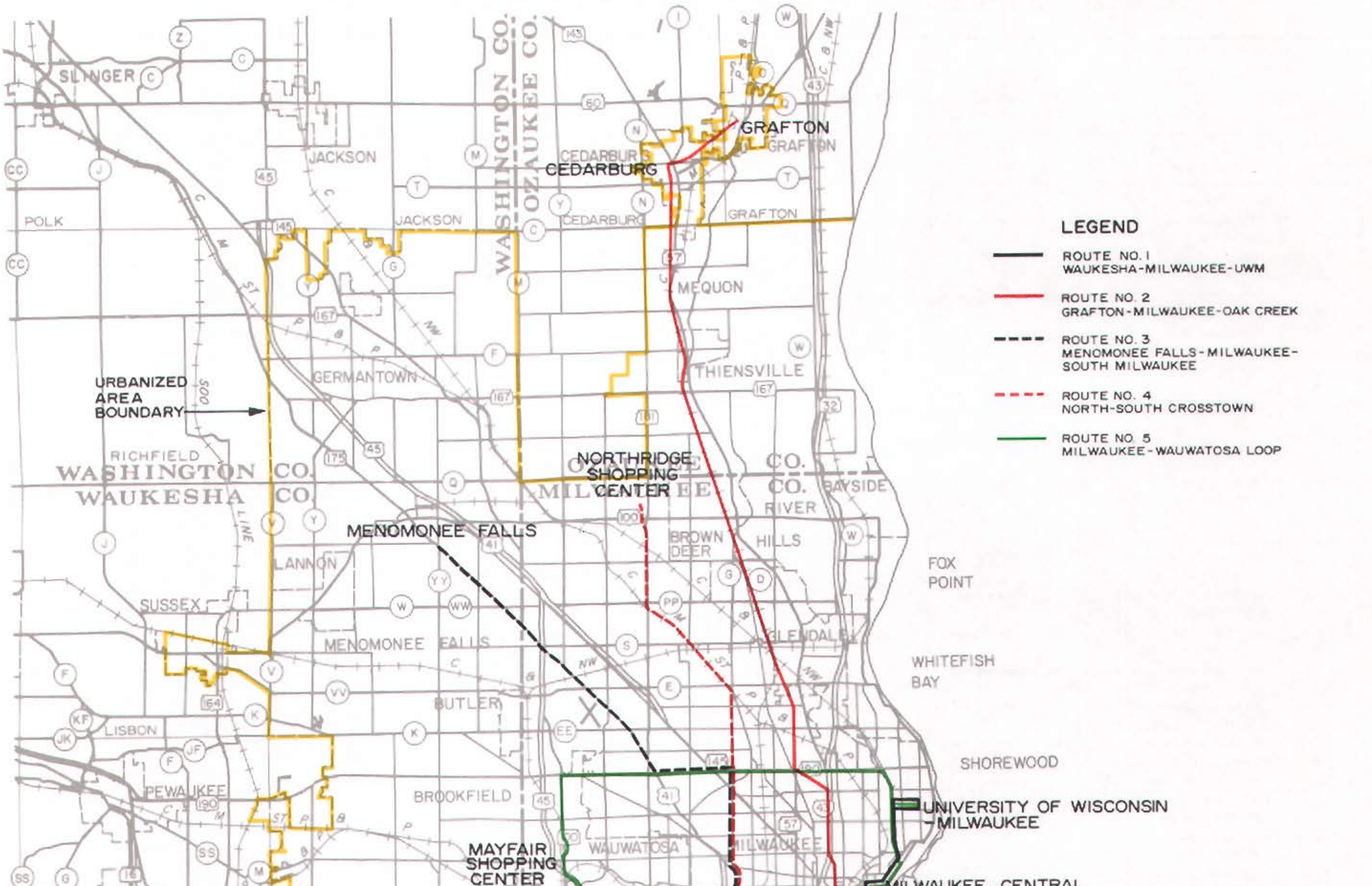


The maximum extent light rail transit system plan would significantly improve and expand primary transit service in the Milwaukee area. Under this plan, primary transit service would be improved within Milwaukee County, and would be extended outside Milwaukee County within the future limits of the Milwaukee urbanized area. All light rail transit service under the maximum extent plan would be provided throughout the day, including midday and evening time periods, and would be operated at headways of from 7 to 20 minutes during peak periods and from 10 to 20 minutes during off-peak periods. In all, five light rail transit routes totaling 255 miles in length and serving 162 primary transit stops or stations would be operated under this maximum extent plan. This compares with the 11 bus-on-freeway routes which operated in 1980 during peak periods only between 19 outlying primary transit stations and the Milwaukee central business district. The five light rail transit routes would be operated using electrically propelled, bidirectional, articulated light rail vehicles. The maximum extent light rail transit system plan also provides for complementary expansion and improvement of the Milwaukee area express and local transit system. Five express or limited stop routes would be provided, and the local transit system would be extended into all contiguous areas of urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County.

Source: SEWRPC.

Map 61

PRIMARY TRANSIT ROUTES FOR THE MAXIMUM EXTENT LIGHT RAIL TRANSIT (AND BUSWAY) SYSTEM PLAN



Primary transit service under the maximum extent light rail transit system plan would be provided over five routes. Route 1 would extend from the City of Waukesha to the University of Wisconsin-Milwaukee, passing through the Milwaukee central business district. Route 2 would extend in a generally north-south direction from the Village of Grafton to the City of Oak Creek through the Milwaukee central business district, and would also serve the Villages of Thiensville and Brown Deer and the Cities of Mequon and Glendale. Route 3 would extend in a generally northwesterly-southeasterly direction from the Village of Menomonee Falls through the central business district of Milwaukee and the Cities of St. Francis and Cudahy, terminating in the City of South Milwaukee. Route 4 would extend in a generally north-south direction along a crosstown alignment. The terminals of Route 4 would be located at the Northridge and Southridge Shopping Centers, and the route would serve the Villages of Greendale and West Milwaukee and the City of Greenfield in addition to the City of Milwaukee. Route 5 would operate in a loop primarily serving the most intensively developed areas of the City of Milwaukee as well as the City of Wauwatosa, the University of Wisconsin-Milwaukee campus area, and the central business district of the City of Milwaukee.

Source: SEWRPC.

Table 134

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (trains per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	W. Broadway and W. Main Street.	City of Waukesha	Proposed	Yes	- -	1	10	49	49	6	6	6	6	8	8	4	4
2	E. Broadway and Pleasant Street.	City of Waukesha	Proposed	Yes	- -	1	1	47	47	6	6	6	6	8	8	4	4
3	Lincoln Avenue and Lake Street.	City of Waukesha	Proposed	Yes	- -	1	- -	45	45	6	6	6	6	8	8	4	4
4	Lincoln Avenue and Frederick Street	City of Waukesha	Proposed	Yes	- -	1	1	43	43	6	6	6	6	8	8	4	4
5	CTH A and Pearl Street . .	City of Waukesha	Proposed	Yes	500	1	- -	40	40	6	6	6	6	8	8	4	4
6	Johnson Road	City of New Berlin	Proposed	- -	150	1	- -	37	37	6	6	6	6	8	8	4	4
7	Calhoun Road and Rogers Drive	City of New Berlin	Proposed	Yes	500	1	- -	34	34	6	6	6	6	8	8	4	4
8	Moorland Road and Rogers Drive	City of New Berlin	Proposed	Yes	- -	1	2	32	32	6	6	6	6	8	8	4	4
9	Sunny Slope Road and Honey Lane	City of New Berlin	Proposed	- -	- -	1	- -	30	30	6	6	6	6	8	8	4	4
10	S. 124th Street and Honey Lane	City of New Berlin	Proposed	- -	- -	1	- -	28	28	6	6	6	6	8	8	4	4
11	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	- -	1	5	26	26	6	6	6	6	8	8	4	4
12	S. 98th Street and W. Washington Street . . .	City of West Allis	Proposed	Yes	- -	1	2	23	23	6	6	6	6	8	8	4	4
13	N. 92nd Street and W. Dixon Street	City of Milwaukee	Proposed	Yes	200	1	- -	21	21	6	6	6	6	8	8	4	4
14	N. 84th Street and W. Hawthorne Avenue . .	City of Milwaukee	Proposed	Yes	- -	2	2	18	18	11	9	10	9	12	15	6	7
15	N. 76th Street and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	17	17	11	9	10	9	12	15	6	7
16	N. 68th Street and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	16	16	11	9	10	9	12	15	6	7
17	N. Hawley Road and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	14	14	11	9	10	9	12	15	6	7
18	County Stadium and Mitchell Boulevard	City of Milwaukee	Proposed	Yes	275	2	- -	13	13	11	9	10	9	12	15	6	7
19	County Stadium and N. 44th Street	City of Milwaukee	Proposed	Yes	225	3	- -	11	11	15	13	14	13	17	20	9	10
20	N. 35th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	7	7	16	14	15	14	19	22	10	11
21	N. 27th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	4	6	6	16	14	15	14	19	22	10	11
22	N. 21st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	4	4	16	14	15	14	19	22	10	11
23	N. 16th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	5	3	3	16	14	15	14	19	22	10	11
24	N. 12th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	6	2	2	16	14	15	14	19	22	10	11
25	N. 6th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	4	7	0	0	21	19	20	19	26	29	14	15
26	N. Plankinton Avenue and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	10	2	2	9	11	9	10	15	12	7	6
27	N. Broadway Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	8	3	3	9	11	9	10	15	12	7	6
28	N. Jackson Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	7	4	4	9	11	9	10	15	12	7	6
29	N. Jackson Street and E. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	1	5	5	9	- -	9	- -	15	- -	7	- -
30	N. Van Buren Street and E. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	1	- -	- -	- -	11	- -	10	- -	12	- -	6
31	N. Jackson Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	7	7	9	- -	9	- -	15	- -	7	- -
32	N. Van Buren Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	- -	- -	- -	11	- -	10	- -	12	- -	6
33	N. Astor Street and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	9	11	9	10	15	12	7	6
34	N. Farwell Avenue and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	9	9	9	11	9	10	15	12	7	6
35	N. Farwell Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	2	10	10	9	- -	9	- -	15	- -	7	- -
36	N. Prospect Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	1	- -	- -	- -	11	- -	10	- -	12	- -	6
37	N. Farwell Avenue and E. Kenilworth Place. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	12	12	9	11	9	10	15	12	7	6
38	N. Oakland Avenue and E. North Avenue.	City of Milwaukee	Proposed	Yes	- -	2	3	13	13	9	11	9	10	15	12	7	6
39	N. Cambridge Avenue and E. Locust Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	15	15	9	11	9	10	15	12	7	6
40	N. Oakland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	Yes	- -	2	1	16	16	9	11	9	10	15	12	7	6
41	N. Maryland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	Yes	- -	2	6	16	16	9	11	9	10	15	12	7	6
42	N. Maryland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	- -	2	4	21	21	9	11	9	10	15	12	7	6
43	N. Oakland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	22	22	9	11	9	10	15	12	7	6
44	Wisconsin Avenue and Broad Street	Village of Grafton	Proposed	Yes	- -	1	1	52	52	5	5	5	5	7	7	4	4

Table 134 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (trains per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
45	1st Avenue and Maple Street	Village of Grafton	Proposed	Yes	500	1	- -	51	51	5	5	5	5	7	7	4	4
46	Cedar Ridge Drive and Georgetown Drive	City of Cedarburg	Proposed	Yes	- -	1	1	49	49	5	5	5	5	7	7	4	4
47	STH 143 (Washington Avenue) and Turner Street.	City of Cedarburg	Proposed	- -	- -	1	1	47	47	5	5	5	5	7	7	4	4
48	Grant Avenue and Western Road	City of Cedarburg	Proposed	- -	- -	1	1	45	45	5	5	5	5	7	7	4	4
49	STH 57 and CTH C (Pioneer Road).	City of Mequon	Proposed	Yes	375	1	- -	43	43	5	5	5	5	7	7	4	4
50	STH 57 (Main Street) and Freistadt Road	Village of Thiensville	Proposed	Yes	- -	1	1	38	38	5	5	5	5	7	7	4	4
51	STH 57 (Green Bay Road) and STH 67 (Mequon Road)	City of Mequon	Proposed	Yes	275	1	- -	36	36	5	5	5	5	7	7	4	4
52	Garden Drive and W. County Line Road. . .	Village of Brown Deer	Proposed	Yes	- -	1	- -	32	32	5	5	5	5	7	7	4	4
53	N. Deerbrook Terrace and STH 100 (W. Brown Deer Road) . .	Village of Brown Deer	Proposed	Yes	- -	1	1	30	30	5	5	5	5	7	7	4	4
54	N. Cedarburg Road and W. Bradley Road.	Village of Brown Deer	Proposed	Yes	- -	1	1	23	28	5	5	5	5	7	7	4	4
55	N. Teutonia Avenue and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	- -	1	2	26	26	5	5	5	5	7	7	4	4
56	N. Sidney Place and W. Mill Road	City of Glendale	Proposed	Yes	275	1	1	24	24	5	5	5	5	7	7	4	4
57	N. Dexter Avenue and W. Silver Spring Drive. . .	City of Glendale	Proposed	Yes	- -	1	1	22	22	5	5	5	5	7	7	4	4
58	N. 20th Street and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	19	19	5	5	5	5	7	7	4	4
59	W. Atkinson Avenue and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	1	15	15	8	10	8	9	14	11	7	6
60	N. 16th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	1	12	12	5	5	5	5	7	7	4	4
61	N. 8th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	9	9	5	5	5	5	7	7	4	4
62	N. 8th Street and W. Burleigh Street.	City of Milwaukee	Proposed	Yes	- -	1	2	8	8	5	- -	5	- -	7	- -	4	- -
63	N. 7th Street and W. Burleigh Street.	City of Milwaukee	Proposed	Yes	- -	1	2	- -	- -	- -	5	- -	5	- -	7	- -	4
64	N. 8th Street and W. Center Street.	City of Milwaukee	Proposed	Yes	- -	1	2	7	7	5	- -	5	- -	7	- -	4	- -
65	N. 7th Street and W. Center Street.	City of Milwaukee	Proposed	Yes	- -	1	2	- -	- -	- -	5	- -	5	- -	7	- -	4
66	N. 8th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	5	5	5	- -	5	- -	7	- -	4	- -
67	N. 7th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	- -	- -	- -	5	- -	5	- -	7	- -	4
68	N. 6th Street and W. Walnut Street.	City of Milwaukee	Proposed	Yes	- -	1	2	4	4	5	5	5	5	7	7	4	4
69	N. 6th Street and W. Juneau Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	2	2	5	5	5	5	7	7	4	4
70	N. 6th Street and W. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	2	1	1	5	5	5	5	7	7	4	4
71	N. 6th Street and W. St. Paul Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	2	2	10	10	10	10	14	14	8	8
72	S. 6th Street and W. Alexander Street. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	4	4	10	10	10	10	14	14	8	8
73	S. 6th Street and W. National Avenue	City of Milwaukee	Proposed	Yes	- -	2	4	- -	- -	- -	10	- -	10	- -	14	- -	8
74	S. 5th Street and W. National Avenue	City of Milwaukee	Proposed	Yes	- -	2	4	6	6	10	- -	10	- -	14	- -	8	- -
75	S. 5th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	2	- -	- -	- -	10	- -	10	- -	14	- -	8
76	S. 4th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	10	- -	10	- -	14	- -	8	- -
77	S. 5th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	- -	2	3	- -	- -	- -	10	- -	10	- -	14	- -	8
78	S. 4th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	- -	1	3	9	9	10	- -	10	- -	14	- -	8	- -
79	S. 5th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	- -	- -	- -	5	- -	5	- -	7	- -	4
80	S. 4th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	11	4	5	- -	5	- -	7	- -	4	- -
81	S. Chase Avenue and W. Rosedale Avenue. . . .	City of Milwaukee	Proposed	Yes	450	1	- -	13	6	5	5	5	5	7	7	4	4
82	S. Chase Avenue and W. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	14	8	5	5	5	5	7	7	4	4
83	S. Howell Avenue and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	15	9	5	5	5	5	7	7	4	4
84	S. Howell Avenue and W. Howard Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	17	17	5	5	5	5	7	7	4	4

Table 134 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (trains per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
85	S. Howell Avenue and W. Layton Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	19	19	5	5	5	5	7	7	4	4
86	General Mitchell Field . . .	City of Milwaukee	Proposed	Yes	200	1	2	21	21	5	5	5	5	7	7	4	4
87	S. Howell Avenue and W. College Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	23	23	5	5	5	5	7	7	4	4
88	S. Howell Avenue and W. Marquette Avenue. . .	City of Oak Creek	Proposed	Yes	- -	1	2	27	27	5	5	5	5	7	7	4	4
89	S. Howell Avenue and W. Forest Hill Avenue. . .	City of Oak Creek	Proposed	Yes	- -	1	2	29	29	5	5	5	5	7	7	4	4
90	S. Howell Avenue and W. Ryan Road	City of Oak Creek	Proposed	Yes	450	1	1	32	32	5	5	5	5	7	7	4	4
91	STH 175 (Appleton Avenue) and Menomonee Avenue. . . .	Village of Menomonee Falls	Proposed	Yes	- -	1	2	44	44	5	5	5	5	7	7	4	4
92	STH 175 (Appleton Avenue) and North Hills Drive	Village of Menomonee Falls	Proposed	Yes	450	1	1	42	42	5	5	5	5	7	7	4	4
93	STH 175 (Appleton Avenue) and Parkway Drive	Village of Menomonee Falls	Proposed	Yes	- -	1	- -	36	36	5	5	5	5	7	7	4	4
94	USH 41 (W. Appleton Avenue) and W. Bobolink Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	33	33	5	5	5	5	7	7	4	4
95	Timmerman Field.	City of Milwaukee	Proposed	Yes	450	1	2	32	32	5	5	5	5	7	7	4	4
96	USH 41 (W. Appleton Avenue) and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	29	29	5	5	5	5	7	7	4	4
97	N. 76th Street and W. Appleton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	28	28	5	5	5	5	7	7	4	4
98	N. 68th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	2	1	24	24	8	10	8	9	14	11	7	6
99	Capitol Court Shopping Center.	City of Milwaukee	Proposed	Yes	275	2	2	23	23	8	10	8	9	14	11	7	6
100	W. Fond du Lac Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	2	2	21	21	8	10	8	9	14	11	7	6
101	N. Sherman Boulevard and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	3	2	19	19	12	14	12	13	19	16	10	9
102	N. Sherman Boulevard and W. Fond du Lac Avenue .	City of Milwaukee	Proposed	Yes	- -	2	2	18	18	9	9	9	9	12	12	7	7
103	N. Sherman Boulevard and W. Burleigh Street . .	City of Milwaukee	Proposed	Yes	- -	2	2	17	17	9	9	9	9	12	12	7	7
104	N. Sherman Boulevard and W. Center Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	15	15	9	9	9	9	12	12	7	7
105	N. Sherman Boulevard and W. North Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	3	14	14	9	9	9	9	12	12	7	7
106	N. 40th Street and W. Lisbon Avenue.	City of Milwaukee	Proposed	Yes	- -	2	2	12	12	9	9	9	9	12	12	7	7
107	W. Highland Boulevard and W. McKinley Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	2	11	11	9	9	9	9	12	12	7	7
108	N. 41st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	1	9	9	9	9	9	9	12	12	7	7
109	S. Kinnickinnic Avenue and E. Becher Street . . .	City of Milwaukee	Proposed	Yes	- -	1	3	12	12	5	5	5	5	7	7	4	4
110	S. Bay Street and E. Lincoln Avenue.	City of Milwaukee	Proposed	Yes	225	1	1	14	14	5	5	5	5	7	7	4	4
111	S. Bay Street and E. Russell Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	16	16	5	5	5	5	7	7	4	4
112	S. Nevada Street and S. Kinnickinnic Avenue. .	City of Milwaukee	Proposed	Yes	- -	1	2	17	17	5	5	5	5	7	7	4	4
113	S. Brust Avenue and E. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	18	13	5	5	5	5	7	7	4	4
114	S. Ellen Street and E. Morgan Avenue.	City of Milwaukee	Proposed	- -	- -	1	1	19	19	5	5	5	5	7	7	4	4
115	S. Bombay Avenue and E. Crawford Avenue. . . .	City of St. Francis	Proposed	Yes	150	1	1	21	21	5	5	5	5	7	7	4	4
116	S. Kinnickinnic Avenue and Lunham Avenue . . .	City of St. Francis	Proposed	Yes	- -	1	1	23	23	5	5	5	5	7	7	4	4
117	S. Kinnickinnic Avenue and E. Layton Avenue . .	City of Cudahy	Proposed	Yes	- -	1	2	24	24	5	5	5	5	7	7	4	4
118	S. Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	400	1	1	26	26	5	5	5	5	7	7	4	4
119	Edgar Avenue and E. College Avenue	City of Cudahy	Proposed	Yes	- -	1	2	28	28	5	5	5	5	7	7	4	4
120	E. Rawson Avenue	City of South Milwaukee	Proposed	Yes	- -	1	1	30	30	5	5	5	5	7	7	4	4
121	Marquette Avenue	City of South Milwaukee	Proposed	Yes	- -	1	2	31	31	5	5	5	5	7	7	4	4
122	S. 9th Avenue and E. Drexel Avenue	City of South Milwaukee	Proposed	Yes	450	1	- -	33	33	5	5	5	5	7	7	4	4
123	Northridge Shopping Center.	City of Milwaukee	Proposed	Yes	150	1	5	39	42	4	4	4	4	5	5	3	3

Table 134 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (trains per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
124	N. 76th Street and W. Bradley Road	City of Milwaukee	Proposed	Yes	200	1	3	35	38	4	4	4	4	5	5	3	3
125	N. 76th Street and W. Good Hope Road	City of Milwaukee	Proposed	Yes	--	1	3	33	36	4	4	4	4	5	5	3	3
126	N. 60th Street and W. Mill Road	City of Milwaukee	Proposed	Yes	--	1	2	30	33	4	4	4	4	5	5	3	3
127	N. Sherman Boulevard and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	250	1	2	28	30	4	4	4	4	5	5	3	3
128	N. Sherman Boulevard and W. Villard Avenue	City of Milwaukee	Proposed	Yes	--	1	3	26	29	4	4	4	4	5	5	3	3
129	N. Sherman Boulevard and W. Hampton Avenue	City of Milwaukee	Proposed	Yes	--	1	2	25	27	4	4	4	4	5	5	3	3
130	N. Sherman Boulevard and W. Congress Street	City of Milwaukee	Proposed	Yes	--	1	1	23	26	4	4	4	4	5	5	3	3
131	S. 44th Street and W. National Avenue	Village of West Milwaukee	Proposed	Yes	--	1	2	15	17	4	4	4	4	5	5	3	3
132	S. 43rd Street and W. Greenfield Avenue	Village of West Milwaukee	Proposed	Yes	--	1	1	16	19	4	4	4	4	5	5	3	3
133	S. 43rd Street and W. Burnham Street	Village of West Milwaukee	Proposed	Yes	--	1	1	17	20	4	4	4	4	5	5	3	3
134	S. 43rd Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	400	1	1	19	21	4	4	4	4	5	5	3	3
135	S. 43rd Street and W. Cleveland Avenue	City of Milwaukee	Proposed	Yes	--	1	--	20	23	4	4	4	4	5	5	3	3
136	S. 43rd Street and W. Oklahoma Avenue	City of Milwaukee	Proposed	Yes	--	1	3	22	24	4	4	4	4	5	5	3	3
137	S. 43rd Street and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	--	1	2	23	25	4	4	4	4	5	5	3	3
138	S. 43rd Street and W. Howard Avenue	City of Greenfield	Proposed	Yes	250	1	1	24	27	4	4	4	4	5	5	3	3
139	S. 60th Street and W. Plainfield Avenue	City of Greenfield	Proposed	--	--	1	1	27	30	4	4	4	4	5	5	3	3
140	W. Forest Home Avenue and W. Plainfield Avenue	City of Greenfield	Proposed	Yes	--	1	2	29	31	4	4	4	4	5	5	3	3
141	S. 76th Street and W. Layton Avenue	City of Greenfield	Proposed	Yes	--	1	5	32	34	4	4	4	4	5	5	3	3
142	N. 9th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	--	3	6	1	1	16	14	15	14	19	22	10	11
143	Southridge Shopping Center	Village of Greendale	Proposed	Yes	300	1	6	35	38	4	4	4	4	5	5	3	3
144	N. Glenview Avenue and W. Wisconsin Avenue	City of Wauwatosa	Proposed	Yes	--	1	4	18	18	5	3	4	3	4	7	2	3
145	Milwaukee County General Hospital	City of Wauwatosa	Proposed	--	--	1	5	22	22	5	3	4	3	4	7	2	3
146	County Institutions	City of Wauwatosa	Proposed	--	--	1	5	24	24	5	3	4	3	4	7	2	3
147	N. Swan Boulevard and W. Watertown Plank Road	City of Wauwatosa	Proposed	Yes	350	1	1	26	26	5	3	4	3	4	7	2	3
148	Mayfair Mall Shopping Center	City of Wauwatosa	Proposed	Yes	200	1	7	30	30	5	3	4	3	4	7	2	3
149	N. Mayfair Road and W. Center Street	City of Wauwatosa	Proposed	Yes	--	1	3	32	32	5	3	4	3	4	7	2	3
150	N. Mayfair Road and W. Burleigh Street	City of Wauwatosa	Proposed	Yes	--	1	2	34	34	5	3	4	3	4	7	2	3
151	N. Mayfair Road and W. Capitol Drive	City of Wauwatosa	Proposed	Yes	--	1	2	33	36	5	3	4	3	4	7	2	3
152	W. Lisbon Avenue and W. Capitol Drive	City of Milwaukee	Proposed	--	--	1	2	32	34	3	5	3	4	7	4	3	2
153	N. 92nd Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	--	1	2	30	33	3	5	3	4	7	4	3	2
154	N. 84th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	--	1	1	29	32	3	5	3	4	7	4	3	2
155	N. 76th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	--	1	3	28	30	3	5	3	4	7	4	3	2
156	N. 35th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	--	1	2	20	22	3	5	3	4	7	4	3	2
157	N. 27th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	--	1	2	19	21	3	5	3	4	7	4	3	2
158	W. Green Bay Avenue and W. Capitol Drive	City of Milwaukee	Proposed	Yes	--	1	2	19	22	3	5	3	4	7	4	3	2
159	N. Port Washington Road and W. Capitol Drive	City of Milwaukee	Proposed	Yes	--	1	2	20	23	3	5	3	4	7	4	3	2
160	N. Richards Street and E. Capitol Drive	City of Milwaukee	Proposed	Yes	--	1	2	22	25	3	5	3	4	7	4	3	2
161	N. Humboldt Boulevard and E. Capitol Drive	City of Milwaukee	Proposed	Yes	--	1	2	23	26	3	5	3	4	7	4	3	2
162	Morris Boulevard and E. Menlo Boulevard	Village of Shorewood	Proposed	Yes	--	1	1	26	26	3	5	3	4	7	4	3	2

Source: SEWRPC.

Table 135

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Base Plan	Maximum Extent Light Rail Transit Plan
Primary		
Exclusive Guideway Miles		
Subway	- -	- -
Elevated	- -	8.0
At-Grade	- -	94.3
Total	- -	102.3
Shared Guideway Miles		
Freeways	51.5	- -
Surface Arterial Streets	49.5	2.2
Total	101.0	104.5
Route Miles	449	253
Vehicle Miles	8,900	28,100
Vehicle Hours	460	1,410
Vehicles Required	78	182
Trains Required	- -	91
Express and Local		
Route Miles	1,302	1,660
Vehicle Miles	85,900	77,200
Vehicle Hours	6,520	5,710
Vehicles Required	823	634
Total System		
Route Miles	1,751	1,913
Vehicle Miles	94,800	105,300
Vehicle Hours	6,980	7,120
Vehicles Required	901	816
Trains Required	- -	91

Source: SEWRPC.

vice bus miles operated, however, would decrease by 10 percent from the number anticipated in the base plan, from 85,900 to 77,200 miles on an average weekday. The express and local transit services would be provided by conventional buses.

A self-service, barrier-free method of fare collection would be used under the light rail transit system alternative. The transit stations would have no turnstyles or other barriers, and in general no fare payments would be made upon boarding the light rail vehicle. Rather, each passenger would purchase a ticket from self-service vending machines located at each station prior to boarding the vehicle and would be required to validate the ticket at one of two validating machines provided in each vehicle. To ensure fare payment, inspectors empowered to issue citations would check that all passengers have valid tickets or passes on a random basis. Under the self-service fare collection proposed by this alternative, 5 percent of all passengers are to be inspected each weekday. Consequently, every passenger on the light rail system would be checked for fare payment an average of once every 20 days. No loss of revenue is assumed under this fare collection system as the fine for fare evasion would be set to cover at least the average fare which should be paid in a 20-day period—about 20 times the base fare, or $12, with increases for repeat offenders.

Use of self-service fare collection during all travel periods under this plan would have a modest but important impact on systemwide operating and capital costs. Importantly, because no operator would be required in the second vehicle of a two-car train, the operating and maintenance costs per vehicle mile for two-car trains would be about 10 percent less than the $3.41 per-vehicle-mile cost for a one-car train with typical fare collection—$3.10 per vehicle mile, including the cost of ticket inspectors.[9] However, there are some increased

[9] *The adjustments in average per-vehicle-mile cost of operating light rail vehicles under self-service fare collection reflect the anticipated reduction in operator requirements on two-car trains, as well as the added costs attributable to inspection on both one- and two-car trains. The operating costs of vehicles without an operator in two-car trains are reduced equal to the portion of the cost directly attributable to the driver. This cost has been estimated to be the proportion of Milwaukee County Transit System bus-per-mile operation and maintenance cost attributable to drivers after adjusting for a 50 percent increase in the average speed of a light rail system over that of the local bus system. This reduction is estimated to be about $0.68 per vehicle mile in 1979 dollars, or 20 percent of the total light rail operating cost. The additional costs per vehicle mile imposed by ticket inspectors on one- and two-car trains are estimated to total 5 percent of this operator cost of $0.68 per vehicle mile, or $0.03 per vehicle mile, based on the assumed inspection rate of 5 percent of all passengers.*

Table 136

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	253	253	253	253	253
Vehicle Miles	7,300	7,200	10,000	3,600	28,100
Vehicle Hours	370	360	500	180	1,410
Vehicles Required	134	66	182	48	182
Trains Required	67	66	91	48	91
Express and Local					
Route Miles.	1,660	1,586	1,660	1,558	1,660
Vehicle Miles	16,600	23,600	20,300	16,700	77,200
Vehicle Hours	1,240	1,720	1,540	1,210	5,710
Vehicles Required	534	280	634	177	634
Total System					
Route Miles.	1,913	1,839	1,913	1,811	1,913
Vehicle Miles	23,900	30,800	30,300	20,300	105,300
Vehicle Hours	1,610	2,080	2,040	1,390	7,120
Vehicles Required	668	346	816	225	816
Trains Required	67	66	91	48	91

Source: SEWRPC.

operating and maintenance costs entailed under the self-service fare collection system attributable to inspection on one-vehicle trains, increasing the per-vehicle-mile cost by $0.03 to $3.44 per vehicle mile. There would also be additional operating and maintenance costs attributable to the ticket vending machines and validators of $63,000 and $120,000 per year, respectively.[10] In addition, the ticket validators—two of which would be located in each vehicle—would increase the capital cost of light rail vehicles by $6,500, from $800,000 per vehicle to $806,500 per vehicle. Ticket vending machines, one of which is to be located at each station and two or more of which are to be located at major stations, would increase the capital cost of each station by an average of $80,000. It should be noted that the capital costs attributable to vending machines and ticket validators include replacement, as necessary, over the design period.

Transit Utilization: Under the maximum extent light rail system plan and the moderate growth scenario-centralized land use plan alternative future, about 358,000 trips may be expected to be made by public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 137 and 138. About 160,000, or 45 percent, of these transit trips may be expected to utilize the primary transit system for all or a portion of the trip. Thus, the maximum extent light rail transit system plan envisions that about 8 percent of the total of 4.4 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that about 4 percent will be made using primary transit. About 31,000, or 10 percent, more transit trips may be expected to be made under this plan than under the base plan.

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[10] *It is estimated that implementation of a self-service fare collection system would increase the total capital investment of the light rail transit system by about $18 million, or 2 percent over the 20-year design period. Based upon an annual operating cost savings of $1.3 million, the capital investment required would be recovered in about 14 years.*

Table 137

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

	Base Plan			Maximum Extent Light Rail Transit Plan		
		Transit Trips			Transit Trips	
Trip Purpose	Total Person Trips[a]	Number	Percent of Total Trips	Total Person Trips[a]	Number	Percent of Total Trips
Home-Based Work	1,112,900	102,100	9.2	1,108,300	116,000	10.5
Home-Based Shopping . .	512,400	39,000	7.6	510,900	43,800	8.6
Home-Based Other	1,502,200	116,900	7.8	1,494,500	131,000	8.8
Nonhome-Based.	837,100	17,500	2.1	831,800	15,700	1.9
School	465,300	51,300	11.0	465,300	51,300	11.0
Total	4,429,900	326,800	7.4	4,410,800	357,800	8.1

[a] *The difference in the total person trips generated under the maximum extent light rail transit plan and the total person trips generated under the base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been found to be correlated with increased automobile ownership, and greater automobile ownership has been found to be correlated with increased trip generation. The Commission travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation rates between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.*

Source: SEWRPC.

Table 138

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

	Base Plan				Maximum Extent Light Rail Transit Plan			
	Primary Element		Total System		Primary Element		Total System	
Time of Day	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	6,800	45.3	70,200	21.5	39,000	24.4	76,200	21.3
Midday	100	0.7	112,800	34.5	45,100	28.3	124,100	34.7
Afternoon . .	8,100	54.0	111,400	34.1	60,900	38.2	121,900	34.1
Evening. . . .	- -	- -	32,400	9.9	14,500	9.1	35,600	9.9
Total	15,000	100.0	326,800	100.0	159,500	100.0	357,800	100.0

Source: SEWRPC.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent light rail transit system plan and the base system plan are summarized in Table 139. The costs shown include all construction and right-of-way acquisition costs, plus the cost of acquiring and replacing vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 139.

The total capital cost of the base plan is estimated at $233 million. Most of this cost would be required to purchase buses for the proposed

Table 139

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Light Rail Transit Plan
Guideway Development[b]	$ --	$ 792,348,000
Station Development[c]	2,893,700	61,644,900
Vehicle Storage and Maintenance Facility Development[c]	24,775,000	71,740,000
Vehicle Acquisition and Replacement[d]	205,660,000	316,276,000
Total	$233,328,700	$1,242,008,900

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent light rail transit plan would be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 to 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and therefore are capable of use beyond the design period.*

[b] *Includes the cost of acquiring about 203 acres of right-of-way for guideway construction, and of acquiring and relocating five residential structures and three steel lattice electric power transmission towers. This land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—12 acres under the base plan and 91 acres under the maximum extent light rail transit plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses and light rail vehicles used in the system. Both plans assume a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years. Light rail vehicles have an estimated useful life of 30 years.*

Source: SEWRPC.

short-range service expansion within Milwaukee County and to replace buses to maintain the existing service to the year 2000. About $22 million, or 10 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent light rail transit plan is estimated at $1.2 billion. About $792 million would be required for the construction of the light rail guideway, including right-of-way, trackage, electrification, signalization, and system control. About $316 million would be incurred in the purchase of new and replacement of transit vehicles—$162 million of which would be for the purchase of 200 articulated light rail vehicles and about $154 million of which would be for the purchase of 1,102 conventional buses. The remaining $134 million would be incurred for the construction of park-ride stations, including the purchase of self-service ticket vending machines and the construction of light rail storage, maintenance, and layover facilities, and the expansion of bus storage and maintenance facilities. About $1 billion, or over 80 percent of the total capital cost of the plan, would be attributable to its primary transit element.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent light rail transit plan would approximate $250 million. The remaining $990 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal and the federal shares are estimated to total $47 million and $186 million, respectively.

Table 140 presents the estimated design year operating and maintenance costs and farebox revenues of the base and maximum extent light rail transit plans. Under the base plan, operating and main-

Table 140

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Light Rail Transit Plan
Ridership		
Primary Element.	3,825,000	40,672,000
Total System.	94,250,000	98,180,000
Operating and Maintenance Cost		
Primary Element.	$ 4,305,500	$ 23,170,900
Total System.	60,313,100	74,215,500
Operating and Maintenance Cost per Passenger		
Primary Element.	$1.12	$0.57
Systemwide Average	0.63	0.76
Operating and Maintenance Cost per Passenger Mile		
Primary Element.	$0.12	$0.09
Total System.	0.15	0.15
Farebox Revenue		
Primary Element.	$ 2,423,200	$ 20,948,300
Total System.	37,114,800	43,890,200
Operating Deficit		
Primary Element.	$ 1,882,300	$ 2,222,600
Total System.	23,198,300	30,325,300
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element.	56	90
Total System.	62	59
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 941,150	$ 1,111,300
Total System	11,599,150	15,162,650
State (72 percent of nonfederal share of operating deficit)		
Primary Element	677,628	800,100
Total System	8,351,388	10,917,100
Local		
Primary Element	263,522	311,200
Total System	3,247,762	4,245,540
Local Operating Deficit per Ride		
Primary Element.	$0.07	$0.01
Total System.	0.03	0.04

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, about equal to the $11.6 million required to provide 50 percent federal funding of the operating deficits under the base plan, but less than the $15.2 million required under the maximum extent light rail plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

tenance costs may be expected to approximate $60 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent light rail transit plan would increase the total operating and maintenance costs for the Milwaukee area in the year 2000 by $14 million to a total cost of about $74 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $4.3 million under the base plan, and $23.2 million under the maximum extent light rail transit plan. Primary transit system operating and maintenance costs would thus represent about 7 percent of the total operating costs expected in the design year for the base plan, and about 32 percent of the total operating costs expected in the design year for the maximum extent light rail transit plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.63. For the maximum extent light rail transit plan, the average operating cost per passenger may be expected to approach $0.76—$0.13, or 20 percent, more than the base plan cost. The average operating cost per passenger mile would be $0.15 for both the base plan and the maximum extent light rail transit plan. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.12 and $0.12, respectively, and for the primary transit element of the maximum extent light rail plan would be $0.57 and $0.09, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $37 million, expressed in 1979 dollars, compared with about $44 million under the maximum extent light rail transit plan. Under the maximum extent light rail transit alternative, the primary transit element would be expected to generate about 48 percent, or about $21 million, of the total revenues compared with 7 percent, or $2.4 million, for the base plan. Under both the base and maximum extent light rail transit plans, the current fares are assumed to increase with general price inflation. The fare under both plans would thus remain at $0.50 per ride, expressed in constant 1979 dollars, for local and express bus service. Similarly, the primary service fare would remain at $0.60 within Milwaukee County, and outside Milwaukee County would range from $1.00 to a maximum of $1.60 at the outer limits of the future urbanized area under the maximum extent light rail plan routes.

The operating deficit in the year 2000 for the maximum extent light rail transit plan would be about $30 million, expressed in 1979 dollars, requiring a subsidy of about $0.31 per passenger. This compares with the base system plan deficit of about $23 million, or $0.25 per passenger. Farebox revenues would cover about 59 percent of the operating costs under the maximum extent light rail plan, and 62 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has in the past funded up to 72 percent of the nonfederal share.[11] The local share of the public funding requirement of the maximum extent light rail transit plan would be about $4.2 million in the plan design year, and the local funding requirement for the base system would be somewhat less, about $3.2 million.

Development of Truncated Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent light rail transit system plan are summarized in Table 141. The maximum extent light rail transit plan has a significantly higher total capital cost and capital cost per passenger, as well as a greater operating deficit, than does the base plan over the 20-year plan design period. The proportion of operating costs expected to be met by farebox revenues is about the same for the base plan and the maximum extent light rail transit plan.

Some of the increases in costs and attendant cost-effectiveness levels of the maximum extent light rail transit plan can be attributed to the overextension of service envisioned in this plan.

Table 141

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Light Rail Transit Plan
Ridership		
In Design Year	94,250,000	98,180,000
To Design Year	1,485,900,000	1,522,385,000
Capital Cost		
Total to Design Year	$ 233,328,700	$1,242,008,900
To Design Year per Passenger	0.16	0.82
To Design Year After Accounting for Useful Life Beyond Design Year	148,842,000	634,960,000
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.42
Operating Cost		
Percent Met by Farebox Revenues in Design Year	62	59
Operating Deficit in Design Year	$ 23,198,300	$ 30,325,300
Operating Deficit per Passenger in Design Year	0.25	0.31
Operating Deficit to Design Year	430,900,000	485,570,000
Operating Deficit to Design Year per Passenger	0.29	0.32
Total Cost		
To Design Year	$ 664,228,700	$1,727,578,900
Federal Share	402,112,960	1,236,392,100
Nonfederal Share	262,115,740	491,186,800
To Design Year per Passenger	0.45	1.14
Federal Share	0.27	0.87
Nonfederal Share	0.18	0.37
To Design Year After Accounting for Useful Life Beyond Design Year	579,742,000	1,120,530,000
Federal Share	334,523,600	750,753,000
Nonfederal Share	245,218,400	369,777,000
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.39	0.74
Federal Share	0.22	0.50
Nonfederal Share	0.16	0.24

Source: SEWRPC.

Under the plan, primary transit service on exclusive guideway would be extended into portions of the Milwaukee area not now served. Nevertheless, the cost-effectiveness of the transit service provided may be expected to be quite similar for the weekday morning, midday, and afternoon periods, and the service provided during the evening period would be only somewhat less cost-effective than that provided throughout the remainder of the day.

The cost-effectiveness of the less productive elements of the maximum extent light rail primary transit system can, in part, be identified on a route-by-route basis through determination of what proportion of the operating costs of the

[11] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, about equal to the $11.6 million required to provide 50 percent federal funding of the operating deficits under the base plan, but substantially less than the $22.9 million required to provide such funding under the maximum extent light rail transit plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the State share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Table 142

OPERATING COST-EFFECTIVENESS OF LIGHT RAIL ROUTES OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicle Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
1—Waukesha/Milwaukee CBD/UWM	193,820	$15,890	6,311	$20,810	76
2—Cedarburg/Grafton/Milwaukee CBD/Oak Creek	266,800	21,870	7,741	25,540	86
3—Menomonee Falls/Milwaukee CBD/South Milwaukee	256,070	20,990	6,178	20,410	103
4—Crosstown: Northridge/Southridge	152,540	12,500	3,546	11,950	105
5—Loop: Capitol Drive/UWM/Wisconsin Avenue/ Mayfair Mall Shopping Center	133,020	10,900	4,365	14,520	75
Total	1,002,250	$82,150	28,141	$93,230	88

Source: SEWRPC.

routes may be expected to be recovered through farebox revenues. As shown in Table 142, all routes meet more than 75 percent of their operating costs with farebox revenues, and thus should require little modification except possibly over some limited segments.

Another basis for the identification of the less productive elements of the maximum extent light rail transit system plan is the operating and capital costs per passenger and passenger mile carried on segments of the system. Table 143 summarizes the capital and operating costs, and passenger volumes and passenger miles carried, for the major segments of the maximum extent light rail transit system, and provides a ranking of the segments in terms of operating cost per passenger mile and capital cost per passenger mile. Map 62 identifies the major segments of the primary transit element of the plan. Maps 63 and 64 show those segments which may be expected to have higher-than-average operating costs and capital costs per passenger mile, respectively, as well as the degree to which such average costs are exceeded. In any consideration of this cost-effectiveness information, it is important to recognize that the outer ends of each route can carry no through traffic, except through connection with a different mode such as a feeder/ distributor bus.

Comparison of the cost-effectiveness of segments of a system can also be made in terms of passenger boardings and deboardings. Table 143 also presents passenger boarding and deboarding volumes by segment and a rank ordering of the segments in terms of operating and capital costs per boarding and deboarding passenger. Maps 65 and 66 show those segments which may be expected to have above average operating and capital costs, respectively, per boarding and deboarding passenger, as well as the degree to which average costs are exceeded.

Based on this cost-effectiveness information, the maximum extent light rail system plan for this alternative future was truncated. The truncations were made with the objective of reducing system capital cost and operating deficits and bringing the total cost per passenger for a light rail system plan under this future closer to that of the base plan, while retaining an integrated system. The proposed truncated light rail system plan under the moderate growth scenario-centralized land use plan alterna-

Table 143

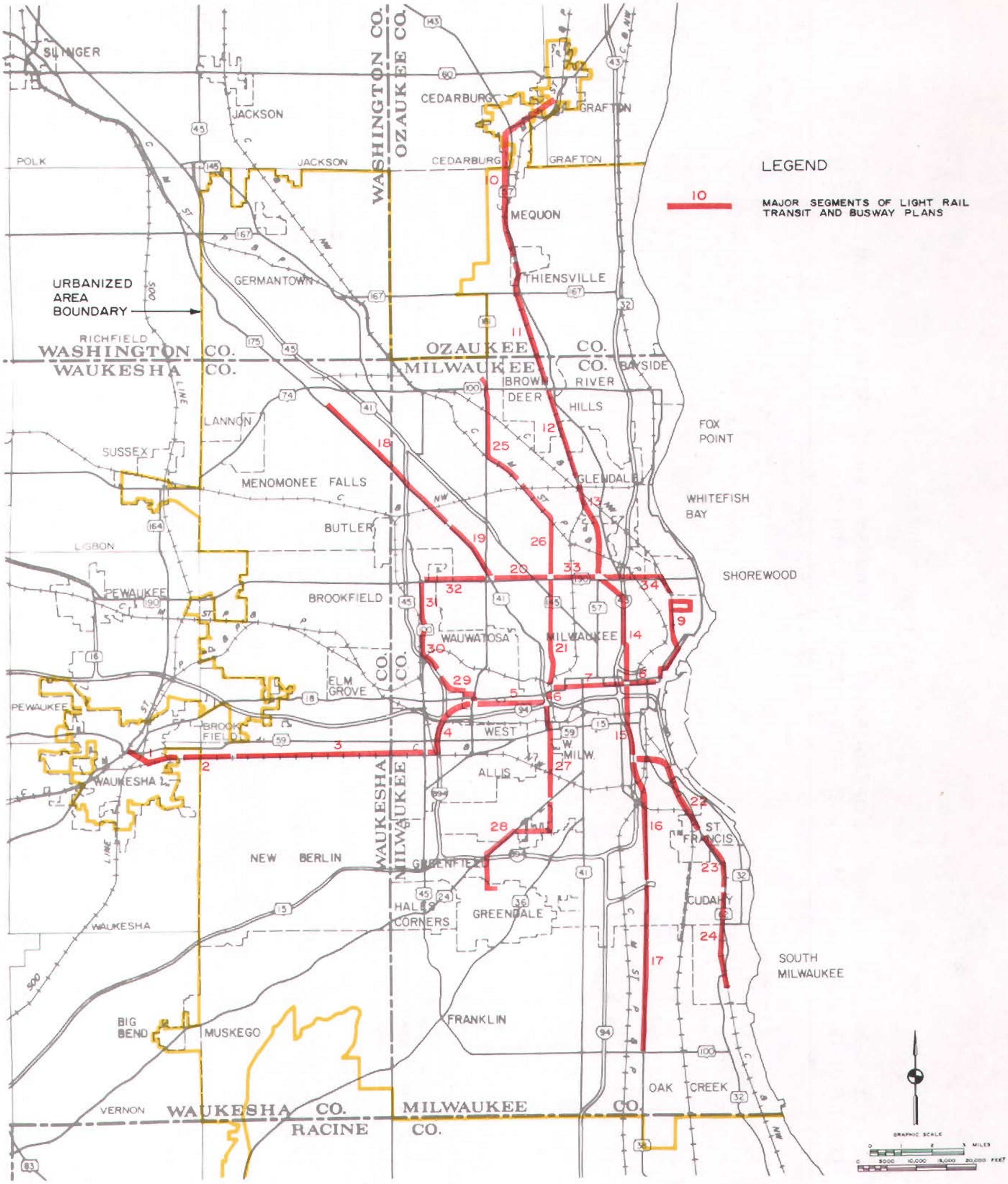
COST-EFFECTIVENESS ANALYSIS OF SEGMENTS OF THE PRIMARY ELEMENT OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Segment Number	Route Number	Transit Ridership				Average Weekday Operating Cost in Design Year	Total Capital Cost Over Design Period	Average Weekday Operating Cost-Effectiveness in Design Year				Total Capital Cost-Effectiveness Over the Design Period			
		Average Weekday Passenger Volume		Total Boarding and Deboarding Passengers	Passenger Miles			Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank
		Range	Average												
1	1	3,440- 4,770	4,070	6,010	7,330	$1,640	$13,705,600	$0.22	31	$0.27	14	$1,870	25	$ 2,280	11
2	1	5,600- 5,750	5,680	2,170	22,730	3,530	30,643,300	0.16	26	1.63	34	1,348	18	14,121	33
3	1	6,600- 7,040	6,790	2,910	27,160	3,560	30,305,100	0.13	22	1.22	32	1,116	15	10,414	32
4	1	9,870-10,980	10,432	5,570	23,990	2,060	31,678,400	0.09	16	0.37	24	1,320	17	5,687	23
5	1 and 5	14,990-19,920	18,830	10,400	45,200	3,540	41,463,100	0.08	12	0.34	18	917	13	3,987	14
6	1 and 5	34,800-34,800	34,800	17,880	20,880	1,230	11,838,400	0.06	3	0.07	2	567	6	662	3
7	1 and 5	34,800-45,680	41,400	81,720	102,840	5,510	45,917,000	0.05	1	0.07	2	446	4	562	2
8	1 and 5	19,050-31,130	26,760	20,740	18,730	1,060	7,147,600	0.06	3	0.05	1	382	2	345	1
9	1 and 5	7,410-16,370	8,580	27,930	42,050	7,310	82,104,900	0.17	27	0.26	13	1,953	27	2,940	12
10	2	2,020- 3,860	3,080	3,210	20,620	5,180	46,436,700	0.25	32	1.61	33	2,252	30	14,466	34
11	2	4,390- 6,180	5,430	4,070	22,810	3,250	29,460,900	0.14	23	0.80	30	1,292	16	7,239	28
12	2	7,140- 8,270	7,630	2,740	24,420	2,480	22,224,200	0.10	18	0.91	31	910	12	8,111	31
13	2	9,350-10,080	9,340	4,310	29,880	2,480	24,772,400	0.08	12	0.58	28	829	11	5,748	24
14	2	9,870-17,650	14,620	26,460	57,000	3,160	34,915,800	0.06	3	0.12	4	613	8	1,320	5
15	2 and 3	27,720-29,040	28,490	19,150	71,220	3,930	27,037,600	0.06	3	0.21	9	380	1	1,412	6
16	2	9,700-14,550	12,500	15,860	47,500	3,020	30,464,700	0.06	3	0.19	7	641	9	1,921	10
17	2	1,890-6,780	4,060	7,280	21,530	4,090	40,687,700	0.19	28	0.56	27	1,890	26	5,589	21
18	3	1,410- 4,940	3,890	5,620	18,700	3,730	39,724,700	0.20	29	0.66	29	2,124	28	7,068	27
19	3	7,880-10,220	9,400	9,350	21,630	1,800	16,252,700	0.08	12	0.19	7	751	10	1,738	8
20	3 and 5	15,300-16,450	15,890	7,860	27,020	2,300	15,075,400	0.09	16	0.29	15	558	5	1,918	9
21	3 and 4	21,600-26,280	23,900	38,300	93,220	5,360	41,564,500	0.06	3	0.14	6	446	3	1,085	4
22	3	11,990-14,810	13,180	7,190	40,870	2,470	58,089,500	0.06	3	0.34	18	1,421	20	8,079	30
23	3	10,020-11,620	10,570	8,230	26,430	1,960	38,687,500	0.08	12	0.24	11	1,463	21	4,701	18
24	3	1,990- 6,790	5,410	6,660	16,230	2,330	48,463,900	0.15	25	0.35	22	2,986	32	7,277	29
25	4	3,840- 5,670	4,770	7,050	18,590	2,320	39,709,500	0.12	20	0.33	17	2,136	29	5,633	22
26	4	6,320-11,320	8,790	9,450	29,010	2,000	40,581,000	0.07	11	0.21	9	1,399	19	4,294	15
27	4	9,720-14,470	11,880	13,710	34,450	1,780	20,564,500	0.05	1	0.13	5	597	7	1,500	7
28	4	3,600- 7,450	5,150	8,430	26,270	3,060	44,678,400	0.12	20	0.36	23	1,701	22	5,300	19
29	5	2,780- 3,150	3,030	3,400	5,760	1,140	15,882,600	0.20	29	0.34	18	2,757	31	4,671	17
30	5	2,000- 2,000	2,000	3,630	3,000	870	15,721,200	0.29	34	0.24	11	5,240	34	4,331	16
31	5	1,640- 2,810	2,310	1,980	4,160	1,050	13,960,400	0.25	32	0.53	26	3,356	33	7,051	26
32	5	3,000- 5,230	4,340	4,260	9,540	1,320	16,866,700	0.14	23	0.31	16	1,768	24	3,959	13
33	5	8,970- 9,790	9,370	2,290	14,050	880	13,480,200	0.06	3	0.38	25	959	14	5,887	25
34	5	4,040- 6,530	5,510	5,410	17,090	1,830	29,341,400	0.11	19	0.34	18	1,717	23	5,424	20

Source: SEWRPC.

Map 62

MAJOR SEGMENTS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT (AND BUSWAY) SYSTEM PLAN

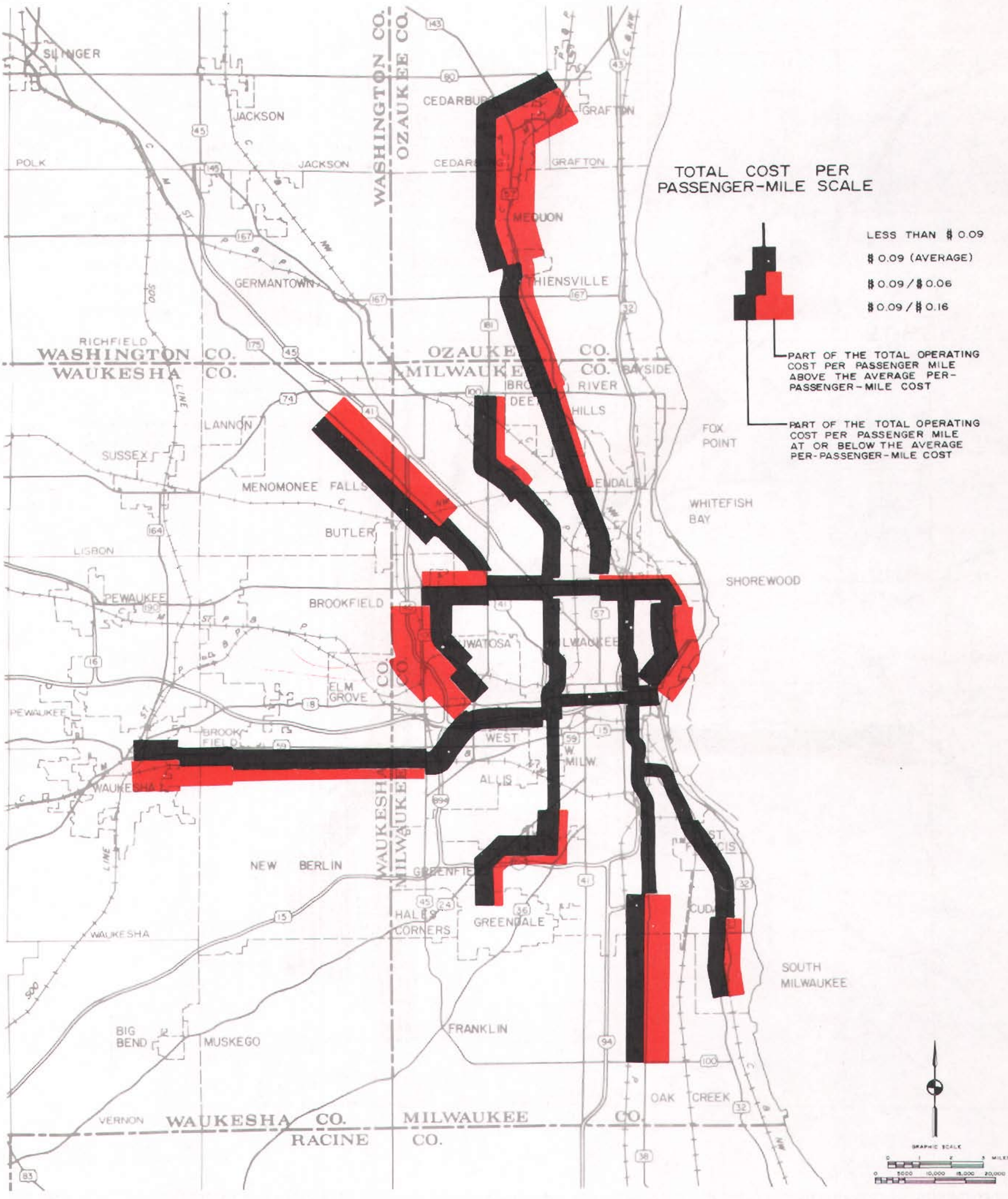


The productivity of different portions of the maximum extent light rail system plan can be more readily evaluated through an analysis of major system segments. This map identifies those major segments of the maximum extent light rail system which were evaluated in greater depth in terms of certain measures of cost-effectiveness. The 34 segments evaluated were delineated on the basis of the probable location of major primary transit stations in the Milwaukee area so that the possible deletion of any segment would provide a logical terminus for the remaining portions of each of the routes.

Source: SEWRPC.

Map 63

OPERATING COST PER PASSENGER MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

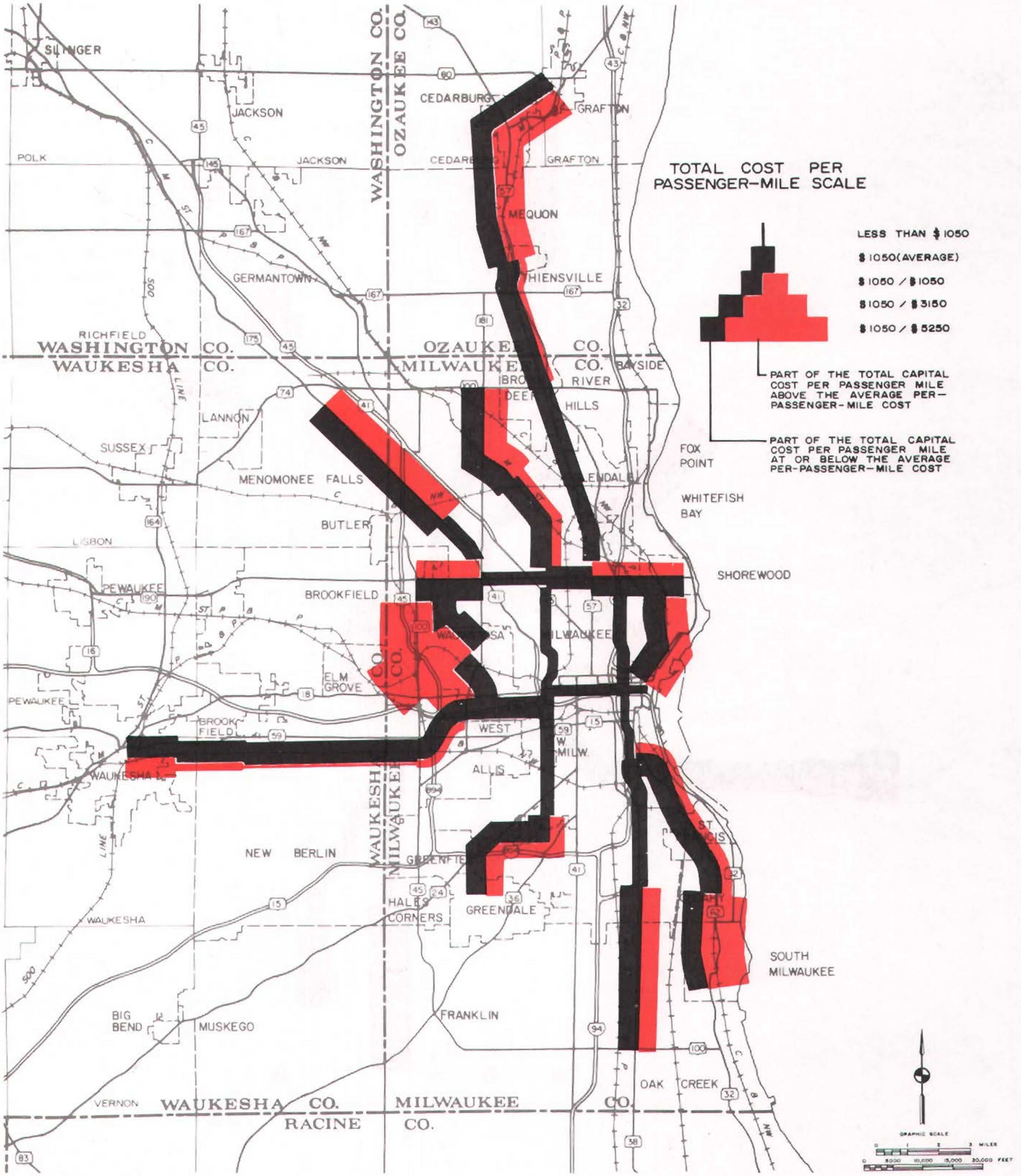


One measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the operating cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average cost per passenger mile, as well as the degree to which such average costs are exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, the outer segments of each route, as well as portions of Route 5 on the City of Milwaukee's east side and in the City of Wauwatosa, suggest an insufficient ridership base to support fixed guideway development, as compared with the remaining system segments. This lower ridership is a consequence of the less intensive urban development in these segments, and the absence of through traffic except by connection with a different mode such as feeder bus or automobile.

Source: SEWRPC.

Map 64

CAPITAL COST PER PASSENGER MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

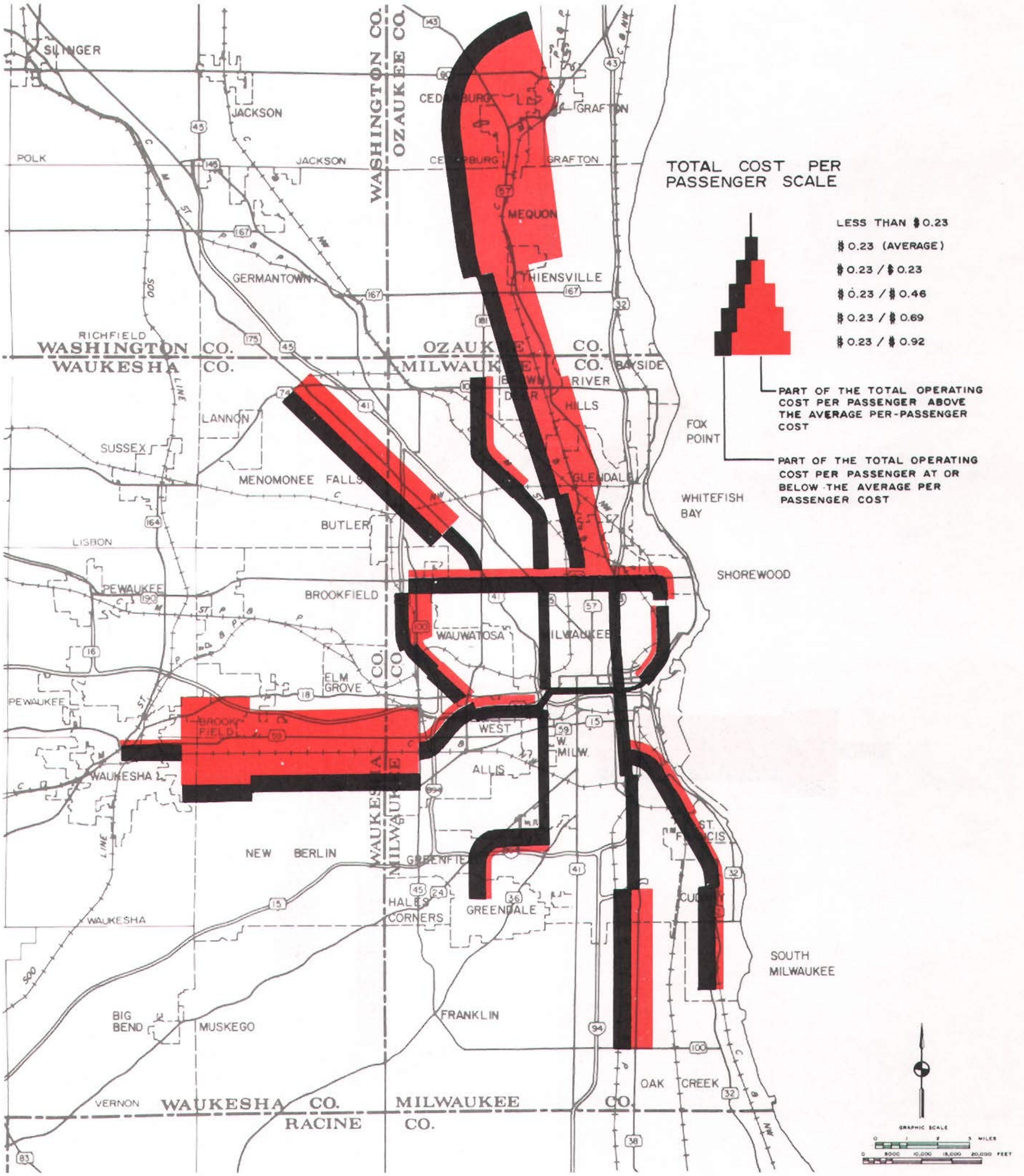


Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the capital cost per passenger mile. This map shows those segments which may be expected to be at, below, or above the average capital cost per passenger mile, as well as the degree to which such average costs are exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, the outer segments of each route, as well as portions of Route 5 on the City of Milwaukee's east side and in the City of Wauwatosa, suggest an insufficient ridership base to support fixed guideway development as compared with the remaining system segments. This lower ridership is a consequence of the less intensive urban development in these segments, and the absence of through traffic except by a connection with a different mode such as feeder bus or automobile. To some degree, these inefficiencies are also generated by the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee' east side.

Source: SEWRPC.

Map 65

OPERATING COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

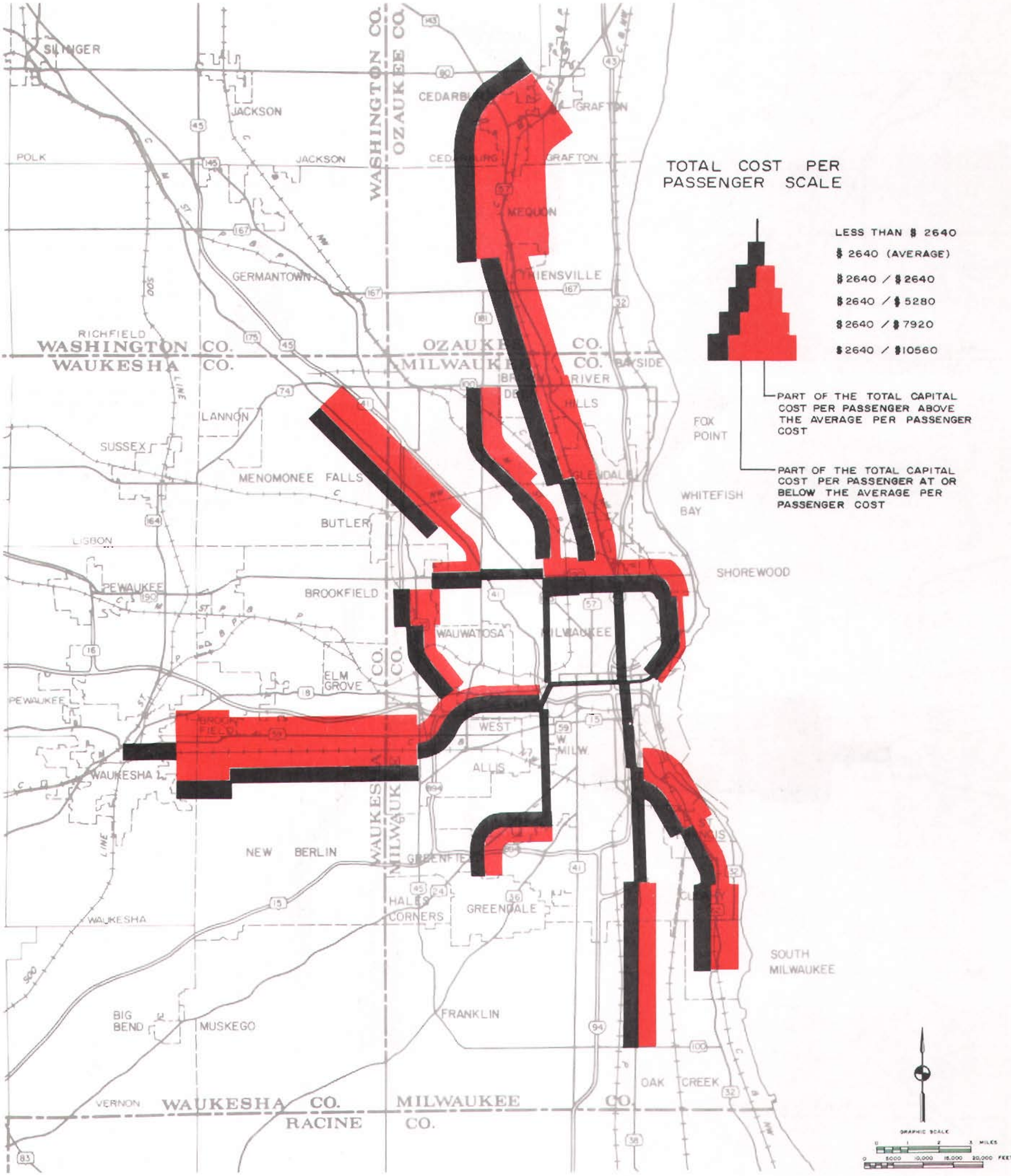


Yet another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the operating cost per boarding and deboarding passenger. This map shows those segments which may be expected to be at, below, or above the average operating cost per boarding and deboarding passenger, as well as the degree to which such average costs are exceeded. As shown on this map, certain system segments within densely developed portions of Milwaukee County are very cost-effective, compared with the remainder of the system, while all segments located within suburban areas outside Milwaukee County are not cost-effective. This is a result of the lower boarding and deboarding passenger volumes in these suburban areas combined with the lengthy distances that the light rail vehicles must operate over.

Source: SEWRPC.

Map 66

CAPITAL COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

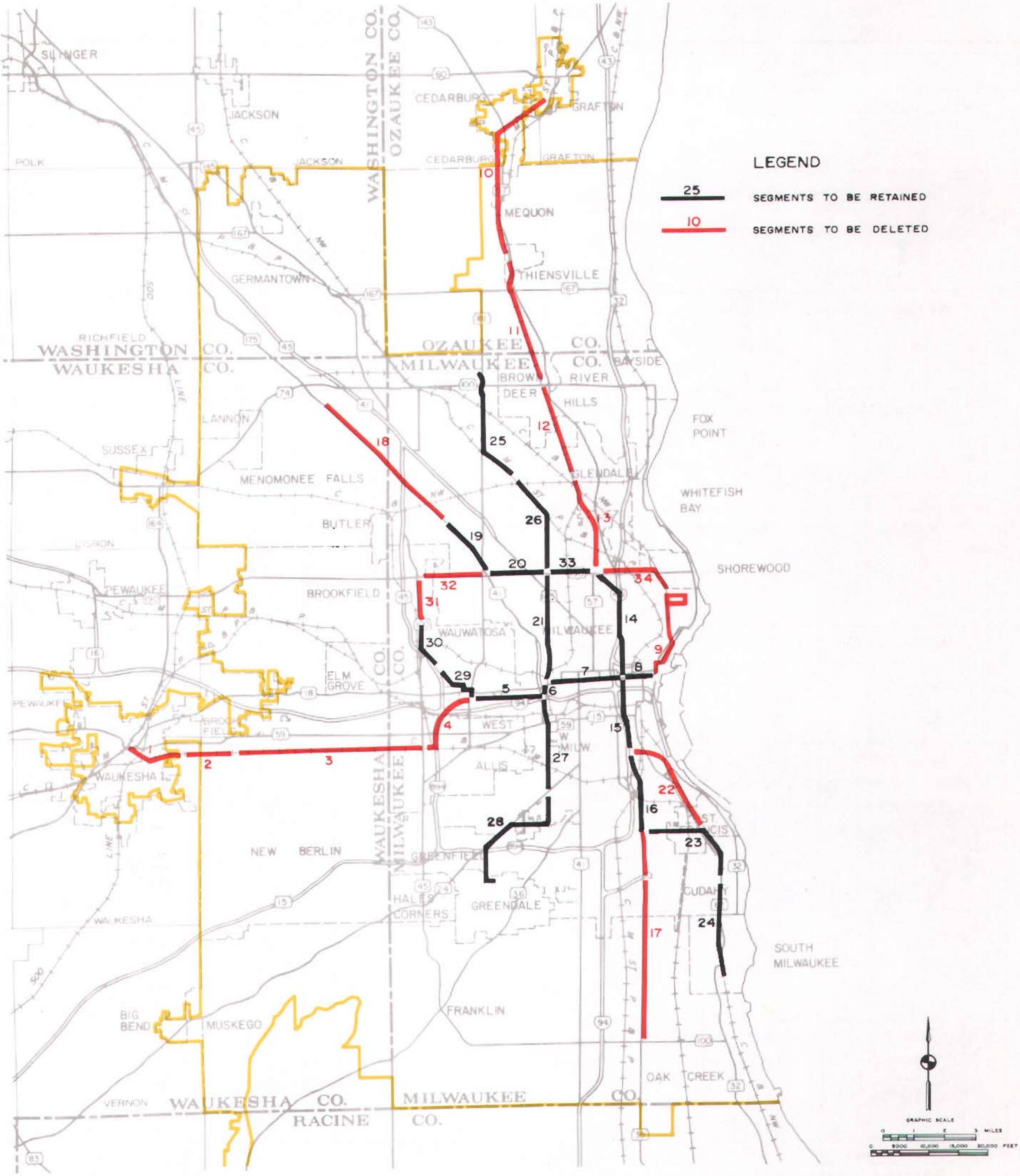


Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan is the capital cost per boarding and deboarding passenger. This map shows those segments which may be expected to be at, below, or above the average capital cost per boarding and deboarding passenger, as well as the degree to which such average costs are exceeded. As shown on this map, certain segments within the densely developed portions of Milwaukee County are very cost-effective compared with the remainder of the system. However, those segments located in Milwaukee County suburbs as well as outside Milwaukee County appear to have an insufficient volume of passenger boardings and deboardings to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development combined with the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee's east side. A noteworthy exception is the segment within the City of Waukesha which, by itself, appears cost-effective, but which nevertheless depends upon a connection to the remainder of the system over two lengthy suburban segments which generate little ridership.

Source: SEWRPC.

Map 67

RECOMMENDED TRUNCATED LIGHT RAIL TRANSIT (AND BUSWAY) SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



This map shows the truncated light rail transit system plan, the result of certain modifications being made in the maximum extent light rail transit system plan. Such modifications included the deletion of 16 segments which were judged to contribute, in their entirety, insufficient operating revenues and ridership to the system in comparison with the operating expenses and capital investment necessary to construct and support those segments. In addition, portions of two other segments were deleted and a new segment was added to provide a more cost-effective alignment between the City of Milwaukee's south side and the suburban communities of Cudahy and South Milwaukee. These modifications were made with the objective of reducing capital cost requirements and operating deficits while bringing the total cost per passenger for a light rail transit system plan under this future closer to that of the base plan, while retaining an integrated primary transit system which serves a large part of the Milwaukee area.

Source: SEWRPC.

Table 144

RECOMMENDED CHANGES IN THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Recommended Change	Reasons
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segment 1	The deletion of Segments 2 and 3 would not logically permit retention of Segment 1
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segments 2 and 3	Segments 2 and 3 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segment 4	Segments 29 and 30 are more cost-effective compared with Segment 4 and provide for a more logical end-of-route
2—Cedarburg/Milwaukee CBD/Oak Creek	Eliminate Segments 10, 11, 12, and 13	Segments 10 through 13 are not capital or operating cost-effective relative to other segments. Also, total boarding and deboardings are low compared with those of other segments
2—Cedarburg/Milwaukee CBD/Oak Creek	Eliminate Segment 17	Segment 17 is not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
3—Menomonee Falls/Milwaukee/ South Milwaukee	Eliminate Segment 18	Segment 18 is not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
3—Menomonee Falls/Milwaukee CBD/ South Milwaukee and Cedarburg/ Milwaukee CBD/Oak Creek	Eliminate Segment 22 and parts of 16 and 23. Add connector segment between Segments 16 and 23	Segments 17 and 22 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments. Portions of Segments 16 and 23 would be deleted for the same reasons. The remainder of Segment 23, which is cost-effective and has significant boardings and deboardings, would be connected to the remainder of the truncated network via the Lakeside Belt Line right-of-way
5—Loop: UWM/Mayfair Mall Shopping Center/ Milwaukee CBD	Eliminate Segments 31, 32, and 34	Segments 31, 32, and 34 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
5—Loop: UWM/Mayfair Mall Shopping Center/ Milwaukee CBD	Eliminate Segment 9	Segment 9 is not capital cost-effective relative to other segments. Service to UWM would be provided by shuttle service from nearby primary transit stations

Source: SEWRPC.

tive future is shown on Map 67. The changes made in the maximum extent plan to produce the truncated plan are summarized in Table 144.

The segments deleted were the less operating and capital cost-effective—that is, segments which, if deleted, would result in relatively large reductions in system capital costs and operating deficits and relatively small reductions in system ridership. These segments include those extending to the communities of Cedarburg and Grafton from Capitol Drive in the City of Milwaukee, those extending to the Village of Menomonee Falls from Silver Spring Drive and 92nd Street in the City of Milwaukee, those extending to the Cities of West Allis and Waukesha from N. 84th Street and W. Fairview Avenue in the City of Milwaukee, those extending to the City of Oak Creek from General Mitchell Field, those looping from the intersection of Appleton Avenue and Capitol Drive to the Mayfair Mall Shopping Center, and the segment from the Milwaukee central business district through the University of Wisconsin-Milwaukee to Capitol Drive and along Capitol Drive to Atkinson Avenue in the City of Milwaukee. The latter segment was deleted because of its high capital cost. The segment from 5th and Becher Streets to the City of St. Francis on the route connecting to the Cities of Cudahy and South Milwaukee was replaced for this same reason by a segment from 5th and Becher Streets along Chase Avenue to the former Milwaukee Electric Lines Lakeside Belt Line, and then along that open right-of-way owned by the Wisconsin Electric Power Company and used for trunkline power transmission to the original routing from 5th and Becher Streets through the City of St. Francis to the Cities of Cudahy and South Milwaukee. Through the elimination of these segments, the capital cost of the primary element of the light rail transit system would decrease from about $1,069 million to about $582 million, and the total cost of the truncated plan would be about $755 million.

Those segments given the higher priority for elimination were Segments 10, 11, 12, and 13 serving northern Milwaukee County and Ozaukee County, and Segments 1, 2, 3, and 18 serving Waukesha County. Segments 31 and 32, providing service along Capitol Drive between Appleton Avenue and Mayfair Road, and Segment 4 providing service to West Allis, were identified as the second set of segments to be deleted. The third set of segments identified to be deleted were those serving General Mitchell Field and the City of Oak Creek, including portions of both Segments 16 and 22 and all of Segment 17. Segments 9 and 34 serving the University of Wisconsin-Milwaukee campus and the lower east side were the final two segments identified for deletion.

Evaluation of Maximum
Extent Busway System Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is buses operating over busways. The maximum extent system plan developed for this technology is shown on Map 60, and summarized with respect to its coverage, stations, routes, and operation in Tables 145 through 147. The maximum extent busway system plan would provide a significant improvement in and expansion of primary transit service in the Milwaukee area. Under this plan, primary transit service would be improved within Milwaukee County, and would be extended outside Milwaukee County within the future limits of the Milwaukee urbanized area. A fleet of 247 high-capacity articulated buses would be used to provide this service. All bus-on-busway service under the maximum extent plan would be provided throughout the day, including midday and evening time periods, and would be operated at headways of from three to eight minutes during peak periods and from 10 to 20 minutes during the midday period, and from 20 to 30 minutes during the evening. In total, five busway routes totaling 253 miles in length and using 162 primary transit stops or stations would be operated under the maximum extent plan. This compares with the 11 bus-on-freeway routes which operated in 1980 during peak periods only between 19 outlying primary transit stations and the Milwaukee central business district. The five busway routes would be operated using high-capacity, articulated, diesel motor buses.

The five routes provided under the maximum extent busway system plan would be the same as those provided under the maximum extent light rail transit system plan and shown on Map 61. Route 1 would extend from the City of Waukesha to the University of Wisconsin-Milwaukee, passing through the Milwaukee central business district. Route 2 would extend in a generally north-south direction from the Village of Grafton to the City of Oak Creek through the Milwaukee central business district, also serving the Villages of Thiensville and Brown Deer, as well as the Cities of Mequon and Glendale. Route 3 would extend in a generally

Table 145

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (buses per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	W. Broadway and W. Main Street.	City of Waukesha	Proposed	Yes	- -	1	10	53	53	15	15	6	6	20	20	3	3
2	E. Broadway and Pleasant Street.	City of Waukesha	Proposed	Yes	- -	1	1	51	51	15	15	6	6	20	20	3	3
3	Lincoln Avenue and Lake Street.	City of Waukesha	Proposed	Yes	- -	1	- -	50	50	15	15	6	6	20	20	3	3
4	Lincoln Avenue and Frederick Street	City of Waukesha	Proposed	Yes	- -	1	1	48	48	15	15	6	6	20	20	3	3
5	CTH A and Pearl Street . .	City of Waukesha	Proposed	Yes	500	1	- -	44	44	15	15	6	6	20	20	3	3
6	Johnson Road.	City of New Berlin	Proposed	- -	125	1	- -	41	41	15	15	6	6	20	20	3	3
7	Calhoun Road and Rogers Drive	City of New Berlin	Proposed	Yes	450	1	- -	37	37	15	15	6	6	20	20	3	3
8	Moorland Road and Rogers Drive	City of New Berlin	Proposed	Yes	- -	1	2	35	35	15	15	6	6	20	20	3	3
9	Sunny Slope Road and Honey Lane	City of New Berlin	Proposed	- -	- -	1	- -	33	33	15	15	6	6	20	20	3	3
10	S. 124th Street and Honey Lane	City of New Berlin	Proposed	- -	- -	1	- -	31	31	15	15	6	6	20	20	3	3
11	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	- -	1	5	28	28	15	15	6	6	20	20	3	3
12	S. 98th Street and W. Washington Street . . .	City of West Allis	Proposed	Yes	- -	1	2	26	26	15	15	6	6	20	20	3	3
13	N. 92nd Street and W. Dixon Street	City of Milwaukee	Proposed	Yes	150	1	- -	23	23	15	15	6	6	20	20	3	3
14	N. 84th Street and W. Hawthorne Avenue . .	City of Milwaukee	Proposed	Yes	- -	2	2	20	20	27	23	10	9	30	38	4	5
15	N. 76th Street and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	19	19	27	23	10	9	30	38	4	5
16	N. 68th Street and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	17	17	27	23	10	9	30	38	4	5
17	N. Hawley Road and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	15	15	27	23	10	9	30	38	4	5
18	County Stadium and Mitchell Boulevard	City of Milwaukee	Proposed	Yes	275	2	- -	14	14	27	23	10	9	30	38	4	5
19	County Stadium and N. 44th Street	City of Milwaukee	Proposed	Yes	225	3	- -	12	12	37	33	14	13	42	50	6	7
20	N. 35th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	8	8	38	34	15	14	45	53	7	8
21	N. 27th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	4	7	7	38	34	15	14	45	53	7	8
22	N. 21st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	5	5	38	34	15	14	45	53	7	8
23	N. 16th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	5	3	3	38	34	15	14	45	53	7	8
24	N. 12th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	6	2	2	38	34	15	14	45	53	7	8
25	N. 6th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	4	7	- -	0	50	46	21	20	63	71	10	11
26	N. Plankinton Avenue and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	10	2	2	23	27	9	10	38	30	5	4
27	N. Broadway Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	8	3	3	23	27	9	10	38	30	5	4
28	N. Jackson Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	7	4	4	23	27	9	10	38	30	5	4
29	N. Jackson Street and E. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	1	6	6	23	- -	9	- -	38	- -	5	- -
30	N. Van Buren Street and E. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	1	6	6	- -	27	- -	10	- -	30	- -	4
31	N. Jackson Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	7	7	23	- -	9	- -	38	- -	5	- -
32	N. Van Buren Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	7	7	- -	27	- -	10	- -	30	- -	4
33	N. Astor Street and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	23	27	9	10	38	30	5	4
34	N. Farwell Avenue and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	9	9	23	27	9	10	38	30	5	4
35	N. Farwell Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	2	11	11	23	- -	9	- -	38	- -	5	- -
36	N. Prospect Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	1	11	11	- -	27	- -	10	- -	30	- -	4
37	N. Farwell Avenue and E. Kenilworth Place. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	12	12	23	27	9	10	38	30	5	4
38	N. Oakland Avenue and E. North Avenue.	City of Milwaukee	Proposed	Yes	- -	2	3	13	13	23	27	9	10	38	30	5	4
39	N. Cambridge Avenue and E. Locust Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	16	16	23	27	9	10	38	30	5	4
40	N. Oakland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	Yes	- -	2	1	24	24	23	27	9	10	38	30	5	4
41	N. Maryland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	Yes	- -	2	6	23	23	23	27	9	10	38	30	5	4
42	N. Maryland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	- -	2	4	19	19	23	27	9	10	38	30	5	4

Table 145 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
43	N. Oakland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	18	18	23	27	9	10	38	30	5	4
44	Wisconsin Avenue and Broad Street	Village of Grafton	Proposed	Yes	- -	1	1	59	59	12	12	6	6	18	18	3	3
45	1st Avenue and Maple Street	Village of Grafton	Proposed	Yes	425	1	- -	57	57	12	12	6	6	18	18	3	3
46	Cedar Ridge Drive and Georgetown Drive	City of Cedarburg	Proposed	Yes	- -	1	1	54	54	12	12	6	6	18	18	3	3
47	STH 143 (Washington Avenue) and Turner Street	City of Cedarburg	Proposed	- -	- -	1	1	53	53	12	12	6	6	18	18	3	3
48	Grant Avenue and Western Road	City of Cedarburg	Proposed	- -	- -	1	1	52	52	12	12	6	6	18	18	3	3
49	STH 57 and CTH C (Pioneer Road).	City of Mequon	Proposed	Yes	350	1	- -	48	48	12	12	6	6	18	18	3	3
50	STH 57 (Main Street) and Freistadt Road	Village of Thiensville	Proposed	Yes	- -	1	1	42	42	12	12	6	6	18	18	3	3
51	STH 57 (Green Bay Road) and STH 67 (Mequon Road)	City of Mequon	Proposed	Yes	225	1	- -	40	40	12	12	6	6	18	18	3	3
52	Garden Drive and W. County Line Road. . .	Village of Brown Deer	Proposed	Yes	- -	1	- -	36	36	12	12	6	6	18	18	3	3
53	N. Deerbrook Terrace and STH 100 (W. Brown Deer Road) . .	Village of Brown Deer	Proposed	Yes	- -	1	1	34	34	12	12	6	6	18	18	3	3
54	N. Cedarburg Road and W. Bradley Road.	Village of Brown Deer	Proposed	Yes	- -	1	1	32	32	12	12	6	6	18	18	3	3
55	N. Teutonia Avenue and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	- -	1	2	29	29	12	12	6	6	18	18	3	3
56	N. Sidney Place and W. Mill Road	City of Glendale	Proposed	Yes	250	1	1	27	27	12	12	6	6	18	18	3	3
57	N. Dexter Avenue and W. Silver Spring Drive. . .	City of Glendale	Proposed	Yes	- -	1	1	25	25	12	12	6	6	18	18	3	3
58	N. 20th Street and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	21	21	12	12	6	6	18	18	3	3
59	W. Atkinson Avenue and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	1	16	16	20	24	9	10	36	28	5	4
60	N. 16th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	1	13	13	12	12	6	6	18	18	3	3
61	N. 8th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	10	10	- -	12	- -	6	- -	18	- -	3
62	N. 8th Street and W. Burleigh Street	City of Milwaukee	Proposed	Yes	- -	1	2	9	9	12	- -	6	- -	18	- -	3	- -
63	N. 7th Street and W. Burleigh Street	City of Milwaukee	Proposed	Yes	- -	1	2	9	9	- -	12	- -	6	- -	18	- -	3
64	N. 8th Street and W. Center Street	City of Milwaukee	Proposed	Yes	- -	1	2	7	7	12	- -	6	- -	18	- -	3	- -
65	N. 7th Street and W. Center Street	City of Milwaukee	Proposed	Yes	- -	1	2	7	7	- -	12	- -	6	- -	18	- -	3
66	N. 8th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	6	6	12	- -	6	- -	18	- -	3	- -
67	N. 7th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	6	6	- -	12	- -	6	- -	18	- -	3
68	N. 6th Street and W. Walnut Street.	City of Milwaukee	Proposed	Yes	- -	1	2	4	4	12	12	6	6	18	18	3	3
69	N. 6th Street and W. Juneau Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	3	3	12	12	6	6	18	18	3	3
70	N. 6th Street and W. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	2	1	1	12	12	6	6	18	18	3	3
71	N. 6th Street and W. St. Paul Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	2	2	23	23	11	11	33	33	6	6
72	S. 6th Street and W. Alexander Street. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	5	5	23	23	11	11	33	33	6	6
73	S. 6th Street and W. National Avenue	City of Milwaukee	Proposed	Yes	- -	2	4	6	6	- -	23	- -	11	- -	33	- -	6
74	S. 5th Street and W. National Avenue	City of Milwaukee	Proposed	Yes	- -	2	4	6	6	- -	23	- -	11	- -	33	- -	6
75	S. 5th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	- -	23	- -	11	- -	33	- -	6
76	S. 4th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	23	- -	11	- -	33	- -	6	- -
77	S. 5th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	- -	2	3	10	10	- -	23	- -	11	- -	33	- -	6
78	S. 4th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	- -	1	3	10	1	23	- -	11	- -	33	- -	6	- -
79	S. 5th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	12	12	- -	12	- -	6	- -	18	- -	3
80	S. 4th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	12	12	12	- -	6	- -	18	- -	3	- -
81	S. Chase Avenue and W. Rosedale Avenue. . . .	City of Milwaukee	Proposed	Yes	425	1	- -	14	14	12	12	6	6	18	18	3	3
82	S. Chase Avenue and W. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	15	15	12	12	6	6	18	18	3	3

Table 145 (continued)

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (buses per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning		Midday		Afternoon		Evening	
										In	Out	In	Out	In	Out	In	Out
83	S. Howell Avenue and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	17	17	12	12	6	6	18	18	3	3
84	S. Howell Avenue and W. Howard Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	18	18	12	12	6	6	18	18	3	3
85	S. Howell Avenue and W. Layton Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	21	21	12	12	6	6	18	18	3	3
86	General Mitchell Field . . .	City of Milwaukee	Proposed	Yes	175	1	2	23	23	12	12	6	6	18	18	3	3
87	S. Howell Avenue and W. College Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	26	26	12	12	6	6	18	18	3	3
88	S. Howell Avenue and W. Marquette Avenue . . .	City of Oak Creek	Proposed	Yes	- -	1	2	33	33	12	12	6	6	18	18	3	3
89	S. Howell Avenue and W. Forest Hill Avenue. . .	City of Oak Creek	Proposed	Yes	- -	1	2	38	38	12	12	6	6	18	18	3	3
90	S. Howell Avenue and W. Ryan Road	City of Oak Creek	Proposed	Yes	425	1	1	44	44	12	12	6	6	18	18	3	3
91	STH 175 (Appleton Avenue) and Menomonee Avenue. . . .	Village of Menomonee Falls	Proposed	Yes	- -	1	2	50	50	11	11	5	5	15	15	3	3
92	STH 175 (Appleton Avenue) and North Hills Drive	Village of Menomonee Falls	Proposed	Yes	400	1	1	47	47	11	11	5	5	15	15	3	3
93	STH 175 (Appleton Avenue) and Parkway Drive	Village of Menomonee Falls	Proposed	Yes	- -	1	- -	40	40	11	11	5	5	15	15	3	3
94	USH 41 (W. Appleton Avenue) and W. Bobolink Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	37	37	11	11	5	5	15	15	3	3
95	Timmerman Field.	City of Milwaukee	Proposed	Yes	425	1	2	34	34	11	11	5	5	15	15	3	3
96	USH 41 (W. Appleton Avenue) and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	32	32	11	11	5	5	15	15	3	3
97	N. 76th Street and W. Appleton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	30	30	11	11	5	5	15	15	3	3
98	N. 68th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	2	1	26	26	19	23	8	9	33	25	5	4
99	Capitol Court Shopping Center.	City of Milwaukee	Proposed	Yes	250	2	2	25	25	19	23	8	9	33	25	5	4
100	W. Fond du Lac Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	2	2	23	23	19	23	8	9	33	25	5	4
101	N. Sherman Boulevard and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	3	2	21	21	29	33	12	13	45	37	7	6
102	N. Sherman Boulevard and W. Fond du Lac Avenue .	City of Milwaukee	Proposed	Yes	- -	2	2	20	20	21	21	9	9	27	27	5	5
103	N. Sherman Boulevard and W. Burleigh Street . .	City of Milwaukee	Proposed	Yes	- -	2	2	18	18	21	21	9	9	27	27	5	5
104	N. Sherman Boulevard and W. Center Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	17	17	21	21	9	9	27	27	5	5
105	N. Sherman Boulevard and W. North Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	3	16	16	21	21	9	9	27	27	5	5
106	N. 40th Street and W. Lisbon Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	14	14	21	21	9	9	27	27	5	5
107	W. Highland Boulevard and W. McKinley Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	2	12	12	21	21	9	9	27	27	5	5
108	N. 41st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	1	10	10	21	21	9	9	27	27	5	5
109	S. Kinnickinnic Avenue and E. Becher Street . . .	City of Milwaukee	Proposed	Yes	- -	1	3	13	13	11	11	5	5	15	15	3	3
110	S. Bay Street and E. Lincoln Avenue.	City of Milwaukee	Proposed	Yes	250	1	1	15	15	11	11	5	5	15	15	3	3
111	S. Bay Street and E. Russell Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	18	18	11	11	5	5	15	15	3	3
112	S. Nevada Street and S. Kinnickinnic Avenue. .	City of Milwaukee	Proposed	Yes	- -	1	2	19	19	11	11	5	5	15	15	3	3
113	S. Brust Avenue and E. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	20	20	11	11	5	5	15	15	3	3
114	S. Ellen Street and E. Morgan Avenue.	City of Milwaukee	Proposed	- -	- -	1	1	22	22	11	11	5	5	15	15	3	3
115	S. Bombay Avenue and E. Crawford Avenue. . . .	City of St. Francis	Proposed	Yes	100	1	1	24	24	11	11	5	5	15	15	3	3
116	S. Kinnickinnic Avenue and Lunham Avenue . . .	City of St. Francis	Proposed	Yes	- -	1	1	26	26	11	11	5	5	15	15	3	3
117	S. Kinnickinnic Avenue and E. Layton Avenue . .	City of Cudahy	Proposed	Yes	- -	1	2	28	28	11	11	5	5	15	15	3	3
118	S. Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	375	1	1	30	30	11	11	5	5	15	15	3	3
119	Edgar Avenue and E. College Avenue.	City of Cudahy	Proposed	Yes	- -	1	2	32	32	11	11	5	5	15	15	3	3
120	E. Rawson Avenue	City of South Milwaukee	Proposed	Yes	- -	1	1	34	34	11	11	5	5	15	15	3	3
121	Marquette Avenue	City of South Milwaukee	Proposed	Yes	- -	1	2	36	36	11	11	5	5	15	15	3	3
122	S. 9th Avenue and E. Drexel Avenue	City of South Milwaukee	Proposed	Yes	425	1	- -	37	37	11	11	5	5	15	15	3	3

Table 145 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
123	Northridge Shopping Center.	City of Milwaukee	Proposed	Yes	150	1	5	42	45	10	10	4	4	12	12	2	2
124	N. 76th Street and W. Bradley Road.	City of Milwaukee	Proposed	Yes	200	1	3	38	41	10	10	4	4	12	12	2	2
125	N. 76th Street and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	- -	1	3	36	38	10	10	4	4	12	12	2	2
126	N. 60th Street and W. Mill Road	City of Milwaukee	Proposed	Yes	- -	1	2	33	35	10	10	4	4	12	12	2	2
127	N. Sherman Boulevard and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	250	1	2	30	33	10	10	4	4	12	12	2	2
128	N. Sherman Boulevard and W. Villard Avenue . .	City of Milwaukee	Proposed	Yes	- -	1	3	28	31	10	10	4	4	12	12	2	2
129	N. Sherman Boulevard and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	27	29	10	10	4	4	12	12	2	2
130	N. Sherman Boulevard and W. Congress Street . .	City of Milwaukee	Proposed	Yes	- -	1	1	25	28	10	10	4	4	12	12	2	2
131	S. 44th Street and W. National Avenue	Village of West Milwaukee	Proposed	Yes	- -	1	2	16	19	10	10	4	4	12	12	2	2
132	S. 43rd Street and W. Greenfield Avenue. . .	Village of West Milwaukee	Proposed	Yes	- -	1	1	18	20	10	10	4	4	12	12	2	2
133	S. 43rd Street and W. Burnham Street	Village of West Milwaukee	Proposed	Yes	- -	1	1	19	22	10	10	4	4	12	12	2	2
134	S. 43rd Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	375	1	1	21	23	10	10	4	4	12	12	2	2
135	S. 43rd Street and W. Cleveland Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	- -	23	25	10	10	4	4	12	12	2	2
136	S. 43rd Street and W. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	25	27	10	10	4	4	12	12	2	2
137	S. 43rd Street and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	27	29	10	10	4	4	12	12	2	2
138	S. 43rd Street and W. Howard Avenue	City of Greenfield	Proposed	Yes	225	1	1	28	30	10	10	4	4	12	12	2	2
139	S. 60th Street and W. Plainfield Avenue . . .	City of Greenfield	Proposed	- -	- -	1	1	31	34	10	10	4	4	12	12	2	2
140	W. Forest Home Avenue and W. Plainfield Avenue	City of Greenfield	Proposed	Yes	- -	1	2	33	35	10	10	4	4	12	12	2	2
141	S. 76th Street and W. Layton Avenue.	City of Greenfield	Proposed	Yes	- -	1	5	36	39	10	10	4	4	12	12	2	2
142	N. 9th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	6	1	1	38	34	15	14	45	53	7	8
143	Southridge Shopping Center.	Village of Greendale	Proposed	Yes	275	1	6	40	42	10	10	4	4	12	12	2	2
144	N. Glenview Avenue and W. Wisconsin Avenue . . .	City of Wauwatosa	Proposed	Yes	- -	1	4	23	23	12	8	4	3	10	18	1	2
145	Milwaukee County General Hospital.	City of Wauwatosa	Proposed	- -	- -	1	5	26	26	12	8	4	3	10	18	1	8
146	County Institutions.	City of Wauwatosa	Proposed	- -	- -	1	5	27	27	12	8	4	3	10	18	1	8
147	N. Swan Boulevard and W. Watertown Plank Road.	City of Wauwatosa	Proposed	Yes	300	1	1	29	29	12	8	4	3	10	18	1	2
148	Mayfair Mall Shopping Center.	City of Wauwatosa	Proposed	Yes	200	1	7	33	33	12	8	4	3	10	18	1	2
149	N. Mayfair Road and W. Center Street.	City of Wauwatosa	Proposed	Yes	- -	1	3	35	35	12	8	4	3	10	18	1	2
150	N. Mayfair Road and W. Burleigh Street.	City of Wauwatosa	Proposed	Yes	- -	1	2	37	37	12	8	4	3	10	18	1	2
151	N. Mayfair Road and W. Capitol Drive.	City of Wauwatosa	Proposed	Yes	- -	1	2	35	38	12	8	4	3	10	18	1	2
152	W. Lisbon Avenue and W. Capitol Drive.	City of Milwaukee	Proposed	- -	- -	1	2	34	36	8	12	3	4	18	10	2	1
153	N. 92nd Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	32	35	8	12	3	4	18	10	2	1
154	N. 84th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	1	31	33	8	12	3	4	18	10	2	1
155	N. 76th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	3	29	32	8	12	3	4	18	10	2	1
156	N. 35th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	21	24	8	12	3	4	18	10	2	1
157	N. 27th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	20	22	8	12	3	4	18	10	2	1
158	W. Green Bay Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	1	2	20	23	8	12	3	4	18	10	2	1
159	N. Port Washington Road and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	1	2	21	24	8	12	3	4	18	10	2	1
160	N. Richards Street and E. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	2	23	25	8	12	3	4	18	10	2	1
161	N. Humboldt Boulevard and E. Capitol Drive. . . .	City of Milwaukee	Proposed	Yes	- -	1	2	24	27	8	12	3	4	18	10	2	1
162	Morris Boulevard and E. Menlo Boulevard	Village of Shorewood	Proposed	Yes	- -	1	1	26	29	8	12	3	4	18	10	2	1

Source: SEWRPC.

Table 146

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Base Plan	Maximum Extent Busway Plan
Primary		
Exclusive Guideway Miles		
Subway	--	--
Elevated	--	8.0
At-Grade	--	94.3
Total	--	102.3
Shared Guideway Miles		
Freeways	51.5	--
Surface Arterial Streets	49.5	2.2
Total	101.0	104.5
Route Miles	449	253
Vehicle Miles	8,900	31,000
Vehicle Hours	460	1,680
Vehicles Required	78	224
Trains Required	--	--
Express and Local		
Route Miles	1,302	1,660
Vehicle Miles	85,900	80,900
Vehicle Hours	6,520	5,920
Vehicles Required	823	656
Total System		
Route Miles	1,751	1,913
Vehicle Miles	94,800	111,900
Vehicle Hours	6,980	7,600
Vehicles Required	901	880
Trains Required	--	--

Source: SEWRPC.

northwesterly-southeasterly direction from the Village of Menomonee Falls through the central business district of Milwaukee and the Cities of St. Francis and Cudahy, terminating in the City of South Milwaukee. Route 4 would extend in a generally north-south direction along a crosstown alignment. The terminals of Route 4 would be located at the Northridge and Southridge Shopping Centers, and the route would serve the Villages of Greendale and West Milwaukee and the City of Greenfield in addition to the City of Milwaukee. Route 5 would operate in a loop primarily serving the most intensively developed areas of the City of Milwaukee, as well as the City of Wauwatosa, the University of Wisconsin-Milwaukee campus area, and the central business district of the City of Milwaukee. The total dual guideway mileage and the right-of-way requirements of this maximum extent system plan would be the same as those of the light rail transit plan. In addition, the location, spacing, and design of stations or stops would be the same as under the maximum extent light rail transit plan. Average speeds on the five routes would be about 18.5 miles per hour, somewhat less than under the light rail transit plan. Headways, however, would be somewhat shorter than under the light rail transit plan. During the peak periods, each articulated bus would be permitted to carry a maximum of 67 seated passengers and up to 40 standees. During off-peak periods, each vehicle would be permitted to carry 67 seated passengers.

The maximum extent busway system plan also envisions complementary expansion and improvement of the Milwaukee area local and express transit system elements. Local transit service, as under the maximum extent plans for all other potential primary transit technologies, would be extended into all contiguous areas of urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County. Also, local transit service would be expanded in the off-peak travel periods, particularly in the evening. Express transit service under this busway plan would be provided over five routes, all of which are designed to complement the busway primary transit system element, and all of which are the same as those provided under the light rail plan. In total, the number of express and local service route miles operated would increase by 27 percent over the number anticipated in the base plan, from 1,302 to 1,660. The number of bus miles of express and local service operated, however, would decrease by about 6 percent from the number envisioned in the base plan, from 85,900 to 80,900 bus miles on an average weekday. The express and local transit services would be provided by conventional buses.

Transit Utilization: Under the maximum extent busway system plan and the moderate growth scenario-centralized land use plan alternative future, about 353,500 trips may be expected to be made by public transit in the Milwaukee area on an average weekday in the plan design year, as shown in

Table 147

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	253	253	253	253	253
Vehicle Miles	8,900	7,600	11,900	2,600	31,000
Vehicle Hours	520	400	630	130	1,680
Vehicles Required	166	71	224	36	224
Express and Local					
Route Miles.	1,660	1,586	1,660	1,558	1,660
Vehicle Miles	17,400	24,800	21,100	17,600	80,900
Vehicle Hours	1,310	1,770	1,610	1,230	5,920
Vehicles Required	556	288	656	180	656
Total System					
Route Miles.	1,913	1,839	1,913	1,811	1,913
Vehicle Miles	26,300	32,400	33,000	20,200	111,900
Vehicle Hours	1,830	2,170	2,240	1,360	7,600
Vehicles Required	722	359	880	216	880

Source: SEWRPC.

Tables 148 and 149. About 138,700, or 39 percent, of these transit trips may be expected to utilize the primary transit system for all or a portion of the trip. Thus, the maximum extent busway system plan envisions that about 8 percent of the total of 4.4 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that about 3 percent will be made using primary transit. About 26,700, or 8 percent, more transit trips may be expected to be made on an average weekday under this plan than under the base plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent busway system plan and the base system plan are summarized in Table 150. The costs shown include all construction costs, plus the cost of right-of-way acquisition and the acquisition and replacement of vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 150.

The total capital cost of the base plan is estimated at $233 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain the existing service to the year 2000. About $22 million, or 10 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent busway system plan is estimated at $771 million. About $466 million would be required for the construction of the busways, including right-of-way, guideways, and preferential intersection treatments. About $234 million would be incurred in the purchase of new and replacement of existing transit vehicles—$74 million of which would be for the purchase of 309 articulated buses, and about $160 million of which would be for the purchase of 1,139 conventional buses. The remaining $71 million would be required to construct stations and storage, maintenance, and layover facilities. About $599 million, or about 78 percent of the total capital cost, would be attributable to the primary transit element of the plan.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent busway plan can be expected

Table 148

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Maximum Extent Busway Plan		
	Total Person Trips[a]	Transit Trips: Number	Transit Trips: Percent of Total Trips	Total Person Trips[a]	Transit Trips: Number	Transit Trips: Percent of Total Trips
Home-Based Work	1,112,900	102,100	9.2	1,109,200	114,000	10.3
Home-Based Shopping . .	512,400	39,000	7.6	511,200	43,300	8.5
Home-Based Other	1,502,200	116,900	7.8	1,496,000	129,000	8.6
Nonhome-Based.	837,100	17,500	2.1	832,500	15,900	1.9
School	465,300	51,300	11.0	465,400	51,300	11.0
Total	4,429,900	326,800	7.4	4,414,200	353,500	8.0

[a] *The difference in the total person trips generated under the maximum extent busway system plan and the total trips generated under the base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been found to be correlated with increased automobile ownership, and greater automobile ownership has been found to be correlated with increased trip generation. The Commission travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.*

Source: SEWRPC.

Table 149

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Time of Day	Base Plan				Maximum Extent Busway Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	6,800	45.3	70,200	21.5	35,300	25.4	75,500	21.3
Midday	100	0.7	112,800	34.5	36,900	26.6	122,200	34.6
Afternoon . .	8,100	54.0	111,400	34.1	54,300	39.2	119,900	33.9
Evening. . . .	- -	- -	32,400	9.9	12,200	8.8	35,900	10.2
Total	15,000	100.0	326,800	100.0	138,700	100.0	353,500	100.0

Source: SEWRPC.

to approximate $154 million. The remaining $617 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal and the federal shares are estimated to total $47 million and $186 million, respectively.

Table 151 presents the design year operating and maintenance costs and farebox revenues for the base and maximum extent busway plans. Under the base plan, operating and maintenance costs may be expected to approximate $60 million in the design year for both primary transit and local and express bus service in the Milwaukee area.

Table 150

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Busway Plan
Guideway Development[b]	$ --	$466,547,800
Station Development[c]	2,893,700	44,284,000
Vehicle Storage and Maintenance Facility Development[c]	24,775,000	26,711,600
Vehicle Acquisition and Replacement[d]	205,660,000	233,618,800
Total	$233,328,700	$771,162,200

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent busway plan would be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 through 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and therefore are capable of use beyond the design period.*

[b] *Includes the cost of acquiring about 203 acres of right-of-way for guideway construction, and the cost of acquiring and relocating five residential structures and three steel lattice electric power transmission towers. This land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—12 acres under the base plan and 91 acres under the busway plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses used in the system. Both plans assume the availability of a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years.*

Source: SEWRPC.

Implementation of the maximum extent busway plan would increase the total operating and maintenance costs for the Milwaukee area in the year 2000 by $15 million, to a total cost of $75 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $4.3 million under the base plan, and $21.1 million under the maximum extent busway plan. Primary transit system operating and maintenance costs would thus represent about 7 percent of the total operating costs expected in the design year for the base plan, and about 28 percent of the total operating costs expected in the design year for the maximum extent busway plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.63. For the maximum extent busway system plan, the average operating cost per passenger may be expected to approximate $0.76, or 21 percent more than the base plan cost. The average operating cost per passenger mile would be $0.15 for both the base and maximum extent busway plans. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.12 and $0.12, respectively, and for the maximum extent busway plan $0.60 and $0.10, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $37 million, expressed in 1979 dollars, compared with about $43 million under the maximum extent busway plan. Under the maximum extent busway alternative, the primary transit element could be expected to generate about 42 percent, or about $18 million, of the total revenues, compared with 7 percent, or $2.4 million, for the base plan. Under both the base and maximum extent busway plans, current fares are assumed to increase with general price inflation. The fare under both plans would thus remain at $0.50 per ride, expressed in constant 1979 dollars, for local and express bus service. Similarly, the primary service fare would remain at $0.60 within

Table 151

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Busway Plan
Ridership		
Primary Element	3,825,000	35,368,000
Total System	94,250,000	97,660,000
Operating and Maintenance Cost		
Primary Element	$ 4,305,500	$ 21,070,700
Total System	60,313,100	74,561,800
Operating and Maintenance Cost per Passenger		
Primary Element	$1.12	$0.60
Systemwide Average	0.63	0.76
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.12	$0.10
Total System	0.15	0.15
Farebox Revenue		
Primary Element	$ 2,423,200	$ 18,176,400
Total System	37,114,800	43,183,100
Operating Deficit		
Primary Element	$ 1,882,300	$ 2,894,300
Total System	23,198,300	31,378,700
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	56	86
Total System	62	58
Public Funding Under Current Programs[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 941,150	$ 1,447,150
Total System	11,599,150	15,689,350
State (72 percent of nonfederal share of operating deficit)		
Primary Element	677,628	1,041,950
Total System	8,351,388	11,296,350
Local		
Primary Element	263,522	305,200
Total System	3,247,762	4,393,000
Local Operating Deficit per Ride		
Primary Element	$0.07	$0.01
Total System	0.03	0.04

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, about equal to the $11.6 million required to provide 50 percent federal funding of the operating deficits under the base plan, but substantially less than the $15.7 million required under the maximum extent busway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

Milwaukee County, and outside Milwaukee County would range from $1.00 to a maximum of $1.60 at the outer limits of the urbanized area.

The operating deficit in the year 2000 for the maximum extent busway plan would be about $31 million, expressed in 1979 dollars, requiring a subsidy of about $0.32 per passenger. This compares with the base system plan deficit of about $23 million, or $0.25 per passenger. Farebox revenues would cover about 58 percent of the operating costs under the maximum extent busway plan and 62 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has in the past funded up to 72 percent of the nonfederal share.[12] The annual local share of the public funding requirement in the design year 2000 would be about $4.4 million for the maximum extent busway system plan and $3.2 million for the base system plan.

Development of Truncated Plan: The result of the traffic assignments to, and attendant evaluation of, the maximum extent busway system plan are summarized in Table 152. The maximum extent busway plan has a significantly higher total capital cost and capital cost per passenger, as well as a greater operating deficit, than does the base plan over the 20-year plan design period. The proportion of operating costs which may be expected to be met by farebox revenues is approximately the same under the two plans, differing by only about 4 percent.

Some of the increases in the costs and decreases in the cost-effectiveness of the maximum extent busway plan may be attributed to the overextension of service envisioned in this plan. Under this plan, primary transit service on exclusive guideway would be extended into portions of the Milwaukee

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[12] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, about equal to the $11.6 million required to provide 50 percent federal funding of the operating deficits under the base plan, but substantially less than the $15.8 million required under the maximum extent busway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Table 152

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Busway Plan
Ridership		
In Design Year	94,250,000	97,660,000
To Design Year	1,485,900,000	1,518,200,000
Capital Cost		
Total to Design Year	$ 233,328,700	$ 771,162,200
To Design Year per Passenger	0.160	0.510
To Design Year After Accounting for Useful Life Beyond Design Year	148,842,000	442,054,490
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.100	0.290
Operating Cost		
Percent Met by Farebox Revenues in Design Year	62	58
Operating Deficit in Design Year	$ 23,198,300	$ 31,378,700
Operating Deficit per Passenger in Design Year	0.250	0.320
Operating Deficit to Design Year	430,900,000	496,340,000
Operating Deficit to Design Year per Passenger	0.290	0.330
Total Cost		
To Design Year	$ 664,228,700	$1,267,502,200
Federal Share	402,112,960	865,099,760
Nonfederal Share	262,115,740	402,402,440
To Design Year per Passenger	0.450	0.840
Federal Share	0.270	0.570
Nonfederal Share	0.180	0.270
To Design Year After Accounting for Useful Life Beyond Design Year	579,742,000	938,394,490
Federal Share	334,523,600	601,813,590
Nonfederal Share	245,218,400	336,580,900
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.390	0.620
Federal Share	0.225	0.400
Nonfederal Share	0.165	0.220

Source: SEWRPC.

urbanized area not now served, and service would be provided throughout the day. Nevertheless, the cost-effectiveness of the transit service provided may be expected to be quite similar for the weekday morning, midday, and afternoon periods, and the service provided in the evening would be only somewhat less cost-effective than that provided during the remainder of the day.

The cost-effectiveness of the less productive elements of the maximum extent busway system plan can, in part, be identified on a route-by-route basis through a determination of what proportion of the operating costs of the routes may be expected to be recovered through farebox revenues. As shown in Table 153, all routes may be expected to meet more than 74 percent of their operating costs with farebox revenues and, thus, should require little truncation except possibly in the extent of service provided over some limited segments of the routes.

Another basis for the identification of the less cost-effective elements of the maximum extent busway system plan is the operating and capital costs per passenger and passenger mile carried on segments of the system. Table 154 summarizes the capital and operating costs, and passenger volumes and passenger miles carried, for the major segments of the maximum extent busway system, and provides a ranking of the segments in terms of operating cost per passenger mile and capital cost per passenger mile. Map 62 identifies the 34 major segments of the primary transit element of the plan. The segments were delineated on the basis

Table 153

OPERATING COST-EFFECTIVENESS OF BUSWAY ROUTES OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicle Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
1—Waukesha/Milwaukee CBD/UWM	167,230	$14,045	7,113	$18,960	74
2—Cedarburg/Grafton/Milwaukee CBD/Oak Creek	226,770	19,045	8,873	23,650	81
3—Menomonee Falls/Milwaukee CBD/South Milwaukee	213,640	17,945	6,300	16,790	107
4—Crosstown: Northridge/Southridge	126,430	10,620	3,869	10,315	103
5—Loop: Capitol Drive/UWM/ Wisconsin Avenue/Mayfair	114,590	9,625	4,844	12,910	75
Total	848,660	$71,280	30,999	$82,625	86

Source: SEWRPC.

Table 154

COST-EFFECTIVENESS ANALYSIS OF SEGMENTS OF THE PRIMARY ELEMENT OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

		Transit Ridership						Average Weekday Operating Cost-Effectiveness in Design Year				Total Capital Cost-Effectiveness Over the Design Period			
		Average Weekday Passenger Volume													
Segment Number	Route Number	Range	Average	Total Boarding and Deboarding Passengers	Passenger Miles	Average Weekday Operating Cost in Design Year	Total Capital Cost Over Design Period	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank
1	1	3,130- 4,300	3,670	5,530	6,600	$1,484	$ 6,382,000	$0.22	30	$0.27	13	$ 967	21	$1,154	8
2	1	4,980- 5,100	5,040	1,960	20,170	3,177	12,317,800	0.16	26	1.62	34	611	16	6,285	33
3	1	5,660- 6,040	5,870	2,530	23,490	3,242	11,868,400	0.14	22	1.28	32	505	14	4,691	30
4	1	8,500- 9,350	8,910	5,150	20,480	1,852	19,760,480	0.09	16	0.36	21	965	20	3,837	28
5	1 and 5	12,090-16,830	15,870	9,460	38,080	3,123	30,035,680	0.08	13	0.33	17	789	17	3,175	19
6	1 and 5	28,780-28,780	28,780	14,010	17,270	1,027	8,252,500	0.06	2	0.07	2	478	10	589	3
7	1 and 5	31,310-36,570	33,290	66,960	83,210	4,617	30,162,672	0.06	2	0.07	2	362	6	450	2
8	1 and 5	17,370-26,510	23,320	17,730	16,330	893	3,633,500	0.05	1	0.05	1	223	2	205	1
9	1 and 5	470-15,010	7,960	25,320	39,010	6,483	52,962,400	0.17	27	0.26	11	1,358	29	2,092	13
10	2	1,710- 3,390	2,690	3,190	18,020	4,705	15,049,300	0.26	32	1.47	33	835	18	4,718	31
11	2	3,830- 5,380	4,710	3,620	19,780	3,010	9,810,700	0.15	24	0.83	30	496	11	2,710	15
12	2	6,220- 6,950	6,500	2,280	20,790	2,203	7,387,400	0.11	18	0.97	31	355	4	3,240	20
13	2	7,720- 8,070	7,890	3,680	25,250	2,323	12,679,300	0.09	16	0.63	29	502	12	3,445	22
14	2	7,940-14,670	11,750	18,100	45,840	2,942	17,696,300	0.06	2	0.16	6	386	7	978	5
15	2 and 3	22,910-23,930	23,400	7,630	58,500	3,265	12,759,500	0.06	2	0.43	24	218	1	1,672	11
16	2	8,590-12,490	10,620	13,330	40,360	2,825	18,027,800	0.07	8	0.21	8	447	8	1,352	10
17	2	1,770- 6,260	3,390	6,730	17,990	3,697	23,420,100	0.21	28	0.55	26	1,302	26	3,480	23
18	3	1,270- 4,470	2,990	5,240	14,340	3,025	19,105,300	0.21	28	0.58	28	1,332	27	3,646	24
19	3	7,150- 9,450	8,320	8,510	19,140	1,496	9,613,500	0.08	13	0.18	7	502	12	1,130	7
20	3 and 5	13,180-14,130	13,630	6,930	23,170	1,923	8,273,500	0.08	13	0.28	14	357	5	1,194	9
21	3 and 4	18,350-21,310	19,730	32,810	76,960	4,407	20,701,100	0.06	2	0.13	4	269	3	631	4
22	3	9,810-12,260	10,860	6,230	33,680	2,239	40,784,000	0.07	8	0.36	21	1,211	25	6,546	34
23	3	8,510- 9,750	8,950	7,130	22,360	1,623	26,378,100	0.07	8	0.23	10	1,180	24	3,700	25
24	3	1,860- 5,910	4,740	5,860	14,230	1,964	34,297,100	0.14	22	0.34	19	2,410	33	5,853	32
25	4	3,570- 5,180	4,390	6,570	17,130	2,091	24,714,000	0.12	20	0.32	15	1,443	30	3,762	26
26	4	5,590- 9,800	7,700	8,470	25,400	1,872	25,182,400	0.07	8	0.22	9	991	22	2,973	18
27	4	7,170-11,790	9,270	11,550	26,880	1,695	12,152,300	0.06	2	0.15	5	452	9	1,052	6
28	4	2,930- 5,690	4,050	6,620	20,660	2,723	27,849,800	0.13	21	0.41	23	1,348	28	4,207	29
29	5	2,130- 2,650	2,470	3,030	4,690	1,072	7,165,700	0.23	31	0.35	20	1,528	31	2,365	14
30	5	1,710- 1,710	1,710	3,130	2,560	827	9,142,400	0.32	34	0.26	11	3,571	34	2,921	16
31	5	1,420- 2,400	1,980	1,690	3,570	969	5,740,500	0.27	33	0.57	27	1,608	32	3,397	21
32	5	2,410- 4,300	3,670	3,660	8,080	1,215	6,966,300	0.15	24	0.33	17	862	19	1,903	12
33	5	7,900- 8,470	8,190	1,820	12,280	832	6,875,800	0.07	8	0.46	25	560	15	3,778	27
34	5	3,760- 6,430	5,290	5,580	16,400	1,774	16,507,300	0.11	18	0.32	15	1,007	23	2,958	17

Source: SEWRPC.

of the probable location of major primary transit stations in the Milwaukee area so that the possible deletion of any segment would provide a logical terminus for the remaining portions of each of the routes. Maps 68 and 69 show those segments which may be expected to have above average operating costs and capital costs per passenger mile, respectively, as well as the degree to which such average costs may be expected to be exceeded. In any consideration of this cost-effectiveness information, it is important to recognize that the outer ends of each route can carry no through traffic, except through a different mode such as a feeder/distributor bus.

Comparison of the cost-effectiveness of segments of a system can also be made in terms of passenger boardings and deboardings. Table 154 also presents passenger boarding and deboarding volumes by segment and a rank ordering of the segments in terms of operating and capital costs per boarding and deboarding passenger. Maps 70 and 71 show those segments which may be expected to have above average operating and capital costs, respectively, per boarding and deboarding passenger, as well as the degree to which average costs are exceeded.

Based on this cost-effectiveness information, the maximum extent busway system plan for this alternative future was truncated. The truncations were made with the objective of reducing system capital cost and operating deficits while bringing the total cost per passenger for a busway plan for this future closer to that of the base plan, while retaining an integrated system. The proposed truncated busway system plan under the moderate growth scenario-centralized land use plan alternative future is shown on Map 67. The changes made in the maximum extent plan to produce the truncated plan are summarized in Table 155. The segments deleted were the less operating and capital cost-effective—that is, segments which, if deleted, would result in relatively large reductions in system capital costs and operating deficits and small reductions in system ridership. These segments consisted of those extending to the communities of Cedarburg and Grafton from Capitol Drive in the City of Milwaukee, those extending to the Village of Menomonee Falls from Silver Spring Drive and 92nd Street in the City of Milwaukee, those extending to the Cities of West Allis and Waukesha from N. 84th Street and W. Fairview Avenue in the City of Milwaukee, those extending to the City of Oak Creek from General Mitchell Field, and those looping from the intersection of Appleton Avenue and Capitol Drive to the Mayfair Mall Shopping Center. The segment from the Milwaukee central business district through the University of Wisconsin-Milwaukee to Capitol Drive and along Capitol Drive to Atkinson Avenue in the City of Milwaukee was deleted because of its high capital cost. The segment from 5th and Becher Streets to the City of St. Francis on the route connecting to the Cities of Cudahy and South Milwaukee was replaced for this same reason by a segment from 5th and Becher Streets along Chase Avenue to the former Milwaukee Electric Lines Lakeside Belt Line, and then along the open right-of-way owned by the Wisconsin Electric Power Company and used for trunkline power transmission to the City of St. Francis and the original routing from 5th and Becher Streets through the City of St. Francis to the Cities of Cudahy and South Milwaukee. Through the elimination of these segments, the capital cost of the primary element of the busway system would decrease from about $594 million to about $259 million, and the total cost of the truncated plan would be about $537 million.

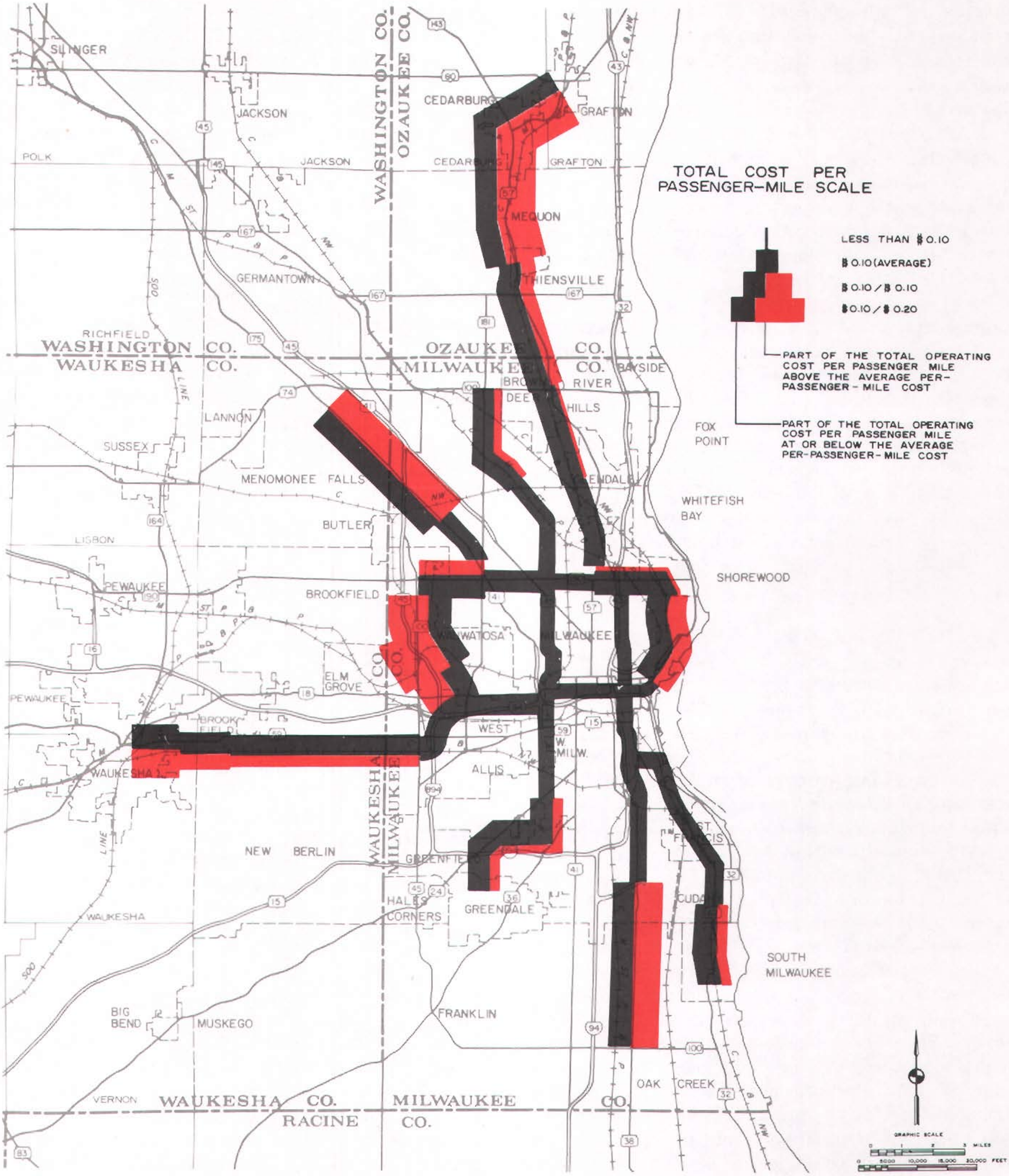
Those segments given the highest priority for elimination were Segments 10, 11, 12, and 13 serving northern Milwaukee County and Ozaukee County, and Segments 1, 2, 3, and 18 serving Waukesha County. Segments 31 and 32, providing service along Capitol Drive between Appleton Avenue and Mayfair Road, and Segment 4 providing service to West Allis, were identified as the second set of segments to be deleted. The third set of segments identified to be deleted were those serving General Mitchell Field and the City of Oak Creek, including portions of both Segments 16 and 22 and all of Segment 17. Segments 9 and 34 serving the University of Wisconsin-Milwaukee campus and the lower east side were the final two segments identified for deletion.

Evaluation of Maximum Extent Heavy Rail Rapid System Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is heavy rail rapid transit. The maximum extent system plan developed for this technology is summarized with respect to its coverage, stations, routes, and operation on Maps 72 and 48, and in Tables 156 through 158. Under this plan, all primary transit service would be provided by a heavy rail rapid transit system operating a fleet of 74 electrically propelled vehicles semipermanently coupled into two-car trains.

Map 68

OPERATING COST PER PASSENGER MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

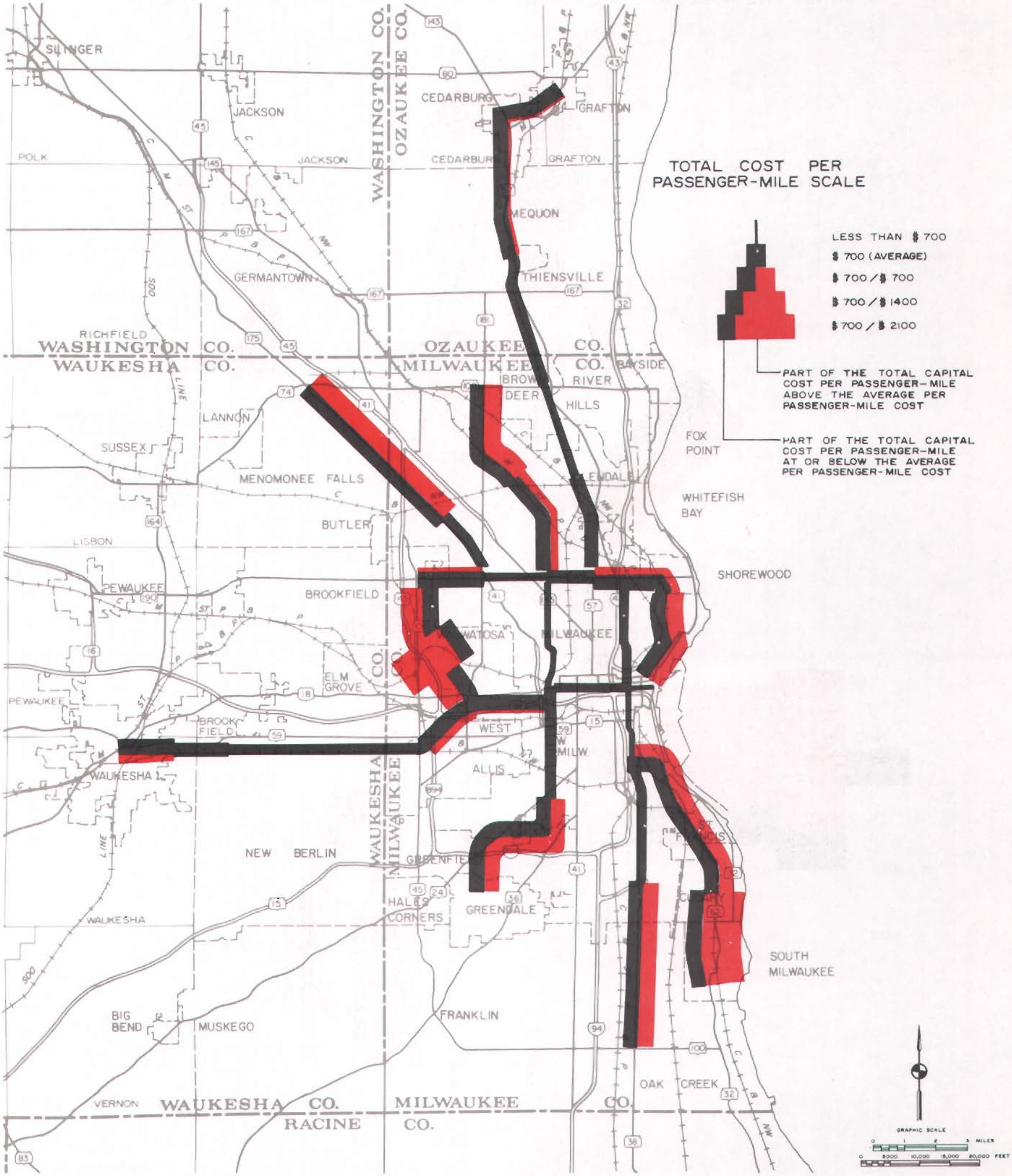


One measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway plan was the operating cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average cost per passenger mile, as well as the degree to which such average costs are exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, the outer segments of each route as well as portions of Route 5 on the City of Milwaukee's east side and in the City of Wauwatosa suggest an insufficient ridership base to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development, and the absence of through traffic except by connection with a different mode such as feeder bus or automobile. To some degree, these inefficiencies are also generated by the lengthy distances of some segments in the suburban areas.

Source: SEWRPC.

Map 69

CAPITAL COST PER PASSENGER MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

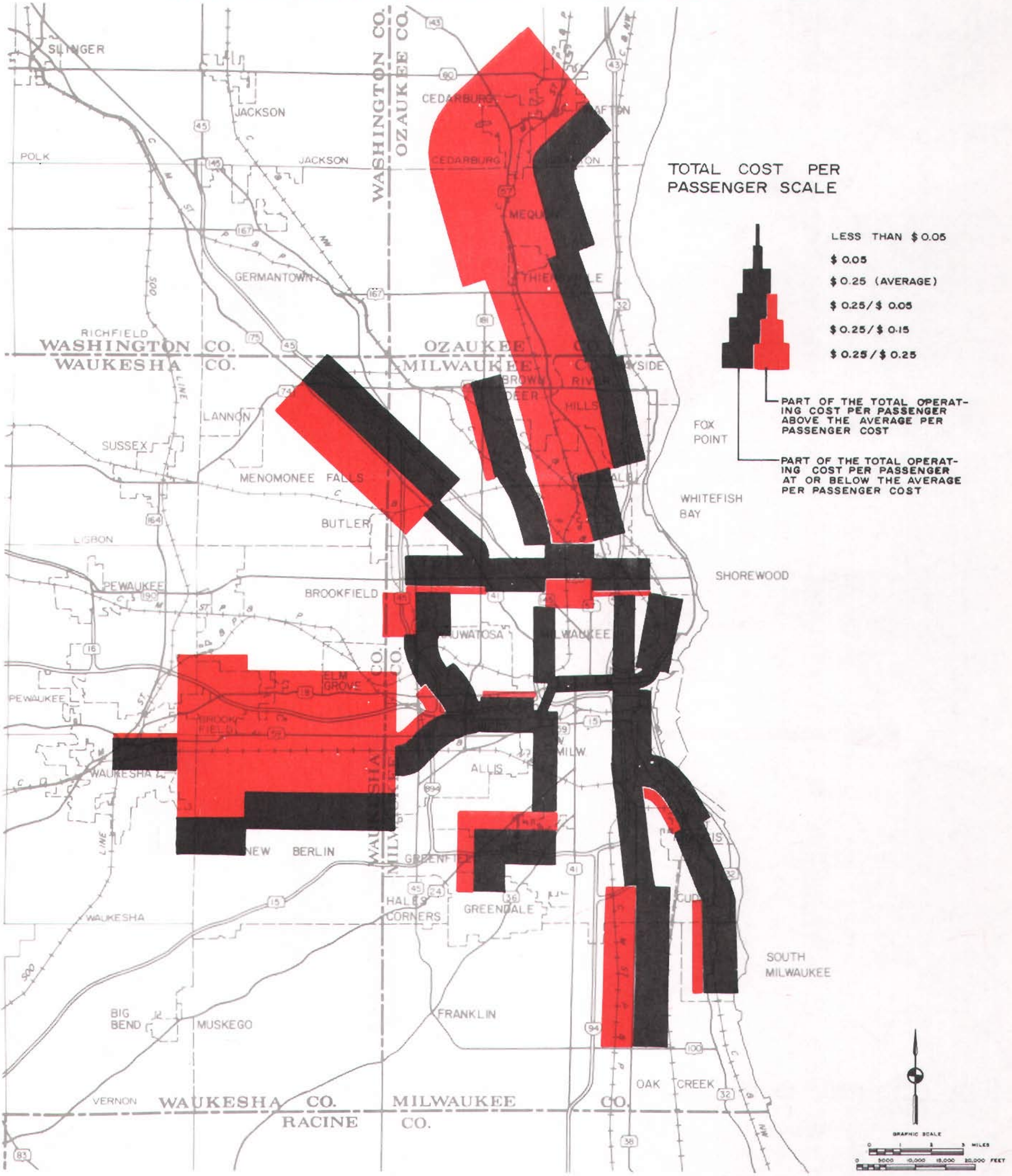


Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway plan was the capital cost per passenger mile. This map shows those segments which may be expected to be at, below, or above the average capital cost per passenger mile, as well as the degree to which such average costs exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, the outer segments of each route as well as portions of Route 5 on the City of Milwaukee's east side and in the City of Wauwatosa suggest an insufficient ridership base to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development, and the absence of through traffic except by connection with a different mode such as feeder bus or automobile. To some degree, these inefficiencies are also generated by the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee's east side.

Source: SEWRPC.

Map 70

OPERATING COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

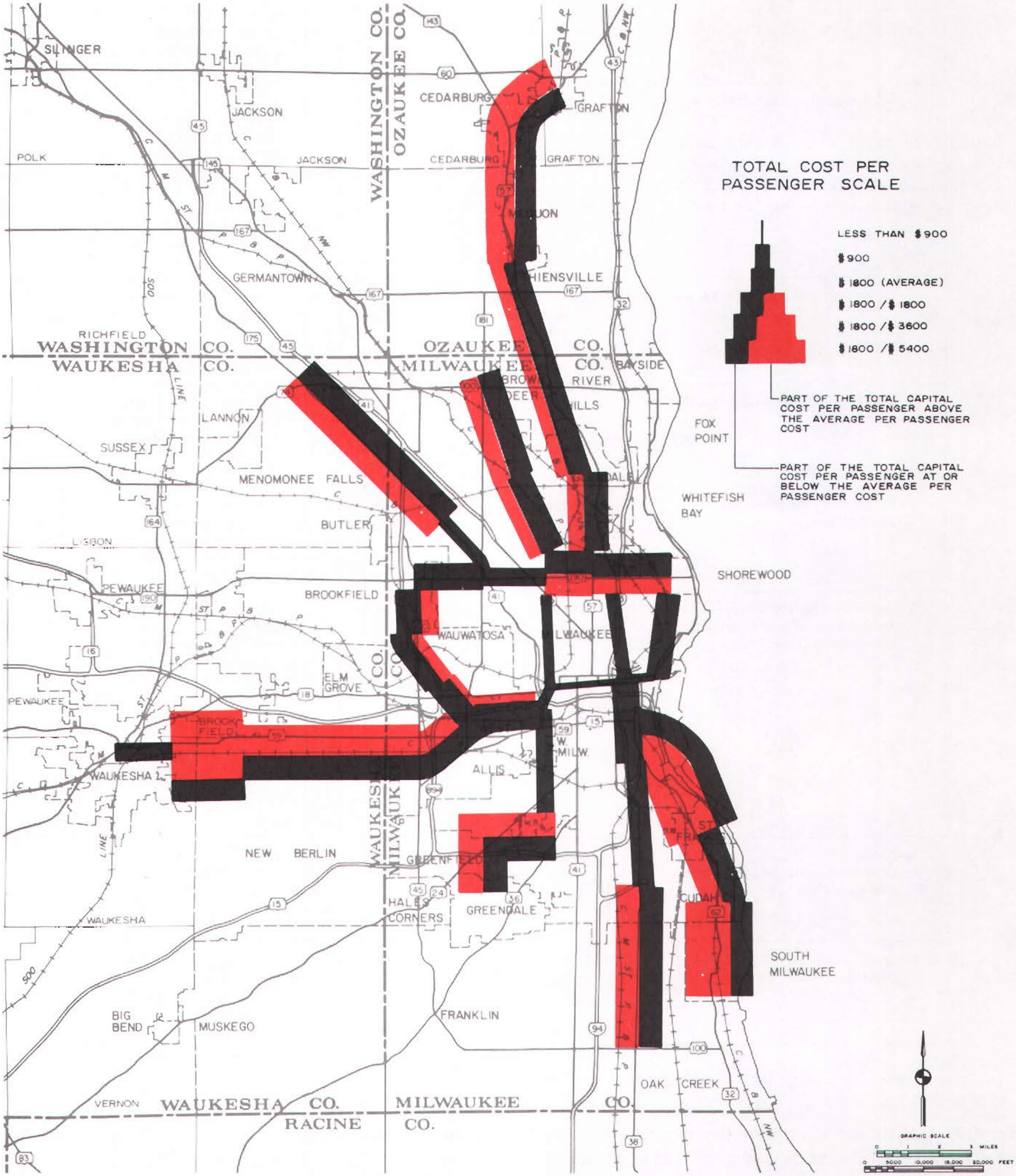


Yet another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway plan was the operating cost per boarding and deboarding passenger. This map shows those segments which may be expected to be at, below, or above the average operating cost per boarding and deboarding passenger, as well as the degree to which such average costs are exceeded. As shown on this map, certain system segments within densely developed portions of Milwaukee County are very cost-effective, compared with the remainder of the system, while all segments located within suburban areas outside Milwaukee County are not cost-effective. This is a result of the lower boarding and deboarding passenger volumes in these suburban areas combined with the lengthy distances that the busway vehicles must operate over.

Source: SEWRPC.

Map 71

CAPITAL COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway plan is the capital cost per boarding and deboarding passenger. This map shows those segments which may be expected to be at, below, or above the average capital cost per boarding and deboarding passenger, as well as the degree to which such average costs are exceeded. As shown on this map, certain segments within the densely developed portions of Milwaukee County are very cost-effective compared with the remainder of the system. However, those segments located in Milwaukee County suburbs as well as outside Milwaukee County appear to have an insufficient volume of passenger boardings and deboardings to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development combined with the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee's east side. A noteworthy exception is the segment within the City of Waukesha which, by itself, appears cost-effective, but which nevertheless depends upon a connection to the remainder of the system over two lengthy suburban segments which generate little ridership.

Source: SEWRPC.

Table 155

RECOMMENDED CHANGES IN THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

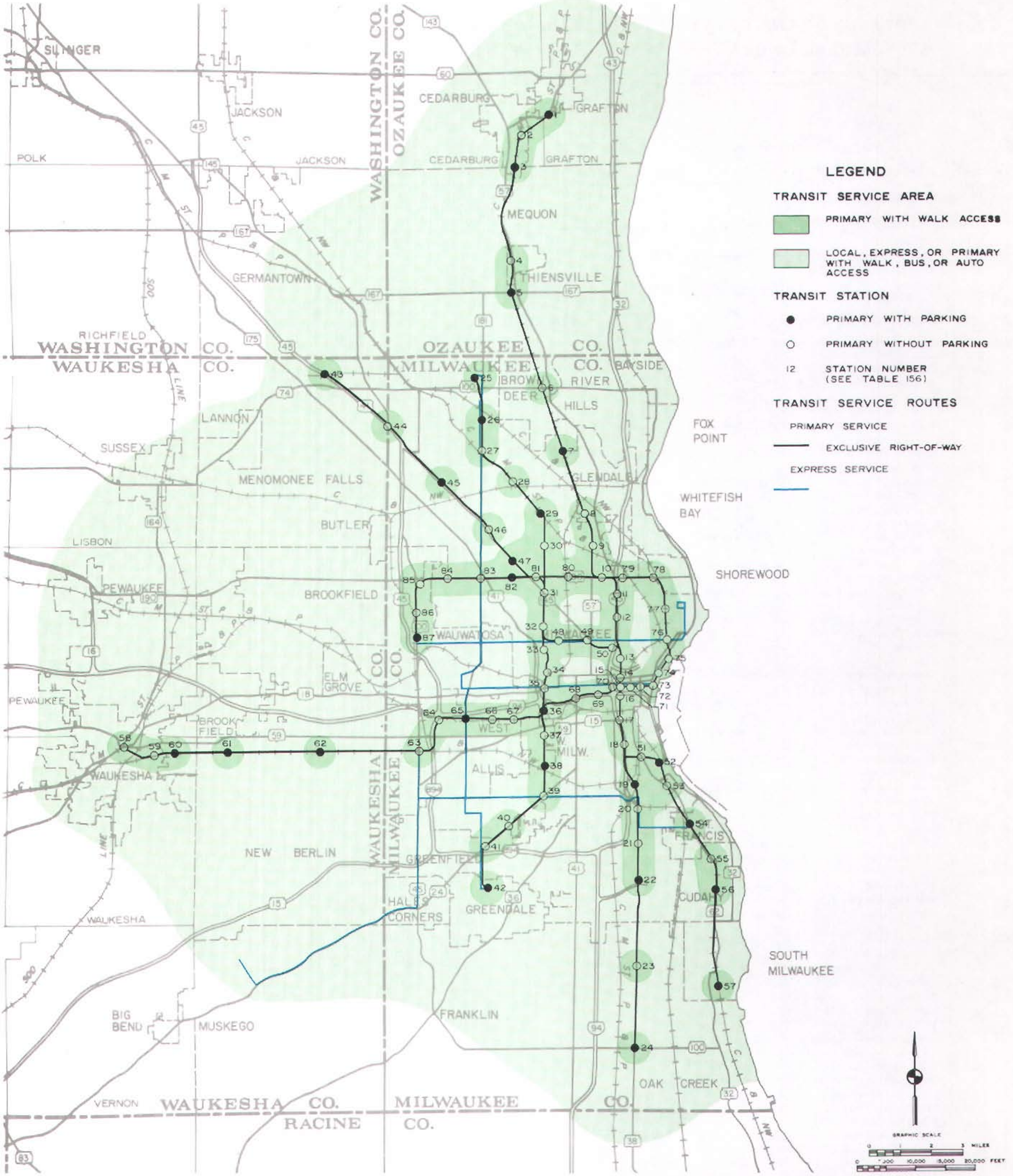
Route	Recommended Change	Reasons
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segment 1	The deletion of Segments 2 and 3 would not logically permit retention of Segment 1
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segments 2 and 3	Segments 2 and 3 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segment 4	Segments 29 and 30 are more cost-effective compared with Segment 4 and provide for a more logical end-of-route
2—Cedarburg/Milwaukee CBD/Oak Creek	Eliminate Segments 10, 11, 12, and 13	Segments 10 through 13 are not capital or operating cost-effective relative to other segments. Also, total boarding and deboardings are low compared with those of other segments
2—Cedarburg/Milwaukee CBD/Oak Creek	Eliminate Segment 17	Segment 17 is not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
3—Menomonee Falls/Milwaukee/ South Milwaukee	Eliminate Segment 18	Segment 18 is not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
3—Menomonee Falls/Milwaukee CBD/ South Milwaukee and Cedarburg/ Milwaukee CBD/Oak Creek	Eliminate Segment 22 and parts of 16 and 23. Add connector segment between Segments 16 and 23	Segments 17 and 22 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments. Portions of Segments 16 and 23 would be deleted for the same reasons. The remainder of Segment 23, which is cost-effective and has significant boardings and deboardings, would be connected to the remainder of the truncated network via the Lakeside Belt Line right-of-way
5—Loop: UWM/Mayfair Mall Shopping Center/ Milwaukee CBD	Eliminate Segments 31, 32, and 34	Segments 31, 32, and 34 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
5—Loop: UWM/Mayfair Mall Shopping Center/ Milwaukee CBD	Eliminate Segment 9	Segment 9 is not capital cost-effective relative to other segments. Service to UWM would be provided by shuttle service from nearby primary transit stations

Source: SEWRPC.

Primary transit service under the maximum extent heavy rail rapid transit system plan would be provided over four routes which together would represent a substantial expansion over existing primary transit service. One route, Route 1, would extend from the City of Waukesha through the Cities of New Berlin and West Allis into the Milwaukee central business district. The route would then extend to the University of Wisconsin-Milwaukee campus and the northerly section of the City of Milwaukee along W. Capitol Drive, and would terminate at the Mayfair Mall Shopping Center in the City of Wauwatosa. The second route, Route 2, would extend in a north-south direction from the Village of Grafton to the City of Oak Creek through the Milwaukee central

Map 72

MAXIMUM EXTENT HEAVY RAIL RAPID TRANSIT SYSTEM PLAN



The maximum extent heavy rail rapid transit system plan would provide a significant improvement in and expansion of primary transit service in the Milwaukee area. Under this plan, primary transit service would be improved within Milwaukee County, and would be extended outside Milwaukee County within the future limits of the Milwaukee urbanized area. All heavy rail rapid transit service under the maximum extent plan would be provided throughout the day, including midday and evening time periods, and would be operated at headways of from 10 to 30 minutes during peak periods and from 30 to 45 minutes during off-peak periods. In all, four heavy rail rapid transit routes totaling 215 miles in length and serving 87 primary transit stops or stations would be operated under the maximum extent plan. This compares with the 11 bus-on-freeway routes which operated in 1980 during peak periods only between 19 outlying primary transit stations and the Milwaukee central business district. The four heavy rail rapid transit routes would be operated using electrically propelled vehicles semi-permanently coupled into two-car units.

The maximum extent heavy rail rapid transit system plan also provides for complementary expansion and improvement of the Milwaukee area express and local transit system. Five express or limited-stop routes would be provided, and the local transit system would be extended into all contiguous areas of urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and western Waukesha County.

Source: SEWRPC.

Table 156

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT HEAVY RAIL RAPID TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (trains per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	STH 57 (Wisconsin Avenue) and Falls Road	Village of Grafton	Proposed	Yes	425	1	--	33	33	3	3	2	2	4	4	2	2
2	Highland Drive and Western Road (CTH T)	City of Cedarburg	Proposed	Yes	--	1	--	31	31	3	3	2	2	4	4	2	2
3	Cardinal Avenue and Pioneer Road (CTH C)	City of Cedarburg	Proposed	Yes	250	1	1	30	30	3	3	2	2	4	4	2	2
4	STH 57 (Main Street) and Friestadt Road	Village of Thiensville	Proposed	Yes	--	1	1	25	25	3	3	2	2	4	4	2	2
5	STH 57 and STH 167 (Mequon Road)	City of Mequon	Proposed	Yes	200	1	1	23	23	3	3	2	2	4	4	2	2
6	N. Deerbrook Terrace and STH 100 (W. Brown Deer Road)	Village of Brown Deer	Proposed	Yes	--	1	1	19	19	3	3	2	2	4	4	2	2
7	N. Teutonia Avenue and W. Good Hope Road	City of Milwaukee	Proposed	Yes	350	1	2	17	17	3	3	2	2	4	4	2	2
8	N. Dexter Avenue and W. Silver Spring Drive	City of Glendale	Proposed	Yes	--	1	1	14	14	3	3	2	2	4	4	2	2
9	N. 20th Street and W. Hampton Avenue	City of Milwaukee	Proposed	Yes	--	1	2	12	12	3	3	2	2	4	4	2	2
10	N. 16th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	--	2	1	9	9	8	8	4	4	10	10	4	4
11	N. 7th Street and W. Keefe Avenue	City of Milwaukee	Proposed	Yes	--	1	2	7	7	3	3	2	2	4	4	2	2
12	N. 7th Street and W. Locust Street	City of Milwaukee	Proposed	Yes	--	1	1	5	5	3	3	2	2	4	4	2	2
13	N. 6th Street and W. Walnut Street	City of Milwaukee	Proposed	Yes	--	2	2	2	2	6	6	4	4	8	8	4	4
14	N. 6th Street and W. State Street	City of Milwaukee	Proposed	Yes	--	2	2	1	1	6	6	4	4	8	8	4	4
15	N. 6th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	--	3	7	--	--	11	11	6	6	14	14	6	6
16	N. 6th Street and W. St. Paul Avenue	City of Milwaukee	Proposed	Yes	--	2	2	1	1	6	6	4	4	8	8	4	4
17	S. 6th Street and W. National Avenue	City of Milwaukee	Proposed	Yes	--	2	3	3	3	6	6	4	4	8	8	4	4
18	S. 4th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	--	2	3	5	5	6	6	4	4	8	8	4	4
19	S. Chase Avenue and W. Rosedale Avenue	City of Milwaukee	Proposed	Yes	400	1	--	8	8	3	3	2	2	4	4	2	2
20	S. Chase Avenue and W. Holt Avenue	City of Milwaukee	Proposed	Yes	--	1	2	10	10	3	3	2	2	4	4	2	2
21	S. Howell Avenue and W. Bolivar Avenue	City of Milwaukee	Proposed	Yes	--	1	1	12	12	3	3	2	2	4	4	2	2
22	General Mitchell Field	City of Milwaukee	Proposed	Yes	275	1	2	14	14	3	3	2	2	4	4	2	2
23	S. Howell Avenue and W. Marquette Avenue	City of Oak Creek	Proposed	Yes	--	1	2	17	17	3	3	2	2	4	4	2	2
24	S. Howell Avenue and W. Ryan Road	City of Oak Creek	Proposed	Yes	450	1	1	20	20	3	3	2	2	4	4	2	2
25	Northridge Shopping Center	City of Milwaukee	Proposed	Yes	150	1	5	32	45	2	2	1	1	3	3	1	1
26	N. 76th Street and W. Bradley Road	City of Milwaukee	Proposed	Yes	125	1	3	30	43	2	2	1	1	3	3	1	1
27	N. 76th Street and W. Good Hope Road	City of Milwaukee	Proposed	Yes	--	1	3	28	41	2	2	1	1	3	3	1	1
28	N. 60th Street and W. Mill Road	City of Milwaukee	Proposed	Yes	--	1	2	26	38	2	2	1	1	3	3	1	1
29	N. Sherman Boulevard and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	250	1	2	24	36	2	2	1	1	3	3	1	1
30	N. Sherman Boulevard and W. Hampton Avenue	City of Milwaukee	Proposed	Yes	--	1	2	22	34	2	2	1	1	3	3	1	1
31	N. Sherman Boulevard and W. Fond du Lac Avenue	City of Milwaukee	Proposed	Yes	--	2	2	12	12	5	5	3	3	7	7	3	3
32	N. Sherman Boulevard and W. Center Street	City of Milwaukee	Proposed	Yes	--	2	2	10	10	5	5	3	3	7	7	3	3
33	N. Sherman Boulevard and W. Lisbon Avenue	City of Milwaukee	Proposed	Yes	--	1	2	19	29	2	2	1	1	3	3	1	1
34	W. Highland Boulevard and W. McKinley Avenue	City of Milwaukee	Proposed	Yes	--	1	2	17	27	2	2	1	1	3	3	1	1
35	N. 41st Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	--	1	2	15	25	2	2	1	1	3	3	1	1
36	County Stadium and N. 44th Street	City of Milwaukee	Proposed	Yes	425	2	--	8	8	7	7	3	3	9	9	3	3
37	S. 43rd Street and W. Greenfield Avenue	Village of West Milwaukee	Proposed	Yes	--	1	1	15	25	2	2	1	1	3	3	1	1
38	S. 43rd Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	350	1	1	17	27	2	2	1	1	3	3	1	1

Table 156 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (trains per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
39	S. 43rd Street and W. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	18	28	2	2	1	1	3	3	1	1
40	W. Forest Home Avenue and W. Howard Avenue. .	City of Milwaukee	Proposed	Yes	- -	1	1	21	31	2	2	1	1	3	3	1	1
41	W. Forest Home Avenue and W. Cold Spring Avenue	City of Greenfield	Proposed	Yes	- -	1	3	23	33	2	2	1	1	3	3	1	1
42	Southridge Shopping Center.	Village of Greendale	Proposed	Yes	300	1	6	28	38	2	2	1	1	3	3	1	1
43	W. Fond du Lac Avenue and Pilgrim Road	Village of Menomonee Falls	Proposed	Yes	475	1	2	28	28	3	3	2	2	4	4	2	2
44	W. Fond du Lac Avenue and STH 145.	City of Milwaukee	Proposed	Yes	- -	1	1	25	25	3	3	2	2	4	4	2	2
45	W. Fond du Lac Avenue and W. Mill Road	City of Milwaukee	Proposed	Yes	375	1	2	22	22	3	3	2	2	4	4	2	2
46	W. Fond du Lac Avenue and W. Grantosa Drive . .	City of Milwaukee	Proposed	Yes	- -	1	1	19	19	3	3	2	2	4	4	2	2
47	W. Fond du Lac Avenue and W. Congress Street . .	City of Milwaukee	Proposed	Yes	200	1	2	17	17	3	3	2	2	4	4	2	2
48	N. 35th Street and W. Meinecke Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	1	8	8	3	3	2	2	4	4	2	2
49	N. 23rd Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	6	6	3	3	2	2	4	4	2	2
50	N. 12th Street and W. Lloyd Street	City of Milwaukee	Proposed	Yes	- -	1	1	5	5	3	3	2	2	4	4	2	2
51	S. Kinnickinnic Avenue and E. Becher Street . . .	City of Milwaukee	Proposed	Yes	- -	1	3	7	7	3	3	2	2	4	4	2	2
52	S. Bay Street and E. Lincoln Avenue.	City of Milwaukee	Proposed	Yes	500	1	1	9	9	3	3	2	2	4	4	2	2
53	S. Nevada Street and S. Kinnickinnic Avenue. .	City of Milwaukee	Proposed	Yes	- -	1	2	11	11	3	3	2	2	4	4	2	2
54	S. Bombay Avenue and E. Crawford Avenue. . . .	City of St. Francis	Proposed	Yes	450	1	1	13	13	3	3	2	2	4	4	2	2
55	S. Kinnickinnic Avenue and E. Layton Avenue . .	City of Cudahy	Proposed	Yes	- -	1	2	15	15	3	3	2	2	4	4	2	2
56	W. Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	800	1	1	17	17	3	3	2	2	4	4	2	2
57	S. 9th Street and Drexel Boulevard	City of South Milwaukee	Proposed	Yes	500	1	- -	21	21	3	3	2	2	4	4	2	2
58	W. Broadway and W. Main Street.	City of Waukesha	Proposed	Yes	- -	1	10	33	33	5	5	2	2	6	6	2	2
59	Lincoln Avenue and Frederick Street	City of Waukesha	Proposed	Yes	- -	1	1	30	30	5	5	2	2	6	6	2	2
60	CTH A and Pearl Street . .	Town of Waukesha	Proposed	Yes	425	1	- -	28	28	5	5	2	2	6	6	2	2
61	Johnson Road	City of New Berlin	Proposed	Yes	150	1	- -	26	26	5	5	2	2	6	6	2	2
62	Moorland Road and Rogers Drive	City of New Berlin	Proposed	Yes	450	1	2	22	22	5	5	2	2	6	6	2	2
63	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	- -	1	75	19	19	5	5	2	2	6	6	2	2
64	S. 98th Street and W. Schlinger Avenue . . .	City of West Allis	Proposed	Yes	- -	1	- -	15	15	5	5	2	2	6	6	2	2
65	State Fair Park	City of Milwaukee	Proposed	Yes	575	1	2	13	13	5	5	2	2	6	6	2	2
66	S. 70th Street and W. Dickinson Street. . . .	City of Milwaukee	Proposed	Yes	- -	1	1	12	12	5	5	2	2	6	6	2	2
67	S. Hawley Road and W. Pierce Street	City of West Allis	Proposed	Yes	- -	1	1	10	10	5	5	2	2	6	6	2	2
68	S. 27th Street and W. Greves Street.	City of Milwaukee	Proposed	Yes	- -	1	1	5	5	5	5	2	2	6	6	2	2
69	N. 16th Street and W. Clybourn Street	City of Milwaukee	Proposed	Yes	- -	1	1	3	3	5	5	2	2	6	6	2	2
70	N. 12th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	6	1	1	5	5	2	2	6	6	2	2
71	N. Plankinton Avenue and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	- -	1	10	1	1	5	5	2	2	6	6	2	2
72	N. Broadway Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	8	2	2	5	5	2	2	6	6	2	2
73	N. Prospect Avenue and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	4	3	3	5	5	2	2	6	6	2	2
74	N. Prospect Avenue and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	1	- -	4	4	5	5	2	2	6	6	2	2
75	N. Prospect Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	1	- -	5	5	5	5	2	2	6	6	2	2
76	N. Oakland Avenue and E. North Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	7	7	5	5	2	2	6	6	2	2
77	N. Oakland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	Yes	- -	1	- -	9	9	5	5	2	2	6	6	2	2
78	N. Humboldt Boulevard and E. Capitol Drive. . . .	City of Milwaukee	Proposed	Yes	- -	1	2	12	12	5	5	2	2	6	6	2	2
79	N. Port Washington Road and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	1	2	14	14	5	5	2	2	6	6	2	2
80	N. 31st Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	1	17	17	5	5	2	2	6	6	2	2

Table 156 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (trains per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
81	N. 47th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	2	1	19	19	8	8	4	4	10	10	4	4
82	N. 60th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	250	1	2	20	20	5	5	4	4	6	6	2	2
83	N. 76th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	3	22	22	5	5	4	4	6	6	2	2
84	N. 92nd Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	23	23	5	5	4	4	6	6	2	2
85	W. Grantosa Drive and W. Vienna Avenue.	City of Wauwatosa	Proposed	Yes	- -	1	- -	25	25	5	5	4	4	6	6	2	2
86	N. Mayfair Road and W. Burleigh Street.	City of Wauwatosa	Proposed	Yes	- -	1	2	27	27	5	5	4	4	6	6	2	2
87	Mayfair Shopping Center. .	City of Wauwatosa	Proposed	Yes	300	1	7	29	29	5	5	4	4	6	6	2	2

Source: SEWRPC.

Table 157

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT HEAVY RAIL RAPID TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Base Plan	Maximum Extent Heavy Rail Rapid Transit Plan
Primary		
Exclusive Guideway Miles		
Subway	- -	6.0
Elevated.	- -	56.5
At-Grade	- -	41.2
Total	- -	103.7
Shared Guideway Miles		
Freeways	51.5	- -
Surface Arterial Streets	50.5	- -
Total	101.0	103.7
Route Miles	449	215
Vehicle Miles.	8,900	17,600
Vehicle Hours	460	500
Vehicles Required	78	66
Trains Required	- -	33
Express and Local		
Route Miles	1,306	1,665
Vehicle Miles.	85,900	77,900
Vehicle Hours	6,520	5,730
Vehicles Required	823	656
Total System		
Route Miles	1,755	1,880
Vehicle Miles.	94,800	95,500
Vehicle Hours	6,980	6,280
Vehicles Required	901	722
Trains Required	- -	33

Source: SEWRPC.

business district, also serving the Villages of Thiensville and Brown Deer as well as the Cities of Mequon and Glendale. The third route, Route 3, would extend in a generally northwest-southeast direction from the Village of Menomonee Falls through the central business district of the City of Milwaukee and the Cities of St. Francis and Cudahy, terminating in the City of South Milwaukee. The fourth and last route, Route 4, would extend in a generally north-south direction along a crosstown alignment. The terminals of Route 4 would be located at the Northridge and Southridge Shopping Centers, and the route would serve the Villages of Greendale and West Milwaukee, the City of Greenfield, and the northwest side of the City of Milwaukee.

The total dual guideway mileage of this maximum extent plan would be approximately 102.4 miles. About 54.5 miles, or 53 percent of the heavy rail rapid transit system, would be located on elevated structure; about 6.4 miles, or 6 percent, would be located in subway; and about 41.5 miles, or 41 percent, would be located on grade-separated surface rights-of-way. Right-of-way requirements would include about 16.5 miles along active mainline railway rights-of-way; about 20.2 miles along former electric interurban railway rights-of-way presently owned by the Wisconsin Electric Power Company; about 1.9 miles along abandoned mainline railway rights-of-way; and about 14.6 miles along both active and cleared freeway rights-of-way, the cleared freeway right-of-way being along the Stadium Freeway-South and Park West Freeway corridors. About 41 miles, or 40 percent of this maximum extent system, would be located within public street rights-of-way, along which the facility would be on an elevated structure for about 35.1 miles and in a subway for 5.9 miles. Other public lands would be used for a total distance of about 4.9 miles. A 3.3-mile strip of

Table 158

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT HEAVY RAIL RAPID TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	215	215	215	215	215
Vehicle Miles	4,400	4,500	5,700	3,000	17,600
Vehicle Hours	140	140	180	90	550
Vehicles Required	54	28	66	28	66
Trains Required	27	14	33	14	33
Express and Local					
Route Miles.	1,665	1,591	1,665	1,560	1,665
Vehicle Miles	17,500	23,000	21,200	16,200	77,900
Vehicle Hours	1,310	1,640	1,610	1,170	5,730
Vehicles Required	558	266	656	171	656
Total System					
Route Miles.	1,880	1,806	1,880	1,775	1,880
Vehicle Miles	21,900	27,500	26,900	19,200	95,500
Vehicle Hours	1,450	1,780	1,790	1,260	6,280
Vehicles Required	612	294	722	199	722

Source: SEWRPC.

private lands, along which a total of eight residential structures, a church, and a library are located, would have to be acquired for the location of the heavy rail fixed guideway. Another 120 acres of new right-of-way would have to be acquired for stations and for storage and maintenance facility development.

Under this maximum extent heavy rail rapid transit system plan, 87 primary transit stations or stops would be provided, of which 76 would be located within Milwaukee County. All of these stations would be grade-separated facilities with high-level platforms, controlled passenger access, fare collection facilities, and, as appropriate, escalators and elevators. Park-ride lots are planned at 26 of the 87 heavy rail rapid transit stations, 19 of which will be located within Milwaukee County.

On the average, one stop would be made about every 0.8 mile on the five routes. Typical stops would be spaced one-half mile apart in the central business district of the City of Milwaukee, one mile apart in areas of high-density development, and two miles apart in areas of medium-density development.

Average speeds on the five routes would be about 32 miles per hour. Headways during the peak periods would range from 10 to 30 minutes, with all service being provided by trains of two vehicles permanently coupled together. With regard to the off-peak periods, headways would range from 30 to 45 minutes during the midday period, and from 30 to 45 minutes during the evening, with all routes operating with trains of two vehicles permanently coupled together. During the peak periods, each two-car heavy rail rapid transit train would carry a maximum of 148 seated passengers and up to 296 standees. During off-peak periods, each two-car train would carry 148 seated passengers and up to 132 standees.

The maximum extent heavy rail rapid transit system plan also envisions complementary expansion and improvement of the Milwaukee area local and express transit system elements. As under the maximum extent plans for all other potential primary transit technology, local transit service would be extended under the heavy rail rapid transit plan into all contiguous areas of urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County. Also, local transit service would be expanded during the off-peak travel periods, particularly in the evening. Express transit service under this plan would be provided over five transit routes, all of which are designed to complement the maximum extent heavy rail rapid transit system plan, serving some areas not directly served by the primary transit system. In total, the number of express and local service route miles operated would increase by 28 percent over the number anticipated in the base plan, from 1,302 to 1,665 miles. However, the number of express and local service bus miles operated would decrease by 10 percent from the number envisioned in the base plan, from 85,900 to 77,900 bus miles on an average weekday. The express and local transit services would be provided by conventional buses.

Transit Utilization: Under the maximum extent heavy rail rapid transit system plan and the moderate growth scenario-centralized land use plan alternative future, about 346,600 trips may be expected to be made using public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 159 and 160.[13] About 104,600, or 30 percent of these transit trips, may be expected to utilize the primary transit system for all or a portion of the trip. Thus, the heavy rail rapid transit plan envisions that about 8 percent of the total of 4.4 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that over 2 percent will be made using primary transit. About 19,800, or 6 percent, more transit trips may be expected under this plan than under the base plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent heavy rail rapid transit system plan and the base system plan are summarized in Table 161. The costs shown include all construction and right-of-way acquisition costs, plus the cost of acquiring and replacing vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 161.

The total capital cost of the base plan is estimated at $233 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain the existing service to the year 2000. About $22 million, or 10 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent heavy rail rapid transit plan is estimated at $2.9 billion. About $2.4 billion would be required for the construction of the heavy rail rapid transit guideway, including right-of-way, trackage, electrification, signalization, and system control. About

[13] *It should be noted that this maximum extent heavy rail system plan would carry from 7,000 to 11,000 fewer transit trips on an average weekday than the maximum extent light rail transit and busway system plans. The heavy rail primary transit element of the plan would carry 34,000 to 55,000 fewer trips than the primary element of the maximum extent light rail and busway system plans. This lower ridership occurs regardless of the fact that the average speed of the heavy rail primary transit element would be 50 percent greater than those of the comparable busway and light rail elements, because the heavy rail plan element must operate at significantly larger headways than the light rail and busway primary transit elements in order to meet a similar proportion of its operating costs from farebox revenues. The longer heavy rail headways increase the lengths of the waiting and transfer times for transit passengers, offsetting any line-haul speed advantage of the heavy rail primary transit element, and, as a result, reducing transit use.*

The larger headways are required because heavy rail is a much higher capacity transit mode per vehicle unit. To be comparable in terms of meeting operating costs with farebox revenues, all modes must generally use, on the average, a similar proportion of their passenger-carrying capacity. At the design load factor for peak travel periods, the smallest heavy rail vehicle unit—a permanently coupled two-car unit—would carry about 50 percent more passengers than a two-vehicle light rail train. During off-peak travel periods at design load factors, a heavy rail unit would carry three times the number of passengers. The results of the traffic assignments to the maximum extent heavy rail system plan at the same headways utilized by the light rail and busway plans indicated that transit passenger demand under such a plan, even under this most optimistic future, was such that a significant proportion of the heavy rail passenger-carrying capacity would not be utilized. Only 34 percent of the operating costs of the primary transit element would be met from farebox revenues under the shorter headways, compared with 74 percent under the longer headways. The heavy rail plan with shorter headways would, however, result in a total transit system average weekday ridership of 366,000 trips, and a primary element average weekday ridership of 152,000 trips, both substantially higher than the heavy rail plan as tested with longer headways—6 and 45 percent, respectively. But even with shorter headways, total transit system ridership would be only about 2 percent greater than that on a light rail transit system. Also, about 4 percent, or 7,500, fewer trips would be made on the primary element of the heavy rail system under shorter headways than under the primary element of the light rail system, 152,000 compared with 159,500. About 4 percent more transit trips could be expected to be made under the heavy rail plan than under the maximum extent busway plan, and 10 percent more trips could be expected to be made on the heavy rail primary transit element than on the busway primary element.

Table 159

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT HEAVY RAIL RAPID TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Maximum Extent Heavy Rail Rapid Transit Plan		
		Transit Trips			Transit Trips	
	Total Person Trips[a]	Number	Percent of Total Trips	Total Person Trips[a]	Number	Percent of Total Trips
Home-Based Work	1,112,900	102,100	9.2	1,105,900	109,900	9.9
Home-Based Shopping . .	512,400	39,000	7.6	510,300	43,100	8.4
Home-Based Other	1,502,200	116,900	7.8	1,490,100	127,800	8.6
Nonhome-Based.	837,100	17,500	2.1	829,700	14,500	1.7
School	465,300	51,300	11.0	465,300	51,300	11.0
Total	4,429,900	326,800	7.4	4,401,300	346,600	7.9

[a] *The difference in the total person trips generated under the maximum extent heavy rail rapid transit system plan and the base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been correlated with increased automobile ownership, and greater automobile ownership has been correlated with increased trip generation. The Commission's travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.*

Source: SEWRPC.

Table 160

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT HEAVY RAIL RAPID TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Time of Day	Base Plan				Maximum Extent Heavy Rail Rapid Transit Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	6,800	45.3	70,200	21.5	24,400	23.3	73,800	21.3
Midday	100	0.7	112,800	34.5	29,300	28.0	120,200	34.7
Afternoon . .	8,100	54.0	111,400	34.1	39,300	37.6	117,300	33.8
Evening. . . .	- -	- -	32,400	9.9	11,600	11.1	35,300	10.2
Total	15,000	100.0	326,800	100.0	104,600	100.0	346,600	100.0

Source: SEWRPC.

$214.2 million would be incurred in the purchase of new and replacement of transit vehicles—$54.8 million of which would be for the purchase of 73 heavy rail rapid transit vehicles and about $159.4 million of which would be for the purchase of 1,139 conventional buses. The remaining $346.1 million would be required for the construction of park-ride stations and of storage, maintenance, and layover facilities, and for the expansion of bus storage and maintenance facilities. About $2.8 billion, or over 96 percent of the total capital cost of the plan, would be attributable to its primary transit element.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent heavy rail rapid transit plan would be expected to approximate $586 million. The remain-

Table 161

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT HEAVY RAIL RAPID TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Heavy Rail Rapid Transit Plan
Guideway Development[b]	$ --	$2,370,223,000
Station Development[c]	2,893,700	311,025,400
Vehicle Storage and Maintenance Facility Development[c]	24,775,000	35,079,600
Vehicle Acquisition and Replacement[d]	205,660,000	214,210,000
Total	$233,328,700	$2,930,538,000

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent heavy rail rapid transit plan will be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 through 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes for the heavy rail rapid transit plan the cost of acquiring about 230 acres of right-of-way for guideway construction, and the cost of acquiring and relocating eight residential structures, one church, one library, and three steel lattice electric power transmission towers. This land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—12 acres under the base plan and 120 acres under the maximum extent heavy rail rapid transit plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses and heavy rail rapid transit vehicles used in the system. Both plans assume the availability of a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years. Heavy rail rapid transit vehicles have an estimated useful life of 30 years.*

Source: SEWRPC.

ing $2.4 billion would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal and the federal shares are estimated to total $47 million and $186 million, respectively.

Table 162 presents the operating and maintenance costs and farebox revenues anticipated for the design year of the base and maximum extent heavy rail rapid transit plans. Under the base plan, operating and maintenance costs may be expected to approximate $60 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent heavy rail rapid transit plan would increase the total operating and maintenance costs by $11.2 million, to a total cost of $71.5 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $4.3 million under the base plan, and $20.0 million under the maximum extent heavy rail rapid transit plan. Primary transit system operating and maintenance costs would thus represent about 7 percent of the total operating costs expected in the design year for the base plan, and about 28 percent of the total operating costs expected in the design year for the maximum extent heavy rail rapid transit plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.63. For the maximum extent heavy rail rapid transit plan, the average operating cost per passenger may be expected to approach $0.74—$0.11, or 7 percent, more than the base plan cost. The average operating cost per passenger mile would be $0.15 for both the base plan and the maximum extent heavy rail rapid transit plan. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.09 and $0.12, respectively, and for the primary element of the heavy rail rapid transit system plan would be $0.75 and $0.10, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $37 million, expressed in 1979 dollars, compared with about $43 million under the maximum extent heavy rail rapid transit plan. Under the maximum extent heavy rail rapid transit alternative, the primary transit element may be expected to generate about 35 percent, or about $15 million, of the total revenues, compared with 7 percent, or $2.4 million, under the base plan. Under both the base and maximum extent heavy rail rapid transit plans, current fares are assumed to increase with general price inflation. The fare under both plans would thus remain at $0.50 per ride, expressed in constant 1979 dollars, for local

Table 162

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT HEAVY RAIL RAPID TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Heavy Rail Rapid Transit Plan
Ridership		
Primary Element	3,825,000	26,673,000
Total System	94,250,000	96,853,000
Operating and Maintenance Cost		
Primary Element	$ 4,305,500	$19,976,700
Total System	60,313,100	71,484,200
Operating and Maintenance Cost per Passenger		
Primary Element	$1.09	$0.75
Systemwide Average	0.63	0.74
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.12	$0.10
Total System	0.15	0.15
Farebox Revenue		
Primary Element	$ 2,423,200	$14,690,600
Total System	37,114,800	42,643,700
Operating Deficit		
Primary Element	$ 1,882,300	$ 5,286,100
Total System	23,198,300	28,840,500
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	56	74
Total System	62	60
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 941,150	$ 2,643,050
Total System	11,599,150	14,420,250
State (72 percent of nonfederal share of operating deficit)		
Primary Element	677,628	1,903,000
Total System	8,351,388	10,382,600
Local		
Primary Element	263,522	740,050
Total System	3,247,762	4,037,650
Local Operating Deficit per Ride		
Primary Element	$0.07	$0.03
Total System	0.03	0.04

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, about equal to the $11.6 million required to provide 50 percent federal funding of the operating deficits under the base plan, but substantially less than the $14.4 million required to provide such funding under the maximum extent heavy rail rapid transit plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

and express bus service. Similarly, the primary service fare would remain at $0.60 within Milwaukee County, and outside Milwaukee County would range from $1.00 to a maximum of a $1.60 at the outer limits of the future urbanized area under the maximum extent heavy rail rapid transit plan.

The operating deficit in the year 2000 for the maximum extent heavy rail rapid transit plan would be about $29 million, expressed in 1979 dollars, requiring a subsidy of about $0.30 per passenger. This compares with the base system plan deficit of about $23 million, or $0.25 per passenger. Farebox revenues would cover about 60 percent of the operating costs under the maximum extent heavy rail rapid transit plan and 62 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has in the past funded up to 72 percent of the nonfederal share.[14] The local share of the public funding requirement would be about $4.0 million for the maximum extent heavy rail rapid transit plan in the plan design year. The local funding requirement for the base system would be somewhat less—$3.2 million.

Development of a Truncated System Plan: It is apparent from this evaluation of the maximum extent heavy rail system plan that sufficient demand for primary transit service in the Milwaukee area cannot be expected on a systemwide or individual corridor basis, even under this most optimistic future for transit over the next 20 years, to warrant construction of a heavy rail system. Traffic assignments indicate that operating the maximum extent heavy rail system at headways comparable to those provided under the

[14] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, about equal to the $11.6 million required to provide 50 percent federal funding of the operating deficits under the base plan, but substantially less than the $15.7 million required to provide such funding under the maximum extent heavy rail rapid transit plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the State share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

maximum extent light rail or busway system plans would result in substantial unused heavy rail capacity for all corridors. Consequently, less than 34 percent of the total heavy rail primary transit element operating costs may be expected to be recovered from farebox revenues, and for no routes would farebox revenues cover 50 percent of the operating costs. Increasing the heavy rail system headways by corridor to meet passenger demand at an acceptable level of operating cost recovery may be expected to result in a decrease in heavy rail system ridership, particularly on the primary transit element, such that both maximum extent light rail and busway system plan alternatives would carry more transit passengers in the design year 2000, particularly on their primary transit elements.

The analyses further indicated that, under either set of operating headways tested, there is no need in any corridor, or in any time period, for a train longer than the minimum of two vehicles . As a consequence, the efficiencies of the passenger-carrying capacity of a heavy rail system—the ability to utilize one operator for up to 10 vehicles—could not be exploited, and the estimated design year heavy rail operating costs may be considered to be optimistic.

Importantly, the maximum extent heavy rail alternative would require a far greater capital investment for guideway and station development than the light rail transit and busway alternatives, while providing no advantage in ridership or in annual operating costs, as shown in Table 163. The total operating costs and operating deficits over the 20-year plan design period of the maximum extent heavy rail system plan may be expected to be similar to those of the other fixed guideway systems; and, in the plan design year, all of the maximum extent fixed guideway plans would have similar operating deficits and similar proportions of total operating costs met by farebox revenues. Yet, since all guideways for the heavy rail rapid transit system must be completely grade-separated and require either subway or elevated structures in high-density urban areas, total capital and system costs, and total capital and system per passenger costs, over the plan design period and in the plan design year would be twice the comparable costs of the light rail transit system—the other electrically propelled guideway alternative considered under this future—and would be more than twice the comparable costs of the other primary transit elements under the moderate growth scenario-centralized land use plan alternative future. Any primary transit system in the Milwaukee area should serve the Milwaukee central business district, preferably along an alignment located over W. Wisconsin Avenue. Under the maximum extent heavy rail system plan, the cost of locating an alignment in a subway beneath W. Wisconsin Avenue for about 1.4 miles between N. 11th Street and the lakefront is estimated to approach $115 million, or about $80 million per mile—or about three times more costly, on the average, than the cost of heavy rail guideway and station development outside the Milwaukee central business district.

Because of the very high capital costs of the heavy rail mode, both on a systemwide basis and corridor basis, and of the inefficient utilization of its potential capacity even under this most optimistic future for transit in the Milwaukee area over the next 20 years, particularly as such inefficient utilization may be expected to result in decreased transit use, it is was determined that heavy rail rapid transit should be eliminated from further consideration as a possible alternative for the provision of primary transit service in the Milwaukee area under the primary transit system alternatives analysis.

EVALUATION AND COMPARISON OF TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS

The fifth and last step in the design, test, and evaluation of alternative primary transit system plans under the moderate growth scenario-centralized land use plan alternative future was the test and evaluation of the truncated system plans for each alternative primary transit technology. Based upon this test and evaluation, a "best" plan for the provision of primary transit service in the Milwaukee area under this alternative future was identified.

The truncated system plans for the bus-on-freeway, commuter rail, light rail transit, and busway alternative primary transit technologies are summarized with respect to their coverage, stations, routes, and operation on Maps 73 through 75 and in Tables 164 through 166. It should be noted that these alternative truncated plans, as presented in the previous section of this chapter, were further refined for comparative test and evaluation so that the geographic extent of primary transit service provided under each alternative was comparable. Specifically, primary transit bus-on-freeway routes from the truncated bus-on-freeway plan were added to the truncated light rail, busway, and commuter rail plans in travel corridors where those modal plans

Table 163

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN, MAXIMUM EXTENT HEAVY RAIL RAPID TRANSIT SYSTEM PLAN, MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN, AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

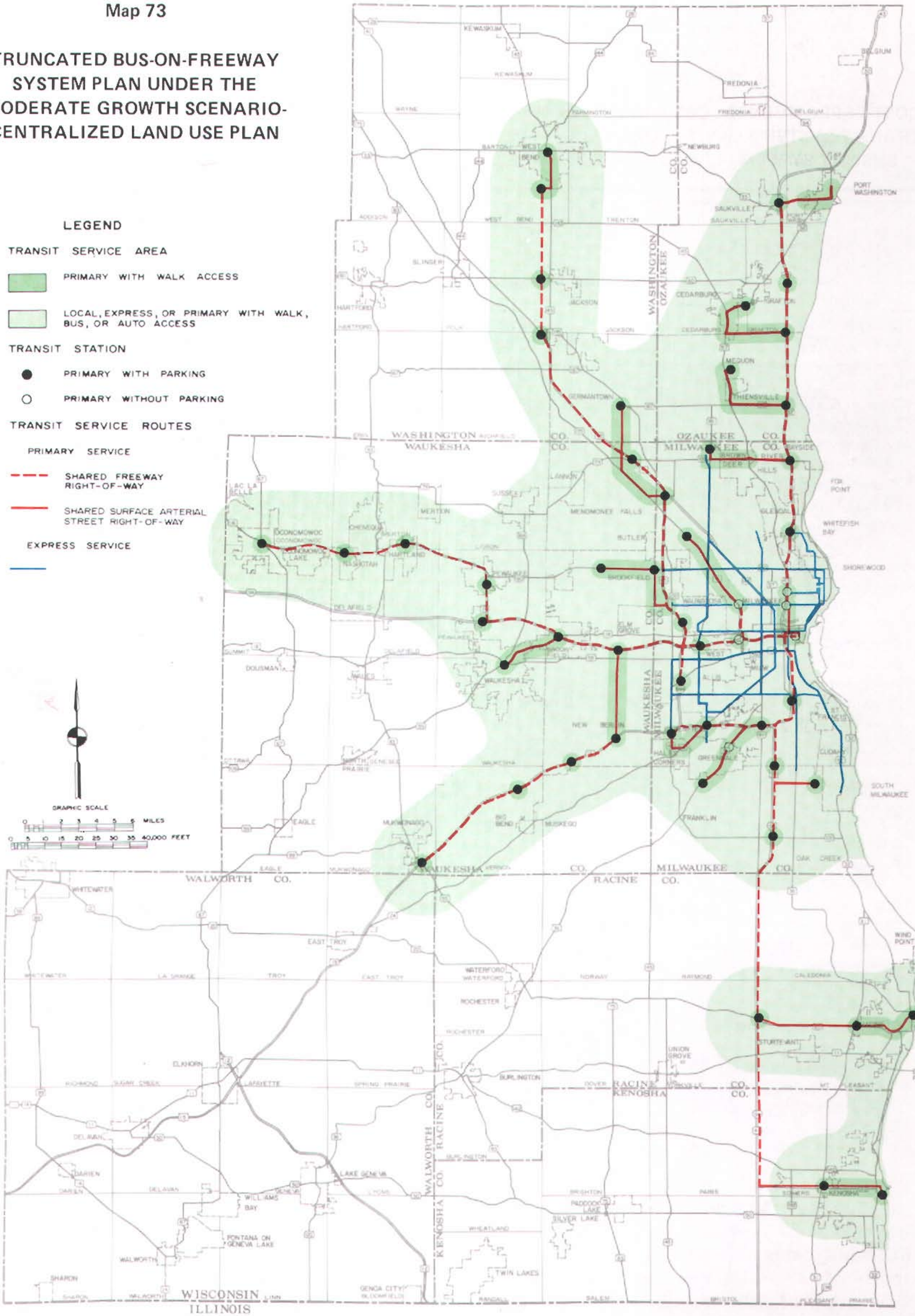
Cost Element	Base Plan	Maximum Extent Heavy Rail Rapid Transit Plan	Maximum Extent Light Rail Transit Plan	Maximum Extent Busway Plan
Ridership				
In Design Year	94,250,000	96,853,000	98,180,000	97,660,000
To Design Year	1,485,900,000	1,511,800,000	1,522,385,000	1,518,200,000
Capital Cost				
Total to Design Year	$233,328,700	$2,930,538,000	$1,231,138,000	$ 771,162,200
To Design Year per Passenger	0.16	1.94	0.81	0.51
To Design Year After Accounting for Useful Life Beyond Design Year	148,842,000	1,572,378,300	628,160,000	442,054,490
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	1.04	0.41	0.29
Operating Cost				
Percent Met by Farebox Revenues in Design Year	62	60	59	58
Operating Deficit in Design Year	$ 23,198,300	$ 28,840,500	$ 30,928,100	$ 31,378,700
Operating Deficit per Passenger in Design Year	0.25	0.30	0.21	0.32
Operating Deficit to Design Year	430,900,000	476,036,600	492,740,000	496,340,000
Operating Deficit to Design Year per Passenger	0.29	0.31	0.32	0.33
Total Cost				
To Design Year	$664,228,700	$3,406,574,600	$1,723,878,000	$1,267,502,200
Federal Share	402,112,960	2,582,448,700	1,231,280,400	865,099,760
Nonfederal Share	262,115,740	824,125,900	492,597,600	402,402,440
To Design Year per Passenger	0.45	2.25	1.13	0.84
Federal Share	0.27	1.71	0.81	0.57
Nonfederal Share	0.18	0.54	0.32	0.27
To Design Year After Accounting for Useful Life Beyond Design Year	579,742,000	2,048,414,900	1,120,900,000	938,394,490
Federal Share	334,523,600	1,495,920,000	748,898,000	601,813,590
Nonfederal Share	245,218,400	552,493,960	372,002,000	336,580,900
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.39	1.35	0.73	0.62
Federal Share	0.225	0.99	0.49	0.40
Nonfederal Share	0.165	0.36	0.24	0.22

Source: SEWRPC.

did not provide service, but where the bus-on-freeway plan did provide service. Without these further refinements to provide a comparable extent of service between the alternative plans, a comparative evaluation of the alternative plans would have been impossible. Also, each individual plan—light rail transit, busway, and commuter rail—would not include primary transit services in some corridors which could reasonably expect to be implemented by the design year, and the cost for which should be accounted for in systems planning. Bus-on-freeway service was added to the other truncated plans to make them composite plans because the bus-on-freeway plan provided greater geographic coverage than any of the other plans, it was the lowest capital cost primary transit alternative, and it represented a continuation and evolutionary extension of existing primary transit service.

Map 73

TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

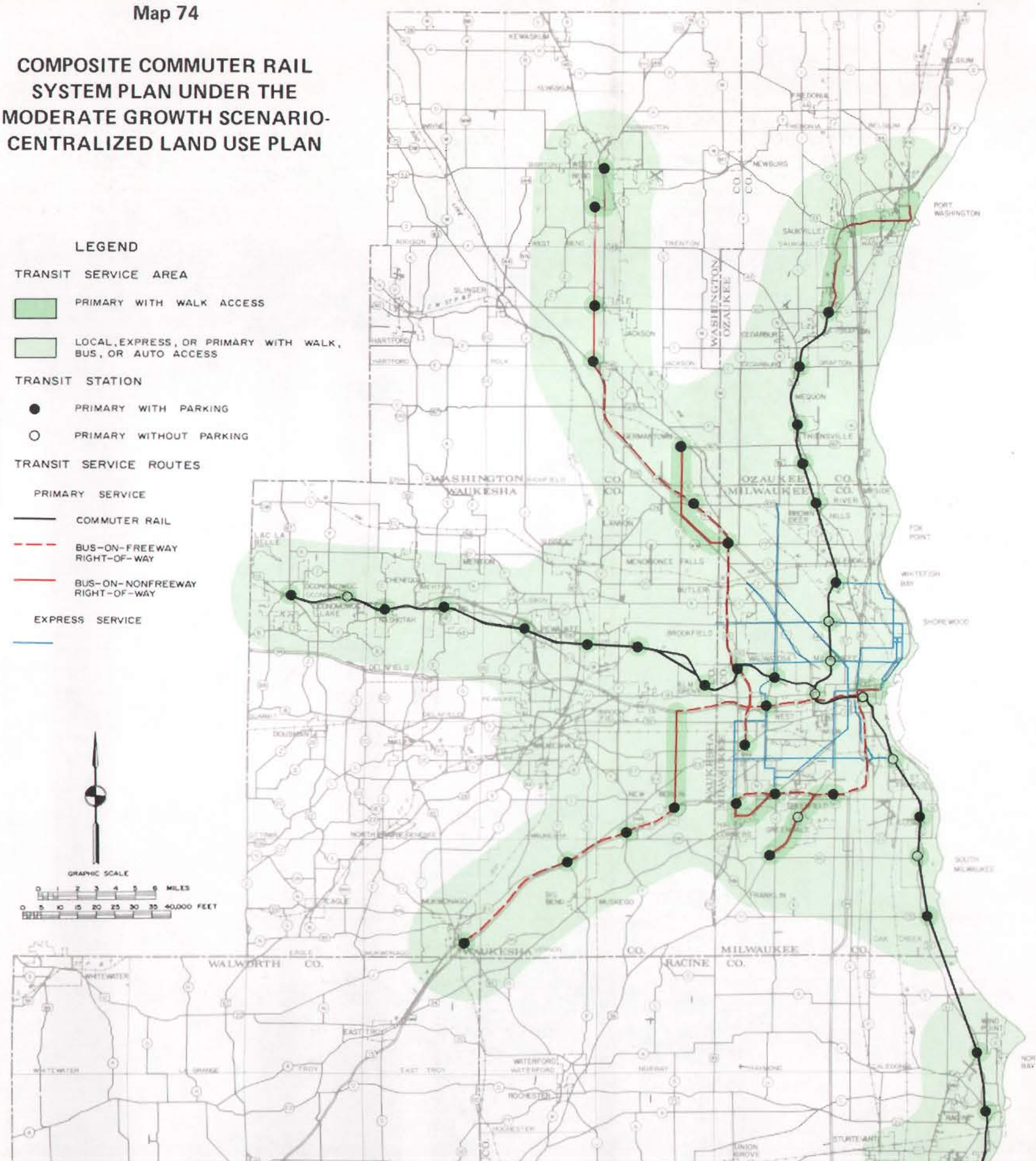


The truncated bus-on-freeway system plan is a carefully cut back version of the maximum extent bus-on-freeway system plan, the cutbacks being made with the objective of creating a more cost-effective system serving a large part of the Milwaukee area. Under the truncated plan, 25 of the 31 routes, totaling 225 miles of line over which 955 round-trip route miles of service would be provided, or about 92 percent of the 246 miles of line and 80 percent of the 1,218 route miles of service provided under the maximum extent plan, were retained. Headways were assumed to remain about the same as under the maximum extent plan, ranging from 7 to 30 minutes during the peak travel periods, and 15 to 60 minutes during the off-peak periods. Under the truncated plan, a total of 52 primary transit stations or stops would be served outside the Milwaukee central business district, 47 of which would have park-ride lots. There would be 22 stations within Milwaukee County, 17 of which would have park-ride lots.

Source: SEWRPC.

Map 74

COMPOSITE COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

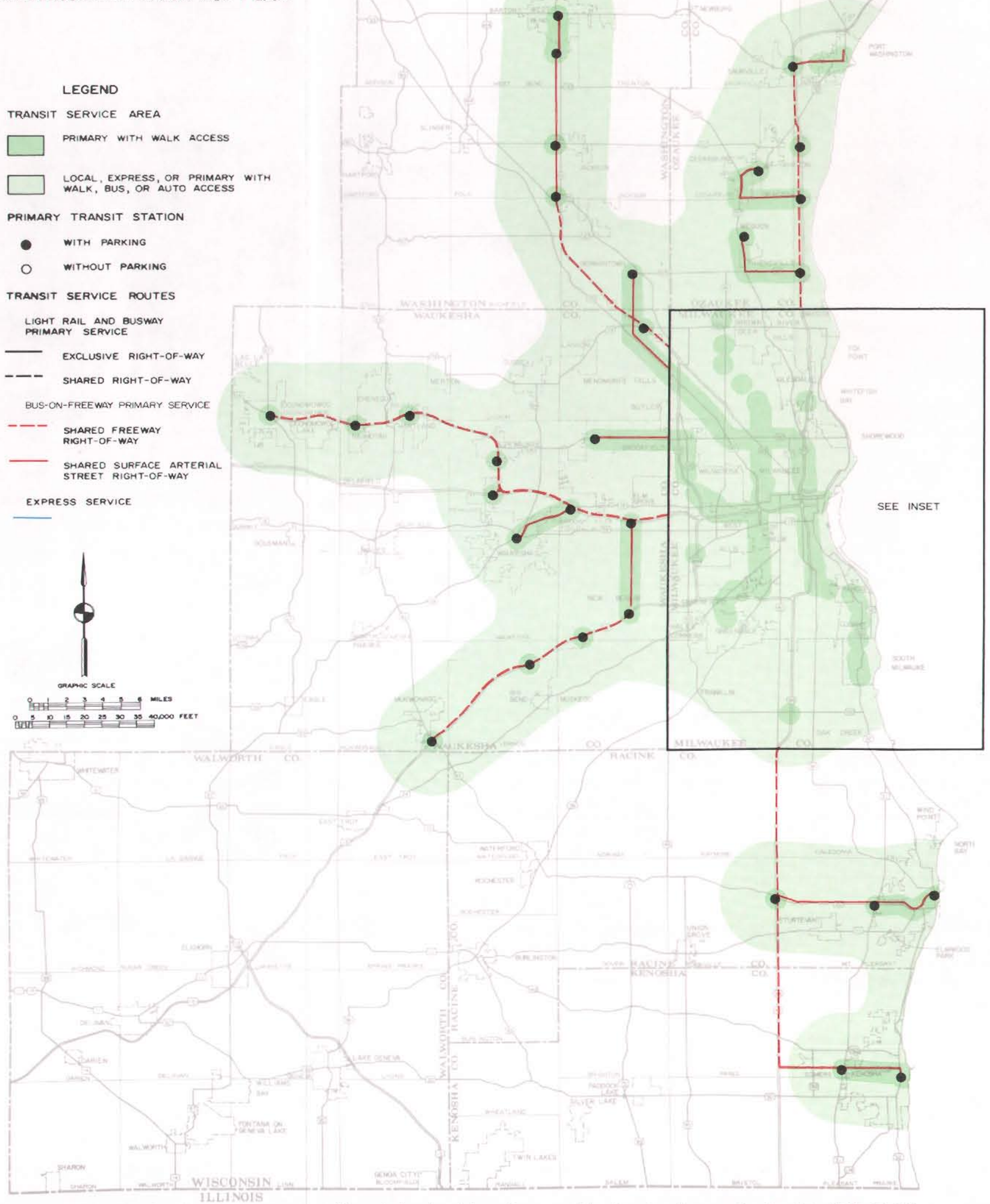


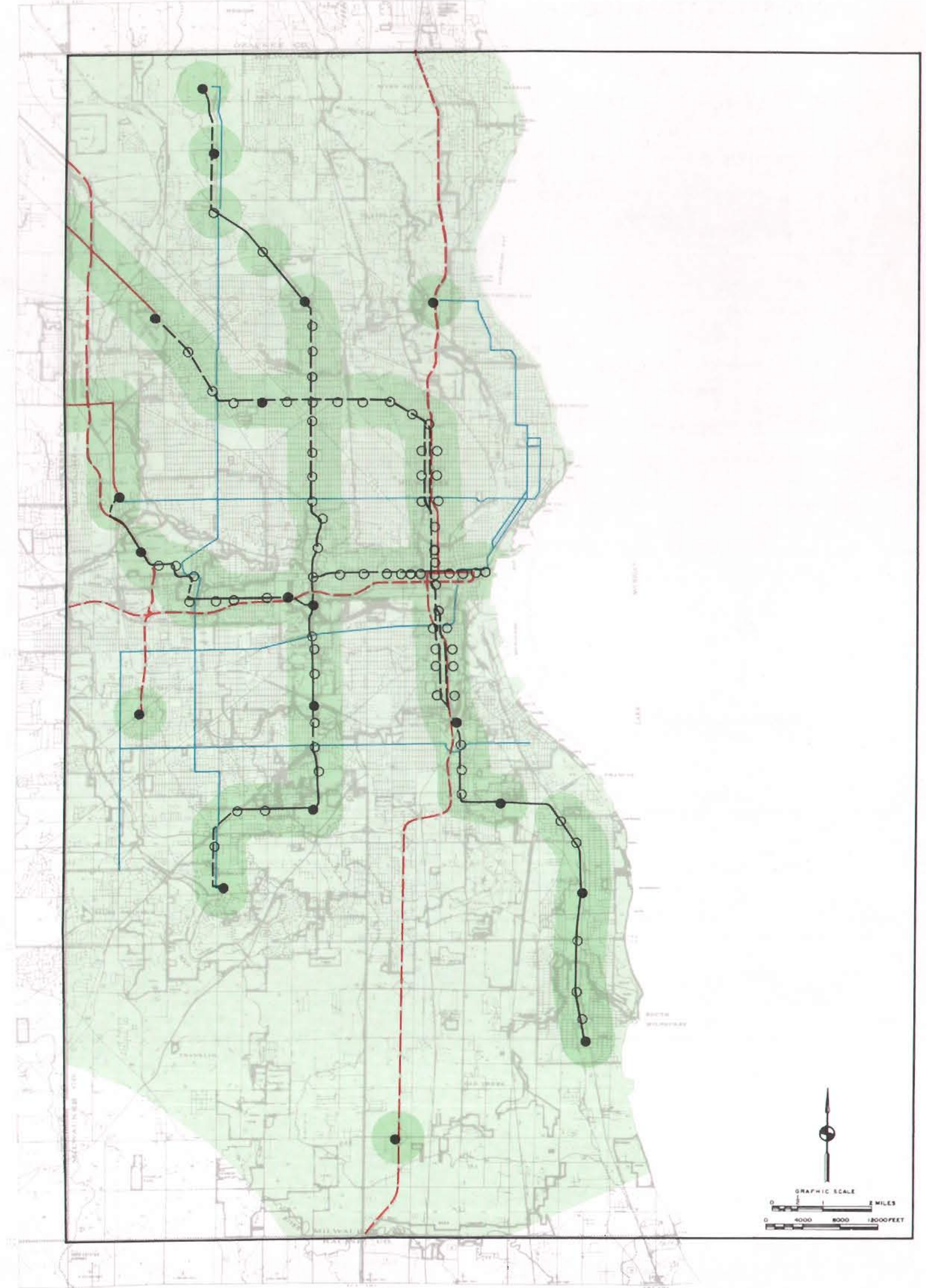
The composite commuter rail system plan is a carefully cut back version of the maximum extent commuter rail system plan, the cutbacks being made with the objective of creating a more cost-effective system serving a large part of the Milwaukee area. Under the composite plan, three of the six commuter rail lines totaling 86.2 miles in length and over which a total of 177 round-trip route miles of service would be provided—or about one-half of the 154.5 miles of line and 354 route miles of service provided under the maximum extent plan—were retained. To make this plan comparable to the truncated bus-on-freeway plan, a total of nine bus-on-freeway routes, representing an additional 344 round-trip route miles of primary service, were added to serve portions of the Milwaukee area that would not be served by the three commuter rail primary transit routes. Headways for the commuter rail system would remain the same as under the maximum extent plan, and headways for the bus-on-freeway service would range from 6 to 30 minutes during the peak travel periods and 40 to 60 minutes during the off-peak periods. A total of 46 primary transit stations or stops would be provided, of which 28 stations would serve the commuter rail system and 18 stations would serve the bus-on-freeway service. Of the 46 stations, 38 would have park-ride lots. There would be 20 stations within Milwaukee County, of which 13 would have park-ride lots.

Source: SEWRPC.

Map 75

COMPOSITE LIGHT RAIL TRANSIT AND BUSWAY SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN





The composite light rail transit and busway system plans are carefully cut back versions of the maximum extent light rail transit and busway system plans. The cutbacks were made with the objective of creating more cost-effective systems which could still serve a large part of the Milwaukee area. Under the composite plans, fixed guideways would be limited to Milwaukee County. A total of 49.3 miles of line over which 103 round-trip route miles of service would be provided were retained on three routes, or about 47 percent of the 104.5 miles of line and about 40 percent of the 253 round-trip route miles of service provided under the maximum extent plan. To make this plan comparable to the bus-on-freeway plan, a total of 14 bus-on-freeway routes, operating over 201 miles of line and providing an additional 743 round-trip route miles of primary service, were added to serve portions of the Milwaukee area that would not be served by the three light rail transit or busway primary transit routes. Headways on the light rail transit system would range from 5 to 10 minutes during the peak travel periods, and 8 to 20 minutes in the off-peak periods. Bus-on-freeway service would be provided with headways ranging from 7 to 30 minutes during the peak travel periods, and 15 to 60 minutes in the off-peak periods. A total of 126 primary transit stations or stops would be provided, of which 93 stations would serve the light rail transit system, and 33 stations would serve the bus-on-freeway service. Of the 126 stations, 16 would have park-ride lots for light rail transit, and 33 would have park-ride lots for bus-on-freeway. A total of 96 stations would be located within Milwaukee County, of which 19 would have park-ride lots.

Source: SEWRPC.

Table 164

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS ON AN AVERAGE WEEKDAY UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Base Plan	Truncated Bus-on-Freeway Plan	Composite Commuter Rail Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Primary					
Exclusive Guideway Miles					
Subway	--	--	--	--	--
Elevated.	--	--	--	6.5	6.5
At-Grade	--	--	--	42.8	42.8
Subtotal	--	--	86.2[b]	49.3	49.3
Shared Guideway Miles					
Freeways	51.5	141.0	68.0	129.4	127.5
Surface Arterial Streets	49.5	84.2	35.4	71.2	67.1
Total	101.0	225.2	189.6	249.9	243.9
Stations.	20	52	46	126	126
Route Miles	449	955	521	846	838
Vehicle Miles[a]	8,900	40,140	19,120	43,570	45,070
Vehicle Hours	460	1,410	660	1,690	1,780
Vehicle Required					
Motor Buses	78	199	52	128	264
Light Rail Vehicles.	--	--	--	98	--
Commuter Rail Coaches.	--	--	60	--	--
Trains Required	--	--	18	61	--
Express and Local					
Route Miles	1,302	1,814	1,775	1,620	1,620
Vehicle Miles.	85,900	99,950	103,970	84,900	87,240
Vehicle Hours	6,520	6,520	6,830	5,600	5,740
Motor Buses Required	823	842	891	698	717
Total System					
Route Miles	1,755	2,769	2,296	2,466	2,458
Vehicle Miles.	94,800	140,090	123,090	128,470	132,310
Vehicle Hours	6,980	7,930	7,490	7,290	7,520
Vehicles Required					
Motor Buses	901	1,041	943	826	981
Light Rail Vehicles.	--	--	--	98	--
Commuter Rail Coaches.	--	--	60	--	--
Trains Required	--	--	18	61	--

[a] *Vehicle miles of travel per average weekday on the bus-on-freeway component of the composite plans are estimated at 11,630 vehicle miles for the composite commuter rail plan; 29,770 vehicle miles for the composite light rail transit plan; and 29,450 vehicle miles for the composite busway plan.*

[b] *Although commuter train operation is designated in this table as being over an exclusive guideway, commuter trains in fact operate over railway trackage shared with freight trains.*

Source: SEWRPC.

Table 165

TIME-OF-DAY OPERATION OF THE TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Truncated Bus-on-Freeway Plan					
Primary Element					
Route Miles	955	955	955	955	955
Vehicle Miles	9,840	10.730	14,270	5,300	40,140
Vehicle Hours	360	350	520	180	1,410
Articulated Motor Buses Required	139	67	199	53	199
Express and Local Elements					
Route Miles	1,814	1,740	1,814	1,631	1,814
Vehicle Miles	22,240	29,500	29,300	18,910	99,950
Vehicle Hours	1,490	1,890	1,970	1,170	6,520
Conventional Motor Buses Required	662	330	842	197	842
Total System					
Route Miles	2,769	2,695	2,769	2,586	2,769
Vehicle Miles	32,080	40,230	43,570	24,210	140,090
Vehicle Hours	1,850	2,240	2,490	1,350	7,930
Vehicles Required	801	397	1,041	250	1,041
Articulated Motor Buses	139	67	199	53	199
Conventional Motor Buses	662	330	842	197	842
Composite Commuter Rail Plan					
Primary Element					
Route Miles	521	521	521	521	521
Vehicle Miles	4,970	4,860	6,530	2,760	19,120
Vehicle Hours	180	150	240	90	660
Vehicles Required	94	38	112	27	112
Commuter Rail Coaches	47	19	54	8	54
Articulated Motor Buses	47	19	58	19	58
Trains Required	18	9	18	6	18
Express and Local Elements					
Route Miles	1,775	1,701	1,775	1,598	1,775
Vehicle Miles	22,970	29,650	30,760	20,590	103,970
Vehicle Hours	1,540	1,910	2,090	1,290	6,830
Conventional Motor Buses Required	679	342	891	206	891
Total System					
Route Miles	2,296	2,222	2,296	2,119	2,296
Vehicle Miles	27,940	34,510	37,290	23,350	123,090
Vehicle Hours	1,720	2,060	2,330	1,380	7,490
Vehicles Required	698	351	899	212	899
Commuter Rail Coaches	47	19	54	8	54
Articulated Motor Buses	47	19	58	19	58
Conventional Motor Buses	679	342	891	206	891
Trains Required	18	9	18	6	18

Table 165 (continued)

Alternative	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Composite Light Rail Transit Plan					
Primary Element					
Route Miles	846	846	846	846	846
Vehicle Miles	10,070	12,370	15,360	5,770	43,570
Vehicle Hours	410	460	610	210	1,690
Vehicles Required	153	84	226	61	226
Articulated Light Rail Vehicles	70	31	98	22	98
Articulated Motor Buses	83	53	128	39	128
Trains Required	43	31	61	22	61
Express and Local Elements					
Route Miles	1,620	1,546	1,620	1,518	1,620
Vehicle Miles	18,200	25,760	23,110	17,830	84,900
Vehicle Hours	1,240	1,670	1,580	1,110	5,600
Conventional Motor Buses Required	572	295	698	182	698
Total System					
Route Miles	2,443	2,369	2,443	2,341	2,466
Vehicle Miles	28,270	38,130	38,470	23,600	128,470
Vehicle Hours	1,650	2,130	2,190	1,320	7,290
Vehicles Required	725	379	924	243	924
Articulated Light Rail Vehicles	70	31	48	22	98
Articulated Motor Buses	83	53	128	39	128
Conventional Motor Buses	572	295	698	182	698
Trains Required	43	31	61	22	61
Composite Busway Plan					
Primary Element					
Route Miles	838	838	838	838	838
Vehicle Miles	11,330	11,090	16,730	5,920	45,070
Vehicle Hours	470	400	690	220	1,780
Articulated Motor Buses Required	184	90	264	63	264
Express and Local Elements					
Route Miles	1,620	1,546	1,620	1,518	1,620
Vehicle Miles	18,960	26,350	23,980	17,950	87,240
Vehicle Hours	1,270	1,710	1,640	1,120	5,740
Conventional Motor Buses Required	581	309	717	184	717
Total System					
Route Miles	2,458	2,384	2,458	2,356	2,458
Vehicle Miles	30,290	37,440	40,710	23,870	132,310
Vehicle Hours	1,740	2,110	2,330	1,340	7,520
Vehicles Required	765	399	981	1,183	981
Articulated Motor Buses	184	90	264	63	264
Conventional Motor Buses	581	309	717	184	717

Source: SEWRPC.

Table 166

SUMMARY OF SERVICE AND FACILITY CHARACTERISTICS OF TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Summary of Truncated and Composite Plans
Truncated Bus-on-Freeway Plan	Extent of Service—Expansion of primary service proposed under the maximum extent plan was not significantly reduced. Under the truncated plan, 25 of the 31 routes totaling 955 route miles, or 80 percent of the 1,218 route miles in the maximum extent plan, were retained. Frequency of Service—Headways would remain about the same, ranging from 7 to 30 minutes in the peak periods and 15 to 60 minutes in the off-peak periods. Operations—Under the truncated plans, bus miles per average weekday of primary service would be reduced by nearly 20 percent, from 49,500 miles under the maximum extent plan to 40,140 miles. Bus miles per average weekday of local and express service would decrease by about 5 percent, from about 103,600 miles to about 99,950 miles. Transit Stations—A total of 52 transit stations or stops would be provided outside the Milwaukee central business district, 47 of which would have park-ride lots. Under the truncated plan, there would be 22 stations in Milwaukee County, 17 of which would have park-ride lots.
Composite Commuter Rail Plan	Extent of Service—Expansion of primary service proposed under the maximum extent commuter rail plan was somewhat reduced. A total of three of the six routes totaling 177 route miles, or 50 percent of the 354 route miles in the maximum extent plan, were retained, all of which would terminate at the Milwaukee passenger station. Service would extend north along one route to the Village of Grafton in Ozaukee County; west along a second route to the City of Oconomowoc in Waukesha County; and south along a third route to the Cities of Racine and Kenosha. To make this plan comparable to the bus-on-freeway plan, a total of nine bus-on-freeway routes, representing an additional 344 route miles of primary service, would be added to serve the communities of Germantown, Menomonee Falls, and West Bend in Waukesha and Washington Counties to the northwest; the communities of Big Bend, Mukwonago, and New Berlin to the southwest; and the communities of Greendale, Hales Corners, and West Allis in Milwaukee County. Frequency of Service—Headways on the commuter rail system would remain the same as under the maximum extent plan; headways on the bus-on-freeway service would range from 6 to 30 minutes in the peak period and 40 to 60 minutes in the off-peak periods. Operations—Total vehicle miles per average weekday of primary service would increase by about 45 percent to 19,120 miles, of which 7,490 miles would be provided by commuter rail and 11,630 miles by the bus-on-freeway service. Bus miles of express and local service would decrease somewhat, from 121,500 miles to 103,970 miles on an average weekday. Transit Stations—A total of 46 transit stations or stops would be provided, of which 28 stations would be on the commuter rail system and 18 would be on the bus-on-freeway system. Of the 46 stations, 38 would have park-ride lots. There would be 20 stations within Milwaukee County, of which 13 would have park-ride lots.
Composite Light Rail Transit Plan	Extent of Service—Expansion of light rail transit primary service proposed under the maximum extent light rail transit plan was somewhat reduced, limiting light rail transit service to Milwaukee County. Under the composite plan, three of the five routes totaling 103 route miles, or 40 percent of the 253 route miles in the maximum extent plan, were retained. Two of the routes would extend from the Milwaukee central business district, providing service between Timmerman Field to the northwest and the communities of Cudahy, St. Francis, and South Milwaukee to the south, and the other terminating at the Mayfair Mall Shopping Center to the west. The third route would be a north-south crosstown route connecting Northridge and Southridge Shopping Centers and passing through the communities of Greendale, Greenfield, Milwaukee, and West Milwaukee. To make this plan comparable to the bus-on-freeway plan, a total of 14 bus-on-freeway routes, representing an additional 743 route miles of primary service, would be added to serve the communities of Cedarburg, Grafton, Mequon, Port Washington, and Saukville in Ozaukee County to the north; the communities of Brookfield and Menomonee Falls in Waukesha County to the northwest, and Germantown and West Bend in Washington County to the northeast; the communities of Oconomowoc and Waukesha to the west; the communities of Mukwonago and New Berlin to the southwest; and the communities of Kenosha, Oak Creek, and Racine to the south.

Table 166 (continued)

Alternative	Summary of Truncated and Composite Plans
Composite Light Rail Transit Plan (continued)	Frequency of Service—Headways on the light rail transit system would range from 5 to 10 minutes in the peak period and 8 to 20 minutes in the off-peak periods; bus-on-freeway service would be provided with headways ranging from 7 to 30 minutes in the peak period and 15 to 60 minutes in the off-peak periods. Operations—In the peak period, trains would consist of two articulated light rail vehicles for both routes extending from the Milwaukee central business district. One-car trains would be provided on the crosstown route in the peak period and on all routes in the off-peak periods. Total vehicle miles per average weekday of primary service would increase two-fold, from 28,100 miles under the maximum extent plan to 43,570 miles, of which 13,800 miles would be provided by light rail transit service and 29,770 miles by bus-on-freeway service. Bus miles of express and local service would increase somewhat, from 77,200 miles to 84,900 miles on an average weekday. Transit Stations—A total of 126 transit stations or stops would be provided, of which 93 stations would be provided on the light rail transit system, and 33 stations on the bus-on-freeway system. Of the 126 stations, 16 would have park-ride lots for light rail transit and 33 would have park-ride lots for bus-on-freeway. A total of 96 stations would be located within Milwaukee County, of which 19 would have park-ride lots. Fare Collection—Fare collection on the light rail transit system would be through a self-service barrier-free method during all travel periods.[a]
Composite Busway Plan	Extent of Service—Busway service would be provided over the same three routes as under the composite light rail transit system plan. Also, the bus-on-freeway routes are the same as provided under the composite light rail transit plan.[b] Frequency of Service—Headways on the busway system would range from 3 to 6 minutes in the peak period and 7 to 30 minutes in the off-peak periods; bus-on-freeway service would be provided with headways ranging from 7 to 30 minutes in the peak period and 15 to 60 minutes in the off-peak periods. Operations—Total vehicle miles per average weekday of primary service would increase by about 45 percent—from 31,000 miles under the maximum extent plan to 45,070 miles—of which 15,620 miles would be provided by busway service and 29,450 miles by bus-on-freeway service. Bus miles of express and local service per average weekday would increase somewhat, from 80,900 miles to 87,240 miles. Transit Stations—The number and location of busway system stations and stops would be the same as under the composite light rail transit plan.

[a] *The use of self-service fare collection during all travel periods under this plan would have a modest impact on systemwide operating and capital costs—specifically, a reduction of $300,000, from $12.0 million to $11.7 million—reflecting the net effect of a reduction in operator requirements for two-car trains, but an increase in costs attributable to inspection and in operating and maintenance costs attributable to ticket vending machines and validators.*

The capital costs attributable to validators and vending machines, including replacement, as necessary, over the design period, would increase the cost of vehicles and stations by an average of, $6,500 and $30,000, respectively, and the total system costs by about $3.1 million over the 20-year design period. It is estimated that, based on an annual operating cost savings of $300,000, this capital investment would be recovered in about 10 years.

[b] *The design of the composite busway plan provided for certain bus-on-freeway routes to operate over the busway for a portion of their trips, if such routing would not provide a travel time disadvantage. Of the 14 bus-on-freeway routes added to the plan, only four routes, all operating over the North-South Freeway (IH 43) and serving the communities of Brown Deer, Cedarburg, Grafton, Port Washington, and Thiensville, would meet this criterion. These routes would enter the busway at Locust Street and remain on the busway through downtown Milwaukee.*

Source: SEWRPC.

Alternative Primary Transit Plan
Evaluation and Comparison—
Satisfaction of Objectives and Standards

The alternative truncated and composite primary transit system plans were evaluated and compared by establishing the degree to which the plans could be expected to meet the adopted primary transit system development objectives.[15] This was determined by scaling each alternative plan against the standards formulated to relate the objectives to specific primary transit system development proposals. So that the evaluative information would be manageable, only those standards which were considered essential to a comparative evaluation of alternative plans, and the subsequent selection of a "best" composite plan, were used, as shown in Table 167. Standards which were satisfied by all plans through the system design or which could be equally satisfied by all plans if properly implemented were not used in this evaluation.

Table 168 provides a summary of the degree to which each alternative truncated system plan satisfies each of the key standards used and, therefore, the adopted objectives. Also included in the table is the measured attainment of the key standards by the base plan.

It should be noted that, while the primary transit facilities and services under each truncated plan have been tested and evaluated in detail, and refined and improved to the maximum extent practicable, the local and express elements of each truncated plan have not. The local and express transit elements of each truncated plan provide the extent of such service recommended under the adopted long-range regional transportation system plan, with modifications made only as necessary to coordinate such service with the primary transit service under each alternative plan. The adopted long-range transportation system plan proposed expansion of local transit service into all areas of contiguous future urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County. Not all of this expanded service may be cost-effective under this alternative future, and such service may thus reduce the cost-effectiveness of the alternative truncated and composite primary transit system plans. Upon selection of a "best" composite plan, the cost-effectiveness of this expanded local and express transit service will be considered, and its extent may be truncated, enabling a better comparison of the final primary transit plan to the base plan.

Objective 1—Serve Land Use: The first objective under this study identifies the need for an accessible primary transit system which, through its location, capacity, and design, will effectively serve existing, and promote sound future, land use development. This objective is measured by two standards. One standard measures the degree to which transit accessibility to the Milwaukee central business district is maximized. The other standard measures the degree to which transit accessibility in the Milwaukee area would support the regional land use plan by providing a higher relative accessibility to areas in which high-density development is planned than to areas planned for low-density development or planned to be protected from development.

The standard calling for maximizing transit accessibility to the Milwaukee central business district was measured by determining the overall travel time, including all access, wait, and transfer time, for transit trips to the Milwaukee central business district from all parts of the Milwaukee area, and the travel time for transit trips as an average for the entire Milwaukee area. The average overall travel times of transit trips to the central business district would be about the same for the four truncated or composite plans under this alternative future, ranging from 34 minutes for the bus-on-freeway plan to 37 minutes for the busway plan. Travel times to the Milwaukee central business district would be the shortest under the bus-on-freeway plan because its primary element would operate nonstop, or with limited stops, to the central business district. The travel contour lines on Maps 76 through 80 indicate the overall transit travel times from each part of the Milwaukee area. These maps indicate that transit accessibility to the central business district would be greater under all the truncated and composite plans than under the base plan. The maps also indicate that in all parts of the Milwaukee area, the bus-on-freeway, light rail transit, and busway plans would generally provide a travel time advantage to the Milwaukee central business district over the commuter rail plan.

[15] *See Chapter II of SEWRPC Planning Report No. 33, A Primary Transit System Plan for the Milwaukee Area.*

Table 167

STANDARDS USED IN ALTERNATIVE PLAN EVALUATION

Objective	Standards Used in Alternative Plan Evaluation	Standards Not Used in Alternative Plan Evaluation		
		Met in Design of Alternative Plans	Could be Met by All Plans	Can Only Be Measured in Facilities Planning
No. 1—Promote Sound Land Use Development				
Standard 1: Maximize number of residents within maximum overall travel times of selected major activity centers		X		
Standard 2: Adjust transit accessibility to land use plan	X			
Standard 3: Maximize accessibility to the central business district	X			
No. 2—Provide an Economical and Efficient Plan				
Standard 1: Minimize operating and capital costs	X			
Standard 2: Direct benefits should exceed costs	X			
Standard 3: Minimize energy use in total and per passenger mile	X			
Standard 4: Minimize net capital and operating costs per ride	X			
Standard 5: Minimize the marginal net capital and operating costs per seat mile and ride	X			
No. 3—Provide an Appropriate Service				
Standard 1: Service should save one minute per mile and in-vehicle trip length should exceed four miles		X		
Standard 2: Maximize the number of residents served	X			
Standard 3: Minimize transfers which would discourage transit use		X		
Standard 4: Provide adequate capacity so as not to exceed load factors		X		
Standard 5: Provide service not to exceed maximum headways		X		
Standard 6: Provide stops at no less than one-half-mile distances		X		
Standard 7: Maximize the number of users walking less than one-quarter mile in downtown		X		
Standard 8: Provide sufficient parking to meet demand at park-ride stations		X		
Standard 9: Design stops for weather protection, feeder access, and modal interface		X	X	
Standard 10: Enhance transit reliability			X	
Standard 11: Maximize the number of jobs served	X			
Standard 12: Maximize transit ridership	X			
No. 4—Minimize Disruption				
Standard 1: Reserve right-of-way in advance			X	
Standard 2: Minimize penetration of neighborhood units				X
Standard 3: Minimize taking of homes, businesses, and industries	X			
Standard 4: Minimize the amount of land taken	X			
Standard 5: Minimize the noise generated			X	X
Standard 6: Minimize the taking of historic, cultural, and scenic buildings and sites	X			
Standard 7: Minimize transportation air pollutant emissions	X			
No. 5—Maximize Quick and Convenient Travel				
Standard 1: Connect and serve major activity centers and areas		X		
Standard 2: Minimize transit travel time per trip	X			
Standard 3: Minimize in-vehicle transit trips length per trip		X		
Standard 4: Minimize transit vehicle miles per trip		X		
Standard 5: Provide service at minimum vehicle speeds		X		
Standard 6: Reduce traffic congestion				X
Standard 7: Maximize the number of new transit users	X			
No. 6—Increase Travel Safety				
Standard 1: Maximize the proportion of travel using transit	X			
Standard 2: Maximize the amount transit use over exclusive guideways	X			
Standard 3: Design transit to maximize personal safety			X	
No. 7—Provide High Aesthetic Quality				
Standard 1: Use sound standards of design			X	
Standard 2: Avoid destruction of pleasing buildings, features, and vistas				X

Source: SEWRPC.

Table 168

SUMMARY OF EVALUATION OF THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Evaluative Measure	Alternative: Base Plan	Truncated Bus-on-Freeway Plan	Composite Commuter Rail Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Objective No. 1—Serve Land Use					
Accessibility					
Average Overall Travel Time of Transit Trips to the Milwaukee Central Business District (minutes)	35	34	36	35	37
Objective No. 2—Minimize Cost and Energy Use					
Cost					
Total Public Cost to Design Year (capital cost and operating and maintenance cost deficit)	$579,742,000	$774,474,000	$781,156,400	$964,264,000	$883,375,000
Average Annual Total Public Cost	27,606,600	36,879,700	37,197,900	45,917,000	42,066,200
Capital Cost[a] and Investment					
Capital Cost to Design Year	148,840,000	222,980,000	214,551,000	435,845,000	347,468,000
Average Annual Capital Cost	7,087,600	10,618,100	10,216,700	20,754,500	16,546,100
Capital Investment to Design Year	233,328,700	341,200,000	374,573,200	833,951,200	626,992,700
Average Annual Capital Investment	11,110,900	16,333,700	17,836,800	39,711,900	29,856,800
Operating and Maintenance Cost Deficit (net cost)					
Deficit in Design Year	23,198,300	38,272,600	40,161,600	35,388,300	36,324,300
Deficit to Design Year	430,900,000	551,494,000	566,605,400	528,419,000	535,907,000
Average Annual Deficit	20,519,000	26,261,600	26,981,200	25,162,800	25,519,400
Cost-Effectiveness					
Total Cost to Design Year per Passenger	0.39	0.47	0.50	0.62	0.57
Capital Cost to Design Year per Passenger	0.10	0.14	0.14	0.28	0.22
Operating Deficit to Design Year per Passenger	0.29	0.34	0.36	0.34	0.35
Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year[b]					
Total Transit System	62	56	54	59	59
Primary Element	56	60	52	76	76
Energy					
Total Transit System Energy Use to Design Year (million (BTU's)	20,278,020	24,749,880	24,560,460	26,987,880	25,364,600
Total Transit Construction Energy Use to Design Year (million (BTU's)	1,498,400	1,914,560	2,414,100	3,940,730	3,321,680
Total Transit Operating and Maintenance Energy Use to Design Year (million BTU's)	18,779,620	22,835,320	22,146,360	23,047,150	22,042,920
Total Transit Energy Use per Passenger Mile to Design Year (BTU's)	3,329	3,007	3,229	3,376	3,172
Total Transit Passenger Miles per Gallon of Diesel Fuel to Design Year (BTU's)	40.9	45.2	42.1	40.2	42.9
Dependence on Petroleum-Based Fuel	All trips dependent	All trips dependent	All trips dependent	27 percent of transit trips not dependent	All trips dependent
Petroleum-Based Fuel Use by Transit to Design Year (gallons of diesel fuel)	134,355,000	161,649,000	158,861,000	143,383,000	155,551,000
Automobile Propulsion Energy Use in Design Year (gallons of gasoline)	404,800,000	388,800,000	397,600,000	395,200,000	396,000,000
Objective Nos. 3 and 5—Provide Appropriate Service and Quick Travel					
Average Weekday Transit Trips					
Total Transit System	326,800	378,600	366,100	374,600	372,900
Primary Element	15,000	75,100	46,300	145,100	134,900
Percent of Transit Trips Using Primary Element	4	20	13	39	36
Service Coverage					
Population Served Within a One-Half-Mile Walking Distance of Primary Transit Service	257,100	373,500	190,500	550,900	550,900
Population Served Within a Three-Mile Driving Distance of Primary Transit Service	1,012,400	1,620,700	1,428,200	1,685,600	1,685,600
Jobs Served Within a One-Half-Mile Walking Distance of Primary Transit Service	237,000	293,600	221,300	441,200	441,200
Average Speed of Transit Vehicle (mph)					
Primary Element	19	29	29	26	25
Total System	14	18	16	18	18
Average Speed of Passenger Travel on Vehicle (mph)					
Primary Element	25	34	30	27	26
Total System	15	21	18	20	20

Table 168 (continued)

Evaluative Measure	Alternative				
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Commuter Rail Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Objective No. 4—Minimize Environmental Impacts					
Community Disruption					
Homes, Businesses, or Industries Taken	None	None	None	None	None
Land Required (acres)	12	70	90	210	200
Air Pollutant Emissions—Total Transportation System (Highway and Transit) in Design Year (tons per year)					
Carbon Monoxide	171,193	167,368	168,440	167,055	167,508
Hydrocarbons	17,361	16,887	17,025	16,853	16,905
Nitrogen Oxides	30,693	29,988	30,371	30,000	30,015
Sulfur Oxides	2,514	2,502	2,533	2,754	2,499
Particulates	4,086	4,018	4,046	4,032	4,019
Objective No. 6—Maximize Safety					
Proportion of Total Person Trips Made on Transit	0.074	0.086	0.083	0.085	0.084

[a] *The capital cost of a composite plan is equal to the plan's required capital investment, or total capital outlays necessary over the plan design period, less the value of that investment beyond the plan design period.*

[b] *Transit revenues were assigned entirely to the primary transit element for primary transit trips which used, through transfers, local or express transit as a feeder or distributor to the primary transit element. The proportion of trips using primary transit which transfers to or from local and express services was found to be highest under the commuter rail plan—1.2 transfers per primary trip—and lowest under the light rail transit and busway plans—0.4 transfer per primary trip. Under the bus-on-freeway plan, 0.7 transfer was made per primary trip. Consequently, to some extent a disproportionate share of transit revenues was assigned to each plans's primary element, this disproportionate share being the highest under the commuter rail plan and the lowest under the light rail transit and busway plans.*

Source: SEWRPC.

The attainment of the other standard under this objective, which calls for adjusting transit accessibility to land use plans, was measured by comparing these contours of central business district transit accessibility to the regional land use plan. [16] The Milwaukee central business district is the most important trip generator in the Milwaukee area, and would, under this alternative future, remain so, accounting for over 6 percent of the approximately 4.4 million trips occurring within the Milwaukee area on an average weekday. It would also be the most important transit trip generator, accounting for about 26 percent of the average weekday transit trips under each alternative truncated or composite system plan. As shown on Maps 76 through 80, all the plans would generally support the adopted regional land use plan.

Objective 2—Cost and Energy: The second objective concerns achievement of a primary transit system which is economical and efficient, satisfying all other objectives at the lowest possible cost. This objective is supported by key standards relating to the minimization of costs and energy consumption, and maximization of cost-effectiveness. As shown in Table 168, of the four alternative truncated and composite primary transit system plans, the plan with the lowest total cost to the design year under this future, including all capital and net operating and maintenance costs, is the truncated bus-on-freeway plan, which has an estimated total cost of $774 million. The second lowest cost plan would be the commuter rail plan, which has a total cost of $781 million. The busway plan follows with a total cost of $883 million, and the most costly plan would be the light rail transit plan, with an estimated total cost of $964 million.

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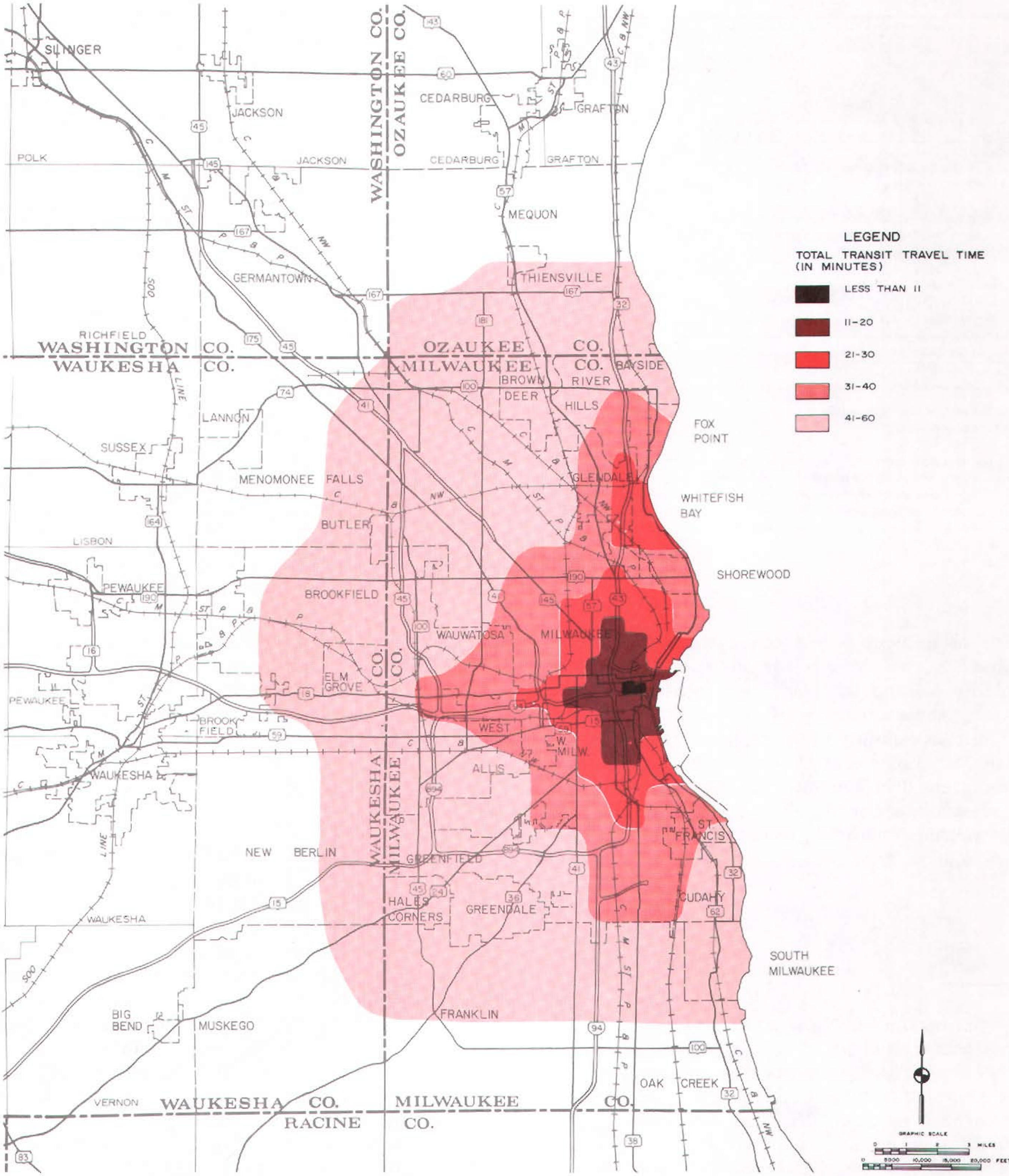
[16] *The regional land use plan recommends a highly centralized land use development pattern. Population and jobs are proposed to be reconcentrated in central Milwaukee County, and new urban development is proposed to occur principally at urban densities along and contiguous to the periphery of existing urban centers. See SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume Two, Alternative and Recommended Plans.*

Map 76

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE BASE SYSTEM PLAN OF THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

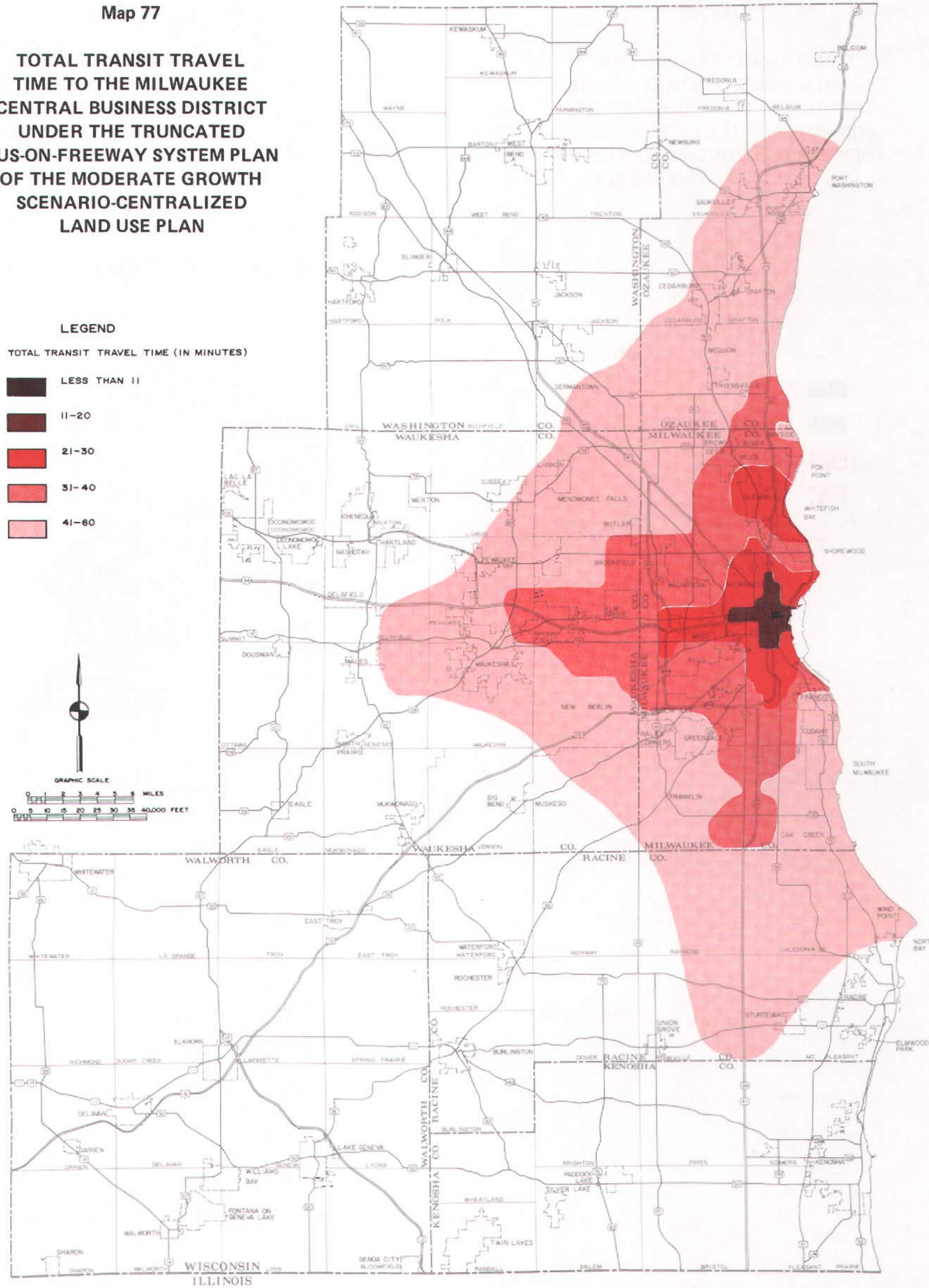


One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the base system plan, the various travel time contours form a concentric ring pattern around the Milwaukee central business district, with areas up to 3 miles away being within 20 minutes travel time. Areas up to 6 miles away in a westerly direction and 8 miles away in a northerly and southerly direction are within 40 minutes travel time. Areas up to 11 miles away in a westerly direction, 13 miles away in a northerly direction, and 10 miles away in a southerly direction are within 60 minutes travel time of downtown Milwaukee.

Source: SEWRPC.

Map 77

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN OF THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

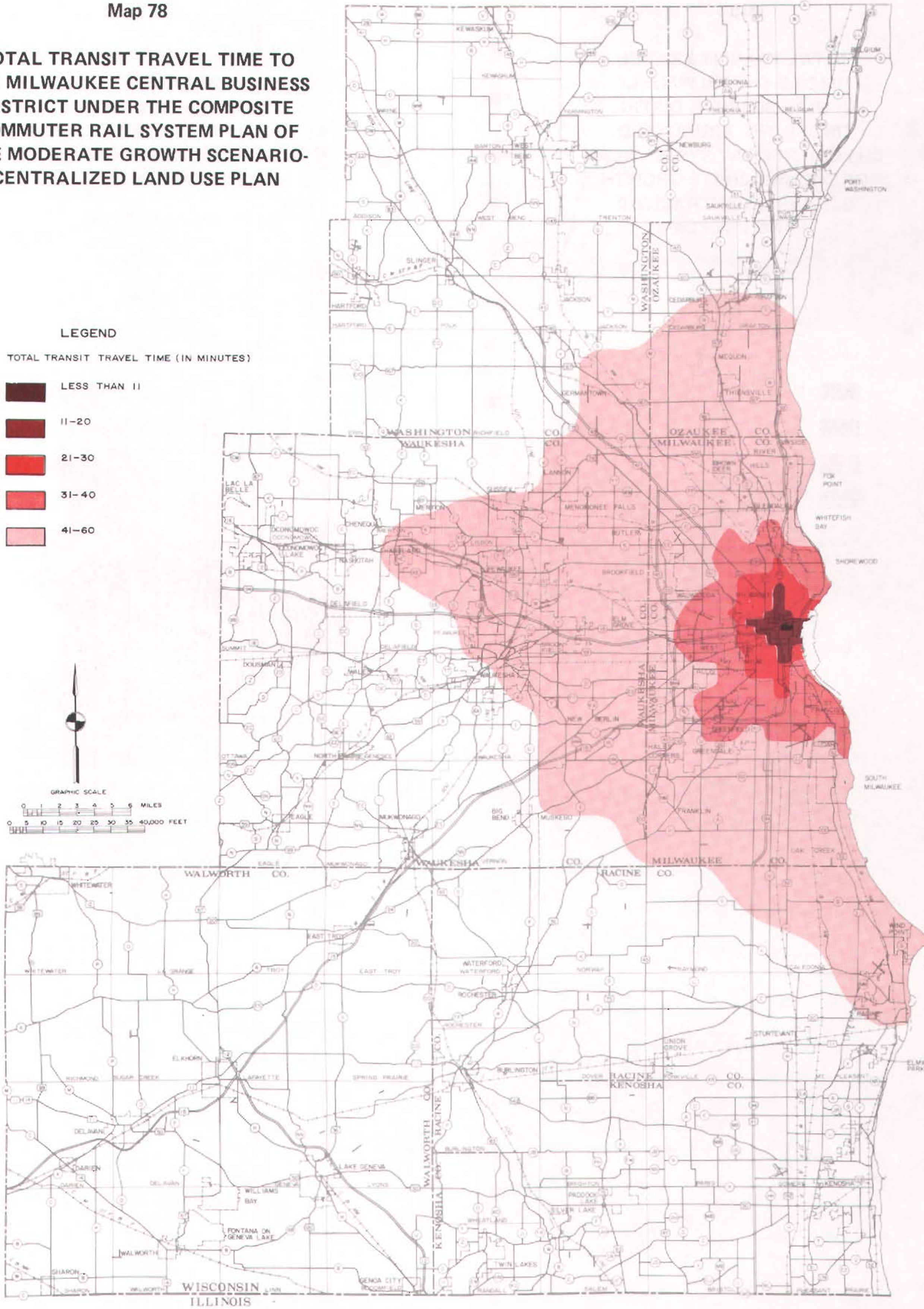


One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the truncated bus-on-freeway plan, the various travel time contours form a lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south. Areas up to 3 miles away are within 20 minutes travel time of downtown Milwaukee, and areas up to 13 miles in a northerly and southerly direction and up to 15 miles in a westerly direction are within 40 minutes travel time of downtown Milwaukee. Areas within 60 minutes travel time extend as far as 27 miles to the north, 25 miles to the south, and 23 miles to the west of downtown Milwaukee.

Source: SEWRPC.

Map 78

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE COMPOSITE COMMUTER RAIL SYSTEM PLAN OF THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

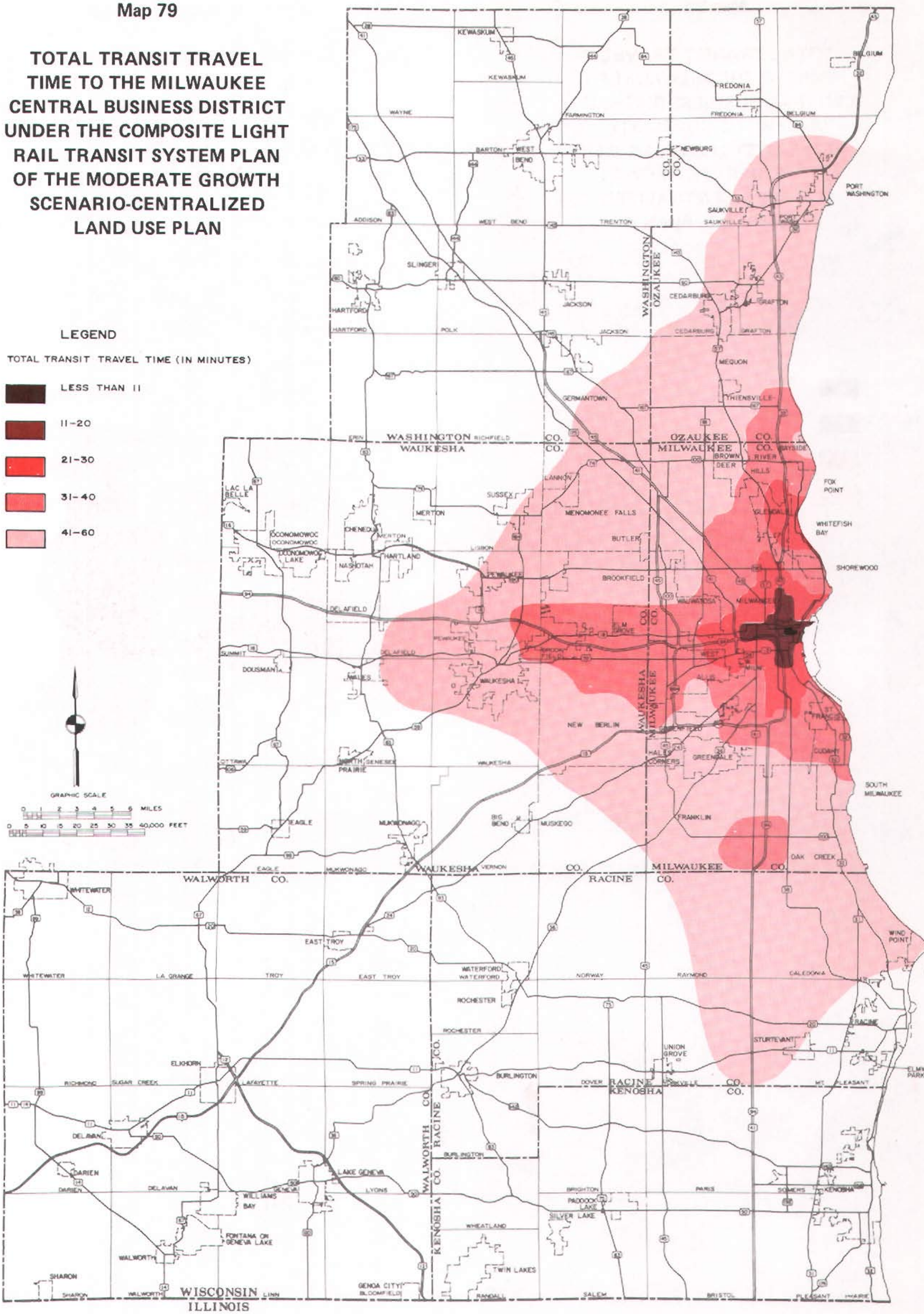


One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the composite commuter rail plan, the various travel time corridors form a concentric ring pattern around the Milwaukee central business district. Such a pattern occurs as a result of the similarity between the travel times of commuter rail routes and bus-on-freeway routes which serve portions of the Milwaukee area not otherwise served by the commuter rail system. Areas up to 3 miles away from the central business district are within 20 minutes travel time, and areas up to 6 miles away are within 40 minutes travel time. Areas within 60 minutes travel time of downtown Milwaukee extend up to 20 miles in a northerly direction, 21 miles in a southerly direction, and 23 miles in a westerly direction.

Source: SEWRPC.

Map 79

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE COMPOSITE LIGHT RAIL TRANSIT SYSTEM PLAN OF THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

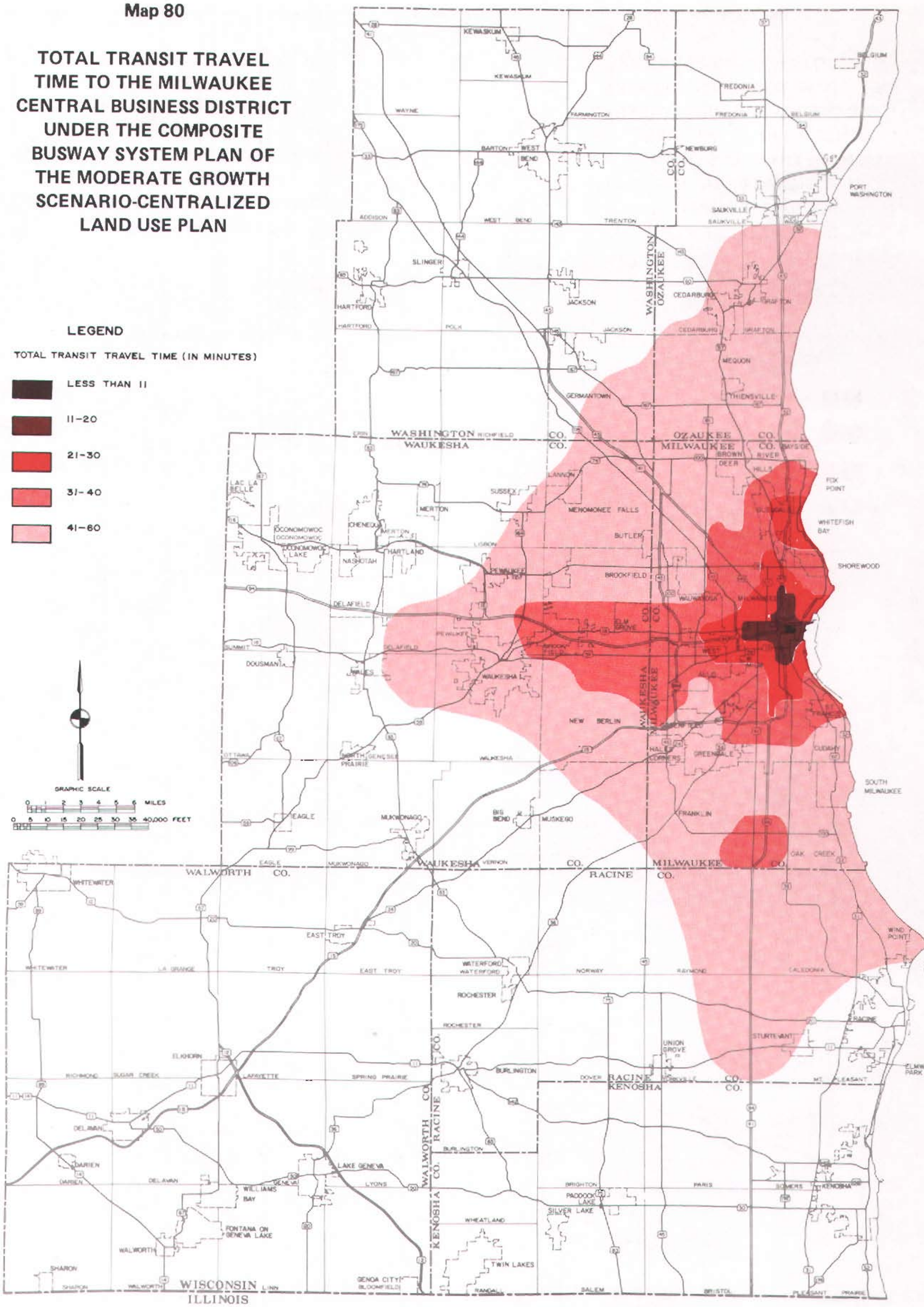


One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the composite light rail transit plan, the various travel time contours form a lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south, with areas that are up to 3 miles from downtown being within 20 minutes travel time. Areas within 40 minutes travel time extend up to 13 miles to the north and south and 15 miles to the west. Areas up to 26 miles in a northerly direction, 22 miles in a westerly direction, and 25 miles in a southerly direction are within 60 minutes travel time of downtown Milwaukee.

Source: SEWRPC.

Map 80

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE COMPOSITE BUSWAY SYSTEM PLAN OF THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the composite busway system plan, the various travel time contours form a lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south, with areas that are up to 3 miles from downtown being within 20 minutes travel time. Areas within 40 minutes travel time extend only 7 miles up to the north, but extend 13 miles to the south and 17 miles to the west. Areas up to 22 miles in a northerly and westerly direction and 25 miles in a southerly direction are within 60 minutes travel time of downtown Milwaukee.

Source: SEWRPC.

Table 169

TOTAL CAPITAL INVESTMENT TO DESIGN YEAR REQUIRED UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Capital Cost Element[a]	Alternative				
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Commuter Rail Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Guideway Development[b]	$ - -	$ 14,326,000	$ 35,624,100[e]	$420,746,200	$273,046,200
Station Development[c]	2,893,700	26,566,800	19,226,300	53,784,200	57,595,500
Vehicle Storage and Maintenance Facility Development	24,775,000	28,375,000	31,842,800	49,572,800	27,851,000
Vehicle Acquisition and Replacement[d]	205,660,000	273,740,000	287,880,000	309,848,000	268,400,000
Total	$233,328,700	$343,007,800	$374,573,200	$833,951,200	$626,992,700

[a] *It is assumed under this capital cost analysis that the base plan and the alternative truncated composite primary transit plans would be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 through 2000. Portions of nearly all of the elements of the plan have useful lives extending beyond the end of the design period and are therefore capable of use beyond the design period.*

[b] *Includes the cost of acquiring about 83 acres of right-of-way for guideway construction for the light rail transit and busway transit plans. This land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years. Also includes the implementation cost of the proposed freeway operational control system in the Milwaukee area, which has a useful life of 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—12 acres under the base plan, 127 acres under the light rail transit plan, 117 acres under the busway system plan, 70 acres under the bus-on-freeway plan, and 90 acres under the commuter rail plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the acquisition and replacement, as necessary, over the 20-year design period of all buses and light rail transit vehicles and commuter rail coaches, used in all elements of the system. All alternative plans under this future are assumed to utilize the entire existing fleet of 640 motor buses which—in 1980—are assumed to have an average age of 10 years each. Buses are assumed to have an average useful life of 12 years. Light rail transit vehicles, commuter rail coaches, and diesel locomotives have an estimated useful life of 30 years.*

[e] *The Milwaukee Road has proposed major track rehabilitation work on some of the railway line segments herein considered for potential use by commuter trains. Should all of this track rehabilitation work be completed, the capital investment necessary for guideway development of the composite commuter rail plan would be reduced by $10,141,000 to $25,483,100. As of April 1981, such rehabilitation work in the amount of $2,589,000 had been completed by the Milwaukee Road during the 1980 and 1981 working seasons.*

Source: SEWRPC.

The principal reason for the difference in the costs between the plans is capital cost—that is, the capital investment over the plan design period less the value of the remaining life of the facilities and vehicles at the end of the 20-year plan design period. The capital cost of the light rail plan is about twice that of the bus-on-freeway and commuter rail plans, and the capital cost of the busway plan is about 50 percent more than that of the bus-on-freeway and commuter rail plans. In terms of the total capital investment which would be required over the plan design period, the bus-on-freeway and commuter rail alternatives require less than one-half the investment of the light rail and busway plans. The bus-on-freeway plan would require an outlay of about $343 million and the commuter rail plan would require an outlay of about $375 million, while the busway plan would require $627 million and the light rail transit plan would require about $834 million, as shown in Table 169. The light rail transit and busway system plans, however, would be expected to provide an annual net operating and maintenance cost advantage over the bus-on-freeway and commuter rail plans. In the design year, the light rail transit plan would require $4.8 million, or 12 percent, less subsidy than the commuter rail plan and $2.9 million, or 8 percent, less subsidy than the bus-on-freeway plan. The busway plan would require about $3.8 million, or 10 percent, less subsidy than the commuter rail plan and $1.9 million, or 5 percent, less subsidy than the bus-on-freeway plan.

In terms of the cost-effectiveness of the alternative truncated and composite primary transit plans, the total cost per passenger to the design year of the busway plan is about 10 percent lower than under the light rail plan, $0.56 per passenger compared with $0.62 per passenger. The total cost per passenger of the bus-on-freeway and commuter rail plans, estimated at about $0.47 and $0.50 per passenger, respectively, are somewhat lower than those of the light rail transit and busway plans. The reason for this difference in total cost per passenger between the truncated plans is again the high capital costs of the light rail transit and busway plans. The capital cost per passenger of the light rail transit plan is double that of the bus-on-freeway and commuter rail plans, and the capital cost per passenger of the busway plan is over 50 percent greater than that of the bus-on-freeway and the commuter rail plans. There is very little difference in the net operating costs per passenger to, or in, the design year between the four truncated plans, as shown in Table 170. The light rail transit, busway, and bus-on-freeway plans have the lowest cost per passenger over the design period—$0.34—and the commuter rail has the highest—$0.36. It should be noted that the estimated net operating costs, or deficit, of the commuter rail plan may be somewhat understated herein. Two of the three commuter rail routes—the north route to Grafton and the west route to Oconomowoc—would operate using trains consisting of only one or two coaches. Such atypical operation may be expected to require a greater operating cost per vehicle mile than those average unit costs used in the systemwide analysis of the commuter rail alternative.

Estimates of the total amount of energy that would be used in the implementation of the truncated primary transit plans under this alternative future are set forth in Tables 168 and 171. Over the 20-year design period, the commuter rail and bus-on-freeway plans would require the least energy consumption, including energy for consumption as well as operation and maintenance—24,560 billion and 24,750 billion BTU's, respectively. However, the total energy consumption under the busway and light rail transit plans would be expected to be only slightly greater, 25,360 billion BTU's and 26,990 billion BTU's, respectively. The energy used for construction under each plan would be minimal compared to the energy required for operation. Of the four plans, the bus-on-freeway plan would require the least energy for construction under the plan—4 percent of total energy consumption. The light rail transit plan would require the most construction energy—15 percent of total energy consumption. The light rail transit system plan would also require the most energy for operation, 23,050 billion BTU's to the design year 2000, while the busway plan would require the least, 22,040 billion BTU's. The light rail transit plan, however, would require the least amount of petroleum energy for vehicle propulsion of all the plans. Specifically, this plan would require between 8 and 12 percent less petroleum energy than the other plans since most of the transit trips under this plan which use the primary element are made on electrically propelled light rail vehicles as opposed to diesel motor buses. Under the light rail transit plan, more than 27 percent of the total transit trips occur on the primary element.[17]

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[17] *Implementation of a light rail transit system in the Milwaukee area can be expected to have an insignificant impact upon existing and future electric power generating requirements within southeastern Wisconsin. Light rail transit system operation can be expected to result in a very small increase in peak demand as well as a negligible increase in total annual power consumption based upon the capacity of the 1980 electric power generating system, and the expanded electric power generating system necessary for other reasons by the plan design year.*

Electric power for the Milwaukee area is supplied by the Wisconsin Electric Power Company (WEPCo), which currently relies on coal-fired power plants for generating more than 95 percent of its electricity. Nuclear power plants provide the remaining electricity generated by WEPCo. According to data acquired by WEPCo in order to plan for future power generation capacity in southeastern Wisconsin, the instantaneous peak demand within the WEPCo service area was 3.3 million kilowatts during the summer season of 1980 and 3.0 million kilowatts during the winter season of 1980. By the year 2000, these peak demands are expected by WEPCo to increase by 40 to 70 percent. The instantaneous peak may be expected to occur between 12:00 p.m. and 4:00 p.m. in the summer and between 5:00 p.m. and 7:00 p.m. in the winter.

The peak power demand for vehicle propulsion on this composite light rail transit system would be approximately 59.7 megawatts during the plan

(footnote continued on next page)

The energy which may be expected to be used in highway travel by automobiles in the plan design year is also expected to be about the same under all four truncated or composite plans, as shown in Table 172. More than 30 times more energy would be used in the plan design year for automobile travel than for transit under this future. Consequently, any petroleum savings of a light rail transit system would represent less than 1 percent of the energy required by the total transportation system, including travel by automobiles.

Objectives 3 and 5—Provision of Adequate Level of Service and Provision for Quick and Convenient Travel: Two of the primary transit system development objectives can be considered together for this evaluation: Objective No. 3, which calls for a transit system which provides an adequate level of service, and Objective No. 5, which calls for a primary transit system which provides for quick and convenient travel. These two objectives are supported by three key standards: level of transit ridership, number of residents and jobs served, and transit trip speed. The remaining standards under these two objectives either have all been met in the design of the alternative plans or could be met by all the plans if properly implemented.

(footnote 17 continued)

design year 2000. This represents about 2 percent of the WEPCo 1980 actual summer and winter peak demands, and less than 2 percent of the WEPCo forecast year 2000 peak demands.

The WEPCo also estimates that annual electrical energy use during 1980 totaled 18,701 gigawatt-hours within the WEPCo service area. The total power consumption for vehicle propulsion on the light rail transit system would be approximately 87 million kilowatt-hours during the design year, or substantially less than 1 percent of the estimated total energy consumption for the WEPCo service area in 1980. Electricity necessary for the operation of a light rail transit system is likely to represent an even smaller percentage during the plan design year, since the total amount of power consumption in southeastern Wisconsin is expected by WEPCo to increase by 70 percent by the year 2000.

Of all the standards under these two objectives, the level of transit ridership best represents the level of transit service provided by alternative plans. Total transit system ridership under the alternative plans is expected to differ by only 3 percent, ranging from a low of 366,100 trips on an average weekday under the commuter rail plan to 378,600 trips per average weekday under the bus-on-freeway plan. However, significant differences are expected in the number and proportion of trips made on the primary element of the alternative transit system plans. As shown in Tables 173 and 174, the proportion of transit trips made on the primary element is expected to be the highest under the composite light rail transit plan, nearly 40 percent of the total 374,600 transit trips made on an average weekday under this plan, or 145,100 trips. The second highest primary transit ridership under this future would be on the composite busway plan, about 134,900 trips, or 35 percent of the total transit ridership. The primary element of the bus-on-freeway and commuter rail plans would carry 75,100 trips, or 20 percent, and 46,300 trips, or 13 percent of total transit system ridership, respectively. Because the total transit system ridership does not vary significantly among the four truncated plans, it can be concluded that the substantial additional ridership on the primary element of the light rail transit and busway plans is comprised of trips which would be expected to use local or express transit services under the bus-on-freeway and commuter rail plans. This assumption is reasonable, given the small travel time advantages expected under the light rail transit and busway plans. Express and local services under all the plans are expected to average 17 and 15 mph, respectively, compared with 20 mph under the light rail transit primary element and 18 mph under the busway primary element. These express and local service speeds are about the same as those achieved on the existing transit system, which is to be expected since little additional street and highway traffic congestion is anticipated in the Milwaukee area under this alternative future.

With respect to the standard calling for maximizing the number of jobs and resident population served, the primary elements of the composite light rail transit and busway plans would serve the greatest number of residents, 1.7 million, within a three-mile driving distance of primary transit service. The primary elements of the bus-on-freeway and composite commuter rail alternative plans would be accessible by driving to 1.6 million and 1.4 million residents, respectively. The light rail transit and

Table 170

PRIMARY AND TOTAL TRANSIT SYSTEM OPERATING AND MAINTENANCE COSTS IN THE DESIGN YEAR FOR THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Alternative				
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Commuter Rail Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Ridership					
Primary Element.	3,825,000	19,150,500	11,806,500	37,000,500	34,399,500
Total System.	94,247,000	106,640,000	104,550,000	103,630,000	103,420,000
Operating Cost					
Primary Element.	$ 4,305,500	$24,500,000	$19,173,500	$29,726,100	$28,353,500
Total System.	60,313,100	90,600,000	87,918,500	85,858,500	86,036,600
Operating Cost per Passenger					
Primary Element.	$1.09	$1.28	$1.62	$0.80	$0.82
Systemwide Average	0.63	0.86	0.85	0.83	0.83
Operating Cost per Passenger Mile					
Primary Element.	$0.12	$0.08	$0.10	$0.09	$0.08
Total System.	0.15	0.13	0.15	0.13	0.13
Annual Farebox Revenue					
Primary Element.	$ 2,423,200	$14,600,000	$ 9,989,100	$22,702,700	$21,610,500
Total System.	37,114,800	52,400,000	47,756,900	50,470,200	49,712,300
Operating Deficit					
Primary Element.	$ 1,882,300	$ 9,900,000	$ 9,184,400	$ 7,023,400	$ 6,743,000
Total System.	23,198,300	38,200,000	40,161,600	35,388,300	36,324,300
Operating Deficit per Passenger					
Primary Element.	$0.49	$0.52	$0.78	$0.19	$0.20
Total System.	0.25	0.36	0.38	0.34	0.35
Farebox Revenue as a Percent of Operating Costs					
Primary Element.	56	60	52	76	76
Total System.	62	58	54	59	59
Public Funding Under Current Program[a]					
Federal (50 percent of operating deficit)					
Primary Element	$ 941,150	$ 4,950,000	$ 4,592,200	$ 3,511,700	$ 3,371,500
Total System	11,599,150	19,100,000	20,080,800	17,694,150	18,162,150
State (72 percent of nonfederal share of operating deficit)					
Primary Element	677,628	3,560,000	3,306,380	2,528,420	2,427,480
Total System	8,351,388	13,750,000	14,458,180	12,739,790	13,076,750
Local					
Primary Element	263,522	1,390,000	1,285,820	983,280	944,020
Total System	3,247,762	5,350,000	5,622,620	4,954,360	5,085,400
Local Operating Deficit per Ride					
Primary Element.	$0.07	$0.07	$0.11	$0.03	0.03
Total System.	0.03	0.05	0.05	0.05	0.05

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, about equal to the $11.6 million required under the base plan, but substantially less than the $22.9 million required under the maximum extent bus-on-freeway plan and substantially less than the $25.8 million required under the maximum extent commuter rail plan. This amount is also less than the $15.5 million required under the maximum extent light rail transit plan, less than the $15.7 million required under the maximum extent busway system plan, and less than the $14.4 million required under the maximum extent heavy rail rapid transit plan. These amounts of public funding for the respective primary transit system plans would provide 50 percent of federal funding of the operating deficits.*

Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the State's operating deficit funding share to 25 percent of the total operating cost of urban transit systems.

Source: SEWRPC.

Table 171

COMPARISON OF TOTAL TRANSIT ENERGY REQUIREMENTS UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Energy Element	Alternative				
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Commuter Rail Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Primary Element					
Operating and Maintenance Energy to Design Year (million BTU's)					
Vehicle Propulsion Energy	951,690	3,457,450	2,581,960	5,044,490	3,837,680
Petroleum Fuel Consumed	951,690	3,457,450	2,581,960	2,476,250	3,837,680
Nonpetroleum Fuel Consumed	--	--	--	2,568,240	--
Station Operation and Maintenance Energy	58,580	182,930	83,000	208,490	203,180
Vehicle Maintenance Energy	26,320	118,850	103,620	146,000	131,980
Total Operating and Maintenance Energy	1,036,590	3,759,230	2,768,580	5,398,980	4,172,840
Total System Construction Energy to Design Year (million BTU's)					
Guideway Construction	--	--	184,000	1,774,400	1,451,000
Vehicle Manufacture	169,320	498,800	746,000	950,490	630,360
Total Construction Energy	169,320	498,800	930,000	2,724,890	2,081,360
Total System					
Operating and Maintenance Energy to Design Year (million BTU's)					
Vehicle Propulsion Energy	18,272,300	21,984,270	21,605,100	22,068,430	21,154,980
Petroleum Fuel Consumed	18,272,300	21,984,270	21,605,100	19,500,190	21,154,980
Nonpetroleum Fuel Consumed	--	--	--	2,568,240	--
Station Operation and Maintenance Energy	64,870	291,030	129,670	341,050	336,400
Vehicle Maintenance Energy	442,450	560,020	411,590	551,670	551,540
Total Operating and Maintenance Energy	18,779,620	22,835,320	22,146,360	23,047,150	22,042,920
Total System Construction Energy to Design Year (million BTU's)					
Guideway Construction	--	--	184,000	1,774,400	1,451,000
Vehicle Manufacture	1,498,400	1,914,560	2,230,100	2,166,400	1,870,680
Total Construction Energy	1,498,400	1,914,560	2,414,100	3,940,730	3,321,680

Source: SEWRPC.

Table 172

COMPARISON OF DESIGN YEAR AUTOMOBILE TRAVEL AND ENERGY CONSUMPTION UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Automobile Vehicle Miles Traveled in Design Year (billions)	Automobile Energy Consumption in Design Year (million BTU's)
Base Plan	10.00	50,600,000
Truncated Bus-on-Freeway Plan	9.67	49,400,000
Composite Commuter Rail Plan	9.77	49,700,000
Composite Light Rail Transit Plan	9.68	49,400,000
Composite Busway Plan	9.70	49,500,000

Source: SEWRPC.

Table 173

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Truncated Bus-on-Freeway Plan			Composite Commuter Rail Plan			Composite Light Rail Transit Plan			Composite Busway Plan		
	Total Person Trips	Transit Trips		Total Person Trips	Transit Trips		Total Person Trips	Transit Trips		Total Person Trips	Transit Trips		Total Person Trips	Transit Trips	
		Number	Percent of Total Trips		Number	Percent of Total Trips		Number	Percent of Total Trips		Number	Percent of Total Trips		Number	Percent of Total Trips
Home-Based Work	1,112,900	102,100	9.2	1,109,600	117,400	10.6	1,111,300	111,400	10.0	1,108,600	117,700	10.6	1,109,300	116,900	10.5
Home-Based Shopping . .	512,400	39,000	7.6	511,400	47,500	9.2	511,800	46,800	9.1	511,000	46,400	9.1	511,300	46,200	9.0
Home-Based Other	1,502,200	116,900	7.8	1,496,900	145,000	9.7	1,499,700	139,500	9.3	1,494,800	142,100	9.5	1,496,200	141,400	9.4
Nonhome Based.	837,100	17,500	2.1	833,400	17,400	2.1	834,500	17,100	2.0	830,300	17,100	2.0	833,100	17,100	2.0
School	465,300	51,300	11.0	465,300	51,300	11.0	465,300	51,300	11.0	465,300	51,300	11.0	465,300	51,300	11.0
Total	4,429,900	326,800	7.4	4,416,600	378,600	8.6	4,422,600	366,100	8.3	4,410,000	374,600	8.5	4,415,200	372,900	8.4

Source: SEWRPC.

Table 174

PRIMARY AND TOTAL TRANSIT TRIPMAKING BY TIME OF DAY UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Time Period	Base Plan				Truncated Bus-on-Freeway Plan				Composite Commuter Rail Plan				Composite Light Rail Transit Plan				Composite Busway Plan			
	Primary Element		Total System		Primary Element		Total System		Primary Element		Total System		Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	6,800	45.3	70,200	21.5	16,200	21.6	79,100	20.9	8,800	19.1	76,200	20.8	32,500	22.5	78,800	21.0	30,100	22.3	78,400	21.0
Midday	800	0.7	112,800	34.5	23,200	30.9	132,600	35.0	14,100	30.4	14,100	30.4	39,200	27.0	130,600	34.9	36,100	26.8	130,000	34.9
Afternoon . .	8,100	54.0	111,400	34.1	27,700	36.9	127,500	33.7	17,700	38.2	123,400	33.7	59,400	40.9	126,400	33.7	55,300	40.9	125,900	33.8
Evening. . . .	- -	- -	32,400	9.9	8,000	10.6	39,400	10.4	5,700	12.3	37,800	10.3	14,000	9.6	38,800	10.4	13,400	10.0	38,600	10.3
Total	15,700	100.0	326,800	100.0	75,100	100.0	378,600	100.0	46,300	100.0	366,100	100.0	145,100	100.0	374,600	100.0	134,900	100.0	372,900	100.0

Source: SEWRPC.

busway plans would also provide the greatest accessibility to residents within walking distance of primary transit stations and stops—about 551,000 residents, compared with 374,000 and 190,000 residents under the bus-on-freeway and commuter rail plans, respectively. Employment served within walking distance would also be greatest under the light rail transit and busway plans, 441,000 jobs, compared with 294,000 jobs under the bus-on-freeway plan. The composite commuter rail plan would serve only 186,000 jobs within walking distance of its stops in the Milwaukee area. However, its feeder/distributor bus through downtown would serve an additional 35,000 jobs. All the additional residents and jobs within walking distance of primary transit under the light rail transit and busway plans would be located within the portions of Milwaukee County planned for urban development under the regional land use plan.

The truncated and composite plans vary only slightly with respect to the standard relating to the average speed provided by primary transit. The average vehicle speeds on the primary transit elements of the plans are expected to range from a low of 25 mph under the composite busway plan to 26 mph under the composite light rail transit plan, 28 mph under the truncated bus-on-freeway plan, and a high of 29 mph under the composite commuter rail plan. The average vehicle speed on all elements of the truncated and composite plans—primary, express, and local—would be expected to be 17.5 mph for all but the commuter rail plan. The commuter rail plan average transit vehicle speed would be 16.5 mph. The average speeds of passenger travel on the primary transit vehicles would range from a high of 34 mph under the bus-on-freeway plan, to 30 mph under the commuter rail plan, 27 mph under the light rail plan, and a low of 26 mph under the busway plan. Average speeds of passenger travel on vehicles of all service elements of the truncated and composite plans would range from 21 mph under the bus-on-freeway plan to 20 mph under the light rail transit and busway plans and 18 mph under the commuter rail plan. Average speeds of passenger travel are higher than vehicle speeds because passengers are typically concentrated on the transit facilities and services of highest speed.

Objective 4—Environmental and Resource Disruption: The fourth objective is to minimize the disruption of existing neighborhood and community development and to minimize deterioration of the natural resource base. This objective is supported by key standards relating to community disruption and air quality.

In terms of community disruption, none of the four alternative truncated primary transit system plans would require the taking of any homes, businesses, or industries. They would, however, require the acquisition of right-of-way for guideway, stations, and maintenance and storage facilities. Of the four truncated and composite primary transit alternatives, both the light rail transit and busway system plans would require the acquisition of more than 200 acres of land, compared with 70 and 90 acres under the truncated bus-on-freeway and composite commuter rail plans, respectively.

Tables 168 and 175 set forth the levels of highway and transit air pollutant emissions anticipated under each of the alternative truncated and composite primary transit system plans under this alternative future. All four truncated and composite plans are expected to have similar levels of total transportation system carbon monoxide, hydrocarbon, particulate matter, and nitrogen oxide air pollutant emissions. Transportation-related sulfur oxide emissions are expected to be about 10 percent higher under the light rail transit plan. However, this difference in sulfur oxide emissions represents a difference of less than one-tenth of 1 percent when considered in the context of the total air pollutant emissions forecast from all air pollutant sources in the Region.

Objective 6—Safety: The sixth transportation objective relates to the reduction of accident exposure and the provision of increased travel safety. This objective is supported by two key standards, one measuring the degree to which travel by transit is maximized and the other measuring the degree to which travel on exclusive guideway transit is maximized. Travel by transit is safer than travel by automobile, and travel on exclusive guideway transit is the safest travel by transit because of the lack of conflicts with pedestrian or vehicle traffic.

As demonstrated in Table 168, there is little difference among the four truncated plans with respect to travel safety. The proportion of total person trips using transit is about the same under the four truncated and composite plans, and none of the alternatives utilizes fully exclusive guideways with grade separation of all crossing vehicle and pedestrian traffic.

Summary

The comparative evaluation of the alternative truncated or composite primary transit system plans—bus-on-freeway, commuter rail, busway, and light rail transit—indicated that, under the moderate growth scenario-centralized land use plan alterna-

Table 175

COMPARISON OF DESIGN YEAR AIR POLLUTANT EMISSIONS OF THE TRANSIT AND HIGHWAY SYSTEM UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

	Alternative				
Air Pollutant	Base Plan (tons per year)	Truncated Bus-on-Freeway Plan (tons per year)	Composite Commuter Rail Plan (tons per year)	Composite Light Rail Transit Plan (tons per year)	Composite Busway Plan (tons per year)
Primary Element					
Carbon Monoxide	72	207	159	142	263
Hydrocarbons	7	23	24	16	28
Nitrogen Oxides	14	53	215	110	60
Sulfur Oxides	7	32	44	295	35
Particulate Matter	5	18	20	41	20
Total Transit System					
Carbon Monoxide	1,213	1,330	1,369	1,130	1,279
Hydrocarbons	118	134	144	114	129
Nitrogen Oxides	165	244	421	278	233
Sulfur Oxides	84	118	137	371	113
Particulate Matter	49	68	73	85	65
Total Transportation System					
Carbon Monoxide	171,193	167,368	168,440	167,055	167,508
Hydrocarbons	17,361	16,887	17,025	16,853	16,905
Nitrogen Oxides	30,693	29,988	30,371	30,000	30,015
Sulfur Oxides	2,514	2,502	2,533	2,754	2,499
Particulate Matter	4,086	4,018	4,046	4,032	4,019

Source: SEWRPC.

tive future, all of the systems may be expected to provide a reasonably comparable and high level of primary transit service in the Milwaukee area in the plan design year. As indicated in Table 176, the alternative systems were found to be quite similar with respect to total ridership, public subsidy required, and operating cost-effectiveness. Each system may be expected to attract about the same level of total transit ridership in the area, varying by no more than 12,500 trips, or by about 3 percent, on an average weekday in the plan design year. Also, each system may be expected to entail a similar annual operating and maintenance cost deficit, varying by no more than $4.8 million, or 13 percent, in the plan design year. And, each plan may be expected to recover a similar proportion of the operating and maintenance costs from farebox revenues, between 54 and 59 percent.

Several significant differences between the plans, however, were also revealed by the comparative evaluation. The largest difference was in the capital cost attendant to the plans, which ranged from a low of about $215 million for the composite commuter rail plan to a high of $436 million for the composite light rail transit plan. Other differences noted included the degree of accessibility to jobs and resident population, the amount of ridership on the primary element, and the degree of use of, and dependence on, petroleum-based fuel (see Table 176).

Because this evaluative information does not clearly identify the best of the alternative composite plans under this alternative future, the key advantages and disadvantages of the alternative plans were

Table 176

KEY DIFFERENCES BETWEEN THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Evaluative Measure	Alternative				
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Commuter Rail Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Objective No. 2–Minimize Cost and Energy Use					
Cost					
Total Public Cost to Design Year (capital cost and operating and maintenance cost deficit)	$579,742,000	$774,474,000	$781,156,400	$964,264,000	$883,375,000
Average Annual Total Public Cost	27,606,600	36,879,700	37,197,900	45,917,000	42,066,200
Capital Cost[a] and Investment					
Capital Cost to Design Year	148,840,000	222,980,000	214,551,000	435,845,000	347,468,000
Average Annual Capital Cost	7,087,600	10,618,100	10,216,700	20,754,500	16,546,100
Capital Investment to Design Year	233,328,700	341,200,000	374,573,200	833,951,200	626,992,700
Average Annual Capital Investment	11,110,900	16,333,700	17,836,800	39,711,900	29,856,800
Operating and Maintenance Cost Deficit (net cost)					
Deficit in Design Year	23,198,300	38,272,600	40,161,600	35,388,300	36,324,300
Deficit to Design Year	430,900,000	551,494,000	566,605,400	528,419,000	535,907,000
Average Annual Deficit	20,519,000	26,261,600	26,981,200	25,162,800	25,519,400
Cost-Effectiveness					
Total Cost to Design Year per Passenger	0.39	0.47	0.50	0.62	0.57
Capital Cost to Design Year per Passenger	0.10	0.14	0.14	0.28	0.22
Operating Deficit to Design Year per Passenger	0.29	0.34	0.36	0.34	0.35
Percent of Operating and Maintenance Cost Met by Farebox Revenue in Design Year					
Total Transit System	62	56	54	59	59
Primary Element	56	60	52	76	76
Energy					
Dependence on Petroleum-Based Fuel	All trips dependent	All trips dependent	All trips dependent	27 percent of transit trips not dependent	All trips dependent
Petroleum-Based Fuel Use by Transit to Design Year (gallons of diesel fuel)	134,355,000	161,649,000	158,861,000	143,383,000	155,551,000
Objective Nos. 3 and 5–Provide Appropriate Service and Quick Travel					
Average Weekday Transit Trips					
Total Transit System	326,800	378,600	366,100	374,600	372,900
Primary Element	15,000	75,100	46,300	145,100	134,900
Service Coverage					
Population Served Within a One-Half-Mile Walking Distance of Primary Transit Service	257,100	373,500	190,500	550,900	550,900
Population Served Within a Three-Mile Driving Distance of Primary Transit Service	1,012,400	1,620,700	1,428,200	1,685,600	1,685,600
Jobs Served Within a One-Half-Mile Walking Distance of Primary Transit Service	237,000	293,600	221,300	441,200	441,200
Average Speed of Transit Vehicle (mph)					
Primary Element	19	29	29	26	25
Total System	14	18	16	18	18
Average Speed of Passenger Travel on Vehicle (mph)					
Primary Element	25	34	30	27	26
Total System	15	21	18	20	20
Objective No. 4–Minimize Environmental Impacts					
Community Disruption					
Land Required (acres)	12	70	90	210	200

[a] *The capital cost of a composite plan is equal to the plan's required capital investment, or total capital outlays necessary over the plan design period, less the value of that investment beyond the plan design period.*

Source: SEWRPC.

Table 177

KEY ADVANTAGES AND DISADVANTAGES OF THE COMPOSITE COMMUTER RAIL SYSTEM PLAN IN COMPARISON TO THE TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Factor	Advantage	Disadvantage
Cost	$8.4 million, or 4 percent less capital cost—that is, the capital investment less the value of the remaining life of the facilities at the end of the 20-year plan design period	$6.7 million, or 1 percent, more total cost over plan design period $33.4 million, or 10 percent, more capital investment required over design period $1.9 million, or 5 percent, more operating subsidy required in design year
Accessibility	- -	183,000, or 49 percent, less resident population within walking diatance 72,300, or 25 percent, fewer jobs within walking distance 192,500, or 12 percent, less resident population within driving distance
Travel Speed	- -	2 miles per hour, or 12 percent, slower for passenger travel on the vehicle portion of the trip, resulting in an additional 2 minutes, or 14 percent, additional travel time per trip
Transit Ridership	- -	28,800, or 38 percent, fewer primary transit trips on an average weekday in design year 12,500, or 3 percent, fewer total transit trips on an average weekday in design year
Disruption	- -	20 acres, or 29 percent, more land required for system development

Source: SEWRPC.

comparatively analyzed. This analysis was done by arranging the alternative plans in order of increasing total cost over the plan design period, and performing successive comparisons of pairs of plans beginning with a comparison of the plan of lowest total cost—the truncated bus-on-freeway plan—and the next least costly plan—the composite commuter rail plan. The plan of this pair which was determined to be better on a systemwide basis was then compared to the next most costly plan—the composite busway plan. The best plan of this pair was then compared to the most costly plan—the composite light rail transit plan, and the best system plan so identified. This successive comparison of alternative plans is not unlike incremental economic plan evaluation techniques, which have long been used to establish whether the marginal benefits of alternative plans exceed their additional costs over the costs of other alternative plans.

Comparison of the Composite Commuter Rail and Truncated Bus-on-Freeway Plans: Of the four truncated and composite alternative primary transit system plans, the least costly was the bus-on-freeway truncated plan. The commuter rail composite plan would entail only a slightly greater total cost—about $6.7 million, or less than 1 percent more than the total cost of the bus-on-freeway plan over the plan design period, as indicated in Table 177. However, the commuter rail plan would have very limited advantages over the bus-on-freeway plan. The only substantial advantage of the commuter rail plan over the bus-on-freeway plan is that its capital cost—that is, the capital investment less the value of the remaining life of the facilities at the end of the 20-year plan design period—over the plan design period is $8.4 million, about 4 percent less than that of the bus-on-freeway plan.

On the other hand, the commuter rail plan would have a number of disadvantages in comparison to the bus-on-freeway plan. The capital investment required to implement the commuter rail plan over the plan design period would be $33.4 million, or 10 percent more than required for the bus-on-freeway plan. Also, the commuter rail plan would be less efficient, requiring $1.9 million, or about 5 percent, more subsidy in the plan design year for operation and maintenance. This greater subsidy requirement is sufficient to offset the small capital cost advantage of the commuter rail plan over the bus-on-freeway plan. Perhaps the most significant disadvantage of the commuter rail plan, however, is that it may be expected to carry fewer transit trips than the bus-on-freeway plan, both on its primary element and on the total system. The primary transit element of the commuter rail plan, consisting of a combination of commuter rail and bus-on-freeway primary transit facilities and services, may be expected to carry 28,800, or 38 percent, fewer primary transit trips on an average weekday in the design year than the primary transit element of the truncated bus-on-freeway plan. However, about 16,300, or nearly 57 percent, of these 28,800 trips may be expected to use the local and express transit element of the commuter rail plan rather than private automobiles. These trips would, however, receive a lower level of transit service than under the bus-on-freeway plan, averaging about 19 mph slower over the on-vehicle portion of the trips, and requiring an average of 12 more minutes per transit trip. The remaining 12,500 weekday transit trips not carried on the primary element of the commuter rail plan may be expected to use private automobiles for tripmaking, and represent that many fewer transit trips than under the bus-on-freeway plan.

Another disadvantage of the commuter rail plan is that its primary element would be less accessible to the population of the Milwaukee area, and the Region. Under this plan a total of 183,000, or 49 percent, fewer residents may be expected to reside within walking distance of a primary transit facility than under the bus-on-freeway plan, and 192,500, or 12 percent, fewer residents may be expected to reside within driving distance. A total of 72,300, or 25 percent, fewer jobs may be expected to be located within walking distance of a primary transit facility under the commuter rail plan. The commuter rail plan would also require 20 more acres of land for system development.

The disadvantages of the commuter rail plan outweigh its advantages under this alternative future. The commuter rail plan would have a slightly higher total cost than the bus-on-freeway plan; yet, at the end of the plan design period, it would be less efficient with respect to meeting its operating and maintenance costs from farebox revenues. The commuter rail plan would also carry substantially less primary transit ridership and slightly less total ridership than the bus-on-freeway plan. In addition, the primary element of the commuter rail plan would provide substantially less accessibility to jobs and residents in the Milwaukee area than the bus-on-freeway plan. Accordingly, it was concluded that the bus-on-freeway plan was, as a system, a superior alternative to the commuter rail plan. Accordingly, the bus-on-freeway plan was compared to the next most costly of the four alternative composite plans, the busway composite plan.

Comparison of the Composite Busway and Truncated Bus-on-Freeway Plans: The composite busway plan would entail $108.9 million, or 14 percent, more total cost over the plan design period than the truncated bus-on-freeway plan. However, it would have a number of advantages over the bus-on-freeway plan. The most significant of these advantages, as listed in Table 178, would be the greater accessibility provided to jobs and residents in the Milwaukee area and the greater number of transit trips made on the primary element of the transit system. About 177,400 more people and 147,600 more jobs—both nearly 50 percent increases, and all within Milwaukee County—may be expected to be within walking distance of primary transit facilities under the composite busway plan than under the truncated bus-on-freeway plan. Nearly 59,800, or 80 percent, more transit trips may be expected to be made on the primary element of the busway plan. All these additional trips made on the primary element of the composite busway plan may be expected to be made under the bus-on-freeway plan as well, but on the local and express elements of that plan. These transit trips would, therefore, receive a lower level of service, averaging about two mph slower over the on-vehicle portion of the trips and requiring an average of four more minutes per transit trip. However, because the bus-on-freeway plan would provide a much faster primary element than the busway plan, overall transit travel would be about one mph faster on the vehicle portion of the trip under the bus-on-freeway plan, saving about one minute per transit trip.

One other advantage of the composite busway plan is that, at the end of the plan design period, it would be more efficient than the bus-on-freeway truncated plan with respect to the proportion of operating and maintenance costs recovered

Table 178

KEY ADVANTAGES AND DISADVANTAGES OF THE COMPOSITE BUSWAY SYSTEM PLAN IN COMPARISON TO THE TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Factor	Advantage	Disadvantage
Cost	\$1.9 million, or 5 percent, less operating subsidy required in design year Total transit system revenues recover 3 percent more operating costs, and primary element revenues recover 16 percent more operating costs, in design year	\$108.9 million, or 14 percent, more total cost over plan design period \$124.7 million, or 55 percent, more capital cost—that is, the capital investment less the value of the remaining life of the facilities at the end of the 20-year plan design period \$285.8 million, or 84 percent, more capital investment required over design period \$0.10, or 21 percent, more total cost per passenger over design period
Accessibility	177,400, or 47 percent, more resident population within walking distance 147,600, or 50 percent, more jobs within walking distance	- -
Transit Ridership	59,800, or 80 percent, more primary transit trips on an average weekday in design year	5,700, or 2 percent, fewer total transit trips on an average weekday in design year
Disruption	- -	140 acres, or 186 percent, more land required for system development

Source: SEWRPC.

from farebox revenues. The busway plan may be expected to require \$1.9 million, or 5 percent, less subsidy in the plan design year than the bus-on-freeway plan, and the busway plan may be expected to recover about 3 percent more of its operating costs from farebox revenues than the bus-on-freeway plan. In addition, the busway plan's primary element may be expected to recover nearly 16 percent more of its operating costs from farebox revenues in the plan design year.

These operating cost and maintenance cost efficiencies, however, are offset by the principal disadvantage of the busway plan, its additional capital costs. The busway plan would entail \$125 million, or 55 percent, more capital costs over the plan design period than the bus-on-freeway plan, and would require \$286 million, or 84 percent, more capital investment over the plan design period. Thus, the total cost of the busway plan would be \$108.9 million, or 14 percent, more than that of the bus-on-freeway plan. Also, the total cost per passenger of the busway plan over the plan design period would be \$0.10, or 21 percent, more than that of the bus-on-freeway plan. In addition, the bus-on-freeway plan may be expected to attract 5,700, or 2 percent, more transit trips from automobiles than the busway plan on an average weekday in the plan design period. Nearly all of this additional transit tripmaking would consist of trips to and from the Milwaukee central business district. Increased use of transit to the central business district may be expected under the bus-on-freeway plan because its service to the central business district would be faster, operating directly from outlying areas with no or few intermediate stops.

The disadvantages of the busway plan outweigh its advantages over the bus-on-freeway plan. Although the busway plan would require less operating subsidy than the bus-on-freeway plan, its capital cost would offset this advantage. Moreover, the bus-on-freeway plan may be expected to divert slightly more automobile travel to the use of public transit.

Table 179

KEY ADVANTAGES AND DISADVANTAGES OF THE COMPOSITE LIGHT RAIL TRANSIT SYSTEM PLAN IN COMPARISON TO THE TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Factor	Advantage	Disadvantage
Cost	$2.9 million, or 7.5 percent, less operating subsidy required in design year Total transit system revenues recover 3 percent more of operating costs, and primary element revenues recover 16 percent more of operating costs in design year	$184.8 million, or 25 percent, more total cost over design period $212.9 million, or 95 percent, more capital cost over design period $492.8 million, or 144 percent, more capital investment over design period $0.15, or 32 percent, more total cost per passenger over design period
Accessibility	177,400, or 47 percent, more resident population within walking distance 147,600, or 50 percent, more jobs within walking distance	- -
Transit Ridership	70,000, or 80 percent, more primary transit trips on an average weekday in design year	4,000, or 1 percent, fewer total transit trips on an average weekday in plan design year
Energy	11 percent savings in petroleum-based fuel used for transit system propulsion over plan design period (less than 1 percent savings in area automobile petroleum-based fuel use over plan design period) 102,400, or 27 percent, of transit trips made partially or totally on transit vehicles not dependent on petroleum-based fuels	- -
Disruption	- -	140 acres, or 200 percent, more land required for system development

Source: SEWRPC.

Accordingly, it was concluded that the truncated bus-on-freeway plan was, as a system, a superior alternative to the composite busway plan. Therefore, the last of the composite plans, the composite light rail transit plan, was compared to the bus-on-freeway plan.

Comparison of the Composite Light Rail Transit and Truncated Bus-on-Freeway Plans: The total cost of the composite light rail transit plan would be $190 million, or 25 percent, more than the total cost of the bus-on-freeway plan. The light rail transit plan would, however, have a number of important advantages over the bus-on-freeway plan, as indicated in Table 179. The primary transit facilities under the light rail transit plan would be accessible within walking distance to nearly 50 percent of the resident population and of the jobs in the Milwaukee area. Partially for this reason, nearly 70,000 more transit trips may be expected to be made on the primary element of the light rail transit plan on an average weekday in the design year than on the primary element of the bus-on-freeway plan. However, under the bus-on-freeway plan these additional trips would not be diverted to the private automobile, but rather would be made on the local or express elements of the plan. These trips would average about six mph slower over the on-vehicle portion of the trip, and would require an average of seven additional minutes per trip. However, because the bus-on-freeway plan would provide a much faster primary element than the light rail transit plan, on-vehicle transit travel would be about one mph faster under this plan, saving about one minute per transit trip.

The composite light rail transit plan would have some important advantages with respect to energy use as it would be based on an electrically propelled primary transit system. It would, therefore, use 11 percent less petroleum-based fuels for transit system propulsion over the plan design period than the bus-on-freeway plan. Such savings, however, would represent less than 1 percent of the total petroleum-based fuel which may be expected to be used in the Milwaukee area over the plan design period by automobile travel. Perhaps more importantly, the use of electricity for propulsion of the light rail system would enable nearly 102,400 transit trips on an average weekday, or 27 percent of all transit tripmaking, to be made on a transit system which is not dependent on petroleum-based fuels.

The composite light rail transit plan would also be expected to be more cost-effective at the end of the plan design period with respect to operating and maintenance costs. The light rail transit plan may be expected to require $2.9 million, or 7.5 percent, less operating subsidy in the plan design year than the bus-on-freeway plan. Total transit system revenues may be expected to recover 3 percent more of the operating and maintenance costs under the light rail transit plan than under the bus-on-freeway plan, and farebox revenues may be expected to recover 16 percent more of the operating and maintenance costs in the design year under the primary element of the light rail transit plan than under the primary element of the bus-on-freeway plan.

These annual operating cost savings would be offset by the substantially greater capital cost of the light rail transit plan. This high capital cost is the principal disadvantage of the light rail transit plan, making it the most costly of the alternative plans to implement. The capital cost of the light rail plan would be about $213 million, or 95 percent, more than that of the bus-on-freeway plan. The capital investment required to implement the plan over the plan design period would be about $493 million, or 144 percent, more than would be required for the bus-on-freeway plan. Consequently, the light rail transit plan would require about $0.15, or 32 percent, more capital investment per passenger carried than the bus-on-freeway plan. Other disadvantages of the light rail transit plan are that it would require more land for system development and that it would attract about 4,000, or 1 percent, fewer transit trips on an average weekday in the design year than the bus-on-freeway plan. About 140 acres, or 200 percent, more land would be needed for the right-of-way for the light rail transit guideway and for the additional stops and stations of the light rail transit plan. Marginally fewer transit trips may be expected to be attracted to the light rail transit plan because some parts of the primary element of the bus-on-freeway plan are expected to provide faster trips to the downtown area, operating on a very limited or nonstop mode, unlike the scheduled stop light rail transit system plans. Nearly all of the additional transit trips which could be expected to be made under the bus-on-freeway plan would be made to the Milwaukee central business district, the focal point of primary transit service under that plan.

Thus, it was concluded that the tangible advantages of a light rail transit plan over a comparable bus-on-freeway plan in the Milwaukee area under the moderate growth scenario-centralized land use plan alternative future would be small compared to the additional costs entailed. The anticipated operating and maintenance cost efficiencies of the light rail transit plan are offset over the plan design period by the additional capital costs. In addition, a light rail transit system, despite its greater cost, cannot be expected to divert substantially more trips from automobiles to public transit than a bus-on-freeway system and, therefore, cannot be expected to provide any substantial incremental benefits with respect to motor fuel consumption or air pollutant emissions. The service provided by the light rail transit plan is not expected to attract more transit trips than comparable bus-on-freeway service, even though it would make primary transit accessible to 50 percent more residents and jobs in the Milwaukee area, and would have about 40 percent faster average vehicle speeds than comparable local or express transit services under the bus-on-freeway plan. This is because the primary element of the bus-on-freeway plan would be expected to operate at speeds nearly 40 percent faster than the comparable light rail transit primary element because of the limited stop or nonstop operation involved. This higher level of primary transit service under the bus-on-freeway plan means that, even though more transit users may be expected to use primary transit service under the light rail transit plan, the overall speed of transit trips under the plans would not differ significantly.

There are other possible benefits to a light rail transit system plan which require consideration. But it must be recognized that most of these benefits are, to a great extent, intangible, and have a degree of uncertainty as to whether they can or would be attained. These benefits include environmental impacts, land use development impacts, operation in an energy contingency, reliability of operation, safety of operation, and rider preference.

Environmental Impacts: There are some limited localized environmental advantages to a light rail transit plan. Electrically propelled light rail vehicles produce no air pollutant emissions in the corridors in which they operate, although the central coal-fired power plants from which they would primarily draw their power in the Milwaukee area would emit air pollutants. Diesel motor buses, on the other hand, emit approximately one-half the carbon monoxide and hydrocarbons and about six times the nitrogen oxides that automobiles do. There would be no areawide differences in the total pollutant emissions expected under the light rail transit and motor bus plans because Milwaukee area automobile traffic and pollutant emissions will be about the same under each plan and may be expected to dominate any pollutant emissions. Moreover, light rail transit may be expected to have significant air quality benefits only in areas of concentrated transit traffic, particularly the Milwaukee central business district, where the level of such traffic may approach that of automobile traffic. Specifically, under the light rail transit plan, up to 200 fewer diesel motor buses can be expected to operate over the transit mall in the downtown area during peak travel hours.

Noise reduction is another advantage of light rail transit, but again, this benefit will be apparent only in those parts of the Milwaukee central business district where transit vehicle volumes will approach automobile volumes. Several components of light rail transit serve to make light rail vehicles quieter than automobiles or diesel motor buses. These components include electric propulsion, welded rail, constant tension overhead catenary, and resilient wheels. A typical diesel motor bus has a greater noise level than an automobile, ranging between 72 dbA and 82 dbA at 25 feet when cruising, and 82 dbA and 96 dbA at 25 feet when accelerating in traffic. The noise level of an automobile will typically range from 62 dbA to 90 dbA at 25 feet, depending upon whether the vehicle is cruising or accelerating. Average noise levels for light rail vehicles are 62 dbA to 76 dbA between 0 and 20 mph and 76 dbA to 82 dbA between 20 and 50 mph. Again, light rail transit may have a significant impact on noise levels only along the proposed Wisconsin Avenue transit mall, which would be used exclusively by transit traffic. Under the light rail transit plan, up to 200 fewer diesel motor buses would be utilizing the transit mall during the peak hour, being replaced by 33 two-car trains of light rail vehicles.

Land Development and Redevelopment: Another important intangible benefit of a light rail transit plan is its possible impact on urban land development and redevelopment. Light rail transit, or any transit mode requiring new fixed guideways, has a purported potential to stimulate land development and redevelopment because it represents a long-term commitment to high-quality public transit service in a corridor, and because it may be expected to provide, through its exclusive guideway, significantly improved travel accessibility to areas surrounding its stations. Because light rail transit would require a greater capital investment, and its guideway could not be as easily converted to other uses, light rail transit has been purported as having greater land development impacts than busways. Light rail transit has also been purported to have greater potential for land development than busways because it would operate at higher speeds and provide greater accessibility. Because little additional automobile traffic congestion is expected under this alternative future, the accessibility provided by the bus-on-metered freeway system plan may be expected to be quite similar to that provided by the light rail transit plan. The supposition that light rail transit will provide a land development inducement because it represents a permanent public commitment to the provision of a high level of transit service in a corridor can be weighed against recent studies of the influence of fixed guideway facilities on land development in United States cities. These studies indicate that for rail transit to influence the distribution of new development and redevelopment, an entire set of conditions must be satisfied.[18] These conditions include the presence of economic forces which support substantial land use development and redevelopment; the existence of a strong demand for such development in the urban area; the attractiveness of sites surrounding rail transit stations in terms of ease of access, utility, and other urban services, physical features, and social characteristics; the existence of a public land use policy which encourages such development through coordinated tax policies, infrastructure supply, and land use controls, as well as local neighborhood approval; the

[18] *See U. S. Department of Transportation, Land Use Impacts of Rapid Transit: Implications of Recent Experience, Final Report, August 1977.*

presence of land near the stations which is available or which can be readily assembled for development; and the provision of a new transportation advantage through improvements in transit travel accessibility. Because the satisfaction of all these conditions in the Milwaukee area is unlikely, and because the degree of transportation advantage to be provided by a light rail transit system is very similar to that provided by a bus-on-metered-freeway system, the ability of the light rail transit plan to induce development in the Milwaukee area must be concluded to be uncertain.

The implementation of a light rail transit plan would, nevertheless, have a greater short-term economic impact on the Region than implementation of any of the other alternative plans considered. A light rail transit system would require the construction of fixed facilities, including railway trackage, power transmission and distribution facilities, stations, and storage and maintenance facilities, resulting in a significant increase of activity, albeit temporary, in the local economy. The additional income from construction wages would result in additional expenditures for retail goods, and in the purchase of construction materials and services which would create additional business for suppliers, material handlers, and contractors.

Energy: The light rail transit plan would have a significant advantage with respect to energy use only under a severe petroleum shortage, as all the transit alternatives under this future would use about the same amount of energy, and even about the same amount of petroleum-based fuels. This is because average weekday energy use by automobiles would dominate energy use by transit, and the levels of automobile travel may be expected to be about the same under all the alternative transit plans. Light rail transit has an advantage under a severe petroleum shortage because the electrical energy it uses would probably not be affected, and the system would therefore have the potential for expanded service. The expansion of such service, however, may be difficult in an emergency situation as vehicles for any additional service may be difficult to obtain quickly. Furthermore, it must be recognized that during a severe petroleum shortage, motor fuels may be expected to be rationed between all motor vehicles, with priority being given to public transit vehicles. Since public transit would use less than one-third the petroleum expected to be used by automobiles under the bus-on-metered freeway plan, it is only reasonable to expect that sufficient fuel for transit will be made available under any petroleum fuel shortfall. Therefore, a light rail transit system may have little advantage over a motor bus system in the event of an emergency petroleum shortage.

Reliability: Public transit service which is provided over fixed guideways is considered to be more reliable than such service provided over public roadways shared with other traffic. Light rail transit or busway systems, to the extent that these modes utilize exclusive rights-of-way, should not be affected to any significant degree by traffic congestion, traffic accidents, or street and utility repairs which are common on public arterial street rights-of-way. Also, operational problems caused by inclement weather—especially snow and ice—may be expected to be less severe than such problems on systems operating over public streets. Light rail transit fixed guideways which are located within public street rights-of-way, however—either in median areas, in reserved lanes, or in mixed traffic—may be expected to be affected by all of these problems to the extent that the guideway is not separated from the adjacent motor vehicle traffic and from cross traffic at intersections. In addition, all rail transit modes suffer from the potential for an entire guideway segment to lose service should a single vehicle or train break down or become involved in an accident since, unlike rubber-tired motor vehicles, light rail vehicles cannot be steered around obstructions. Service disruptions can also occur from a power outage, a breakdown in the overhead power distribution system, and such emergencies as fires which may require hose lines to be placed across trackage.

Safety: Safety may be expected to be greater under the light rail transit plan than under the motor bus-on-freeway plan because of the extensive use of dedicated street right-of-way, in addition to signals at crossings which provide preferential treatment for the light rail vehicles. In addition, if high-level boarding platforms are used, boarding and deboarding accidents, which are among the most common types of accidents in current day transit operations, would be significantly reduced.

Rider Preference: Proponents of light rail transit systems argue that transit passengers prefer rail transit services over motor bus transit services and will therefore make greater use of the rail services. This argument is based on the contention that there is something about the light rail transit mode which makes it intrinsically more attractive than other primary transit modes even if the levels of service provided are the same. This attraction is usually described in terms of ride quality or comfort, and image. It is probably true that there is a certain fascination with light rail transit technology as there is with other rail-related modes for moving people. This interest appears to stem either from interest in railways as a leisure-time activity, or from an historical perspective inasmuch as light rail transit technology is often equated with street railway technology reminiscent of the "good old days." In this respect, it should be noted that the historic conversion of street railway lines to electric trolley bus and motor bus lines in Milwaukee was received with expressions of great public joy and increased levels of ridership on the converted lines. There is also a feeling on the part of some light rail transit proponents that, by providing the Milwaukee area with a fixed guideway primary transit facility, the implementation of a light rail transit system will assist in promoting Milwaukee as the center of an important and progressive major metropolitan area.

However, because the degree to which these intangible benefits can actually be attained must be regarded as uncertain, and because the development of a light rail transit system would require two-and-one-half times as much capital cost over the design period while attracting about the same total transit ridership as the bus-on-freeway plan, it was concluded that the bus-on-freeway plan was the superior plan of the alternatives considered under the moderate growth scenario-centralized land use plan alternative future.

It may be nevertheless possible that, within certain corridors, elements of the light rail transit, busway, or commuter rail plans may be superior to comparable elements of the bus-on-freeway plan. In the following sections of this chapter, therefore, the commuter rail, busway, and light rail transit plans will be examined by route and corridor to determine their best elements, and to establish whether these best elements are superior to the comparable elements of the bus-on-freeway plan and, therefore, whether they should be included in the best system plan for this alternative future.

Evaluation of Individual Commuter Rail Plan Corridors: Under the commuter rail composite plan, commuter rail facilities and services would be provided in three corridors radiating from downtown Milwaukee: one to the north to Grafton, one to the west to Oconomowoc, and one to the south to Kenosha. The primary transit service which would be provided by the proposed commuter rail facilities in these three corridors was compared with such service under the bus-on-freeway truncated plan, the bus-on-freeway plan having been identified as the best system plan under the moderate growth scenario-centralized land use plan alternative future. This comparison was intended to determine whether, in any of the three commuter rail corridors, commuter rail facilities and services could be recommended over bus-on-freeway facilities and services, the bus-on-freeway plan providing essentially the same type of long-distance transit service focused on the central business district as the commuter rail plan.

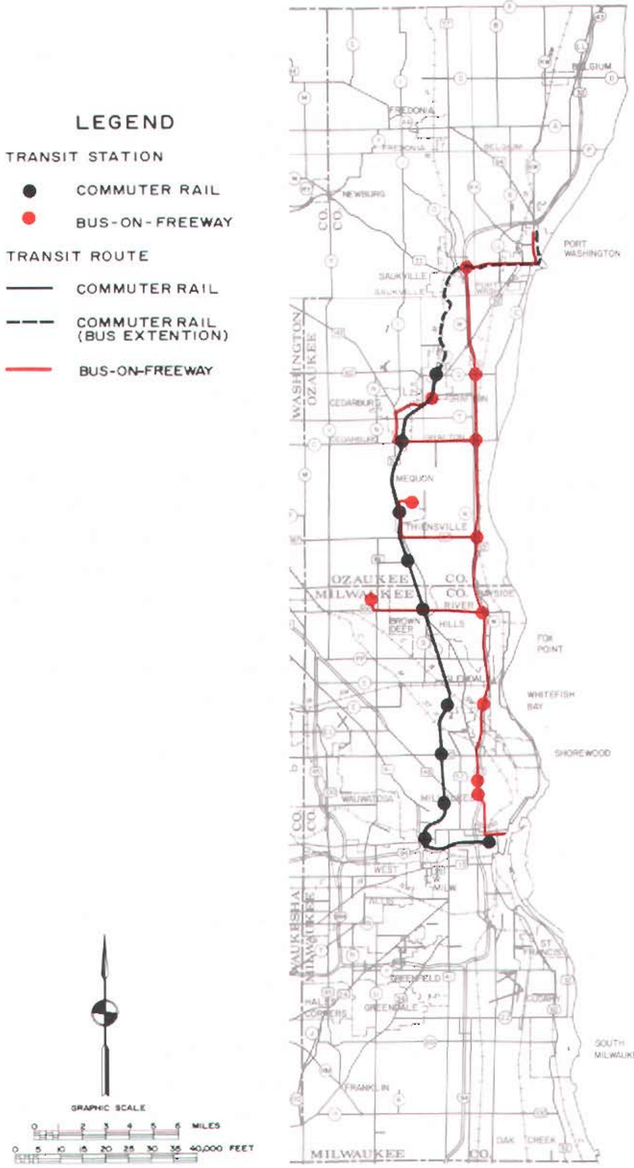
Northern Corridor to Port Washington: As shown on Map 81, bus-on-freeway service in the corridor radiating to the north from the Milwaukee central business district to Port Washington would be provided over the North-South Freeway (IH 43) to the communities of Port Washington, Grafton, Cedarburg, Mequon, Thiensville, Brown Deer, and Shorewood. Five bus-on-freeway routes totaling 198 route miles would provide this service from a total of 11 stations located outside the Milwaukee central business district, 9 of which would have park-ride lots. Headways on the bus-on-freeway service would range from 9 to 15 minutes in the peak travel periods, and from 38 to 55 minutes in the off-peak travel periods to meet the forecast demand.

With a shuttle bus service operating between Port Washington and the end of the commuter rail line at Grafton, commuter rail service would serve the same communities in this corridor along a single alignment 23 miles in length. A total of 10 stations would be provided along the route, six of which would have park-ride lots. Trains would consist of a locomotive and two coaches in the peak travel periods and the midday off-peak period, and one coach in the evening off-peak period. Commuter trains would operate at the maximum headways prescribed in the adopted standards—30 minutes in the peak travel periods in the peak direction and 60 minutes otherwise.

The bus-on-freeway service in this corridor may be expected to carry about three times as many passengers in the design year as the commuter rail service, as indicated in Table 180. Nearly 16,000 passengers may be expected to use the bus-on-freeway primary transit service on an average weekday in the design year, compared with 5,700 passengers for the commuter rail service.

Map 81

COMPARABLE BUS-ON-FREEWAY AND COMMUTER RAIL ROUTES IN THE NORTH CORRIDOR TO PORT WASHINGTON



In an effort to identify elements of the composite commuter rail system plan that may be superior to comparable elements of the truncated bus-on-freeway system plan, commuter rail and bus-on-freeway routes in the corridor between the Milwaukee central business district and the City of Port Washington were examined separately from the remainder of each of the primary transit systems. The proposed bus-on-freeway service, as shown above, would be comprised of five routes over which 198 round-trip route miles of service would be provided to a total of 11 stations located outside downtown Milwaukee, nine of which would have park-ride lots. The comparable commuter rail service, also shown above, would be provided over a single alignment 23 miles in length, over which 46 round-trip route miles of service would be provided to 10 stations, six of which would have park-ride lots. In addition, a feeder bus service would operate between the end of the commuter rail route in the City of Grafton and the City of Port Washington.

Source: SEWRPC.

Under both the bus-on-freeway and commuter rail services in this corridor, a large proportion of these trips would either terminate or begin in the Milwaukee central business district. Under the bus-on-freeway service, 65 percent, or 10,400 trips, would have one trip end in the Milwaukee central business district, compared with 47 percent, or 2,700 trips, under the commuter rail service.

The net cost of operating and maintaining commuter rail service in this corridor in the design year—that is, the required subsidy or the total operating and maintenance costs less farebox revenues—may be expected to be $97,200, or about 7 percent less than the same cost for bus-on-freeway service. However, the net operating and maintenance cost per passenger on the bus-on-freeway service would be less than one-half that required for the commuter rail service. The bus-on-freeway service would require, on the average, a subsidy of $0.33 per passenger, compared with $0.88 per passenger for the commuter rail service. Another indication of the superior cost-effectiveness of the bus-on-freeway service is that it may be expected to recover 18 percent more of its design year operating and maintenance costs from farebox revenues than the commuter rail service, 66 percent compared with 48 percent.

The capital investment required to provide primary transit service in this corridor, including the cost of all construction, right-of-way acquisition, and the acquisition and replacement of vehicles over the plan design period, would be only slightly higher for commuter rail service than for bus-on-freeway service, as shown in Table 180. However, the capital cost—that is, the capital investment less the value of the remaining life of the facilities and vehicles at the end of the 20-year plan design period—of the commuter rail service is expected to be slightly less than that of the bus-on-freeway service in this corridor. The total capital cost per boarding passenger in the design year of the bus-on-freeway service would, however, be less than one-half that of the commuter rail service.

Accordingly, it was concluded that bus-on-freeway service in this corridor would be superior to commuter rail service, attracting substantially greater ridership and being more cost-effective. These advantages would outweigh the somewhat higher capital cost and lower public subsidy of bus-on-freeway service in comparison to commuter rail service.

It should be noted that some additional ridership on local and express transit service may be expected in this corridor under the commuter rail

Table 180

SUMMARY OF EVALUATIVE MEASURES FOR CORRIDOR COMPARISON OF BUS-ON-FREEWAY AND COMMUTER RAIL ALTERNATIVES TO THE MILWAUKEE AREA UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Evaluative Measure	Port Washington Corridor		Oconomowoc Corridor		Racine-Kenosha Corridor	
	Bus-on-Freeway	Commuter Rail	Bus-on-Freeway	Commuter Rail	Bus-on-Freeway	Commuter Rail
Ridership						
Average Weekday Passengers	16,000	5,700	10,500	4,400	21,700	13,200
Design Year Boarding Passengers . .	4,088,000	1,457,000	2,689,000	1,117,000	5,532,000	3,376,000
Capital Cost and Investment						
Total Capital Cost to Design Year . .	$13,637,400	$11,257,700[b]	$ 9,362,100	$ 8,402,600[b]	$17,070,200	$16,000,000[b]
Total Capital Investment to Design Year	24,657,200	28,348,000[b]	17,019,000	21,878,000[b]	30,270,600	40,900,000[b]
Operating Cost						
Operating Cost in Design Year. . . .	$ 4,119,600	$ 2,473,200	$ 3,356,000	$ 2,503,200	$ 8,175,000	$ 6,617,400
Percent of Operating Cost Met by Farebox Revenue in Design Year[a].	66	48	61	42	63	60
Net Operating Cost (deficit) in Design Year	1,384,200	1,287,000	1,323,400	1,440,400	3,000,500	2,663,100
Cost-Effectiveness						
Net Operating Cost per Passenger in Design Year	$0.33	$0.88	$0.49	$1.29	$0.54	$0.78
Capital Cost to Design Year per Passenger in Design Year	3.30	7.70	3.50	7.50	3.10	4.70

[a] *Fares under all the alternative plans are assumed to increase with general price inflation. The fare for local and express bus service under both plans would remain at $0.50 per ride, expressed in constant 1979 dollars. The primary service fare would remain at $0.60 within Milwaukee County, and would increase with distance from Milwaukee County to between $1.00 and $1.40 at the future urbanized area limits, and to between $1.80 and $2.20 at the extreme limits of service.*

[b] *The Milwaukee Road has proposed major track rehabilitation work on each of the three railway routes identified in each of these corridors for potential use by commuter rail trains. Should all this track rehabilitation work be completed, the total capital investment would be reduced by $8.4 million to $19.9 million in the Port Washington corridor; by $0.8 million to $21.1 million in the Oconomowoc corridor; and by $0.9 million to $40.0 million in the Kenosha corridor. As of April 1981, such rehabilitation work had been completed on the Oconomowoc and Kenosha commuter rail routes, and $0.8 million in work had been completed on the Port Washington route.*

Source: SEWRPC.

plan. Although the commuter rail service would carry 28,800 fewer primary transit trips on an average weekday in the design year than the bus-on-freeway service, about 16,300 of these trips, or 57 percent, may be expected to use the express and local, as opposed to the primary, transit services. As shown in Table 181, the fact that commuter rail would carry these additional transit trips on the local and express transit services does not alter the conclusion that bus-on-freeway service is superior to commuter rail service in this corridor. While the substantial ridership and cost-effectiveness advantages of the bus-on-freeway services in the corridor are reduced somewhat when considering the express and local services as well as the primary services, the advantages of the commuter rail services with respect to capital cost and operating subsidy are eliminated.

West Corridor to Oconomowoc: As shown on Map 82, bus-on-freeway service in the corridor radiating to the west from the Milwaukee central business district to Oconomowoc would be provided over the East-West Freeway (IH 94) to the

Table 181

EVALUATION OF COMPOSITE COMMUTER RAIL PLAN BY CORRIDOR, ACCOUNTING FOR POTENTIAL SHARE OF ADDITIONAL LOCAL AND EXPRESS TRANSIT SERVICE AND USE UNDER THE COMPOSITE COMMUTER RAIL PLAN

Evaluative Measure	Port Washington Corridor			Oconomowoc Corridor			Racine-Kenosha Corridor		
	Primary Element	Local and Express Element[a]	Total	Primary Element	Local and Express Element[a]	Total	Primary Element	Local and Express Element[a]	Total
Ridership									
Average Weekday Passengers	5,700	5,800	11,500	4,400	3,400	7,800	13,200	4,800	18,000
Design Year Passengers	1,457,000	1,682,000	3,139,000	1,117,000	986,000	2,103,000	3,376,000	1,392,000	4,768,000
Capital Cost and Investment									
Total Capital Cost to Design Year . . .	$11,257,700[c]	$2,670,100	$13,927,800	$ 8,402,600[c]	$1,565,200	$ 9,967,800	$16,000,000[c]	$2,118,500	$18,118,500
Total Capital Investment to Design Year	28,348,000[c]	4,138,700	32,486,700	21,878,000[c]	2,426,100	24,304,100	40,900,000[c]	3,851,800	44,751,800
Operating Cost									
Operating Cost in Design Year	$ 2,473,200	$1,246,800	$ 3,720,000	$ 2,503,200	$ 730,900	$ 3,234,100	$ 6,617,400	$1,163,800	$ 7,781,200
Percent of Operating Cost Met by Farebox Revenue in Design Year[b]	48	55	50	42	55	45	60	55	59
Net Operating Cost (deficit) in Design Year	1,287,000	561,800	1,848,800	1,440,400	329,300	1,769,700	2,663,100	526,400	3,189,500
Cost-Effectiveness									
Net Operating Cost per Passenger in Design Year	$0.88	$0.33	$0.59	$1.29	$0.33	$0.84	$0.78	$0.33	$0.67
Capital Cost to Design Year per Passenger in Design Year	7.70	1.60	4.40	7.50	1.60	4.70	4.70	1.60	3.80

[a] *The local and express service ridership and costs in this table represent the additional local and express ridership and cost of the commuter rail plan over the bus-on-freeway plan in each corridor. It has been assumed for this analysis that, of the additional transit trips which would be made on the primary element under the bus-on-freeway plan, 57 percent would be made on the local and express element under the commuter rail plan within each corridor. It has also been assumed that the operating and capital costs of carrying these local and express transit trips will not vary between the corridors and the entire commuter rail local and express transit system element.*

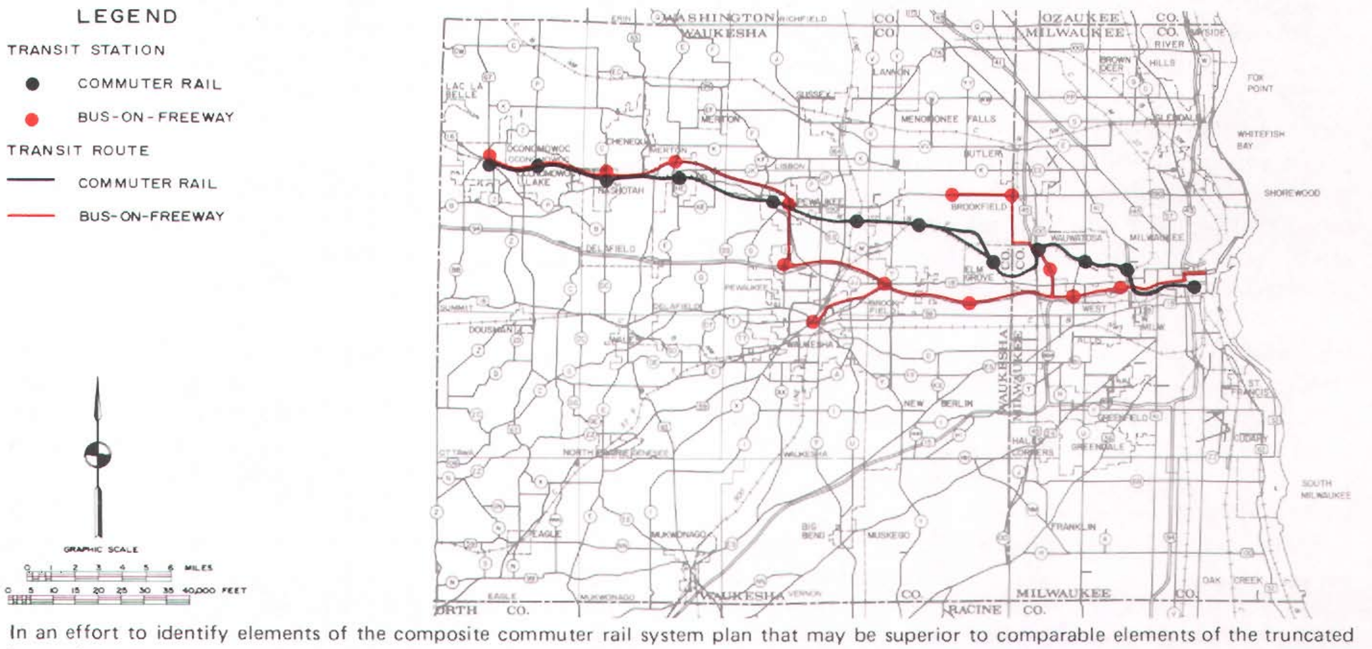
[b] *Fares under all the alternative plans are assumed to increase from the current fares with general price inflation. The fare for local and express bus service under both plans would remain at $0.50 per ride, expressed in 1979 constant dollars. The primary service fare would remain at $0.60 within Milwaukee County, and would increase with distance from Milwaukee County to between $1.00 and $1.40 at the future urbanized area limits, and to between $1.80 and $2.20 at the extreme limits of service.*

[c] *The Milwaukee Road has proposed major track rehabilitation work on each of the three railway routes identified in each of these corridors for potential use by commuter rail trains. Should all this track rehabilitation work be completed, the total capital investment would be reduced by $8.4 million to $19.9 million in the Port Washington corridor; by $0.8 million to $21.1 million in the Oconomowoc corridor; and by $0.9 million to $40.0 million in the Kenosha corridor. As of April 1981, such rehabilitation work had been completed on the Oconomowoc and Kenosha commuter rail routes, and $0.8 million in work had been completed on the Port Washington route.*

Source: SEWRPC.

Map 82

COMPARABLE BUS-ON-FREEWAY AND COMMUTER RAIL ROUTES IN THE WEST CORRIDOR TO OCONOMOWOC



In an effort to identify elements of the composite commuter rail system plan that may be superior to comparable elements of the truncated bus-on-freeway system plan, commuter rail and bus-on-freeway routes in the corridor between the Milwaukee central business district and the City of Oconomowoc were examined separately from the remainder of each of the primary transit systems. The proposed bus-on-freeway service, as shown above, would be comprised of five routes over which 197 round-trip route miles of service would be provided to a total of 13 stations located outside downtown Milwaukee, 12 of which would have park-ride lots. The comparable commuter rail service, also shown above, would be provided over a single alignment of 32 miles in length, over which 64 round-trip route miles of service would be provided to a total of 12 stations, nine of which would have park-ride lots.

Source: SEWRPC.

communities of Oconomowoc, Nashotah, Hartland, Pewaukee, Waukesha, Brookfield, Elm Grove, and Wauwatosa. Five bus-on-freeway routes totaling 197 route miles would provide this service from a total of 13 stations located outside the Milwaukee central business district, 12 of which would have park-ride lots. Headways on the bus-on-freeway service would range from 10 to 30 minutes in the peak travel periods, and from 40 to 55 minutes in the off-peak travel periods to meet the forecast demand.

Commuter rail service would serve the same communities in this corridor along a single alignment 32 miles in length. A total of 12 stations would be provided along the route, 9 of which would have park-ride lots. Trains would consist of a locomotive and 2 coaches in the peak travel periods, and 1 coach in the off-peak periods. The commuter trains would operate at the maximum headways prescribed in the adopted standards—30 minutes in the peak travel periods in the peak direction and 60 minutes otherwise.

The bus-on-freeway service in this corridor may be expected to carry about two-and-one-half times as many passengers in the design year as the commuter rail service, as indicated in Table 180. Nearly 10,500 passengers may be expected to use the bus-on-freeway primary transit service on an average weekday in the design year, compared with 4,400 passengers for the commuter rail service. Under both the bus-on-freeway and commuter rail services in this corridor, most of these trips would either terminate or begin in the Milwaukee central business district. Under the bus-on-freeway service, 75 percent, or 7,900 trips, would have one trip end in the Milwaukee central business district, compared with 71 percent, or 3,100 trips, under the commuter rail service.

The net cost of operating and maintaining commuter rail service in this corridor in the design year—that is, the required subsidy or the total operating and maintenance costs less farebox revenues—may be expected to approximate $117,000, or 9 percent more than for the bus-on-freeway service.

Moreover, the net operating and maintenance cost per passenger of the commuter rail service may be expected to be more than two-and-one-half times that of the bus-on-freeway service. The bus-on-freeway service would require, on the average, a subsidy of $0.49 per passenger, compared with $1.29 per passenger for the commuter rail service. Another indication of the superior cost-effectiveness of the bus-on-freeway service is that it may be expected to recover about 19 percent more of its design year operating and maintenance costs from farebox revenues than the commuter rail service, 61 percent compared with 42 percent.

The capital investment required to provide primary transit service in this corridor, including the cost of all construction, right-of-way acquisition, and acquisition and replacement of vehicles over the plan design period, would be only slightly higher for commuter rail service than for bus-on-freeway service, as shown in Table 180. However, the capital cost—that is, the capital investment less the value of the remaining life of the facilities and vehicles at the end of the 20-year plan design period—of the commuter rail service is expected to be slightly less than that of the bus-on-freeway service in this corridor. The total capital cost per boarding passenger in the design year of the bus-on-freeway service would, however, be about one-half that of the commuter rail service.

Accordingly, it was concluded that bus-on-freeway service in this corridor would be superior to commuter rail service, attracting substantially greater ridership and being more cost-effective, and thereby requiring a smaller public operating subsidy. These advantages would outweigh the somewhat higher capital cost of the bus-on-freeway service in comparison to the commuter rail service.

It should be noted that some additional ridership on local and express transit service may be expected in this corridor under the commuter rail plan. Although the commuter rail service would carry 28,800 fewer primary transit trips on an average weekday in the design year than the bus-on-freeway service, about 16,300 of these trips, or 57 percent, may be expected to use the express and local, as opposed to the primary, transit services. As shown in Table 181, the fact that commuter rail would carry these additional transit trips on the local and express transit services does not alter the conclusion that bus-on-freeway service is superior to commuter rail service in this corridor. While the substantial ridership and cost-effectiveness advantages of the bus-on-freeway services in the corridor are reduced somewhat when considering the express and local services as well as the primary services, the advantages of the commuter rail services with respect to capital cost are eliminated, and the disadvantage of the commuter rail plan with respect to operating cost subsidy is increased.

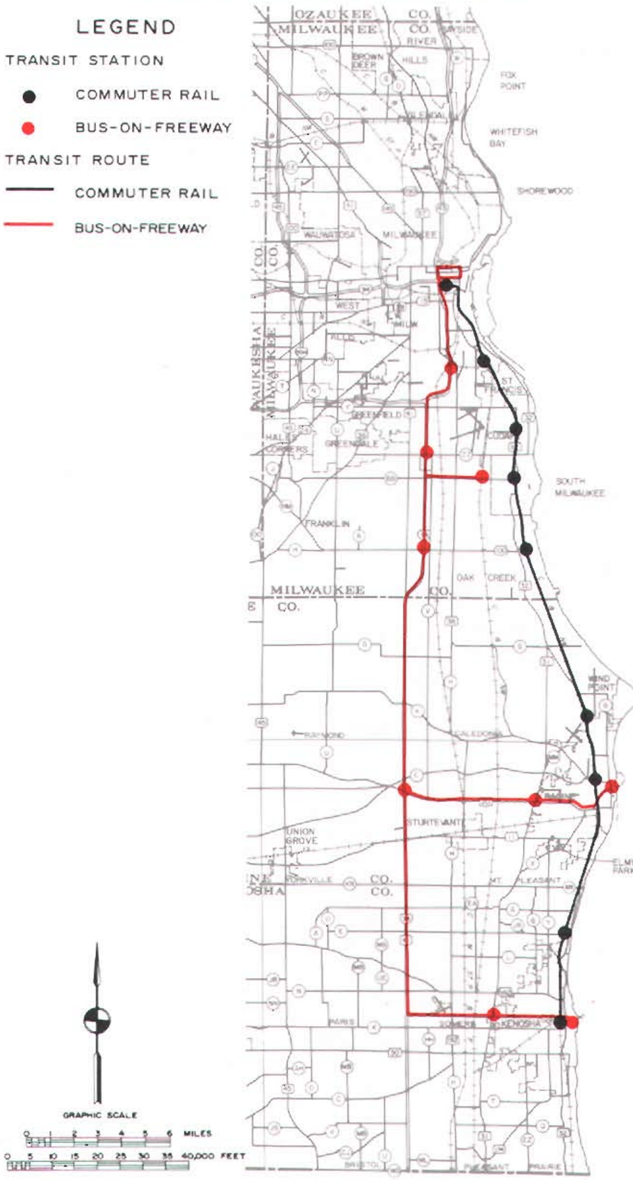
South Corridor to Kenosha: As shown on Map 83, bus-on-freeway service in the corridor radiating to the south from the Milwaukee central business district to Kenosha would be provided over the North-South Freeway (IH 94) to the communities of Kenosha, Racine, Oak Creek, South Milwaukee, Cudahy, and St. Francis. Six bus-on-freeway routes totaling 242 route miles would provide this service from a total of nine stations located outside the Milwaukee central business district, all of which would have park-ride lots. Headways on the bus-on-freeway service would range from 7 to 27 minutes in the peak travel periods, and from 15 to 60 minutes in the off-peak travel periods to meet the forecast demand.

Commuter rail service would serve the same communities in this corridor along a single alignment 33 miles in length. A total of nine stations would be provided along the route, six of which would have park-ride lots. Trains would consist of a locomotive and three coaches in the morning peak travel period, five coaches in the evening peak travel period, three coaches in the midday off-peak travel period, and two coaches in the evening off-peak travel period. Commuter trains would operate at the maximum headways prescribed in the adopted standards—30 minutes in the peak travel periods in the peak direction and 60 minutes otherwise.

The bus-on-freeway service in this corridor may be expected to carry about 60 percent more passengers in the design year than the commuter rail service, as shown in Table 180. Nearly 21,700 passengers on an average weekday may be expected to use the bus-on-freeway service, compared with 13,200 passengers for the commuter rail service. Under both the bus-on-freeway and commuter rail services in this corridor, most of these trips would either terminate or begin in the Milwaukee central business district. Under the bus-on-freeway service, 83 percent, or 18,000 trips, would have one trip end in the Milwaukee central business district, compared with 74 percent, or 9,800 trips, under the commuter rail service.

Map 83

COMPARABLE BUS-ON-FREEWAY AND COMMUTER RAIL ROUTES IN THE SOUTH CORRIDOR TO KENOSHA



In an effort to identify elements of the composite commuter rail system plan that may be superior to comparable elements of the truncated bus-on-freeway system plan, commuter rail and bus-on-freeway routes in the corridor between the Milwaukee central business district and the City of Kenosha were examined separately from the remainder of each of the primary transit systems. The proposed bus-on-freeway service, as shown above, would be comprised of six routes over which 242 round-trip route miles of service would be provided to a total of nine stations located outside downtown Milwaukee, all of which would have park-ride lots. The comparable commuter rail service, also shown above, could be provided over a single alignment of 33 miles in length, over which 66 round-trip route miles of service would be provided to a total of nine stations, six of which would have park-ride lots.

Source: SEWRPC.

The net cost of operating and maintaining commuter rail service in this corridor in the design year—that is, the required subsidy or the total operating and maintenance costs less farebox revenues—may be expected to be $337,400, or 11 percent less than the same cost for bus-on-freeway service. However, the net operating and maintenance cost per passenger on the bus-on-freeway service would be about 70 percent of that of the commuter rail service. The bus-on-freeway service would require, on the average, a subsidy of $0.54 per passenger, compared with $0.78 per passenger for the commuter rail service. Another indication of the greater cost-effectiveness of the bus-on-freeway service is that it may be expected to recover about 3 percent more of its design year operating and maintenance costs from farebox revenues than the commuter rail service, 63 percent compared with 60 percent.

The capital investment required to provide primary transit service in this corridor, including the cost of all construction, right-of-way acquisition, and acquisition and replacement of vehicles over the plan design period, would be about 25 percent, or about $11 million, higher for the commuter rail service than for the bus-on-freeway service, as shown in Table 180. However, the capital cost—that is, the capital investment less the value of the remaining life of the facilities and vehicles at the end of the 20-year plan design period—of the commuter rail service is expected to be slightly less than that of the bus-on-freeway service in this corridor. The total capital cost per boarding passenger in the design year of the bus-on-freeway service would, however, be about 66 percent of that of the commuter rail service.

Accordingly, it was concluded that bus-on-freeway service in this corridor would be superior to commuter rail service, attracting substantially greater ridership and being more cost-effective. These advantages would outweigh the small additional capital cost and public operating subsidy necessary to provide that service.

It should be noted that some additional ridership on local and express transit service may be expected in this corridor under the commuter rail plan. Although the commuter rail service would carry 28,800 fewer primary transit trips on an average weekday in the design year than the bus-on-freeway service, about 16,300 of these trips, or 57 percent, may be expected to use the express and local, as opposed to the primary, transit services. As shown in Table 181, the fact that commuter rail would carry these additional transit trips on local and express transit services does not alter the conclusion that bus-on-freeway service is superior to commuter rail service in this corridor. While the substantial ridership and cost-effectiveness advantages of the bus-on-freeway services in the corridor are reduced somewhat when considering the express and local services as well as primary services, the advantages of the commuter rail services with respect to capital cost and operating subsidy are eliminated.

Evaluation of Individual Light Rail Transit and Busway Corridors: Under the light rail transit and busway composite plans, a system of guideways would be provided for three light rail transit/busway routes: one route extending westerly from the Milwaukee central business district to the Mayfair Mall Shopping Center area; one route extending northwesterly and southeasterly from the central business district to the Timmerman Field and South Milwaukee areas, respectively; and one crosstown route extending north and south on an alignment located about four miles west of the central business district between the Northridge and Southridge Shopping Center areas. The merits of each of these routes were considered on a route-by-route basis in order to establish whether any of the routes could be expected to perform better than, and therefore be recommended over, the alternative transit services provided in these corridors under the bus-on-freeway truncated system plan, that plan having been identified as the best system plan under this moderate growth scenario-centralized land use plan alternative future.

Because individual consideration of a crosstown route was not considered appropriate in the absence of a connecting route to the central business district, this comparison of alternative bus-on-freeway services to light rail transit/busway services was performed for a four-route light rail transit/busway system. The four-route system, as shown on Map 84, would use the same guideways as the three-route system, but all of the four routes would be designed to extend from the Milwaukee central business district. The only difference between the three- and four-route systems is that the crosstown route is replaced with two routes. One of the two replacement routes would extend from the central business district westerly along the Mayfair route to the intersection with the former crosstown route, and then southerly and westerly along that route to its terminus at the Southridge Shopping Center. The second replacement route would also extend from the central business district westerly along the Mayfair route to the intersection with the former crosstown route, and then would follow that route northerly and westerly to its terminus at the Northridge Shopping Center.

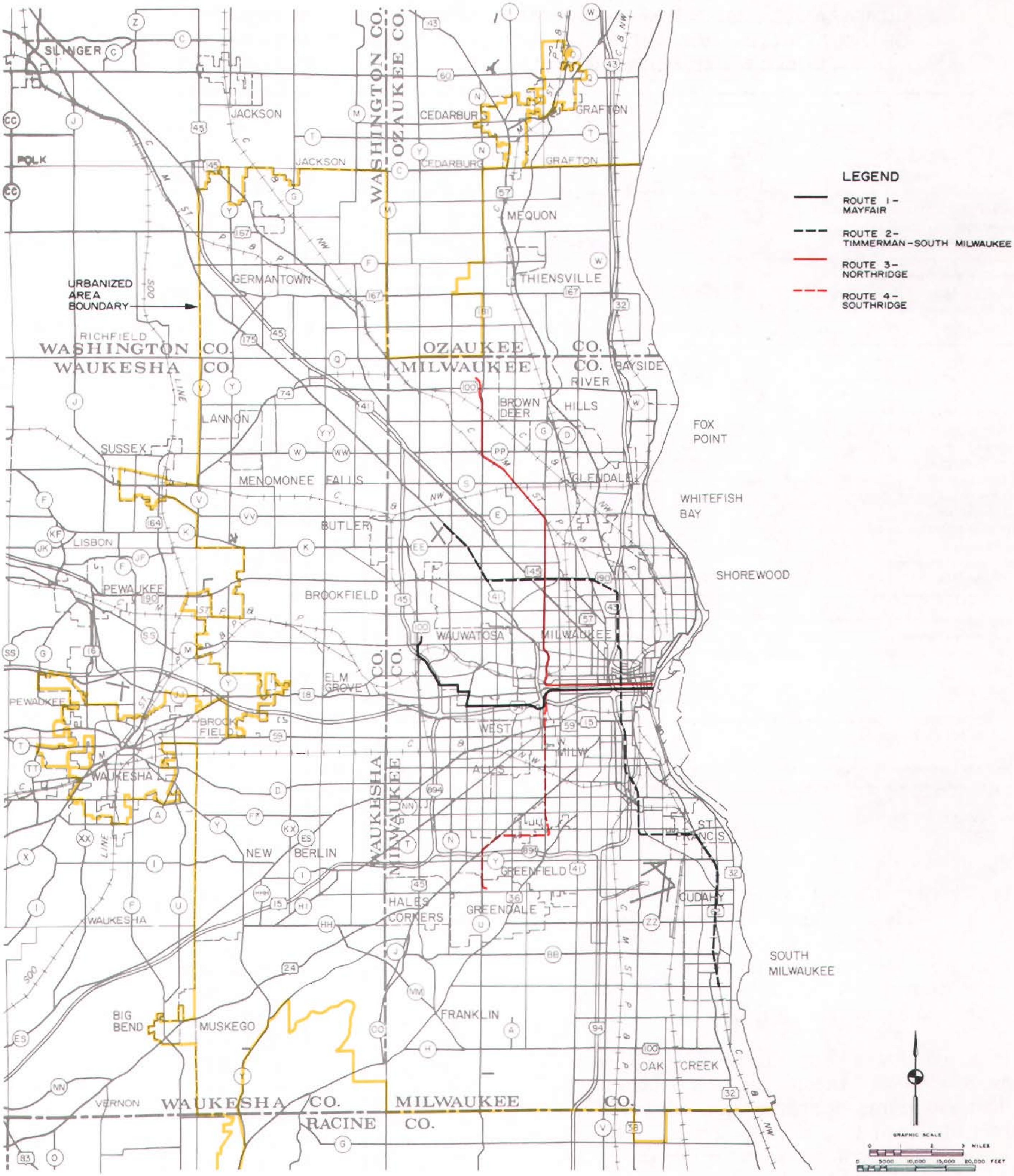
Tables 182 through 185 provide a corridor-by-corridor comparison of alternative light rail transit, busway, and bus-on-freeway services, including data on ridership, capital cost, net operating and maintenance cost, and per-passenger cost-effectiveness. The evaluative information derived from system level analyses of the busway and bus-on-freeway plans includes for each corridor some trips made on, and costs attendant to, supporting local and express transit services, as well as all those trips made on, and costs attendant to, the primary transit services. This is because, in each corridor, the local and express elements of the busway and bus-on-freeway plans may be expected to carry those additional trips that are carried on the primary element of the light rail transit alternative primary transit mode, but which are not carried on the primary element of the busway or bus-on-freeway mode.

The results of the systemwide testing of the alternative plans indicate that, while the primary element of the light rail transit plan may be expected to carry about 10 percent more trips than the primary element of the busway plan and nearly 100 percent more trips than the primary element of the bus-on-freeway plan, the light rail transit plan as a system, including the supporting local and express transit services, may be expected to carry about the same number of transit trips in total as the busway and bus-on-freeway system plans. Consequently, in the preparation of comparative information for alternative modes in each corridor, it was assumed that the total number of transit trips in each corridor will not vary significantly between the three plans. Whatever decrease in primary transit tripmaking is indicated by the simulation model analyses to be attendant to the bus-on-freeway or busway routes in each corridor, as opposed to the light rail transit routes, may be assumed to be made on the express and local elements within the corridors for the purpose of the comparative cost analyses.

It was also assumed that the unit capital costs attendant to carrying these passengers on the local and express transit elements of the busway and bus-on-freeway plans will not vary significantly between corridors or from the systemwide average

Map 84

PRIMARY TRANSIT ROUTES UNDER A FOUR-ROUTE SYSTEM FOR THE COMPOSITE LIGHT RAIL TRANSIT AND BUSWAY SYSTEM PLANS



In the comparison of individual elements of the composite light rail transit/busway system plans with individual elements of the truncated bus-on-freeway plan, the three-route light rail transit/busway system originally proposed was modified into a plan which would be comprised of four primary transit routes. Because individual consideration of a crosstown route was not considered appropriate in the absence of a connecting route to the central business district, the comparison of alternative light rail transit/busway services to alternative bus-on-freeway services was performed for this four-route light rail transit/busway system. The four-route system would use the same fixed guideway alignments as the three-route system, but all four routes would be designed to serve the Milwaukee central business district. Accordingly, the north-south crosstown route was replaced with two radial routes, one located along an alignment between Milwaukee's downtown and northwest side, and the other located along an alignment between Milwaukee's downtown and the southwest suburban area.

Source: SEWRPC.

Table 182

COMPARATIVE EVALUATION FOR THE MAYFAIR LIGHT RAIL TRANSIT/BUSWAY ROUTE OF LIGHT RAIL, BUSWAY, AND BUS-ON-FREEWAY ALTERNATIVES FOR THE MILWAUKEE AREA UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Evaluative Measure	Light Rail Transit		Busway		Bus-on-Freeway	
	Primary Service	Total Transit Service	Primary Service	Total Transit Service	Primary Service	Total Transit Service
Ridership						
Average Weekday Passengers	18,200	18,200	15,400	18,200	8,200	18,200
Design Year Passengers	4,641,000	4,641,000	3,927,000	4,739,000	2,091,000	4,991,000
Capital Cost and Investment						
Total Capital Cost to Design Year	$48,535,900	$48,535,900	$41,068,000	$42,573,000	$ 9,567,200	$14,152,200
Total Capital Investment to Design Year	93,338,300	93,338,300	74,670,600	77,003,600	12,820,100	19,985,100
Operating Cost						
Operating Cost in Design Year	$ 1,642,200	$ 1,642,200	$ 1,519,800	$ 2,228,200	$ 2,499,000	$ 4,676,900
Percent of Operating Cost Met by Farebox Revenue in Design Year	90	53	79	48	44	50
Net Operating Cost (deficit) in Design Year	173,400	775,400[a]	316,200	1,368,400[b]	1,394,800	2,327,300[c]
Cost-Effectiveness						
Net Operating Cost per Passenger to Design Year	$0.04	$0.17	$0.08	$0.29	$0.67	$0.46
Capital Cost to Design Year per Passenger	1.31	1.31	1.31	1.12	0.58	0.35
Total Cost per Passenger to Design Year	1.35	1.47	1.39	1.41	1.25	0.81

[a] *The total light rail transit operating deficit in this corridor includes $602,000 more than the primary element operating deficit in order to reflect the overall lesser cost-effectiveness of the local transit services of the light rail transit plan in this corridor relative to those of the bus-on-freeway plan. The lesser cost-effectiveness results from the substantial diversion in this corridor under the light rail transit plan of trips to primary services from local transit services relative to the bus-on-freeway plan.*

[b] *The total busway operating deficit in this corridor is $1,052,200 more than the primary element deficit of $316,200 for two reasons. First, it was necessary to include the subsidy entailed in carrying those transit trips which are carried by local transit in the corridor under the busway plan, but by primary transit under the light rail transit plan. This additional subsidy is $363,300. The second addition to the subsidy—$689,000—was necessary to reflect the overall lesser cost-effectiveness of local transit services of the busway plan relative to those of the bus-on-freeway plan.*

[c] *The total bus-on-freeway plan operating deficit in this corridor is $932,400 more than the primary element deficit of $1,394,800 in order to reflect the deficit entailed by carrying transit trips in the corridor which are made on local and express services under the bus-on-freeway plan, but on primary transit services under the light rail plan.*

Source: SEWRPC.

costs. The unit net operating and maintenance costs attendant to carrying passengers on the local and express transit elements of the bus-on-freeway plan, however, have been determined for each corridor through analysis of a sample of local and express routes in each corridor.

It should also be noted that the increased local and express transit element deficit attendant to each light rail transit/busway route's substantial diversion of transit trips from local and express routes was included as a necessary part of the operating subsidy under each route of the light rail transit and busway plans. The amount of trips diverted to the light rail transit/busway primary element results in a reduction in the potential to provide attractive headways along local and express routes, further decreasing local and express transit ridership and operating cost-effectiveness. The local and express system of the light rail and busway plans may be expected to recover about 49 percent of total operating costs from farebox revenues, while the local and express system of the bus-on-freeway plan may be expected to recover about 57 percent. Operation of the local and express element of the light rail transit and busway plans at this lower operating cost-effectiveness results in a systemwide increase in necessary operating subsidy of $4.3 and $5.3 million, respectively. This additional subsidy was allocated to each light rail transit/busway route based on the proportion of the total trips diverted from the light rail transit/busway local and express elements to the primary element, as compared to the bus-on-freeway plan.

Table 183

COMPARATIVE EVALUATION FOR THE NORTHRIDGE LIGHT RAIL TRANSIT/BUSWAY ROUTE OF LIGHT RAIL, BUSWAY, AND BUS-ON-FREEWAY ALTERNATIVES FOR THE MILWAUKEE AREA UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Evaluative Measure	Light Rail Transit		Busway		Bus-on-Freeway	
	Primary Service	Total Transit Service	Primary Service	Total Transit Service	Primary Service	Total Transit Service
Ridership						
Average Weekday Passengers	27,500	27,500	22,600	27,500	4,600	27,500
Design Year Passengers	7,012,500	7,012,500	5,763,000	7,184,000	1,173,000	7,814,000
Capital Cost and Investment						
Total Capital Cost to Design Year	$ 73,808,600	$ 73,808,600	$ 60,453,200	$ 63,066,700	$4,069,500	$14,735,200
Total Capital Investment to Design Year	141,939,600	141,939,600	113,551,200	117,634,800	6,250,900	22,659,700
Operating Cost						
Operating Cost in Design Year	$ 2,996,300	$ 2,996,300	$ 2,685,200	$ 3,924,900	$ 861,900	$ 5,849,300
Percent of Operating Cost Met by Farebox Revenue in Design Year	94	49	90	32	70	91
Net Operating Cost (deficit) in Design Year	186,200	1,519,200[a]	278,000	2,662,700[b]	249,900	499,300[c]
Cost-Effectiveness						
Net Operating Cost per Passenger to Design Year	$0.03	$0.22	$0.05	$0.37	$0.21	$0.06
Capital Cost to Design Year per Passenger	1.32	1.32	1.32	1.10	0.44	0.24
Total Cost per Passenger to Design Year	1.34	1.53	- -	1.47	- -	0.30

[a] *The total light rail transit operating deficit in this corridor includes $1,333,000 more than the primary element operating deficit in order to reflect the overall lesser cost-effectiveness of the local transit services of the light rail transit plan in this corridor relative to those of the bus-on-freeway plan. The lesser cost-effectiveness results from the substantial diversion in this corridor under the light rail transit plan of trips to primary services from local transit services relative to the bus-on-freeway plan.*

[b] *The total busway operating deficit in this corridor is $2,384,700 more than the primary element deficit of $278,000 for two reasons. First, it was necessary to include the subsidy entailed in carrying those transit trips which are carried by local transit in the corridor under the busway plan, but by primary transit under the light rail transit plan. This additional subsidy is $635,700. The second addition to the subsidy—$1,749,000—was necessary to reflect the overall lesser cost-effectiveness of local transit services of the busway plan relative to those of the bus-on-freeway plan.*

[c] *The total bus-on-freeway plan operating deficit in this corridor is $249,400 more than the primary element deficit of $249,900 in order to reflect the deficit entailed by carrying transit trips in the corridor which are made on local and express services under the bus-on-freeway plan, but on primary transit services under the light rail plan.*

Source: SEWRPC.

Mayfair Route: As shown on Map 85, the Mayfair light rail transit/busway route would provide service in a corridor radiating to the west from the central business district through the City of Milwaukee to the Mayfair Mall Shopping Center in the City of Wauwatosa. The route would have 21 stops, 4 of which would be park-ride lot stations. Headways on the light rail transit service would range from 6 to 9 minutes in the peak travel periods, and from 12 to 30 minutes in the off-peak travel periods. Headways on the busway service would range from 3 to 4 minutes in the peak travel periods, and from 12 to 30 minutes in the off-peak travel periods.

Alternative bus-on-freeway services along this corridor would include those bus-on-freeway routes and stations serving the communities of West Allis, Wauwatosa, and Brookfield. Two bus-on-freeway routes operating over the East-West Freeway (IH 94) would provide most of this service from a total of five stations located outside the Milwaukee central business district, all of which would have park-ride lots. An additional seven bus-on-freeway routes extending to the communities of Waukesha, Oconomowoc, and Mukwonago in Waukesha County, and West Bend in Washington County, were also included in this analysis, but only to the extent that these routes would pick

Table 184

COMPARATIVE EVALUATION FOR THE TIMMERMAN FIELD-SOUTH MILWAUKEE LIGHT RAIL TRANSIT/BUSWAY ROUTE OF LIGHT RAIL, BUSWAY, AND BUS-ON-FREEWAY ALTERNATIVES FOR THE MILWAUKEE AREA UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Evaluative Measure	Light Rail Transit		Busway		Bus-on-Freeway	
	Primary Service	Total Transit Service	Primary Service	Total Transit Service	Primary Service	Total Transit Service
Ridership						
Average Weekday Passengers	41,200	41,200	34,400	41,200	16,100	41,200
Design Year Passengers	10,506,000	10,506,000	8,772,000	10,744,000	4,105,500	1,384,500
Capital Cost and Investment						
Total Capital Cost to Design Year	$120,706,000	$120,706,000	$102,135,800	$105,819,400	$12,059,800	$23,750,200
Total Capital Investment to Design Year	232,127,800	232,127,800	185,701,600	186,268,300	18,553,600	36,538,600
Operating Cost						
Operating Cost in Design Year	$ 5,963,400	$ 5,963,400	$ 5,372,900	$ 7,093,300	$ 4,110,600	$ 9,557,200
Percent of Operating Cost Met by Farebox Revenue in Design Year	88	64	82	49	53	51
Net Operating Cost (deficit) in Design Year	687,500	2,149,500[a]	958,800	3,590,000[b]	1,925,200	4,658,500[c]
Cost-Effectiveness						
Net Operating Cost per Passenger to Design Year	$0.07	$0.20	$0.11	$0.33	$0.47	$0.41
Capital Cost to Design Year per Passenger	1.44	1.44	1.45	1.23	0.37	0.26
Total Cost per Passenger to Design Year	1.51	1.64	1.56	1.56	0.84	0.67

[a] *The total light rail transit operating deficit in this corridor includes $1,462,000 more than the primary element operating deficit in order to reflect the overall lesser cost-effectiveness of the local transit services of the light rail transit plan in this corridor relative to those of the bus-on-freeway plan. The lesser cost-effectiveness results from the substantial diversion in this corridor under the light rail transit plan of trips to primary services from local transit services relative to the bus-on-freeway plan.*

[b] *The total busway operating deficit in this corridor is $2,631,200 more than the primary element deficit of $958,800 for two reasons. First, it was necessary to include the subsidy entailed in carrying those transit trips which are carried by local transit in the corridor under the busway plan, but by primary transit under the light rail transit plan. This additional subsidy is $882,200. The second addition to the subsidy—$1,749,000—was necessary to reflect the overall lesser cost-effectiveness of local transit services of the busway plan relative to those of the bus-on-freeway plan.*

[c] *The total bus-on-freeway plan operating deficit in this corridor is $2,733,300 more than the primary element deficit of $1,925,200 in order to reflect the deficit entailed by carrying transit trips in the corridor which are made on local and express services under the bus-on-freeway plan, but on primary transit services under the light rail plan.*

Source: SEWRPC.

up and distribute passengers between the bus-on-freeway station at State Fair Park in the City of West Allis and downtown Milwaukee. Headways on the bus-on-freeway service would range from 8 to 20 minutes in the peak travel periods, and 15 to 30 minutes in the off-peak travel periods. More frequent service would be provided from the State Fair Park station because of the additional routes serving that station, with headways ranging from 3 to 5 minutes in the peak travel periods, and from 5 to 7 minutes in the off-peak travel periods.

The light rail transit service in this corridor may be expected to carry about 18,200 passengers on its primary element on an average weekday in the plan design year—about 20 percent more than would be carried by busway service in the corridor, and more than twice that which would be carried by bus-on-freeway service. However, systemwide analyses of the three alternative plans, as well as corridor-by-corridor analyses of the number of transit trip ends located within a one-mile band along the light rail transit routes, indicate that the total number of transit passengers in the corridor, including those carried on local and express transit services, would not be significantly different between the plans.

The light rail transit service in this corridor is expected to have a significant operating cost advantage over the busway and bus-on-freeway

Table 185

COMPARATIVE EVALUATION FOR THE SOUTHRIDGE LIGHT RAIL TRANSIT/BUSWAY ROUTE OF LIGHT RAIL, BUSWAY, AND BUS-ON-FREEWAY ALTERNATIVES FOR THE MILWAUKEE AREA UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Evaluative Measure	Light Rail Transit Primary Service	Light Rail Transit Total Transit Service	Busway Primary Service	Busway Total Transit Service	Bus-on-Freeway Primary Service	Bus-on-Freeway Total Transit Service
Ridership						
Average Weekday Passengers	22,900	22,900	19,000	22,900	7,200	22,900
Design Year Passengers	5,839,500	5,839,500	4,845,000	5,976,000	1,836,000	6,389,000
Capital Cost and Investment						
Total Capital Cost to Design Year	$48,640,700	$48,640,700	$41,157,500	$43,370,200	$10,190,500	$17,502,800
Total Capital Investment to Design Year	93,539,800	93,539,800	74,831,800	78,081,900	15,677,700	26,927,400
Operating Cost						
Operating Cost in Design Year	$ 2,249,100	$ 2,249,100	$ 2,101,200	$ 3,087,900	$ 2,496,400	$ 5,917,700
Percent of Operating Cost Met by Farebox Revenue in Design Year	107	61	96	45	40	63
Net Operating Cost (deficit) in Design Year	- 153,000	750,000[a]	94,400	1,713,400[b]	1,522,400	2,206,300[c]
Cost-Effectiveness						
Net Operating Cost per Passenger to Design Year	- $0.03	$0.13	$0.02	$0.29	$0.83	$0.34
Capital Cost to Design Year per Passenger	1.04	1.04	1.06	0.91	0.69	0.34
Total Cost per Passenger to Design Year	1.01	1.17	1.08	1.19	1.52	0.68

[a] The total light rail transit operating deficit in this corridor includes $903,000 more than the primary element operating deficit in order to reflect the overall lesser cost-effectiveness of the local transit services of the light rail transit plan in this corridor relative to those of the bus-on-freeway plan. The lesser cost-effectiveness results from the substantial diversion in this corridor under the light rail transit plan of trips to primary services from local transit services relative to the bus-on-freeway plan.

[b] The total busway operating deficit in this corridor is $1,619,000 more than the primary element deficit of $94,400 for two reasons. First, it was necessary to include the subsidy entailed in carrying those transit trips which are carried by local transit in the corridor under the busway plan, but by primary transit under the light rail transit plan. This additional subsidy is $506,000. The second addition to the subsidy—$1,113,000—was necessary to reflect the overall lesser cost-effectiveness of local transit services of the busway plan relative to those of the bus-on-freeway plan.

[c] The total bus-on-freeway plan operating deficit in this corridor is $683,900 more than the primary element deficit of $1,522,400 in order to reflect the deficit entailed by carrying transit trips in the corridor which are made on local and express services under the bus-on-freeway plan, but on primary transit services under the light rail plan.

Source: SEWRPC.

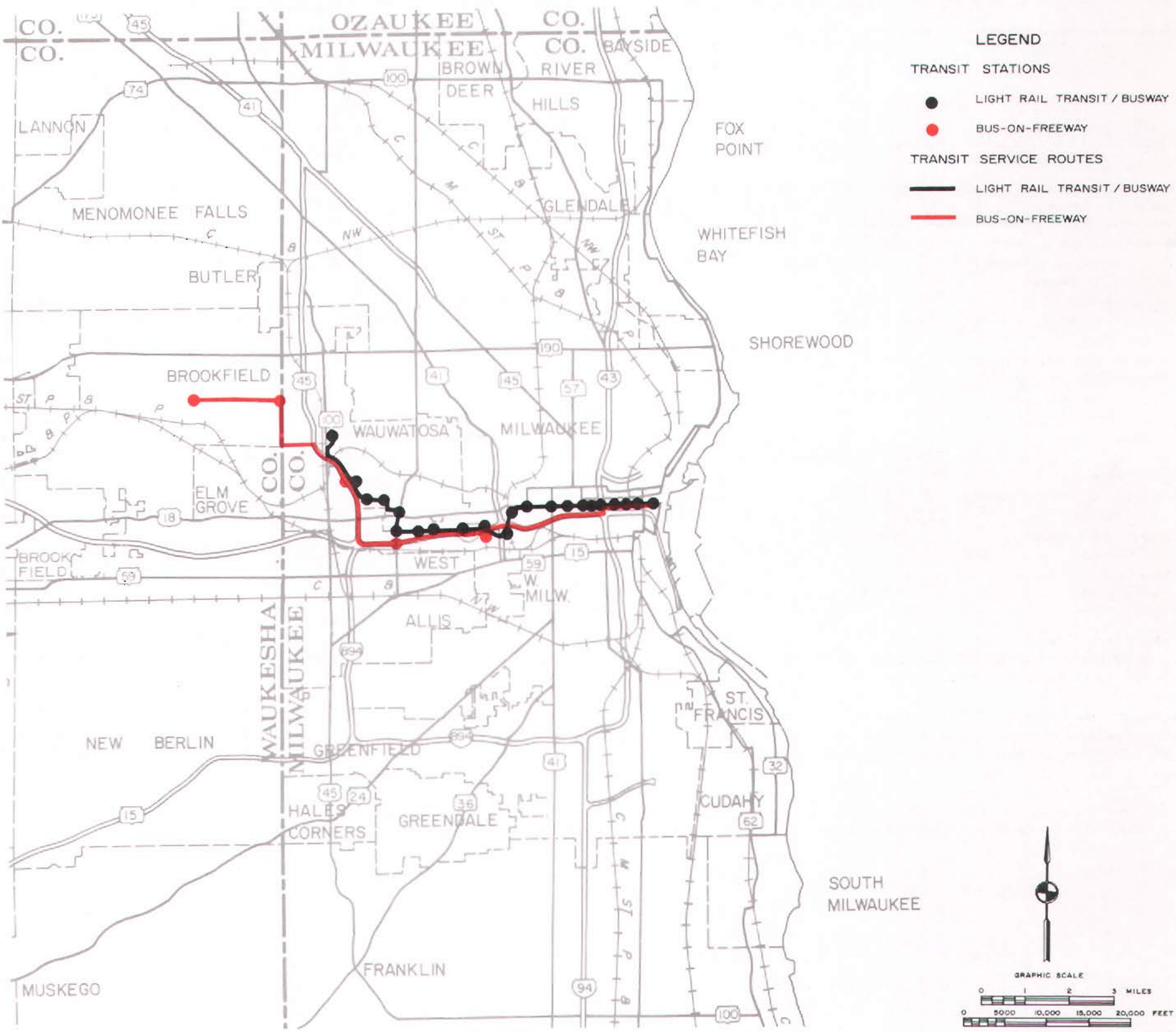
services. The operating subsidy in the design year required for the busway plan in this corridor may be expected to be $393,000 greater than that required for the light rail transit plan. The operating subsidy required in the design year for the bus-on-freeway plan in this corridor may be expected to be $1,551,900 greater than the subsidy required for the light rail transit plan.

The light rail transit plan does have a capital cost disadvantage in the Mayfair corridor. Over the plan design period, the capital cost—that is, the capital investment less the value of the remaining life of the facilities and vehicles at the end of the plan design period—of the light rail transit facilities is expected to be nearly $6 million, or 14 percent, greater than that of the busway plan, and more than $34 million, or 230 percent, greater than that of the bus-on-freeway plan.

The cost-effectiveness measure quantifying the total cost—both capital and operating—per passenger over the plan design period indicates that the greater capital cost of light rail transit and busway facilities and services in the Mayfair corridor significantly outweighs the operating cost advantages of these services over bus-on-freeway services in the corridor. The total cost per passenger of the light rail transit and busway service would be more than two-thirds greater than that of the bus-on-freeway service. Accordingly, it was concluded that bus-on-freeway service in this cor-

Map 85

COMPARABLE BUS-ON-FREEWAY SERVICE TO THE LIGHT RAIL TRANSIT/BUSWAY MAYFAIR ROUTE



In an effort to identify elements of the composite light rail transit and busway system plans that may be superior to comparable elements of the truncated bus-on-freeway system plan, such routes in the corridor between the Milwaukee central business district and the City of Wauwatosa were examined separately from the remainder of each of the primary transit systems. The bus-on-freeway service, as shown above, would be comprised of two routes operating over the East-West Freeway (IH 94) and serving a total of five stations located outside downtown Milwaukee, all of which would have park-ride lots. An additional seven bus-on-freeway routes were also included in this evaluation, but only to the extent that they would serve trips between the station at State Fair Park and downtown Milwaukee. The comparable light rail transit/busway service, also shown above, would be comprised of a single route serving 22 stations or stops, four of which would have park-ride lots.

Source: SEWRPC.

ridor would be superior to light rail transit or busway service, attracting the same ridership at a lower cost.

Timmerman-South Milwaukee Route: As shown on Map 86, the Timmerman-South Milwaukee light rail transit/busway route would provide service in a corridor radiating northwest of the Milwaukee central business district through the City of Milwaukee to the Timmerman Field area, as well as in a corridor radiating southeast of the Milwaukee central business district through the communities of Milwaukee, St. Francis, and Cudahy, and terminating in the City of South Milwaukee. The route would have 44 stops, of which 6 would be park-ride lot stations. Headways on the light rail service would range from 6 to 9 minutes in the peak travel periods, and 9 to 12 minutes in the off-peak travel periods. Headways on the busway service would range from 3 to 7 minutes in the peak travel periods, and 7 to 12 minutes in the off-peak travel periods.

Alternative bus-on-freeway services along this corridor would include bus-on-freeway routes extending to the communities of Whitefish Bay and Shorewood to the north along the North-South Freeway (IH 43); to the north to Timmerman Field along the Zoo Freeway (IH 894); and to the south to the communities of South Milwaukee and Oak Creek along the North-South Freeway (IH 94). Five bus-on-freeway routes would provide most of this service from a total of eight stations located outside the Milwaukee central business district, five of which would have park-ride lots. An additional five bus-on-freeway routes extending into Ozaukee and Racine and Kenosha Counties were also included in this analysis, but only to the extent that these routes would pick up and distribute passengers between the College Avenue, Silver Spring, and North Avenue bus-on-freeway stations and downtown Milwaukee.

In general, headways on the bus-on-freeway routes would range from 7 to 20 minutes in the peak travel periods, and from 20 to 60 minutes in the off-peak travel periods. More frequent service would be provided from the College Avenue, Silver Spring, and North Avenue stations because of the additional routes serving these stations, with headways ranging from 3 to 6 minutes in the peak travel periods, and from 8 to 15 minutes in the off-peak travel periods.

The light rail transit service in this corridor may be expected to carry about 41,200 passengers on an average weekday in the plan design year—about 20 percent more than would be carried by busway service in the corridor, and more than two-and-one-half times that which would be carried by bus-on-freeway service. However, systemwide analyses of the three alternative plans, as well as corridor-by-corridor analyses of the number of transit trip ends within one-mile bands of the light rail transit routes, indicate that the total number of transit passengers in the corridor, including those carried on local and express transit services, would not be significantly different between the three plans.

The light rail transit service in this corridor is expected to have a significant operating cost advantage over the busway and bus-on-freeway services. The operating subsidy required in the design year for the busway plan in this corridor may be expected to be $1,440,500 greater than that required for the light rail transit plan. The operating subsidy required in the design year of the bus-on-freeway plan in this corridor may be expected to be $2,409,000 greater than the subsidy required for the light rail transit plan.

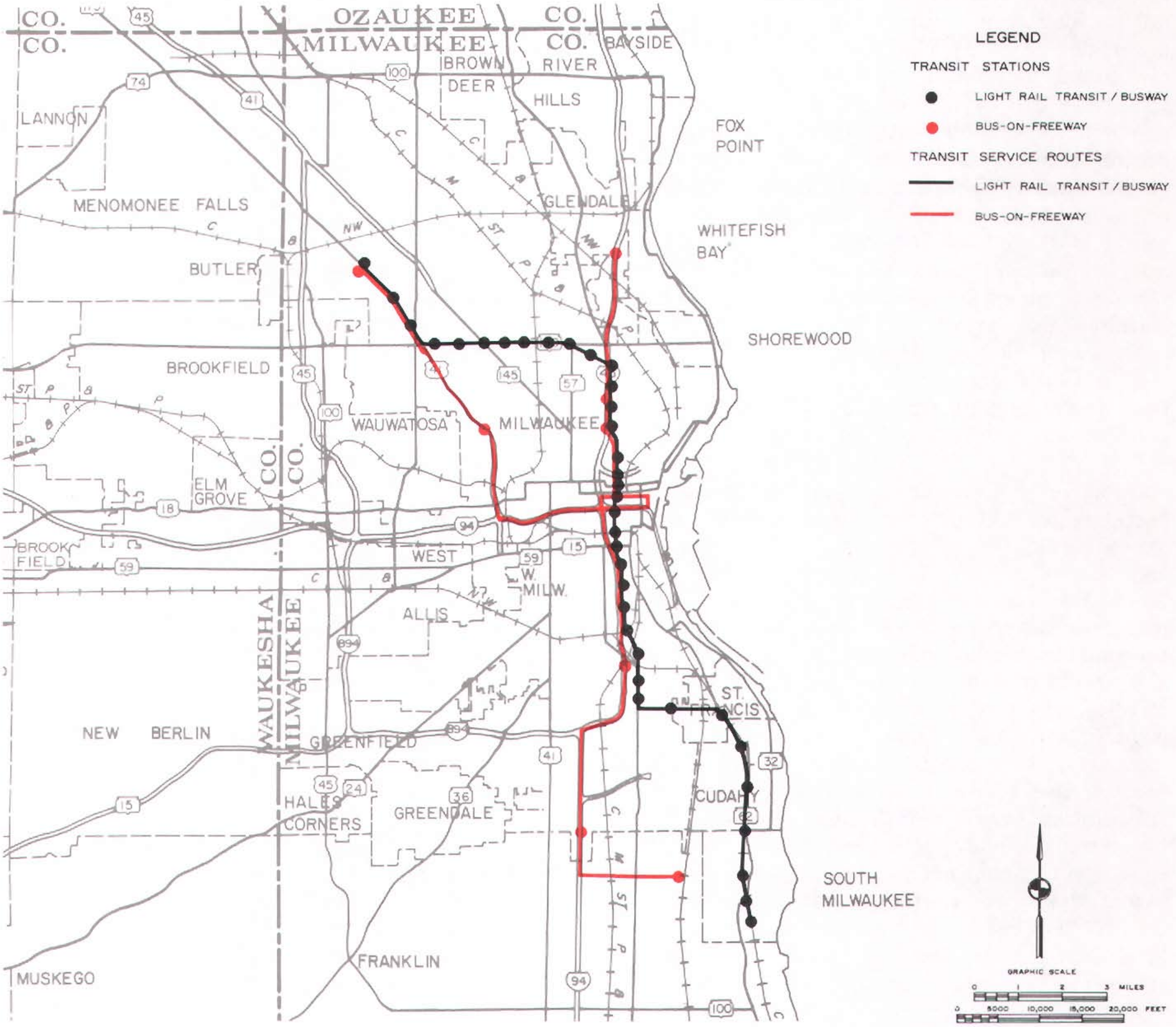
The light rail transit plan does have a capital cost disadvantage in the Timmerman Field-South Milwaukee corridor. Over the plan design period, the capital cost—that is, the capital investment less the value of the remaining life of the facilities and vehicles at the end of the plan design period—of the light rail transit facilities is expected to be nearly $15 million, or 14 percent greater than that of the busway plan, and more than $96 million, or 410 percent, greater than that of the bus-on-freeway plan.

The cost-effectiveness measure quantifying the total cost—both capital and operating—per passenger over the plan design period indicates that the greater capital cost of light rail transit and busway facilities and services in the Timmerman Field-South Milwaukee corridor significantly outweighs the operating cost advantages of these services over bus-on-freeway services in the corridor. The total cost per passenger of the light rail transit and busway service would be more than twice that of the bus-on-freeway service. Accordingly, it was concluded that bus-on-freeway service in this corridor would be superior to light rail transit or busway service, attracting the same ridership at a lower cost.

Northridge Route: As shown on Map 87, the Northridge light rail transit/busway route radiates through the City of Milwaukee west from the central business district for about three miles and then north to the Northridge Shopping Center. The

Map 86

COMPARABLE BUS-ON-FREEWAY SERVICE TO THE LIGHT RAIL TRANSIT/BUSWAY TIMMERMAN FIELD-SOUTH MILWAUKEE ROUTE

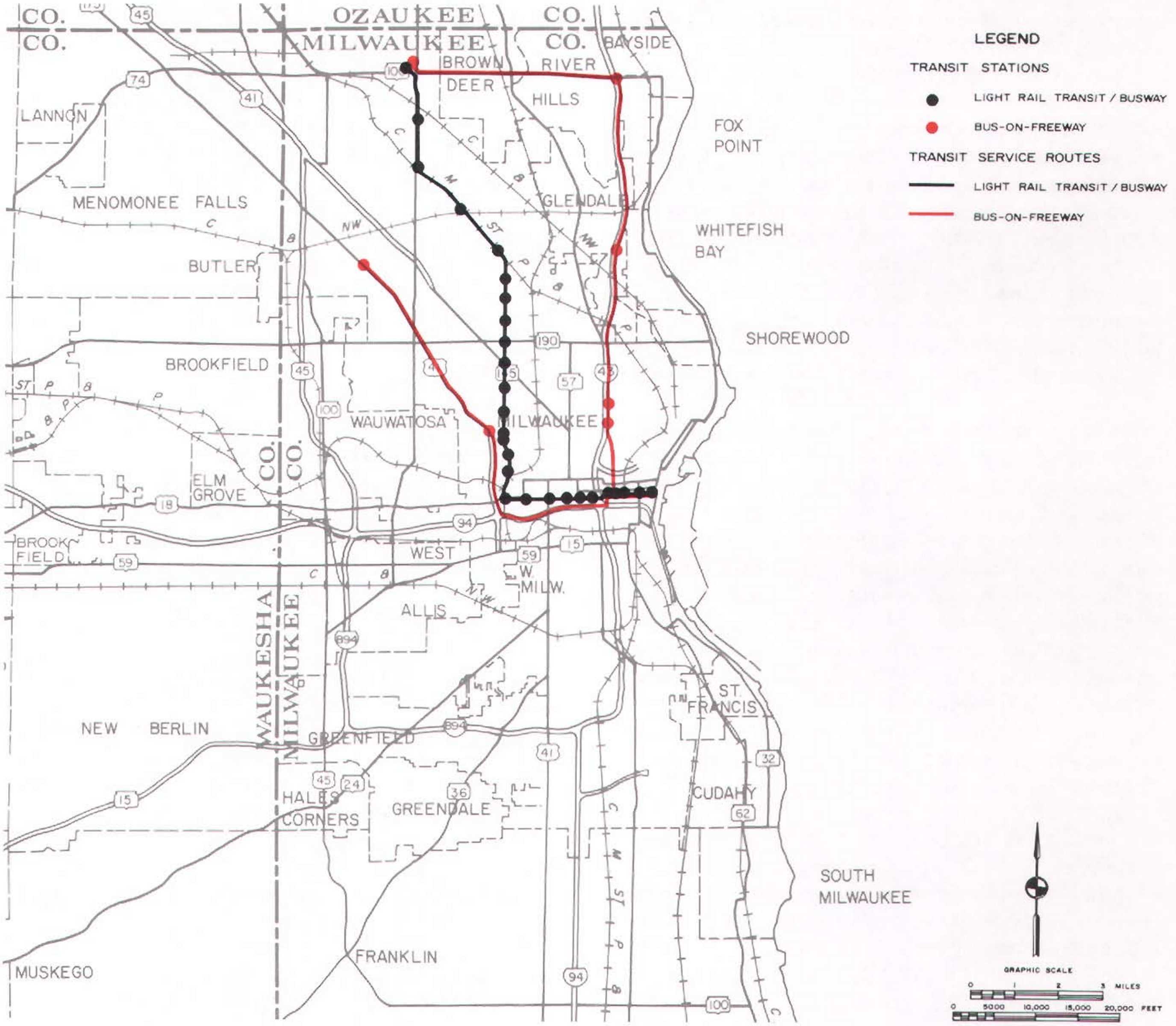


In an effort to identify elements of the composite light rail transit and busway system plans that may be superior to comparable elements of the truncated bus-on-freeway system plan, such routes in the corridor between the Timmerman Field area of the City of Milwaukee and the City of South Milwaukee were examined separately from the remainder of each of the primary transit systems. The bus-on-freeway service, as shown above, would be comprised of five routes serving a total of eight stations located outside downtown Milwaukee, five of which would have park-ride lots. An additional five bus-on-freeway routes were also included in this evaluation, but only to the extent that they would serve trips between the stations at W. College Avenue, W. North Avenue, and W. Silver Spring Drive and downtown Milwaukee. The comparable light rail transit/busway service, also shown above, would be comprised of a single route serving 44 stations or stops, of which six would have park-ride lots.

Source: SEWRPC.

Map 87

COMPARABLE BUS-ON-FREEWAY SERVICE TO THE LIGHT RAIL TRANSIT/BUSWAY NORTHRIDGE ROUTE



In an effort to identify elements of the composite light rail transit and busway system plans that may be superior to comparable elements of the truncated bus-on-freeway system plan, such routes in the corridor between the Northridge Shopping Center and the Milwaukee central business district were examined separately from the remainder of each of the primary transit systems. The bus-on-freeway service, as shown above, would be comprised of two routes serving a total of seven stations located outside downtown Milwaukee, four of which would have park-ride lots. The comparable light rail transit/busway service, also shown above, would be comprised of a single route serving 25 stations or stops, of which three would have park-ride lots.

Source: SEWRPC.

route would have 25 stops, of which 3 would be park-ride lot stations. Headways on the light rail transit service would range from 4 to 6 minutes in the peak travel periods, and from 12 to 20 minutes in the off-peak travel periods. Headways on the busway service would range from 3 to 5 minutes in the peak travel periods, and from 15 to 30 minutes in the off-peak travel periods.

Alternative bus-on-freeway services along this corridor would include bus-on-freeway routes extending to the Village of Brown Deer along the North-South Freeway (IH 43) and to Timmerman Field along the Zoo Freeway (IH 894). Two routes would provide this service from a total of seven stations, of which four would have park-ride lots. Headways on the bus-on-freeway service would range from 8 to 20 minutes in the peak travel periods, and from 20 to 30 minutes in the off-peak travel periods.

The light rail transit service in this corridor is expected to carry about 27,500 passengers on an average weekday in the plan design year—about 20 percent more than would be carried by the busway service in the corridor, and about six times that which would be carried by the bus-on-freeway service. However, systemwide analyses of the three alternative plans, as well as corridor-by-corridor analyses of the number of transit trip ends within one-mile bands of the light rail transit routes, indicate that the total number of transit passengers in the corridor, including those carried on local and express transit service, would not be significantly different between the three plans.

The light rail transit service in this corridor is expected to have an operating cost advantage over the busway service, but not over the bus-on-freeway services. The required operating subsidy for the busway plan in this corridor may be expected to be $1,143,500 greater than that required for the light rail transit plan. The operating subsidy required in the design year of the bus-on-freeway plan in this corridor, however, is expected to be about $1,001,300 less than the subsidy necessary for the light rail transit plan.

The light rail transit plan does have a definite capital cost disadvantage in the Northridge corridor. Over the plan design period, the capital cost—that is, the capital investment less the value of the remaining life of the facilities and vehicles at the end of the plan design period—of the light rail facilities is expected to be nearly $11 million, or 17 percent, greater than that of the busway plan, and about $59 million, or 400 percent, greater than that of the bus-on-freeway plan.

The cost-effectiveness measure quantifying the total cost—both capital and operating—per passenger over the plan design period indicates the greater capital and net operating costs of light rail transit and busway facilities and services in the Northridge corridor. The total cost per passenger of the light rail transit and busway service would be five times that of the bus-on-freeway service. Accordingly, it was concluded that bus-on-freeway service in this corridor would be superior to light rail transit or busway service, attracting the same ridership at a lower cost.

Southridge Route: As shown on Map 88, the Southridge light rail transit/busway route would provide service radiating west through the City of Milwaukee three miles from the central business district and then southwest to the Southridge Shopping Center through the communities of West Milwaukee, Greenfield, and Greendale, as well as Milwaukee. The route would have 23 stops, of which 4 would be park-ride lot stations. Headways on the light rail transit service would range from 5 to 8 minutes in the peak travel periods, and from 12 to 15 minutes in the off-peak travel periods. Headways on the busway service would range from 4 to 6 minutes in the peak travel periods, and from 15 to 20 minutes in the off-peak travel periods.

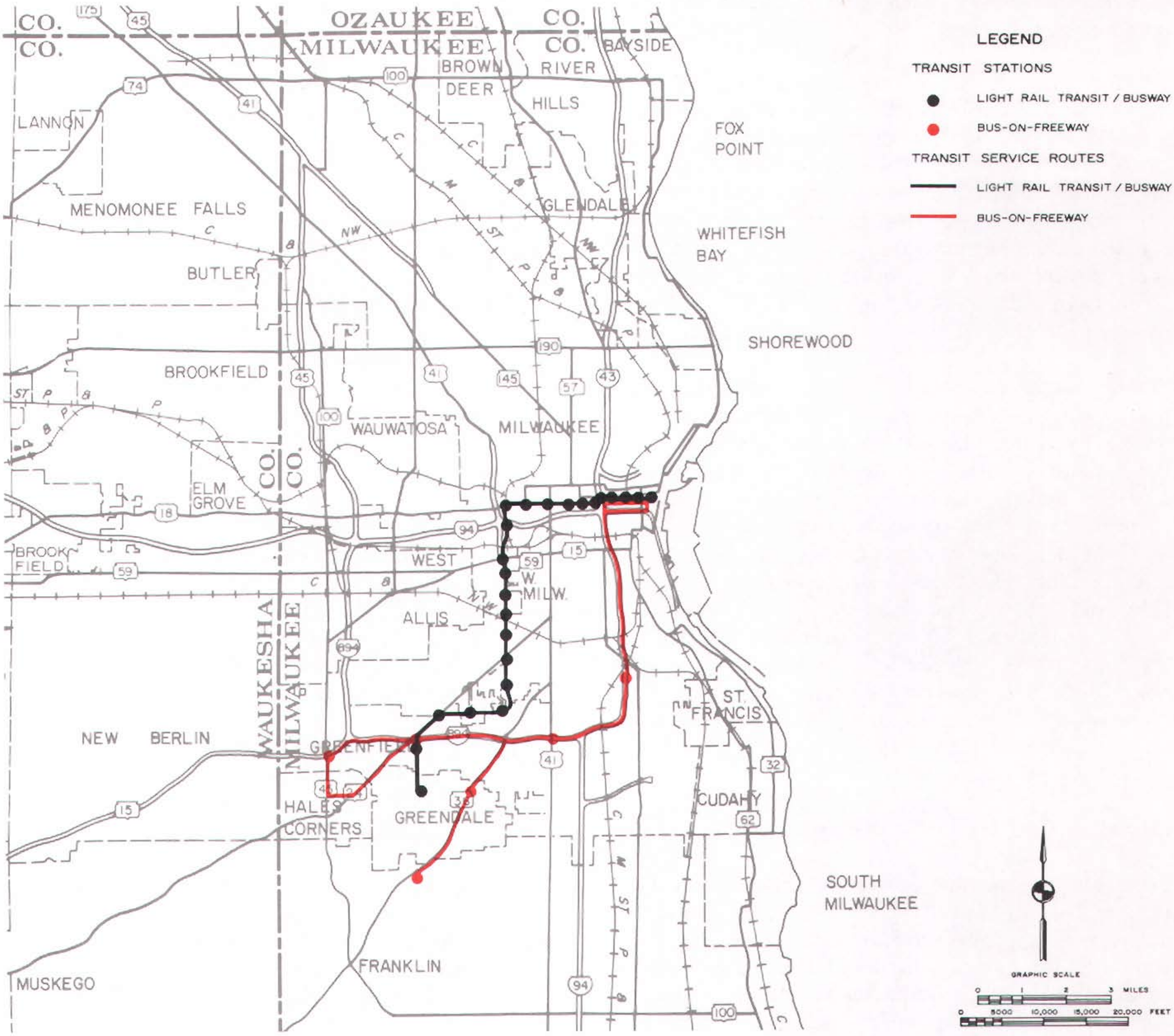
Alternative bus-on-freeway services along this corridor would include bus-on-freeway routes serving the communities of Hales Corners, Greenfield, Greendale, and Franklin. Three bus-on-freeway routes would provide this service from a total of six stations, five of which would be park-ride lots. Headways on the bus-on-freeway service would range from 7 to 20 minutes in the peak travel periods, and would be 30 minutes in the off-peak travel periods.

The light rail transit service in this corridor is expected to carry about 22,900 passengers on an average weekday in the plan design year—about 20 percent more than would be carried by the busway service in the corridor, and more than three times that which would be carried by the bus-on-freeway service. However, systemwide analyses of the three alternative plans, as well as corridor-by-corridor analyses of the number of transit trip ends within one-mile bands of the light rail transit routes, indicate that the total number of transit passengers in the corridor, including those carried on local and express transit services would not be significantly different between the plans.

The operating subsidy required for the busway plan in this corridor may be expected to be

Map 88

COMPARABLE BUS-ON-FREEWAY SERVICE TO THE LIGHT RAIL TRANSIT/BUSWAY SOUTHRIDGE ROUTE



In an effort to identify elements of the composite light rail transit and busway system plans that may be superior to comparable elements of the truncated bus-on-freeway system plan, such routes in the corridor between the Southridge Shopping Center and the Milwaukee central business district were examined separately from the remainder of each of the primary transit systems. The bus-on-freeway service, as shown above, would be comprised of three routes serving a total of six stations located outside downtown Milwaukee, five of which would have park-ride lots. The comparable light rail transit/busway service, also shown above, would be comprised of a single route serving 23 stations or stops, of which four would have park-ride lots.

Source: SEWRPC.

$963,400 greater than the subsidy required for the light rail transit plan. The operating subsidy required in the design year for the bus-on-freeway plan in this corridor may be expected to be $1,456,300 greater than that required for the light rail transit plan.

The light rail transit plan does have a capital cost disadvantage in the Southridge corridor. Over the plan design period, the capital cost—that is, the capital investment less the value of the remaining life of the facilities and vehicles at the end of the plan design period—of the light rail transit facilities is expected to be more than $5 million, or 12 percent, greater than that of the busway plan, and more than $31 million, or about 180 percent, greater than that of the bus-on-freeway plan.

The cost-effectiveness measure quantifying the total cost—both capital and operating—per passenger over the plan design period indicates that the greater capital cost of light rail transit and busway facilities and services in the Southridge corridor outweighs the operating cost advantages of these services over bus-on-freeway services in the corridor. The total cost per passenger of the light rail transit and busway service would be $0.49, or about 72 percent greater than that of the bus-on-freeway service. Accordingly, it was concluded that bus-on-freeway service in this corridor would be superior to light rail transit or busway service, attracting the same ridership at substantially lower cost.

SUMMARY AND CONCLUSIONS

This chapter documents the results of the design, test, and evaluation of system plans for five alternative primary transit modes—bus on metered freeway, bus on busway, light rail transit, heavy rail rapid transit, and commuter rail—under what is considered to be the most optimistic future for transit use in the Milwaukee area over the next 20 years. This alternative future, one of four under which these five primary transit modes have been analyzed in this study, envisions moderate regional population and economic growth, a centralized land use pattern, and a substantial increase in energy cost.

The alternative system plans prepared for each of these primary transit technologies were carefully designed to serve the corridors of heaviest travel demand in the Milwaukee area effectively, and, to the maximum extent practicable, use available facilities and rights-of-way. Considerations in defining the major travel corridors to be served by the primary transit facilities included the locations of existing and proposed regional activity centers, future concentrations of travel desire lines, future concentrations of arterial streets with heavy traffic volumes and congestion, and concentrations of heavily used transit routes. The available facilities and rights-of-way considered in plan design included freeways and their medians, shoulders, and nonroadway rights-of-way; active and abandoned railways and their rights-of-way; former electric interurban and street railway rights-of-way; and the medians and parking lanes of arterial streets having at least three lanes in each direction. Following the identification of the major travel corridors best served by primary transit, and the selection of specific alignments for each alternative primary transit mode from among the facility and right-of-way options in each corridor, system plans were developed for each mode, including the identification of routes, stops, and stations.

The test and evaluation of these maximum extent alternative modal system plans indicated the need to truncate the facilities and services postulated under four of the primary transit mode alternatives in order to provide reasonably cost-effective system plans. Three of the four modal system plans required substantial truncation: the bus on busway, light rail transit, and commuter rail plans. Thus, only the bus-on-freeway plan was found able to cost-effectively provide primary transit throughout the greater Milwaukee area, rather than just in certain corridors of the area.

With respect to the fifth primary transit mode considered—heavy rail rapid transit—it was determined not only that it would entail substantially greater capital costs than any of the other alternatives, but also that its speed and capacity could not be efficiently utilized in the Milwaukee area for at least the next two decades under even the most optimistic future for transit use. Therefore, it was recommended that heavy rail rapid transit be eliminated from further consideration under the study. The analyses clearly established that the only way that heavy rail rapid transit could operate as cost-effectively as the other alternative fixed guideway systems would be at excessively long headways. The operation at longer headways would be necessary because the attainment on the smallest heavy rail vehicle unit—a two-car train—of passenger load factors, and therefore cost-effectiveness, similar to those of the largest light rail vehicle unit—also a two-car train—would require that heavy rail rapid transit carry 50 percent more passengers than light rail transit. Compared with an articulated bus on a busway, the smallest heavy rail rapid transit vehicle unit would need to carry over 300 percent more passengers to attain similar load factors. Thus, the transit travel demand in any corridor of the Milwaukee area even under this most optimistic future for transit use was determined to be insufficient to permit heavy rail rapid transit headways to be short enough so as to be convenient for passenger use. The inconvenience of the necessarily longer headways outweighed any speed advantages of heavy rail rapid transit in attracting transit ridership. The heavy rail rapid transit plan was expected to carry between 7,000 and 11,000, or 2 to 3 percent, fewer passenger trips on an average weekday than the light rail transit and busway alternatives. In addition, the capital cost of the heavy rail alternative, as a result of its need for a fully grade-separated, exclusive right-of-way, was over two-and-one-half times that of the comparable light rail transit plan, and three-and-one-half times that of the comparable busway plan.

Further testing of the alternative truncated primary transit system plans, and subsequent testing of composite light rail transit, busway, and commuter rail system plans—in which the service provided by these modes was supplemented in certain corridors by bus-on-freeway facilities to provide comparable areawide coverage of primary transit service—indicated that all these alternative truncated and composite primary transit system plans could be expected to work well in the design year 2000, providing a reasonably similar high level of primary transit service. The alternative systems were found to be quite similar with respect to total ridership, required annual public subsidy of operating and maintenance costs, operating and maintenance cost-effectiveness, and overall level of service. Each system was expected to result in about the same level of total transit use in the area—specifically, between 366,100 and 378,600 trips on an average weekday in the plan design year. In addition, each system was expected to entail a similar annual operating and maintenance cost deficit, between $35 and $40 million in the plan design year, and to recover a similar proportion of the design year operating and maintenance costs from farebox revenues, between 54 and 59 percent. Finally, each plan was expected to result in about the same average overall speed of travel for transit trips on the total transit system in the design year, between 18 and 21 miles per hour (mph).

The analyses indicated that substantially more transit trips may be expected to be made on the primary element of the light rail transit and busway plans; 145,100 and 134,900 weekday trips, respectively, compared with 75,100 trips under the bus-on-freeway plan and 46,300 trips under the commuter rail plan. These additional trips, however, may be expected to be made under the bus-on-freeway and commuter rail plans as well, but on the local and express elements of those plans at a lower level of service; that is, at speeds of about 16 mph compared with 25 mph on the light rail and busway primary elements. The overall level of service provided to all transit trips made on the bus-on-freeway and commuter rail plans, however, may be expected to be about the same as under the light rail transit and busway plans because the bus-on-freeway and commuter rail plans would provide a faster trip of about 29 mph on the primary elements.

There are significant differences in the capital investment and capital costs attendant to the implementation of the alternative plans. (Capital investment is defined as the total outlay of funds for guideway, station, and support facility construction and vehicle acquisition necessary to implement a plan over the plan design period, and indicates total capital resources required for plan implementation. Capital cost is defined as the capital investment less the value of the remaining life of facilities and vehicles beyond the plan design period, and indicates the true capital cost of plan implementation over the plan design period.) The bus-on-freeway plan was found to require the least capital outlay over the plan design period, $341 million, with the commuter rail plan requiring only slightly more, $375 million. The two plans involving new fixed guideway construction, the busway and light rail transit plans, were found to require substantially more capital investment, $627 and $834 million, respectively. Because of the expected 30-year life of any new guideways to be constructed, and the relatively longer life of rail transit vehicles, the differences in capital costs between the plans over the design period, while still substantial, were considerably less than the differences in capital investment. The commuter rail plan was found to have the lowest capital cost of $215 million, followed by the bus-on-freeway plan at $223 million. The busway and light rail transit plans were found to entail capital costs of $347 million and $436 million, respectively.

The differences in capital costs between the plans may be expected to dominate the small differences found in the annual operating and maintenance cost subsidies.

The bus-on-freeway plan was found to have the lowest total public cost to the plan design year of $774 million, or $0.47 per passenger to the design year, based on two assumptions: first, that each plan would be implemented incrementally over the plan design period and that an equal capital expenditure would be made in each year over the 20-year plan design period, and second, that the annual operating and maintenance cost subsidy would increase linearly from the current level of about $19 million to the plan design year level of between $35 and $40 million. The commuter rail plan was found to have a total public cost to the plan design year of $781 million, or $0.50 per passenger to the design year. The busway plan was found to have a total public cost to the design year of $883 million, or $0.57 per passenger to the design year; and the light rail transit plan was found to have a total public cost to the design year of $964 million, or $0.62 per passenger to the design year. Thus, the light rail transit plan would entail about 25 percent more total public costs over the design period than the bus-on-freeway plan.

Certain intangible benefits, however, would support development of the higher cost light rail transit plan. These include environmental advantages, advantages in shaping land use development and redevelopment, energy advantages, travel safety advantages, and advantages in reliability of operation. The light rail transit plan was determined to have some environmental advantages with respect to air pollution and noise within the specific corridors, although total areawide transportation system air pollutant emissions and noise generation would not differ significantly under any of the transit system plans, because automobile and truck traffic and attendant air pollution and noise would be nearly the same under all of the transit plans. Within specific corridors and areas, however, the light rail vehicles would emit no air pollutants, such emissions occurring at a remotely located central power generating station. A bus would, however, emit air pollutants locally, releasing about one-half the carbon monoxide and hydrocarbons as an automobile and six times the nitrogen oxides. Also, a bus may be expected to generate about 20 percent more noise than a light rail vehicle, and about 5 to 15 percent more noise than an automobile. The principal noise and air pollution impacts may be expected to be effected in the Milwaukee central business district, where transit traffic volumes would be significant. Specifically, on the proposed Wisconsin Avenue transit mall, the light rail transit plan would result in the replacement of up to 200 buses during peak hours with 33 two-car trains of light rail vehicles.

All transit guideway alternatives have a potential to attract, and thereby guide and shape, land use development and redevelopment because they represent a public commitment to high-quality transit service and would increase transit travel accessibility. Light rail transit is considered by some to have a greater potential effect on development than the bus-on-freeway, bus-on-busway, and commuter rail alternatives because it represents the greatest permanent public commitment to a high level of transit service in a specific location, and because its exclusive guideway and electrically propelled vehicles should provide the greatest increase in transit travel accessibility. However, the analyses indicated that the light rail transit system plan would provide about the same accessibility as the bus-on-freeway plan. Moreover, there are other factors which affect land development and redevelopment which could offset the land development potential of light rail transit. These factors are the presence of economic forces which support substantial land use development and redevelopment; the existence of a strong demand for such development and redevelopment in the urban area; the attractiveness of sites surrounding rail transit stations in terms of ease of access, utility and other urban services, physical features, and social characteristics; the existence of a public land use policy which encourages such development and redevelopment through coordinated tax policies, infrastructure supply, and appropriate land use controls, as well as local neighborhood and community acceptance and approval; the presence of land near the stations which is available, or which can be readily assembled, for development; and the provision of a new transportation advantage through improvements in transit travel accessibility. Thus, the increased land development potential of light rail transit must be considered uncertain at best.

The analyses indicated that the light rail transit plan may expected to effect little savings of petroleum use over the other alternative plans considered because it would not result in significantly less automobile use than any of the other alternatives, and automobile energy use dominates transit energy use. The use of electricity by light rail transit may, however, be regarded as a significant advantage in the event of a serious petroleum shortage, because the electrical energy it uses would not be affected and the system would have the potential for expanding service. The expansion of light rail transit service may, however, be difficult in an emergency situation as vehicles for additional service may be difficult to obtain quickly.

Also, because they would be provided over fixed guideways, light rail transit or bus-on-busway transit service would be considered to be more reliable than transit service provided over public roadways shared with other traffic. Light rail transit or bus-on-busway transit, particularly to the extent that these modes utilize exclusive rights-of-way, should not be affected to any significant degree by traffic congestion, traffic accidents, or street and utility repairs which are common on public arterial street rights-of-way. Also, operational problems caused by inclement weather—especially snow and ice—may be expected to be less severe than such problems on public streets. Light rail transit fixed guideways which are located within public street rights-of-way, however—either in median areas, in reserved lanes, or in mixed traffic—may be expected to be affected by all these problems to the extent that the guideway is not separated from adjacent motor vehicle traffic and from cross traffic at intersections. In addition, light rail transit suffers from the potential for an entire guideway segment to lose service should a single vehicle or train break down or become involved in an accident since, unlike rubber-tired motor vehicles, light rail vehicles cannot be steered around obstructions. Service disruptions can also occur from power outages, a breakdown in the overhead power distribution system, and such emergencies as fires which may require hose lines to be stretched across trackage.

The safety of the light rail transit plan may be expected to be greater than that of the motor bus-on-freeway plan because of the extensive use of dedicated street right-of-way in addition to signals at crossings which provide preferential treatment for light rail vehicles. In addition, if high-level boarding platforms are used, it may be expected that boarding and deboarding accidents, which are among the most common types of accidents in current day transit operations, would be significantly reduced. In addition, the massive structure of a light rail vehicle offers more protection to passengers than a bus in the event of vehicle-to-vehicle and vehicle-to-fixed object collisions.

The light rail transit plan would also have an advantage with respect to operating and maintenance cost-effectiveness or efficiency as it would have the smallest necessary public subsidy in the plan design year, although the other plans would have only slightly higher subsidies. In the design year, the light rail transit plan would require $4.8 million, or 12 percent, less subsidy than the commuter rail plan; $2.9 million, or 8 percent, less subsidy than the bus-on-freeway plan; and $0.9 million, or 2 percent, less subsidy than the busway plan.

However, even when considered together, these intangible benefits supporting the development of the higher cost light rail transit plan probably do not outweigh the capital cost difference between that plan and bus-on-freeway plans. Therefore, because the bus-on-freeway plan would attract the highest transit ridership of the plans and would have the lowest total public cost over the plan design period, the bus-on-freeway plan was recommended as the best plan under this alternative future.

Analyses of comparable commuter rail and bus-on-freeway services in each corridor in which commuter rail service was provided under the commuter rail plan support this conclusion. In every corridor, the bus-on-freeway plan would attract more transit ridership in the plan design year and entail no greater capital cost and no greater public operating and maintenance cost subsidy than the commuter rail plan.

Similarly, analyses of comparable bus-on-freeway plan services in each of the corridors in which light rail transit and busway facilities and services were proposed to be provided indicated the substantially higher total public cost of the light rail transit and busway plans in each corridor and the inability of these fixed guideway plans to attract any significant additional transit ridership.

It should be noted that the bus-on-freeway plan recommended under this future is a unique plan involving the provision of primary transit service over an operationally controlled freeway system. The resulting high-speed, nonstop or limited stop rapid transit service over those freeways would provide a very high level of service, a service supplemented by coordinated express and local feeder bus service. Labor productivity of the system would be enhanced by the use of high-capacity articulated buses. Only substantial additional automobile traffic congestion in Milwaukee area, which is not expected under this alternative future, would give the exclusive fixed guideway alternative plans a level-of-service advantage over the recommended bus-on-freeway alternative.

It is important to note that the recommended bus-on-freeway plan represents a significant improvement over the present transit system. It will, however, be necessary to implement each component of the recommended plan if the level of service and cost-effectiveness of the bus-on-freeway alternative is to approach that of the busway and light rail transit alternatives. One of these improvements is the emphasis on carrying a significant proportion of the total transit trips on primary and secondary or express lines, and not on tertiary lines. Only with emphasis on faster primary and secondary lines which are more labor-efficient and attractive to travelers, and only with the use of high-capacity articulated buses which are more labor-efficient, will the bus-on-freeway plan approach the alternative fixed guideway plans in number of trips carried and cost-effectiveness. A particularly important improvement required under the bus-on-freeway plan is extensive preferential treatment for transit vehicles, particularly through the areawide freeway traffic management system.

The implementation of a freeway traffic management system would require ramp meters to be constructed at freeway entrance ramps throughout the Milwaukee area, including all of Milwaukee County, substantial parts of Waukesha and Ozaukee Counties, and parts of Washington and Racine Counties. This extensive ramp metering would be essential to attainment of the free-flowing operation of the area freeway system envisioned under the bus-on-freeway plan. Under the plan, it is envisioned that the freeway traffic management system would exercise sufficient constraint on freeway access to ensure uninterrupted freeway traffic flow and operating speeds of at least 40 to 45 mph over essentially all of the freeway system in the Milwaukee area during average weekday peak travel periods.

A limited freeway traffic management system implemented incrementally by the Wisconsin Department of Transportation since 1969 is in operation today in central Milwaukee County. The system consists of ramp meters and corresponding freeway traffic detectors at 20 freeway entrance ramps in central Milwaukee County. This limited system was originally operated primarily to facilitate the smooth entry of vehicles into the traffic stream on the most heavily congested freeway segments in the central area of Milwaukee County. This original objective has been broadened to include reducing total freeway traffic volumes by restricting access. While providing important benefits in promoting the safer and smoother flow of traffic near entrance ramps, this limited system would not attain the high level of freeway operation envisioned under the bus-on-freeway plan, particularly under this alternative future which envisions substantial growth in total regional travel. The access at the limited freeway entrance ramps located on congested freeway segments which are now metered would have to be severely constrained to potentially attain the level of freeway operation envisioned under the bus-on-freeway plan. Only with an areawide system of ramp meters and attendant control of freeway access would the envisioned freeway operation be practically attainable.

It should be recognized in this respect that there are obstacles to expanding the present limited freeway traffic management system. The Regional Planning Commission's Intergovernmental Coordinating and Advisory Committee on Transportation System Planning and Programming for the Milwaukee Urbanized Area has refused to include the installation of any further ramp meters in the transportation improvement program for southeastern Wisconsin, and recommended in the transportation systems management plan for the Milwaukee area (see SEWRPC Community Assistance Planning Report No. 21, A Transportation Systems Management Plan for the Kenosha, Milwaukee, and Racine Urbanized Areas in Southeastern Wisconsin: 1978) that a prospectus for a preliminary engineering study of an areawide freeway traffic management system be prepared prior to endorsement by the Committee of any further implementation of such a system.[19] The study was to provide recommendations concerning the extent of freeway ramp metering and attendant preferential motor bus access to the freeway system in the greater Milwaukee area; the speeds and volumes to which the area freeway system should be controlled; and, importantly, the degree of metering which would

[19] *An areawide freeway traffic management system was also recommended for implementation under the Commission's long-range regional transportation system plan. See SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume Two, Alternative and Recommended Plans.*

be necessary at each on-ramp to achieve those freeway speeds and volumes. The study was to address the potential costs and benefits of freeway traffic management, assessing resultant freeway and surface arterial street congestion and travel speeds, freeway entrance ramp queues and the impacts of such queues on connecting surface arterial streets, and the equity as well as costs of freeway traffic management.

On March 26, 1979, the prospectus for the required preliminary engineering study was completed by the Commission staff and unanimously approved by the steering committee created by the Commission to guide the preparation of the prospectus. The prospectus was approved by the Commission itself on June 7, 1979. However, funding for the conduct of the study recommended in the prospectus has not been obtained to date. As a consequence, the Intergovernmental Coordinating and Advisory Committee on Transportation System Planning and Programming for the Milwaukee Urbanized Area did not approve the installation of any additional ramp meters in the Milwaukee area in either 1980 or 1981.

The areawide freeway traffic management system would have to consist of an interconnected system of ramp meters throughout the Milwaukee area, a centralized control computer system governing operation of the ramp meters, surveillance equipment, changeable message signs, lane control signals, and entrance ramp reconstruction for transit vehicle bypass lanes. The capital investment required for such a system, consisting of an estimated total of 166 ramp-meter locations, has been estimated to total $14.5 million in 1979 dollars. The operation and maintenance of such an areawide system, including building maintenance, computer maintenance, staff salaries, and the operation and maintenance of the ramp meters, has been estimated to cost $870,000 annually in 1979 dollars. All these costs have been included in the bus-on-freeway plan.

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Chapter IV

ALTERNATIVE PRIMARY TRANSIT SYSTEM PLAN DESIGN, TEST, AND EVALUATION FOR THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN ALTERNATIVE FUTURE

INTRODUCTION

This chapter describes the formulation, test, and evaluation of primary transit alternatives under that future of the four alternative futures considered under this study which is intended to provide the least favorable conditions in the Region for primary transit system development and use. This future assumes stable or declining levels of population and economic activity within the Region; decentralized land use development; a moderate increase in the cost of motor fuel, but an actual decrease in the out-of-pocket cost of automobile travel due to increased efficiency in automobile fuel utilization; and a continuation of population lifestyle trends which include a continued increase in female labor force participation and decreases in household size. New urban development under this alternative future would occur primarily at low densities in a highly diffused pattern well beyond the periphery of existing urban centers. Salient aspects of this alternative future are summarized in Table 186, and are described in greater detail in a companion document to this report, SEWRPC Technical Report No. 25, Alternative Futures for Southeastern Wisconsin.

Alternative primary transit system plans for this future have been designed, tested, and evaluated utilizing the procedures described in Chapter II of this report. The first step of the testing and evaluation process was the identification under each alternative future of a set of maximum extent corridors to be considered for the provision of primary transit facilities and services in the Milwaukee area. A set of such corridors was identified under each future for each primary transit mode—bus-on-freeway, fixed guideway modes of bus-on-busway and light rail transit, and commuter rail.[1] The corridors were identified primarily on the basis of existing and future travel demand in the Milwaukee area. Also considered in the identification of the maximum extent corridors was the availability of rights-of-way, or facilities, as appropriate, suitable for the location of guideways for the various modes at a minimum of cost and disruption. Because the bus-on-freeway and commuter rail modes use existing guideway facilities—freeways and certain active railway lines, respectively—and because none of the sets of maximum extent corridors for these two modes contained more than one alternative alignment, while some corridors had no available alignments, maximum extent system plans specific in alignment were able to be identified in the first step of the plan design, test, and evaluation process under each future for these two modes.

In the second step of the plan design, test, and evaluation process, alternative alignments under each alternative future were designed and evaluated within each of the corridors identified for each of the fixed guideway modes. Common alignments were designed for the bus-on-busway and light rail transit modes, but both Class A and Class B alignments were investigated for these two modes in each corridor. Specific alignments were selected from among the alternatives within each corridor for each mode on the basis of capital cost, travel

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[1] *Maximum extent corridors were also defined for heavy rail rapid transit under the moderate growth scenario-centralized land use plan alternative future, the most optimistic future of the four considered and the first for which alternative primary transit plans were designed, tested, and evaluated under this study. Under the moderate growth scenario-centralized land use plan alternative future, specific heavy rail rapid transit alignments were selected within each of the corridors of major travel demand, and a maximum extent system plan was quantitatively tested and evaluated. When comparing the heavy rail mode with the light rail mode, the test and evaluation showed the heavy rail rapid transit mode as recovering a similar proportion of operating and maintenance costs from farebox revenues, but carrying less ridership and requiring more than twice the capital cost. Accordingly, heavy rail rapid transit was eliminated from further consideration as an alternative primary transit mode and was not considered under the three less optimistic futures considered under this study.*

Table 186

CHARACTERISTICS OF THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN ALTERNATIVE FUTURE

Key External Factors		
Energy	**Economic Conditions**	**Population Lifestyles**
Oil price to converge with world oil price, which will increase at 2 percent annual rate to $39 per barrel in the year 2000 (1979 dollars) Petroleum-based motor fuel to increase to $1.50 per gallon by the year 2000 (1979 dollars) Assumes no major or continuing disruptions in oil supply High degree of conservation in all sectors resulting in increase in energy use of 2 percent or less per year	Region is considered to have relatively low attractiveness and competitiveness Per capita increase likely but no household increase envisioned as a result of the lack of attractiveness and competitiveness of Region, but increased proportion of the population is of work force age, and there is increased labor force participation	Female labor force participation increases to 65 to 70 percent and total labor force participation is 70 to 75 percent A continuation of below replacement fertility rates by the year 2000 Average household size continues to decline

Attendant Regional Change	
Economic Activity of Region in the Year 2000	**Population of Region in the Year 2000**
887,000 jobs Manufacturing . . . . 30 percent Services . . . . 41 percent Other . . . . 29 percent Income of $23,700 per household in 1979 dollars (11 percent increase since 1970, or a 0.3 percent annual rate of increase) Income of $9,500 per capita in 1979 dollars (46 percent increase since 1970, or a 1.3 percent annual rate of increase)	1,688,400 persons 26.8 percent—0-19 years of age 60.6 percent—20-64 years of age 12.6 percent—65 years of age or older 673,600 households Average household size of 2.3 persons

Land Use Plan				
Urban Growth and Density	**Population Distribution**		**Employment Distribution**	
Occurs primarily at low and suburban residential density in a diffused pattern in areas proximate to and removed from existing urban centers Existing developed portions of Milwaukee may decrease in residential density between 1970 and 2000	Milwaukee County		Milwaukee County	
	Population	700,000 persons	Employment	525,300 jobs
	Percent Change from 1970	- 33.6	Percent Change from 1970	2.7
	Percent Change from 1978	- 26.6	Percent Change from 1978	- 6.6
	Outlying County Population (Ozaukee, Washington, Waukesha)	605,000 persons	Outlying County Employment (Ozaukee, Washington, Waukesha)	206,900 jobs
	Percent Change from 1970	73.1	Percent Change from 1970	96.3
	Percent Change from 1978	36.4	Percent Change from 1978	46.3

Source: SEWRPC.

time advantage, travel market potential, and community disruption. In the third step, maximum system plans were prepared under each alternative future for each fixed guideway mode by judiciously combining the selected alignments in each corridor into a system.

In the fourth step of the plan design, test, and evaluation process, the maximum system plans for all of the modes considered under each alternative future were subject to testing—using traffic simulation model studies—evaluation, and comparison. Some services and facilities in some of the corridors in the maximum system plans were "cut back" or deleted following evaluation. The truncated systems were then tested, reevaluated, and again compared to the other truncated system plans.

In the fifth step of the process, a best plan was synthesized for each alternative future. That plan was, for some futures, a combination of the truncated plans tested and compared for the various modes, and for others was entirely the truncated system plan of one of the modes.

In the sixth and final step, the recommended primary transit system plan was developed. This recommended plan consisted of two tiers, a "lower tier" and an "upper tier." The lower tier, intended for immediate implementation, is comprised of those elements of the alternative primary transit system plans which appeared in the best plans selected for three or four of the alternative futures, and which, therefore, could be considered robust and viable under the full range of possible futures and under greatly varying future conditions. The upper tier consisted of those elements which appeared in the best plans selected for only one or two of the futures. Facilities in the lower tier, as noted, are intended for immediate implementation. Implementation of facilities in the upper tier is intended to be postponed for a period of time, until the need for the facilities can be better established over time. Available rights-of-way for such facilities are, however, intended to be preserved in order to retain maximum flexibility for future development.

DEVELOPMENT OF MAXIMUM EXTENT PRIMARY TRANSIT SYSTEM NETWORKS

As already noted, the first step in the design, test, and evaluation of alternative primary transit system plans under each of the alternative futures was the identification of a set of maximum extent corridors within which the provision of each type of primary transit mode could be considered. In the previous chapter of this report, such a set of corridors was identified for the moderate growth scenario-centralized land use plan alternative future—the most optimistic future for the development and use of primary transit facilities and services in the Milwaukee area. The set consisted of three maximum extent networks: one for motor bus on freeways, one for the fixed guideway modes of motor bus on busway and light rail transit, and one for commuter rail. Only those corridors marked by heavy concentrations of travel demand or by the availability of rights-of-way—or of facilities in the case of bus-on-freeway and commuter rail—with attendant potentially low development cost and minimum disruption were included in each of the three sets of corridors.

Service to Major Travel Demands

Corridors of major travel demand in the Milwaukee area under the moderate growth scenario-centralized land use plan alternative future were identified through analyses of the location of existing and proposed major trip generators and of existing and future travel desire lines; of the impact of probable future travel demand on the transportation system in the absence of any future transit improvements; and of the utilization of existing transit routes.

The maximum networks of corridors for the stable or declining growth scenario-decentralized land use plan alternative future, as well as for the two futures under this study which are intermediate with respect to potential transit need and use—the stable or declining growth scenario-centralized land use plan alternative future and the moderate growth scenario-decentralized land use plan alternative future—may be expected to be similar to those already defined for the moderate growth scenario-centralized land use plan alternative future. This is because the incremental increases or decreases in, and the redistribution of, population, households, and employment are necessarily relatively small under all of the four futures over the 20-year planning horizon, and the location of major corridors of travel demand in the Milwaukee area may be expected to remain unchanged over that time. The differences between the futures in the levels of population, employment, and households, however, along with the postulated differences in external factors such as motor fuel cost and availability, may be expected to significantly affect the practicality of developing primary transit facilities, particularly fixed guideway facilities, in each of the identified corridors.

In the following paragraphs, those factors unique to the identification of major corridors of travel demand under the stable or declining growth scenario-decentralized land use plan alternative future are presented and compared with those unique to the moderate growth scenario-centralized land use plan alternative future, including the location of certain proposed major trip generators, probable future travel desire lines, and probable future arterial street and highway traffic and public transit loadings on a transportation system which includes no significant public transit system improvement. The intent of this comparison is to determine if indeed there is little difference between major travel corridors under these two divergent futures; one the most transit-oriented of the four futures considered, and the other the least transit-oriented. If no significant differences are found, then it is reasonable to use the same set of major travel corridors for all four alternative futures as the point of departure for system plan design. The remaining two futures are intermediate futures to the two extreme futures. It should be recognized that many factors considered in the identification of major travel corridors are not unique to any particular alternative future, including the location of existing major trip generators, existing travel desire lines, existing public transit routes of heavy ridership, and existing rights-of-way or facilities available for primary transit development at a minimum of cost and disruption.

Major Land Use Activity Centers: The location of major travel corridors in the Milwaukee area and in the Southeastern Wisconsin Region can be identified, in part, through an examination of the location of existing and proposed major land use activity centers. Travel to, from, and between these centers and areas may be expected to represent a substantial proportion of the travel in the corridors of heavy travel demand within the Milwaukee area.

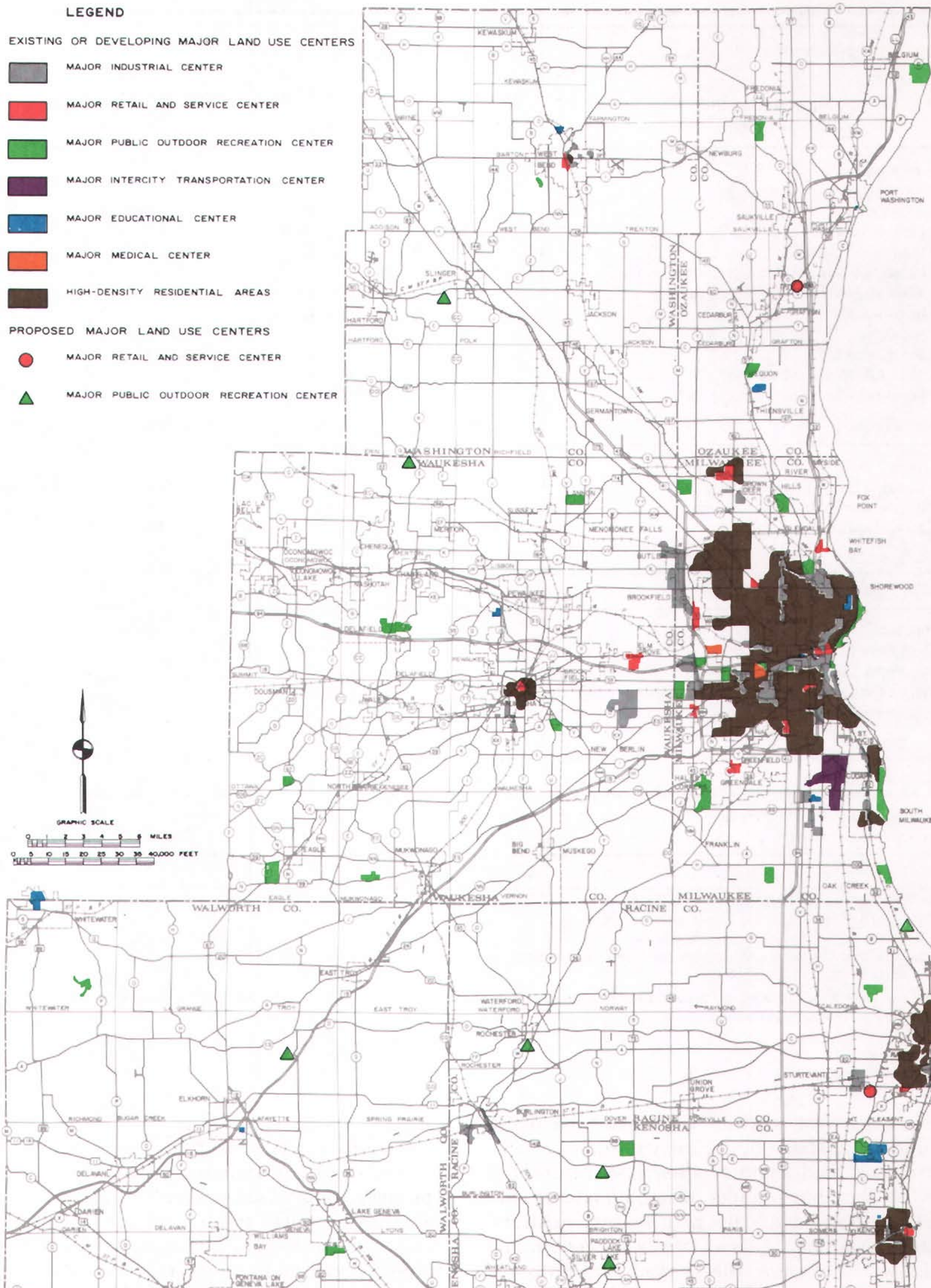
All existing and many proposed major land use activity centers which primary transit should connect and serve are identical under each of the two extreme futures, including existing and proposed major medical centers; existing and proposed major park and outdoor recreation areas; existing technical and vocational schools, colleges, and universities; and existing and proposed intercity transportation terminals. The existing ana proposed locations of these land use activity centers and areas in the year 2000 under the stable or declining growth scenario-decentralized land use plan alternative future are shown on Map 89, and under the moderate growth scenario-centralized land use plan alternative future on Map 5.

There are some differences between the two futures with respect to proposed major retail and service centers and major industrial centers. As of January 1980, there were 13 major retail and service centers located in the Region, 10 of which were located within the Milwaukee area. Under the stable or declining growth scenario-decentralized land use plan alternative future, four additional retail and service centers within the Region would be developed—specifically, in Cedarburg-Grafton, the Waukesha central business district, the West Bend central business district, and Racine-West, as shown in Table 187. Three of these centers—the Waukesha central business district, the West Bend central business district, and Racine-West—are also proposed to be developed under the moderate growth scenario-centralized land use plan alternative future. The retail center that would be developed in the Region under the stable or declining growth scenario-decentralized land use plan alternative future, but not under the moderate growth scenario-centralized land use plan alternative future, would be located in the Cedarburg-Grafton area. On the other hand, one retail center—located in Oak Creek—would be developed under the moderate growth scenario-centralized land use plan alternative future, but not under the stable or declining growth scenario-decentralized land use plan alternative future.

Major industrial centers include the larger and more concentrated locations of manufacturing activities, wholesaling offices, and warehouse and storage areas within the Region. As of January 1980, there were 18 major industrial centers located in the Region, 15 of which were located in the Milwaukee area. Under the stable or declining growth scenario-decentralized land use plan alternative future, three new major industrial centers would be developed in the Region—specifically, in Cedarburg-Grafton, Waukesha, and Burlington—as shown in Table 188. Two of these—the Waukesha and Burlington centers—would also be developed under the moderate growth scenario-centralized land use plan alternative future. The one center to be developed under the stable or declining growth scenario-decentralized land use plan alternative future but not under the moderate growth scenario-centralized land use plan alternative future would be located in the Cedarburg-Grafton area. Three centers—the Milwaukee-Granville, Oak Creek,

Map 89

EXISTING AND PROPOSED LAND USE ACTIVITY CENTERS IN THE REGION UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



One of the considerations in the identification of potential fixed guideway alignments was the location of major land use activity centers in the Milwaukee area and in the Southeastern Wisconsin Region. Such major activity centers and areas include the large retail and service centers, major industrial centers, intercity transportation terminals, regional parks, major medical centers, colleges and universities, and concentrations of high-density residential development. Shown on this map are the existing major land use centers as of 1980, as well as such major centers proposed for development by the year 2000 under the stable or declining growth scenario-decentralized land use plan alternative future.

Source: SEWRPC.

Table 187

EXISTING AND PROPOSED MAJOR RETAIL AND SERVICE CENTERS IN THE REGION UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Major Retail and Service Centers[a]	Net Land Use Area[b] (acres)		Employment	
	1970	2000	1972	2000
Existing				
Milwaukee Area				
Bay Shore	28	28	5,600	5,700
Capitol Court	28	28	3,000	3,100
Mayfair	21	38	3,600	5,500
Milwaukee Central Business District	97	97	65,000	59,400
Mitchell Street	20	- -	4,400	- -
Northridge	- -	45	- -	4,500
Southgate	28	28	2,400	2,500
Southridge	25	43	2,700	4,500
West Allis-West	21	26	1,500	2,100
Brookfield Square	44	82	1,900	6,100
Subtotal	330	415	91,000	93,400
Other				
Kenosha Central Business District	29	29	2,400	2,400
Racine Central Business District	31	31	4,100	4,300
Elmwood Plaza[c]	18	- -	1,700	- -
Subtotal	78	60	8,200	6,700
Existing Total	408	475	99,200	100,100
Proposed				
Cedarburg-Grafton	- -	29	- -	2,900
Waukesha Central Business District	- -	42	- -	6,200
West Bend Central Business District	- -	43	- -	2,900
Racine-West	- -	34	- -	3,500
Subtotal	- -	148	- -	15,500
Proposed Total	408	623	99,200	115,600
Neighborhood and Other Retail and Service Centers	6,109	6,273	205,900	295,700
Total	6,517	6,896	305,100	411,300

[a] *See Map 5 in Chapter III.*

[b] *Includes only that land actually used for retail and service purposes.*

[c] *This center would be replaced by a proposed new center at the intersection of STH 1? and STH 31. Elmwood Plaza would remain as a community-level retail and service center.*

Source: SEWRPC.

and Kenosha-West centers—would not be developed under this stable or declining growth scenario-decentralized land use plan alternative future, but would be developed under the moderate growth scenario-centralized land use plan alternative future. With the exception of these two retail centers and four industrial centers, the existing and proposed major activity centers and areas within the Region are similar, particularly in terms of their influence on future travel corridors.

Future Travel Desire Lines: An important factor considered in the identification of the maximum networks of corridors for the potential location of primary transit facilities and services was the probable future travel desire lines within the Milwaukee area and the Region. An examination of the probable pattern and volume of travel which may be expected to occur in the year 2000 under the stable or declining growth scenario-decentralized land use plan alternative future indicates little change in

Table 188

EXISTING AND PROPOSED MAJOR INDUSTRIAL CENTERS IN THE REGION UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Major Industrial Centers[a]	Net Land Use Area[b] (acres)		Employment	
	1970	2000	1972	2000
Existing				
Milwaukee Area				
Cudahy-South Milwaukee	256	270	7,300	7,500
Milwaukee-Glendale	358	358	17,800	17,900
Milwaukee-Menomonee Valley East	398	398	18,600	14,700
Milwaukee-Menomonee Valley West	120	120	5,300	5,400
Milwaukee-Near North	123	123	15,000	13,800
Milwaukee-Near South	280	280	12,600	12,700
Milwaukee North	342	342	20,800	19,900
Milwaukee South	89	89	4,100	4,200
Oak Creek	- -	327	- -	3,800
West Allis-East	220	220	9,300	9,400
West Allis-West	129	129	3,600	3,700
West Milwaukee	408	408	15,400	14,500
West Bend	83	139	3,800	4,700
Butler-Wauwatosa-Brookfield	375	375	14,600	14,700
New Berlin	174	524	3,500	8,400
Subtotal	3,355	3,775	151,700	151,500
Other				
Kenosha-East	214	214	11,600	10,600
Mt. Pleasant	162	183	3,500	3,800
Racine	273	273	12,500	11,600
Subtotal	649	670	27,600	26,000
Existing Total	4,004	4,445	179,300	177,500
Proposed				
Cedarburg-Grafton	- -	245	- -	3,500
Waukesha	- -	394	- -	7,400
Burlington	- -	264	- -	4,600
Subtotal	- -	1,230	- -	19,300
Proposed Total	4,004	5,675	179,300	196,800
Local and Other Industrial Centers	6,034	7,184	120,800	137,400
Total	10,038	12,859	300,100	334,200

[a] *See Map 5 in Chapter III.*

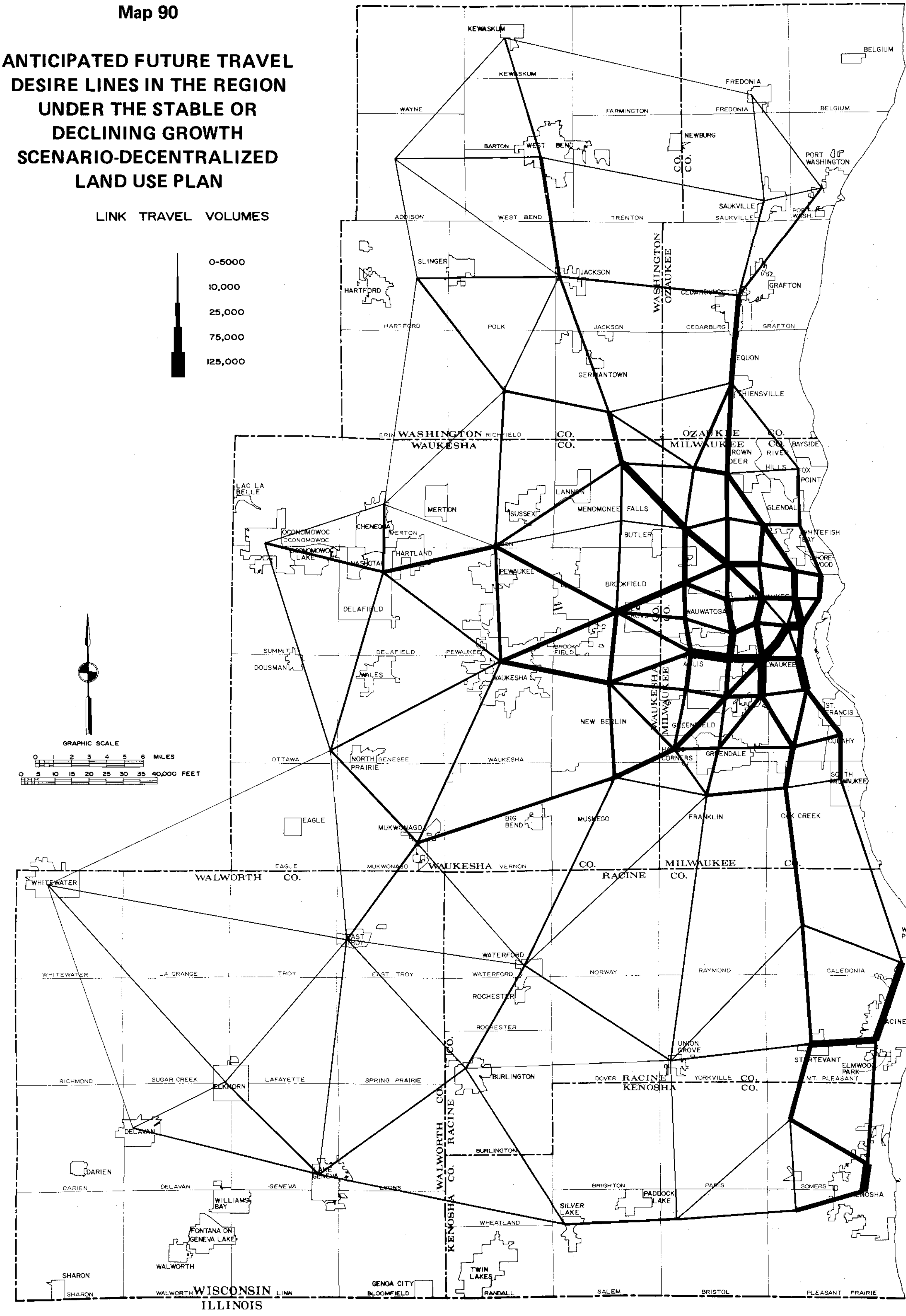
[b] *Includes only that land actually used for industrial purposes.*

Source: SEWRPC.

regional travel demand, and a regional travel desire line pattern that continues to be concentrated in Milwaukee County, focusing on the City of Milwaukee and the Milwaukee central business district (see Map 90). The major corridors of travel desires radiating from the Milwaukee central business district to the southeast, southwest, north, and northeast, as shown on Map 6 of Chapter III of this report, may be expected to remain, as may the crosstown corridors oriented in an east-west direction north of the central business district. The travel desire line pattern under the stable or declining growth scenario-decentralized land use plan alternative future is also similar to that under the moderate growth scenario-centralized land use plan alternative future, which is shown on Map 7 of Chapter III of this report, with the exception that significantly lower volumes of travel may be

Map 90

ANTICIPATED FUTURE TRAVEL DESIRE LINES IN THE REGION UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



Another consideration in the identification of potential fixed guideway alignments was the probable future location of major corridors of travel demand as indicated by future travel desire lines. Under the stable or declining growth scenario-decentralized land use plan alternative future, major corridors of travel demand as indicated by concentrations of travel "desire lines" connecting person trip origins and destinations may be expected to continue to be concentrated in the Milwaukee area, focusing on downtown Milwaukee, as do the existing travel desire lines (see Map 6). Travel volumes within Milwaukee County may be expected to remain heavy along most major corridors, but at a somewhat reduced level from those travel desires anticipated under the moderate growth scenario-centralized land use plan alternative future. Also, the overall demand can be expected to be distributed over a large area, especially in the eastern Waukesha County, southeastern Washington County, and southern Ozaukee County areas.

Source: SEWRPC.

expected in all corridors under the stable or declining growth scenario-decentralized land use plan alternative future.

Future Travel Volumes: Another important consideration in the identification of the maximum networks of corridors for the potential location of primary transit facilities is the probable future traffic volumes which may be expected to occur on a transportation system which includes long-range arterial highway improvements—those included in the "lower tier" of the arterial street and highway element of the adopted long-range regional transportation system plan—but only short-range transit improvements—those included in the adopted Milwaukee County Transit System short-range plan. Those segments of this postulated future transportation system which carry the highest volumes of traffic may be expected to identify corridors of heavy travel demand with future potential for primary transit facility and service development. Those parts of the arterial street system carrying both high traffic volumes and experiencing severe traffic congestion will, in particular, identify corridors with a good potential for future development.

Under this alternative future and the "base" transportation system, more fully described in Chapter III of this report, a total of about 4.71 million person trips may be expected to be generated on an average weekday within the Region by the year 2000. As shown in Table 189, this represents an increase of about 4 percent over the approximately 4.51 million person trips generated within the Region on an average weekday in 1972. The overall 4 percent increase in total person trips generated within the Region from 1972 to 2000 is consistent with the regional changes in population, household, and employment levels and characteristics under the stable or declining growth scenario-decentralized land use plan alternative future. Employment in the Region under this future is expected to increase by about 18 percent, and home-based work person trips under this future would increase by about 14 percent. Person trips for all other purposes except work and school—such as shopping, social and recreational, and medical or dental purposes—would increase by approximately 1 percent. The lack of significant change in tripmaking for these purposes is reasonable, because while the number of households, or "units of tripmaking," would increase by about 20 percent under this future, the number of persons per household, or per unit of tripmaking, would decline by more than 20 percent. In addition, household levels of income and automobile availability would not change significantly from levels existing in 1972 under this future. School trips, however, are anticipated to increase by about 9 percent, despite the 7 percent decline in regional population and 35 percent decline in school-age population. This increase in school trips would result from the decentralization of the Region's population under this future, and the consequent decline in the proportion of school person trips which can be expected to be made by walking. School bus person trips, largely made in outlying and rural areas, are expected to increase by 33 percent under this future. School person trips made by automobile are expected to decrease by about 3 percent. School person trips made by urban transit are expected to decline by about 25 percent—much more than the decline in regional population and about the same as the decrease in regional school-age population.

The distribution of person trips internal to the Region anticipated under this alternative future and base transportation system is summarized in Table 190. Under this alternative future and base transportation system, about 3.1 million automobile driver trips may be expected to be generated on an average weekday in the Region, as well as 1.1 million automobile passenger trips, 208,300 transit passenger trips, and 231,200 school bus passenger trips. Most significant under this alternative future and base plan is the small change in transit passenger trips anticipated in the Region between 1972 and the year 2000, and the decline in transit passenger trips expected in the Milwaukee area, as shown in Table 191. This lack of significant change in transit use in the Milwaukee area over the 28-year period from 1972 to 2000 appears reasonable under this, the least optimistic future for transit use in the Milwaukee area. The cost of automobile travel per mile would not change significantly from 1972 levels under this future, as shown in Table 192, and the total amount of travel in the Milwaukee area would decline. Population in Milwaukee County would decline by nearly 34 percent, and the number of households in Milwaukee County would decline by more than 12 percent. Average levels of household income and automobile availability in Milwaukee County would increase by only 8 and 2 percent, respectively. However, public transit in the Milwaukee area would nearly maintain its 1972 level of ridership despite this decline in total person travel, because under this future and base plan transit fares would be reduced by nearly one-half over the planning period, expressed in constant 1972 dollars, and the base plan includes route

Table 189

COMPARISON OF THE DISTRIBUTION OF INTERNAL PERSON TRIPS IN THE REGION BY TRIP PURPOSE: 1972, ADOPTED REGIONAL LAND USE AND TRANSPORTATION SYSTEM PLANS, AND BASE PRIMARY TRANSIT SYSTEM PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Trip Purpose	Internal Person Trips Generated on an Average Weekday					
	Existing 1972		2000 Adopted Plan		Base Plan	
	Number of Trips	Percent of Total	Number of Trips	Percent of Total	Number of Trips	Percent of Total
Home-Based Work	1,055,500	23.7	1,364,600	23.7	1,198,600	25.7
Home-Based Shopping . . .	673,600	15.1	848,700	14.8	668,300	14.3
Home-Based Other	1,532,600	34.3	1,948,600	33.9	1,514,000	32.5
Nonhome Based.	779,800	17.5	1,001,300	17.4	852,700	17.7
School	418,900	9.4	587,700	10.2	456,600	9.8
Total	4,460,400	100.0	5,750,900	100.0	4,660,200	100.0

Source: SEWRPC.

Table 190

COMPARISON OF THE DISTRIBUTION OF INTERNAL PERSON TRIPS IN THE REGION BY MODE OF TRAVEL 1972, ADOPTED REGIONAL LAND USE AND TRANSPORTATION SYSTEM PLANS, AND BASE PRIMARY TRANSIT SYSTEM PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Mode of Travel	Internal Person Trips Generated on an Average Weekday					
	Existing 1972		2000 Adopted Plan		Base Plan	
	Number of Trips	Percent of Total	Number of Trips	Percent of Total	Number of Trips	Percent of Total
Automobile Driver	2,884,700	64.7	3,764,100	65.5	3,144,400	67.4
Automobile Passenger . . .	1,217,900	27.3	1,363,200	23.7	1,076,300	23.1
Transit Passenger	184,200	4.1	335,000	5.8	208,300	4.5
School Bus Passenger. . . .	173,600	3.9	288,600	5.0	231,200	5.0
Total	4,460,400	100.0	5,750,900	100.0	4,660,200	100.0

Source: SEWRPC.

extensions and level-of-service improvements actually made in the Milwaukee area transit system since 1972, together with those proposed in the recommended five-year transit system plan for Milwaukee County.

The forecast ridership increase is inconsistent with trends in transit use in the Milwaukee area. Since public ownership of the system in 1975, when fares were stabilized and service improved, and since the cost of motor fuel and automobile travel began to increase substantially, transit ridership in the Milwaukee area has increased at an average annual rate of about 5 percent.

The traffic volumes anticipated on the arterial street and highway system under this alternative future and base transportation system are shown on Map 91. As under the moderate growth scenario-centralized land use plan alternative future, the heaviest traffic volumes are expected to be carried on the freeway system, and the heaviest traffic volumes on the freeway system may be expected to occur in Milwaukee County. Within Milwaukee County, the heaviest concentrations of traffic volumes may be expected to occur on freeways emanating radially from the City of Milwaukee central business district to the north on the North-South Freeway (IH 43), to the west on

Table 191

COMPARISON OF THE DISTRIBUTION OF INTERNAL TRANSIT PASSENGER TRIPS IN THE MILWAUKEE AREA BY TRIP PURPOSE: 1972, ADOPTED REGIONAL LAND USE AND TRANSPORTATION SYSTEM PLANS, AND BASE PRIMARY TRANSIT SYSTEM PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Trip Purpose	Average Weekday Transit Passenger Trips					
	Existing 1972		2000 Adopted Plan		Base Plan	
	Number of Trips	Percent of Total	Number of Trips	Percent of Total	Number of Trips	Percent of Total
Home-Based Work	70,100	39.4	123,000	41.8	60,900	35.9
Home-Based Shopping . . .	18,000	10.1	33,000	11.2	21,700	12.8
Home-Based Other	26,900	15.1	77,500	26.3	42,000	24.8
Nonhome Based.	12,600	7.1	9,800	3.3	8,400	5.0
School	50,200	28.3	51,300	17.4	36,400	21.5
Total	177,800	100.0	294,600	100.0	169,400	100.0

Source: SEWRPC.

Table 192

COMPARISON OF FACTORS WHICH AFFECT TRAVEL MODE CHOICE: 1972 AND 1979 CONDITIONS, ADOPTED REGIONAL LAND USE AND TRANSPORTATION SYSTEM PLANS, AND BASE PRIMARY TRANSIT SYSTEM PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Factor	Existing 1972	Existing 1979	2000 Adopted Plan	Base Plan
Motor Fuel				
Cost per Gallon (in 1979 dollars) . . .	$0.65 ($0.36 in 1972 dollars)	$1.00	$1.80 ($1.00 in 1972 dollars)	$1.50
Automobile Fuel Efficiency (miles per gallon).	12	14	27.5	32.0
Cost per Mile (in 1979 dollars).	$0.05 ($0.03 in 1972 dollars)	$0.07	$0.07 ($0.04 in 1972 dollars)	$0.05
Milwaukee Area Transit Fare (in 1979 dollars).	$0.90 ($0.50 in 1972 dollars)	$0.50	$0.90 ($0.50 in 1972 dollars)	$0.50
Regional Automobile Availability				
Total.	704,600	802,100	1,002,500	901,700
Average Number of Persons per Auto	2.6	2.2	2.2	1.9

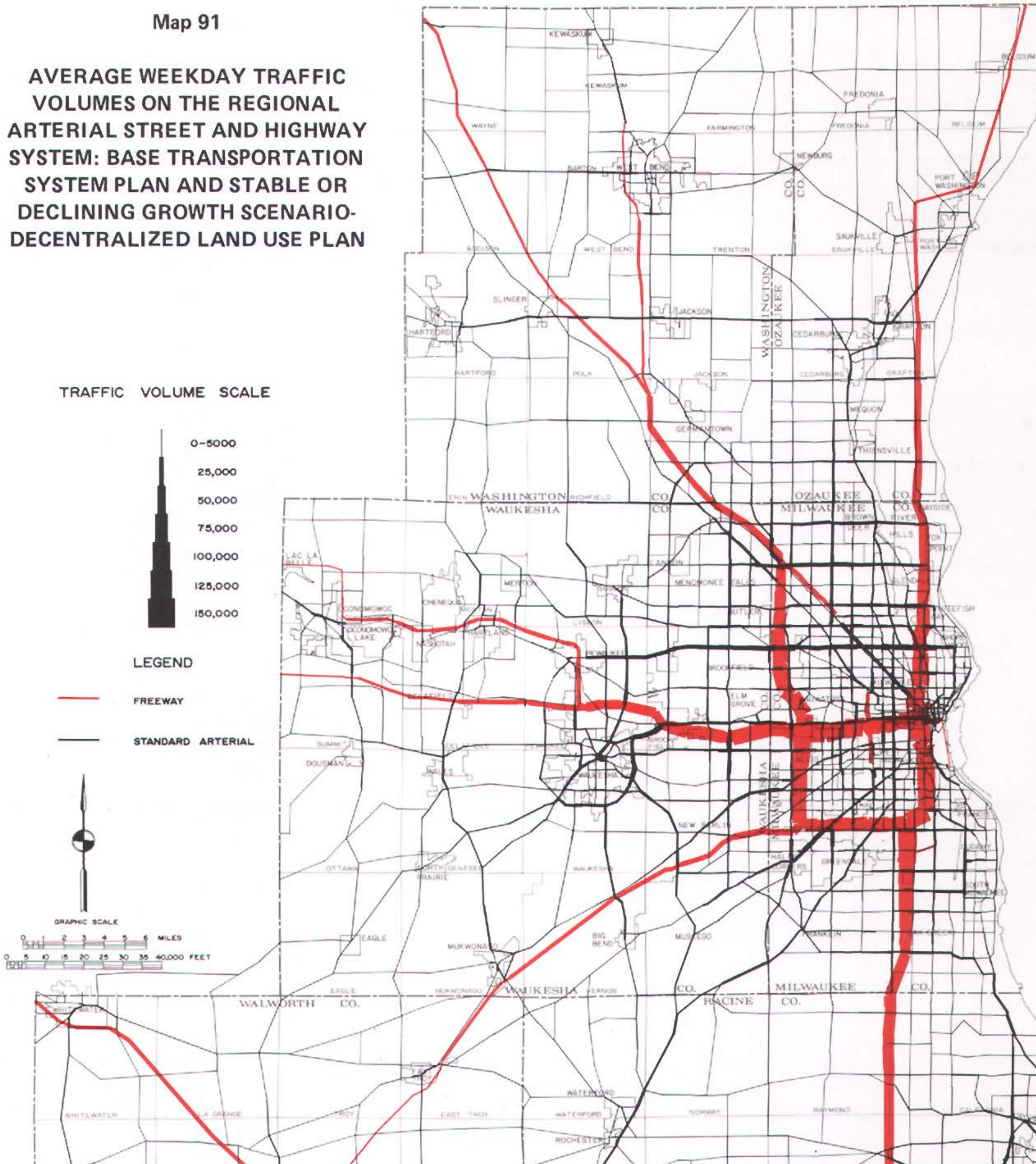
Source: SEWRPC.

the East-West Freeway (IH 94), and to the south on the North-South Freeway (IH 94). In addition, heavy traffic volumes may be expected in an east-west direction on the Airport Freeway (IH 894) south of the Milwaukee central business district, as well as in a north-south direction along the Zoo Freeway (USH 45 and IH 894) west of the City of Milwaukee.

Standard arterial streets and highways which may be expected to carry substantial average weekday traffic volumes in the year 2000 under this future are located primarily in north-central and northwestern Milwaukee County, where there are no existing or planned freeways, as under the moderate growth scenario-centralized land use plan alternative future. Particularly heavily traveled arte-

Map 91

AVERAGE WEEKDAY TRAFFIC VOLUMES ON THE REGIONAL ARTERIAL STREET AND HIGHWAY SYSTEM: BASE TRANSPORTATION SYSTEM PLAN AND STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



The average weekday traffic volumes anticipated on the regional arterial street and highway system in the year 2000 under the base transportation system for the stable or declining growth scenario-decentralized land use plan alternative future are shown on this map. The greatest traffic volumes may be expected to be carried on the freeway system. Of particular significance to transit planning are the standard surface arterial streets and highways which are expected to carry substantial average weekday traffic volumes in the year 2000. Such facilities are located principally in north-central and northwestern Milwaukee County, where there are no existing or planned freeways.

Source: SEWRPC.

rials in Milwaukee County would include W. Capitol Drive, W. Silver Spring Drive, W. Good Hope Road, W. Brown Deer Road, W. Fond du Lac Avenue, W. Blue Mound Road, W. Wisconsin Avenue, and N. and S. 27th Street.

As under the moderate growth scenario-centralized land use plan alternative future, traffic congestion may be expected to occur on the freeway system in the Milwaukee area, particularly on the East-West (IH 94), North-South (IH 94 and IH 43), and Zoo and Airport (IH 894 and USH 45) Freeways, as shown on Map 92. Primary transit improvement and expansion would provide an alternative to the provision of additional highway system capacity in these corridors.

Transit passenger volumes on the primary, secondary, and tertiary transit elements of the base transportation system may be expected to be significantly less under this alternative future than under the moderate growth scenario-centralized land use plan alternative future, as shown on Map 93. Under this future, the heaviest volumes of transit passengers on an average weekday may be expected to occur in a radial pattern, emanating from the Milwaukee central business district. Seven transit passenger volume corridors are focused on the downtown Milwaukee area and extend in all landward directions from the Milwaukee central business district, as under the moderate growth scenario-centralized land use plan alternative future. The major corridors of transit ridership radiate from the Milwaukee central business district to the northeast, north, northwest, west, southwest, south, and southeast. In addition, crosstown corridors are evident in an east-west direction north and south of the Milwaukee central business district as well as in a north-south direction west of the central business district.

Conclusions for Major Travel Corridors: The location and pattern of the corridors of major travel demand under the stable or declining growth scenario-decentralized land use plan alternative future may be expected to be virtually identical to those under the moderate growth scenario-centralized land use plan alternative future, although the levels of demand in the corridors may be expected to be quite different. This conclusion is based upon consideration of the location and intensity of existing and proposed major activity centers, existing and anticipated future travel desires, anticipated traffic on the base transportation system—both highway and transit components, and current public transit use in the Milwaukee area. The seven one- to two-mile-wide corridors of major travel demand, as identified in the analyses in Chapter III of this report and shown on Map 14 in that chapter, have a combined length of about 70 miles.

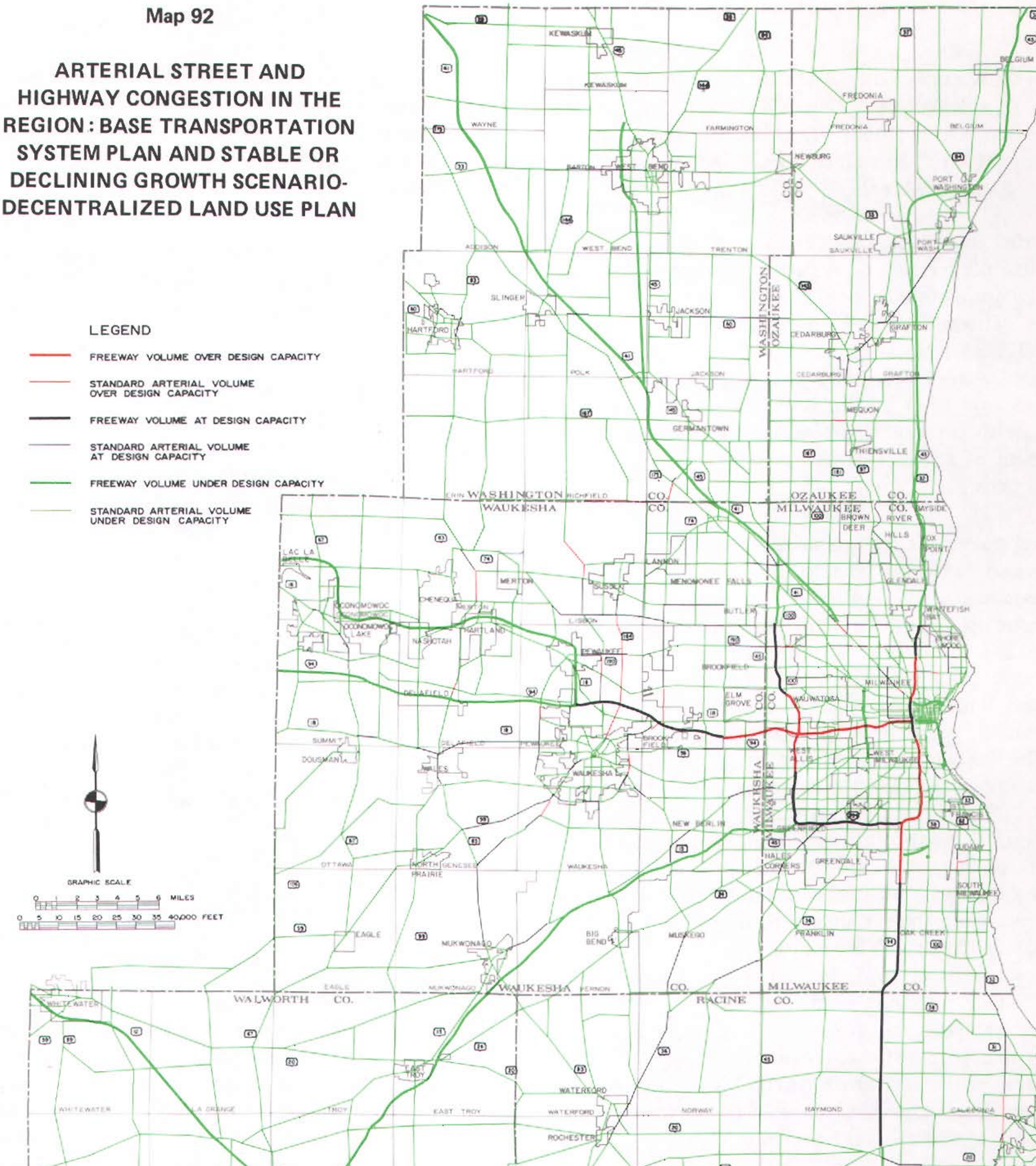
The corridors of major travel demand include: 1) a northeast corridor—extending radially from the Milwaukee central business district in a northeasterly direction into the Village of Shorewood; 2) a north corridor—extending radially from the Milwaukee central business district in a northerly direction into the City of Glendale; 3) a northwest corridor—extending radially from the Milwaukee central business district in a northwesterly direction into the Village of Menomonee Falls in Waukesha County; 4) a west corridor—extending radially from the Milwaukee central business district in a southwesterly direction into the Village of West Milwaukee and then westerly into the Cities of Brookfield and New Berlin in Waukesha County; 5) a southeast corridor—extending radially from the Milwaukee central business district in a southeasterly direction into the City of Cudahy; 6) a north-south crosstown corridor—located west of the Milwaukee central business district and extending from the north side of the City of Milwaukee to the City of Greenfield and Village of Greendale; and 7) an east-west crosstown corridor—located north of the central business district and extending from the Village of Shorewood to the western fringes of the City of Wauwatosa.

Conclusions for Maximum Networks of Corridors

The maximum networks, or sets of corridors, for each primary transit mode under this alternative future are the same as the networks defined under the moderate growth scenario-centralized land use plan alternative future. These networks will establish, in effect, the maximum extent of primary transit development to be considered further in the study under this stable or declining growth scenario-decentralized land use plan alternative future. This maximum set of corridors includes all seven of the corridors of major travel demand just determined to be essentially identical for the two alternative futures, together with readily available rights-of-way or existing transportation facilities which would provide unique opportunities for primary transit facility development at a minimum of cost and disruption, and would provide extensions either to individual corridors of major travel demand or to a system of such corridors. Such available rights-of-way were described in Chapter III of this report.

Map 92

ARTERIAL STREET AND HIGHWAY CONGESTION IN THE REGION: BASE TRANSPORTATION SYSTEM PLAN AND STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

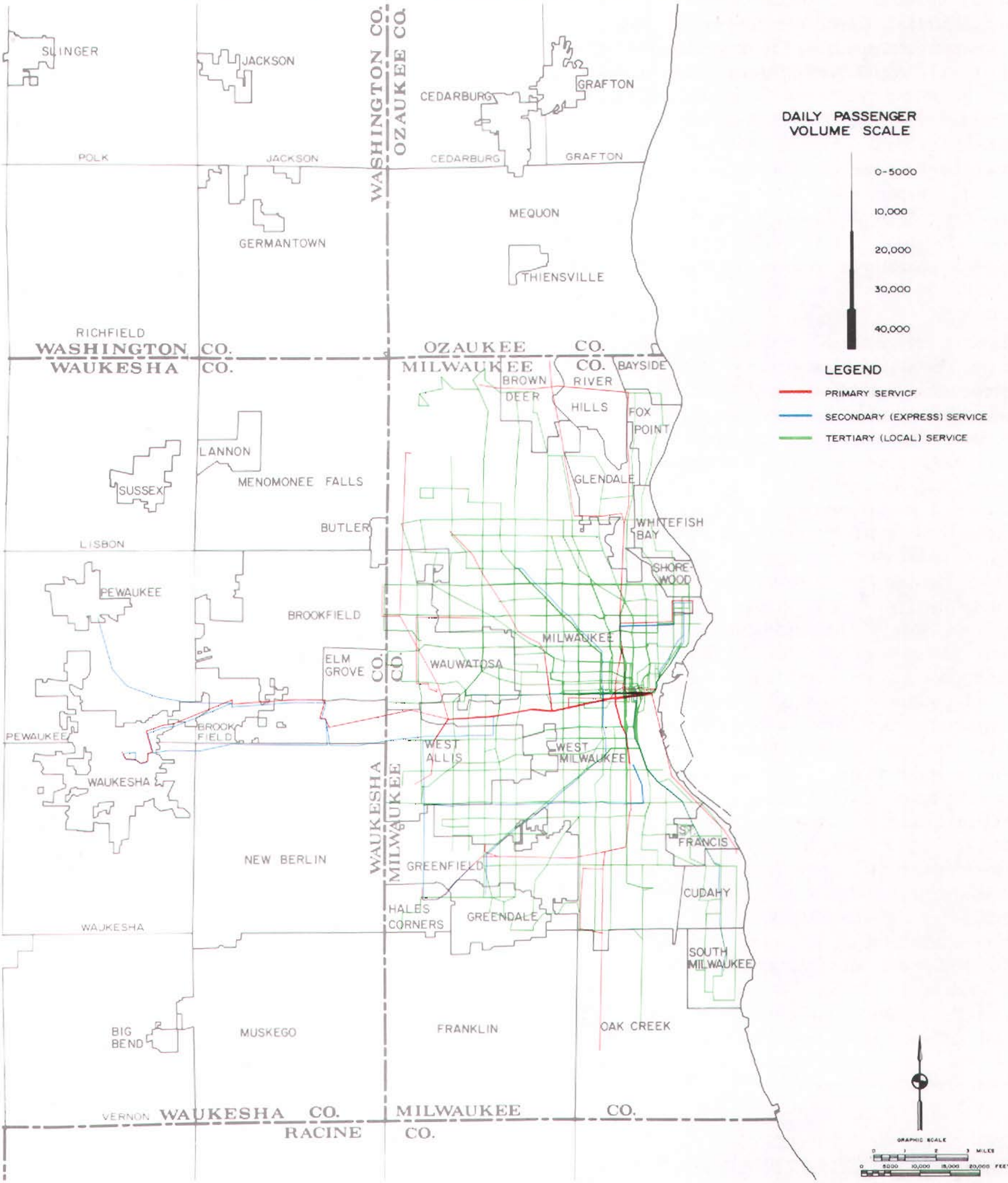


This map shows the relationship which may be expected between average weekday traffic volumes and the capacity of arterial street and highway system segments in the Milwaukee area and Southeastern Wisconsin Region under the base transportation system for the stable or declining growth scenario-decentralized land use plan alternative future. The most severe traffic congestion may be anticipated to occur on the freeway system in the Milwaukee area, where most segments may be expected to be operating either at or over design capacity. An alternative to providing additional capacity for these congested freeway segments is the improvement and expansion of primary transit service.

Source: SEWRPC.

Map 93

TRANSIT PASSENGER VOLUMES ON THE MILWAUKEE AREA PUBLIC TRANSIT SYSTEM: BASE TRANSPORTATION SYSTEM PLAN AND STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



This map indicates the future transit passenger volumes which may be expected to be carried on the primary, secondary, and tertiary transit system elements of the base transportation system under the stable or declining growth scenario-decentralized land use plan. Corridors of high transit passenger volumes are evident in most landward directions radiating from the Milwaukee central business district.

Source: SEWRPC.

The maximum network of corridors for the primary transit modes requiring fixed guideway construction under this future, motor bus on busway and light rail transit, are shown on Map 18; the maximum network for the bus-on-freeway mode is shown on Map 19; and the maximum network for the commuter rail mode is shown on Map 16 in Chapter III of this report. These same networks of maximum corridors will be used to establish the maximum extent of primary transit consideration under the remaining two alternative futures: the moderate growth scenario-decentralized land use plan alternative future and the stable or declining growth scenario-centralized land use plan alternative future.

The similarity of the maximum networks of corridors between these futures is to be expected because the intent at this stage in the plan design, test, and evaluation process is to identify and include for testing every corridor which could potentially support the development of primary transit facilities and services under each alternative future. The difference in population and employment levels between the futures, although substantial, is relatively insignificant with respect to the effect on the identification of major travel corridors. Also, the existing transportation facilities and rights-of-way readily available for primary transit development and use at a minimum of cost and disruption, other important considerations in the development of the maximum networks, are the same under the two futures. However, the levels of travel demand in the individual corridors of the maximum network under the stable or declining growth scenario-decentralized land use plan alternative future and the two intermediate alternative futures will be significantly lower than under the more optimistic future for primary transit system development and use in the Milwaukee area. This difference is attributable to the differences in population and employment between the futures, and to the external factors assumed to be operative in each of the futures. It may be further expected that the extent to which primary transit facilities and services, particularly fixed guideway facilities, will be found to be warranted will differ substantially under the futures.

REFINEMENT OF THE FIXED GUIDEWAY MAXIMUM NETWORK

The second step in the development, test, and evaluation of alternative primary transit system plans under the stable or declining growth scenario-decentralized land use plan alternative future was the identification and evaluation of alternative alignments within the maximum network of corridors for the modes requiring construction of new fixed guideway—light rail transit and motor bus on busway—and, for each of the fixed guideway modes within each corridor, the selection from among the alternatives of a preferred alignment. The third step was the synthesis of a maximum system plan for each fixed guideway mode, accomplished by judiciously combining its selected alignments in each corridor. At the completion of these steps, maximum extent networks for each of the primary transit modes were ready for test, evaluation, and comparison, using travel simulation model studies. Maximum extent networks for bus on freeway and for commuter rail were not included in the second and third steps of the plan design, test, and evaluation process because both of these modes would use existing facilities—freeways and active railway lines—as alignments within the corridors of their maximum networks, with no corridor using more than one existing facility. The specific alignments for the maximum extent commuter rail primary transit system plan are shown on Map 16, and for the bus-on-freeway maximum system plan on Map 19 in Chapter III of this report.

Alignment Selection for Busways and Light Rail Transit Guideways

Alternative alignments within each corridor of the maximum networks for the primary transit modes requiring new fixed guideway construction—light rail transit and motor bus on busway—were first identified and evaluated, and a preferred alignment for further testing was then selected for each mode under the moderate growth scenario-centralized land use plan alternative future, as documented in Chapter III of this report. The alternative alignments all met the engineering design standards and requirements for each mode with respect to horizontal and vertical configuration and minimum guideway right-of-way widths. Because the controlling design standards for light rail transit guideways and busways were identical for all practical purposes, including, importantly, flexibility in the use of grade separation, common Class A and Class B alignments for these two modes were defined.

The alignments were evaluated and a preferred alignment selected based upon the capital cost of guideway construction, the amount and type of right-of-way and disruption entailed, the travel times provided, and accessibility to jobs and to resident population within walking distance, feeder bus distance, and driving access distance. Only one of the above considerations differed significantly between the moderate growth scenario-centralized land use plan and the stable or declining growth scenario-decentralized land use plan: accessibility to jobs and population. However, a preferred alignment different from that selected under the moderate growth scenario-centralized land use plan would have been selected for the stable or declining growth scenario-decentralized land use plan only if one of the alternative alignments other than the preferred alignment selected for the moderate growth scenario-centralized land use plan would have provided a greater magnitude of accessibility under the stable or declining growth scenario-decentralized land use plan. As shown in Table 193, the relative magnitude of the accessibility to employment and resident population provided by the preferred and other alignments in all seven corridors does not vary significantly between the two futures. Therefore, the preferred alignments for the moderate growth scenario-centralized land use plan alternative future may also be used for the stable or declining growth scenario-decentralized land use plan alternative future.

FORMULATION OF MAXIMUM EXTENT SYSTEM PLANS FOR FIXED GUIDEWAY PRIMARY TRANSIT ALTERNATIVES

The third step in the design, test, and evaluation of alternative primary transit system plans under the stable or declining growth scenario-centralized land use plan alternative future was the formulation of maximum extent light rail transit and busway system plans from the selected light rail transit and busway alignments in each of the seven travel corridors to be served. The maximum extent system plans for light rail transit and busways under this more pessimistic future for transit use were concluded to be essentially the same as those plans already developed under the moderate growth scenario-centralized land use plan alternative future for two reasons: 1) the light rail transit and busway alignments selected under this alternative future were the same as those selected under the moderate growth scenario-centralized land use plan alternative future; and 2) the selected alignments under both the moderate growth scenario-centralized land use plan alternative future and the stable or declining growth scenario-decentralized land use plan alternative future would be modified for the same reasons—specifically, to minimize cost and disruption, to minimize duplication of alignments, and to serve as many major land use activity centers as practicable. The maximum extent system plans for light rail transit and busway plans, together with any necessary modifications to the selected light rail transit and busway alignments, are described in Chapter III of this report and are shown on Map 50.

EVALUATION OF ALTERNATIVE PRIMARY TRANSIT SYSTEM PLANS

The fourth step in the design, test, and evaluation of alternative primary transit system plans under the stable or declining growth scenario-centralized land use plan alternative future consisted of the test and evaluation of each of the maximum extent system plans for each of the four alternative transit modes. Based upon this initial test and evaluation, truncated "best" system plans were developed for each mode. These best systems represent truncated versions of the maximum extent system plans from which facilities and services indicated by the test and evaluation process to be relatively unproductive were deleted. The findings of this initial test and evaluation under the stable or declining growth scenario-decentralized land use plan alternative future are summarized in this section, and the four "best" plans for this alternative future, one for each potential Milwaukee area primary transit mode—bus on freeway, commuter rail, light rail transit, and motor bus on busways—are described. Because the maximum extent system plans tested and evaluated under this alternative future were the same as those tested under the moderate growth scenario-centralized land use plan alternative future, and because these plans were described in Chapter III of this report, the facilities and services of these maximum extent plans are not described in this chapter.

Because the plans initially considered were intended to be maximum extent plans which proposed to extend service beyond what would be reasonably warranted limits, the initial evaluation of the plans was confined to a few selected, basic measures of the service provided, the potential utilization, and the costs entailed—measures which consisted of a small, but important, subset of the primary transit system development objectives and standards adopted under the study. Later in the process the "best" plans for each of the different primary transit modes were subject to further test and evaluation and were compared, and a "best" overall plan for each alternative future was identified.

Evaluation of Maximum Extent Bus-on-Freeway System Plan

One of the primary transit technologies potentially applicable in the Milwaukee area over the next

Table 193

COMPARISON OF ACCESS TO JOBS AND POPULATION BY ALTERNATIVE AND PREFERRED LIGHT RAIL TRANSIT/BUSWAY ALIGNMENTS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

		Moderate Growth Scenario-Centralized Land Use Plan				Stable or Declining Growth Scenario-Decentralized Land Use Plan			
Corridor	Alternative Alignment	Jobs Within Walking Distance	Residents Within Walking Distance	Residents Within Feeder Bus	Residents Within Driving Distance	Jobs Within Walking Distance	Residents Within Walking Distance	Residents Within Feeder Bus	Residents Within Driving Distance
Northeast[a]	1LB	86,500	90,100	335,900	448,700	90,700	67,700	250,800	332,600
	2LB	88,300	92,800	337,700	484,000	89,700	67,500	250,200	331,200
	3LB (preferred)	90,500	98,700	334,700	482,500	94,000	69,100	249,100	319,400
	UWM Spur[b]	6,000	12,000	36,000	50,000	4,000	9,000	21,000	29,000
North	1LB	61,800	63,100	297,300	388,500	66,300	42,200	192,800	270,400
	2LB (preferred)	63,000	64,300	298,700	390,100	68,000	43,300	193,000	271,600
	3LB	57,000	56,500	282,800	391,300	64,000	35,100	181,500	263,000
Northwest	1LB	75,500	111,100	446,000	521,300	75,700	77,500	303,700	395,600
	2LB (preferred)	77,000	113,500	449,300	592,600	79,100	84,300	310,900	382,400
	3LB	74,100	114,600	447,900	575,600	83,700	90,800	307,000	387,500
	4LB								
West	1LB	88,900	83,700	378,100	535,100	99,000	65,000	270,800	388,300
	2LB (preferred)	79,600	84,900	372,700	537,900	87,300	66,200	270,600	392,800
	3LB	80,100	86,000	375,400	541,000	87,700	67,200	271,800	394,900
	Wauwatosa Spur[b]	19,000	9,000	123,000	225,000	17,800	6,000	77,000	145,600
Southeast	1LB	75,400	69,200	260,300	349,200	66,200	61,300	218,300	276,400
	2LB (preferred)	75,400	69,200	260,300	349,200	66,200	61,300	218,300	276,400
	3LB	64,400	62,700	227,200	336,500	56,100	56,100	198,400	258,900
	4LB	53,200	59,000	229,300	323,800	53,000	40,200	156,300	206,600
East-West Crosstown	1LB	65,800	79,600	335,800	439,400	63,000	51,600	221,900	254,200
	2LB	57,300	80,900	323,700	463,600	53,400	51,700	214,400	296,900
	3LB (preferred)	65,800	79,600	335,800	439,400	63,000	51,600	221,900	254,200
	4LB	57,300	80,900	323,700	463,600	53,400	51,700	214,400	296,900
North-South Crosstown	1LB	84,600	139,700	658,200	876,000	70,700	99,800	428,900	549,000
	2LB	92,500	150,600	630,700	814,000	82,400	105,000	427,700	531,700
	3LB (preferred)	84,600	139,700	658,200	876,000	70,700	99,800	428,900	549,000
	4LB	92,500	150,600	630,700	814,600	82,400	105,000	427,700	531,700

[a] *In the northeast corridor a fourth alternative alignment, 4LB, was also designed and evaluated. It is not shown in this table because its length, and therefore access provided to jobs and population, is not directly comparable to any of the other three alternative alignments. Under the moderate growth scenario-centralized land use plan alternative future, the best configuration of Alternative 4LB using Santa Monica Boulevard would serve 65,700 jobs and 71,600 residents within walking distance, 313,400 residents within feeder bus distance, and 405,300 residents within driving distance. Alternative 3LB, the preferred alignment, would serve, over a comparable length, 70,500 jobs and 79,800 residents within walking distance, 305,200 residents within feeder bus distance, and 445,500 residents within driving distance. Under the stable or declining growth scenario-decentralized land use plan alternative future, Alternative 4LB would serve about 71,500 jobs and 47,900 residents within walking distance, 184,100 residents within feeder bus distance, and 238,100 residents within driving distance, while Alternative 3LB would serve, over a comparable length, 64,300 jobs and 50,200 residents within walking distance, 181,400 residents within feeder bus distance, and 264,800 residents within driving distance.*

[b] *The spur alignments under the northeast and west corridors were developed to provide more direct service to the University of Wisconsin-Milwaukee and the City of Wauwatosa, respectively, and are to be included as part of the preferred alignment in each of these two corridors.*

Source: SEWRPC.

20 years is that of buses operating over operationally controlled freeways. The maximum extent system plan developed for this technology is summarized with respect to its coverage and routes in Chapter III of this report on Map 52 and in Table 108, and is summarized with respect to its performance under this future in Tables 194, 195, and 196. Map 53 and Table 111 of Chapter III and Tables 195, 197, and 198 provide comparable information for the base, or benchmark, plan used in the study. A description of the facilities and services of the primary, express, and local elements of both the bus-on-freeway maximum extent system plan and of the base plan was presented in Chapter III of this report and will not be repeated here. Only those characteristics of the maximum extent

Table 194

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	IH 43 and STH 33	Village of Saukville	Proposed	Yes	75	1	- -	47	44	2	2	1	1	2	2	1	1
2	IH 43 and CTH Q.	Town of Grafton	Proposed	Yes	75	1	1	40	37	3	2	1	1	2	3	1	1
3	S. 1st Avenue and Wisconsin Avenue	Village of Grafton	Proposed	Yes	50	1	1	51	48	2	2	1	1	2	2	1	1
4	IH 43 and CTH C	Town of Grafton	Existing	Yes	60	1	- -	37	34	2	2	1	1	2	2	1	1
5	Cedarburg Road and Highland Road.	City of Mequon	Existing	Yes	200	1	1	46	43	2	2	1	1	2	2	1	1
6	IH 43 and Mequon Road. .	City of Mequon	Proposed	Yes	70	1	1	32	29	2	2	1	1	2	2	1	1
7	N. 76th Street and W. Brown Deer Road . . .	City of Milwaukee	Proposed	Yes	100	1	5	38	35	3	3	2	2	3	4	2	2
8	IH 43 and Brown Deer Road	Village of River Hills	Existing	Yes	250	1	2	28	25	3	3	2	2	3	4	2	2
9	N. Teutonia Avenue and W. Florist Avenue . .	City of Milwaukee	Proposed	Yes	40	1	1	42	39	3	3	1	1	3	3	1	1
10	IH 43 and W. Silver Spring Drive. . .	Village of Glendale	Existing	Yes	190	4	7	22	19	9	8	6	6	8	9	6	6
11	IH 43 and W. Locust Street.	City of Milwaukee	Proposed	Yes	- -	3	4	16	14	3	3	2	2	3	4	2	2
12	IH 43 and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	5	4	13	12	12	11	8	8	11	13	8	8
13	W. Appleton Avenue and W. Silver Spring Drive. . .	City of Milwaukee	Proposed	Yes	125	1	1	37	34	3	3	2	2	3	4	2	2
14	W. North Avenue and W. Lisbon Avenue.	City of Milwaukee	Proposed	Yes	- -	1	3	21	18	3	3	2	2	3	4	2	2
15	W. Main Street and W. Washington Street . . .	City of West Bend	Proposed	Yes	40	1	- -	83	78	2	2	1	1	2	2	1	1
16	S. Main Street and W. Paradise Drive	City of West Bend	Proposed	Yes	70	1	- -	75	70	2	2	1	1	2	2	1	1
17	USH 45 and STH 60	Town of Polk	Proposed	Yes	50	1	- -	66	61	2	2	1	1	2	2	1	1
18	USH 45 and USH 145 . . .	Town of Polk	Proposed	Yes	50	1	- -	57	52	2	2	1	1	2	2	1	1
19	Pilgrim Road and Mequon Road	Village of Germantown	Proposed	Yes	50	1	1	46	41	2	2	1	1	2	2	1	1
20	USH 41 and Main Street . .	Village of Menomonee Falls	Proposed	Yes	125	2	1	40	35	4	4	2	2	4	4	2	2
21	N. 107th Street and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	75	1	3	38	33	2	2	1	1	2	2	1	1
22	N. Calhoun Road and W. Capitol Drive.	City of Brookfield	Proposed	Yes	140	1	1	40	35	3	3	2	2	3	3	2	2
23	N. 124th Street and W. Capitol Drive.	City of Wauwatosa	Proposed	Yes	100	1	3	35	30	3	3	2	2	3	3	2	2
24	USH 45 and W. Watertown Plank Road	City of Wauwatosa	Existing	Yes	200	2	2	28	24	5	5	4	4	5	6	4	4
25	S. Main Street and E. Wisconsin Avenue . . .	City of Oconomowoc	Proposed	Yes	10	1	- -	71	67	2	2	2	2	2	2	2	2
26	E. Summit Avenue and Pabst Road	City of Oconomowoc	Proposed	Yes	10	1	- -	64	60	3	3	2	2	3	3	2	2
27	Summit Avenue and Delafield Road.	Town of Summit	Existing	Yes	50	1	- -	59	55	3	3	2	2	3	3	2	2
28	Lakeland Road and STH 16	Village of Nashotah	Existing	Yes	30	1	- -	63	59	2	2	2	2	2	2	2	2
29	STH 83 and IH 94	City of Delafield	Proposed	Yes	50	1	- -	50	46	3	3	2	2	3	3	2	2
30	Merton Avenue and STH 16	Village of Hartland	Proposed	Yes	60	1	- -	56	52	2	2	2	2	2	2	2	2
31	Main Street and USH 16 . .	Village of Pewaukee	Proposed	Yes	40	1	1	46	42	2	2	2	2	2	2	2	2
32	Grandview Boulevard and IH 94.	City of Waukesha	Proposed	Yes	125	1	1	43	39	3	3	2	2	3	3	2	2
33	N. Barstow Street and W. Main Street.	City of Waukesha	Proposed	Yes	50	1	1	44	40	3	3	1	1	3	3	1	1
34	N. Barker Road and W. Blue Mound Road . . .	Town of Brookfield	Existing	Yes	250	1	1	34	30	3	3	1	1	3	3	1	1
35	N. Moorland Road and IH 94.	City of Brookfield	Proposed	Yes	60	3	2	30	26	10	10	7	7	10	10	7	7
36	N. 84th Street and IH 94. .	City of Milwaukee	Proposed	Yes	200	9	2	22	18	21	21	13	13	21	21	13	13
37	Cemetery Access Road and IH 94.	City of Milwaukee	Proposed	Yes	- -	1	- -	20	16	5	5	4	4	5	6	4	4
38	N. 3rd Street and W. Wisconsin Avenue . . .	City of Milwaukee	Existing	Yes	- -	29	23	- -	- -	77	71	52	52	71	89	51	51
39	USH 45 and W. National Avenue. . . .	City of West Allis	Proposed	Yes	130	1	4	24	20	3	2	2	2	2	6	2	2
40	S. 43rd Street and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	75	1	1	30	27	3	3	2	2	3	3	2	2
41	S. 44th Street and W. National Avenue. . . .	Village of West Milwaukee	Proposed	Yes	- -	1	2	20	17	3	3	2	2	3	3	2	2
42	S. 108th Street and STH 15	City of Greenfield	Existing	Yes	360	1	3	30	27	3	3	2	2	3	3	2	2
43	W. Loomis Road and W. Rawson Avenue	City of Franklin	Proposed	Yes	75	1	1	37	33	3	3	2	2	3	3	2	2
44	S. 76th Street and W. Cold Spring Road . . .	City of Greenfield	Proposed	Yes	150	1	2	29	26	3	2	2	2	2	4	2	2

Table 194 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
45	W. Loomis Road and W. Grange Avenue.	Village of Greendale	Proposed	Yes	- -	1	2	29	26	3	3	2	2	3	3	2	2
46	S. 27th Street and IH 894.	City of Milwaukee	Proposed	Yes	225	1	3	25	22	3	2	2	2	2	5	2	2
47	STH 15 and STH 20	Town of East Troy	Proposed	Yes	20	1	- -	74	70	2	2	2	2	2	2	2	2
48	STH 83 and STH 15	Town of Mukwonago	Existing	Yes	75	1	- -	65	61	2	2	2	2	2	2	2	2
49	CTH F and STH 15.	Town of Vernon	Existing	Yes	90	1	- -	55	51	2	2	2	2	2	2	2	2
50	Racine Avenue and STH 15	City of New Berlin	Existing	Yes	140	1	- -	49	45	2	2	2	2	2	2	2	2
51	S. Moorland Road and STH 15	City of New Berlin	Proposed	Yes	75	1	2	43	39	2	2	2	2	2	2	2	2
52	6th Avenue and 56th Street.	City of Kenosha	Existing	Yes	50	1	6	72	69	2	2	2	2	2	2	2	2
53	STH 31 and 52nd Avenue.	City of Kenosha	Proposed	Yes	110	1	1	58	55	2	2	2	2	2	2	2	2
54	Wisconsin Avenue and 6th Street.	City of Racine	Proposed	Yes	25	1	8	66	63	2	2	2	2	2	3	2	2
55	STH 31 and 12th Street . .	Town of Mt. Pleasant	Proposed	Yes	110	1	1	54	51	2	2	2	2	2	3	2	2
56	IH 94 and STH 20	Town of Mt. Pleasant	Proposed	Yes	100	1	- -	44	41	2	2	2	2	2	3	2	2
57	IH 94 and Ryan Road . . .	City of Oak Creek	Proposed	Yes	160	1	2	30	27	3	2	2	2	2	3	2	2
58	Nicholson Avenue and E. Rawson Avenue	City of Oak Creek	Proposed	Yes	80	1	1	31	28	3	3	2	2	3	3	2	2
59	IH 94 and W. College Avenue.	City of Milwaukee	Existing	Yes	425	4	4	26	23	6	6	4	4	6	7	4	4
60	IH 94 and W. Holt Avenue	City of Milwaukee	Existing	Yes	240	1	3	21	20	5	3	3	3	3	5	2	2
61	S. Lake Drive and E. Lunham Avenue	City of Cudahy	Proposed	Yes	60	1	- -	28	27	3	2	2	2	2	3	2	2

Source: SEWRPC.

system plan which vary between the alternative futures, such as the frequency of service provided to meet demand, will be discussed.

Headways on the bus-on-freeway primary transit element under this future would generally range from 15 to 30 minutes during the peak travel periods. During the off-peak travel periods, headways would generally range from 30 to 60 minutes in both the midday and evening travel periods. Consequently, about five times more bus miles of primary transit service would be provided under the maximum extent plan under the stable or declining growth scenario-decentralized land use plan alternative future than under the base plan. A significant part of this difference would result from the extension of primary service into off-peak travel periods during the midday and evening, as indicated in Tables 196 and 198. About 42 percent more bus miles of express and local service operated would be provided under the maximum extent plan than under the base plan—about 75,000 bus miles on an average weekday, compared with 53,000 under the base plan.

Transit Utilization: Under the maximum extent bus-on-freeway system plan of the stable or declining growth scenario-centralized land use plan, about 193,000 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 199 and 200. About 31,000, or 16 percent of these transit trips, may be expected to utilize the primary transit system for all or a portion of the trip. Thus, the maximum extent bus-on-freeway plan envisions that about 5 percent of the total of 3.6 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made on public transit, and that less than 1 percent will be made on primary transit. About 24,000, or 14 percent, more transit trips may be expected under this plan than under the base plan. Nearly all of this increased transit use would be on the primary transit element of the plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent bus-on-freeway system plan and the

Table 195

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Bus-on-Freeway Plan
Primary Element		
Exclusive Guideway Miles		
Subway	--	--
Elevated	--	--
At-Grade	--	--
Total	--	--
Shared Guideway Miles		
Freeways	51.5	163.6
Surface Arterial Streets	49.5	81.9
Total	101.0	245.5
Route Miles	449	1,218
Vehicle Miles	6,620	34,980
Vehicle Hours	280	1,240
Vehicles Required	55	144
Trains Required	--	--
Express and Local Elements		
Route Miles	1,302	1,823
Vehicle Miles	52,680	75,120
Vehicle Hours	3,610	4,740
Vehicles Required	521	594
Total System		
Route Miles	1,751	3,041
Vehicle Miles	59,300	110,100
Vehicle Hours	3,890	5,980
Vehicles Required	576	738
Trains Required	--	--

Source: SEWRPC.

base system plan are summarized in Table 201. The costs shown include all construction costs, plus the cost of right-of-way acquisition and the acquisition and replacement of vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 201.

The total capital cost of the base plan is estimated at $162 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses in order to maintain the existing service to the year 2000. About $19 million, or 12 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent bus-on-freeway plan is estimated at $253 million. About $14 million, or about 6 percent of this cost, would be required to implement a freeway operational control system in the Milwaukee urbanized area. About $208 million would be incurred in the purchase of new and replacement of transit vehicles—$61 million of which would be for the purchase of 254 articulated buses, and $147 million of which would be for the purchase of 1,048 conventional buses. The remaining $31 million would be required to construct park-ride stations and to expand bus storage and maintenance facilities. About $90 million, or 36 percent of the total capital cost of the plan, would be required for its primary transit element.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent bus-on-freeway plan can be expected to approximate $51 million. The remaining $202 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal share and the federal share are estimated to total $32 million and $130 million, respectively.

Table 202 presents the annual operating and maintenance costs and farebox revenues anticipated for the design year of the base and maximum extent bus-on-freeway plans. Under the base plan, operating and maintenance costs may be expected to approximate $36 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent bus-on-freeway plan would increase the total operating and maintenance costs for the Milwaukee area in the year 2000 by about $30 million over the base plan, to a total cost of $66 million. The cost of operating and maintaining the primary transit system in the design year may

Table 196

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles	1,218	1,197	1,218	1,141	1,218
Vehicle Miles	8,160	11,260	8,450	7,110	34,980
Vehicle Hours	300	380	310	250	1,240
Vehicles Required	137	81	144	77	144
Trains Required	--	--	--	--	--
Express and Local					
Route Miles	1,823	1,749	1,823	1,646	1,823
Vehicle Miles	18,070	19,090	19,900	18,060	75,120
Vehicle Hours	1,170	1,190	1,300	1,080	4,740
Vehicles Required	532	211	594	179	594
Total System					
Route Miles	3,041	2,946	3,041	2,787	3,041
Vehicle Miles	26,230	30,350	28,350	25,170	110,100
Vehicle Hours	1,470	1,570	1,610	1,330	5,980
Vehicles Required	669	292	738	256	738
Trains Required	--	--	--	--	--

Source: SEWRPC.

Table 197

CHARACTERISTICS OF TRANSIT STATIONS FOR THE BASE SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (buses per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	N. 76th Street and W. Brown Deer Road	City of Milwaukee	Existing[a]	Yes	170	1	3	38	--	5	3	--	--	3	6	--	--
2	N. Green Bay Road and W. Brown Deer Road	Village of Brown Deer	Existing[a]	Yes	100	2	--	32	--	5	3	--	--	3	6	--	--
3	IH 43 and W. Brown Deer Road	Village of River Hills	Existing	Yes	275	1	1	25	24	5	3	2	2	3	6	--	--
4	N. Teutonia Avenue and W. Florist Avenue	City of Milwaukee	Existing[a]	Yes	50	1	1	30	--	2	--	--	--	--	3	--	--
5	IH 43 and W. Silver Spring Drive	Village of Glendale	Existing	Yes	190	2	6	22	19	4	2	2	2	2	5	--	--
6	W. Appleton Avenue and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	100	1	1	37	--	4	2	--	--	3	4	--	--
7	W. North Avenue and W. Lisbon Avenue	City of Milwaukee	Proposed	Yes	--	1	2	21	--	4	2	--	--	3	4	--	--
8	N. 107th Street and W. Good Hope Road	City of Milwaukee	Proposed	Yes	125	1	--	36	--	3	2	--	--	2	3	--	--
9	N. 124th Street and W. Capitol Drive	City of Wauwatosa	Existing[a]	Yes	225	1	1	33	--	4	2	--	--	3	4	--	--
10	USH 45 and W. Watertown Plank Road	City of Wauwatosa	Existing	Yes	200	1	2	26	--	4	--	--	--	--	4	--	--
11	N. Clinton Street and W. Madison Street	City of Waukesha	Existing	Yes	50	1	1	52	--	3	--	--	--	--	3	--	--
12	N. Barker Road and W. Blue Mound Road	Town of Brookfield	Existing	Yes	250	1	--	38	--	3	--	--	--	--	3	--	--
13	N. 3rd Street and W. Wisconsin Avenue	City of Milwaukee	Existing	Yes	--	16	21	--	--	51	24	2	2	26	54	--	--
14	S. 108th Street and W. Cleveland Avenue	City of West Allis	Existing[a]	Yes	225	1	3	29	--	3	3	--	--	2	3	--	--
15	S. 108th Street and STH 15	City of Greenfield	Existing	Yes	360	1	2	30	--	3	2	--	--	3	3	--	--
16	S. 76th Street and W. Cold Spring Road	City of Greenfield	Existing[a]	Yes	200	1	1	29	--	4	3	--	--	3	4	--	--
17	IH 94 and W. Ryan Road	City of Oak Creek	Proposed	Yes	75	1	--	30	--	3	--	--	--	--	3	--	--
18	IH 94 and W. College Avenue	City of Milwaukee	Existing	Yes	425	1	2	26	--	3	--	--	--	--	4	--	--
19	IH 94 and W. Holt Avenue	City of Milwaukee	Existing	Yes	240	1	2	21	--	4	3	--	--	3	4	--	--
20	S. Lake Drive and E. Lunham Avenue	City of Cudahy	Proposed	Yes	100	1	--	28	--	4	2	--	--	2	4	--	--

[a] *Station is currently, and would continue to be, part of a privately owned shopping center parking lot.*

Source: SEWRPC.

Table 198

TIME-OF-DAY OPERATION OF THE BASE SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	449	45	449	--	449
Vehicle Miles	3,020	390	3,210	--	6,620
Vehicle Hours	130	10	140	--	280
Vehicles Required	52	3	55	--	55
Trains Required	--	--	--	--	--
Express and Local					
Route Miles.	1,284	1,071	1,302	953	1,302
Vehicle Miles	13,320	13,520	15,060	10,780	52,680
Vehicle Hours	933	907	1,070	704	3,610
Vehicles Required	470	162	521	117	521
Total System					
Route Miles.	1,733	1,116	1,751	953	1,751
Vehicle Miles	16,340	13,910	18,270	10,780	59,300
Vehicle Hours	1,060	922	1,208	704	3,890
Vehicles Required	522	163	576	117	576
Trains Required	--	--	--	--	--

Source: SEWRPC.

be expected to approximate $3 million under the base plan, and $19 million under the maximum extent bus-on-freeway plan. Primary transit system operating and maintenance costs would thus represent more than 8 percent of the total operating and maintenance costs expected in the design year for the base plan, and about 30 percent of the total operating and maintenance costs expected in the design year for the maximum extent bus-on-freeway plan.

The average operating and maintenance cost per passenger for the base plan in the plan design year is estimated at $0.73. For the maximum extent bus-on-freeway plan, the average cost per passenger may be expected to approach $1.22—$0.49, or 67 percent, more than the base plan cost. The average operating and maintenance cost per passenger mile would be about 25 percent greater under the maximum extent bus-on-freeway plan alternative, $0.25, compared with $0.20 for the base plan. The average operating and maintenance cost per passenger and per passenger mile for the primary element of the base plan would be $1.22 and $0.17, respectively, and for the primary element of the maximum extent bus-on-freeway plan, $2.41 and $0.20, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $19 million in 1979 dollars, compared with about $30 million under the maximum extent bus-on-freeway plan. Under the maximum extent bus-on-freeway alternative, the

Table 199

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan: Total Person Trips[a]	Base Plan: Transit Trips Number	Base Plan: Transit Trips Percent of Total Trips	Maximum Extent Bus-on-Freeway Plan: Total Person Trips[a]	Maximum Extent Bus-on-Freeway Plan: Transit Trips Number	Maximum Extent Bus-on-Freeway Plan: Transit Trips Percent of Total Trips
Home-Based Work	958,800	60,900	6.4	959,000	71,500	7.4
Home-Based Shopping . .	502,600	21,700	4.3	502,000	25,900	5.2
Home-Based Other	1,139,400	42,000	3.7	1,136,700	50,700	4.5
Nonhome Based.	655,600	8,400	1.3	653,600	8,600	1.3
School	364,900	36,400	10.0	364,900	36,400	10.0
Total	3,621,300	169,400	4.7	3,616,200	193,100	5.3

[a] *The difference in the total person trips generated under the maximum extent bus-on-freeway plan and the total trips generated under base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been found to be correlated with increased automobile ownership, and greater automobile ownership has been found to be correlated with increased trip generation. The Commission travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.*

Source: SEWRPC.

Table 200

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Time of Day	Base Plan: Primary Element Transit Trips	Base Plan: Primary Element Percent of Total	Base Plan: Total System Transit Trips	Base Plan: Total System Percent of Total	Maximum Extent Bus-on-Freeway Plan: Primary Element Transit Trips	Maximum Extent Bus-on-Freeway Plan: Primary Element Percent of Total	Maximum Extent Bus-on-Freeway Plan: Total System Transit Trips	Maximum Extent Bus-on-Freeway Plan: Total System Percent of Total
Morning . . .	4,000	42.1	41,800	24.7	8,900	28.9	46,500	24.1
Midday	200	2.1	53,400	31.5	7,100	23.0	61,800	32.0
Afternoon . .	5,300	55.8	59,800	35.3	12,300	40.0	67,800	35.1
Evening. . . .	- -	- -	14,400	8.5	2,500	8.1	17,000	8.8
Total	9,500	100.0	169,400	100.0	30,800	100.0	193,100	100.0

Source: SEWRPC.

primary transit element could be expected to generate about 17 percent, or $5 million, of the total revenues, compared with 8 percent, or $1.5 million, for the base plan.

The operating deficit in the year 2000 for the maximum extent bus-on-freeway plan would be about $36 million, expressed in 1979 dollars, requiring a subsidy of about $0.65 per passenger. This compares with the base system plan deficit of about $16 million, or $0.33 per passenger. Farebox revenues would cover about 45 percent of operating costs under the maximum extent bus-on-freeway plan, and 54 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund

Table 201

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Bus-on-Freeway Plan
Guideway Development[b]	$ --	$ 14,326,000
Station Development[c]	2,387,700	10,400,300
Vehicle Storage and Maintenance Facility Development[c]	15,850,000	20,300,000
Vehicle Acquisition and Replacement[d]	143,360,000	207,680,000
Total	$161,597,700	$252,706,300

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent bus-on-freeway plan would be implemented incrementally from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 to 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes for the bus-on-freeway plan the implementation cost of the proposed freeway operational control system in the Milwaukee area, which has an estimated useful life of 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—10 acres under the base plan and 29 acres under the maximum extent bus-on-freeway plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of the acquisition and replacement as necessary over the 20-year design period of all buses used in the system. Both plans assume the availability of a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years.*

Source: SEWRPC.

50 percent of the operating deficit up to the total urbanized area apportionment, and the State has, in the past, funded up to 72 percent of the nonfederal share.[2] The annual local share of the public funding requirement in the year 2000 would be about $5 million for the maximum extent bus-on-freeway system, and somewhat less, $2.3 million, for the base system.

Development of Truncated Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent bus-on-freeway system plan are summarized in Table 203. The maximum extent bus-on-freeway system plan has higher capital costs and greater operating deficits, both in total and on a per-passenger basis, than does the base plan. In addition, farebox revenues under the maximum extent bus-on-freeway system plan cover a much smaller proportion of operating costs in the plan design year than do such revenues under the base plan, particularly with respect to its primary element.

Most of the increases in the cost and decreases in the cost-effectiveness of the maximum extent bus-on-freeway system plan can be attributed to

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[2] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, greater than the $8.2 million required to provide 50 percent federal funding of the operating deficits under the base plan, but somewhat less than the $17.9 million required to provide such funding under the maximum extent bus-on-freeway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Table 202

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Bus-on-Freeway Plan
Ridership		
Primary Element	2,422,500	7,854,000
Total System	48,793,500	54,920,000
Operating and Maintenance Cost		
Primary Element	$ 2,950,400	$18,954,200
Total System	35,646,200	65,577,500
Operating and Maintenance Cost per Passenger		
Primary Element	$1.22	$2.41
Systemwide Average	0.73	1.22
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.17	$0.20
Total System	0.20	0.25
Farebox Revenue		
Primary Element	$ 1,453,500	$ 5,115,300
Total System	19,317,500	29,686,500
Operating Deficit		
Primary Element	$ 1,496,900	$13,838,900
Total System	16,328,700	35,891,000
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	49	27
Total System	54	45
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 748,450	$ 6,919,450
Total System	8,164,350	17,945,500
State (72 percent of nonfederal share of operating deficit)		
Primary Element	538,884	4,982,000
Total System	5,878,332	12,920,760
Local		
Primary Element	209,566	1,937,450
Total System	2,286,018	5,024,740
Local Operating Deficit per Ride		
Primary Element	$0.09	$0.25
Total System	0.05	0.09

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, greater than the $8.2 million required to provide 50 percent federal funding of the operating deficit under the base plan, but less than the $17.9 million required to provide such funding under the maximum extent bus-on-freeway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

the overextension of primary transit service envisioned in this plan.[3] Under the maximum extent plan, primary transit service would be extended into large areas of the Region not now served. In addition, it would be expanded into an all-day operation, and it would be provided with headways of no more than 30 minutes during the peak travel periods in the peak direction and of no more than 60 minutes otherwise. Thus, the primary transit service proposed would be a true transit service, available for tripmaking of all purposes. The cost-effectiveness of the less productive routes on which bus-on-freeway service would be extended can be identified through a determination of what proportion of the operating costs may be expected to be recovered through farebox revenues. As shown in Table 204, only three of the routes under the maximum extent plan are expected to meet more than one-half of their operating costs through farebox revenues.

To reduce operating deficits and increase the proportion of primary transit operating costs met by farebox revenues, it was necessary to truncate the maximum extent bus-on-freeway plan. In order to do so while maintaining a framework of true primary transit service in the Milwaukee area, and, importantly, to assure reasonable comparability between all primary transit alternatives tested, this truncation was limited to reductions in the extent of service provided. Nevertheless, those bus-on-freeway facilities and services which could be reasonably cost-effective if the time periods and frequency of service offered were reduced were identified so that these reduced services could be

[3] *The extension of local and express service under the maximum extent bus-on-freeway plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express (secondary) and local (tertiary) service included in each maximum extent primary transit system plan is basically in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules were modified, however, to coordinate properly the secondary and tertiary service proposed to be provided with the primary service proposed under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service would equally affect the cost of each primary transit alternative considered, and should, therefore, not affect a comparison of those alternatives.*

Table 203

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Bus-on-Freeway Plan
Ridership		
In Design Year	48,793,500	54,920,000
To Design Year	1,127,300,000	1,176,300,000
Capital Cost		
Total to Design Year	$161,597,700	$252,706,300
To Design Year per Passenger	0.14	0.21
To Design Year After Accounting for Useful Life Beyond Design Year	107,761,000	155,958,000
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.13
Operating Cost		
Percent Met by Farebox Revenues in Design Year	54	45
Operating Deficit in Design Year	$ 16,328,700	$ 35,891,000
Operating Deficit per Passenger in Design Year	0.33	0.65
Operating Deficit to Design Year	375,942,200	532,440,600
Operating Deficit to Design Year per Passenger	0.33	0.45
Total Cost		
To Design Year	$537,539,900	$785,146,900
Federal Share	317,249,000	468,385,340
Nonfederal Share	220,290,900	316,761,560
To Design Year per Passenger	0.47	0.66
Federal Share	0.27	0.40
Nonfederal Share	0.20	0.26
To Design Year After Accounting for Useful Life Beyond Design Year	483,703,200	688,398,600
Federal Share	274,179,900	390,986,700
Nonfederal Share	209,523,300	297,411,900
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.43	0.58
Federal Share	0.24	0.33
Nonfederal Share	0.19	0.25

Source: SEWRPC.

considered for addition to the "best" primary transit system plan for this future as "specialized" transit service.[4]

Accordingly, with the objective of reducing bus-on-freeway operating deficits by increasing the proportion of bus-on-freeway operating costs met by farebox revenues to at least 50 percent, the maximum extent bus-on-freeway system plan was truncated as set forth in Table 205 and on Map 94. Each bus-on-freeway route for which farebox revenues were not expected to approach 50 percent of operating costs on an all-day and minimum frequency basis was cut back. However, those routes which could be expected to meet 50 percent of their operating costs through farebox revenues

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[4] *Reductions in the time periods of service and increases in the headways operated have the potential to affect primary transit cost-effectiveness significantly. The off-peak-period operations of bus-on-freeway service under this future are less cost-effective than the peak-period operations. However, limiting bus-on-freeway service to the peak travel periods may be expected to increase the average systemwide proportion of bus-on-freeway operating costs met by farebox revenues by less than 5 percent, because under peak-period-only operation, travel on the bus-on-freeway system may be expected to be reduced to the primarily work- and school-related travel generated during the morning peak period. Nevertheless, because travel on the bus-on-freeway system during the peak periods is highly directional, being largely oriented to the Milwaukee central business district in the morning and from the central business district in the afternoon, limiting service in the peak period to the peak direction could be expected to double the proportion of bus-on-freeway operating costs met by farebox revenues. This conclusion assumes the use of satellite storage facilities for the limited number of peak-period buses required to serve the most outlying stations. Under such an arrangement, drivers would have to report to, and leave work from, the outlying stations. Otherwise, the extent of deadhead bus miles required for such a peak-period and peak-direction operation would be inconsistent with the average operating cost per revenue bus mile used to estimate the costs of bus alternatives under this study.*

To reduce the frequency of service, maximum headways in the peak periods and the peak direction were increased from 30 to 60 minutes with only a relatively small reduction in transit use and a substantial reduction in operating cost. The decrease in ridership would result from the attendant increase in wait time for transit service. First wait times under this study were assumed to approximate one-half of the headway up to a maximum of 10 minutes. Consequently, the increases in maximum headway would not affect this wait time. However, all subsequent wait times, which were attendant to transfers, were estimated at one-half of the headway with no upper limit. It should be noted that, by not permitting headways greater than 60 minutes, it was assumed that any decrease in operating costs possible through further headway increases would result in ridership and revenue reductions and a subsequent stabilization or decline in the proportion of operating costs recovered from farebox revenues. The ridership reductions would result from the inconvenient schedule.

Table 204

OPERATING COST-EFFECTIVENESS OF BUS-ON-FREEWAY ROUTES OF THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicles Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
1—Port Washington	11,780	$ 640	1,834	$ 3,900	16
2—Cedarburg	9,900	530	1,002	2,127	25
3—Mequon	7,870	420	885	1,885	22
4—Brown Deer	18,170	980	1,013	2,157	45
5—River Hills	6,950	380	1,177	2,500	15
6—Northwest Side	16,670	900	821	1,744	52
7—Wauwatosa	2,850	150	1,424	3,024	5
8—West Bend	10,240	550	1,901	4,042	14
9—Germantown	6,040	330	1,187	2,520	13
10—Menomonee Falls	5,700	310	1,124	2,389	13
11—Menomonee Falls	14,740	780	1,015	2,157	36
12—Brookfield	11,770	640	971	2,066	31
13—Milwaukee County Institutions/UWM	320	20	670	1,421	1
14—Oconomowoc/Pewaukee	8,890	480	1,994	4,233	11
15—Oconomowoc/Delafield	10,050	540	1,842	3,911	14
16—Waukesha	13,880	750	979	2,076	36
17—East Troy	22,050	1,190	1,808	3,840	31
18—Hales Corners	12,470	670	996	2,117	32
19—Greenfield	8,150	440	826	1,754	25
20—West Allis	10,820	580	814	1,734	33
21—Stadium	2,980	160	610	1,300	12
22—Franklin	6,420	350	912	1,935	18
23—Kenosha	57,890	3,130	2,296	4,878	64
24—Racine	55,430	2,990	1,969	4,182	71
25—Oak Creek/Ryan Road	11,760	640	1,016	2,157	30
26—Oak Creek/Rawson Avenue	5,120	280	1,001	2,127	13
27—South Side/UWM	700	40	605	1,290	3
28—South Side/College Avenue	1,760	100	245	524	19
29—South Side/IH 894	7,370	400	769	1,633	24
30—South Side/Holt Avenue	9,250	500	674	1,431	35
31—Cudahy	3,810	200	604	1,280	16
Total	371,810	$20,060	34,981	$74,330	27

Source: SEWRPC.

with reductions in the time periods or frequency of service were identified for consideration later in the study, and are summarized in Table 205.

Evaluation of Maximum Extent Commuter Rail System Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is commuter rail. The maximum extent system plan developed for this technology is summarized with respect to its coverage and routes in Chapter III of this report on Map 57 and in Table 122 and is summarized with respect to its operation under this future in Tables 206 through 208. Map 53 and Table 111 of Chapter III and Tables 207, 197, and 198 provide comparable information for the base, or benchmark, plan used in the study. A description of the facilities and services of the primary, express, and local elements of both the maximum extent commuter

Table 205

RECOMMENDED CHANGES IN THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Recommended Change
1—Port Washington	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
2—Cedarburg	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
3—Mequon	Route to be truncated but retained for consideration as addition to the final plan, with service limited to peak periods and peak directions, and possibly increased headways
5—River Hills	Route to be cut back but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways. Also, route to park-ride lot at the North-South Freeway (IH 43) and W. Silver Spring Drive to be cut back
7—Wauwatosa	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways. Also, feeder loop operating over W. Burleigh Street and N. Mayfair Road to park-ride lot at Zoo Freeway (USH 45) and W. Watertown Plank Road to be dropped. Express service to N. Glenview Avenue to be cut back
8—West Bend	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
9—Germantown, and 10 and 11—Menomonee Falls	Routes to be combined into one route
12—Brookfield	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
13—Milwaukee County Institutions/UWM	Route to be eliminated
14—Oconomowoc/Pewaukee	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
15—Oconomowoc/Delafield	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
17—East Troy	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
18—Hales Corners	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
20—West Allis	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
21—Stadium	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways

Table 205 (continued)

Route	Recommended Change
22–Franklin	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
25–Oak Creek/Ryan Road	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
26–Oak Creek/Rawson Avenue	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
27–South Side/UWM	Route to be eliminated
28–South Side/College Avenue	Route to be eliminated
29–South Side/IH 894	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
30–South Side/Holt Avenue	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
31–Cudahy	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways

Source: SEWRPC.

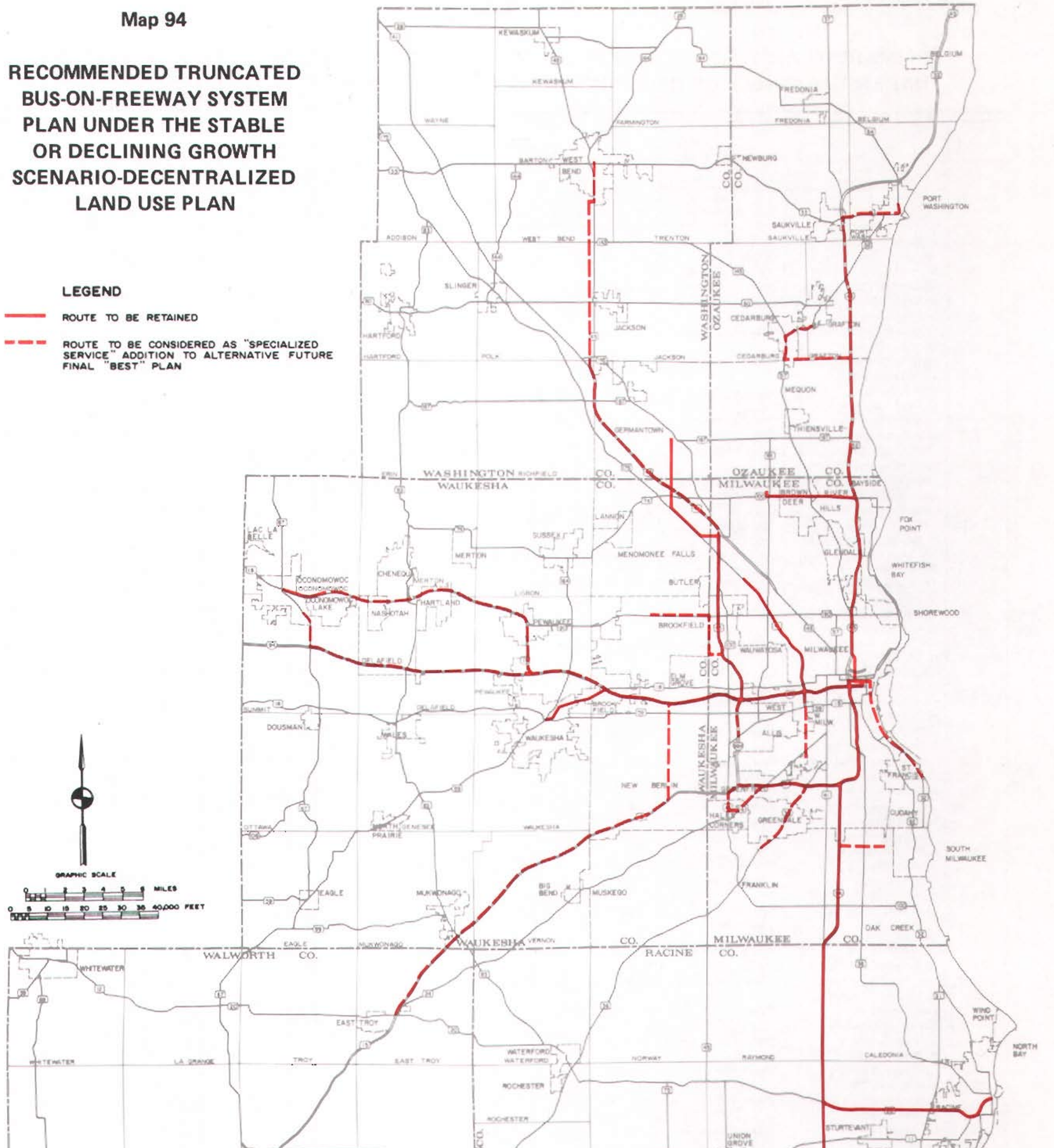
rail plan and the base plan is provided in Chapter III of this report and will not be repeated here. Only those characteristics of the maximum extent commuter rail plan which vary between the futures, specifically, the provision of service to meet demand, will be discussed.

Under this alternative future, headways on the commuter rail primary transit element were assumed to be one-half hour in the peak period in the peak direction, and every hour otherwise. Commuter rail trains would consist of a locomotive and one coach, except on the route through Racine to Kenosha, where trains of two coaches would be used during the peak periods. Under the maximum extent commuter rail plan for this future, there would be 7,120 vehicle miles of primary transit service—an 8 percent increase over the level of service provided in the base plan. The number of express and local service bus miles operated would increase by about 40 percent over the number envisioned in the base plan, from about 52,700 to about 75,000 bus miles on an average weekday.

Transit Utilization: Under the maximum extent commuter rail system plan for the stable or declining growth scenario-decentralized land use plan alternative future, about 183,000 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 209 and 210. About 8,900, or 5 percent, of these transit trips may be expected to utilize the primary transit system for all or a portion of the trip. Thus, the maximum extent commuter rail system plan envisions that about 5 percent of the total of 3.6 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that less than 1 percent will be made using pri-

Map 94

RECOMMENDED TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



The maximum extent bus-on-freeway system plan shown on Map 52 in Chapter III was truncated with the objective of maximizing the number of bus-on-freeway primary transit routes for which 50 percent of the operating costs could be met with farebox revenues. A total of 7 of the 31 routes in the maximum extent plan, totaling 322 route miles in length, were proposed to be retained in the truncated plan. Nineteen of the 24 routes proposed to be deleted from the truncated plan were recommended to be considered for addition to the final "best" plan recommended for this future as specialized peak-period-only service.

Source: SEWRPC.

Table 206

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (trains per period): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	N. Maple Street and W. Grand Avenue	City of Port Washington	Proposed	Yes	25	1	--	55	55	6	3	6	6	3	6	4	4
2	IH 43 and CTH C	Town of Grafton	Proposed	Yes	30	1	--	44	44	6	3	6	6	3	6	4	4
3	IH 43 and Mequon Road	City of Mequon	Proposed	Yes	25	1	1	38	38	6	3	6	6	3	6	4	4
4	Rexleigh Drive and E. Brown Deer Road	Village of Bayside	Proposed	Yes	--	1	2	32	32	6	3	6	6	3	6	4	4
5	Railroad Street and Dekora Street	Village of Saukville	Proposed	Yes	25	1	--	58	58	6	3	6	6	3	6	4	4
6	11th Avenue and North Street	Village of Grafton	Proposed	Yes	60	1	1	51	51	6	3	6	6	3	6	4	4
7	Cardinal Avenue and Pioneer Road	City of Cedarburg	Proposed	Yes	150	1	1	44	44	6	3	6	6	3	6	4	4
8	Main Street and Friestadt Road	Village of Thiensville	Proposed	Yes	50	1	1	39	39	6	3	6	6	3	6	4	4
9	Baehr Road and Donges Bay Road	City of Mequon	Proposed	Yes	50	1	1	34	34	6	3	6	6	3	6	4	4
10	Deerbrook Trail and W. Brown Deer Road	Village of Brown Deer	Proposed	Yes	40	1	1	29	29	6	3	6	6	3	6	4	4
11	N. Teutonia Avenue and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	100	3	2	22	22	18	9	18	18	9	18	12	12
12	N. 34th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	--	3	2	17	17	18	9	18	18	9	18	12	12
13	N. 30th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	--	3	2	13	13	18	9	18	18	9	18	12	12
14	N. 44th Street and W. Blue Mound Road	City of Milwaukee	Proposed	Yes	--	4	1	6	6	24	12	24	24	12	24	16	16
15	N. 5th Street and W. St. Paul Avenue	City of Milwaukee	Existing	Yes	--	6	3	--	--	36	18	36	36	18	36	24	24
16	Island Drive and E. Washington Street	City of West Bend	Proposed	Yes	25	1	--	64	64	6	3	6	6	3	6	4	4
17	N. Center Street and Main Street	Village of Jackson	Proposed	Yes	80	1	--	53	53	6	3	6	6	3	6	4	4
18	S. Country Aire Drive and Mequon Road	Village of Germantown	Proposed	Yes	75	1	1	42	42	6	3	6	6	3	6	4	4
19	N. 107th Street and W. Brown Deer Road	City of Milwaukee	Proposed	Yes	60	1	2	35	35	6	3	6	6	3	6	4	4
20	N. 68th Street and W. Bradley Road	City of Milwaukee	Proposed	Yes	60	1	1	29	29	6	3	6	6	3	6	4	4
21	S. Main Street and Collins Street	City of Oconomowoc	Proposed	Yes	25	1	--	62	62	6	3	6	6	3	6	4	4
22	Sawyer Road and USH 16	Town of Oconomowoc	Proposed	Yes	--	1	--	55	55	6	3	6	6	3	6	4	4
23	Lakeland Road and CTH PP	Village of Nashotah	Proposed	Yes	25	1	--	50	50	6	3	6	6	3	6	4	4
24	Cottonwood Avenue and Pawling Avenue	Village of Hartland	Proposed	Yes	100	1	--	45	45	6	3	6	6	3	6	4	4
25	W. Wisconsin Avenue and Capitol Drive	Village of Pewaukee	Proposed	Yes	75	1	1	38	38	6	3	6	6	3	6	4	4
26	Duplainville Road and Marjean Lane	Town of Pewaukee	Proposed	Yes	80	1	1	32	32	6	3	6	6	3	6	4	4
27	N. Brookfield Road and River Road	City of Brookfield	Proposed	Yes	50	1	1	27	27	6	3	6	6	3	6	4	4
28	Legion Drive and Watertown Plank Road	Village of Elm Grove	Proposed	Yes	60	1	1	19	19	6	3	6	6	3	6	4	4
29	N. 75th Street and W. State Street	City of Wauwatosa	Proposed	Yes	25	1	4	12	12	6	3	6	6	3	6	4	4
30	N. Barstow Street and Cutler Street	City of Waukesha	Proposed	Yes	90	1	1	46	46	6	3	6	6	3	6	4	4
31	Pearl Street and CTH A	Town of Waukesha	Proposed	Yes	125	1	--	40	40	6	3	6	6	3	6	4	4
32	S. Moorland Road and Honey Lane	City of New Berlin	Proposed	Yes	50	1	2	33	33	6	3	6	6	3	6	4	4
33	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	40	1	4	26	26	6	3	6	6	3	6	4	4
34	S. 70th Street and Dickinson Street	City of Milwaukee	Proposed	Yes	--	1	1	19	19	6	3	6	6	3	6	4	4
35	S. 27th Street and W. Dakota Street	City of Milwaukee	Proposed	Yes	--	1	4	12	12	6	3	6	6	3	6	4	4
36	14th Avenue and 54th Street	City of Kenosha	Existing	Yes	50	1	1	63	63	6	3	6	6	3	6	4	4
37	STH 32 and CTH E	Town of Somers	Proposed	Yes	75	1	1	57	57	6	3	6	6	3	6	4	4
38	Memorial Drive and State Street	City of Racine	Proposed	Yes	75	1	1	45	45	6	3	6	6	3	6	4	4
39	STH 32 and Three Mile Road	Town of Caledonia	Proposed	Yes	100	1	1	39	39	6	3	6	6	3	6	4	4
40	5th Avenue and E. Ryan Road	City of Oak Creek	Proposed	Yes	50	1	2	29	29	6	3	6	6	3	6	4	4
41	13th Avenue and E. Rawson Avenue	City of South Milwaukee	Proposed	Yes	--	1	2	22	22	6	3	6	6	3	6	4	4
42	Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	50	1	2	18	18	6	3	6	6	3	6	4	4
43	Brust Avenue and E. Oklahoma Avenue	City of Milwaukee	Proposed	Yes	--	1	2	10	10	6	3	6	6	3	6	4	4

Source: SEWRPC.

Table 207

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Commuter Rail Plan
Primary Element		
Exclusive Guideway Miles		
Subway	--	--
Elevated	--	--
At-Grade	--	157.3
Total	--	157.3[a]
Shared Guideway Miles		
Freeways	51.5	--
Surface Arterial Streets	49.5	--
Total	101.0	--
Route Miles	449	354
Vehicle Miles	6,620	7,120
Vehicle Hours	280	230
Vehicles Required	55	42
Trains Required	--	36
Express and Local Elements		
Route Miles	1,302	1,853
Vehicle Miles	52,680	75,030
Vehicle Hours	3,610	5,500
Vehicles Required	521	645
Total System		
Route Miles	1,751	2,207
Vehicle Miles	59,300	82,150
Vehicle Hours	3,890	5,730
Vehicles Required	576	687
Trains Required	--	36

[a]*Although commuter rail operation is designated in this table as being over an exclusive guideway, commuter trains would, in fact, operate over railway trackage shared with freight trains.*

Source: SEWRPC.

mary transit. It should be noted that, under this future, primary transit usage could be expected to be about 6 percent less under the commuter rail plan than under the base plan, or 8,900 trips on an average weekday, compared with 9,500 trips under the primary element of the base plan. About 14,000, or 8 percent, more transit trips may be expected to be made under this plan, including local and express service, than under the base plan. All of this increase in transit use would occur on the local and express elements of the plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent commuter rail system plan and the base system plan are summarized in Table 211. The costs shown include all track rehabilitation and construction costs, plus the cost of all locomotive and passenger coach, and supporting bus, acquisition and replacement, as needed, over the plan design period. Most capital items required to implement the plan would have useful lives beyond the 20-year plan design period, as noted in Table 211.

The total capital cost of the base plan is estimated at $162 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain existing service to the year 2000. About $19 million, or 12 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent commuter rail plan is estimated at $285 million. About 39 percent of the total cost, or $111 million, would be required for the primary transit element of the plan.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent commuter rail plan can be expected to approximate $57 million. The remaining $228 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal and the federal shares are estimated to total $32 million and $130 million, respectively.

Table 212 presents the annual operating and maintenance costs and farebox revenues anticipated for the design year of the base and maximum extent commuter rail plans. Under the base plan, operating and maintenance costs may be expected to approximate $36 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent commuter rail plan would increase the total operating and maintenance costs by $21 million, to a total cost of $57 million. The

Table 208

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN
UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	354	354	354	354	354
Vehicle Miles	1,790	2,120	1,790	1,420	7,120
Vehicle Hours	60	70	60	40	230
Vehicles (coaches) Required.	42	18	42	18	42
Trains Required	36	18	36	18	36
Express and Local					
Route Miles.	1,853	1,775	1,853	1,672	1,853
Vehicle Miles	18,110	18,600	21,450	16,870	75,030
Vehicle Hours	1,340	1,340	1,580	1,240	5,500
Vehicles Required	566	216	645	186	645
Total System					
Route Miles.	2,207	2,129	2,207	2,026	2,207
Vehicle Miles	19,900	20,720	23,240	18,290	82,150
Vehicle Hours	1,400	1,410	1,640	1,280	5,730
Vehicles Required	608	234	687	204	687
Trains Required	36	18	36	18	36

Source: SEWRPC.

cost of operating and maintaining the primary transit system in the design year may be expected to approximate $3 million under the base plan, and $10 million under the maximum extent commuter rail plan. Primary transit system operating and maintenance costs would thus represent 8 percent of the total operating and maintenance costs expected in the design year of the base plan, and 17 percent of the total operating and maintenance costs expected in the design year of the maximum extent commuter rail plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.73. For the maximum extent commuter rail plan, the average cost per passenger may be expected to approach $1.10—$0.37, or 51 percent, more than the base plan cost. The average operating cost per passenger mile would be somewhat greater under the maximum extent commuter rail plan, $0.26, than under the base plan, $0.20. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.22 and $0.17, respectively, and for the maximum extent commuter rail plan would be $4.53 and $0.29, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $19 million, expressed in 1979 dollars, compared with $22 million under the maximum extent commuter rail plan. Under the commuter rail alternative, the primary transit element may be expected to generate about 9 percent, or $2 million, of the total revenues, compared with 7 percent, or $1.4 million, under the base plan.

The operating deficit in the year 2000 for the maximum extent commuter rail plan would be about $35 million, expressed in 1979 dollars, requiring a subsidy of about $0.65 per passenger. This compares with the base system plan deficit of about $16 million, or $0.33 per passenger. Fare-

Table 209

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan: Total Person Trips	Base Plan: Transit Trips Number	Base Plan: Transit Trips Percent of Total Trips	Maximum Extent Commuter Rail Plan: Total Person Trips	Maximum Extent Commuter Rail Plan: Transit Trips Number	Maximum Extent Commuter Rail Plan: Transit Trips Percent of Total Trips
Home-Based Work	958,800	60,900	6.4	959,200	66,200	6.9
Home-Based Shopping . .	502,600	21,700	4.3	502,200	24,900	5.0
Home-Based Other	1,139,400	42,000	3.7	1,137,900	47,100	4.1
Nonhome Based.	655,600	8,400	1.3	653,800	8,600	1.3
School	364,900	36,400	10.0	364,900	36,400	10.0
Total	3,621,300	169,400	4.7	3,618,000	183,200	5.1

Source: SEWRPC.

Table 210

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Time of Day	Base Plan: Primary Element Transit Trips	Base Plan: Primary Element Percent of Total	Base Plan: Total System Transit Trips	Base Plan: Total System Percent of Total	Maximum Extent Commuter Rail Plan: Primary Element Transit Trips	Maximum Extent Commuter Rail Plan: Primary Element Percent of Total	Maximum Extent Commuter Rail Plan: Total System Transit Trips	Maximum Extent Commuter Rail Plan: Total System Percent of Total
Morning . . .	4,000	42.1	41,800	24.7	2,800	31.5	44,400	24.2
Midday	200	2.1	53,400	31.5	2,000	22.5	58,400	31.9
Afternoon . .	5,300	55.8	59,800	35.3	3,300	37.0	64,400	35.2
Evening. . . .	- -	- -	14,400	8.5	800	9.0	16,000	8.7
Total	9,500	100.0	169,400	100.0	8,900	100.0	183,200	100.0

Source: SEWRPC.

box revenues could cover about 39 percent of the operating costs under the maximum extent commuter rail plan and 53 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has, in the past, funded up to 72 percent of the nonfederal share.[5] The annual local share of the public funding requirement in the year 2000 would be about $5 million for the maximum extent commuter rail plan. The local funding requirement for the base system would be somewhat less—$2.3 million.

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[5] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.2 million required to provide 50 percent federal funding of the operating deficits under the base plan, but somewhat less than the $17.2 million required to provide such funding under the maximum extent commuter rail plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Table 211

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Commuter Rail Plan
Guideway Development	$ --	$ 34,536,900[d]
Station Development[b]	2,387,700	6,418,400
Vehicle Storage and Maintenance Facility Development[b]	15,850,000	24,470,800
Vehicle Acquisition and Replacement[c]	143,360,000	219,150,000
Total	$161,547,700	$284,576,100

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent commuter rail plan would be implemented incrementally from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 to 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—10 acres under the base plan and 21 acres under the maximum extent commuter rail plan. Right-of-way is assumed to have a life of 100 years. The useful life of stations is estimated at 30 years.*

[c] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses and commuter rail coaches and locomotives. Both plans assume a fleet of 640 buses with an average age of 10 years in 1980. Buses have an average useful life of 12 years. Commuter rail coaches and locomotives have an estimated useful life of 30 years.*

[d] *The Milwaukee Road has proposed major track rehabilitation work on some of the railway line segments herein considered for potential use by commuter trains. Should all of this track rehabilitation work be completed, the capital investment necessary for guideway development of the maximum extent commuter rail system would be reduced by $12,274,000 to $22,262,900. As of April 1981, such rehabilitation work in the amount of $3,458,000 had been completed by the Milwaukee Road during the 1980 and 1981 working seasons.*

Source: SEWRPC.

Development of Truncated Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent commuter rail system plan are summarized in Table 213. The maximum extent commuter rail system plan may be expected to have higher capital costs and greater operating deficits, both in total and on a per-passenger basis, than the base plan. In addition, farebox revenues under the maximum extent commuter rail system plan may be expected to cover a much smaller proportion of operating costs in the plan design year than would such revenues under the base plan, particularly with respect to its primary element.

Most of the increases in the cost and decreases in the cost-effectiveness of the maximum extent commuter rail system plan can be attributed to the overextension of primary transit service envisioned in this plan.[6] Under the maximum extent plan, primary transit service would be extended into large

[6] *The extension of local and express service under the maximum extent commuter rail plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express (secondary) and local (tertiary) service included in each maximum extent primary transit system plan is basically in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules were modified, however, to coordinate properly the secondary and tertiary service proposed to be provided with the primary service proposed under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered, and should, therefore, not affect a comparison of those alternatives.*

Table 212

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Commuter Rail Plan
Ridership		
Primary Element	2,422,500	2,269,500
Total System	48,793,500	52,816,500
Operating and Maintenance Cost		
Primary Element	$ 2,950,400	$10,284,200
Total System	35,646,200	56,847,800
Operating and Maintenance Cost per Passenger		
Primary Element	$1.22	$4.53
Systemwide Average	0.73	1.10
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.17	$0.29
Total System	0.20	0.26
Farebox Revenue		
Primary Element	$ 1,453,500	$ 1,935,500
Total System	19,317,500	22,367,500
Operating Deficit		
Primary Element	$ 1,496,900	$ 8,348,700
Total System	16,328,700	34,480,300
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	49	19
Total System	53	39
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 748,450	$ 4,174,350
Total System	8,164,350	17,240,150
State (72 percent of nonfederal share of operating deficit)		
Primary Element	538,884	3,005,530
Total System	5,878,332	12,412,910
Local		
Primary Element	209,566	1,168,820
Total System	2,286,018	4,827,240
Local Operating Deficit per Ride		
Primary Element	$0.09	$0.52
Total System	0.05	0.09

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.2 million required to provide 50 percent federal funding of the operating deficits under the base plan, but less than the $7.2 million required to provide such funding under the maximum extent light rail plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

Table 213

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Commuter Rail Plan
Ridership		
In Design Year	48,793,500	52,816,500
To Design Year	1,127,300,000	1,159,500,000
Capital Cost		
Total to Design Year	$161,597,700	$284,576,100
To Design Year per Passenger	0.14	0.25
To Design Year After Accounting for Useful Life Beyond Design Year	107,761,000	158,285,100
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.14
Operating Cost		
Percent Met by Farebox Revenues in Design Year	54	39
Operating Deficit in Design Year	$ 16,328,700	$ 34,480,300
Operating Deficit per Passenger in Design Year	0.33	0.65
Operating Deficit to Design Year	375,942,200	521,155,000
Operating Deficit to Design Year per Passenger	0.33	0.45
Total Cost		
To Design Year	$537,539,900	$805,731,000
Federal Share	317,249,000	488,238,300
Nonfederal Share	220,290,900	317,492,700
To Design Year per Passenger	0.47	0.70
Federal Share	0.27	0.42
Nonfederal Share	0.20	0.28
To Design Year After Accounting for Useful Life Beyond Design Year	483,703,200	679,440,000
Federal Share	274,179,900	387,205,500
Nonfederal Share	209,523,300	292,234,500
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.43	0.59
Federal Share	0.24	0.34
Nonfederal Share	0.19	0.25

Source: SEWRPC.

areas of the Region not now served. In addition, it would be expanded into an all-day operation, and it would be provided at headways of no more than 30 minutes during the peak travel periods in the peak direction and 60 minutes otherwise. Thus, the primary transit service proposed would be a true transit service, available for tripmaking of all purposes. The cost-effectiveness of the less productive routes on which commuter rail service would be extended can be identified through a determination of what proportion of the operating costs may be expected to be recovered through farebox revenues. As shown in Table 214, none of the routes under the maximum extent plan may be expected to meet one-half of their operating costs through farebox revenues, and even the Kenosha route may be expected to meet only 37 percent of its operating costs through such revenues.

To reduce operating deficits and increase the proportion of primary transit operating costs met by farebox revenues, it was necessary to truncate the maximum extent commuter rail plan. In order

Table 214

OPERATING COST-EFFECTIVENESS OF COMMUTER RAIL ROUTES OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicle Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
Kenosha	62,630	$3,440	1,655	$ 9,380	37
Waukesha	15,480	850	749	4,240	20
Oconomowoc	20,190	1,109	1,224	6,940	16
Saukville	16,980	930	1,049	5,940	16
West Bend	15,560	850	1,319	7,470	11
Port Washington.	7,380	410	1,121	6350	6
Total	138,210	$7,590	7,117	$40,330	19

Source: SEWRPC.

to do so while maintaining a framework of true primary transit service in the Milwaukee area, and, importantly, to assure reasonable comparability between all primary transit alternatives tested, this truncation was limited to reductions in the extent of service provided. Nevertheless, those commuter rail facilities and services which could be reasonably cost-effective if the time periods and frequency of service offered were reduced were identified so that these reduced services could be considered for addition to the "best" primary transit system plan for this future as "specialized" transit service.[7]

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[7] *Reductions in the time periods of service and increases in the headways operated have the potential to affect primary transit cost-effectiveness significantly. The off-peak-period operations of commuter rail service under this future are less cost-effective than the peak-period operations. However, limiting commuter rail service to the peak travel periods may be expected to increase the average systemwide proportion of commuter rail operating costs met by farebox revenues only slightly, because, under peak-period-only operation, travel on the commuter rail system may be expected to be reduced to the largely work- and school-related travel generated during the morning peak period. Nevertheless, because travel on the commuter rail system during the peak periods is highly directional, being largely oriented to the Milwaukee central business district in the morning and from the central business district in the afternoon, limiting service in the peak period to the peak direction could allow for a substantial increase in the proportion of commuter rail operating costs met by farebox revenues.*

Reducing the frequency of service by increasing maximum headways in the peak periods and peak direction from 30 to 60 minutes could increase the percentage of the systemwide operating cost met by farebox revenues to about 40 percent, because such an increase in headways would result in only a small reduction in transit use and a substantial reduction in operating cost. The decrease in ridership would result from the attendant increase in wait time for transit service. First wait times under this study were assumed to approximate one-half of the headway up to a maximum of 10 minutes. Consequently, increases in maximum headway would not affect this wait time. However, all subsequent wait times, which are attendant to transfers, were estimated at one-half of the headway with no upper limit. It should be noted that, by not permitting headways greater than 60 minutes, it was assumed that any decrease in operating costs possible through further headway increases would result in ridership and revenue reductions and a subsequent stabilization or decline in the proportion of operating costs recovered from farebox revenues. The ridership reductions would result from the inconvenient schedule.

Accordingly, as summarized in Table 215, no commuter rail route was retained for further consideration on an all-day and minimum frequency of service basis, as the analyses indicated that no commuter rail route could be expected to meet at least 50 percent of its operating costs on such a basis through farebox revenues. However, those routes which could be expected to meet about 50 percent of their operating costs through farebox revenues with reductions in the time periods or frequency of service were cut back and retained for consideration as additions to the final plan; these routes consisted of those to Kenosha, Saukville, Oconomowoc, and Waukesha, as summarized in Table 215 and shown on Map 95.

Table 215

RECOMMENDED CHANGES IN THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Recommended Change
1–Port Washington	Route to be eliminated
2–Saukville	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods, and possibly peak directions, and increased headways
3–West Bend	Route to be eliminated
4–Oconomowoc	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods, and possibly peak directions, and increased headways
5–Waukesha	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods, and possibly peak directions, and increased headways
6–Kenosha	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods, and possibly peak directions, and increased headways

Source: SEWRPC.

Evaluation of Maximum Extent Light Rail Transit System Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is light rail transit. The maximum extent system plan developed for this technology is summarized with respect to its coverage and routes in Chapter III of this report on Maps 60 and 61, and in Tables 216 and 217 with respect to its operation and station size requirements under the stable or declining growth scenario-decentralized land use plan alternative future. Map 53 and Table 111 of Chapter III and Tables 217 and 197 of this chapter provide comparable information for the base, or benchmark, plan used in the study. A discussion of the facilities and services of the primary, express, and local elements of both the maximum extent light rail transit system plan and the base plan is included in Chapter III of this report, and will not be repeated here.

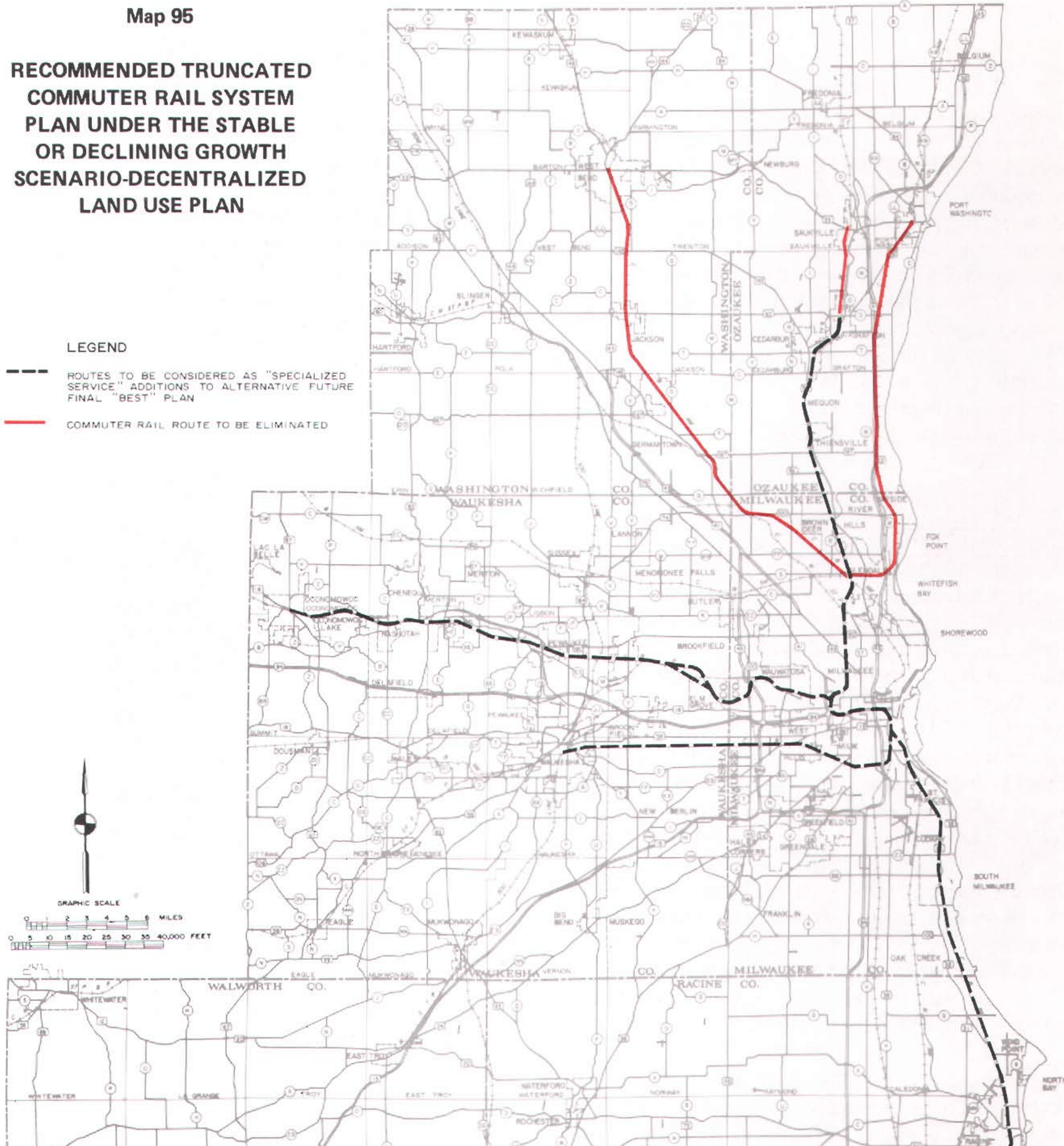
In comparison to the base plan, the maximum extent light rail system plan under this future would entail about a two-fold increase in vehicle miles of primary transit service, or 12,800 vehicle miles compared with 6,600 vehicle-miles under the base plan. A significant part of this increase would be the result of the extension of primary service into off-peak travel periods during the midday and evenings, as indicated in Tables 198 and 218. Bus miles of express and local service operated under this plan to supplement the light rail transit service under this future would increase by about 13 percent over the base plan, from about 52,700 to about 59,400 bus miles on an average weekday.

Headways on the primary element of the maximum extent light rail transit plan under this alternative future would range from 7 to 15 minutes during the peak periods. During the off-peak periods, headways would range from 30 to 60 minutes in the midday period, and from 40 to 60 minutes during the evening. During all periods of the day, light rail transit primary service would operate with single-articulated vehicles.

Transit Utilization: Under the maximum extent light rail transit system plan of the stable or declining growth scenario-decentralized land use plan alternative future, about 180,000 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 219 and 220.

Map 95

RECOMMENDED TRUNCATED COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



The maximum extent commuter rail system plan shown on Map 57 in Chapter III was truncated with the objective of maximizing the number of commuter rail routes for which at least 50 percent of the operating costs could be met with farebox revenues. None of the six routes in the maximum extent plan was proposed to be retained in the truncated plan. However, four of these routes were recommended to be considered for addition to the final "best" plan recommended for this future as specialized peak-period-only service.

Source: SEWRPC.

Table 216

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (trains per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	W. Broadway and W. Main Street.	City of Waukesha	Proposed	Yes	- -	1	10	49	49	8	8	2	2	10	10	2	2
2	E. Broadway and Pleasant Street.	City of Waukesha	Proposed	Yes	- -	1	1	47	47	8	8	2	2	10	10	2	2
3	Lincoln Avenue and Lake Street.	City of Waukesha	Proposed	Yes	- -	1	- -	45	45	8	8	2	2	10	10	2	2
4	Lincoln Avenue and Frederick Street	City of Waukesha	Proposed	Yes	- -	1	1	43	43	8	8	2	2	10	10	2	2
5	CTH A and Pearl Street . .	City of Waukesha	Proposed	Yes	350	1	- -	40	40	8	8	2	2	10	10	2	2
6	Johnson Road	City of New Berlin	Proposed	- -	100	1	- -	37	37	8	8	2	2	10	10	2	2
7	Calhoun Road and Rogers Drive	City of New Berlin	Proposed	Yes	275	1	- -	34	34	8	8	2	2	10	10	2	2
8	Moorland Road and Rogers Drive	City of New Berlin	Proposed	Yes	- -	1	2	32	32	8	8	2	2	10	10	2	2
9	Sunny Slope Road and Honey Lane	City of New Berlin	Proposed	- -	- -	1	- -	30	30	8	8	2	2	10	10	2	2
10	S. 124th Street and Honey Lane	City of New Berlin	Proposed	- -	- -	1	- -	28	28	8	8	2	2	10	10	2	2
11	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	- -	1	5	26	26	8	8	2	2	10	10	2	2
12	S. 98th Street and W. Washington Street . . .	City of West Allis	Proposed	Yes	- -	1	2	23	23	8	8	2	2	10	10	2	2
13	N. 92nd Street and W. Dixon Street	City of Milwaukee	Proposed	Yes	100	1	- -	21	21	8	8	2	2	10	10	2	2
14	N. 84th Street and W. Hawthorne Avenue . .	City of Milwaukee	Proposed	Yes	- -	2	2	18	18	14	12	3	3	15	19	3	3
15	N. 76th Street and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	17	17	14	12	3	3	15	19	3	3
16	N. 68th Street and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	16	16	14	12	3	3	15	19	3	3
17	N. Hawley Road and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	14	14	14	12	3	3	15	19	3	3
18	County Stadium and Mitchell Boulevard	City of Milwaukee	Proposed	Yes	125	2	- -	13	13	14	12	3	3	15	19	3	3
19	County Stadium and N. 44th Street	City of Milwaukee	Proposed	Yes	100	3	- -	11	11	18	16	4	4	20	24	4	4
20	N. 35th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	7	7	20	18	4	4	21	25	4	4
21	N. 27th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	4	6	6	20	18	4	4	21	25	4	4
22	N. 21st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	4	4	20	18	4	4	21	25	4	4
23	N. 16th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	5	3	3	20	18	4	4	21	25	4	4
24	N. 12th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	6	2	2	20	18	4	4	21	25	4	4
25	N. 6th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	4	7	- -	- -	26	24	5	5	28	32	5	5
26	N. Plankinton Avenue and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	10	2	2	12	14	3	3	19	15	3	3
27	N. Broadway Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	8	3	3	12	14	3	3	19	15	3	3
28	N. Jackson Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	7	4	4	12	14	3	3	19	15	3	3
29	N. Jackson Street and E. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	1	5	5	12	- -	3	- -	19	- -	3	- -
30	N. Van Buren Street and E. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	1	- -	- -	- -	14	- -	3	- -	15	- -	3
31	N. Jackson Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	7	7	12	- -	3	- -	19	- -	3	- -
32	N. Van Buren Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	- -	- -	- -	14	- -	3	- -	15	- -	3
33	N. Astor Street and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	12	14	3	3	19	15	3	3
34	N. Farwell Avenue and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	9	9	12	14	3	3	19	15	3	3
35	N. Farwell Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	2	10	10	12	- -	3	- -	19	- -	3	- -
36	N. Prospect Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	1	- -	- -	- -	14	- -	3	- -	15	- -	3
37	N. Farwell Avenue and E. Kenilworth Place. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	12	12	12	14	3	3	19	15	3	3
38	N. Oakland Avenue and E. North Avenue.	City of Milwaukee	Proposed	Yes	- -	2	3	13	13	12	14	3	3	19	15	3	3
39	N. Cambridge Avenue and E. Locust Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	15	15	12	14	3	3	19	15	3	3
40	N. Oakland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	Yes	- -	2	1	16	16	12	14	3	3	19	15	3	3
41	N. Maryland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	Yes	- -	2	6	16	16	12	14	3	3	19	15	3	3
42	N. Maryland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	- -	2	4	21	21	12	14	3	3	19	15	3	3

Table 216 (continued)

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (trains per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
43	N. Oakland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	22	22	12	14	3	3	19	15	3	3
44	Wisconsin Avenue and Broad Street	Village of Grafton	Proposed	Yes	- -	1	1	52	52	6	6	1	1	7	7	1	1
45	1st Avenue and Maple Street	Village of Grafton	Proposed	Yes	150	1	- -	51	51	6	6	1	1	7	7	1	1
46	Cedar Ridge Drive and Georgetown Drive	City of Cedarburg	Proposed	Yes	- -	1	1	49	49	6	6	1	1	7	7	1	1
47	STH 143 (Washington Avenue) and Turner Street	City of Cedarburg	Proposed	- -	- -	1	1	47	47	6	6	1	1	7	7	1	1
48	Grant Avenue and Western Road	City of Cedarburg	Proposed	- -	- -	1	1	45	45	6	6	1	1	7	7	1	1
49	STH 57 and CTH C (Pioneer Road).	City of Mequon	Proposed	Yes	200	1	- -	43	43	6	6	1	1	7	7	1	1
50	STH 57 (Main Street) and Freistadt Road	Village of Thiensville	Proposed	Yes	- -	1	1	38	38	6	6	1	1	7	7	1	1
51	STH 57 (Green Bay Road) and STH 67 (Mequon Road)	City of Mequon	Proposed	Yes	125	1	- -	36	36	6	6	1	1	7	7	1	1
52	Garden Drive and W. County Line Road. . .	Village of Brown Deer	Proposed	Yes	- -	1	- -	32	32	6	6	1	1	7	7	1	1
53	N. Deerbrook Terrace and STH 100 (W. Brown Deer Road) . .	Village of Brown Deer	Proposed	Yes	- -	1	1	30	30	6	6	1	1	7	7	1	1
54	N. Cedarburg Road and W. Bradley Road.	Village of Brown Deer	Proposed	Yes	- -	1	1	23	28	6	6	1	1	7	7	1	1
55	N. Teutonia Avenue and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	- -	1	2	26	26	6	6	1	1	7	7	1	1
56	N. Sidney Place and W. Mill Road	City of Glendale	Proposed	Yes	150	1	1	24	24	6	6	1	1	7	7	1	1
57	N. Dexter Avenue and W. Silver Spring Drive. . .	City of Glendale	Proposed	Yes	- -	1	1	22	22	6	6	1	1	7	7	1	1
58	N. 20th Street and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	19	19	6	6	1	1	7	7	1	1
59	W. Atkinson Avenue and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	1	15	15	10	12	3	3	19	15	3	3
60	N. 16th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	1	12	12	6	6	1	1	7	7	1	1
61	N. 8th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	9	9	6	6	1	1	7	7	1	1
62	N. 8th Street and W. Burleigh Street	City of Milwaukee	Proposed	Yes	- -	1	2	8	8	6	- -	1	- -	7	- -	1	- -
63	N. 7th Street and W. Burleigh Street	City of Milwaukee	Proposed	Yes	- -	1	2	- -	- -	- -	6	- -	1	- -	7	- -	1
64	N. 8th Street and W. Center Street	City of Milwaukee	Proposed	Yes	- -	1	2	7	7	6	- -	1	- -	7	- -	1	- -
65	N. 7th Street and W. Center Street	City of Milwaukee	Proposed	Yes	- -	1	2	- -	- -	- -	6	- -	1	- -	7	- -	1
66	N. 8th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	5	5	6	- -	1	- -	7	- -	1	- -
67	N. 7th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	- -	- -	- -	6	- -	1	- -	7	- -	1
68	N. 6th Street and W. Walnut Street.	City of Milwaukee	Proposed	Yes	- -	1	2	4	4	6	6	1	1	7	7	1	1
69	N. 6th Street and W. Juneau Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	2	2	6	6	1	1	7	7	1	1
70	N. 6th Street and W. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	2	1	1	6	6	1	1	7	7	1	1
71	N. 6th Street and W. St. Paul Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	2	2	12	12	2	2	13	13	1	1
72	S. 6th Street and W. Alexander Street. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	4	4	12	12	2	2	13	13	1	1
73	S. 6th Street and W. National Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	4	- -	- -	- -	12	- -	2	- -	13	- -	1
74	S. 5th Street and W. National Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	4	6	6	12	- -	2	- -	13	- -	1	- -
75	S. 5th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	2	- -	- -	- -	12	- -	2	- -	13	- -	1
76	S. 4th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	12	- -	2	- -	13	- -	1	- -
77	S. 5th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	- -	2	3	- -	- -	- -	12	- -	2	- -	13	- -	1
78	S. 4th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	- -	1	3	9	9	12	- -	2	- -	13	- -	1	- -
79	S. 5th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	- -	- -	- -	6	- -	1	- -	7	- -	1
80	S. 4th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	11	4	6	- -	1	- -	7	- -	1	- -
81	S. Chase Avenue and W. Rosedale Avenue. . . .	City of Milwaukee	Proposed	Yes	250	1	- -	13	6	6	6	1	1	7	7	1	1
82	S. Chase Avenue and W. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	14	8	6	6	1	1	7	7	1	1

Table 216 (continued)

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (trains per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning		Midday		Afternoon		Evening	
										In	Out	In	Out	In	Out	In	Out
83	S. Howell Avenue and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	15	9	6	6	1	1	7	7	1	1
84	S. Howell Avenue and W. Howard Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	17	17	6	6	1	1	7	7	1	1
85	S. Howell Avenue and W. Layton Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	19	19	6	6	1	1	7	7	1	1
86	General Mitchell Field . . .	City of Milwaukee	Proposed	Yes	100	1	2	21	21	6	6	1	1	7	7	1	1
87	S. Howell Avenue and W. College Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	23	23	6	6	1	1	7	7	1	1
88	S. Howell Avenue and W. Marquette Avenue . . .	City of Oak Creek	Proposed	Yes	- -	1	2	27	27	6	6	1	1	7	7	1	1
89	S. Howell Avenue and W. Forest Hill Avenue. . .	City of Oak Creek	Proposed	Yes	- -	1	2	29	29	6	6	1	1	7	7	1	1
90	S. Howell Avenue and W. Ryan Road	City of Oak Creek	Proposed	Yes	100	1	1	32	32	6	6	1	1	7	7	1	1
91	STH 175 (Appleton Avenue) and Menomonee Avenue. . . .	Village of Menomonee Falls	Proposed	Yes	- -	1	2	44	44	6	6	1	1	7	7	1	1
92	STH 175 (Appleton Avenue) and North Hills Drive	Village of Menomonee Falls	Proposed	Yes	175	1	1	42	42	6	6	1	1	7	7	1	1
93	STH 175 (Appleton Avenue) and Parkway Drive	Village of Menomonee Falls	Proposed	Yes	- -	1	- -	36	36	6	6	1	1	7	7	1	1
94	USH 41 (W. Appleton Avenue) and W. Bobolink Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	33	33	6	6	1	1	7	7	1	1
95	Timmerman Field.	City of Milwaukee	Proposed	Yes	225	1	2	32	32	6	6	1	1	7	7	1	1
96	USH 41 (W. Appleton Avenue) and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	29	29	6	6	1	1	7	7	1	1
97	N. 76th Street and W. Appleton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	28	28	6	6	1	1	7	7	1	1
98	N. 68th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	2	1	24	24	10	12	2	2	15	11	1	1
99	Capitol Court Shopping Center.	City of Milwaukee	Proposed	Yes	175	2	2	23	23	10	12	2	2	15	11	1	1
100	W. Fond du Lac Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	2	2	21	21	10	12	2	2	15	11	1	1
101	N. Sherman Boulevard and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	3	2	19	19	14	16	3	3	25	21	3	3
102	N. Sherman Boulevard and W. Fond du Lac Avenue .	City of Milwaukee	Proposed	Yes	- -	2	2	18	18	10	10	2	2	11	11	2	2
103	N. Sherman Boulevard and W. Burleigh Street . .	City of Milwaukee	Proposed	Yes	- -	2	2	17	17	10	10	2	2	11	11	2	2
104	N. Sherman Boulevard and W. Center Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	15	15	10	10	2	2	11	11	2	2
105	N. Sherman Boulevard and W. North Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	3	14	14	10	10	2	2	11	11	2	2
106	N. 40th Street and W. Lisbon Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	12	12	10	10	2	2	11	11	2	2
107	W. Highland Boulevard and W. McKinley Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	2	11	11	10	10	2	2	11	11	2	2
108	N. 41st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	1	9	9	10	10	2	2	11	11	2	2
109	S. Kinnickinnic Avenue and E. Becher Street . . .	City of Milwaukee	Proposed	Yes	- -	1	3	12	12	6	6	1	1	5	5	1	1
110	S. Bay Street and E. Lincoln Avenue.	City of Milwaukee	Proposed	Yes	125	1	1	14	14	6	6	1	1	5	5	1	1
111	S. Bay Street and E. Russell Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	16	16	6	6	1	1	5	5	1	1
112	S. Nevada Street and S. Kinnickinnic Avenue. .	City of Milwaukee	Proposed	Yes	- -	1	2	17	17	6	6	1	1	5	5	1	1
113	S. Brust Avenue and E. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	18	13	6	6	1	1	5	5	1	1
114	S. Ellen Street and E. Morgan Avenue.	City of Milwaukee	Proposed	- -	- -	1	1	19	19	6	6	1	1	5	5	1	1
115	S. Bombay Avenue and E. Crawford Avenue. . . .	City of St. Francis	Proposed	Yes	75	1	1	21	21	6	6	1	1	5	5	1	1
116	S. Kinnickinnic Avenue and Lunham Avenue . . .	City of St. Francis	Proposed	Yes	- -	1	1	23	23	6	6	1	1	5	5	1	1
117	S. Kinnickinnic Avenue and E. Layton Avenue . .	City of Cudahy	Proposed	Yes	- -	1	2	24	24	6	6	1	1	5	5	1	1
118	S. Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	200	1	1	26	26	6	6	1	1	5	5	1	1
119	Edgar Avenue and E. College Avenue	City of Cudahy	Proposed	Yes	- -	1	2	28	28	6	6	1	1	5	5	1	1
120	E. Rawson Avenue	City of South Milwaukee	Proposed	Yes	- -	1	1	30	30	6	6	1	1	5	5	1	1
121	Marquette Avenue	City of South Milwaukee	Proposed	Yes	- -	1	2	31	31	6	6	1	1	5	5	1	1
122	S. 9th Avenue and E. Drexel Avenue	City of South Milwaukee	Proposed	Yes	150	1	- -	33	33	6	6	1	1	5	5	1	1

Table 216 (continued)

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (trains per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
123	Northridge Shopping Center.	City of Milwaukee	Proposed	Yes	200	1	5	39	42	4	4	1	1	5	5	1	1
124	N. 76th Street and W. Bradley Road.	City of Milwaukee	Proposed	Yes	100	1	3	35	38	4	4	1	1	5	5	1	1
125	N. 76th Street and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	- -	1	3	33	36	4	4	1	1	5	5	1	1
126	N. 60th Street and W. Mill Road	City of Milwaukee	Proposed	Yes	- -	1	2	30	33	4	4	1	1	5	5	1	1
127	N. Sherman Boulevard and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	125	1	2	28	30	4	4	1	1	5	5	1	1
128	N. Sherman Boulevard and W. Villard Avenue . .	City of Milwaukee	Proposed	Yes	- -	1	3	26	29	4	4	1	1	5	5	1	1
129	N. Sherman Boulevard and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	25	27	4	4	1	1	5	5	1	1
130	N. Sherman Boulevard and W. Congress Street . .	City of Milwaukee	Proposed	Yes	- -	1	1	23	26	4	4	1	1	5	5	1	1
131	S. 44th Street and W. National Avenue. . . .	Village of West Milwaukee	Proposed	Yes	- -	1	2	15	17	4	4	1	1	5	5	1	1
132	S. 43rd Street and W. Greenfield Avenue. . .	Village of West Milwaukee	Proposed	Yes	- -	1	1	16	19	4	4	1	1	5	5	1	1
133	S. 43rd Street and W. Burnham Street	Village of West Milwaukee	Proposed	Yes	- -	1	1	17	20	4	4	1	1	5	5	1	1
134	S. 43rd Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	200	1	1	19	21	4	4	1	1	5	5	1	1
135	S. 43rd Street and W. Cleveland Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	- -	20	23	4	4	1	1	5	5	1	1
136	S. 43rd Street and W. Oklahoma Avenue. . .	City of Milwaukee	Proposed	Yes	- -	1	3	22	24	4	4	1	1	5	5	1	1
137	S. 43rd Street and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	23	25	4	4	1	1	5	5	1	1
138	S. 43rd Street and W. Howard Avenue	City of Greenfield	Proposed	Yes	150	1	1	24	27	4	4	1	1	5	5	1	1
139	S. 60th Street and W. Plainfield Avenue . . .	City of Greenfield	Proposed	- -	- -	1	1	27	30	4	4	1	1	5	5	1	1
140	W. Forest Home Avenue and W. Plainfield Avenue	City of Greenfield	Proposed	Yes	- -	1	2	29	31	4	4	1	1	5	5	1	1
141	S. 76th Street and W. Layton Avenue.	City of Greenfield	Proposed	Yes	- -	1	5	32	34	4	4	1	1	5	5	1	1
142	N. 9th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	6	1	1	20	18	4	4	21	25	4	4
143	Southridge Shopping Center.	Village of Greendale	Proposed	Yes	125	1	6	35	38	4	4	1	1	5	5	1	1
144	N. Glenview Avenue and W. Wisconsin Avenue . . .	City of Wauwatosa	Proposed	Yes	- -	1	4	18	18	6	4	1	1	5	9	1	1
145	Milwaukee County General Hospital.	City of Wauwatosa	Proposed	- -	- -	1	5	22	22	6	4	1	1	5	9	1	1
146	County Institutions.	City of Wauwatosa	Proposed	- -	- -	1	5	24	24	6	4	1	1	5	9	1	1
147	N. Swan Boulevard and W. Watertown Plank Road.	City of Wauwatosa	Proposed	Yes	175	1	1	26	26	6	4	1	1	9	9	1	1
148	Mayfair Mall Shopping Center.	City of Wauwatosa	Proposed	Yes	100	1	7	30	30	6	4	1	1	5	9	1	1
149	N. Mayfair Road and W. Center Street.	City of Wauwatosa	Proposed	Yes	- -	1	3	32	32	4	6	1	1	5	9	1	1
150	N. Mayfair Road and W. Burleigh Street.	City of Wauwatosa	Proposed	Yes	- -	1	2	34	34	4	6	1	1	5	9	1	1
151	N. Mayfair Road and W. Capitol Drive.	City of Wauwatosa	Proposed	Yes	- -	1	2	33	36	4	6	1	1	5	9	1	1
152	W. Lisbon Avenue and W. Capitol Drive.	City of Milwaukee	Proposed	- -	- -	1	2	32	34	4	6	1	1	5	9	1	1
153	N. 92nd Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	30	33	4	6	1	1	5	9	1	1
154	N. 84th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	1	29	32	4	6	1	1	5	9	1	1
155	N. 76th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	3	28	30	4	6	1	1	5	9	1	1
156	N. 35th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	20	22	4	6	1	1	5	9	1	1
157	N. 27th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	19	21	4	6	1	1	5	9	1	1
158	W. Green Bay Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	1	2	19	22	4	6	1	1	5	9	1	1
159	N. Port Washington Road and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	1	2	20	23	4	6	1	1	5	9	1	1
160	N. Richards Street and E. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	2	22	25	4	6	1	1	5	9	1	1
161	N. Humboldt Boulevard and E. Capitol Drive. . . .	City of Milwaukee	Proposed	Yes	- -	1	2	23	26	4	6	1	1	5	9	1	1
162	Morris Boulevard and E. Menlo Boulevard	Village of Shorewood	Proposed	Yes	- -	1	1	26	26	4	6	1	1	5	9	1	1

Source: SEWRPC.

Table 217

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Element	Base Plan	Maximum Extent Light Rail Transit Plan
Primary		
Exclusive Guideway Miles		
Subway	- -	- -
Elevated	- -	8.0
At-Grade	- -	94.3
Total	- -	102.3
Shared Guideway Miles		
Freeways	51.5	- -
Surface Arterial Streets	49.5	2.2
Total	101.0	104.5
Route Miles	449	253
Vehicle Miles	6,620	12,800
Vehicle Hours	280	640
Vehicles Required	55	97
Trains Required	- -	97
Express and Local		
Route Miles	1,302	1,660
Vehicle Miles	52,680	59,390
Vehicle Hours	3,610	4,440
Vehicles Required	521	481
Total System		
Route Miles	1,751	1,913
Vehicle Miles	59,305	72,190
Vehicle Hours	3,890	5,080
Vehicles Required	576	578
Trains Required	- -	97

Source: SEWRPC.

About 67,800, or 38 percent of these transit trips, may be expected to be made on the primary transit system for all or a portion of the trip. Thus, the maximum extent light rail transit system plan envisions that about 5 percent of the total 3.6 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that about 2 percent will be made using primary transit. About 11,000, or 6 percent, more transit trips may be expected to be made under this plan than under the base plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent light rail transit system plan and the base system plan are summarized in Table 221. The costs shown include all construction and right-of-way acquisition costs, plus the cost of acquiring and replacing vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 221.

The total capital cost of the base plan is estimated at $162 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain the existing service to the year 2000. About $19 million, or 12 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent light rail transit plan is estimated at $1.1 billion. About $792 million would be required for construction of the light rail guideway, including right-of-way, trackage, electrification, signalization, and system control. About $214 million would be incurred in the purchase of new and replacement of transit vehicles—$86 million of which would be for the purchase of 107 articulated light rail vehicles and about $128 million of which would be for the purchase of 913 conventional buses. The remaining $75 million would be incurred in the construction of park-ride stations and of light rail storage, maintenance, and layover facilities, and the expansion of bus storage and maintenance facilities. About $940 million, or over 85 percent of the total capital cost of the plan, would be attributable to its primary transit element.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent light rail transit plan would approximate $216 million. The remaining $864 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal and the federal shares are estimated to total $32 million and $130 million, respectively.

Table 222 presents the estimated design year operating and maintenance costs and farebox revenues of the base and maximum extent light rail transit plans. Under the base plan, operating and main-

Table 218

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles	253	253	253	253	253
Vehicle Miles	4,450	1,850	5,340	1,160	12,800
Vehicle Hours	223	93	269	58	643
Vehicles Required	81	17	97	16	97
Trains Required	81	17	97	16	97
Express and Local					
Route Miles	1,660	1,586	1,660	1,558	1,660
Vehicle Miles	13,590	16,170	14,210	15,420	59,390
Vehicle Hours	1,029	1,187	1,083	1,142	4,441
Vehicles Required	463	191	481	167	481
Total System					
Route Miles	1,913	1,839	1,913	1,811	1,913
Vehicle Miles	18,040	18,020	19,550	16,580	72,190
Vehicle Hours	1,252	1,280	1,352	1,200	5,084
Vehicles Required	544	208	578	183	578
Trains Required	81	17	97	16	97

Source: SEWRPC.

Table 219

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Maximum Extent Light Rail Transit Plan		
	Total Person Trips[a]	Transit Trips: Number	Transit Trips: Percent of Total Trips	Total Person Trips[a]	Transit Trips: Number	Transit Trips: Percent of Total Trips
Home-Based Work	958,800	60,900	6.4	959,000	70,800	7.4
Home-Based Shopping	502,600	21,700	4.3	501,500	22,600	4.5
Home-Based Other	1,139,400	42,000	3.7	1,135,100	42,700	3.8
Nonhome Based	655,600	8,400	1.3	652,100	7,500	1.2
School	364,900	36,400	10.0	364,900	36,400	10.0
Total	3,621,300	169,400	4.7	3,612,600	180,000	5.0

[a] *The difference in the total person trips generated under the maximum extent light rail transit plan and the total person trips generated under the base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been found to be correlated with increased automobile ownership, and greater automobile ownership has been found to be correlated with increased trip generation. The Commission travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.*

Source: SEWRPC.

Table 220

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Time of Day	Base Plan				Maximum Extent Light Rail Transit Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,000	42.1	41,800	24.7	23,200	34.2	45,400	25.2
Midday	200	2.1	53,400	31.5	9,200	13.6	55,400	30.8
Afternoon . .	5,300	55.8	59,800	35.3	31,100	45.9	63,800	35.4
Evening. . . .	- -	- -	14,400	8.5	4,300	6.3	15,400	8.6
Total	9,500	100.0	169,400	100.0	67,800	100.0	180,000	100.0

Source: SEWRPC.

tenance costs may be expected to approximate $36 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent light rail transit plan would increase the total operating and maintenance costs for the Milwaukee area in the year 2000 by about $12 million to a total cost of about $48 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $3 million under the base plan, and $11 million under the maximum extent light rail transit plan. Primary transit system operating and maintenance costs would thus represent about 8 percent of the total operating and maintenance costs expected in the design year for the base plan, and about 23 percent of the total operating and maintenance costs expected in the design year for the maximum extent light rail transit plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.73. For the maximum extent light rail transit system plan, the average operating cost per passenger may be expected to approach $0.96—$0.23, or 30 percent, more than the base plan cost. The average operating cost per passenger-mile would also be higher under the maximum extent light rail transit plan, $0.24 compared with $0.20 for the base plan. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.22 and $0.17, respectively, and for the primary element of the maximum extent light rail transit plan, $0.63 and $0.13, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $19 million, expressed in 1979 dollars, compared with about $22 million under the maximum extent light rail transit plan. Under the maximum extent light rail transit alternative, the primary transit element would be expected to generate about 41 percent, or about $9 million, of the total revenues, compared with 8 percent, or $1.4 million, for the base plan.

The operating deficit in the year 2000 for the maximum extent light rail transit plan would be about $26 million, expressed in 1979 dollars, requiring a subsidy of about $0.52 per passenger. This compares with the base system plan deficit of about $16 million, or $0.33 per passenger. Farebox revenues would cover about 45 percent of the operating costs under the maximum extent light rail transit plan, and 54 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has,

Table 221

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Light Rail Transit Plan
Guideway Development[b]	$ --	$ 792,348,000
Station Development[c]	2,387,700	31,751,800
Vehicle Storage and Maintenance Facility Development[c]	15,850,000	43,361,400
Vehicle Acquisition and Replacement[d]	143,360,000	213,420,000
Total	$161,597,700	$1,080,881,200

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent light rail transit plan will be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 through 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and therefore are capable of use beyond the design period.*

[b] *Includes the cost of acquiring about 203 acres of right-of-way for guideway construction, and of acquiring and relocating five residential structures and three steel lattice electric power transmission towers. This land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—10 acres under the base plan and 48 acres under the maximum extent light rail transit plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses and light rail vehicles used in the system. Both plans assume a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years. Light rail vehicles have an estimated useful life of 30 years.*

Source: SEWRPC.

in the past, funded up to 72 percent of the nonfederal share.[8] The local share of the public funding requirement of the maximum extent light rail transit plan would be about $3.6 million in the plan design year, and the local funding requirement for the base system would be somewhat less, about $2.3 million.

Development of Truncated Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent light rail transit system plan are summarized in Table 223. The maximum extent light rail transit plan has significantly higher capital costs, both in total and on a per-passenger basis, as well as a greater operating deficit, than does the base plan. However, farebox revenues meet only a slightly smaller proportion of total operating costs under the light rail transit plan than under the base plan. Consequently, the total cost per passenger to the design year for the maximum extent light rail transit plan is more than twice that of the base plan under this future. It was therefore necessary to truncate this maximum extent light rail transit plan.

Some of the increases in the capital costs and operating deficits under the maximum extent light rail transit plan can be attributed to the overextension

[8] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.2 million required to provide 50 percent federal funding of the operating deficits under the base plan, but less than the $13 million required to provide such funding under the maximum extent light rail transit plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Table 222

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Light Rail Transit Plan
Ridership		
Primary Element	2,422,500	17,290,000
Total System	48,793,500	49,900,000
Operating and Maintenance Cost		
Primary Element	$ 2,950,400	$10,875,800
Total System	35,646,200	47,733,400
Operating and Maintenance Cost per Passenger		
Primary Element	$1.22	$0.63
Systemwide Average	0.73	0.96
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.17	$0.13
Total System	0.20	0.24
Farebox Revenue		
Primary Element	$ 1,453,500	$ 8,557,800
Total System	19,317,500	21,683,600
Operating Deficit		
Primary Element	$ 1,496,900	$ 2,318,000
Total System	16,328,700	26,049,800
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	49	79
Total System	54	45
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 748,450	$ 1,159,000
Total System	8,164,350	13,024,900
State (72 percent of nonfederal share of operating deficit)		
Primary Element	538,884	838,480
Total System	5,878,332	9,377,980
Local		
Primary Element	209,566	324,520
Total System	2,286,018	3,646,970
Local Operating Deficit per Ride		
Primary Element	$0.09	$0.02
Total System	0.05	0.07

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.2 million required to provide 50 percent federal funding of the operating deficits under the base plan, but less than the $13 million required to provide such funding under the maximum extent light rail transit plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

of service envisioned in this plan.[9] Under the plan, primary transit service on exclusive guideway would be extended into portions of the Milwaukee area not now served; would be expanded into an all-day operation; and would be provided at headways of no more than 30 minutes in the peak period and peak direction and no more than 60 minutes otherwise.

Table 223

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Light Rail Transit Plan
Ridership		
In Design Year	48,793,500	49,900,000
To Design Year	1,127,300,000	1,135,600,000
Capital Cost		
Total to Design Year	$161,597,700	$1,080,881,200
To Design Year per Passenger	0.14	0.95
To Design Year After Accounting for Useful Life Beyond Design Year	$107,761,000	$ 563,200,000
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.50
Operating Cost		
Percent Met by Farebox Revenues in Design Year	54	45
Operating Deficit in Design Year	$ 16,328,700	$ 26,049,800
Operating Deficit per Passenger in Design Year	0.33	0.52
Operating Deficit to Design Year	375,942,200	453,711,000
Operating Deficit to Design Year per Passenger	0.33	0.40
Total Cost		
To Design Year	$537,539,900	$1,534,592,200
Federal Share	317,249,000	1,091,560,300
Nonfederal Share	220,290,900	443,031,900
To Design Year per Passenger	0.47	1.35
Federal Share	0.27	0.96
Nonfederal Share	0.20	0.39
To Design Year After Accounting for Useful Life Beyond Design Year	483,703,200	1,016,911,000
Federal Share	274,179,900	677,415,500
Nonfederal Share	209,523,300	339,495,500
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.43	0.90
Federal Share	0.24	0.60
Nonfederal Share	0.19	0.30

Source: SEWRPC.

[9] *The extension of local and express service under the maximum extent light rail transit plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express (secondary) and local (tertiary) service included in each maximum extent primary transit system plan is in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules were modified, however, to coordinate properly the secondary and teritary service proposed to be provided with the primary service proposed under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered, and should, therefore, not affect a comparison of those alternatives.*

Table 224

OPERATING COST-EFFECTIVENESS OF LIGHT RAIL ROUTES OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicle Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
1–Waukesha/ Milwaukee CBD/UWM	77,986	$7,722	3,341	$11,130	69
2–Cedarburg/Grafton/ Milwaukee CBD/Oak Creek	69,089	6,841	3,214	10,707	64
3–Menomonee Falls/ Milwaukee CBD/ South Milwaukee	80,443	7,966	2,410	8,028	99
4–Crosstown: Northridge/Southridge	53,095	5,258	1,458	4,857	108
5–Loop: Capitol Drive/UWM/ Wisconsin Avenue/Mayfair	58,297	5,773	2,380	7,928	73
Total	338,910	$33,560	12,803	$42,650	79

Source: SEWRPC.

The cost-effectiveness of the less productive elements of the maximum extent light rail primary transit system plan can, in part, be identified on a route-by-route basis through a determination of what proportion of the operating costs of the routes may be expected to be recovered through farebox revenues. As shown in Table 224, about 79 percent of the total light rail transit primary element operating costs may be expected to be recovered from farebox revenues, and not less than 64 percent of the operating costs for any route will be met by farebox revenues. Therefore, routes should require little modification except possibly over some limited segments.

Another basis for the identification of the less productive elements of the maximum extent light rail transit plan is the operating and capital costs per passenger and per passenger mile carried on segments of the system. Table 225 summarizes the capital and operating costs, and passenger miles carried, for the major segments of the maximum extent light rail transit system, and provides a ranking of the segments in terms of operating cost per passenger mile and capital cost per passenger mile. Map 62 in Chapter III of this report identifies the major segments of the primary transit element of the plan. Maps 96 and 97 show those segments which may be expected to have higher-than-average operating costs and capital costs per passenger mile, respectively, as well as the degree to which such average costs may be expected to be exceeded, along a route and between routes. In any consideration of this cost-effectiveness information, it is important to recognize that the outer ends of each route can carry no through traffic, except through connection with a different mode such as a feeder/distributor bus.

Comparison of the cost-effectiveness of segments of a system can also be made in terms of passenger boardings and deboardings. Table 225 also presents passenger boarding and deboarding volumes by segment and a rank ordering of the segments in terms of operating and capital costs per boarding and deboarding passenger. Maps 98 and 99 show those

Table 225

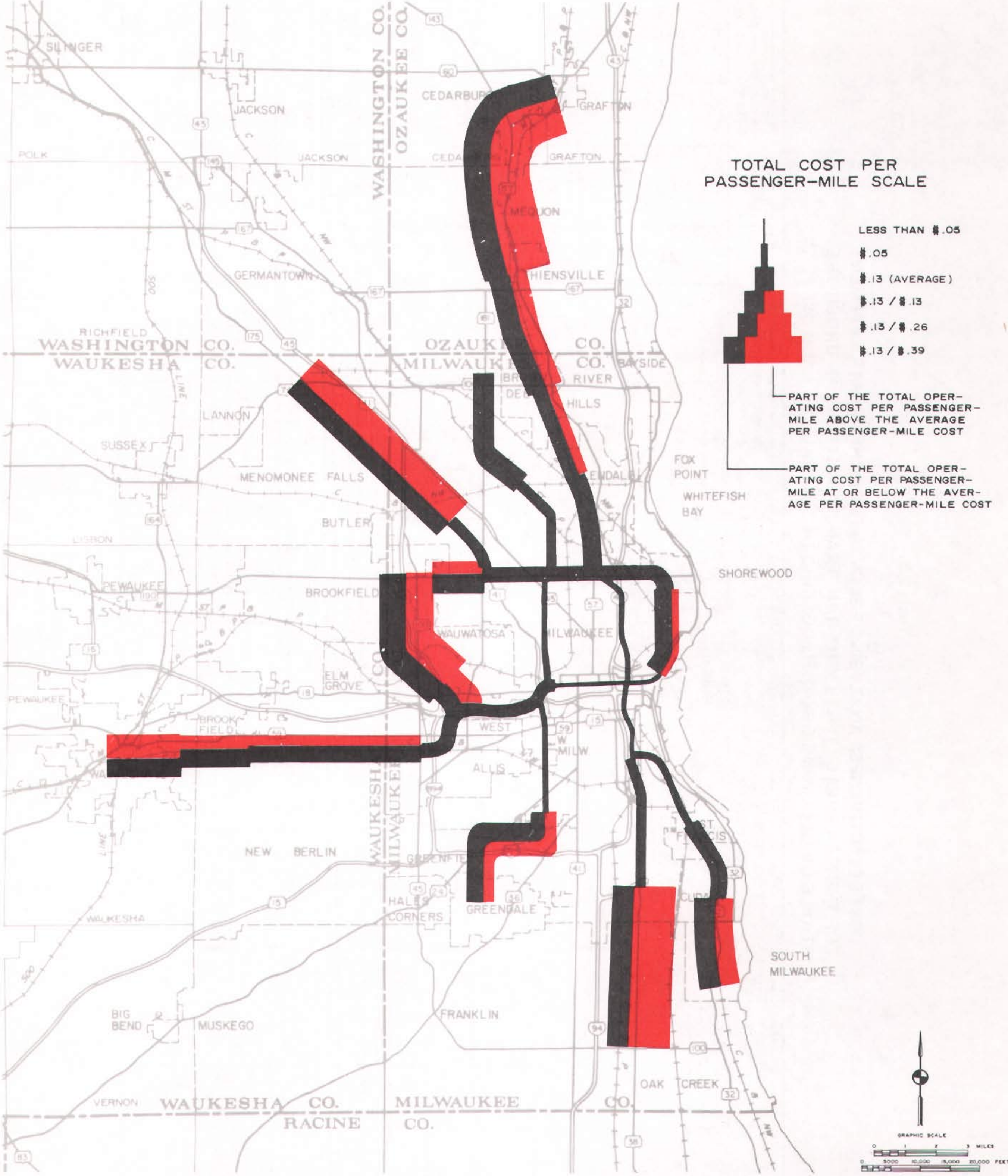
COST-EFFECTIVENESS ANALYSIS OF SEGMENTS OF THE PRIMARY ELEMENT OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Segment Number	Route Number	Transit Ridership						Average Weekday Operating Cost-Effectiveness in Design Year				Total Capital Cost-Effectiveness Over the Design Period			
		Average Weekday Passenger Volume		Total Boarding and Deboarding Passengers	Passenger Miles	Average Weekday Operating Cost in Design Year	Total Capital Cost Over Design Period	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank
		Range	Average												
1	1	1,530- 1,650	1,580	2,610	2,850	$ 870	$12,315,200	$0.31	29	$0.33	14	$ 4,321	21	$ 4,718	11
2	1	1,670- 1,780	1,730	1,280	6,920	1,910	27,139,472	0.28	27	1.49	32	3,922	19	21,203	31
3	1	2,040- 2,270	2,160	1,350	8,630	1,910	26,782,976	0.22	23	1.41	31	3,103	14	19,839	29
4	1	3,440- 3,710	3,550	2,310	8,150	1,100	29,142,992	0.13	17	0.48	24	3,576	16	12,616	20
5	1 and 5	5,140- 7,690	7,100	4,220	17,050	1,910	36,205,168	0.11	13	0.45	23	2,123	11	8,579	14
6	1 and 5	13,070-13,070	13,070	7,780	7,840	630	9,695,900	0.08	7	0.08	3	1,237	6	1,246	3
7	1 and 5	15,060-20,140	17,370	37,650	43,420	2,730	38,741,376	0.06	2	0.07	2	892	2	1,029	2
8	1 and 5	10,050-16,090	13,990	10,700	9,790	560	5,825,700	0.06	2	0.05	1	595	1	544	1
9	1 and 5	1,900- 7,410	4,680	13,160	22,910	3,920	73,535,392	0.17	20	0.30	11	3,210	15	5,588	12
10	2	600- 830	660	960	4,450	2,180	39,227,584	0.49	34	2.27	34	8,815	31	40,862	34
11	2	900- 1,300	1,160	1,270	4,860	1,370	25,213,888	0.28	27	1.08	30	5,188	25	19,853	30
12	2	1,440- 1,690	1,560	540	4,990	1,050	19,557,696	0.21	22	1.94	33	3,919	18	36,217	33
13	2	2,230- 2,590	2,360	1,640	7,560	1,050	21,829,984	0.14	18	0.64	26	2,888	13	13,310	22
14	2	2,910- 6,000	4,630	9,330	18,070	1,280	31,403,376	0.07	4	0.14	5	1,738	8	3,366	8
15	2 and 3	8,380- 9,160	8,890	6,380	22,230	1,580	22,201,776	0.07	4	0.25	10	999	3	3,480	9
16	2	2,440- 4,530	3,510	6,230	13,350	1,240	26,413,376	0.09	9	0.20	3	1,979	10	4,240	10
17	2	230- 1,670	680	1,890	3,580	1,720	35,312,992	0.48	33	0.91	29	9,864	32	18,684	27
18	3	350- 1,380	900	1,890	4,340	1,470	33,993,872	0.34	30	0.77	28	7,833	29	17,986	26
19	3	2,640- 3,590	3,180	4,110	7,320	710	13,417,400	0.10	11	0.17	7	1,833	9	3,264	7
20	3 and 5	5,270- 5,770	5,510	3,600	9,370	1,070	11,523,800	0.11	13	0.30	11	1,230	5	3,201	6
21	3 and 4	7,100- 8,960	7,960	14,370	31,040	2,160	34,476,384	0.07	4	0.15	6	1,111	4	2,400	4
22	3	3,030- 4,250	3,550	2,820	11,010	950	53,961,697	0.09	9	0.34	16	4,901	23	19,135	28
23	3	2,380- 2,860	2,540	2,550	6,350	760	35,602,576	0.12	15	0.30	11	5,607	26	13,961	25
24	3	550- 1,560	1,270	1,680	3,800	920	44,027,872	0.24	25	0.55	25	11,586	33	26,207	32
25	4	1,620- 2,200	2,000	2,720	7,800	960	31,315,968	0.12	15	0.35	17	4,784	22	13,719	24
26	4	2,300- 4,040	3,120	3,500	10,310	820	37,563,168	0.08	7	0.23	9	3,643	17	10,732	17
27	4	2,530- 4,940	4,600	5,780	13,330	710	18,238,992	0.05	1	0.12	4	1,368	7	3,155	5
28	4	1,160- 2,200	1,400	3,090	7,160	1,260	40,366,480	0.18	21	0.41	19	5,638	27	13,063	21
29	5	1,080- 1,290	1,210	1,660	2,290	610	13,662,800	0.27	26	0.37	18	5,966	28	8,231	13
30	5	790- 790	790	1,440	1,190	480	13,827,900	0.40	32	0.33	14	11,620	34	9,602	15
31	5	640- 1,010	850	910	1,530	580	12,346,700	0.38	31	0.64	26	8,070	30	13,568	23
32	5	880- 1,850	1,500	1,700	3,290	710	16,671,900	0.22	23	0.42	22	5,067	24	9,807	16
33	5	3,040- 3,510	3,250	1,160	4,880	480	13,343,300	0.10	11	0.41	19	2,734	12	11,503	18
34	5	1,830- 2,630	2,340	2,420	7,250	990	28,953,392	0.14	18	0.41	19	3,994	20	11,964	19

Source: SEWRPC.

Map 96

OPERATING COST PER PASSENGER-MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

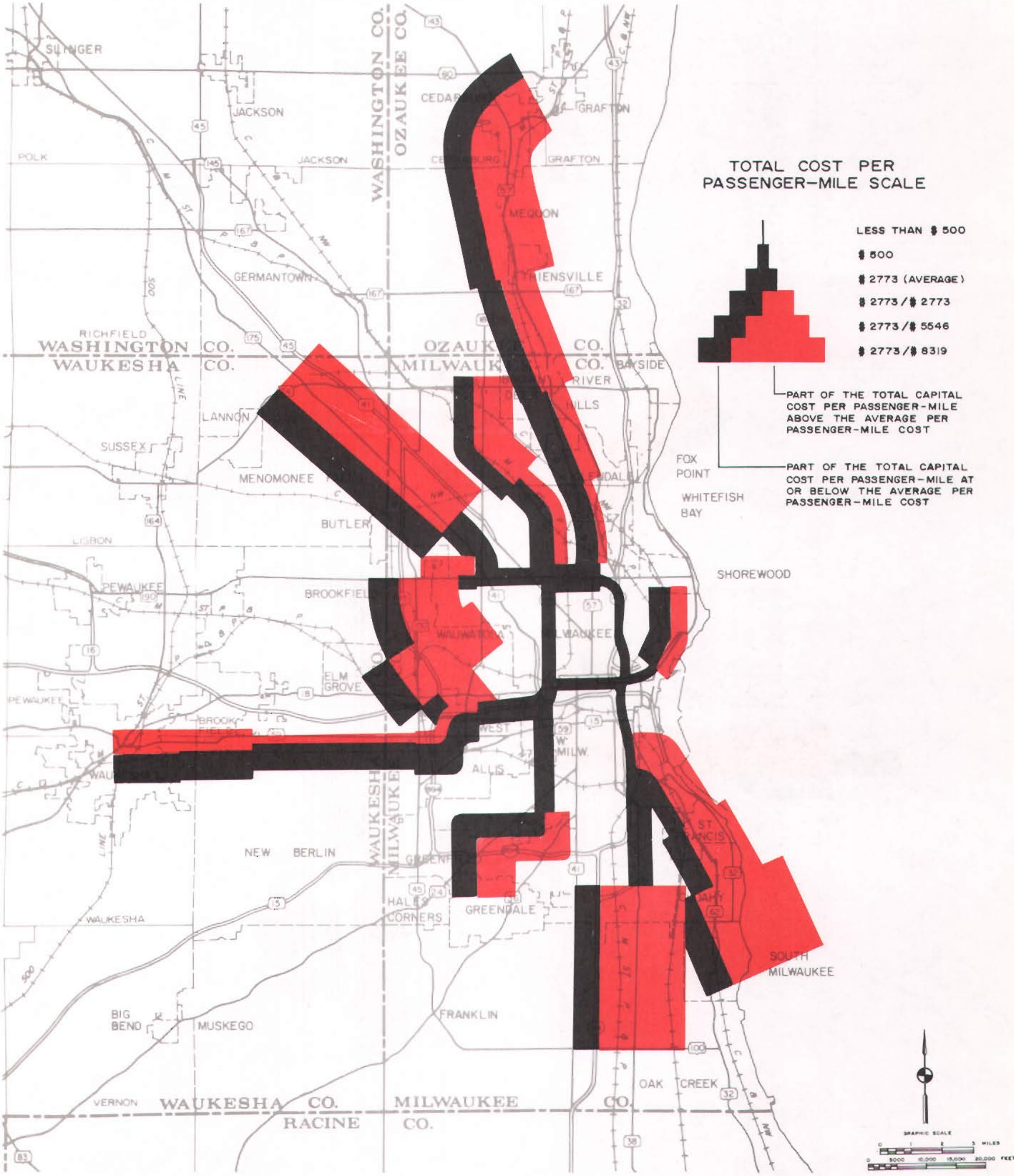


One measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the operating cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average operating cost per passenger mile, as well as the degree to which such average costs may be expected to be exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, for the outer segments of each route, as well as a portion of Route 5 in the City of Wauwatosa, these data suggest an insufficient ridership base to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development in these segments, and the absence of through traffic except by connection with a different mode such as feeder bus or automobile.

Source: SEWRPC.

Map 97

CAPITAL COST PER PASSENGER-MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

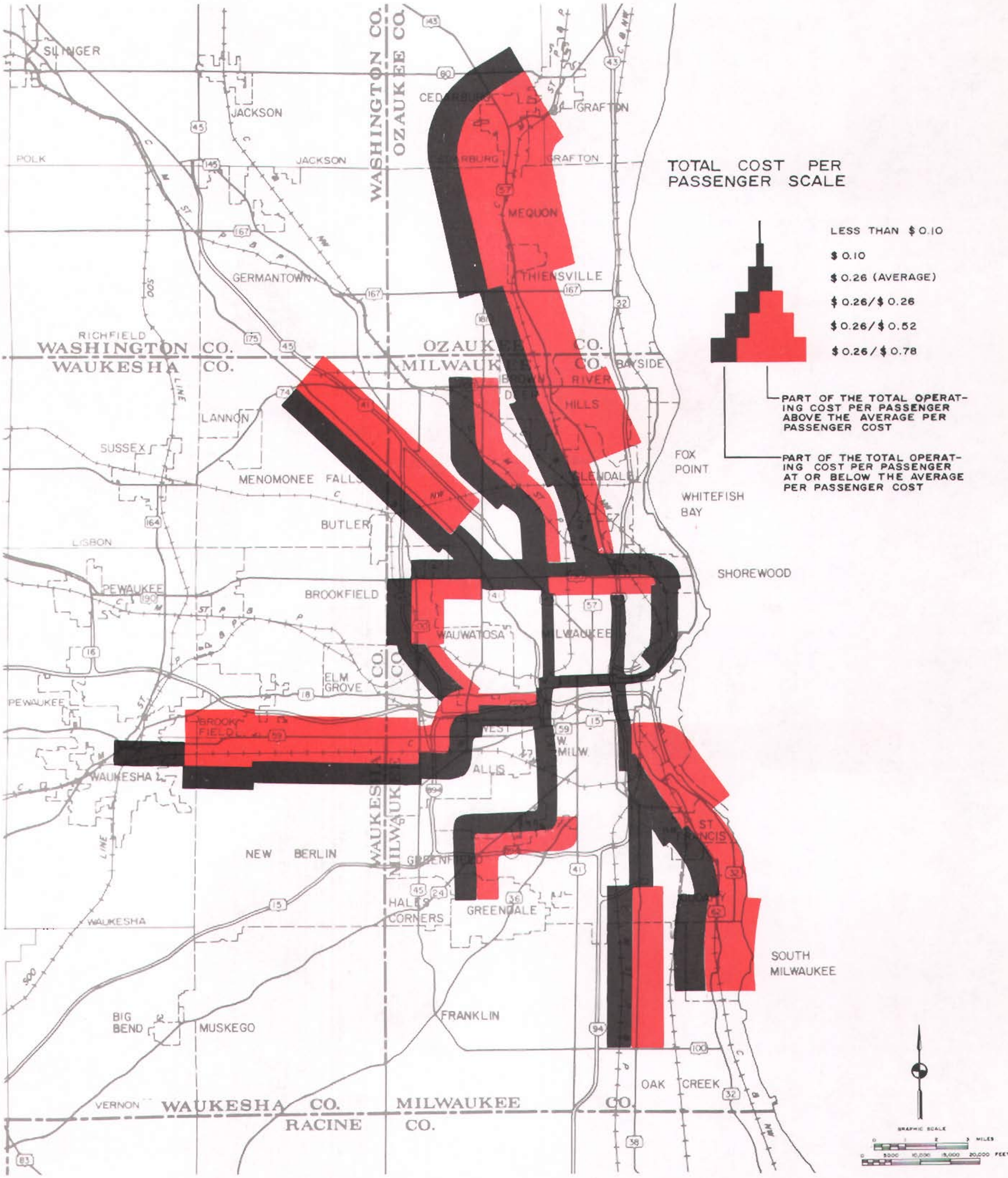


Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the capital cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average capital cost per passenger mile, as well as the degree to which such average costs may be expected to be exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, for the outer segments of each route, as well as portions of Route 5 on the City of Milwaukee's east side and in the City of Wauwatosa, these data suggest an insufficient ridership base to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development in these segments, and the absence of through traffic except by a connection with a different mode such as feeder bus or automobile. To some degree, these inefficiencies are also generated by the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee's east side.

Source: SEWRPC.

Map 98

OPERATING COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

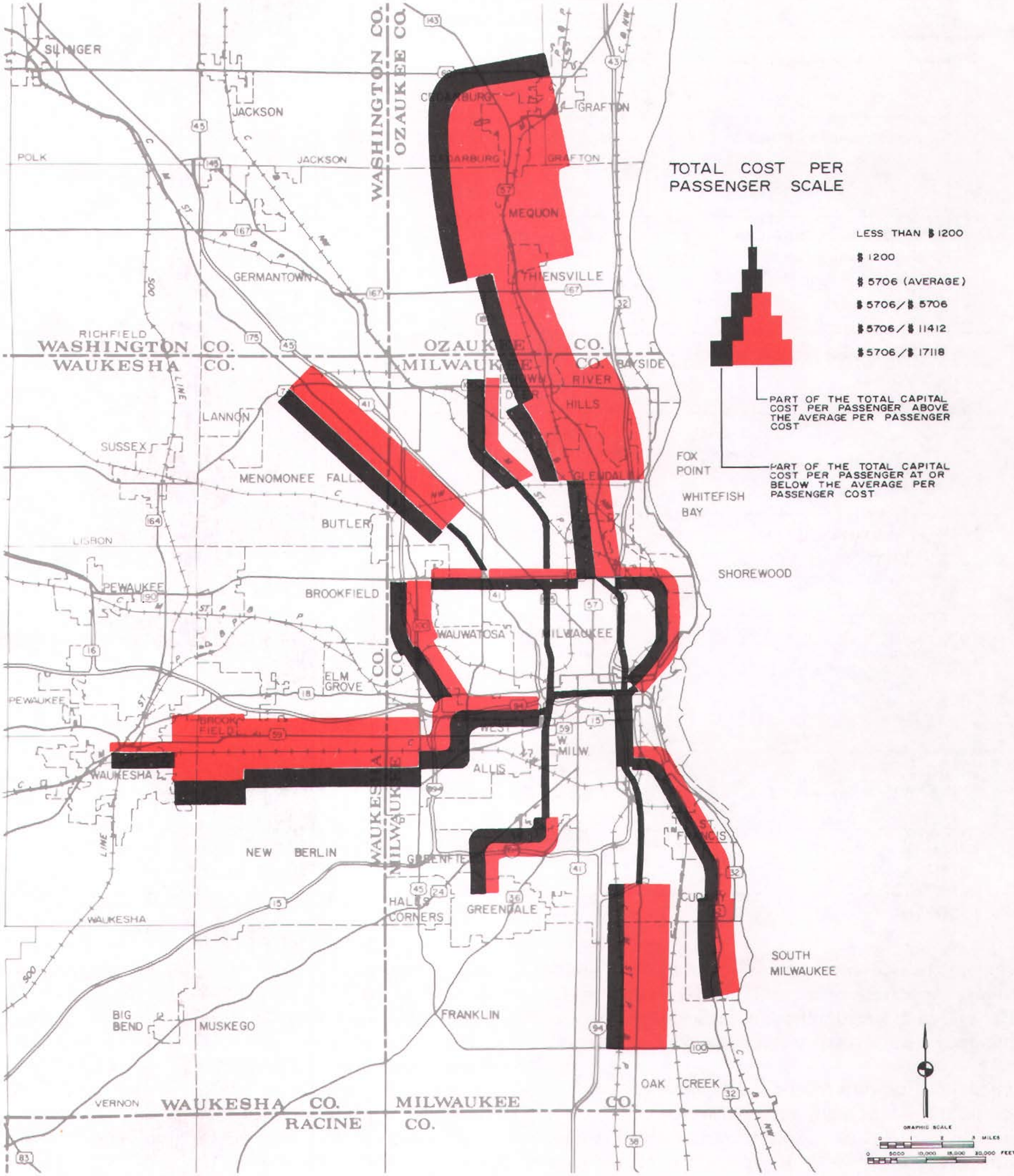


Yet another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the operating cost per boarding and deboarding passenger. This map shows those segments which may be expected to operate at, below, or above the average operating cost per boarding and deboarding passenger, as well as the degree to which such average costs may be expected to be exceeded. As shown on this map, certain system segments within the densely developed areas of Milwaukee County are very cost-effective, compared with the remainder of the system, while all segments located within suburban areas outside Milwaukee County are not cost-effective. This is a result of the lower boarding and deboarding passenger volumes in these suburban areas combined with the lengthy distances that the light rail vehicles must operate over. A noteworthy exception is the segment within the City of Waukesha which, by itself, appears cost-effective, but which nevertheless depends upon a connection to the remainder of the system over two lengthy suburban segments which generate little ridership.

Source: SEWRPC.

Map 99

CAPITAL COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan is the capital cost per boarding and deboarding passenger. This map shows those segments which may be expected to operate at, below, or above the average capital cost per boarding and deboarding passenger, as well as the degree to which such average costs may be expected to be exceeded. As shown on this map, certain segments within the densely developed portions of Milwaukee County are very cost-effective compared with the remainder of the system. However, those segments located in Milwaukee County suburbs as well as outside Milwaukee County appear to have an insufficient volume of passenger boardings and deboardings to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development combined with the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee's east side.

Source: SEWRPC.

Table 226

RECOMMENDED CHANGES IN THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Recommended Change	Reasons
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segment 1	The deletion of Segments 2 and 3 would not logically permit retention of Segment 1
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segments 2 and 3	Not operating or capital cost-effective, principally because of few boardings and deboardings in areas that would be sparsely developed
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segment 4	Less cost-effective than Segments 29 and 30, which are retained. Also, some of its users should use Segments 29 and 30, which would increase the cost-effectiveness of those segments
2—Cedarburg/Milwaukee CBD/Oak Creek	Eliminate Segments 10, 11, 12, and 13	Not capital or operating cost-effective, and would not significantly contribute to the route's ridership
2—Cedarburg/Milwaukee CBD/Oak Creek	Eliminate Segment 17	Not capital or operating cost-effective. Also, boardings and deboardings on this segment would not significantly contribute to total route ridership
3—Menomonee Falls/Milwaukee/ South Milwaukee	Eliminate Segment 18	Not capital or operating cost-effective relative to other segments. Boardings and deboardings are small relative to total route ridership
3—Menomonee Falls/Milwaukee CBD/ South Milwaukee and Cedarburg/ Milwaukee CBD/Oak Creek	Eliminate Segments 22, 24, and part of 16. Add segment from middle of Segment 16 to Segment 23	Deleted segments are less capital and operating cost-effective than added segment. Total boardings and deboardings along Segment 23 would not significantly contribute to total route ridership
5—Loop: UWM/Mayfair/Milwaukee CBD	Eliminate Segments 31, 32, and 34	Not capital or operating cost-effective. Also, total boardings and deboardings are small relative to other segments
5—Loop: UWM/Mayfair/Milwaukee CBD	Eliminate Segment 9	High capital cost. Service to UWM would be provided by shuttle service

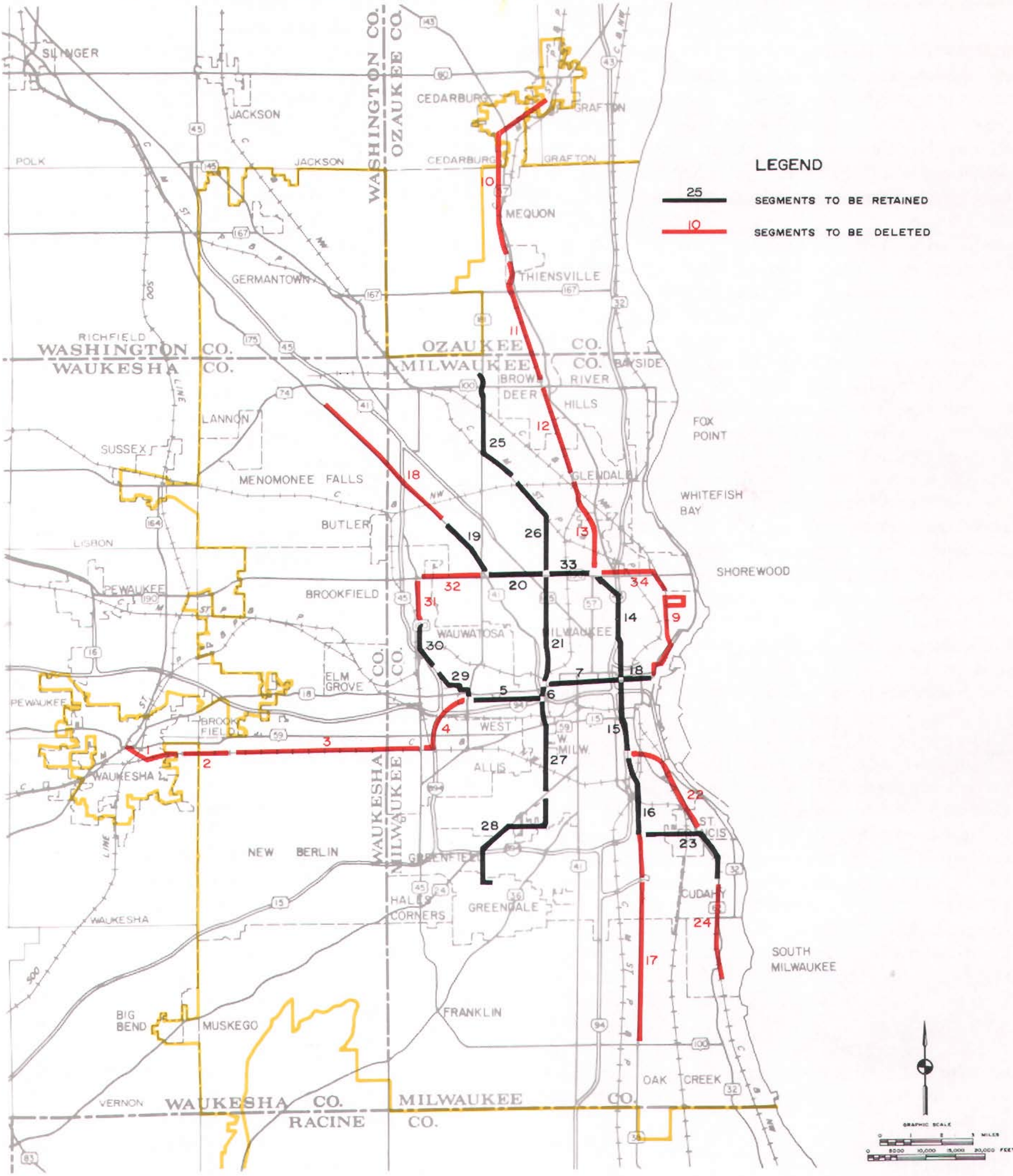
Source: SEWRPC.

segments which may be expected to have above average operating and capital costs, respectively, per boarding and deboarding passenger, as well as the degree to which average costs are exceeded.

Based on this cost-effectiveness information, the maximum extent light rail transit system plan for this alternative future was truncated. The truncations were made with the objective of reducing system capital cost and operating deficits and bringing the total cost per passenger for a light rail plan under this future closer to that of the base plan, while retaining an integrated system. The proposed truncated light rail transit system plan under the stable or declining growth scenario-decentralized land use plan alternative future is shown on Map 100. The changes made in the maximum extent plan to produce the truncated plan are summarized in Table 226. The segments deleted were the less cost-effective segments—that is, segments which, if deleted, would result in relatively large reductions in system capital costs and operating deficits and relatively small reductions in system ridership. These segments include those extending to the communities of Cedarburg and Grafton from W. Capitol Drive in the City of Milwaukee, those extending to the Village of Menomonee Falls from W. Silver Spring Drive and W. 92nd Street in the City of Milwaukee, those extending to the Cities of West Allis and

Map 100

RECOMMENDED TRUNCATED LIGHT RAIL TRANSIT (AND BUSWAY) SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



This map shows the truncated light rail transit (and busway) system plan, the result of certain modifications being made in the maximum extent light rail transit (and busway) system plan. Such modifications included the deletion of 16 segments which were judged in their entirety to contribute insufficient operating revenues and ridership to the system in comparison with the operating expenses and capital investment necessary to construct and support those segments. In addition, portions of two other segments were deleted and a new segment was added to provide a more cost-effective alignment between the City of Milwaukee's south side and the suburban communities of Cudahy and South Milwaukee. These modifications were made with the objective of reducing capital cost requirements and operating deficits while bringing the total cost per passenger for a light rail transit system plan under this future closer to that of the base plan, while retaining an integrated primary transit system which serves a large part of the Milwaukee area.

Source: SEWRPC.

Waukesha from N. 84th Street and W. Fairview Avenue in the City of Milwaukee, those extending to the City of Oak Creek from General Mitchell Field, those looping from the intersection of W. Appleton Avenue and W. Capitol Drive to the Mayfair Mall Shopping Center, and that extending from the City of Cudahy to the City of South Milwaukee. Because of its high capital cost, the segment from S. 5th and W. Becher Streets to the City of St. Francis along E. and S. Bay Street and the Chicago & North Western's Kenosha Subdivision railway main line on the route connecting to the City of Cudahy was replaced by a segment from S. 5th and W. Becher Streets along Chase Avenue to the former Milwaukee Electric Lines Lakeside Belt Line, and then along that open right-of-way owned by the Wisconsin Electric Power Company and used for trunkline power transmission to the original routing from S. 5th and W. Becher Streets through the City of St. Francis to the City of Cudahy. The segment from the Milwaukee central business district through the University of Wisconsin-Milwaukee to Capitol Drive and along Capitol Drive to W. Atkinson Avenue in the City of Milwaukee was deleted because of its high capital cost relative to its ridership. Through the elimination of these segments, the capital cost of the primary element of the light rail transit system would decrease from $940 million to about $470 million, and the total cost of the truncated plan would be about $600 million.

Those segments given the highest priority for elimination were Segments 10, 11, 12, and 13 serving northern Milwaukee County and Ozaukee County, and Segments 1, 2, 3, and 18 serving Waukesha County. Segments 31 and 32, providing service along Capitol Drive between Appleton Avenue and Mayfair Road, and Segment 4 providing service to West Allis, were identified as the second set of segments to be deleted. The third set of segments identified to be deleted were those serving General Mitchell Field, the City of Oak Creek, and the City of South Milwaukee, including portions of both Segments 16 and 22 and all of Segments 17 and 24. Segments 9 and 34, serving the University of Wisconsin-Milwaukee campus and the lower east side, were the final two segments identified for deletion.

Evaluation of Maximum
Extent Busway System Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is motor buses operating over busways. The maximum extent system plan developed for this technology is summarized with respect to its coverage and routes on Maps 60 and 61 of Chapter III. Its performance under the stable or declining growth scenario-decentralized land use plan alternative future is summarized in Tables 227 and 228. Map 53 and Table 111 of Chapter III, and Tables 228 and 197 provide comparable information for the base, or benchmark, plan used in the study. A discussion of the facilities and services of the primary, local, and express elements of both the maximum extent busway plan and the base plan is included in Chapter III of this report, and will not be repeated here.

In comparison to the base plan, the maximum extent busway system plan under this future would entail more than a two-fold increase in vehicle miles of primary transit service, or 17,200 vehicle miles compared with 6,600 vehicle miles under the base plan. A significant part of this increase in primary transit service would be the result of the extension of primary service into off-peak travel periods during the midday and evenings, as indicated in Tables 198 and 229. About 14 percent more bus miles of express and local service would be operated under this plan than under the base plan—60,100 as opposed to 52,700 bus miles on an average weekday.

Headways on the primary element of the maximum extent busway plan under this future would range from 4 to 10 minutes during the peak periods. During the off-peak periods, headways would range from 30 to 60 minutes in the midday period, and from 40 to 60 minutes during the evening.

Transit Utilization: Under the maximum extent busway system plan of the stable or declining growth scenario-decentralized land use plan alternative future, about 178,300 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 230 and 231. About 59,200, or 33 percent, of these transit trips may be expected to be made on the primary transit system for all or a portion of the trip. Thus, the maximum extent busway system plan envisions that about 5 percent of the total of 3.6 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that about 2 percent will be made using primary transit. About 8,900, or 5 percent, more transit trips may be expected to be made on an average weekday, under this plan than under the base plan.

Table 227

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	W. Broadway and W. Main Street.	City of Waukesha	Proposed	Yes	- -	1	10	53	53	12	12	4	4	15	15	2	2
2	E. Broadway and Pleasant Street.	City of Waukesha	Proposed	- -	- -	1	1	51	51	12	12	4	4	15	15	2	2
3	Lincoln Avenue and Lake Street.	City of Waukesha	Proposed	Yes	- -	1	- -	50	50	12	12	4	4	15	15	2	2
4	Lincoln Avenue and Frederick Street	City of Waukesha	Proposed	- -	- -	1	1	48	48	12	12	4	4	15	15	2	2
5	CTH A and Pearl Street . .	City of Waukesha	Proposed	Yes	325	1	- -	44	44	12	12	4	4	15	15	2	2
6	Johnson Road.	City of New Berlin	Proposed	- -	100	1	- -	41	41	12	12	4	4	15	15	2	2
7	Calhoun Road and Rogers Drive	City of New Berlin	Proposed	Yes	250	1	- -	37	37	12	12	4	4	15	15	2	2
8	Moorland Road and Rogers Drive	City of New Berlin	Proposed	- -	- -	1	2	35	35	12	12	4	4	15	15	2	2
9	Sunny Slope Road and Honey Lane.	City of New Berlin	Proposed	- -	- -	1	- -	33	33	12	12	4	4	15	15	2	2
10	S. 124th Street and Honey Lane.	City of New Berlin	Proposed	- -	- -	1	- -	31	31	12	12	4	4	15	15	2	2
11	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	- -	1	5	28	28	12	12	4	4	15	15	2	2
12	S. 98th Street and W. Washington Street . . .	City of West Allis	Proposed	Yes	- -	1	2	26	26	12	12	4	4	15	15	2	2
13	N. 92nd Street and W. Dixon Street	City of Milwaukee	Proposed	- -	75	1	- -	23	23	12	12	4	4	15	15	2	2
14	N. 84th Street and W. Hawthorne Avenue . .	City of Milwaukee	Proposed	Yes	- -	2	2	20	20	20	18	7	6	22	27	3	3
15	N. 76th Street and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	19	19	20	18	7	6	22	27	3	3
16	N. 68th Street and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	17	17	20	18	7	6	22	27	3	3
17	N. Hawley Road and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	- -	- -	2	1	15	15	20	18	7	6	22	27	3	3
18	County Stadium and Mitchell Boulevard	City of Milwaukee	Proposed	Yes	125	2	- -	14	14	20	18	7	6	22	27	3	3
19	County Stadium and N. 44th Street	City of Milwaukee	Proposed	Yes	100	3	- -	12	12	26	24	10	9	30	35	4	5
20	N. 35th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	8	8	20	26	11	10	34	39	5	5
21	N. 27th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	4	7	7	20	26	11	10	34	39	5	5
22	N. 21st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	5	5	20	26	11	10	34	39	5	5
23	N. 16th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	5	3	3	20	26	11	10	34	39	5	5
24	N. 12th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	6	2	2	28	26	11	10	34	39	5	5
25	N. 6th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	4	7	- -	- -	36	34	15	14	41	46	7	7
26	N. Plankinton Avenue and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	10	2	2	18	20	6	9	27	22	3	3
27	N. Broadway Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	8	3	3	18	20	6	9	27	22	3	3
28	N. Jackson Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	7	4	4	18	20	6	9	27	22	3	3
29	N. Jackson Street and E. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	- -	- -	1	1	6	6	18	- -	6	- -	27	- -	3	- -
30	N. Van Buren Street and E. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	- -	- -	1	1	6	6	- -	20	- -	9	- -	22	- -	3
31	N. Jackson Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	7	7	18	- -	6	- -	27	- -	3	- -
32	N. Van Buren Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	7	7	- -	20	- -	9	- -	22	- -	3
33	N. Astor Street and E. Ogden Avenue	City of Milwaukee	Proposed	- -	- -	2	2	8	8	18	20	6	9	27	22	3	3
34	N. Farwell Avenue and E. Ogden Avenue	City of Milwaukee	Proposed	- -	- -	2	1	9	9	18	20	6	9	27	22	3	3
35	N. Farwell Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	2	11	11	18	- -	6	- -	27	- -	3	- -
36	N. Prospect Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	1	11	11	- -	20	- -	9	- -	22	- -	3
37	N. Farwell Avenue and E. Kenilworth Place. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	12	12	18	20	6	9	27	22	3	3
38	N. Oakland Avenue and E. North Avenue.	City of Milwaukee	Proposed	Yes	- -	2	3	13	13	18	20	6	9	27	22	3	3
39	N. Cambridge Avenue and E. Locust Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	16	16	18	20	6	9	27	22	3	3
40	N. Oakland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	- -	- -	2	1	24	24	18	20	6	9	27	22	3	3
41	N. Maryland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	Yes	- -	2	6	23	23	18	20	6	9	27	22	3	3
42	N. Maryland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	- -	2	4	19	19	18	20	6	9	27	22	3	3

Table 227 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
43	N. Oakland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	- -	- -	2	1	18	18	18	20	6	9	27	22	3	3
44	Wisconsin Avenue and Broad Street	Village of Grafton	Proposed	- -	- -	1	1	59	59	8	8	4	4	12	12	2	2
45	1st Avenue and Maple Street	Village of Grafton	Proposed	- -	125	1	- -	57	57	8	8	4	4	12	12	2	2
46	Cedar Ridge Drive and Georgetown Drive	City of Cedarburg	Proposed	- -	- -	1	1	54	54	8	8	4	4	12	12	2	2
47	STH 143 (Washington Avenue) and Turner Street	City of Cedarburg	Proposed	- -	- -	1	1	53	53	8	8	4	4	12	12	2	2
48	Grant Avenue and Western Road	City of Cedarburg	Proposed	- -	- -	1	1	52	52	8	8	4	4	12	12	2	2
49	STH 57 and CTH C (Pioneer Road).	City of Mequon	Proposed	Yes	200	1	- -	48	48	8	8	4	4	12	12	2	2
50	STH 57 (Main Street) and Freistadt Road	Village of Thiensville	Proposed	- -	- -	1	1	42	42	8	8	4	4	12	12	2	2
51	STH 57 (Green Bay Road) and STH 67 (Mequon Road)	City of Mequon	Proposed	Yes	100	1	- -	40	40	8	8	4	4	12	12	2	2
52	Garden Drive and W. County Line Road. . .	Village of Brown Deer	Proposed	- -	- -	1	- -	36	36	8	8	4	4	12	12	2	2
53	N. Deerbrook Terrace and STH 100 (W. Brown Deer Road) . .	Village of Brown Deer	Proposed	- -	- -	1	1	34	34	8	8	4	4	12	12	2	2
54	N. Cedarburg Road and W. Bradley Road.	Village of Brown Deer	Proposed	- -	- -	1	1	32	32	8	8	4	4	12	12	2	2
55	N. Teutonia Avenue and W. Good Hope Road . . .	City of Milwaukee	Proposed	- -	- -	1	2	29	29	8	8	4	4	12	12	2	2
56	N. Sidney Place and W. Mill Road	City of Glendale	Proposed	Yes	150	1	1	27	27	8	8	4	4	12	12	2	2
57	N. Dexter Avenue and W. Silver Spring Drive. . .	City of Glendale	Proposed	- -	- -	1	1	25	25	8	8	4	4	12	12	2	2
58	N. 20th Street and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	21	21	8	8	4	4	12	12	2	2
59	W. Atkinson Avenue and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	1	16	16	14	16	6	7	24	19	3	3
60	N. 16th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	- -	- -	1	1	13	13	8	8	4	4	12	12	2	2
61	N. 8th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	10	10	- -	8	- -	4	- -	12	- -	2
62	N. 8th Street and W. Burleigh Street	City of Milwaukee	Proposed	- -	- -	1	2	9	9	8	- -	4	- -	12	- -	2	- -
63	N. 7th Street and W. Burleigh Street	City of Milwaukee	Proposed	- -	- -	1	2	9	9	- -	8	- -	4	- -	12	- -	2
64	N. 8th Street and W. Center Street	City of Milwaukee	Proposed	Yes	- -	1	2	7	7	8	- -	4	- -	12	- -	2	- -
65	N. 7th Street and W. Center Street	City of Milwaukee	Proposed	Yes	- -	1	2	7	7	- -	8	- -	4	- -	12	- -	2
66	N. 8th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	6	6	8	- -	4	- -	12	- -	2	- -
67	N. 7th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	6	6	- -	8	- -	4	- -	12	- -	2
68	N. 6th Street and W. Walnut Street.	City of Milwaukee	Proposed	Yes	- -	1	2	4	4	8	8	4	4	12	12	2	2
69	N. 6th Street and W. Juneau Avenue	City of Milwaukee	Proposed	- -	- -	1	2	3	3	8	8	4	4	12	12	2	2
70	N. 6th Street and W. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	2	1	1	8	8	4	4	12	12	2	2
71	N. 6th Street and W. St. Paul Avenue	City of Milwaukee	Proposed	- -	- -	2	2	2	2	16	16	8	8	22	22	4	4
72	S. 6th Street and W. Alexander Street. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	5	5	16	16	8	8	22	22	4	4
73	S. 6th Street and W. National Avenue	City of Milwaukee	Proposed	--	- -	2	4	6	6	- -	16	- -	8	- -	22	- -	4
74	S. 5th Street and W. National Avenue	City of Milwaukee	Proposed	- -	- -	2	4	6	6	- -	16	- -	8	- -	22	- -	4
75	S. 5th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	- -	16	- -	8	- -	22	- -	4
76	S. 4th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	16	- -	8	- -	22	- -	4	- -
77	S. 5th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	- -	2	3	10	10	- -	16	- -	8	- -	22	- -	4
78	S. 4th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	- -	2	3	10	10	16	- -	8	- -	22	- -	4	- -
79	S. 5th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	- -	- -	1	1	12	12	8	8	4	4	12	12	2	2
80	S. 4th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	- -	- -	1	1	12	12	8	8	4	4	12	12	2	2
81	S. Chase Avenue and W. Rosedale Avenue. . . .	City of Milwaukee	Proposed	Yes	200	1	- -	14	14	8	8	4	4	12	12	2	2
82	S. Chase Avenue and W. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	15	15	8	8	4	4	12	12	2	2

Table 227 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
83	S. Howell Avenue and W. Morgan Avenue	City of Milwaukee	Proposed	- -	- -	1	2	17	17	8	8	4	4	12	12	2	2
84	S. Howell Avenue and W. Howard Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	18	18	8	8	4	4	12	12	2	2
85	S. Howell Avenue and W. Layton Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	21	21	8	8	4	4	12	12	2	2
86	General Mitchell Field . . .	City of Milwaukee	Proposed	Yes	75	1	2	23	23	8	8	4	4	12	12	2	2
87	S. Howell Avenue and W. College Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	26	26	8	8	4	4	12	12	2	2
88	S. Howell Avenue and W. Marquette Avenue . . .	City of Oak Creek	Proposed	- -	- -	1	2	33	33	8	8	4	4	12	12	2	2
89	S. Howell Avenue and W. Forest Hill Avenue. . .	City of Oak Creek	Proposed	- -	- -	1	2	38	38	8	8	4	4	12	12	2	2
90	S. Howell Avenue and W. Ryan Road	City of Oak Creek	Proposed	- -	100	1	1	44	44	8	8	4	4	12	12	2	2
91	STH 175 (Appleton Avenue) and Menomonee Avenue. . . .	Village of Menomonee Falls	Proposed	- -	- -	1	2	50	50	8	8	4	4	10	10	2	2
92	STH 175 (Appleton Avenue) and North Hills Drive	Village of Menomonee Falls	Proposed	Yes	150	1	1	47	47	8	8	4	4	10	10	2	2
93	STH 175 (Appleton Avenue) and Parkway Drive	Village of Menomonee Falls	Proposed	Yes	- -	1	- -	40	40	8	8	4	4	10	10	2	2
94	USH 41 (W. Appleton Avenue) and W. Bobolink Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	37	37	8	8	4	4	10	10	2	2
95	Timmerman Field.	City of Milwaukee	Proposed	Yes	200	1	2	34	34	8	8	4	4	10	10	2	2
96	USH 41 (W. Appleton Avenue) and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	32	32	8	8	4	4	10	10	2	2
97	N. 76th Street and W. Appleton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	30	30	8	8	4	4	10	10	2	2
98	N. 68th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	2	1	26	26	14	16	6	7	22	17	3	3
99	Capitol Court Shopping Center.	City of Milwaukee	Proposed	Yes	175	2	2	25	25	14	16	6	7	22	17	3	3
100	W. Fond du Lac Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	2	2	23	23	14	16	6	7	22	17	3	3
101	N. Sherman Boulevard and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	3	2	21	21	20	22	9	10	30	25	5	5
102	N. Sherman Boulevard and W. Fond du Lac Avenue .	City of Milwaukee	Proposed	Yes	- -	2	2	20	20	14	14	7	7	18	18	4	4
103	N. Sherman Boulevard and W. Burleigh Street . .	City of Milwaukee	Proposed	Yes	- -	2	2	18	18	14	14	7	7	18	18	4	4
104	N. Sherman Boulevard and W. Center Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	17	17	14	14	7	7	18	18	4	4
105	N. Sherman Boulevard and W. North Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	3	16	16	14	14	7	7	18	18	4	4
106	N. 40th Street and W. Lisbon Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	14	14	14	14	7	7	18	18	4	4
107	W. Highland Boulevard and W. McKinley Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	2	12	12	14	14	7	7	18	18	4	4
108	N. 41st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	1	10	10	14	14	7	7	18	18	4	4
109	S. Kinnickinnic Avenue and E. Becher Street . . .	City of Milwaukee	Proposed	Yes	- -	1	3	13	13	8	8	4	4	10	10	2	2
110	S. Bay Street and E. Lincoln Avenue.	City of Milwaukee	Proposed	Yes	125	1	1	15	15	8	8	4	4	10	10	2	2
111	S. Bay Street and E. Russell Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	18	18	8	8	4	4	10	10	2	2
112	S. Nevada Street and S. Kinnickinnic Avenue. .	City of Milwaukee	Proposed	Yes	- -	1	2	19	19	8	8	4	4	10	10	2	2
113	S. Brust Avenue and E. Oklahoma Avenue . . .	City of Milwaukee	Proposed	- -	- -	1	2	20	20	8	8	4	4	10	10	2	2
114	S. Ellen Street and E. Morgan Avenue.	City of Milwaukee	Proposed	- -	- -	1	1	22	22	8	8	4	4	10	10	2	2
115	S. Bombay Avenue and E. Crawford Avenue. . . .	City of St. Francis	Proposed	- -	50	1	1	24	24	8	8	4	4	10	10	2	2
116	S. Kinnickinnic Avenue and Lunham Avenue . . .	City of St. Francis	Proposed	Yes	- -	1	1	26	26	8	8	4	4	10	10	2	2
117	S. Kinnickinnic Avenue and E. Layton Avenue . .	City of Cudahy	Proposed	- -	- -	1	2	28	28	8	8	4	4	10	10	2	2
118	S. Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	150	1	1	30	30	8	8	4	4	10	10	2	2
119	Edgar Avenue and E. College Avenue.	City of Cudahy	Proposed	- -	- -	1	2	32	32	8	8	4	4	10	10	2	2
120	E. Rawson Avenue	City of South Milwaukee	Proposed	Yes	- -	1	1	34	34	8	8	4	4	10	10	2	2
121	Marquette Avenue	City of South Milwaukee	Proposed	Yes	- -	1	2	36	36	8	8	4	4	10	10	2	2
122	S. 9th Avenue and E. Drexel Avenue	City of South Milwaukee	Proposed	Yes	125	1	- -	37	37	8	8	4	4	10	10	2	2

Table 227 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
123	Northridge Shopping Center.	City of Milwaukee	Proposed	Yes	175	1	5	42	45	6	6	3	3	8	8	2	2
124	N. 76th Street and W. Bradley Road.	City of Milwaukee	Proposed	Yes	75	1	3	38	41	6	6	3	3	8	8	2	2
125	N. 76th Street and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	- -	1	3	36	38	6	6	3	3	8	8	2	2
126	N. 60th Street and W. Mill Road.	City of Milwaukee	Proposed	Yes	- -	1	2	33	35	6	6	3	3	8	8	2	2
127	N. Sherman Boulevard and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	100	1	2	30	33	6	6	3	3	8	8	2	2
128	N. Sherman Boulevard and W. Villard Avenue . .	City of Milwaukee	Proposed	Yes	- -	1	3	28	31	6	6	3	3	8	8	2	2
129	N. Sherman Boulevard and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	27	29	6	6	3	3	8	8	2	2
130	N. Sherman Boulevard and W. Congress Street . .	City of Milwaukee	Proposed	- -	- -	1	1	25	28	6	6	3	3	8	8	2	2
131	S. 44th Street and W. National Avenue. . . .	Village of West Milwaukee	Proposed	Yes	- -	1	2	16	19	6	6	3	3	9	9	2	2
132	S. 43rd Street and W. Greenfield Avenue. . .	Village of West Milwaukee	Proposed	Yes	- -	1	1	18	20	6	6	3	3	9	9	2	2
133	S. 43rd Street and W. Burnham Street	Village of West Milwaukee	Proposed	Yes	- -	1	1	19	22	6	6	3	3	9	9	2	2
134	S. 43rd Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	150	1	1	21	23	6	6	3	3	9	9	2	2
135	S. 43rd Street and W. Cleveland Avenue . . .	City of Milwaukee	Proposed	- -	- -	1	- -	23	25	6	6	3	3	9	9	2	2
136	S. 43rd Street and W. Oklahoma Avenue. . .	City of Milwaukee	Proposed	Yes	- -	1	3	25	27	6	6	3	3	9	9	2	2
137	S. 43rd Street and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	27	29	6	6	3	3	9	9	2	2
138	S. 43rd Street and W. Howard Avenue	City of Greenfield	Proposed	Yes	125	1	1	28	30	6	6	3	3	9	9	2	2
139	S. 60th Street and W. Plainfield Avenue . . .	City of Greenfield	Proposed	- -	- -	1	1	31	34	6	6	3	3	9	9	2	2
140	W. Forest Home Avenue and W. Plainfield Avenue	City of Greenfield	Proposed	- -	- -	1	2	33	35	6	6	3	3	9	9	2	2
141	S. 76th Street and W. Layton Avenue.	City of Greenfield	Proposed	- -	- -	1	5	36	39	6	6	3	3	9	9	2	2
142	N. 9th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	- -	- -	3	6	1	1	28	26	11	10	34	39	5	5
143	Southridge Shopping Center.	Village of Greendale	Proposed	Yes	100	1	6	40	42	6	6	3	3	9	9	2	2
144	N. Glenview Avenue and W. Wisconsin Avenue . . .	City of Wauwatosa	Proposed	- -	- -	1	4	23	23	8	6	3	2	7	12	1	1
145	Milwaukee County General Hospital.	City of Wauwatosa	Proposed	- -	- -	1	5	26	26	8	6	3	2	7	12	1	1
146	County Institutions.	City of Wauwatosa	Proposed	- -	- -	1	5	27	27	8	6	3	2	7	12	1	1
147	N. Swan Boulevard and W. Watertown Plank Road.	City of Wauwatosa	Proposed	Yes	150	1	1	29	29	8	6	3	2	7	12	1	1
148	Mayfair Mall Shopping Center.	City of Wauwatosa	Proposed	Yes	75	1	7	33	33	8	6	3	2	7	12	1	1
149	N. Mayfair Road and W. Center Street.	City of Wauwatosa	Proposed	- -	- -	1	3	35	35	8	6	3	2	7	12	1	1
150	N. Mayfair Road and W. Burleigh Street.	City of Wauwatosa	Proposed	Yes	- -	1	2	37	37	8	6	3	2	7	12	1	1
151	N. Mayfair Road and W. Capitol Drive.	City of Wauwatosa	Proposed	Yes	- -	1	2	35	38	6	8	2	3	12	7	1	1
152	W. Lisbon Avenue and W. Capitol Drive.	City of Milwaukee	Proposed	- -	- -	1	2	34	36	6	8	2	3	12	7	1	1
153	N. 92nd Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	32	35	6	8	2	3	12	7	1	1
154	N. 84th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	1	31	33	6	8	2	3	12	7	1	1
155	N. 76th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	3	29	32	6	8	2	3	12	7	1	1
156	N. 35th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	21	24	6	8	2	3	12	7	1	1
157	N. 27th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	20	22	6	8	2	3	12	7	1	1
158	W. Green Bay Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	1	2	20	23	6	8	2	3	12	7	1	1
159	N. Port Washington Road and W. Capitol Drive . . .	City of Milwaukee	Proposed	- -	- -	1	2	21	24	6	8	2	3	12	7	1	1
160	N. Richards Street and E. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	2	23	25	6	8	2	3	12	7	1	1
161	N. Humboldt Boulevard and E. Capitol Drive. . . .	City of Milwaukee	Proposed	Yes	- -	1	2	24	27	6	8	2	3	12	7	1	1
162	Morris Boulevard and E. Menlo Boulevard	Village of Shorewood	Proposed	- -	- -	1	1	26	29	6	8	2	3	12	7	1	1

Source: SEWRPC.

Table 228

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Busway Plan
Primary Element		
Exclusive Guideway Miles		
Subway	- -	- -
Elevated	- -	8.0
At-Grade	- -	94.3
Total	- -	102.3
Shared Guideway Miles		
Freeways	51.5	- -
Surface Arterial Streets	49.5	2.2
Total	101.0	104.5
Route Miles	449	253
Vehicle Miles	6,620	17,200
Vehicle Hours	280	910
Vehicles Required	55	142
Trains Required	- -	- -
Express and Local Elements		
Route Miles	1,302	1,660
Vehicle Miles	52,680	60,140
Vehicle Hours	3,610	4,480
Vehicles Required	521	490
Total System		
Route Miles	1,751	1,913
Vehicle Miles	59,300	77,340
Vehicle Hours	3,890	5,390
Vehicles Required	576	646
Trains Required	- -	- -

Source: SEWRPC.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent busway system plan and the base system plan are summarized in Table 232. The costs shown include all construction costs, plus the costs of right-of-way acquisition and the acquisition and replacement of vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 232.

The total capital cost of the base plan is estimated at $162 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain the existing service to the year 2000. About $19 million, or 12 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent busway system plan is estimated at $709 million. About $480 million would be required for the construction of the busways, including right-of-way, guideways, and preferential intersection treatments. About $176 million would be incurred in the purchase of new and replacement of transit vehicles—$47 million of which would be for the purchase of 195 articulated buses, and about $129 million of which would be for the purchase of 922 conventional buses. The remaining $52 million would be required to construct stations and storage, maintenance, and layover facilities. About $567 million, or about 80 percent of the total capital cost, would be attributable to the primary transit element of the plan.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent busway plan can be expected to be approximately $142 million. The remaining $567 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal and the federal shares are estimated to total $32 million and $130 million, respectively.

Table 233 presents the design year operating and maintenance costs and farebox revenues for the base and maximum extent busway plans. Under the base plan, operating and maintenance costs may be expected to approximate $36 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent busway plan would increase the total operating and maintenance costs for the Milwaukee area in the year 2000 by $12 million, to a total cost of $48 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $3 million under the base plan, and $11 million under the maximum extent busway plan. Primary transit system operating and maintenance costs would thus represent about 8 percent

Table 229

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	253	253	253	253	253
Vehicle Miles	6,540	1,950	7,550	1,160	17,200
Vehicle Hours	350	100	400	60	910
Vehicles Required	123	19	142	17	142
Express and Local					
Route Miles.	1,660	1,586	1,660	1,558	1,660
Vehicle Miles	13,880	16,200	14,640	15,420	60,140
Vehicle Hours	1,030	1,200	1,110	1,140	4,480
Vehicles Required	464	193	490	167	490
Total System					
Route Miles.	1,913	1,839	1,913	1,811	1,913
Vehicle Miles	20,420	18,150	22,190	16,580	77,340
Vehicle Hours	1,380	1,300	1,510	1,200	5,390
Vehicles Required	1,153	1,219	632	184	632

Source: SEWRPC.

Table 230

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

	Base Plan			Maximum Extent Busway Plan		
		Transit Trips			Transit Trips	
Trip Purpose	Total Person Trips[a]	Number	Percent of Total Trips	Total Person Trips[a]	Number	Percent of Total Trips
Home-Based Work	958,800	60,900	6.4	959,100	69,300	7.2
Home-Based Shopping . .	502,600	21,700	4.3	501,900	22,500	4.4
Home-Based Other	1,139,400	42,000	3.7	1,136,200	42,500	3.7
Nonhome Based.	655,600	8,400	1.3	652,700	7,600	1.2
School	364,900	36,400	10.0	364,900	36,400	10.0
Total	3,621,300	169,400	4.7	3,614,800	178,300	4.9

[a] *The difference in the total person trips generated under the maximum extent busway system plan and total person trips generated under the base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been found to be correlated with increased automobile ownership, and greater automobile ownership has been found to be correlated with increased trip generation. The Commission travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.*

Source: SEWRPC.

Table 231

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Time of Day	Base Plan				Maximum Extent Busway Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,000	42.1	41,800	24.7	21,000	35.5	44,900	25.2
Midday	200	2.1	53,400	31.5	7,000	11.8	55,000	30.8
Afternoon . .	5,300	55.8	59,800	35.3	27,700	46.8	63,100	35.4
Evening. . . .	- -	- -	14,400	8.5	3,500	5.9	15,300	8.6
Total	9,500	100.0	169,400	100.0	59,200	100.0	178,300	100.0

Source: SEWRPC.

Table 232

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Busway Plan
Guideway Development[b]	$ - -	$480,648,800
Station Development[c]	2,387,700	32,574,000
Vehicle Storage and Maintenance Facility Development[c]	15,850,000	20,055,700
Vehicle Acquisition and Replacement[d]	143,360,000	175,880,000
Total	$161,597,700	$709,158,500

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent busway plan will be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 through 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and therefore are capable of use beyond the design period.*

[b] *Includes the cost of acquiring about 203 acres of right-of-way for guideway construction, and of acquiring and relocating five residential structures and three steel lattice electric power transmission towers. This land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—10 acres under the base plan, and 42 acres under the maximum extent busway plan. This land is assumed to have a useful life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses used in the system. Both plans assume the availability of a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years.*

Source: SEWRPC.

Table 233

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Busway Plan
Ridership		
Primary Element	2,422,500	15,096,000
Total System	48,793,500	49,635,000
Operating and Maintenance Cost		
Primary Element	$ 2,950,400	$11,120,600
Total System	35,646,200	48,441,600
Operating and Maintenance Cost per Passenger		
Primary Element	$1.22	$0.74
Systemwide Average	0.73	0.97
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.17	$0.15
Total System	0.20	0.26
Farebox Revenue		
Primary Element	$ 1,453,500	$ 7,471,500
Total System	19,317,500	21,416,200
Operating Deficit		
Primary Element	$ 1,496,900	$ 3,649,100
Total System	16,328,700	27,025,400
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	49	67
Total System	54	44
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 748,450	$ 1,824,550
Total System	8,164,350	13,512,700
State (72 percent of nonfederal share of operating deficit)		
Primary Element	538,884	1,313,680
Total System	5,878,332	9,729,140
Local		
Primary Element	209,566	510,870
Total System	2,286,018	3,783,560
Local Operating Deficit per Ride		
Primary Element	$0.09	$0.03
Total System	0.05	0.07

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.1 million required to provide 50 percent federal funding of the operating deficits under the base plan, but less than the $13.5 million required to provide such funding under the maximum extent busway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

of the total operating costs expected in the design year for the base plan, and about 23 percent of the total operating costs expected in the design year for the maximum extent busway plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.73. For the maximum extent busway system plan, the average operating cost per passenger may be expected to approximate $0.97—$0.24, or 33 percent, more than the base plan cost. The average operating cost per passenger mile would also be higher for the maximum extent busway plan, $0.26 compared with $0.20 for the base plan. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.22 and $0.17, respectively, and for the maximum extent busway system plan, $0.74 and $0.15, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is estimated at $19 million, expressed in 1979 dollars, compared with about $21 million under the maximum extent busway plan. Under the maximum extent busway alternative, the primary transit element could be expected to generate about 36 percent, or about $7.5 million, of the total revenues compared with 8 percent, or $1.5 million, for the base plan.

The operating deficit in the year 2000 for the maximum extent busway plan would be about $27 million, expressed in 1979 dollars, requiring a subsidy of about $0.54 per passenger. This compares with the base system plan deficit of about $16 million, or $0.33 per passenger. Farebox revenues would cover about 44 percent of the operating costs under the maximum extent busway plan and 54 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has, in the past, funded up to 72 percent of the nonfederal share.[10] The annual local share of the public

[10] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.1 million required to provide 50 percent federal funding of the operating deficits under the base plan, but somewhat less than the $13.5 million required to provide such funding under the maximum extent busway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

funding requirement in the design year 2000 would be about $3.8 million for the maximum extent busway system plan and about 40 percent less, $2.3 million, for the base system plan.

Development of Truncated System Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent busway system plan are summarized in Table 234. The maximum extent busway plan has significantly higher capital costs as well as greater operating deficits, both in total and on a per-passenger basis, than does the base plan. However, only a slightly smaller proportion of total operating costs are met through farebox revenues under the maximum extent busway plan than under the base plan. Consequently, the total cost per passenger to the design year for the maximum extent busway plan is more than twice that of the base plan under this future. It was therefore necessary to truncate this maximum extent busway system plan.

Some of the increases in the capital costs and operating deficits under the maximum extent busway plan may be attributed to the overextension of service envisioned in this plan.[11] Under this plan, primary transit service on exclusive guideway would be extended into portions of the Milwaukee urbanized area not now served; would be expanded into an all-day operation; and would be provided at headways of no more than 30 minutes in the peak period and peak direction and no more than 60 minutes otherwise.

Table 234

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Busway Plan
Ridership		
In Design Year	48,793,500	49,635,000
To Design Year	1,127,300,000	1,134,029,200
Capital Cost		
Total to Design Year	$161,597,700	$ 709,158,500
To Design Year per Passenger	0.14	0.62
To Design Year After Accounting for Useful Life Beyond Design Year	107,761,000	393,968,500
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.35
Operating Cost		
Percent Met by Farebox Revenues in Design Year	54	44
Operating Deficit in Design Year	$ 16,328,700	$ 27,025,400
Operating Deficit per Passenger in Design Year	0.33	0.54
Operating Deficit to Design Year	375,942,200	461,515,800
Operating Deficit to Design Year per Passenger	0.33	0.41
Total Cost		
To Design Year	$537,539,900	$1,170,684,300
Federal Share	317,249,000	798,074,300
Nonfederal Share	220,290,900	372,600,000
To Design Year per Passenger	0.47	1.03
Federal Share	0.27	0.70
Nonfederal Share	0.20	0.33
To Design Year After Accounting for Useful Life Beyond Design Year	483,703,200	855,484,300
Federal Share	274,179,900	545,932,700
Nonfederal Share	209,523,300	305,551,600
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.43	0.75
Federal Share	0.24	0.48
Nonfederal Share	0.19	0.27

Source: SEWRPC.

The cost-effectiveness of the less productive elements of the primary element of the maximum extent busway system plan can, in part, be identified on a route-by-route basis through a determination of what proportion of the operating costs of the routes may be expected to be recovered through farebox revenues. As shown in Table 235, about 67 percent of the total busway primary transit element operating costs may be expected to be recovered from farebox revenues, and not less than 52 percent of the operating costs for any route will be met through farebox revenues. Therefore, routes should require little modification except possibly over some limited segments.

[11] *The extension of local and express service under the maximum extent busway plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express (secondary) and local (tertiary) service included in each maximum extent primary transit system plan is in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules have been modified, however, to coordinate properly the secondary and tertiary service proposed to be provided with the primary service proposed under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered, and should, therefore, not affect a comparison of those alternatives.*

Table 235

OPERATING COST-EFFECTIVENESS OF BUSWAY ROUTES OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicles Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
1—Waukesha/ Milwaukee CBD/UWM	67,880	$ 6,990	4,455	$11,300	62
2—Cedarburg/Grafton/ Milwaukee CBD/Oak Creek	56,680	5,840	4,395	11,140	52
3—Menomonee Falls/ Milwaukee CBD/ South Milwaukee	64,300	6,620	3,144	7,970	83
4—Crosstown: Northridge/Southridge	44,210	4,550	1,931	4,900	93
5—Loop: Capital Drive/UWM/ Wisconsin Avenue/Mayfair	51,450	5,300	3,273	8,300	64
Total	284,520	$29,300	17,198	$43,610	67

Source: SEWRPC.

Another basis for the identification of the less productive elements of the maximum extent busway system plan is the operating and capital costs per passenger and per passenger mile carried on segments of the system. Table 236 summarizes the estimated capital and operating costs, and passenger miles carried, for the major segments of the maximum extent busway system, and provides a ranking of the segments in terms of operating costs per passenger mile and capital cost per passenger mile. Map 62 in Chapter III of this report identifies the major segments of the primary transit element of the plan. Maps 101 and 102 show those segments which may be expected to have above average operating costs and capital costs per passenger mile, respectively, as well as the degree to which such average costs may be expected to be exceeded, along a route and between routes. In any consideration of this cost-effectiveness information, it is important to recognize that the outer ends of each route can carry no through traffic, except through connection with a different mode such as a feeder/distributor bus.

The cost-effectiveness of segments of a system can also be compared in terms of passenger boardings and deboardings. Table 236 also presents passenger boarding and deboarding volumes and a rank ordering of the segments in terms of operating and capital costs per boarding and deboarding passenger. Maps 103 and 104 show those segments which may be expected to have above average operating and capital costs, respectively, per boarding and deboarding passenger, as well as the degree to which average costs may be expected to be exceeded.

Based on this cost-effectiveness information, the maximum extent busway system plan for this alternative future was truncated. The truncations were made with the objective of reducing system capital cost and operating deficits while bringing the total cost per passenger for a busway system plan for this future closer to that of the base plan, while retaining an integrated system. The proposed truncated busway system plan under the stable or declining growth scenario-decentralized land use plan alternative future is shown on Map 100. The changes made in the maximum extent plan to reduce the truncated plan are summarized in Table 237.

The segments deleted were the less cost-effective segments—that is, segments which, if deleted, would result in relatively large reductions in system capital costs and operating deficits and relatively

Table 236

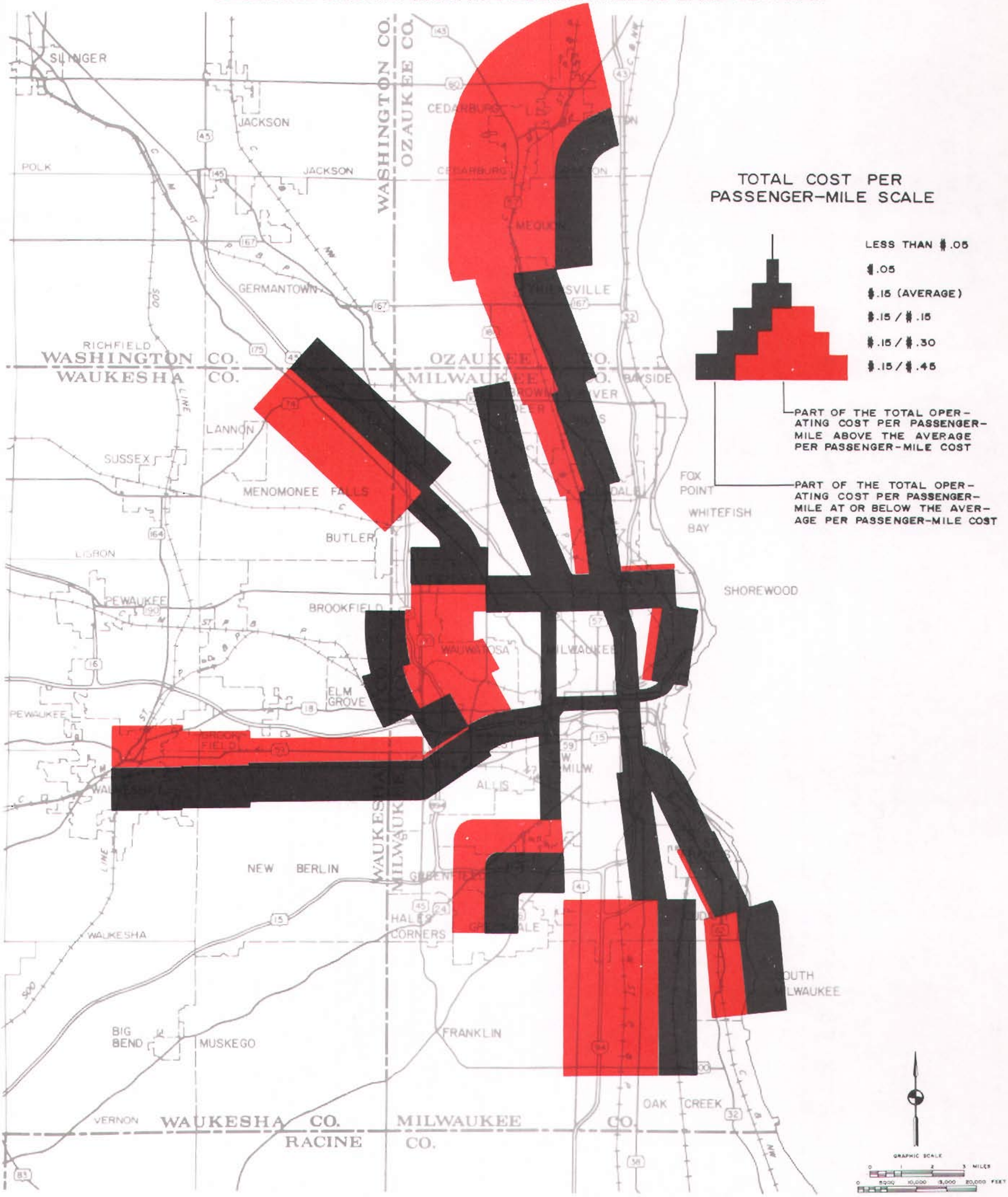
COST-EFFECTIVENESS ANALYSIS OF SEGMENTS OF THE PRIMARY ELEMENT OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

		Transit Ridership						Average Weekday Operating Cost-Effectiveness in Design Year				Total Capital Cost-Effectiveness Over the Design Period			
		Average Weekday Passenger Volume													
Segment Number	Route Number	Range	Average	Total Boarding and Deboarding Passengers	Passenger Miles	Average Weekday Operating Cost in Design Year	Total Capital Cost Over Design Period	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank
1	1	1,410- 1,540	1,470	2,480	2,640	$ 868	$ 5,956,600	$0.33	27	$0.35	13	$ 2,256	19	$ 2,402	10
2	1	1,500- 1,600	1,550	1,210	6,220	1,812	11,971,300	0.29	25	1.50	31	1,925	15	9,894	25
3	1	1,790- 2,040	1,900	1,230	7,610	1,874	11,155,500	0.25	21	1.52	32	1,466	11	9,070	23
4	1	3,010- 3,230	3,100	2,100	7,130	1,124	18,633,600	0.16	16	0.54	22	2,613	21	8,873	22
5	1 and 5	4,400- 6,660	6,130	3,760	14,720	1,828	27,829,968	0.12	9	0.49	18	1,891	14	7,402	19
6	1 and 5	11,150-11,150	11,150	6,360	6,690	539	7,255,100	0.08	3	0.08	2	1,084	8	1,141	3
7	1 and 5	13,850-16,020	14,300	30,550	35,750	2,447	27,865,984	0.07	2	0.08	2	779	4	912	2
8	1 and 5	9,290-13,820	12,300	9,070	8,610	513	3,222,000	0.06	1	0.06	1	374	1	355	1
9	1 and 5	1,820- 7,590	4,370	12,170	21,390	3,855	50,568,176	0.18	19	0.32	11	2,364	20	4,155	13
10	2	6380- 660	540	880	3,650	2,199	20,074,576	0.60	34	2.50	33	5,500	31	22,812	33
11	2	730- 1,070	940	1,080	3,950	1,432	14,498,100	0.36	28	1.33	30	3,670	25	13,424	30
12	2	1,180- 1,290	1,230	380	3,920	1,014	6,480,500	0.26	22	2.67	34	1,653	13	17,054	32
13	2	1,690- 2,010	1,840	1,410	5,900	1,132	11,891,600	0.19	20	0.80	27	2,016	16	8,434	21
14	2	2,300- 5,150	3,910	8,040	15,260	1,490	16,452,600	0.10	7	0.19	5	1,078	7	2,046	5
15	2 and 3	6,130- 7,550	7,280	5,250	18,200	1,529	11,333,800	0.08	3	0.29	8	623	2	2,159	6
16	2	2,130- 3,850	2,920	4,720	11,110	1,401	16,644,700	0.13	11	0.30	9	1,498	12	3,526	11
17	2	200- 1,500	590	1,720	3,150	1,702	21,295,776	0.54	33	0.99	29	6,761	32	12,381	29
18	3	300- 1,220	800	1,720	3,830	1,443	17,359,888	0.38	30	0.84	28	4,533	28	10,093	26
19	3	2,390- 3,170	2,810	3,830	6,470	729	8,938,200	0.11	8	0.19	5	1,381	9	2,334	8
20	3 and 5	4,630- 5,090	4,840	3,210	8,230	1,037	7,642,500	0.13	11	0.32	11	929	5	2,381	9
21	3 and 4	5,900- 7,130	6,460	12,350	25,180	2,107	18,150,688	0.08	3	0.17	4	721	3	1,470	4
22	3	2,420- 3,460	2,840	2,490	8,810	1,208	39,052,784	0.14	13	0.49	18	4,433	27	15,684	31
23	3	1,870- 2,270	2,010	2,210	5,020	790	25,431,680	0.16	16	0.36	14	5,066	29	11,508	28
24	3	480- 1,250	1,030	1,380	3,090	971	32,418,176	0.31	26	0.70	25	10,491	34	23,491	34
25	4	1,690- 2,030	1,850	2,550	7,200	1,043	24,296,080	0.14	13	0.41	15	3,374	22	9,528	24
26	4	2,040- 3,560	1,950	3,130	6,440	977	23,320,176	0.15	15	0.31	10	3,621	24	7,451	20
27	4	1,970- 4,090	3,630	4,890	10,540	905	11,296,100	0.09	6	0.19	5	1,072	6	2,310	7
28	4	940- 1,380	950	2,460	4,830	1,335	26,117,680	0.28	24	0.54	22	5,407	30	10,617	27
29	5	860- 1,110	1,010	1,500	1,910	687	6,712,400	0.36	28	0.46	17	3,514	23	4,475	14
30	5	680- 680	680	1,270	1,020	527	8,396,400	0.52	32	0.41	15	8,232	33	6,611	16
31	5	590- 920	780	830	1,400	619	5,410,700	0.44	31	0.75	26	3,865	26	6,519	15
32	5	800- 1,420	1,340	1,580	2,950	776	6,528,600	0.26	22	0.49	18	2,213	18	4,132	12
33	5	2,890- 3,230	3,040	960	4,560	542	6,594,200	0.12	9	0.56	24	1,446	10	6,869	18
34	5	1,780- 2,680	2,330	2,350	7,200	1,158	15,809,400	0.16	16	0.49	18	2,196	17	6,727	17

Source: SEWRPC.

Map 101

OPERATING COST PER PASSENGER-MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

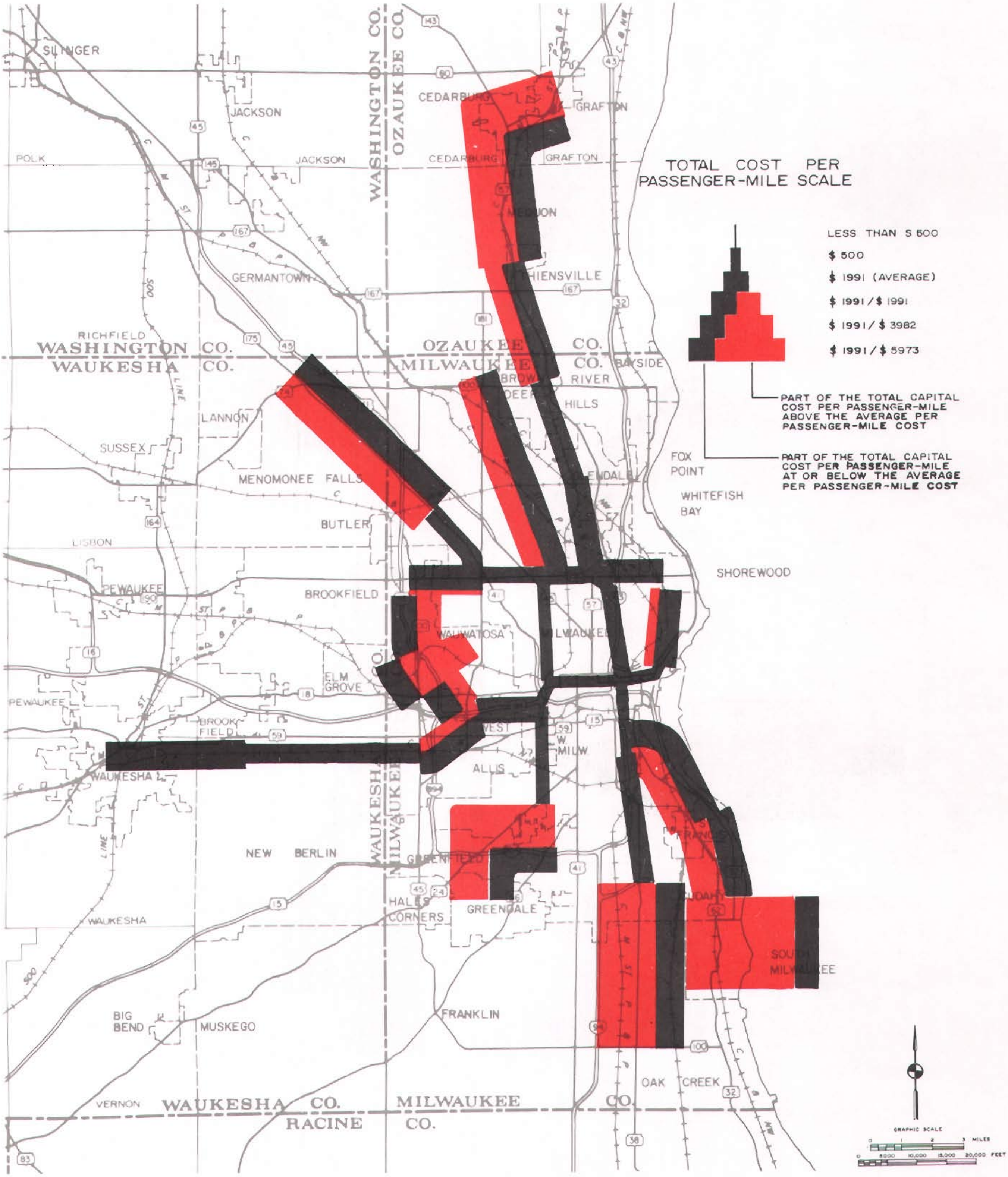


One measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway system plan was the operating cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average operating cost per passenger mile, as well as the degree to which such average costs may be expected to be exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, the data indicate that for the outer segments of each route as well as portions of Route 5 in the City of Wauwatosa, the ridership base would be insufficient to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development, and the absence of through traffic except by connection with a different mode such as feeder bus or automobile. To some degree, these inefficiencies are also generated by the lengthy distances of some segments in the suburban areas.

Source: SEWRPC.

Map 102

CAPITAL COST PER PASSENGER-MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

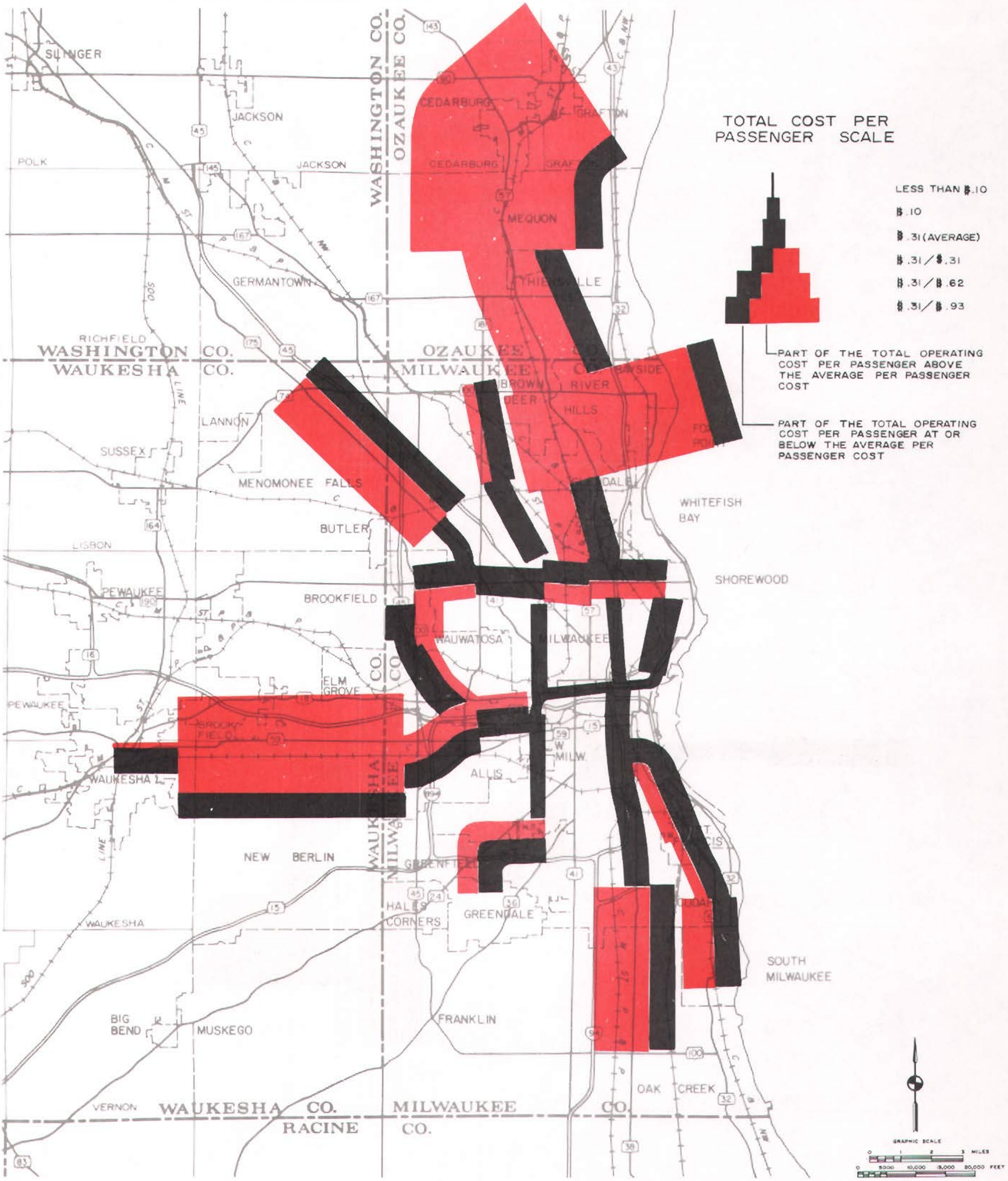


Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway system plan was the capital cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average capital cost per passenger mile, as well as the degree to which such average costs may be expected to be exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, the data indicate that for the outer segments of each route as well as portions of Route 5 on the City of Milwaukee's east side and in the City of Wauwatosa, the ridership base would be insufficient to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development, and the absence of through traffic except by a connection with a different mode such as feeder bus or automobile. To some degree, these inefficiencies are also generated by the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee's east side.

Source: SEWRPC.

Map 103

OPERATING COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

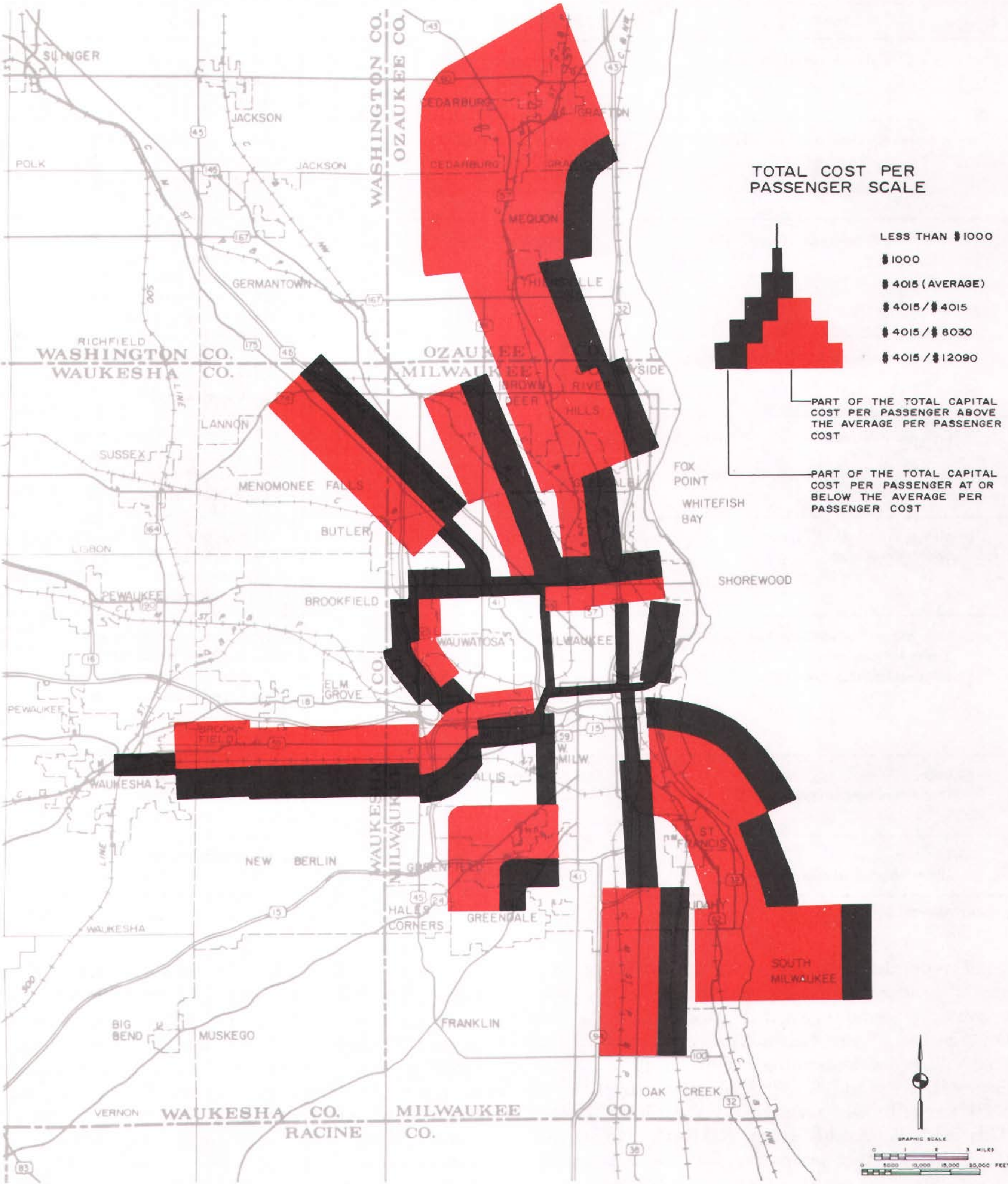


Yet another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway system plan was the operating cost per boarding and deboarding passenger. This map shows those segments which may be expected to operate at, below, or above the average operating cost per boarding and deboarding passenger, as well as the degree to which such average costs may be expected to be exceeded. As shown on this map, certain system segments within densely developed portions of Milwaukee County would be very cost-effective, compared with the remainder of the system, while all segments located within suburban areas outside Milwaukee County are not cost-effective. This is a result of the lower boarding and deboarding passenger volumes in these suburban areas combined with the lengthy distances that the vehicles must operate over.

Source: SEWRPC.

Map 104

CAPITAL COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway system plan is the capital cost per boarding and deboarding passenger. This map shows those segments which may be expected to be at, below, or above the average capital cost per boarding and deboarding passenger, as well as the degree to which such average costs may be expected to be exceeded. As shown on this map, certain segments within the densely developed portions of Milwaukee County would be very cost-effective compared with the remainder of the system. However, those segments located in Milwaukee County suburbs as well as outside Milwaukee County appear to have an insufficient volume of passenger boardings and deboardings to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development combined with the large capital investments necessary for guideway structures and station facilities in some suburban areas. A noteworthy exception is the segment within the City of Waukesha which, by itself, appears cost-effective, but which nevertheless depends upon a connection to the remainder of the system over two lengthy suburban segments which generate little ridership.

Source: SEWRPC.

Table 237

RECOMMENDED CHANGES IN THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Recommended Change	Reasons
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segment 1	The deletion of Segments 2 and 3 would not logically permit retention of Segment 1
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segments 2 and 3	Not operating or capital cost-effective, principally because of few boardings and deboardings in areas that would be sparsely developed
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segment 4	Less cost-effective than Segments 29 and 30, which are retained. Also, some of its users should use Segments 29 and 30, which would increase the cost-effectiveness of those segments
2—Cedarburg/Milwaukee CBD/Oak Creek	Eliminate Segments 10, 11, 12, and 13	Not capital or operating cost-effective, and would not significantly contribute to the route's ridership
2—Cedarburg/Milwaukee CBD/Oak Creek	Eliminate Segment 17	Not capital or operating cost-effective. Also, boardings and deboardings on this segment would not significantly contribute to total route ridership
3—Menomonee Falls/Milwaukee/ South Milwaukee	Eliminate Segment 18	Not capital or operating cost-effective relative to other segments. Boardings and deboardings are small relative to total route ridership
3—Menomonee Falls/Milwaukee CBD/ South Milwaukee and Cedarburg/ Milwaukee CBD/Oak Creek	Eliminate Segments 22, 24, and part of 16. Add segment from middle of Segment 16 to Segment 23	Deleted segments are less capital and operating cost-effective than added segment. Total boardings and deboardings along Segment 23 would not significantly contribute to total route ridership
5—Loop: UWM/Mayfair/Milwaukee CBD	Eliminate Segments 31, 32, and 34	Not capital or operating cost-effective. Also, total boardings and deboardings are small relative to other segments
5—Loop: UWM/Mayfair/Milwaukee CBD	Eliminate Segment 9	High capital cost. Service to UWM would be provided by shuttle service

Source: SEWRPC.

small reductions in system ridership. These segments consisted of those extending to the communities of Cedarburg and Grafton from W. Capitol Drive in the City of Milwaukee; those extending to the Village of Menomonee Falls from W. Silver Spring Drive and W. 92nd Street in the City of Milwaukee; those extending to the Cities of West Allis and Waukesha from N. 84th Street and W. Fairview Avenue in the City of Milwaukee; those extending to the City of Oak Creek from General Mitchell Field; those looping from the intersection of W. Appleton Avenue and W. Capitol Drive to the Mayfair Mall Shopping Center; and that segment extending from the City of Cudahy to the City of South Milwaukee. Because of its high capital cost, the segment from S. 5th and W. Becher Streets to the City of St. Francis along E. and S. Bay Street and the Chicago & North Western's Kenosha Subdivision railway main line on the route connecting to the City of Cudahy was replaced by a segment from S. 5th and W. Becher Streets along Chase Avenue to the former Milwaukee Electric Lines Lakeside Belt Line, and then along that open right-of-way owned by the Wisconsin Electric Power Company and used for trunkline power transmission to the original routing from S. 5th and W. Becher Streets through the City of St. Francis to the City of Cudahy.

The segment from the Milwaukee central business district through the University of Wisconsin-Milwaukee to Capitol Drive and along Capitol Drive to W. Atkinson Avenue in the City of Milwaukee was deleted because of its high capital cost relative to its ridership. Through the elimination of these segments, the capital cost of the primary element of the busway system would decrease from about $567 million to about $290 million, and the total cost of the truncated plan would be about $430 million.

Those segments given the highest priority for elimination were Segments 10, 11, 12, and 13 serving northern Milwaukee County and Ozaukee County, and Segments 1, 2, 3, and 18 serving Waukesha County. Segments 31 and 32, providing service along Capitol Drive between Appleton Avenue and Mayfair Road, and Segment 4, providing service to West Allis, were identified as the second set of segments to be deleted. The third set of segments identified to be deleted were those serving General Mitchell Field, the City of Oak Creek, and the City of South Milwaukee, including portions of both Segments 16 and 22 and all of Segments 17 and 24. Segments 9 and 34, serving the University of Wisconsin-Milwaukee campus and the lower east side, were the final two segments identified for deletion.

EVALUATION AND COMPARISON OF TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS

The fifth and last step in the design, test, and evaluation of alternative primary transit system plans under the stable or declining growth scenario-decentralized land use plan alternative future was the test and evaluation of the truncated system plans for the bus-on-freeway, light rail transit, and busway technologies.[12] Based upon this test and evaluation, a "best" composite plan for the provision of primary transit service in the Milwaukee area under this alternative future was identified.

The truncated system plans for the bus-on-freeway, light rail transit, and busway alternative primary transit technologies are summarized with respect to their coverage, stations, routes, and operation on Maps 105 and 106, and in Tables 238 through 240. It should be noted that these alternative truncated plans, as presented in the previous section of this chapter, were further refined for comparative test and evaluation so that the geographic extent of primary transit service provided under each alternative was comparable. Specifically, primary transit bus-on-freeway routes from the truncated bus-on-freeway plan were added to the truncated light rail transit and busway plans in travel corridors where those modal plans did not provide service, but where the bus-on-freeway plan did provide service. Without these further refinements to provide a comparable extent of service between the alternative plans, a comparative evaluation of the alternative plans would have been impossible. Also, each individual plan—light rail transit and busway—would not include primary transit services in some corridors which could reasonably be expected to have such service by the design year, and the costs for which should be accounted for in systems planning. Bus-on-freeway service was added to the other truncated plans to make them composite plans because the bus-on-freeway plan provided greater geographic coverage than any of the other plans, it was the lowest capital cost primary transit alternative, and it represented a continuation and evolutionary extension of existing primary transit service.

Alternative Primary Transit Plan Evaluation and Comparison— Satisfaction of Objectives and Standards

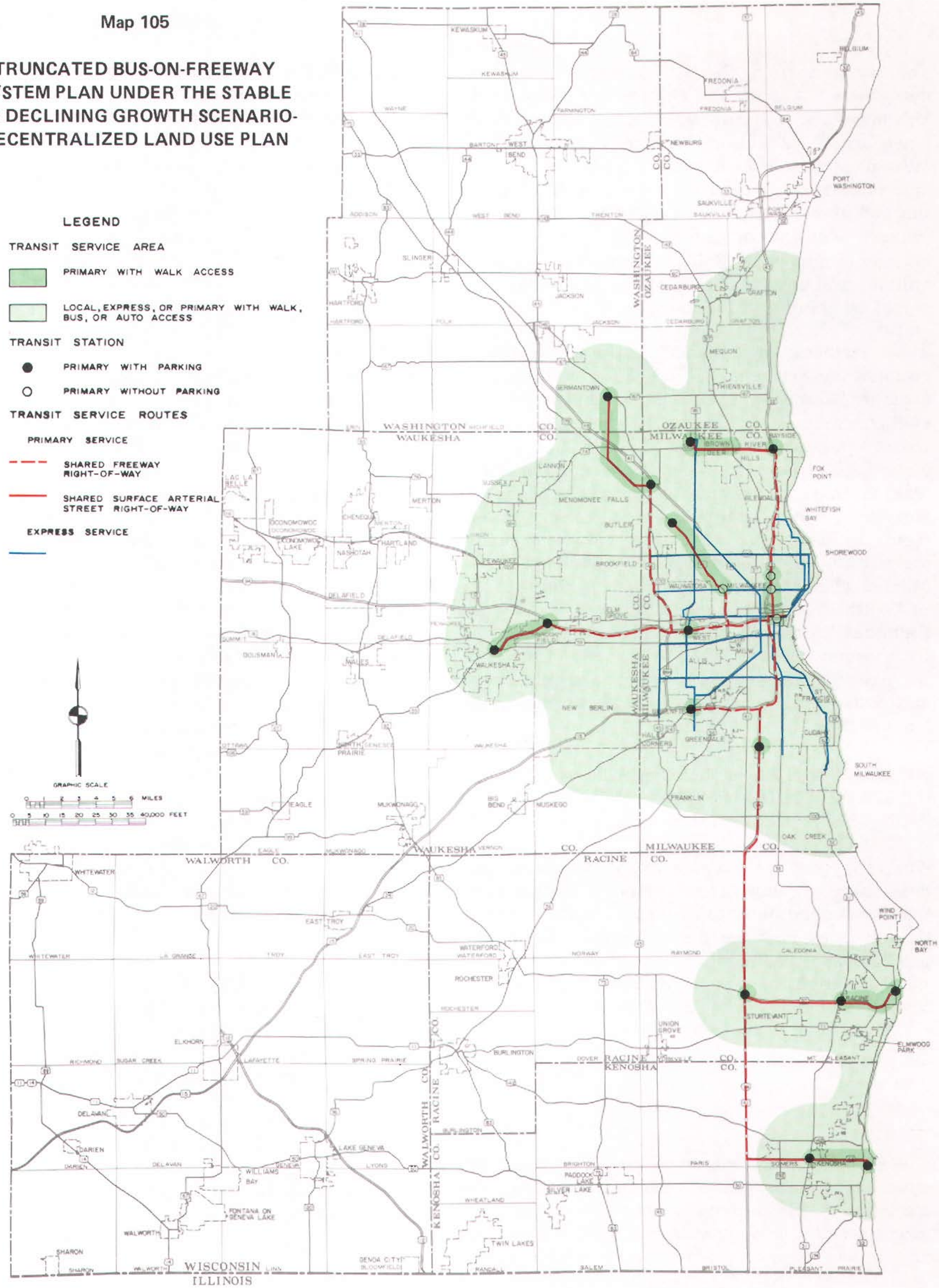
The alternative truncated and composite primary transit system plans were evaluated and compared by establishing the degree to which the plans could be expected to meet the adopted primary transit system development objectives.[13] This was determined by scaling each alternative plan against the standards formulated to relate the objectives to specific primary transit system development proposals. So that the evaluative information would be

[12] *A composite commuter rail plan was not developed under this future because, based on the analyses of the maximum extent commuter rail plan presented in the previous section of this chapter, it was recommended that no commuter rail route be retained for further consideration under this future, since no route would be expected to meet at least 50 percent of its operating costs on an all-day and minimum frequency-of-service basis.*

[13] *See Chapter II of SEWRPC Planning Report No. 33, A Primary Transit System Plan for the Milwaukee Area.*

Map 105

TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



The truncated bus-on-freeway system plan is a carefully cut back version of the maximum extent bus-on-freeway system plan, the cutbacks being made with the objective of creating a more cost-effective system serving a large part of the Milwaukee area. Under the truncated plan, 7 of the 31 routes, totaling 113 miles of line over which 322 round-trip route miles of service would be provided, or about 46 percent of the 246 miles of line and less than 30 percent of the 1,218 route miles of service provided under the maximum extent plan, were retained. Headways were assumed to remain about the same as under the maximum extent plan, ranging from 12 to 30 minutes during the peak travel periods and 40 to 60 minutes during the off-peak periods. Under the truncated plan, a total of 18 primary transit stations or stops would be served outside the Milwaukee central business district, 15 of which would have park-ride lots. There would be 10 stations within Milwaukee County, 7 of which would have park-ride lots.

Source: SEWRPC.

Map 106

COMPOSITE LIGHT RAIL TRANSIT AND BUSWAY SYSTEM PLANS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

LEGEND

TRANSIT SERVICE AREA

- PRIMARY WITH WALK ACCESS
- LOCAL, EXPRESS, OR PRIMARY WITH WALK, BUS, OR AUTO ACCESS

PRIMARY TRANSIT STATION

- WITH PARKING
- WITHOUT PARKING

TRANSIT SERVICE ROUTES

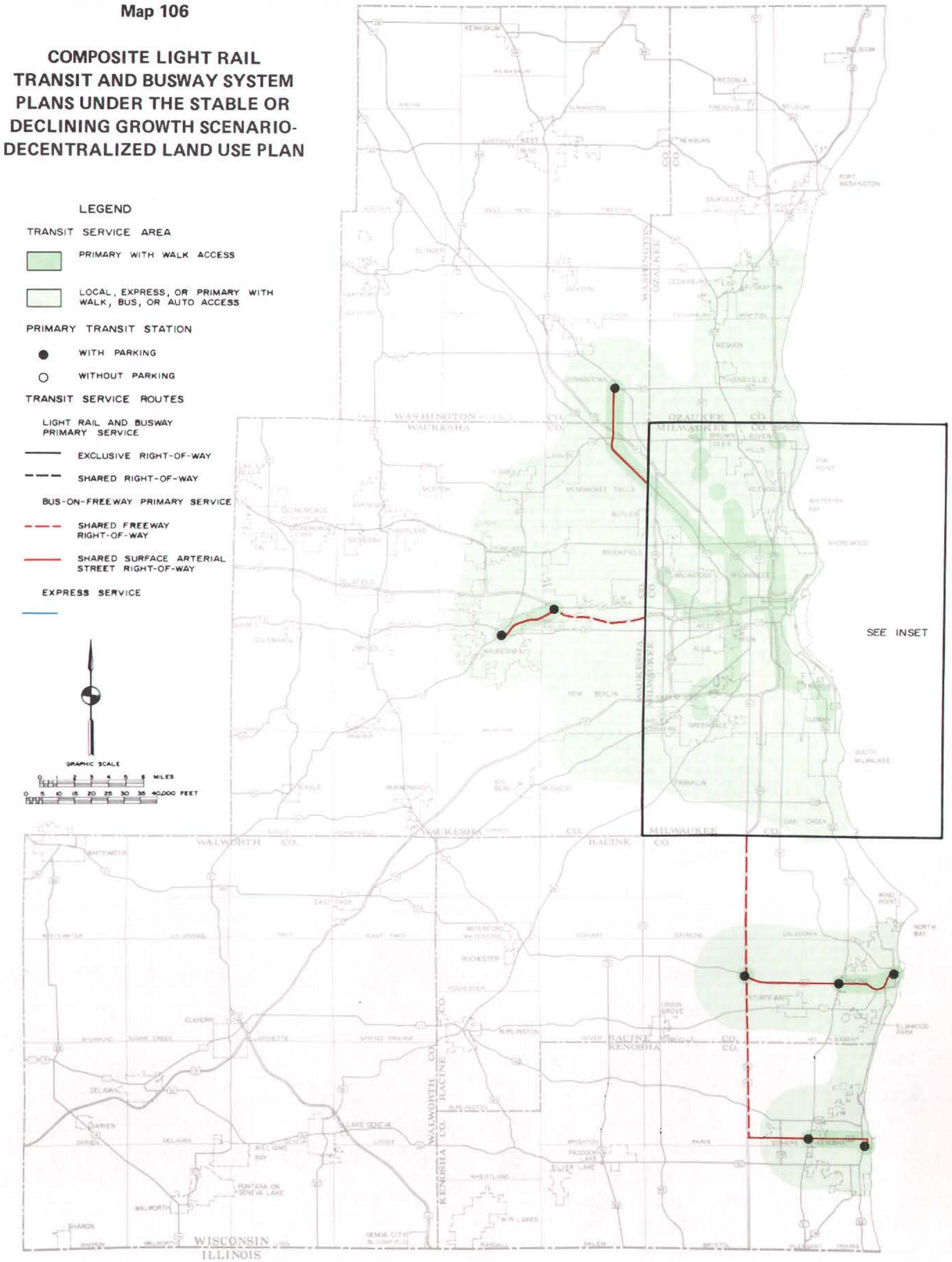
LIGHT RAIL AND BUSWAY PRIMARY SERVICE

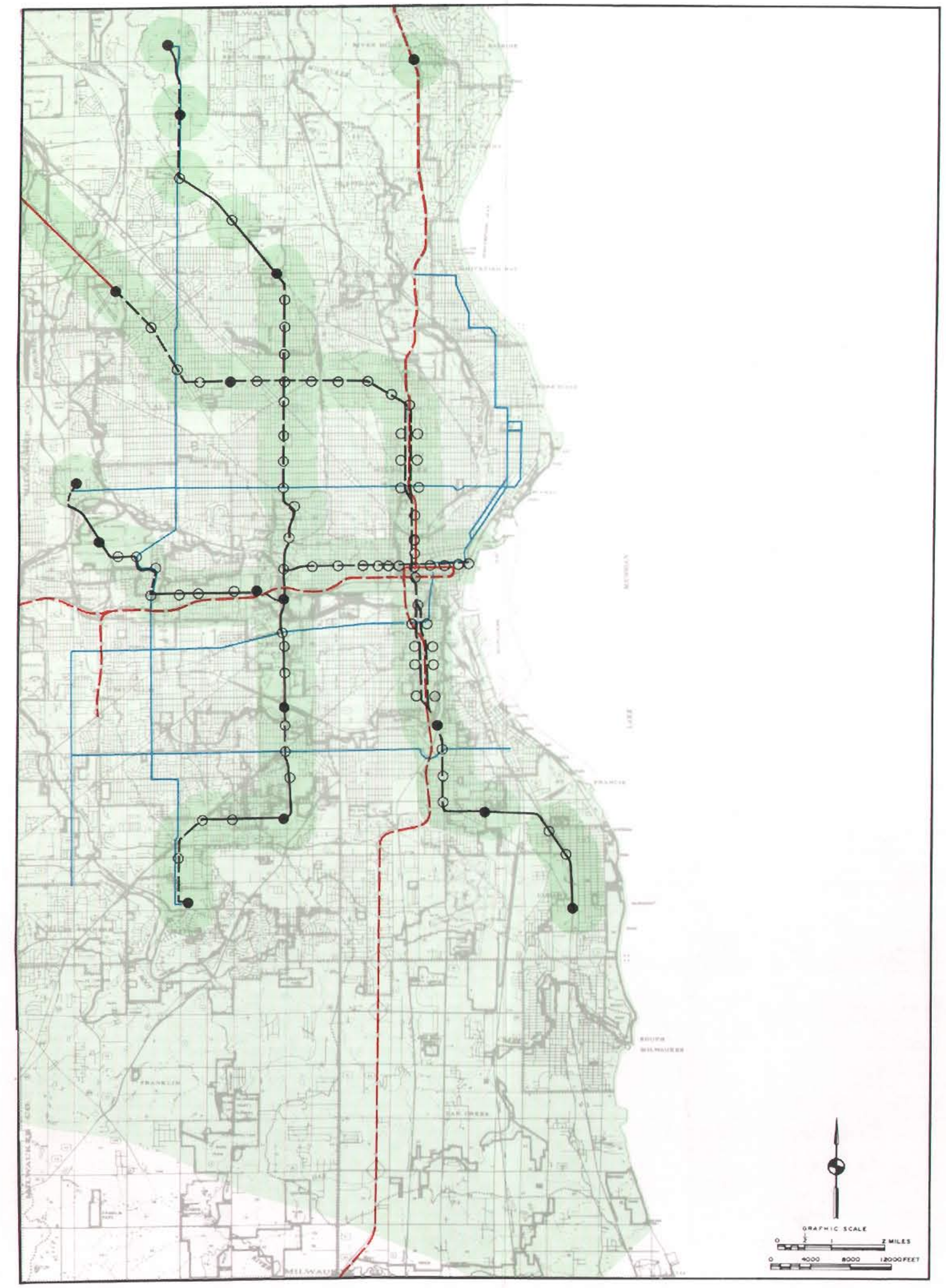
- EXCLUSIVE RIGHT-OF-WAY
- SHARED RIGHT-OF-WAY

BUS-ON-FREEWAY PRIMARY SERVICE

- SHARED FREEWAY RIGHT-OF-WAY
- SHARED SURFACE ARTERIAL STREET RIGHT-OF-WAY

EXPRESS SERVICE





The composite light rail transit and busway system plans are carefully cut back versions of the maximum extent light rail transit and busway system plans. The cutbacks were made with the objective of creating more cost-effective systems which could still serve a large part of the Milwaukee area. Under the composite plans, fixed guideways would be limited to Milwaukee County. A total of 46 miles of line over which 97 round-trip route miles of service would be provided were retained on three routes, or about 44 percent of the 105 miles of line, and about 40 percent of the 253 route miles of service provided under the maximum extent plan. To make this plan comparable to the bus-on-freeway plan, a total of five bus-on-freeway routes operating over 80 miles of line and providing an additional 234 route miles of primary service were added to serve portions of the Milwaukee area that would not be served by the three light rail transit or busway primary transit routes. Headways on the light rail transit system would range from 6 to 12 minutes during the peak travel periods, and would be 60 minutes in the off-peak periods. Bus-on-freeway service would be provided with headways ranging from 22 to 30 minutes during the peak travel periods, and 40 to 60 minutes in the off-peak periods. A total of 98 primary transit stations or stops would be provided, of which 89 stations would serve the light rail transit system and 9 stations would serve the bus-on-freeway service. Of the 98 stations, 15 would have park-ride lots for light rail transit and 9 would have park-ride lots for bus-on-freeway. A total of 90 stations would be located within Milwaukee county, of which 16 would have park-ride lots.

Source: SEWRPC.

Table 238

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS ON AN AVERAGE WEEKDAY UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Primary Element				
Exclusive Guideway Miles				
Subway	- -	- -	- -	- -
Elevated	- -	- -	5.3	5.3
At-Grade	- -	- -	41.0	41.0
Total	- -	- -	46.3	46.3
Shared Guideway Miles				
Freeway Miles	51.5	70.6	55.0	53.1
Surface Arterial Streets	49.5	42.1	24.6	20.5
Total	101.0	112.7	79.6	73.6
Stations	20	18	98	98
Route Miles	449	322	331	328
Vehicle Miles[a]	6,620	9,900	10,730	11,550
Vehicle Hours	280	350	440	510
Vehicles Required				
Motor Buses	55	47	18	75
Light Rail Vehicles	- -	- -	44	- -
Trains Required	- -	- -	44	- -
Express and Local Elements				
Route Miles	1,302	1,811	1,620	1,620
Vehicle Miles	52,680	66,920	59,890	59,910
Vehicle Hours	3,610	4,340	3,950	3,950
Motor Buses Required	521	567	501	503
Total System				
Route Miles	1,751	2,133	1,951	1,948
Vehicle Miles	59,300	76,820	70,620	71,460
Vehicle Hours	3,890	4,690	4,390	4,460
Vehicles Required				
Motor Buses	576	614	519	578
Light Rail Vehicles	- -	- -	44	- -
Trains Required	- -	- -	44	- -

[a] *Vehicle miles of travel per average weekday on the bus-on-freeway component of the composite plans are estimated at 5,190 vehicle miles for the composite light rail transit plan, and 5,550 vehicle miles for the composite busway plan.*

Source: SEWRPC.

manageable, only those standards which were considered essential to a comparative evaluation of alternative plans and the subsequent selection of a "best" composite plan, were used, as shown in Table 167 in Chapter III of this report.

Table 241 provides a summary of the degree to which each alternative truncated system plan satisfies each of the key standards used and, therefore, the adopted objectives. Also included in the table is the measured attainment of the key standards by the base plan.

It should be noted that, while the primary transit facilities and services under each truncated plan were tested and evaluated in detail, and refined and improved to the maximum extent practicable, the local and express elements of each truncated plan

Table 239

TIME-OF-DAY OPERATION OF THE TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Alternative	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Truncated Bus-on-Freeway Plan					
Primary Element					
Route Miles	322	322	322	322	322
Vehicle Miles	2,700	2,230	3,480	1,490	9,900
Vehicle Hours	100	80	120	50	350
Articulated Motor Buses Required	37	15	47	15	47
Express and Local Elements					
Route Miles	1,811	1,737	1,811	1,628	1,811
Vehicle Miles	16,580	16,840	18,240	15,260	66,920
Vehicle Hours	1,100	1,080	1,220	940	4,340
Conventional Motor Buses Required	530	196	567	163	567
Total System					
Route Miles	2,133	2,059	2,133	1,950	2,133
Vehicle Miles	19,280	19,070	21,720	16,750	76,820
Vehicle Hours	1,200	1,160	1,340	990	4,690
Vehicles Required	567	211	614	178	614
Articulated Motor Buses	37	15	47	15	47
Conventional Motor Buses	530	196	567	163	567
Composite Light Rail Transit Plan					
Primary Element					
Route Miles	331	331	331	331	331
Vehicle Miles	3,450	2,160	3,680	1,440	10,730
Vehicle Hours	150	80	160	50	440
Vehicles Required	57	16	62	16	62
Articulated Light Rail Vehicles	39	6	44	6	44
Articulated Motor Buses	18	10	18	10	18
Trains Required	39	6	44	6	44
Express and Local Elements					
Route Miles	1,620	1,546	1,620	1,518	1,620
Vehicle Miles	14,150	16,070	15,270	14,400	59,890
Vehicle Hours	960	1,060	1,040	890	3,950
Conventional Motor Buses Required	469	183	501	148	501
Total System					
Route Miles	1,951	1,877	1,951	1,849	1,951
Vehicle Miles	17,600	18,230	18,950	15,840	70,620
Vehicle Hours	1,110	1,140	1,200	940	4,390
Vehicles Required	526	199	563	164	563
Articulated Light Rail Vehicles	39	6	44	6	44
Articulated Motor Buses	18	10	18	10	18
Conventional Motor Buses	469	183	501	148	501
Trains Required	39	6	44	6	44
Composite Busway Plan					
Primary Element					
Route Miles	328	328	328	328	328
Vehicle Miles	3,840	2,140	4,140	1,430	11,550
Vehicle Hours	180	80	200	50	510
Articulated Motor Buses Required	67	16	75	16	75
Express and Local Elements					
Route Miles	1,620	1,546	1,620	1,518	1,620
Vehicle Miles	14,020	16,040	15,450	14,400	59,910
Vehicle Hours	950	1,050	1,060	890	3,950
Conventional Motor Buses Required	466	184	503	148	503
Total System					
Route Miles	1,948	1,874	1,948	1,846	1,948
Vehicle Miles	17,860	18,180	19,590	15,830	71,460
Vehicle Hours	1,130	1,130	1,260	940	4,460
Vehicles Required	533	200	578	164	578
Articulated Motor Buses	67	16	75	16	75
Conventional Motor Buses	466	184	503	148	503

Source: SEWRPC.

Table 240

SUMMARY OF SERVICE AND FACILITY CHARACTERISTICS OF TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Alternative	Summary of Truncated and Composite Plans
Truncated Bus-on-Freeway Plan	Extent of Service—Expansion of primary service proposed under the maximum extent plan was significantly reduced. Under the truncated plan, only 7 of the 31 routes totaling 322 route miles, or less than 30 percent of the 1,218 route miles in the maximum extent plan, were retained. Frequency of Service—Headways would remain about the same, ranging from 12 to 30 minutes in the peak periods and 40 to 60 minutes in the off-peak periods. Operation—Under the truncated plan, bus miles per average weekday of primary service would be reduced by over 70 percent, from 34,980 miles under the maximum extent plan to 9,900 miles. Bus miles per average weekday of local and express service would decrease by about 10 percent, from about 75,120 miles to about 66,920 miles. Transit Stations—A total of 18 transit stations or stops would be provided outside the Milwaukee central business district, 15 of which would have park-ride lots. Under the truncated plan, there would be 10 stations in Milwaukee County, 7 of which would have park-ride lots.
Composite Light Rail Transit Plan	Extent of Service—Expansion of light rail transit primary service proposed under the maximum extent light rail transit plan was somewhat reduced, limiting light rail service to Milwaukee County. Under the composite plan, three of the five routes totaling 97 route miles, or 40 percent of the 253 route miles in the maximum extent plan, were retained. Two of the routes would extend from the Milwaukee central business district, providing service between Timmerman Field to the northwest and the communities of St. Francis and Cudahy to the south, and the other terminating at the Mayfair Mall Shopping Center to the west. The third route would be a north-south crosstown route connecting Northridge and Southridge Shopping Centers and passing through the communities of Greendale, Greenfield, Milwaukee, and West Milwaukee. To make this plan comparable to the bus-on-freeway plan, a total of five bus-on-freeway routes, representing an additional 234 route miles of primary service, would be added to serve the communities of Bayside and River Hills in Milwaukee County to the north; the communities of Menomonee Falls in Waukesha County and Germantown in Washington County to the northwest; the City of Waukesha to the west; and the communities of Kenosha and Racine to the south. Frequency of Service—Headways on the light rail transit system would range from 6 to 12 minutes in the peak period and 60 minutes in the off-peak periods; bus-on-freeway service would be provided with headways ranging from 22 to 30 minutes in the peak period and 40 to 60 minutes in the off-peak periods. Operations—One-car trains would be provided on all three routes in both the peak and off-peak periods. Total vehicle miles per average weekday of primary service would decrease by about 15 percent, from 12,800 miles under the maximum extent plan to 10,730 miles, of which 5,540 miles would be provided by light rail transit service and 5,190 miles by bus-on-freeway service. Bus miles of express and local service would increase somewhat, from 59,390 under the maximum extent plan to 59,890 miles under the composite plan. Transit Stations—A total of 98 transit stations or stops would be provided, of which 89 stations would be provided on the light rail transit system, and 9 stations on the bus-on-freeway system. Of the 98 stations, 15 would have park-ride lots for light rail transit and 9 would have park-ride lots for bus-on-freeway. A total of 90 stations would be located within Milwaukee County, of which 16 would have park-ride lots.
Composite Busway Plan	Extent of Service—Busway service would be provided over the same three routes as under the composite light rail transit plan. Also, the bus-on-freeway routes are the same as provided under the composite light rail transit plan.[a] Frequency of Service—Headways on the busway system would range from 4 to 10 minutes in the peak period, and would be 60 minutes in the off-peak periods; bus-on-freeway service would be provided with headways ranging from 20 to 30 minutes in the peak period and 40 to 60 minutes in the off-peak periods. Operations—Total vehicle miles per average weekday of primary service would decrease by about 33 percent—from 17,200 miles under the maximum extent plan to 11,550 miles, of which 6,000 miles would be provided by busway service and 5,550 miles by bus-on-freeway service. Bus miles of express and local service per average weekday would decrease somewhat, from 60,140 miles to 59,910 miles. Transit Stations—The number and location of busway system stations and stops would be the same as under the composite light rail transit plan.

[a] *The design of the composite busway plan provided for certain bus-on-freeway routes to operate over the busway for a portion of their trips, if such routing would not provide a travel time disadvantage. Of the five bus-on-freeway routes added to the plan, only the route operating over the North-South Freeway (IH 43) serving the communities of Bayside and River Hills would meet this criterion. This route would enter the busway at Locust Street and remain on the busway through downtown Milwaukee.*

Source: SEWRPC.

Table 241

SUMMARY OF EVALUATION OF THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Evaluative Measure	Alternative: Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Objective No. 1—Serve Land Use				
Accessibility				
Average Overall Travel Time of Transit Trips to the Milwaukee Central Business District (minutes)	34	34	35	36
Objective No. 2—Minimize Cost and Energy Use				
Cost				
Total Public Cost to Design Year (capital cost and operating and maintenance deficit)	$483,703,200	$593,539,800	$771,032,400	$709,009,800
Average Annual Total Public Cost	23,033,500	28,263,800	36,715,850	33,762,400
Capital Cost[a] and Investment				
Capital Cost to Design Year	107,761,000	143,648,000	336,039,000	268,270,000
Average Annual Capital Cost	5,131,500	6,840,400	16,001,900	12,774,800
Capital Investment to Design Year	161,597,700	203,037,300	606,946,100	452,763,300
Average Annual Capital Investment	7,695,100	9,668,400	28,902,200	21,560,100
Operating and Maintenance Cost Deficit (net cost)				
Deficit in Design Year	16,328,700	25,572,400	23,710,100	23,828,400
Deficit to Design Year	375,942,200	449,891,800	434,993,400	440,739,800
Average Annual Deficit	17,902,000	21,423,400	20,713,450	20,987,600
Cost-Effectiveness				
Total Cost to Design Year per Passenger	0.43	0.52	0.68	0.62
Capital Cost to Design Year per Passenger	0.10	0.12	0.30	0.24
Operating Deficit to Design Year per Passenger	0.33	0.39	0.38	0.39
Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year				
Total Transit System	53	46	48	47
Primary Element	49	42	72	64
Energy				
Total Transit System Energy Use to Design Year (million BTU's)	15,037,280	16,809,400	18,676,480	18,075,450
Total Transit Construction Energy Use to Design Year (million BTU's)	1,044,480	1,193,400	3,038,580	2,906,250
Total Transit Operating and Maintenance Energy Use to Design Year (million BTU's)	13,992,800	15,616,000	15,637,900	15,169,200
Total Transit Energy Use per Passenger Mile to Design Year (BTU's)	3,530	3,650	4,150	4,020
Total Transit Passenger Miles per Gallon of Diesel Fuel to Design Year (BTU's)	38.5	37.3	32.8	33.8
Dependence on Petroleum-Based Fuel	All trips dependent	All trips dependent	21 percent of transit trips not dependent	All trips dependent
Petroleum-Based Fuel Use by Transit to Design Year (gallons of diesel fuel)	100,744,850	112,045,440	103,587,210	108,893,900
Automobile Propulsion Energy Use in Design Year (gallons of gasoline)	338,400,000	332,800,000	332,800,000	333,600,000

Table 241 (continued)

Evaluative Measure	Alternative: Base Plan	Alternative: Truncated Bus-on-Freeway Plan	Alternative: Composite Light Rail Transit Plan	Alternative: Composite Busway Plan
Objective Nos. 3 and 5—Provide Appropriate Service and Quick Travel				
Average Weekday Transit Trips				
Total Transit System	169,400	180,200	178,100	177,200
Primary Element	9,500	15,300	43,500	37,600
Proportion of Transit Trips Using Primary Element	0.06	0.08	0.24	0.21
Service Coverage				
Population Served Within a One-Half Mile Walking Distance of Primary Transit Service	181,500	163,700	294,800	294,800
Population Served Within a Three-Mile Driving Distance of Primary Transit Service	698,800	741,700	917,300	917,300
Jobs Served Within a One-Half-Mile Walking Distance of Primary Transit Service	194,600	186,900	315,500	315,500
Average Speed of Transit Vehicle (mph)				
Primary Element	24	28	24	23
Total System	15	16	16	16
Average Speed of Passenger Travel on Vehicle (mph)				
Primary Element	25	32	25	23
Total System	15	18	17	17
Objective No. 4—Minimize Environmental Impacts				
Community Disruption				
Homes, Businesses, or Industries Taken	None	None	None	None
Land Required (acres)	10	14	103	100
Air Pollutant Emissions—Total Transportation System (Highway and Transit) in Design Year (tons per year)				
Carbon Monoxide	165,764	163,309	163,283	163,395
Hydrocarbons	16,702	16,392	16,392	16,405
Nitrogen Oxides	30,073	29,183	29,206	29,201
Sulfur Oxides	2,426	2,410	2,540	2,400
Particulates	3,959	3,909	3,917	3,910
Objective No. 6—Maximize Safety				
Proportion of Total Person Trips Made on Transit	0.047	0.050	0.049	0.049

[a] *The capital cost of a composite plan is equal to the plan's required capital investment, or total capital outlays necessary over the plan design period, less the value of that investment beyond the plan design period.*

Source: SEWRPC.

were not. The local and express transit elements of each truncated plan provide the extent of such service recommended under the adopted long-range regional transportation system plan, with modifications made only as necessary to coordinate such service with the primary transit service under each alternative plan. The adopted long-range transportation system plan proposed expansion of local transit service into all areas of contiguous future urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County. Not all of this expanded service may be cost-effective under this alternative future, and such service may thus reduce the cost-effectiveness of the alternative truncated and composite primary transit system plans. Upon selection of a "best" composite plan, the cost-effectiveness of this expanded local and express transit service will be considered, and its extent may be truncated, enabling a better comparison of the final primary transit plan to the base plan.

Objective 1—Serve Land Use: The first objective under this study identifies the need for an accessible primary transit system which, through its location, capacity, and design, will effectively serve existing, and promote sound future, land use development. This objective is measured by two standards. One standard measures the degree to which transit accessibility to the Milwaukee central business district is maximized. The other standard measures the degree to which transit accessibility in the Milwaukee area would support the regional land use plan by providing a higher relative accessibility to areas in which high-density development is planned than to areas planned for low-density development or planned to be protected from development.

The standard calling for maximizing transit accessibility to the Milwaukee central business district was measured by determining the overall travel time, including all access, wait, and transfer time, for transit trips to the Milwaukee central business district from all parts of the Milwaukee area, and the travel time for transit trips as an average for the entire Milwaukee area. The average overall travel times of transit trips to the central business district would be about the same for the three truncated or composite plans under this alternative future, ranging from 34 minutes for the bus-on-freeway plan to 36 minutes for the busway plan. The travel contour lines shown on Map 76 in Chapter III for the base plan and on Maps 107 through 109 for the bus-on-freeway, light rail transit, and busway plans indicate the overall transit travel times from each part of the Milwaukee area. Under the base system plan, the various travel time contours form a pattern of concentric rings centered on the Milwaukee central business district, with areas up to 2 miles away being within 20 minutes travel time. Areas up to 7 miles away in a westerly direction, 9 miles away in a northerly direction, and 8 miles away in a southerly direction are within 40 minutes travel time. Areas up to 11 miles away in a westerly direction, 13 miles away in a northerly direction, and 10 miles away in a southerly direction are within 60 minutes travel time of downtown Milwaukee. These maps indicate that transit accessibility to the central business district would be greater under all the truncated and composite plans than under the base plan.

The attainment of the other standard under this objective, which calls for adjusting transit accessibility to land use plans, was measured by comparing these contours of central business district transit accessibility to the regional land use plan.[14] The Milwaukee central business district is the most important trip generator in the Milwaukee area, and would, under this alternative future, remain so, accounting for over 6 percent of the approximately 3.6 million trips occurring within the Milwaukee area on an average weekday. It would also be the most important transit trip generator, accounting for about 25 percent of the average weekday transit trips under each alternative truncated or composite system plan. As shown on Map 76 in Chapter III and on Maps 107 through 109, all the plans would generally support the adopted regional land use plan.

Objective 2—Cost and Energy: The second objective concerns achievement of a primary transit system which is economical and efficient, satisfying all other objectives at the lowest possible cost. This objective is supported by key standards relating to the minimization of costs and energy consumption, and maximization of cost-effectiveness. As shown in Table 241, of the three alternative truncated and composite primary transit system plans, the plan with the lowest total cost to the design year under this future, including all capital and net operating and maintenance costs, is the truncated bus-on-freeway plan, which has an estimated total cost of $594 million. The busway plan follows with a total cost of $709 million, and the most costly plan would be the light rail transit plan, with an estimated total cost of $771 million.

The principal reason for the difference in the costs between the plans is capital cost—that is, the capital investment over the plan design period less the value of the remaining life of the facilities and vehicles at the end of the 20-year plan design period. The capital cost of the light rail plan is more than twice that of the bus-on-freeway plan, and the capital cost of the busway plan is nearly 90 percent more than that of the bus-on-freeway plan. In terms of the total capital investment which would be required over the plan design period, the

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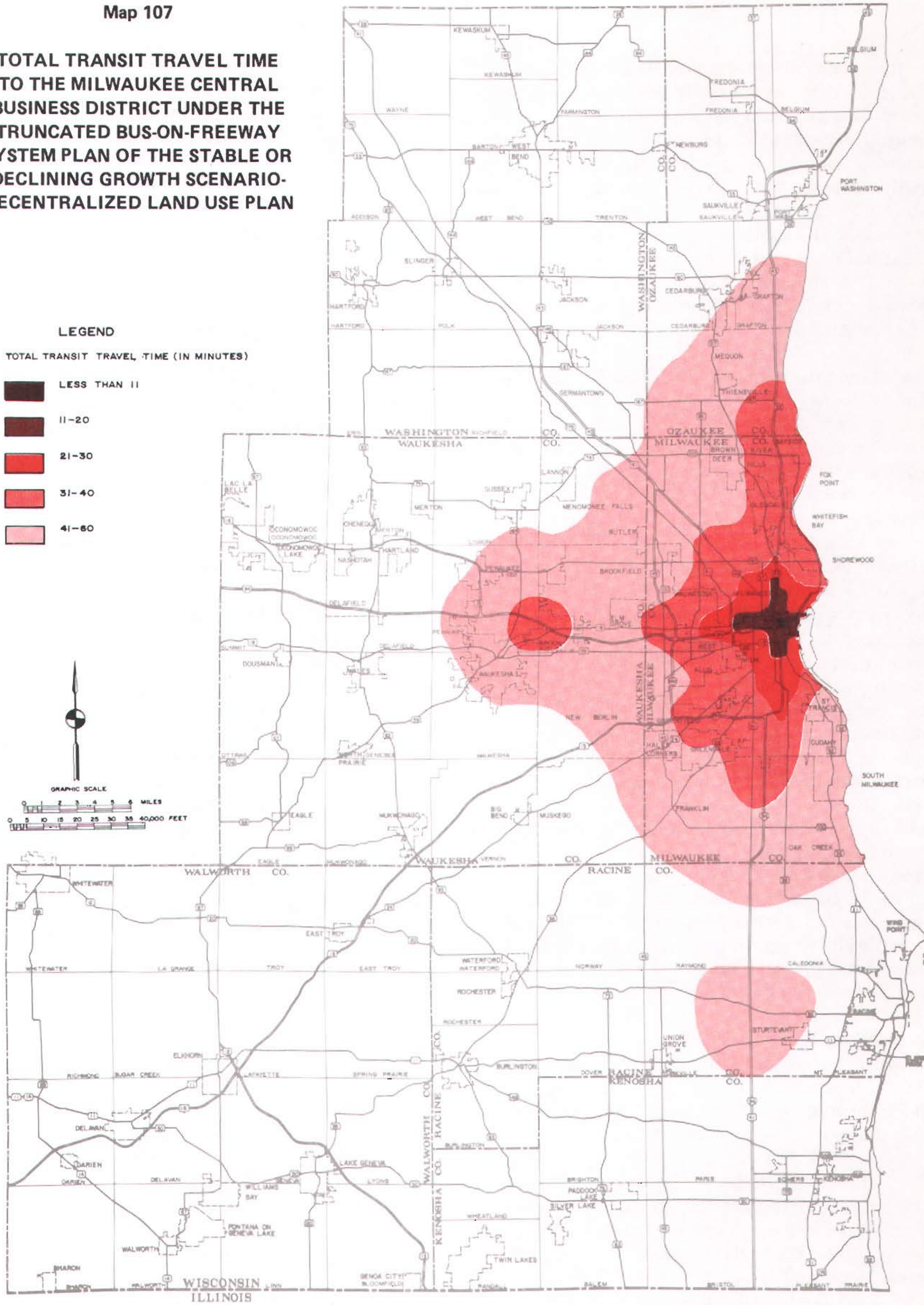
[14] *The regional land use plan recommends a highly centralized land use development pattern. Population and jobs are proposed to be reconcentrated in central Milwaukee County, and new urban development is proposed to occur principally at urban densities along and contiguous to the periphery of existing urban centers. See SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume Two, Alternative and Recommended Plans.*

Map 107

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN OF THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

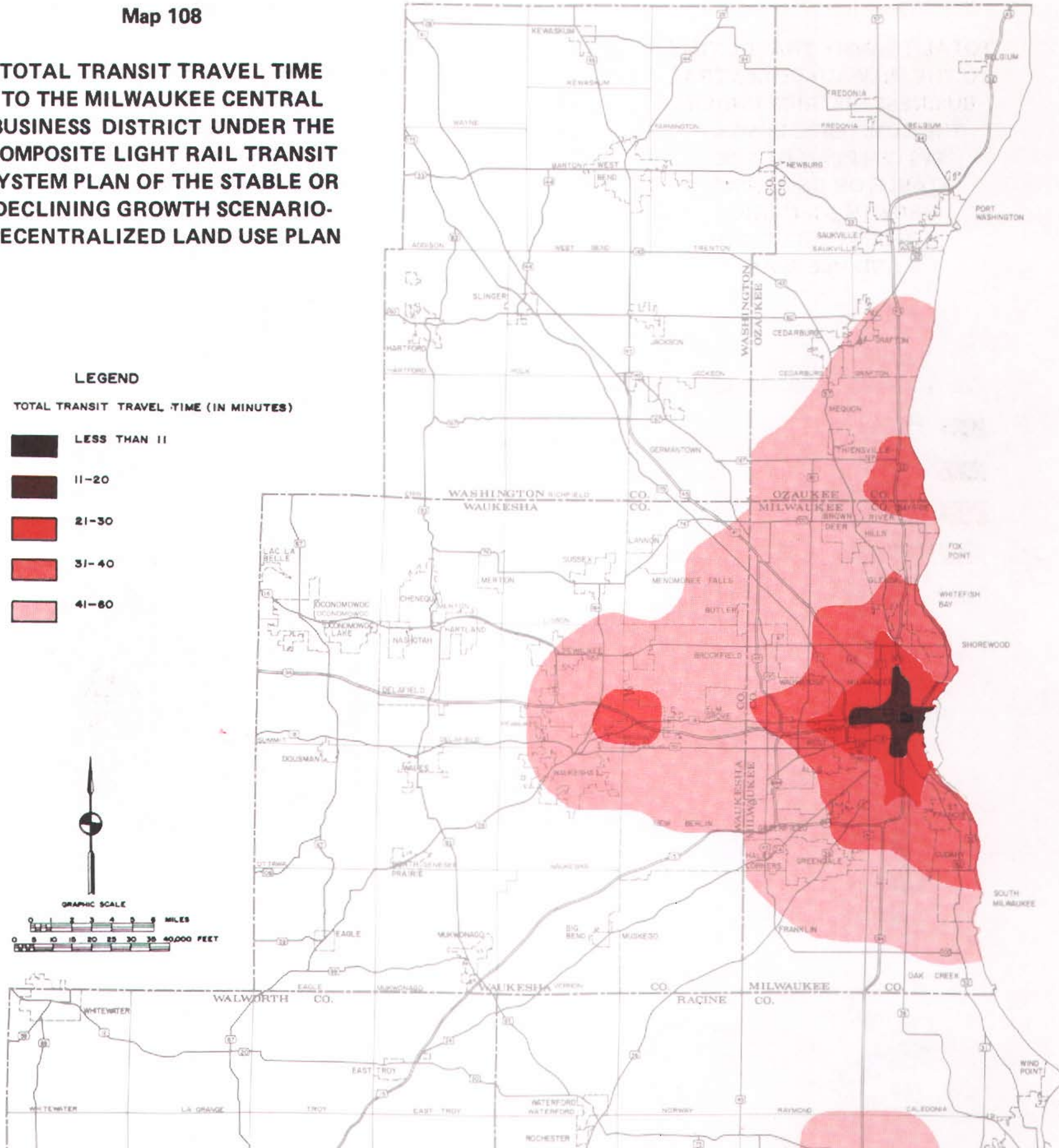


One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the truncated bus-on-freeway plan, the various travel time contours form a disconnected lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south. Areas up to 2 miles away are within 20 minutes travel time, and areas up to 13 miles in a northerly direction, up to 15 miles in a westerly direction, and up to 10 miles in a southerly direction are within 40 minutes travel time of downtown Milwaukee. Areas within 60 minutes travel time extend as far as 19 miles to the north and west, and as far as 25 miles to the south of downtown Milwaukee.

Source: SEWRPC.

Map 108

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE COMPOSITE LIGHT RAIL TRANSIT SYSTEM PLAN OF THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

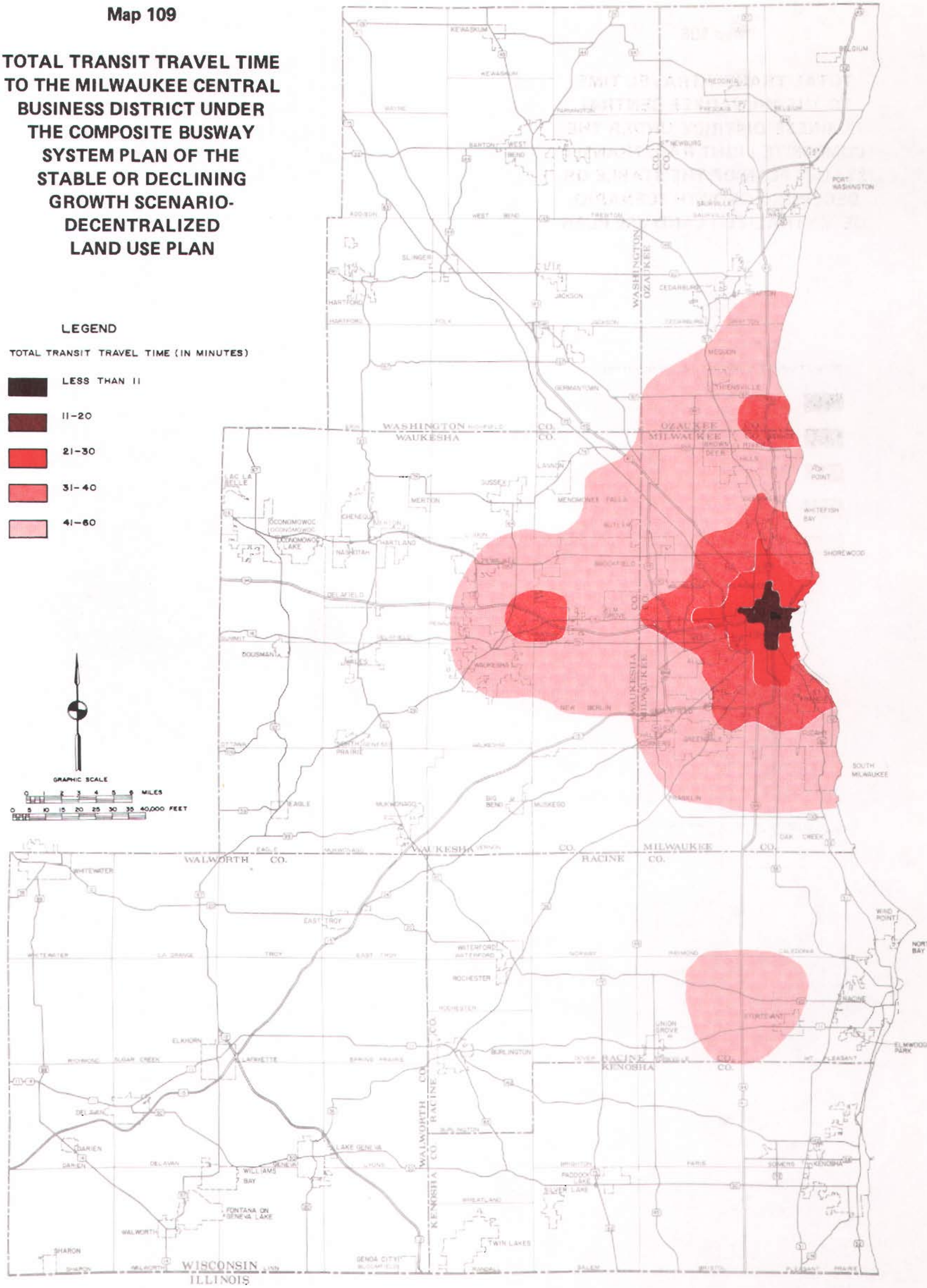


One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the composite light rail transit plan, the various travel time contours form a disconnected lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south, with areas that are up to 2 miles from downtown being within 20 minutes travel time. Areas within 40 minutes travel time extend only 8 miles to the south, but extend up to 13 miles to the north and 15 miles to the west. Areas up to 19 miles in a northerly direction, 18 miles in a westerly direction, and 25 miles in a southerly direction are within 60 minutes travel time of downtown Milwaukee.

Source: SEWRPC.

Map 109

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE COMPOSITE BUSWAY SYSTEM PLAN OF THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the composite busway system plan, the various travel time contours form a disconnected lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south, with areas that are up to 2 miles from downtown being within 20 minutes travel time. Areas within 40 minutes travel time extend only 7 miles to the south, but 12 miles to the north and 15 miles to the west. Areas up to 18 miles in a northerly direction, 19 miles in a westerly direction, and 25 miles in a southerly direction are within 60 minutes travel time of downtown Milwaukee.

Source: SEWRPC.

Table 242

TOTAL CAPITAL INVESTMENT TO DESIGN YEAR REQUIRED UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Capital Cost Element[a]	Alternative			
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Guideway Development[b]	$ --	$ 14,326,000	$380,284,200	$242,904,200
Station Development[c]	2,387,700	4,891,300	19,690,500	22,144,100
Vehicle Storage and Maintenance Facility Development	15,850,000	16,900,000	27,231,400	16,575,000
Vehicle Acquisition and Replacement[d]	143,360,000	166,920,000	179,740,000	171,140,000
Total	$161,597,700	$203,037,300	$606,946,100	$452,763,300

[a] *It is assumed under this capital cost analysis that the base plan and the alternative truncated and composite primary transit plans will be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 through 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes the cost of acquiring about 70 acres of right-of-way for guideway construction for the light rail transit and busway system plans. This land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years. Also includes the implementation cost of the proposed freeway operational control system in the Milwaukee area, which has a useful life of 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—10 acres under the base plan, 33 acres under the light rail transit plan, 30 acres under the busway system plan, and 14 acres under the bus-on-freeway plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement, as necessary, over the 20-year design period of all buses and light rail vehicles used in all elements of the system. All alternative plans under this future are assumed to utilize the entire existing fleet of 640 motor buses, which—in 1980—are assumed to have an average age of 10 years each. Buses are assumed to have an average useful life of 12 years. Light rail vehicles have an estimated useful life of 30 years.*

Source: SEWRPC.

bus-on-freeway alternative requires less than one-half the investment of the light rail transit and busway plans. The bus-on-freeway plan would require an outlay of about $203 million, while the busway plan would require $452 million and the light rail transit plan would require about $607 million, as shown in Table 242. The light rail transit and busway system plans, however, would be expected to provide an annual net operating and maintenance cost advantage over the bus-on-freeway plan. In the design year, the light rail transit plan would require about $1.9 million, or 7.5 percent, less subsidy than the bus-on-freeway plan. The busway plan would require about $1.8 million, or 7 percent, less subsidy than the bus-on-freeway plan.

In terms of the cost-effectiveness of the alternative truncated and composite primary transit plans, the total cost per passenger to the design year of the busway plan is about 9 percent lower than under the light rail transit plan, $0.62 per passenger compared with $0.68 per passenger. The total cost per passenger of the bus-on-freeway plan, estimated at $0.52, is somewhat lower than those of the light rail transit and busway plans. The reason for this difference in total cost per passenger between the truncated plans is again the high capital costs of the light rail transit and busway plans. The capital cost per passenger of the light rail transit plan is more than double that of the bus-on-freeway plan, and the capital cost per passenger of the busway plan is twice that of the bus-on-freeway plan. There is very little difference in the net operating costs per passenger to, or in, the design year between the three truncated plans, as shown in Tables 241 and 243. The light rail transit plan has the lowest net operating cost per passenger over the design period, \$0.38, and the bus-on-freeway and busway plans have the highest, \$0.39 each.

Estimates of the total amount of energy that would be used in the implementation of the truncated primary transit plans under this alternative future are set forth in Tables 241 and 244. Over the 20-year design period, the bus-on-freeway plan would consume the least amount of energy, about 16,809 billion British Thermal Units (BTU's). The total energy consumption under the busway and light rail transit plans would be expected to be about 10 percent greater, 18,676 billion BTU's and 18,075 billion BTU's, respectively. The energy consumed per passenger mile traveled would also be the lowest under the bus-on-freeway plan, 3,650 BTU's, compared with 4,020 BTU's under the composite busway plan and 4,150 BTU's under the composite light rail transit plan.

The energy used for construction under each plan would be minimal compared to the energy required for operation. Of the three plans, the bus-on-freeway plan would require the least energy for construction—7 percent of the total energy consumption under the plan. Both the light rail transit and busway plans would use 16 percent of the total plan energy for construction. The light rail transit plan would require the most energy for operation, 15,637 billion BTU's to the design year 2000, while the busway plan would require the least, 15,169 billion BTU's. However, the light rail transit plan would require the least petroleum energy for vehicle propulsion, 4.5 percent less than the busway plan and 7 percent less than the bus-on-freeway plan, since most of the transit trips made on the primary element of this plan would be made on electrically propelled vehicles, as opposed to diesel motor buses. Under the light rail transit plan, more than 21 percent of the transit trips occur on the primary element.[15]

The energy which may be expected to be used in highway travel by automobiles in the plan design year is also expected to be about the same under all three truncated or composite plans, as shown in Table 245. More than 30 times more energy would be used in the plan design year for automobile travel than for transit under this future. Consequently, any petroleum savings of a light rail

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[15] *Implementation of a light rail transit system in the Milwaukee area can be expected to have an insignificant impact upon existing and future electric power generating requirements within southeastern Wisconsin. Light rail transit system operation can be expected to result in a very small increase in peak demand as well as a negligible increase in total annual power consumption based upon the capacity of the 1980 electric power generating system, and the expanded electric power generating system necessary for other reasons by the plan design year.*

Electric power for the Milwaukee area is supplied by the Wisconsin Electric Power Company (WEPCo), which currently relies on coal-fired power plants for generating more than 95 percent of its electricity. Nuclear power plants provide the remaining electricity generated by WEPCo. According to data acquired by WEPCo in order to plan for future power generation capacity in southeastern Wisconsin, the instantaneous peak demand within the WEPCo service area was 3.3 million kilowatts during the summer season of 1980 and 3.0 million kilowatts during the winter season of 1980. By the year 2000, these peak demands are expected by WEPCo to increase by 40 to 70 percent. The instantaneous peak may be expected to occur between 12:00 p.m. and 4:00 p.m. in the summer and between 5:00 p.m. and 7:00 p.m. in the winter.

The peak power demand for vehicle propulsion for this composite light rail transit system would be approximately 24.0 megawatts during the plan design year 2000. This represents about 0.8 percent of the WEPCo 1980 actual summer and winter peak demands, and less than 0.8 percent of the WEPCo forecast year 2000 peak demands.

The WEPCo also estimates that annual electrical energy use during 1980 totaled 18,701 gigawatt-hours within the WEPCo service area. The total power consumption for vehicle propulsion on the light rail transit system would be approximately 35 million kilowatt-hours during the design year, or substantially less than 1 percent of the estimated total energy consumption for the WEPCo service area in 1980. Electricity necessary for the operation of a light rail transit system is likely to represent an even smaller percentage during the plan design year, since the total amount of power consumption in southeastern Wisconsin is expected by WEPCo to increase by 70 percent by the year 2000.

Table 243

PRIMARY AND TOTAL TRANSIT SYSTEM OPERATING AND MAINTENANCE COSTS IN THE DESIGN YEAR FOR THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Alternative			
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Ridership				
Primary Element	2,422,500	3,901,500	11,092,500	9,588,000
Total System	48,793,500	51,751,500	50,155,500	50,101,000
Operating and Maintenance Cost				
Primary Element	$ 2,950,400	$ 5,978,700	$ 8,244,200	$ 8,232,200
Total System	35,646,200	47,530,600	45,412,100	45,412,200
Operating and Maintenance Cost per Passenger				
Primary Element	$1.22	$1.53	$0.74	$0.86
Total System	0.73	0.92	0.90	0.91
Operating and Maintenance Cost per Passenger Mile				
Primary Element	$0.17	$0.11	$0.11	$0.12
Total System	0.20	0.21	0.22	0.22
Farebox Revenue				
Primary Element	$ 1,453,500	$ 2,536,000	$ 5,914,700	$ 5,223,400
Total System	19,317,500	21,958,200	21,702,000	21,583,800
Operating Deficit				
Primary Element	$ 1,496,900	$ 3,442,700	$ 2,329,500	$ 3,008,800
Total System	16,328,700	25,572,400	23,710,100	23,828,400
Operating Deficit per Passenger				
Primary Element	$0.62	$0.88	$0.21	$0.31
Total System	0.33	0.49	0.47	0.48
Farebox Revenue as a Percent of Operating Costs				
Primary Element	49	42	72	64
Total System	53	46	48	47
Public Funding Under Current Program[a]				
Federal (50 percent of operating deficit)				
Primary Element	$ 748,450	$ 1,721,350	$ 1,164,750	$ 1,504,400
Total System	8,164,350	12,786,200	11,855,050	11,914,200
State (72 percent of nonfederal share of operating deficit)				
Primary Element	538,884	1,239,370	838,620	1,083,168
Total System	5,878,332	9,206,060	8,535,640	8,578,224
Local				
Primary Element	209,566	481,980	326,130	421,232
Total System	2,286,018	3,580,140	3,319,410	3,335,976
Local Operating Deficit per Ride				
Primary Element	$0.09	$0.12	$0.03	$0.04
Total System	0.05	0.07	0.07	0.07

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.2 million required under the base plan, but less than the $12.9 million required under the maximum extent bus-on-freeway plan and about equal to the $11.9 million required under the maximum extent light rail transit and maximum extent busway system plans. These amounts of public funding for the respective primary transit system plans would provide 50 percent of federal funding of the operating deficits. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

Table 244

COMPARISON OF TOTAL TRANSIT ENERGY REQUIREMENTS UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Energy Element	Alternative			
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Primary Transit Element				
Operating and Maintenance Energy to Design Year (million BTU's)				
Vehicle Propulsion Energy	800,440	1,125,570	1,692,600	1,252,910
Petroleum Fuel Consumed	800,440	1,125,570	500,180	1,252,910
Nonpetroleum Fuel Consumed	- -	- -	1,192,420	- -
Station Operation and Maintenance Energy	49,320	59,570	62,020	66,290
Vehicle Maintenance Energy	22,180	38,790	45,520	43,100
Total Operating and Maintenance Energy	871,940	1,223,930	1,800,140	1,362,300
Total System Construction Energy to Design Year (million BTU's)				
Guideway Construction	- -	- -	1,753,560	1,695,000
Vehicle Manufacture	112,200	159,120	325,200	249,400
Total Construction Energy	112,200	159,120	2,078,760	1,944,400
Total System				
Operating and Maintenance Energy to Design Year (million BTU's)				
Vehicle Propulsion Energy	13,701,300	15,238,180	15,280,280	14,809,570
Petroleum Fuel Consumed	13,701,300	15,238,180	14,087,860	14,809,570
Nonpetroleum Fuel Consumed	- -	- -	1,192,420	- -
Station Operation and Maintenance Energy	49,320	59,570	62,020	66,290
Vehicle Maintenance Energy	242,180	318,250	295,600	293,340
Total Operating and Maintenance Energy	13,992,800	15,616,000	15,637,900	15,169,200
Total System Construction Energy to Design Year (million BTU's)				
Guideway Construction	- -	- -	1,753,560	1,695,000
Vehicle Manufacture	1,044,480	1,193,400	1,285,020	1,211,250
Total Construction Energy	1,044,480	1,193,400	3,038,580	2,906,250

Source: SEWRPC.

Table 245

COMPARISON OF DESIGN YEAR AUTOMOBILE TRAVEL AND ENERGY CONSUMPTION UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Alternative	Automobile Vehicle Miles Traveled in the Design Year (billions)	Automobile Energy Consumption in the Design Year (million BTU's)
Base Plan	9.62	42,300,000
Truncated Bus-on-Freeway Plan	9.39	41,600,000
Composite Light Rail Transit Plan	9.40	41,600,000
Composite Busway Plan	9.41	41,700,000

Source: SEWRPC.

transit system would represent less than 1 percent of the energy required by the total transportation system, including travel by automobiles.

Objectives 3 and 5—Provision of Adequate Level of Service and Provision for Quick and Convenient Travel: Two of the primary transit system development objectives can be considered together for this evaluation: Objective No. 3, which calls for a transit system which provides an adequate level of service, and Objective No. 5, which calls for a primary transit system which provides for quick and convenient travel. These two objectives are supported by three key standards: level of transit ridership, number of residents and jobs served, and transit trip speed. The remaining standards under these two objectives either have all been met in the design of the alternative plans or could be met by all the plans if properly implemented.

Of all the standards under these two objectives, the level of transit ridership best represents the level of transit service provided by alternative transit plans. Total transit system ridership under the alternative plans is expected to differ by only 3 percent, ranging from a low of 177,200 trips on an average weekday under the busway plan to 180,200 trips per average weekday under the bus-on-freeway plan. However, significant differences are expected in the number and proportion of trips made on the primary element of the alternative transit system plans. As shown in Tables 246 and 247, the proportion of transit trips made on the primary element is expected to be the highest under the composite light rail transit plan, nearly 25 percent of the total 178,100 transit trips made on an average weekday under this plan, or 43,500 trips. The second highest primary transit ridership under this future would be on the composite busway plan—about 37,600 trips, or 20 percent of the total transit ridership. The primary element of the bus-on-freeway plan would carry 15,300 trips, or 8 percent of total transit system ridership. Because the total transit system ridership does not vary significantly among the three truncated plans, it can be concluded that the substantial additional ridership on the primary element of the light rail transit and busway plans is comprised of trips which would be expected to use local or express transit services under the bus-on-freeway plan. This assumption is reasonable given the small travel time advantages expected under the light rail transit and busway plans. Express and local services under all the plans are expected to average 17 and 14 mph, respectively, compared with 20 mph under the light rail transit primary element and 18 mph under the busway primary element. These express and local service speeds are about the same as those achieved on the existing transit system, which is to be expected since little additional street and highway traffic congestion is anticipated in the Milwaukee area under this alternative future.

With respect to the standard calling for maximizing the number of jobs and resident population served, the primary elements of the composite light rail transit and busway plans would serve the greatest number of residents, 917,300 within a three-mile driving distance of primary transit service. The primary element of the bus-on-freeway alternative plan would be accessible by driving to about 741,700 residents. The light rail transit and busway plans would also provide the greatest accessibility to residents within walking distance of primary transit stations and stops—about 294,800 residents, compared with 163,700 residents under the bus-on-freeway plan. Employment served within walking distance would also be greatest under the light rail transit and busway plans, 315,500 jobs compared with 186,900 jobs under the bus-on-freeway plan. All the additional residents and jobs within walking distance of primary transit under the light rail transit and busway plans would be located within the portions of Milwaukee County planned for urban development under the regional land use plan.

The truncated and composite plans are only slightly different with respect to the standard relating to the average speed provided by primary transit. The average vehicle speeds on the primary transit elements of the plans are expected to range from a low of 23 mph under the composite busway plan to 24 mph under the composite light rail transit plan, and to a high of 28 mph under the truncated bus-on-freeway plan. The average vehicle speed on all elements—primary, express, and local—of the light rail and busway plans would be expected to be 17 mph. The average transit vehicle speed under the bus-on-freeway plan would be 18 mph. The average speeds of passenger travel on the primary transit vehicles would range from a high of 32 mph under the bus-on-freeway plan, to 25 mph under the light rail transit plan, and a low of 23 mph under the busway plan. Average speeds of passenger travel on vehicles of all service elements of the truncated and composite plans would range from 18 mph under the bus-on-freeway plan to 17 mph under the light rail transit and busway plans. Average speeds of pas-

Table 246

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Trip Purpose	Alternative					
	Base Plan			Truncated Bus-on-Freeway Plan		
	Total Person Trips	Transit Trips		Total Person Trips	Transit Trips	
		Number	Percent of Total Trips		Number	Percent of Total Trips
Home-Based Work	958,800	60,900	6.4	959,100	66,200	6.9
Home-Based Shopping . .	502,600	21,700	4.3	502,400	23,500	4.7
Home-Based Other	1,139,400	42,000	3.7	1,138,200	45,900	4.0
Nonhome Based.	655,600	8,400	1.3	654,300	8,200	1.2
School	364,900	36,400	10.0	365,000	36,400	10.0
Total	3,621,300	169,400	4.7	3,619,000	180,200	5.0

Trip Purpose	Alternative					
	Composite Light Rail Transit Plan			Composite Busway Plan		
	Total Person Trips	Transit Trips		Total Person Trips	Transit Trips	
		Number	Percent of Total Trips		Number	Percent of Total Trips
Home-Based Work	958,900	67,000	7.0	959,100	66,100	6.9
Home-Based Shopping . .	501,800	22,600	4.5	502,100	22,600	4.5
Home-Based Other	1,136,100	44,300	3.9	1,137,100	44,300	3.9
Nonhome Based.	653,200	7,800	1.2	653,700	7,800	1.2
School	365,000	36,400	10.0	365,000	36,400	10.0
Total	3,615,000	178,100	4.9	3,617,000	177,200	4.9

Source: SEWRPC.

senger travel are generally higher than vehicle speeds because passengers are typically concentrated on the transit facilities and services of highest speed.

Objective 4—Environmental and Resource Disruption: The fourth objective is to minimize the disruption of existing neighborhood and community development and to minimize deterioration of the natural resource base. This objective is supported by key standards relating to community disruption and air quality.

In terms of community disruption, none of the three alternative truncated primary transit system plans would require the taking of any homes, businesses, or industries. They would, however, require the acquisition of right-of-way for guideway, stations, and maintenance and storage facilities. Of the three truncated and composite primary transit alternatives, both the light rail transit and busway system plans would require the acquisition of about 100 acres of land, compared with 14 acres under the truncated bus-on-freeway plan.

Tables 241 and 248 set forth the levels of highway and transit air pollutant emissions anticipated under each of the alternative truncated and composite primary transit system plans under this alternative future. All three plans are expected to have similar levels of total transportation system carbon monoxide, hydrocarbon, particulate matter, and nitrogen oxide air pollutant emissions. Transportation-related sulfur oxide emissions are expected

Table 247

PRIMARY AND TOTAL TRANSIT TRIPMAKING BY TIME OF DAY UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Time Period	Alternative							
	Base Plan				Truncated Bus-on-Freeway Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,000	42.1	41,800	24.7	4,200	27.4	43,300	24.0
Midday	200	2.1	53,400	31.5	3,700	24.2	57,300	31.8
Afternoon . .	5,300	55.8	59,800	35.3	5,900	38.6	63,800	35.4
Evening. . . .	- -	- -	14,400	8.5	1,500	9.8	15,800	8.8
Total	9,500	100.0	169,400	100.0	15,300	100.0	180,200	100.0

Time Period	Alternative							
	Composite Light Rail Transit Plan				Composite Busway Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	15,100	34.7	44,200	24.8	13,100	34.8	43,900	24.8
Midday	5,300	12.2	55,700	31.3	4,600	12.2	55,600	31.4
Afternoon . .	20,500	47.1	62,900	35.3	17,700	47.1	62,500	35.2
Evening. . . .	2,600	6.0	15,400	8.6	2,200	5.9	15,300	8.6
Total	43,500	100.0	178,200	100.0	37,600	100.0	177,300	100.0

Source: SEWRPC.

to be about 5 percent higher under the light rail transit plan. However, this difference in sulfur oxide emissions represents a difference of less than one-tenth of 1 percent when considered in the context of the total air pollutant emissions forecast from all air pollutant sources in the Region.

Objective 6—Safety: The sixth transportation objective relates to the reduction of accident exposure and the provision of increased travel safety. This objective is supported by two key standards, one measuring the degree to which travel by transit is maximized and the other measuring the degree to which travel on exclusive guideway transit is maximized. Travel by transit is safer than travel by automobile, and travel on exclusive guideway transit is the safest travel by transit because of the lack of conflicts with pedestrian or vehicle traffic. As demonstrated in Table 241, there would be little difference among the three truncated plans with respect to travel safety. The proportion of total person trips using transit is about the same under the three truncated and composite plans, and none of the alternatives utilizes fully exclusive guideways with grade separation of all crossing vehicle and pedestrian traffic.

Summary

The comparative evaluation of the alternative truncated or composite primary transit system plans—bus-on-freeway, busway, and light rail transit—indicated that, under the stable or declining growth scenario-decentralized land use plan alternative future, all the systems may be expected to provide a reasonably comparable level of primary transit service in the Milwaukee area in the

Table 248

COMPARISON OF DESIGN YEAR AIR POLLUTANT EMISSIONS OF THE TRANSIT AND HIGHWAY SYSTEM UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Air Pollutant	Alternative			
	Base Plan (tons per year)	Truncated Bus-on-Freeway Plan (tons per year)	Composite Light Rail Transit Plan (tons per year)	Composite Busway Plan (tons per year)
Primary Element				
Carbon Monoxide	39	50	27	67
Hydrocarbons	4	6	3	7
Nitrogen Oxides	9	13	34	15
Sulfur Oxides.	5	8	116	9
Particulate Matter	3	4	14	5
Total System				
Carbon Monoxide	652	829	724	764
Hydrocarbons	65	83	72	76
Nitrogen Oxides	113	146	153	134
Sulfur Oxides.	52	68	170	63
Particulate Matter	30	38	45	36
Total Transportation System				
Carbon Monoxide	165,764	163,309	163,283	163,395
Hydrocarbons	16,702	16,392	16,392	16,405
Nitrogen Oxides	30,073	29,183	29,206	29,201
Sulfur Oxides.	2,426	2,411	2,514	2,400
Particulate Matter	3,959	3,909	3,917	3,910

Source: SEWRPC.

plan design year. As indicated in Table 249, the alternative systems were found to be quite similar with respect to total ridership, public subsidy required, and operating cost-effectiveness. Each system may be expected to attract about the same level of total transit ridership in the area, varying by no more than 3,000 trips, or by about 2 percent, on an average weekday in the plan design year. Also, each system may be expected to entail a similar annual operating and maintenance cost deficit, varying by no more than $1.9 million, or 8 percent, in the plan design year. And, each plan may be expected to recover a similar proportion of the operating and maintenance costs from farebox revenues, between 46 and 48 percent.

Several significant differences between the plans, however, were also revealed by the comparative evaluation. The largest difference was in the capital cost attendant to the plans, which ranged from a low of about $144 million for the truncated bus-on-freeway plan to a high of $336 million for the composite light rail transit plan. Other differences noted included the degree of accessibility to jobs and resident population, the amount of ridership on the primary element, and the degree of use of, and dependence on, petroleum-based fuel (see Table 249).

Because this evaluative information does not clearly identify the best of the alternative composite plans under this alternative future, the key advantages and disadvantages of the alternative plans were comparatively analyzed. This analysis was done by arranging the alternative plans in order of increasing total cost over the plan design period, and performing successive comparisons of pairs of the plans beginning with a comparison of the plan of lowest total cost plan—the truncated bus-on-freeway plan—and the next least costly plan—the composite busway plan. The best plan of this pair was then compared to the most costly

Table 249

KEY DIFFERENCES BETWEEN THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Evaluative Measure	Alternative			
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Objective No. 2—Minimize Cost and Energy Use				
Cost				
Total Public Cost to Design Year (capital cost and operating and maintenance deficit)	$483,703,200	$593,593,800	$771,032,400	$709,009,800
Average Annual Total Public Cost	23,033,500	28,263,800	36,715,850	33,762,400
Capital Cost[a] and Investment				
Capital Cost to Design Year	107,761,000	143,648,000	336,039,000	268,270,000
Average Annual Capital Cost	5,131,500	6,840,400	16,001,900	12,774,800
Capital Investment to Design Year	161,597,700	203,037,300	606,946,100	452,843,300
Average Annual Capital Investment	7,695,100	9,668,400	28,902,200	21,560,100
Operating and Maintenance Cost Deficit (net cost)				
Deficit in Design Year	16,328,700	25,572,400	23,710,100	23,828,400
Deficit to Design Year	375,942,200	449,891,800	434,993,400	440,739,800
Average Annual Deficit	17,902,000	21,423,400	20,713,450	20,987,600
Cost-Effectiveness				
Total Cost to Design Year per Passenger	0.43	0.52	0.68	0.62
Capital Cost to Design Year per Passenger	0.10	0.12	0.30	0.24
Operating Deficit to Design Year per Passenger	0.33	0.39	0.38	0.39
Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year				
Total Transit System	53	46	48	47
Primary Element	49	42	72	64
Energy				
Dependence on Petroleum-Based Fuel	All trips dependent	All trips dependent	21 percent of trips not dependent	All trips dependent
Petroleum-Based Fuel Use by Public Transit to Design Year (gallons of diesel fuel)	100,744,850	112,045,440	103,587,210	108,893,900
Objective Nos. 3 and 5—Provide Appropriate Service and Quick Travel				
Average Weekday Transit Trips				
Total Transit System	169,400	180,200	178,100	177,200
Primary Element	9,500	15,300	43,500	37,600
Service Coverage				
Population Served Within a One-Half-Mile Walking Distance of Primary Transit Service	181,500	163,700	294,800	294,800
Population Served Within a Three-Mile Driving Distance of Primary Transit Service	698,800	741,700	917,300	917,300
Jobs Served Within a One-Half-Mile Walking Distance of Primary Transit Service	194,600	186,900	315,500	315,500
Average Speed of Transit Vehicle (mph)				
Primary Element	24	28	24	23
Total System	15	16	16	16
Average Speed of Passenger Travel on Vehicle (mph)				
Primary Element	25	32	25	23
Total System	15	18	17	17
Objective No. 4—Minimize Environmental Impacts				
Community Disruption				
Land Required (acres)	10	14	103	100

[a] *The capital cost of a composite plan is equal to the plan's required capital investment, or total capital outlays necessary over the plan design period, less the value of that investment beyond the plan design period.*

Source: SEWRPC.

Table 250

KEY ADVANTAGES AND DISADVANTAGES OF THE COMPOSITE BUSWAY SYSTEM PLAN IN COMPARISON TO THE TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Factor	Advantage	Disadvantage
Cost	$1.8 million, or 7 percent, less operating subsidy required in design year Total transit system revenues recover 1 percent more operating costs, and primary element revenues recover 22 percent more operating costs, in design year	$116 million, or 20 percent, more total cost over plan design period $124.7 million, or 87 percent, more capital cost—that is, the capital investment less the value of the remaining life of the facilities at the end of the 20-year plan design period $249.8 million, or 123 percent, more capital investment required over design period $0.10, or 20 percent, more total cost per passenger over design period
Accessibility	131,100, or 80 percent, more resident population within walking distance 128,600, or 70 percent, more jobs within walking distance	- -
Transit Ridership	22,300, or 145 percent, more primary transit trips on an average weekday in design year	3,000, or 2 percent, fewer total transit trips on an average weekday in design year
Disruption	- -	86 acres, or more than six times, more land required for system development

Source: SEWRPC.

plan—the composite light rail transit plan, and the best system plan so identified. This successive comparison of alternative plans is not unlike incremental economic plan evaluation techniques, which have long been used to establish whether the marginal benefits of alternative plans exceed their additional costs over the cost of other alternative plans.

Comparison of Composite Busway and Truncated Bus-on-Freeway Plans: The busway composite plan would entail about $116 million, or 20 percent, more total cost over the plan design period than the truncated bus-on-freeway plan. However, it would have a number of advantages over the bus-on-freeway plan. The most significant of these advantages, as indicated in Table 250, would be the greater accessibility provided to jobs and residents in the Milwaukee area and the greater number of transit trips made on the primary element of the transit system. About 80 percent, or 131,100, more people, and 70 percent, or 128,600, more jobs may be expected to be within walking distance of primary transit facilities under the busway composite plan than under the bus-on-freeway plan. Nearly 22,300, or 145 percent, more transit trips may be expected to be made on the primary element of the busway plan. All these additional trips made on the primary element of the composite busway plan may be expected to be made under the bus-on-freeway plan as well, but on the local and express elements of that plan. These transit trips would, therefore, receive a lower level of service, averaging about two mph slower over the vehicle portion of the trips and requiring an average of three more minutes per transit trip. However, because the bus-on-freeway plan would provide a much faster primary element than the busway plan, overall transit travel would be about one mph faster on the vehicle portion of the trip under the bus-on-freeway plan, saving about one minute per transit trip.

One other advantage of the composite busway plan is that, at the end of the plan design period, it would be more efficient than the truncated bus-on-freeway plan with respect to the proportion of operating and maintenance costs recovered from farebox revenues. The busway plan may be expected to require $1.8 million, or 7 percent, less subsidy in the plan design year than the bus-on-freeway plan, and the busway plan may be expected to recover about 1 percent more of its operating costs from farebox revenues than the bus-on-freeway plan. In addition, the busway plan's primary element may be expected to recover nearly 22 percent more of its operating costs from farebox revenues in the plan design year.

These operating and maintenance cost efficiencies, however, are offset by the principal disadvantage of the busway plan, its additional capital costs. The busway plan would entail $125 million, or 87 percent, more capital costs over the plan design period than the bus-on-freeway plan, and would require $250 million, or 123 percent, more capital investment over the plan design period. Thus, the total cost of the busway plan would be $116 million, or 20 percent, more than that of the bus-on-freeway plan. Also, the total cost per passenger of the busway plan over the plan design period would be $0.10, or 20 percent, more than that of the bus-on-freeway plan. In addition, the bus-on-freeway plan may be expected to attract 3,000, or 2 percent, more transit trips from automobiles than the busway plan on an average weekday in the plan design period. Nearly all this additional transit tripmaking would consist of trips to and from the Milwaukee central business district. Increased use of transit to the central business district may be expected under the bus-on-freeway plan because its service to the central business district would be faster, operating directly from outlying areas with no or few intermediate stops.

The disadvantages of the busway plan outweigh its advantages over the bus-on-freeway plan. Although the busway plan would require less operating subsidy than the bus-on-freeway plan, its capital cost would offset this advantage. Moreover, the bus-on-freeway plan may be expected to divert slightly more automobile travel to the use of public transit. Accordingly, it was concluded that the truncated bus-on-freeway plan was, as a system, a superior alternative to the composite busway plan. Therefore, the last of the composite plans, the composite light rail transit plan, was compared to the bus-on-freeway plan.

Comparison of the Composite Light Rail Transit and Truncated Bus-on-Freeway Plans: The total cost of the composite light rail transit plan would be $175 million, or 29 percent more than the total cost of the bus-on-freeway plan. The light rail transit plan would, however, have a number of important advantages over the bus-on-freeway plan, as indicated in Table 251. The primary transit facilities under the light rail transit plan would be accessible within walking distance to nearly 80 percent more of the resident population and 70 percent more of the jobs in the Milwaukee area. Partially for this reason, nearly 28,000 more transit trips may be expected to be made on the primary element of the light rail transit plan on an average weekday in the design year than on the primary element of the bus-on-freeway plan. However, under the bus-on-freeway plan, these additional trips would not be diverted to the private automobile, but rather would be made on the local or express elements of the plan. These trips would average about five mph slower over the on-vehicle portion of the trip, and would require an average of four additional minutes per trip. However, because the bus-on-freeway plan would provide a much faster primary element than the light rail transit plan, on-vehicle transit travel would be about one mph faster under this plan, saving about one minute per transit trip.

The composite light rail plan would have some important advantages with respect to energy use as it would be based on an electrically propelled primary transit system. It would, therefore, use 7 percent less petroleum-based fuels for transit system propulsion over the plan design period than the bus-on-freeway plan. Such savings, however, would represent less than 3 percent of the total petroleum-based fuel which may be expected to be used in the Milwaukee area over the plan design period by automobile travel. Perhaps more importantly, the use of electricity for propulsion of the light rail transit system would enable nearly 38,000 transit trips on an average weekday, or 21 percent of all transit tripmaking, to be made on a transit system which is not dependent on petroleum-based fuels.

The composite light rail transit plan would also be expected to be more cost-effective at the end of the plan design period with respect to operating and maintenance costs. The light rail transit plan may be expected to require $1.9 million, or 7.4 percent, less operating subsidy in the plan design year than the bus-on-freeway plan. Total

Table 251

KEY ADVANTAGES AND DISADVANTAGES OF THE COMPOSITE LIGHT RAIL TRANSIT SYSTEM PLAN IN COMPARISON TO THE TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Factor	Advantage	Disadvantage
Cost	$1.9 million, or 7.4 percent, less operating subsidy required in design year Total transit system revenues recover 2 percent more operating costs, and primary element revenues recover 30 percent more operating costs, in design year	$174.5 million, or 29 percent, more total cost over design period $192.4 million, or 133 percent, more capital cost over design period $403.9 million, or 200 percent, more capital investment over design period $0.16, or 31 percent, more total cost per passenger over design period
Accessibility	131,100, or 80 percent, more resident population within walking distance 128,600, or 70 percent, more jobs within walking distance	- -
Transit Ridership	28,200, or 184 percent, more primary transit trips on an average weekday in design year	2,000, or 1 percent, fewer total transit trips on an average weekday in plan design year
Energy	7 percent savings in petroleum-based fuel used for transit system propulsion over plan design period (less than 1 percent savings in area automobile petroleum-based fuel use over plan design period) 37,400, or 21 percent, of transit trips made partially or totally on transit vehicles not dependent on petroleum-based fuels	- -
Disruption	- -	89 acres, or more than six times, more land required for system development

Source: SEWRPC.

transit system revenues may be expected to recover 2 percent more of the operating and maintenance costs under the light rail transit plan than under the bus-on-freeway plan, and farebox revenues may be expected to recover 30 percent more of the operating and maintenance costs in the design year of the primary element of the light rail transit plan than of the primary element of the bus-on-freeway plan.

These annual operating cost savings would be offset by the substantially greater capital cost of the light rail transit plan. This high capital cost is the principal disadvantage of the light rail transit plan, making it the most costly of the alternative plans to implement. The capital cost of the light rail transit plan would be about $192 million, or 133 percent, more than that of the bus-on-freeway plan. The capital investment required to implement the plan over the plan design period would be about $404 million, or 200 percent, more than would be required for the bus-on-freeway plan. Consequently, the light rail transit plan would require about $0.16, or 31 percent, more capital investment per passenger carried than the bus-on-freeway plan. Other disadvantages of the light rail transit plan are that it would require more land for system development and that it would attract about 2,000, or 1 percent, fewer total transit trips on an averge weekday in the design year than the bus-on-freeway plan. About 89 acres, or six times, more land would be needed for the right-of-way for the light rail transit guideway and for the additional stops and stations of the light rail transit plan. Marginally fewer transit trips may be expected to be attracted to the light rail transit system because some parts of the primary element of the bus-on-freeway system are expected to provide faster trips to the downtown area, operating on a very limited or nonstop mode, unlike the scheduled-stop light rail transit system. Nearly all the additional transit trips which could be expected to be made under the bus-on-freeway plan would be made to the Milwaukee central business district, the focal point of primary transit service under that plan.

Thus, it was concluded that the tangible advantages of a light rail transit plan over a comparable bus-on-freeway plan in the Milwaukee area under the stable or declining growth scenario-decentralized land use plan alternative future would be small compared to the additional costs entailed. The anticipated operating and maintenance cost efficiencies of the light rail transit plan are offset over the plan design period by the additional capital costs. In addition, a light rail transit system, despite its greater cost, cannot be expected to divert substantially more trips from automobiles to public transit than a bus-on-freeway system and, therefore, cannot be expected to provide any substantial incremental benefits with respect to motor fuel consumption or air pollutant emissions. The service provided by the light rail transit plan is not expected to attract more transit trips than comparable bus-on-freeway service, even though it would make primary transit accessible to 80 percent more residents and 70 percent more jobs in the Milwaukee area, and would have about 40 percent faster average vehicle speeds than comparable local or express transit services under the bus-on-freeway plan. This is because the primary element of the bus-on-freeway plan would be expected to operate at speeds nearly 40 percent faster than the comparable light rail transit primary element because of the limited stop or nonstop operation involved. This higher level of primary transit service under the bus-on-freeway plan means that, even though more transit users may be expected to use primary transit service under the light rail transit plan, the overall speed of transit trips under the plans would not differ significantly.

There are other possible benefits to a light rail transit system plan which require consideration. But it must be recognized that these benefits are, to a great extent, intangible, and there is uncertainty as to the degree to which these benefits can be attained. These benefits include environmental impacts, land use development impacts, operation in an energy emergency, reliability of operation, safety of operation, and rider preference.

Environmental Impacts: There are some localized environmental advantages to a light rail transit plan. Electrically propelled light rail vehicles produce no air pollutant emissions in the corridors in which they operate, although the central coal-fired power plants from which they would primarily draw their power in the Milwaukee area would emit air pollutants. Diesel motor buses, on the other hand, emit approximately one-half the carbon monoxide and hydrocarbons and about six times the nitrogen oxides that automobiles do. There would be no significant areawide differences in the total pollutant emissions expected under the light rail transit and motor bus plans because Milwaukee area automobile traffic and pollutant emissions would be about the same under each plan and may be expected to dominate any pollutant emissions. Moreover, light rail transit may be expected to have significant air quality benefits only in areas of concentrated transit traffic, particularly the Milwaukee central business district, where the level of such traffic may approach that of automobile traffic. Specifically, under the light rail transit plan, up to 100 fewer diesel motor buses can be expected to operate over the transit mall in the downtown area during peak travel hours.

Noise reduction is another advantage of light rail transit, but again, this benefit will be apparent only in those parts of the Milwaukee central business district where transit vehicle volumes will approach automobile volumes. Several components of light rail transit serve to make light rail vehicles quieter than automobiles or diesel motor buses. These components include electric propulsion, welded rail, constant tension overhead catenary, and resilient wheels. A typical diesel motor bus has a greater noise level than an automobile, ranging between 72 dbA and 82 dbA at 25 feet when cruising, and 82 dbA and 96 dbA at 25 feet when accelerating in traffic. The noise level of an automobile will typically range from 62 dbA to 90 dbA at 25 feet, depending upon whether the vehicle is cruising or accelerating. Average noise levels for light rail vehicles are 62 dbA to 76 dba between 0 and 20 mph and 76 dbA to 82 dbA between 20 and 50 mph. Again, light rail transit may have a significant impact on noise levels only along the proposed Wisconsin Avenue transit mall, which would be used exclusively by transit traffic. Under the light rail transit plan, up to 100 fewer diesel motor buses would be utilizing the transit mall during the peak travel hours, being replaced by 36 light rail vehicles.

Land Development and Redevelopment: Another important intangible benefit of a light rail transit plan is its possible impact on urban land development and redevelopment. Light rail transit, or any transit mode requiring fixed guideways, has a purported potential to stimulate land development and redevelopment because it represents a long-term commitment to high-quality public transit service in a corridor, and because it may be expected to provide, through its exclusive guideway, significantly improved accessibility to areas surrounding its stations. Because light rail transit would require a greater capital investment, and its guideway could not be as easily converted to other uses, light rail transit has been purported as having greater land development impacts than busways. Light rail transit has also been purported to have greater potential for land development than busways because it would operate at higher speeds and provide greater accessibility. Because little additional automobile traffic congestion is expected under this alternative future, the accessibility provided by the bus-on-metered freeway system plan may be expected to be quite similar to that provided by the light rail transit plan. The supposition that light rail transit will provide a land development inducement because it represents a permanent public commitment to the provision of a high level of transit service in a corridor can be weighed against recent studies of the influence of fixed guideway facilities on land development in United States cities. These studies indicate that for rail transit to influence the distribution of new development and redevelopment, an entire set of conditions must be satisfied.[16] These conditions include the presence of economic forces which support substantial land use development and redevelopment; the existence of a strong demand for such development and redevelopment in the urban area; the attractiveness of sites surrounding rail transit stations in terms of ease of access, utility and other urban services, physical features, and social characteristics; the existence of a public land use policy which encourages such development and redevelopment through coordinated tax policies, infrastructure supply, and land use controls, as well as local neighborhood approval; the presence of land near the stations which is available or which can be readily assembled for development; and the provision of a new transportation advantage through improvements in transit travel accessibility. Because the satisfaction of all these conditions in the Milwaukee area is unlikely, and because the degree of transportation advantage to be provided by a light rail transit system is very similar to that provided by a bus-on-metered freeway system, the ability of the light rail transit plan to induce development in the Milwaukee area must be concluded to be uncertain.

The implementation of a light rail transit plan would, nevertheless, have a greater short-term economic impact on the Region than implementation of any of the other alternative plans considered. A light rail transit system would require the construction of fixed facilities, including railway trackage, power transmission and distribution facilities, stations, and storage and maintenance facilities, resulting in a significant increase of activity, albeit temporary, in the local economy. The additional income from construction wages may be expected to result in additional expenditures for retail goods, and in the purchase of construction materials and services which would create additional business for suppliers, material handlers, and contractors.

Energy: The light rail transit plan would have a significant advantage with respect to energy use only under a severe petroleum shortage, as all the transit alternatives under this future would use about the same amount of energy, and even about the same amount of petroleum-based fuels. This is because average weekday energy use by automobiles would dominate energy use by transit, and the levels of automobile travel may be expected to be about the same under all the alternative transit plans. Light rail transit has an advantage under a severe petroleum shortage because the electrical energy it uses would probably not be affected, and the system would therefore have the potential for expanded service. The expansion of such service, however, may be difficult in an emergency situation as vehicles for any additional service may be difficult to obtain quickly. Furthermore, it must be recognized that during a severe petroleum shortage, motor fuels may be expected to be rationed between all motor vehicles, with priority

[16] *See U. S. Department of Transportation, Land Use Impacts of Rapid Transit: Implications of Recent Experience, Final Report, August 1977.*

being given to public transit vehicles. Since public transit would use about one-third the petroleum expected to be used by automobiles under the bus-on-metered freeway plan, it is only reasonable to expect that sufficient fuel for transit will be made available under any petroleum fuel shortfall. Therefore, a light rail transit system may have little advantage over a motor bus system in the event of an emergency petroleum shortage.

Reliability: Public transit service which is provided over fixed guideways is considered to be more reliable than such service provided over public roadways shared with other traffic. Light rail transit or busway systems, particularly to the extent that these modes utilize exclusive rights-of-way, should not be affected to any significant degree by traffic congestion, traffic accidents, or street and utility repairs which are common on public arterial street rights-of-way. Also, operational problems caused by inclement weather—especially snow and ice—may be expected to be less severe than such problems on systems operating over public streets. Light rail transit fixed guideways which are located within public street rights-of-way, however—either in median areas, in reserved lanes, or in mixed traffic—may be expected to be affected by all these problems to the extent that the guideway is not separated from the adjacent motor vehicle traffic and from cross traffic at intersections. In addition, all rail transit modes suffer from the potential for an entire guideway segment to lose service should a single vehicle or train break down or become involved in an accident since, unlike rubber-tired motor vehicles, light rail vehicles cannot be steered around obstructions. Service disruptions can also occur from power outages, a breakdown in the overhead power distribution system, and such emergencies as fires which may require hose lines to be placed across trackage.

Safety: Safety may be expected to be greater under the light rail transit plan than under the motor bus-on-freeway plan because of the extensive use of dedicated street right-of-way, in addition to signals at crossings which provide preferential treatment for the light rail vehicles. In addition, if high-level boarding platforms are used, boarding and deboarding accidents, which are among the most common types of accidents in current day transit operations, would be significantly reduced.

Rider Preference: Proponents of light rail transit systems argue that transit passengers prefer rail transit services over motor bus transit services and will therefore make greater use of the rail services. This argument is based on the contention that there is something about the light rail transit mode which makes it intrinsically more attractive than other primary transit modes even if the levels of service provided are the same. This attraction is usually described in terms of ride quality or comfort, and image. It is probably true that there is a certain fascination with light rail transit technology as there is with other rail-related modes for moving people. This interest appears to stem either from interest in railways as a leisure-time activity, or from an historical perspective inasmuch as light rail transit technology is often equated with street railway technology reminiscent of the "good old days." In this respect, it should be noted that the historic conversion of street railway lines to electric trolley bus and motor bus lines in Milwaukee was received with expressions of great public joy and increased levels of ridership on the converted lines. There is also a feeling on the part of some light rail transit proponents that, by providing the Milwaukee area with a fixed guideway primary transit facility, the implementation of a light rail transit system will assist in promoting Milwaukee as the center of an important and progressive major metropolitan area.

However, because the degree to which these intangible benefits can actually be attained must be regarded as uncertain, and because the development of a light rail transit system would require two- and one-half times as much capital cost over the design period while attracting about the same total transit ridership as the bus-on-freeway plan, it was concluded that the bus-on-freeway plan was the superior plan of the alternatives considered under the stable or declining growth scenario-decentralized land use plan alternative future.

SUMMARY AND CONCLUSIONS

This chapter documents the results of the design, test, and evaluation of system plans for four alternative primary transit modes—bus on metered freeway, bus on busway, light rail transit, and commuter rail—under what is considered to be the most pessimistic future for transit use in the Milwaukee area over the next 20 years. This alternative future, one of four under which these four primary transit modes have been analyzed in this study, envisions a declining regional population, little economic growth, a decentralized land use pattern, and a moderate increase in energy cost, but an actual decrease in the out-of-pocket cost of automobile travel due to increased efficiency in automobile fuel utilization.

The alternative system plans prepared for each of these primary transit technologies were carefully designed to serve the corridors of heaviest travel demand in the Milwaukee area effectively and, to the maximum extent practicable, use available facilities and rights-of-way. Considerations in defining the major travel corridors to be served by the primary transit facilities included the locations of existing and proposed regional activity centers, future concentrations of travel desire lines, future concentrations of arterial streets with heavy traffic volumes and congestion, and concentrations of heavily used transit routes. The available facilities and rights-of-way considered in plan design included freeways and their medians, shoulders, and nonroadway rights-of-way; active and abandoned railways and their rights-of-way; former electric interurban and street railway rights-of-way; and the medians and parking lanes of arterial streets having at least three lanes in each direction. Following the identification of the major travel corridors best served by primary transit, and the selection of specific alignments for each alternative primary transit mode from among the facility and right-of-way options in each corridor, system plans were developed for each mode, including the identification of routes, stops, and stations.

The test and evaluation of these maximum extent alternative modal system plans indicated the need to truncate the facilities and services postulated under each of the primary transit mode alternatives in order to provide reasonably cost-effective system plans. Three of the four modal system plans required substantial truncation: the bus-on-busway, light rail transit, and bus-on-freeway plans. With respect to the commuter rail plan, it was determined that no commuter rail route would meet at least one-half of its operating and maintenance costs on an all-day and minimum frequency-of-service basis under this future. It was therefore recommended that commuter rail not be given further consideration under this future.

Testing of the truncated bus-on-freeway plan and of the composite light rail and busway system plans—in which the service provided by these modes was supplemented in certain corridors by bus-on-freeway facilities in order to provide comparable areawide coverage of primary transit service—indicated that all these alternative truncated and composite primary transit system plans could be expected to work well in the design year 2000, providing a reasonably similar high level of primary transit service. The alternative systems were found to be quite similar with respect to total ridership, required annual public subsidy of operating and maintenance costs, operating and maintenance cost-effectiveness, and overall level of service. Each system was expected to result in about the same level of total transit use in the area—specifically, between 177,200 and 180,200 trips on an average weekday in the plan design year. In addition, each system was expected to entail a similar annual operating and maintenance cost deficit, between $23 and $26 million in the plan design year, and to recover a similar proportion of the design year operating and maintenance costs from farebox revenues, between 46 and 48 percent. Finally, each plan was expected to result in about the same average overall speed of travel for transit trips on the total transit system in the design year, between 17 and 18 mph.

The analyses indicated that substantially more transit trips may be expected to be made on the primary element of the light rail transit and busway plans; 43,500 and 37,600 weekday trips, respectively, compared with 15,300 trips under the bus-on-freeway plan. These additional trips, however, may be expected to be made under the bus-on-freeway plan as well, but on the local and express elements of that plan at a lower level of service; that is, at speeds of about 15 mph compared with 24 mph on the light rail transit and busway primary elements. The overall level of service provided to all transit trips made on the bus-on-freeway plan, however, may be expected to be about the same as under the light rail transit and busway plans because the bus-on-freeway plan would provide a faster trip of about 28 mph on the primary elements.

There are significant differences in the capital investment and capital costs attendant to the implementation of the alternative plans. (Capital investment is defined as the total outlay of funds for guideway, station, and support facility construction and vehicle acquisition necessary to implement a plan over the plan design period, and indicates total capital resources required for plan implementation. Capital cost is defined as the capital investment less the value of the remaining life of facilities and vehicles beyond the plan design period, and indicates the true capital cost of plan implementation over the plan design period.) The bus-on-freeway plan was found to require the least capital outlay over the plan design period, $203 million. The other two plans, busway and light rail transit, were found to require substantially more capital investment, $453 and $607 million, respectively, as they would both require new fixed guideway constructon. Because of the expected 30-year life of any new guideways to be constructed, and the relatively longer life of rail transit vehicles, the differences in capital costs between the plans over the design period, while substantial, were considerably less than the differences in capital investment. The bus-on-freeway plan was found to have the lowest capital cost of $143 million. The busway and light rail transit plans were found to entail capital costs of $268 million and $336 million, respectively.

The differences in capital costs between the plans may be expected to dominate the small differences found in annual operating and maintenance cost subsidy. The bus-on-freeway plan was found to have the lowest total public cost to the plan design year of $594 million, or $0.52 per passenger to the design year, based on two assumptions: first, each plan would be implemented incrementally over the plan design period and that an equal capital expenditure would be made in each year over the 20-year plan design period, and second, that the annual operating and maintenance cost subsidy would increase linearly from the current level of about $19 million to the plan design year level of between $23 and $26 million. The busway plan was found to have a total public cost to the design year of $709 million, or $0.62 per passenger to the design year; and the light rail transit plan was found to have a total public cost to the design year of $771 million, or $0.68 per passenger to the design year. Thus, the light rail transit plan would entail about 30 percent more total public costs over the design period than the bus-on-freeway plan.

Certain intangible benefits, however, would support development of the higher cost light rail transit plan. These include environmental advantages, advantages in shaping land use development and redevelopment, energy advantages, travel safety advantages, and advantages in reliability of operation. The light rail transit plan was determined to have some environmental advantages with respect to air pollution and noise within the specific corridors, although total areawide transportation system air pollutant emissions and noise generation would not differ significantly under any of the transit system plans, because automobile and truck traffic and attendant air pollution and noise would be nearly the same under all of the transit plans. Within specific corridors and areas, however, the light rail vehicles would emit air pollutants, such emissions occurring at a remotely located central power generating station. A bus would, however, emit air pollutants locally, releasing about one-half the carbon monoxide and hydrocarbons as an automobile and six times the nitrogen oxides. Also, a bus may be expected to generate about 20 percent more noise than a light rail vehicle, and about 5 to 15 percent more noise than an automobile. The principal noise and air pollution impacts may be expected to be effected in the Milwaukee central business district, where transit traffic volumes would be significant. Specifically, on the proposed Wisconsin Avenue transit mall, the light rail transit plan would result in the replacement of up to 100 buses during peak hours with 36 one-car trains of articulated light rail vehicles.

All transit guideway alternatives may have a potential to attract, and thereby guide and shape, land use development and redevelopment, because they represent a public commitment to high-quality transit service and would increase transit travel accessibility. Light rail transit is considered by some to have a greater potential effect on development than the bus-on-freeway and bus-on-busway alternatives because it represents the greatest permanent public commitment to a high level of transit service in a specific location, and because its exclusive guideway and electrically propelled vehicles should provide the greatest increase in transit travel accessibility. However, the analyses indicated that the light rail transit system plan would provide about the same accessibility as the bus-on-freeway plan. Moreover, there are other factors which affect land development and redevelopment which could offset the land development potential of light rail transit. These factors are the presence of economic forces which support substantial land use development and redevelopment; the existence of a strong demand for such development and redevelopment in the urban area; the attractiveness of sites surrounding rail transit stations in terms of ease of access, utility and other urban services, physical features, and social characteristics; the existence of a public land use policy which encourages such development and redevelopment through coordinated tax policies, infrastructure supply, and appropriate land use controls, as well as local neighborhood and community acceptance and approval; the presence of land near the stations which is available, or which can be readily assembled, for development; and the provision of a new transportation advantage through improvements in transit travel accessibility. Thus, increased land development potential of light rail transit must be considered uncertain at best.

The analyses indicated that the light rail transit plan may be expected to effect little savings of petroleum use over the other alternative plans considered because it would not result in significantly less automobile use than any of the other alternatives, and automobile energy use dominates transit energy use. The use of electricity by light rail transit may, however, be regarded as a significant advantage in the event of a serious petroleum shortage, because the electrical energy it uses would not be affected and the system would have the potential for expanding service. The expansion of light rail transit service may, however, be difficult in an emergency situation as vehicles for additional service may be difficult to obtain quickly.

Also, because they would be provided over fixed guideways, light rail transit or bus-on-busway transit service would be considered to be more reliable than transit service provided over public roadways shared with other traffic. Light rail transit or bus-on-busway transit, particularly to the extent that these modes utilize exclusive rights-of-way, should not be affected to any significant degree by traffic congestion, traffic accidents, or street and utility repairs which are common on public arterial street rights-of-way. Also, operational problems caused by inclement weather—especially snow and ice—may be expected to be less severe than such problems on public streets. Light rail transit fixed guideways which are located within public street rights-of-way, however—either in median areas, in reserved lanes, or in mixed traffic—may be expected to be affected by all these problems to the extent that the guideway is not separated from adjacent motor vehicle traffic and from cross traffic at intersections. In addition, light rail transit suffers from the potential for an entire guideway segment to lose service should a single vehicle or train break down or become involved in an accident since, unlike rubber-tired motor vehicles, light rail vehicles cannot be steered around obstructions. Service disruptions can also occur from power outages, a breakdown in the overhead power distribution system, and such emergencies as fires which may require hose lines to be stretched across trackage.

The safety of the light rail transit plan may be expected to be greater than that of the motor bus-on-freeway plan because of the extensive use of dedicated street right-of-way in addition to signals at crossings which provide preferential treatment for the light rail vehicles. In addition, if high-level boarding platforms are used, it may be expected that boarding and deboarding accidents, which are among the most common types of accidents in current day transit operations, would be significantly reduced. In addition, the massive structure of a light rail vehicle offers more protection to passengers than a bus in the event of vehicle-to-vehicle and vehicle-to-fixed object collisions.

The light rail transit plan would also have an advantage with respect to operating and maintenance cost-effectiveness or efficiency as it would have the smallest necessary public subsidy in the plan design year, although the other plans would have only slightly higher subsidies. In the design year, the light rail transit plan would require $1.9 million, or 7 percent, less subsidy than the bus-on-freeway plan, and about the same subsidy as the busway plan.

However, even when considered together, these intangible benefits supporting the development of the higher cost light rail transit plan probably do not outweigh the capital cost difference between that plan and the bus-on-freeway plan. Therefore, because the bus-on-freeway plan would attract the highest transit ridership of the plans and would have the lowest total public cost over the plan design period, the bus-on-freeway plan was recommended as the best plan under this alternative future.

It should be noted that the bus-on-freeway plan recommended under this future is a unique plan involving the provision of primary transit service over an operationally controlled freeway system. The resulting high-speed, nonstop or limited stop rapid transit service over those freeways would provide a very high level of service, a service supplemented by coordinated express and local feeder bus service. Labor productivity of the system would be enhanced by the use of high-capacity articulated buses. Only substantial additional automobile traffic congestion in the Milwaukee area, which is not expected under this alternative future, would give the exclusive fixed guideway alternative plans a level-of-service advantage over the recommended bus-on-freeway alternative.

It is important to note that the recommended bus-on-freeway plan represents a significant improvement over the present transit system. It will, however, be necessary to implement each component of the recommended plan if the level of service and cost-effectiveness of the bus-on-freeway alternative is to approach that of the busway and light rail transit alternatives. One of these improvements is the emphasis on carrying a significant proportion of the total transit trips on primary and secondary or express lines, and not on tertiary lines. Only with emphasis on faster primary and secondary lines which are more labor-efficient and attractive to travelers, and only with the use of high-capacity articulated buses which are more labor-efficient, will the bus-on-freeway plan approach the alternative fixed guideway plans in number of trips carried and cost-effectiveness. A particularly important improvement required under the bus-on-freeway plan is extensive preferential treatment for transit vehicles, particularly through the areawide freeway traffic management system.

The implementation of a freeway traffic management system would require ramp meters to be constructed at freeway entrance ramps throughout the Milwaukee area, including all of Milwaukee County, substantial parts of Waukesha and Ozaukee Counties, and parts of Washington and Racine Counties. This extensive ramp metering would be essential to attainment of the free-flowing operation of the area freeway system envisioned under the bus-on-freeway plan. Under the plan, it is envisioned that the freeway traffic management system would exercise sufficient constraint on freeway access to ensure uninterrupted freeway traffic flow and operating speeds of at least 40 to 45 mph over essentially all of the freeway system in the Milwaukee area during average weekday peak travel periods.

A limited freeway traffic management system implemented incrementally by the Wisconsin Department of Transportation since 1969 is in operation today in central Milwaukee County. The system consists of ramp meters and corresponding freeway traffic detectors at 20 freeway entrance ramps in central Milwaukee County. This limited system was originally operated primarily to facilitate the smooth entry of vehicles into the traffic stream on the most heavily congested freeway segments in the central area of Milwaukee County. This original objective has been broadened to include reducing total freeway traffic volumes by restricting access. While providing important benefits in promoting the safer and smoother flow of traffic near entrance ramps, this limited system would not attain the high level of freeway operation envisioned under the bus-on-freeway plan, particularly under this alternative future which envisions growth in total regional travel. The access at the limited freeway entrance ramps located on congested freeway segments which are now metered would have to be severely constrained to potentially attain the level of freeway operation envisioned under the bus-on-freeway plan. Only with an areawide system of ramp meters and attendant control of freeway access would the envisioned freeway operation be practically attainable.

It should be recognized in this respect that there are obstacles to expanding the present limited freeway traffic management system. The Regional Planning Commission's Intergovernmental Coordinating and Advisory Committee on Transportation System Planning and Programming for the Milwaukee Urbanized Area has refused to include the installation of any further ramp meters in the transportation improvement program for southeastern Wisconsin, and recommended in the transportation systems management plan for the Milwaukee area (see SEWRPC Community Assistance Planning Report No. 21, A Transportation Systems Management Plan for the Kenosha, Milwaukee, and Racine Urbanized Areas in Southeastern Wisconsin: 1978) that a prospectus for a preliminary engineering study of an areawide freeway traffic management system be prepared prior to endorsement by the Committee of any further implementation of such a system.[17] The study was to provide recommendations concerning the extent of freeway ramp metering and attendant preferential motor bus access to the freeway system in the greater Milwaukee area; the speeds and volumes to which the area freeway system should be controlled; and, importantly, the degree of metering which would

[17] *An areawide freeway traffic management system was also recommended for implementation under the Commission's long-range regional transportation system plan (see SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume Two, Alternative and Recommended Plans).*

be necessary at each on-ramp to achieve those freeway speeds and volumes. The study was to address the potential costs and benefits of freeway traffic management, assessing resultant freeway and surface arterial street congestion and travel speeds, freeway entrance ramp queues and the impacts of such queues on connecting surface arterial streets, and the equity as well as costs of freeway traffic management.

On March 26, 1979, the prospectus for the required preliminary engineering study was completed by the Commission staff and unanimously approved by the steering committee created by the Commission to guide the preparation of the prospectus. The prospectus was approved by the Commission itself on June 7, 1979. However, funding for the conduct of the study recommended in the prospectus has not been obtained to date. As a consequence, the Intergovernmental Coordinating and Advisory Committee on Transportation System Planning and Programming for the Milwaukee Urbanized Area did not in 1980 and 1981 approve the installation of any additional ramp meters in the Milwaukee area.

The areawide freeway traffic management system would have to consist of an interconnected system of ramp meters throughout the Milwaukee area, a centralized control computer system governing operation of the ramp meters, surveillance equipment, changeable message signs, lane control signals, and entrance ramp reconstruction for transit vehicle bypass lanes. The capital investment required for such a system, consisting of an estimated total of 166 ramp-meter locations, has been estimated to total $14.5 million in 1979 dollars. The operation and maintenance of such an areawide system, including building maintenance, computer maintenance, staff salaries, and the operation and maintenance of the ramp meters, has been estimated to cost $870,000 annually in 1979 dollars. All these costs have been included in the bus-on-freeway plan.

Chapter V

ALTERNATIVE PRIMARY TRANSIT SYSTEM PLAN COMPARISON AND EVALUATION FOR THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN ALTERNATIVE FUTURE

INTRODUCTION

This chapter describes the design, test, and evaluation of primary transit alternatives under the moderate growth scenario-decentralized land use plan alternative future. This alternative future is one of the two futures which lie between the most optimistic and pessimistic futures for transit use in the Milwaukee area considered in this planning effort. The moderate growth scenario-decentralized land use future assumes moderate increases in the levels of population and economic activity within the Region; a substantial increase in the cost of motor fuel, as well as a real increase in the out-of-pocket cost of automobile travel; and a stabilization of population lifestyle trends, with only small increases in female labor force participation and little change in household size. New urban development under this alternative future is assumed to take place in accordance with a decentralized land use plan and therefore to occur primarily at low densities in a highly diffused pattern, with much of the new development being located well beyond the periphery of existing urban centers. Salient aspects of this alternative future are summarized in Table 252, and are described in greater detail in a companion document to this report, SEWRPC Technical Report No. 25, Alternative Futures for Southeastern Wisconsin.

Alternative primary transit system plans for this future were designed, tested, and evaluated utilizing the six-step procedure described in Chapter II of this report. The first step in this process was the identification of the maximum extent of the corridors to be considered for the provision of primary transit facilities and services. This step was readily accomplished because it had been concluded earlier in the study that the two extreme futures considered under the study had essentially the same seven maximum extent corridors. It could therefore be reasonably assumed that these corridors were the maximum extent of primary transit facilities and services to be considered under any intermediate future.

In the second step of the plan design, test, and evaluation process under this future, preferred alternative alignments were selected within each of the corridors for each of the modes: bus-on-freeway, commuter rail, busway, and light rail transit.[1] Because it had been established that the preferred alternative alignments would be the same under both of the two extreme futures—as the costs of the alternative alignments and their relative travel speeds would not vary between the futures, and as the relative magnitude of accessibility to employment and resident population of the preferred and alternative alignments in the seven corridors was determined not to vary significantly between the two extreme futures—it was concluded that these same preferred alignments should be used to test alternative primary transit system plans under this future.

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[1] *Maximum extent corridors were also defined for heavy rail rapid transit under the moderate growth scenario-centralized land use plan alternative future, the most optimistic future of the four considered and the first for which alternative primary transit plans were designed, tested, and evaluated under this study. Under the moderate growth scenario-centralized land use plan alternative future, specific heavy rail rapid transit alignments were selected within each of the corridors of major travel demand, and a maximum extent system plan was quantitatively tested and evaluated. When comparing the heavy rail mode with the light rail mode, the test and evaluation showed the heavy rail rapid transit mode as recovering a similar proportion of operating and maintenance costs from farebox revenues, but carrying less ridership and requiring more than twice the capital cost. Accordingly, heavy rail rapid transit was eliminated from further consideration as an alternative primary transit mode and was not evaluated under the three less optimistic futures considered under this study.*

Table 252

CHARACTERISTICS OF THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN ALTERNATIVE FUTURE

Key External Factors

Energy	Economic Conditions	Population Lifestyles
Oil price to converge with world oil price, which will increase at 5 percent annual rate to $72 per barrel in the year 2000 (1979 dollars) Petroleum-based motor fuel to increase to $2.30 per gallon by the year 2000 (1979 dollars) Assumes some potential for major or continuing disruptions in oil supply Low degree of conservation in all sectors resulting in increase in energy use of 3 percent per year Average automobile fuel efficiency of 27.5 miles per gallon	Region is considered to have relatively high attractiveness and competitiveness Per capita and household income increase as a result of attractiveness and competitiveness of Region, an increased proportion of the population is of work force age, and there is increased labor force participation	Female labor force participation increases to 50 to 55 percent and total labor force participation is 60 to 65 percent A continuation of below replacement fertility rates during the next decade, followed by an increase to replacement level by the year 2000 Average household size stabilizes

Attendant Regional Change

Economic Activity of Region in the Year 2000	Population of Region in the Year 2000
1,016,000 jobs Manufacturing . . . . 32 percent Services . . . . 40 percent Other . . . . 28 percent Income of $29,600 per household in 1979 dollars (38 percent increase since 1970, or a 1.1 percent annual rate of increase) Income of $10,000 per capita in 1979 dollars (54 percent increase since 1970, or a 1.4 percent annual rate of increase)	2,219,300 persons 29.2 percent—0-19 years of age 58.5 percent—20-64 years of age 12.3 percent—65 years of age or older 739,400 households Average household size of 2.9 persons

Land Use Plan

Urban Growth and Density	Population Distribution		Employment Distribution	
Occurs primarily at suburban residential densities in a diffused pattern in areas proximate to, and removed from, existing urban centers Existing developed portions of Milwaukee may decrease in residential density between 1970 and 2000	Milwaukee County		Milwaukee County	
	Population	898,500 persons	Employment	523,400 jobs
	Percent Change from 1970	- 14.8	Percent Change from 1970	2.4
	Percent Change from 1978	- 5.8	Percent Change from 1978	- 6.9
	Outlying County Population (Ozaukee, Washington, Waukesha)	786,700 persons	Outlying County Employment (Ozaukee, Washington, Waukesha)	274,800 jobs
	Percent Change from 1970	125.0	Percent Change from 1970	160.7
	Percent Change from 1978	77.4	Percent Change from 1978	94.3

Source: SEWRPC.

In the third step of the plan design, test, and evaluation process under this future, maximum extent system plans for each primary transit mode were formulated by combining the preferred alignments into a system, and the routes, stations, and maintenance and storage facility needs for each mode were identified. Again, it was concluded that the same system plan design considerations that applied to the two extreme futures applied to this future, and, consequently, the maximum extent system plans under all three futures are the same.

In the fourth step of the plan design, test, and evaluation process under this future, the maximum extent system plans were subject to test and evaluation using traffic simulation model studies. Based upon this evaluation of the maximum extent system plans, truncated plans for each mode were developed. Those facilities and services shown by the test and evaluation of the maximum extent plans to be unproductive were deleted from these truncated versions of the maximum extent system plans. The truncated system plans were then tested, evaluated, and compared.

In the fifth step of the process, a best system plan was synthesized for this alternative future. That plan was a combination of the truncated plans tested and compared for the various modes. This best plan for the moderate growth scenario-decentralized land use plan alternative future was then used along with the best plans for the other three alternative futures in the sixth and final step of the process—the development of a recommended primary transit system plan for the Milwaukee area. This recommended plan consisted of two tiers, a "lower tier" and an "upper tier."

The lower tier, intended for immediate implementation, is comprised of those elements of the alternative primary transit system plans which appeared in the best plans selected for three or four of the alternative futures and which, therefore, could be considered robust and viable under the full range of possible futures and under greatly varying future conditions. The upper tier consisted of those elements which appeared in the best plans selected for only one or two of the futures. Implementation of facilities in the upper tier is intended to be postponed for a period of time, until the need for the facilities can be better established over time. Available rights-of-way for such facilities were, however, intended to be preserved in order to retain maximum flexibility for future primary transit development.

EVALUATION OF ALTERNATIVE PRIMARY TRANSIT SYSTEM PLANS

The definition of the maximum extent network of corridors under this future, as well as the selection of the preferred alignments within the corridors of those networks and the combination of these preferred alignments into system plans, was accomplished without significant analysis as it had earlier been established in the study that the same corridors, alignments, and system plans could be defined for the two extreme futures under the study. Accordingly, the first major step of the moderate growth scenario-decentralized land use plan was the design, test, and evaluation of the maximum extent system plans for each of the modes. Because these plans were maximum extent plans which proposed to extend service beyond what could be considered reasonably warranted limits, the initial evaluation of the plans was confined to a few selected, basic measures of the service provided, the potential utilization, and the costs entailed—measures which consisted of a small, but important, subset of the primary transit system development objectives and standards adopted under the study.

Evaluation of Maximum Extent Bus-on-Freeway System Plan

One of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is that of buses operating over operationally controlled freeways. The maximum extent system plan developed for this technology is summarized with respect to its coverage and routes in Chapter III of this report on Map 52 and in Table 108, and is summarized with respect to its performance under this future in Tables 253 through 255. Map 53 and Table 111 of Chapter III and Tables 254, 256, and 257 provide comparable information for the base, or benchmark, plan used in the study. A description of the facilities and services of the primary, express, and local elements of both the maximum extent bus-on-freeway system plan and of the base plan was presented in Chapter III of this report and will not be repeated here. Only those characteristics of the maximum extent system plan which vary between the alternative futures, such as the frequency of service provided to meet demand, will be discussed.

Headways on the bus-on-freeway primary transit element under this future would generally range from 12 to 30 minutes during the peak travel periods. During the off-peak travel periods, head-

Table 253

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (buses per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning		Midday		Afternoon		Evening	
										In	Out	In	Out	In	Out	In	Out
1	IH 43 and STH 33	Village of Saukville	Proposed	Yes	225	1	- -	47	44	2	2	1	1	3	3	1	1
2	IH 43 and CTH Q.	Town of Grafton	Proposed	Yes	175	1	1	40	37	2	2	1	1	3	3	1	1
3	S. 1st Avenue and Wisconsin Avenue	Village of Grafton	Proposed	Yes	75	1	1	51	48	2	2	1	1	3	3	1	1
4	IH 43 and CTH C	Town of Grafton	Existing	Yes	75	1	- -	37	34	2	2	1	1	3	3	1	1
5	Cedarburg Road and Highland Road.	City of Mequon	Existing	Yes	200	1	1	46	43	2	2	1	1	3	3	1	1
6	IH 43 and Mequon Road. .	City of Mequon	Proposed	Yes	125	1	1	32	29	2	2	1	1	3	3	1	1
7	N. 76th Street and W. Brown Deer Road . . .	City of Milwaukee	Proposed	Yes	150	1	5	38	35	3	3	2	2	5	5	2	2
8	IH 43 and Brown Deer Road	Village of River Hills	Existing	Yes	250	1	2	28	25	3	3	2	2	5	5	2	2
9	N. Teutonia Avenue and W. Florist Avenue . .	City of Milwaukee	Proposed	Yes	50	1	1	42	39	2	2	1	1	3	3	1	1
10	IH 43 and W. Silver Spring Drive. . .	Village of Glendale	Existing	Yes	200	4	7	22	19	11	11	5	5	15	15	5	5
11	IH 43 and W. Locust Street.	City of Milwaukee	Proposed	Yes	- -	3	4	16	14	3	3	2	2	5	5	2	2
12	IH 43 and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	5	4	13	12	14	14	7	7	20	20	7	7
13	W. Appleton Avenue and W. Silver Spring Drive. . .	City of Milwaukee	Proposed	Yes	150	1	1	37	34	4	4	2	2	5	5	2	2
14	W. North Avenue and W. Lisbon Avenue.	City of Milwaukee	Proposed	Yes	- -	1	3	21	18	4	4	2	2	5	5	2	2
15	N. Main Street and W. Washington Street . . .	City of West Bend	Proposed	Yes	75	1	- -	83	78	2	2	1	1	2	2	1	1
16	S. Main Street and W. Paradise Drive	City of West Bend	Proposed	Yes	175	1	- -	75	70	2	2	1	1	2	2	1	1
17	USH 45 and STH 60	Town of Polk	Proposed	Yes	100	1	- -	66	61	2	2	1	1	2	2	1	1
18	USH 45 and USH 145 . . .	Town of Polk	Proposed	Yes	100	1	- -	57	52	2	2	1	1	2	2	1	1
19	Pilgrim Road and Mequon Road	Village of Germantown	Proposed	Yes	50	1	1	46	41	3	3	1	1	3	3	1	1
20	USH 41 and Main Street . .	Village of Menomonee Falls	Proposed	Yes	175	2	1	40	35	4	4	2	2	4	4	2	2
21	N. 107th Street and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	100	1	3	38	33	2	2	1	1	2	2	1	1
22	N. Calhoun Road and W. Capitol Drive	City of Brookfield	Proposed	Yes	200	1	1	40	35	3	3	2	2	4	4	2	2
23	N. 124th Street and W. Capitol Drive	City of Wauwatosa	Proposed	Yes	150	1	3	35	30	3	3	2	2	4	4	2	2
24	USH 45 and W. Watertown Plank Road	City of Wauwatosa	Existing	Yes	250	2	2	28	24	4	4	3	3	4	4	3	3
25	S. Main Street and E. Wisconsin Avenue . . .	City of Oconomowoc	Proposed	Yes	90	1	- -	71	67	2	2	1	1	2	2	1	1
26	E. Summit Avenue and Pabst Road	City of Oconomowoc	Proposed	Yes	25	1	- -	64	60	2	2	1	1	2	2	1	1
27	Summit Avenue and Delafield Road.	Town of Summit	Existing	Yes	50	1	- -	59	55	2	2	1	1	2	2	1	1
28	Lakeland Road and STH 16	Village of Nashotah	Existing	Yes	60	1	- -	63	59	2	2	1	1	2	2	1	1
29	STH 83 and IH 94	City of Delafield	Proposed	Yes	50	1	- -	50	46	2	2	1	1	2	2	1	1
30	Merton Avenue and STH 16	Village of Hartland	Proposed	Yes	150	1	- -	56	52	2	2	1	1	2	2	1	1
31	Main Street and USH 16 . .	Village of Pewaukee	Proposed	Yes	100	1	1	46	42	2	2	1	1	2	2	1	1
32	Grandview Boulevard and IH 94.	City of Waukesha	Proposed	Yes	200	1	1	43	39	2	2	1	1	2	2	1	1
33	N. Barstow Street and W. Main Street	City of Waukesha	Proposed	Yes	75	1	1	44	40	2	2	1	1	2	2	1	1
34	N. Barker Road and W. Blue Mound Road . . .	Town of Brookfield	Existing	Yes	250	1	1	34	30	2	2	1	1	2	2	1	1
35	N. Moorland Road and IH 94.	City of Brookfield	Proposed	Yes	150	3	2	30	26	6	6	3	3	6	6	3	3
36	N. 84th Street and IH 94. .	City of Milwaukee	Proposed	Yes	275	9	2	22	18	20	20	10	10	21	21	10	10
37	Cemetery Access Road and IH 94.	City of Milwaukee	Proposed	Yes	- -	1	- -	20	16	4	4	3	3	4	4	3	3
38	N. 3rd Street and W. Wisconsin Avenue . . .	City of Milwaukee	Existing	Yes	- -	29	23	- -	- -	79	78	43	43	106	107	40	40
39	USH 45 and W. National Avenue	City of West Allis	Proposed	Yes	200	1	4	24	20	3	3	1	1	7	7	1	1
40	S. 43rd Street and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	75	1	1	30	27	3	3	1	1	3	3	1	1
41	S. 44th Street and W. National Avenue	Village of West Milwaukee	Proposed	Yes	- -	1	2	20	17	3	3	1	1	3	3	1	1
42	S. 108th Street and STH 15	City of Greenfield	Existing	Yes	360	1	3	30	27	2	2	2	2	4	4	2	2
43	W. Loomis Road and W. Rawson Avenue	City of Franklin	Proposed	Yes	75	1	1	37	33	2	2	2	2	2	2	2	2

Table 253 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
44	S. 76th Street and W. Cold Spring Road . . .	City of Greenfield	Proposed	Yes	150	1	2	29	26	2	2	1	1	5	5	1	1
45	W. Loomis Road and W. Grange Avenue.	Village of Greendale	Proposed	Yes	- -	1	2	29	26	2	2	2	2	2	2	2	2
46	S. 27th Street and IH 894.	City of Milwaukee	Proposed	Yes	300	1	3	25	22	3	3	2	2	4	4	2	2
47	STH 15 and STH 20	Town of East Troy	Proposed	Yes	75	1	- -	74	70	2	2	1	1	2	2	1	1
48	STH 83 and STH 15	Town of Mukwonago	Existing	Yes	130	1	- -	65	61	2	2	1	1	2	2	1	1
49	CTH F and STH 15.	Town of Vernon	Existing	Yes	100	1	- -	55	51	2	2	1	1	2	2	1	1
50	Racine Avenue and STH 15	City of New Berlin	Existing	Yes	205	1	- -	49	45	2	2	1	1	2	2	1	1
51	S. Moorland Road and STH 15	City of New Berlin	Proposed	Yes	125	1	2	43	39	2	2	1	1	2	2	1	1
52	6th Avenue and 56th Street.	City of Kenosha	Existing	Yes	75	1	6	72	69	3	3	3	3	6	6	2	2
53	STH 31 and 52nd Avenue.	City of Kenosha	Proposed	Yes	450	1	1	58	55	3	3	3	3	6	6	2	2
54	Wisconsin Avenue and 6th Street.	City of Racine	Proposed	Yes	90	1	8	66	63	3	3	3	3	6	6	2	2
55	STH 31 and 12th Street . .	Town of Mt. Pleasant	Proposed	Yes	350	1	1	54	51	3	3	3	3	6	6	2	2
56	IH 94 and STH 20	Town of Mt. Pleasant	Proposed	Yes	300	1	- -	44	41	3	3	3	3	6	6	2	2
57	IH 94 and Ryan Road . . .	City of Oak Creek	Proposed	Yes	250	1	2	30	27	3	3	2	2	3	3	1	1
58	Nicholson Avenue and E. Rawson Avenue	City of Oak Creek	Proposed	Yes	175	1	1	31	28	3	3	1	1	4	4	1	1
59	IH 94 and W. College Avenue.	City of Milwaukee	Existing	Yes	425	4	4	26	23	8	8	6	6	14	14	4	4
60	IH 94 and W. Holt Avenue	City of Milwaukee	Existing	Yes	240	1	3	21	20	5	5	2	2	8	8	2	2
61	S. Lake Drive and E. Lunham Avenue	City of Cudahy	Proposed	Yes	200	1	- -	28	27	3	2	1	1	2	3	1	1

Source: SEWRPC.

ways would generally range from 30 to 60 minutes in both the midday and evening travel periods. Consequently, nearly five times more bus miles of primary transit service would be provided under the maximum extent plan under the moderate growth scenario-decentralized land use plan alternative future than under the base plan. A significant part of this difference would result from the extension of primary service into off-peak travel periods during the midday and evening, as indicated in Tables 255 and 257. About 28 percent more bus miles of express and local service operated would be provided under the maximum extent plan than under the base plan—about 83,000 bus miles on an average weekday, compared with 65,000.

Transit Utilization: Under the maximum extent bus-on-freeway system plan of the moderate growth scenario-decentralized land use plan, about 256,700 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 258 and 259. About 52,300, or 20 percent of these transit trips, may be expected to utilize the primary transit system for all or a portion of the trip. Thus, the maximum extent bus-on-freeway plan envisions that about 6 percent of the total of 4.4 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made on public transit, and that about 1 percent will be made on primary transit. More than 39,000, or about 18 percent, more transit trips may be expected under this plan than under the base plan. Nearly all of this increased transit use would be on the primary transit element of the plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent bus-on-freeway system plan and the base system plan are summarized in Table 260. The costs shown include all construction costs, plus the

Table 254

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Bus-on-Freeway Plan
Primary Element		
Exclusive Guideway Miles		
Subway	- -	- -
Elevated	- -	- -
At-Grade	- -	- -
Total	- -	- -
Shared Guideway Miles		
Freeways	51.5	163.6
Surface Arterial Streets	49.5	81.9
Total	101.0	245.5
Route Miles	449	1,218
Vehicle Miles	7,200	35,640
Vehicle Hours	310	1,250
Vehicles Required	63	172
Express and Local Elements		
Route Miles	1,302	1,823
Vehicle Miles	64,820	83,060
Vehicle Hours	4,440	5,290
Vehicles Required	496	670
Total System		
Route Miles	1,755	3,041
Vehicle Miles	72,020	118,700
Vehicle Hours	4,750	6,540
Vehicles Required	559	842

Source: SEWRPC.

cost of right-of-way acquisition and the acquisition and replacement of vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 260.

The total capital cost of the base plan is estimated at $186 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses in order to maintain the existing service to the year 2000. About $19.2 million, or 10 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent bus-on-freeway plan is estimated at $286 million. About $14 million, or about 5 percent of this cost, would be required to implement a freeway operational control system in the Milwaukee urbanized area. About $231 million would be incurred in the purchase of new and replacement of transit vehicles—$69.6 million of which would be for the purchase of 290 articulated buses, and $161.1 million of which would be for the purchase of 1,151 conventional buses. The remaining $41 million would be required to construct park-ride stations and to expand bus storage and maintenance facilities. About $106.8 million, or 37 percent of the total capital cost of the plan, would be required for its primary transit element.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent bus-on-freeway plan can be expected to approximate $57 million. The remaining $229 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal share and the federal share are estimated to total $37 million and $149 million, respectively.

Table 261 presents the annual operating and maintenance costs and farebox revenues anticipated for the design year of the base and maximum extent bus-on-freeway plans. Under the base plan, operating and maintenance costs may be expected to approximate $46 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent bus-on-freeway plan would increase the total operating and maintenance costs for the Milwaukee area in the year 2000 by about $30 million over the base plan, to a total cost of $76 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $3 million under the base plan, and $21 million under the maximum extent bus-on-freeway plan. Primary transit system operating and maintenance costs would thus represent more than 6 percent of the total operating and maintenance costs expected in the design year for the base plan, and about 28 percent of the total operating and maintenance costs expected in the design year for the maximum extent bus-on-freeway plan.

Table 255

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	1,218	1,197	1,218	1,141	1,218
Vehicle Miles	8,510	9,930	11,460	5,740	35,640
Vehicle Hours	310	330	410	200	1,250
Vehicles Required	130	74	172	63	172
Express and Local					
Route Miles.	1,823	1,749	1,823	1,646	1,823
Vehicle Miles	19,170	23,210	23,060	17,490	83,060
Vehicle Hours	1,250	1,460	1,520	1,060	5,290
Vehicles Required	570	262	670	183	670
Total System					
Route Miles.	3,041	2,946	3,041	2,787	3,041
Vehicle Miles	27,680	33,140	34,520	23,230	118,700
Vehicle Hours	1,560	1,790	1,930	1,260	6,540
Vehicles Required	700	336	842	246	842

Source: SEWRPC.

Table 256

CHARACTERISTICS OF TRANSIT STATIONS FOR THE BASE SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	N. 76th Street and W. Brown Deer Road . . .	City of Milwaukee	Existing[a]	Yes	100	1	3	38	--	5	3	--	--	3	7	--	--
2	N. Green Bay Road and W. Brown Deer Road . . .	Village of Brown Deer	Existing[a]	Yes	100	2	--	32	--	5	3	--	--	3	7	--	--
3	IH 43 and W. Brown Deer Road . . .	Village of River Hills	Existing	Yes	300	1	1	25	24	5	3	2	2	3	7	--	--
4	N. Teutonia Avenue and W. Florist Avenue	City of Milwaukee	Existing[a]	Yes	50	1	1	30	--	2	--	--	--	--	5	--	--
5	IH 43 and W. Silver Spring Drive. . .	Village of Glendale	Existing	Yes	190	2	6	22	19	4	2	2	2	2	9	--	--
6	W. Appleton Avenue and W. Silver Spring Drive. . .	City of Milwaukee	Proposed	Yes	100	1	1	37	--	4	2	--	--	3	4	--	--
7	W. North Avenue and W. Lisbon Avenue.	City of Milwaukee	Proposed	Yes	--	1	2	21	--	4	2	--	--	3	4	--	--
8	N. 107th Street and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	125	1	--	36	--	3	2	--	--	2	3	--	--
9	N. 124th Street and W. Capitol Drive	City of Wauwatosa	Existing[a]	Yes	250	1	1	33	--	4	2	--	--	3	4	--	--
10	USH 45 and W. Watertown Plank Road	City of Wauwatosa	Existing	Yes	200	1	2	26	--	5	--	--	--	--	8	--	--
11	N. Clinton Street and W. Madison Street.	City of Waukesha	Existing	Yes	60	1	1	52	--	3	--	--	--	--	3	--	--
12	N. Barker Road and W. Blue Mound Road . . .	Town of Brookfield	Existing	Yes	250	1	--	38	--	3	--	--	--	--	3	--	--
13	N. 3rd Street and W. Wisconsin Avenue . . .	City of Milwaukee	Existing	Yes	--	16	21	--	--	57	28	2	2	35	68	--	--
14	S. 108th Street and W. Cleveland Avenue . . .	City of West Allis	Existing[a]	Yes	250	1	3	29	--	4	3	--	--	4	6	--	--
15	S. 108th Street and STH 15	City of Greenfield	Existing	Yes	360	1	2	30	--	3	2	--	--	3	4	--	--
16	S. 76th Street and W. Cold Spring Road . . .	City of Greenfield	Existing[a]	Yes	200	1	1	29	--	3	3	--	--	3	3	--	--
17	IH 94 and W. Ryan Road .	City of Oak Creek	Proposed	Yes	75	1	--	30	--	3	--	--	--	--	3	--	--
18	IH 94 and W. College Avenue.	City of Milwaukee	Existing	Yes	425	1	2	26	--	3	--	--	--	--	4	--	--
19	IH 94 and W. Holt Avenue	City of Milwaukee	Existing	Yes	240	1	2	21	--	4	4	--	--	5	5	--	--
20	S. Lake Drive and E. Lunham Avenue	City of Cudahy	Proposed	Yes	150	1	--	28	--	6	2	--	--	4	3	--	--

[a] *Station is currently, and would continue to be, part of a privately owned shopping center parking lot.*

Source: SEWRPC.

Table 257

TIME-OF-DAY OPERATION OF THE BASE SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	449	45	449	- -	449
Vehicle Miles	3,070	390	3,740	- -	7,200
Vehicle Hours	130	20	160	- -	310
Vehicles Required	53	3	63	- -	63
Express and Local					
Route Miles.	1,284	1,071	1,302	953	1,302
Vehicle Miles	14,260	19,550	19,180	11,830	64,820
Vehicle Hours	990	1,310	1,360	780	4,440
Vehicles Required	363	222	496	129	496
Total System					
Route Miles.	1,733	1,116	1,751	953	1,751
Vehicle Miles	17,330	19,940	22,920	11,830	72,020
Vehicle Hours	1,120	1,330	1,520	780	4,750
Vehicles Required	416	225	559	129	559

Source: SEWRPC.

The average operating and maintenance cost per passenger for the base plan in the plan design year is estimated at $0.74. For the maximum extent bus-on-freeway plan, the average cost per passenger may be expected to approach $1.06—$0.32, or 43 percent, more than the base plan cost. The average operating and maintenance cost per passenger mile would be about 6 percent less under the maximum extent bus-on-freeway plan alternative, $0.16, compared with $0.17 for the base plan. The average operating and maintenance cost per passenger and per passenger mile for the primary element of the base plan would be $1.32 and $0.16, respectively, and for the primary element of the maximum extent bus-on-freeway plan, $1.60 and $0.10, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $25 million in 1979 dollars, compared with about $33 million under the maximum extent bus-on-freeway plan. Under the maximum extent bus-on-freeway alternative, the primary transit element could be expected to generate about 31 percent, or $10 million, of the total revenues, compared with 9 percent, or $1.9 million, for the base plan.

The operating deficit in the year 2000 for the maximum extent bus-on-freeway plan would be about $43 million, expressed in 1979 dollars, requiring a subsidy of about $0.59 per passenger. This compares with the base system plan deficit of about $22 million, or $0.34 per passenger. Farebox revenues would cover about 43 percent of operating costs under the maximum extent bus-on-freeway plan, and 53 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has, in the past, funded up to 72 percent of the nonfederal share.[2] The annual local share of the public

[2] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, greater than the $10.8 million required to provide 50 percent federal funding of the operating deficits under the base plan, but somewhat less than the $21.6 million required to provide such funding under the maximum extent bus-on-freeway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Table 258

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Maximum Extent Bus-on-Freeway Plan		
		Transit Trips			Transit Trips	
	Total Person Trips[a]	Number	Percent of Total Trips	Total Person Trips[a]	Number	Percent of Total Trips
Home-Based Work	1,061,500	57,500	5.4	1,059,900	67,300	6.3
Home-Based Shopping . .	627,900	33,100	5.3	627,300	39,100	6.2
Home-Based Other	1,464,800	67,300	4.6	1,461,700	89,300	6.1
Nonhome Based.	778,800	13,700	1.8	776,300	15,200	2.0
School	454,200	45,800	10.0	454,200	45,800	10.1
Total	4,387,200	217,400	5.0	4,379,400	256,700	5.9

[a] *The difference in the total person trips generated under the maximum extent bus-on-freeway plan and the total person trips generated under the base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been found to be correlated with increased automobile ownership, and greater automobile ownership has been found to be correlated with increased trip generation. The Commission travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.*

Source: SEWRPC.

Table 259

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Time of Day	Base Plan				Maximum Extent Bus-on-Freeway Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,300	41.7	46,900	21.6	11,300	21.6	53,300	20.8
Midday	400	3.9	75,900	34.9	15,900	30.4	91,300	35.6
Afternoon . .	5,600	54.4	74,900	34.4	19,800	37.9	87,300	34.0
Evening. . . .	- -	- -	19,700	9.1	5,300	10.1	24,800	9.6
Total	10,300	100.0	217,400	100.0	52,300	100.0	256,700	100.0

Source: SEWRPC.

funding requirement in the year 2000 would be about $6 million for the maximum extent bus-on-freeway system, and somewhat less, $3 million, for the base system.

Development of Truncated Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent bus-on-freeway system plan are summarized in Table 262. The maximum extent bus-on-freeway system plan has higher capital costs and greater operating deficits, both in total and on a per-passenger basis, than does the base plan. In addition, farebox revenues under the maximum extent bus-on-freeway system plan cover a much smaller proportion of operating costs in the plan design year than do such revenues under the base plan, particularly with respect to its primary element.

Table 260

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Bus-on-Freeway Plan
Guideway Development[b]	$ --	$ 14,326,000
Station Development[c]	2,468,500	18,169,500
Vehicle Storage and Maintenance Facility Development[c]	18,950,000	23,150,000
Vehicle Acquisition and Replacement[d]	164,780,000	230,740,000
Total	$186,198,500	$286,385,500

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent bus-on-freeway plan would be implemented incrementally from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 to 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes for the bus-on-freeway plan the implementation cost of the proposed freeway operational control system in the Milwaukee area, which has an estimated useful life of 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—nine acres under the base plan and 52 acres under the maximum extent bus-on-freeway plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses used in the system. Both plans assume the availability of the existing fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years.*

Source: SEWRPC.

Most of the increases in the cost and decreases in the cost-effectiveness of the maximum extent bus-on-freeway system plan can be attributed to the overextension of primary transit service envisioned in this plan.[3] Under the maximum extent plan, primary transit service would be extended into large areas of the Region not now served. In addition, it would be expanded into an all-day operation, and it would be provided with headways of no more than 30 minutes during the peak travel periods in the peak direction and 60 minutes otherwise. Thus, the primary transit service proposed would be a true transit service, available for tripmaking of all purposes. The cost-effectiveness of the routes on which bus-on-freeway service would be extended can be identified through a determination of what proportion of the operating costs of the routes may be expected to be recovered through farebox revenues. As shown in Table 263, only four of the routes under the maximum extent

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[3] *The extension of local and express service under the maximum extent bus-on-freeway plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express (secondary) and local (tertiary) service included in each maximum extent primary transit system plan is basically in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules were modified, however, to coordinate properly the secondary and tertiary service proposed to be provided with the primary service proposed under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered, and should, therefore, not affect a comparison of those alternatives.*

Table 261

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Bus-on-Freeway Plan
Ridership		
Primary Element	2,626,500	13,336,500
Total System	62,685,500	72,612,500
Operating and Maintenance Cost		
Primary Element	$ 3,464,400	$21,344,800
Total System	46,323,500	76,265,000
Operating and Maintenance Cost per Passenger		
Primary Element	$1.32	$1.60
Systemwide Average	0.74	1.06
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.16	$0.10
Total System	0.17	0.16
Farebox Revenue		
Primary Element	$ 1,575,900	$10,299,500
Total System	24,697,600	33,094,000
Operating Deficit		
Primary Element	$ 1,888,500	$11,045,300
Total System	21,625,900	43,171,000
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	45	48
Total System	53	43
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 944,250	$ 5,522,650
Total System	10,812,950	21,581,500
State (72 percent of nonfederal share of operating deficit)		
Primary Element	679,860	3,976,310
Total System	7,785,320	15,541,560
Local		
Primary Element	264,390	1,546,340
Total System	3,027,630	6,043,940
Local Operating Deficit per Ride		
Primary Element	$0.10	$0.12
Total System	0.05	0.08

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, greater than the $10.8 million required to provide 50 percent federal funding of the operating deficit under the base plan, but less than the $21.6 million required to provide such funding under the maximum extent bus-on-freeway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

Table 262

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Bus-on-Freeway Plan
Ridership		
In Design Year	62,685,500	72,612,500
To Design Year	1,238,433,200	1,317,849,200
Capital Cost		
Total to Design Year	$186,198,500	$286,385,500
To Design Year per Passenger	0.15	0.22
To Design Year After Accounting for Useful Life Beyond Design Year	124,606,570	180,135,500
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.14
Operating Cost		
Percent Met by Farebox Revenues in Design Year	53	43
Operating Deficit in Design Year	$ 21,625,900	$ 43,171,000
Operating Deficit per Passenger in Design Year	0.34	0.59
Operating Deficit to Design Year	418,319,800	590,680,600
Operating Deficit to Design Year per Passenger	0.34	0.45
Total Cost		
To Design Year	$604,518,300	$877,066,100
Federal Share	258,118,700	524,448,700
Nonfederal Share	246,399,600	352,617,400
To Design Year per Passenger	0.49	0.67
Federal Share	0.29	0.40
Nonfederal Share	0.20	0.27
To Design Year After Accounting for Useful Life Beyond Design Year	542,926,370	770,816,100
Federal Share	308,845,160	439,448,700
Nonfederal Share	234,081,210	331,367,400
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.44	0.59
Federal Share	0.25	0.34
Nonfederal Share	0.19	0.25

Source: SEWRPC.

plan are expected to meet at least one-half of their operating costs through farebox revenues. Ten of the routes are expected to meet between 40 and 50 percent of their operating costs through farebox revenues.

To reduce operating deficits and increase the proportion of primary transit operating costs met by farebox revenues, it was necessary to truncate the maximum extent bus-on-freeway plan. In order to do so while maintaining a framework of true primary transit service in the Milwaukee area, and, importantly, to assure reasonable comparability between all primary transit alternatives tested, this truncation was limited to reductions in the extent of service provided. Nevertheless, those bus-on-freeway facilities and services which could be reasonably cost-effective if the time periods and frequency of service offered were reduced were identified so that these reduced services could be

Table 263

OPERATING COST-EFFECTIVENESS OF BUS-ON-FREEWAY ROUTES
OF THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER
THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicles Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
1–Port Washington	41,010	$ 2,010	1,981	$ 4,301	47
2–Cedarburg	21,720	1,060	1,235	2,681	40
3–Mequon	12,530	610	1,040	2,258	27
4–Brown Deer	26,580	1,300	1,193	2,590	50
5–River Hills	12,680	620	1,146	2,488	25
6–Northwest Side	22,190	1,090	1,042	2,262	48
7–Wauwatosa	5,050	250	1,208	2,622	9
8–West Bend	34,050	1,670	1,822	3,955	42
9–Germantown	12,230	600	1,320	2,866	21
10–Menomonee Falls	11,540	560	1,215	2,638	21
11–Menomonee Falls	21,980	1,080	1,125	2,442	44
12–Brookfield	19,460	950	1,177	2,555	37
13–Milwaukee County Institutions/UWM	750	40	524	1,138	3
14–Oconomowoc/Pewaukee	30,580	1,500	1,666	3,617	41
15–Oconomowoc/Delafield	17,340	850	1,728	3,751	23
16–Waukesha	26,920	1,320	945	2,052	64
17–East Troy	35,450	1,740	1,815	3,940	44
18–Hales Corners	19,120	940	1,106	2,401	39
19–Greenfield	12,020	590	778	1,689	35
20–West Allis	16,760	820	824	1,789	46
21–Stadium	4,660	230	434	942	24
22–Franklin	7,840	380	896	1,945	20
23–Kenosha	185,440	9,090	4,213	9,146	99
24–Racine	161,980	7,940	3,557	7,722	103
25–Oak Creek/Ryan Road	17,460	860	986	2,140	40
26–Oak Creek/Rawson Avenue	12,600	620	853	1,852	33
27–South Side/UWM	1,520	80	473	1,027	7
28–South Side/College Avenue	2,510	120	276	599	21
29–South Side/IH 894	8,960	440	840	1,824	24
30–South Side/Holt Avenue	14,090	690	675	1,465	47
31–Cudahy	7,280	360	464	1,007	35
Total	824,300	$40,410	38,557	$83,704	48

Source: SEWRPC.

considered for addition to the "best" primary transit system plan for this future as "specialized" transit service.[4]

Accordingly, with the objective of reducing bus-on-freeway operating deficits by increasing the proportion of bus-on-freeway operating costs met by farebox revenues to at least 50 percent, the maximum extent bus-on-freeway system plan was truncated as set forth in Table 264 and on Map 110. Each bus-on-freeway route for which farebox revenues were not expected to approach 50 per-

[4] *Reductions in the time periods of service and increases in the headways operated have the potential to affect primary transit cost-effectiveness significantly. The off-peak-period operations of bus-on-freeway service under this future are less cost-effective than the peak-period operations. However, limiting bus-on-freeway service to the peak travel periods may be expected to increase*

(footnote continued on next page)

(footnote 4 continued)

only slightly the average systemwide proportion of bus-on-freeway operating costs met by farebox revenues because under peak-period-only operation, travel on the bus-on-freeway system may be expected to be reduced to the primarily work- and school-related travel generated during the morning peak period. Nevertheless, because travel on the bus-on-freeway system during the peak periods is highly directional, being largely oriented to the Milwaukee central business district in the morning and from the central business district in the afternoon, limiting service in the peak period to the peak direction could be expected to double the proportion of bus-on-freeway operating costs met by farebox revenues. This conclusion assumes the use of satellite storage facilities for the limited number of peak-period buses required to serve the most outlying stations. Under such an arrangement, drivers would have to report to, and leave work from, the outlying stations. Otherwise, the extent of deadhead bus miles required for such a peak-period and peak-direction operation would be inconsistent with the average operating cost per revenue bus mile used to estimate the costs of bus alternatives under this study.

To reduce the frequency of service, maximum headways in the peak periods and the peak direction were increased from 30 to 60 minutes with only a relatively small reduction in transit use and a substantial reduction in operating cost. The decrease in ridership would result from the attendant increase in wait time for transit service. First wait times under this study were assumed to approximate one-half of the headway up to a maximum of 10 minutes. Consequently, the increases in maximum headway would not affect this wait time. However, all subsequent wait times, which were attendant to transfers, were estimated at one-half of the headway with no upper limit. It should be noted that, by not permitting headways greater than 60 minutes, it was assumed that any decrease in operating costs possible through further headway increases would result in ridership and revenue reductions and a subsequent stabilization or decline in the proportion of operating costs recovered from farebox revenues. The ridership reductions would result from the inconvenient schedule.

cent of operating costs on an all-day and minimum frequency basis was cut back. However, those routes which could be expected to meet 50 percent of their operating costs through farebox revenues with reductions in the time periods or frequency of service were identified for consideration later in the study, and are summarized in Table 264.

Evaluation of Maximum Extent Commuter Rail System Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is commuter rail. The maximum extent system plan developed for this technology is summarized with respect to its coverage and routes in Chapter III of this report on Map 57 and in Table 122, and is summarized with respect to its operation under this future in Tables 265 through 267. Map 53 and Table 111 of Chapter III and Tables 266, 256, and 257 provide comparable information for the base, or benchmark, plan used in the study. A description of the facilities and services of the primary, express, and local elements of both the maximum extent commuter rail plan and the base plan is provided in Chapter III of this report and will not be repeated here. Only those characteristics of the maximum extent commuter rail plan which vary between the futures, specifically, the provision of service to meet demand, will be discussed.

Under this alternative future, headways on the commuter rail primary transit element were assumed to be one-half hour in the peak period in the peak direction, and every hour otherwise. Commuter rail trains would consist of a locomotive and one coach, except on the route through Racine to Kenosha, where trains of four coaches would be used during the peak periods, and on the route to Oconomowoc, where trains of two coaches would be used in the peak periods and trains of two coaches would be used during the off-peak periods. Under the maximum extent commuter rail plan for this future, there would be 10,150 vehicle miles of primary transit service—a 41 percent increase over the level of service provided in the base plan. The number of express and local service bus miles operated would increase by about 42 percent over the number envisioned in the base plan, from about 64,800 to about 91,900 bus miles on an average weekday.

Transit Utilization: Under the maximum extent commuter rail system plan for the moderate growth scenario-decentralized land use plan alter-

Table 264

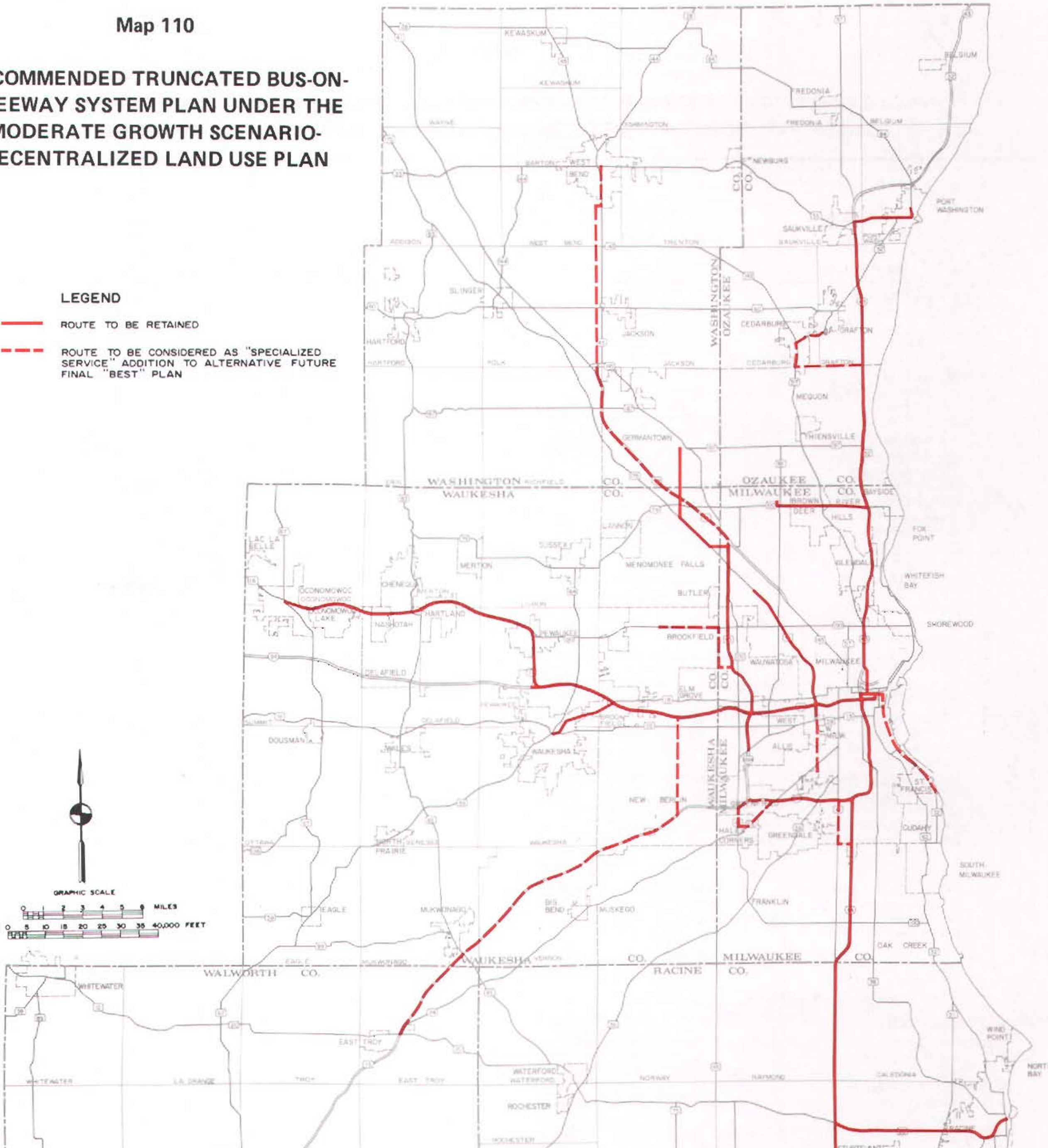
RECOMMENDED CHANGES IN THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Recommended Change
2—Cedarburg	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
3—Mequon	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak period and peak direction
5—River Hills	Route to be cut back to park-ride lot at the North-South Freeway (IH 43) and W. Silver Spring Drive
7—Wauwatosa	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways. Also, feeder loop operating over W. Burleigh Street and N. Mayfair Road to park-ride lot at Zoo Freeway (USH 45) and W. Watertown Plank Road to be dropped. Express service to N. Glenview Avenue to be cut back
8—West Bend	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
9—Germantown, and 10, and 11—Menomonee Falls	Routes to be combined into one route
12—Brookfield	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
13—Milwaukee County Institutions/UWM	Route to be eliminated
15—Oconomowoc/Delafield	Route to be cut back to Waukesha at Station 32
17—East Troy	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
18—Hales Corners	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
21—Stadium	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
22—Franklin	Route to be eliminated
25—Oak Creek/Ryan Road	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
26—Oak Creek/Rawson Avenue	Route to be eliminated
27—South Side/UWM	Route to be eliminated
28—South Side/College Avenue	Route to be eliminated
29—South Side/IH 894	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
31—Cudahy	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways

Source: SEWRPC.

Map 110

RECOMMENDED TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



The maximum extent bus-on-freeway system plan shown on Map 52 in Chapter III was truncated with the objective of maximizing the number of bus-on-freeway primary transit routes for which 50 percent of the operating costs could be met with farebox revenues. A total of 15 of the 31 routes in the maximum extent plan, totaling 569 route miles in length, were proposed to be retained in the truncated plan. Eleven of the 16 routes proposed to be deleted from the truncated plan were recommended to be considered for addition to the final "best" plan recommended for this future as specialized peak-period-only service.

Source: SEWRPC.

Table 265

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (trains per period)							
										Morning		Midday		Afternoon		Evening	
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	In	Out	In	Out	In	Out	In	Out
1	N. Maple Street and W. Grand Avenue	City of Port Washington	Proposed	Yes	150	1	- -	55	55	6	3	6	6	3	6	4	4
2	IH 43 and CTH C	Town of Grafton	Proposed	Yes	50	1	- -	44	44	6	3	6	6	3	6	4	4
3	IH 43 and Mequon Road. .	City of Mequon	Proposed	Yes	75	1	1	38	38	6	3	6	6	3	6	4	4
4	Rexleigh Drive and E. Brown Deer Road . . .	Village of Bayside	Proposed	Yes	- -	1	2	32	32	6	3	6	6	3	6	4	4
5	Railroad Street and Dekora Street	Village of Saukville	Proposed	Yes	75	1	- -	58	58	6	3	6	6	3	6	4	4
6	11th Avenue and North Street	Village of Grafton	Proposed	Yes	150	1	1	51	51	6	3	6	6	3	6	4	4
7	Cardinal Avenue and Pioneer Road.	City of Cedarburg	Proposed	Yes	225	1	1	44	44	6	3	6	6	3	6	4	4
8	Main Street and Friestadt Road.	Village of Thiensville	Proposed	Yes	75	1	1	39	39	6	3	6	6	3	6	4	4
9	Baehr Road and Donges Bay Road	City of Mequon	Proposed	Yes	100	1	1	34	34	6	3	6	6	3	6	4	4
10	Deerbrook Trail and W. Brown Deer Road . . .	Village of Brown Deer	Proposed	Yes	75	1	1	29	29	6	3	6	6	3	6	4	4
11	N. Teutonia Avenue and W. Silver Spring Drive. . .	City of Milwaukee	Proposed	Yes	125	3	2	22	22	18	9	18	18	9	18	12	12
12	N. 34th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	3	2	17	17	18	9	18	18	9	18	12	12
13	N. 30th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	3	2	13	13	18	9	18	18	9	18	12	12
14	N. 44th Street and W. Blue Mound Road . . .	City of Milwaukee	Proposed	Yes	- -	4	1	6	6	24	12	24	24	12	24	16	16
15	N. 5th Street and W. St. Paul Avenue	City of Milwaukee	Existing	Yes	- -	6	3	- -	- -	36	18	36	36	18	36	24	24
16	Island Drive and E. Washington Street . . .	City of West Bend	Proposed	Yes	125	1	- -	64	64	6	3	6	6	3	6	4	4
17	N. Center Street and Main Street.	Village of Jackson	Proposed	Yes	175	1	- -	53	53	6	3	6	6	3	6	4	4
18	S. Country Aire Drive and Mequon Road.	Village of Germantown	Proposed	Yes	100	1	1	42	42	6	3	6	6	3	6	4	4
19	N. 107th Street and W. Brown Deer Road . . .	City of Milwaukee	Proposed	Yes	50	1	2	35	35	6	3	6	6	3	6	4	4
20	N. 68th Street and W. Bradley Road.	City of Milwaukee	Proposed	Yes	50	1	1	29	29	6	3	6	6	3	6	4	4
21	S. Main Street and Collins Street.	City of Oconomowoc	Proposed	Yes	125	1	- -	62	62	6	3	6	6	3	6	4	4
22	Sawyer Road and USH 16	Town of Oconomowoc	Proposed	Yes	- -	1	- -	55	55	6	3	6	6	3	6	4	4
23	Lakeland Road and CTH PP	Village of Nashotah	Proposed	Yes	50	1	- -	50	50	6	3	6	6	3	6	4	4
24	Cottonwood Avenue and Pawling Avenue. . . .	Village of Hartland	Proposed	Yes	175	1	- -	45	45	6	3	6	6	3	6	4	4
25	W. Wisconsin Avenue and Capitol Drive	Village of Pewaukee	Proposed	Yes	150	1	1	38	38	6	3	6	6	3	6	4	4
26	Duplainville Road and Marjean Lane	Town of Pewaukee	Proposed	Yes	150	1	1	32	32	6	3	6	6	3	6	4	4
27	N. Brookfield Road and River Road	City of Brookfield	Proposed	Yes	75	1	1	27	27	6	3	6	6	3	6	4	4
28	Legion Drive and Watertown Plank Road . .	Village of Elm Grove	Proposed	Yes	100	1	1	19	19	6	3	6	6	3	6	4	4
29	N. 75th Street and W. State Street.	City of Wauwatosa	Proposed	Yes	50	1	4	12	12	6	3	6	6	3	6	4	4
30	N. Barstow Street and Cutler Street	City of Waukesha	Proposed	Yes	150	1	1	46	46	6	3	6	6	3	6	4	4
31	Pearl Street and CTH A . .	Town of Waukesha	Proposed	Yes	175	1	- -	40	40	6	3	6	6	3	6	4	4
32	S. Moorland Road and Honey Lane.	City of New Berlin	Proposed	Yes	50	1	2	33	33	6	3	6	6	3	6	4	4
33	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	50	1	4	26	26	6	3	6	6	3	6	4	4
34	S. 70th Street and Dickinson Street.	City of Milwaukee	Proposed	Yes	- -	1	1	19	19	6	3	6	6	3	6	4	4

Table 265 (continued)

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (trains per period)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning		Midday		Afternoon		Evening	
										In	Out	In	Out	In	Out	In	Out
35	S. 27th Street and W. Dakota Street	City of Milwaukee	Proposed	Yes	- -	1	4	12	12	6	3	6	6	3	6	4	4
36	14th Avenue and 54th Street.	City of Kenosha	Existing	Yes	200	1	1	63	63	6	3	6	6	3	6	4	4
37	STH 32 and CTH E.	Town of Somers	Proposed	Yes	300	1	1	57	57	6	3	6	6	3	6	4	4
38	Memorial Drive and State Street.	City of Racine	Proposed	Yes	150	1	1	45	45	6	3	6	6	3	6	4	4
39	STH 32 and Three Mile Road.	Town of Caledonia	Proposed	Yes	275	1	1	39	39	6	3	6	6	3	6	4	4
40	5th Avenue and E. Ryan Road	City of Oak Creek	Proposed	Yes	75	1	2	29	29	6	3	6	6	3	6	4	4
41	13th Avenue and E. Rawson Avenue	City of South Milwaukee	Proposed	Yes	- -	1	2	22	22	6	3	6	6	3	6	4	4
42	Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	100	1	2	18	18	6	3	6	6	3	6	4	4
43	Brust Avenue and E. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	10	10	6	3	6	6	3	6	4	4

Source: SEWRPC.

native future, about 245,100 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 268 and 269. About 20,800, or 8 percent, of these transit trips may be expected to utilize the primary transit system for all or a portion of the trip. Thus, the maximum extent commuter rail system plan envisions that about 6 percent of the total of 4.4 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that less than 1 percent will be made using primary transit. Under this future, primary transit usage under the commuter rail plan would be double that under the base plan, or 20,800 trips on an average weekday on commuter rail, compared with 10,300 trips under the primary element of the base plan. About 27,700 more transit trips may be expected to be made under the maximum extent commuter rail system plan than under the base plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent commuter rail system plan and the base system plan are summarized in Table 270. The costs shown include all track rehabilitation and construction costs, plus the cost of all locomotive and passenger coach, and supporting bus, acquisition and replacement, as needed, over the plan design period. Most capital items required to implement the plan would have useful lives beyond the 20-year plan design period, as noted in Table 270.

The total capital cost of the base plan is estimated at $186 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain existing service to the year 2000. About $19.2 million, or 10 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent commuter rail plan is estimated at $335 million. About 38 percent of the total cost, or $129 million, would be required for the primary transit element of the plan.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent commuter rail plan can be expected to approximate $67 million. The remaining $268 million would constitute the federal share of the capital cost under the Urban Mass Transportation

Table 266

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Commuter Rail Plan
Primary Element		
Exclusive Guideway Miles		
Subway	- -	- -
Elevated	- -	- -
At-Grade	- -	157.3
Total	- -	157.3[a]
Shared Guideway Miles		
Freeways	51.5	- -
Surface Arterial Streets	49.5	- -
Total	101.0	- -
Route Miles	449	354
Vehicle Miles	7,200	10,150
Vehicle Hours	310	329
Vehicles Required	63	60
Trains Required	- -	36
Express and Local Elements		
Route Miles	1,302	1,853
Vehicle Miles	64,820	91,900
Vehicle Hours	4,440	5,973
Vehicles Required	496	791
Total System		
Route Miles	1,755	2,207
Vehicle Miles	72,020	102,050
Vehicle Hours	4,750	6,302
Vehicles Required	559	851
Trains Required	- -	36

[a]*Although commuter rail operation is designated in this table as being over an exclusive guideway, commuter trains would, in fact, operate over railway trackage shared with freight trains.*

Source: SEWRPC.

Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal share and the federal share are estimated to total $37 million and $149 million, respectively.

Table 271 presents the annual operating and maintenance costs and farebox revenues anticipated for the design year of the base and maximum extent commuter rail plans. Under the base plan, operating and maintenance costs may be expected to approximate $46 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent commuter rail plan would increase the total operating and maintenance costs by $31 million, to a total cost of $77 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $3 million under the base plan, and $16 million under the maximum extent commuter rail plan. Primary transit system operating and maintenance costs would thus represent 7 percent of the total operating and maintenance costs expected in the design year of the base plan, and 21 percent of the total operating and maintenance costs expected in the design year of the maximum extent commuter rail plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.74. For the maximum extent commuter rail plan, the average cost per passenger may be expected to approach $1.11—$0.37, or 50 percent, more than the base plan cost. The average operating cost per passenger mile would be somewhat greater under the maximum extent commuter rail plan, $0.19, than under the base plan, $0.17. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.32 and $0.16, respectively, and for the maximum extent commuter rail plan would be $2.98 and $0.15, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $25 million, expressed in 1979 dollars, compared with $32 million under the maximum extent commuter rail plan. Under the commuter rail alternative, the primary element may be expected to generate about 18 percent, or $6 million, of the total revenues, compared with 6 percent, or $1.6 million, under the base plan.

The operating deficit in the year 2000 for the maximum extent commuter rail plan would be about $45 million, expressed in 1979 dollars, requiring a subsidy of about $0.63 per passenger. This compares with the base system plan deficit of about $22 million, or $0.39 per passenger. Farebox revenues could cover 42 percent of the operating costs under the maximum extent commuter rail plan and 53 percent of such costs under the base plan.

Table 267

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	354	354	354	354	354
Vehicle Miles	2,710	2,980	2,780	1,680	10,150
Vehicle Hours	88	97	90	54	329
Vehicles (coaches) Required.	60	24	60	21	60
Trains Required	36	18	36	18	36
Express and Local					
Route Miles.	1,853	1,775	1,853	1,672	1,853
Vehicle Miles	20,340	25,950	27,840	17,770	91,900
Vehicle Hours	1,347	1,663	1,868	1,095	5,973
Vehicles Required	613	294	791	196	791
Total System					
Route Miles.	2,207	2,129	2,207	2,026	2,207
Vehicle Miles	23,050	28,930	30,620	19,450	102,050
Vehicle Hours	1,435	1,760	1,958	1,149	6,302
Vehicles Required	673	318	851	217	851
Trains Required	36	18	36	18	36

Source: SEWRPC.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has, in the past, funded up to 72 percent of the nonfederal share.[5] The annual local share of the public funding requirement in the year 2000 would be about $6 million for the maximum extent commuter rail plan. The local funding requirement for the base system would be somewhat less—$3 million.

[5] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $10.8 million required to provide 50 percent federal funding of the operating deficits under the base plan, but somewhat less than the $22.3 million required to provide such funding under the maximum extent commuter rail plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Development of Truncated Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent commuter rail system plan are summarized in Table 272. The maximum extent commuter rail system plan may be expected to have higher capital costs and greater operating deficits, both in total and on a per-passenger basis, than the base plan. In addition, farebox revenues under the maximum extent commuter rail system plan may be expected to cover a much smaller proportion of operating costs in the plan design year than would such revenues under the base plan, particularly with respect to its primary element.

Most of the increases in the cost and decreases in the cost-effectiveness of the maximum extent commuter rail system plan can be attributed to the overextension of primary transit service envisioned

Table 268

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Maximum Extent Commuter Rail Plan		
		Transit Trips			Transit Trips	
	Total Person Trips	Number	Percent of Total Trips	Total Person Trips	Number	Percent of Total Trips
Home-Based Work	1,061,500	57,500	5.4	1,061,000	62,000	5.8
Home-Based Shopping . .	627,900	33,100	5.3	627,700	38,600	6.1
Home-Based Other	1,464,800	67,300	4.6	1,463,800	83,900	5.7
Nonhome Based.	778,800	13,700	1.8	777,000	14,800	1.9
School	454,200	45,800	10.0	454,200	45,800	10.0
Total	4,387,200	217,400	5.0	4,383,700	245,100	5.6

Source: SEWRPC.

Table 269

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Time of Day	Base Plan				Maximum Extent Commuter Rail Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,300	41.7	46,900	21.6	4,100	19.7	50,600	20.7
Midday	400	3.9	75,900	34.9	7,000	33.7	87,700	35.8
Afternoon . .	5,600	54.4	74,900	34.4	7,100	34.1	83,400	34.0
Evening. . . .	--	--	19,700	9.1	2,600	12.5	23,400	9.5
Total	10,300	100.0	217,400	100.0	20,800	100.0	245,100	100.0

Source: SEWRPC.

in this plan.[6] Under the maximum extent plan, primary transit service would be extended into large areas of the Region not now served. In addition, it would be expanded into an all-day operation, and it would be provided at headways of no more than 30 minutes during the peak travel periods in the

[6] *The extension of local and express service under the maximum extent commuter rail plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express (secondary) and local (tertiary) service included in each maximum extent primary transit system plan is basically in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules were modified, however, to coordinate properly the secondary and tertiary service proposed to be provided with the primary service proposed under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered, and should, therefore, not affect a comparison of those alternatives.*

Table 270

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Commuter Rail Plan
Guideway Development	$ --	$ 34,536,900[d]
Station Development[b]	2,486,500	11,979,900
Vehicle Storage and Maintenance Facility Development[b]	18,950,000	29,278,900
Vehicle Acquisition and Replacement[c]	164,780,000	258,870,000
Total	$186,198,500	$334,665,700

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent commuter rail plan would be implemented incrementally from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 to 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—9 acres under the base plan and 41 acres under the maximum extent commuter rail plan. Right-of-way is assumed to have a life of 100 years. The useful life of stations is estimated at 30 years.*

[c] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses and commuter rail coaches and locomotives. Both plans assume the availability of the existing fleet of 640 buses with an average age of 10 years in 1980. Buses have an average useful life of 12 years. Commuter rail coaches and locomotives have an estimated useful life of 30 years.*

[d] *The Milwaukee Road has proposed major track rehabilitation work on some of the railway line segments herein considered for potential use by commuter trains. Should all of this track rehabilitation work be completed, the capital investment necessary for guideway development of the maximum extent commuter rail system would be reduced by $12,274,000 to $22,262,900. As of April 1981, such rehabilitation work in the amount of $3,458,000 had been completed by the Milwaukee Road during the 1980 and 1981 working seasons.*

Source: SEWRPC.

peak direction and 60 minutes otherwise. Thus, the primary transit service proposed would be a true transit service, available for tripmaking of all purposes. The cost-effectiveness of the routes on which commuter rail service would be extended can be identified through a determination of what proportion of the operating costs of the routes may be expected to be recovered through farebox revenues. As shown in Table 273, under the maximum extent plan only the route through Racine to Kenosha may be expected to meet one-half of its operating costs through farebox revenues, and none of the other routes may be expected to meet more than 34 percent of their operating costs through such revenues.

To reduce operating deficits and increase the proportion of primary transit operating costs met by farebox revenues, it was necessary to truncate the maximum extent commuter rail plan. In order to do so while maintaining a framework of true primary transit service in the Milwaukee area, and, importantly, to assure reasonable comparability between all primary transit alternatives tested, this truncation was limited to reductions in the extent of service provided. Nevertheless, those commuter rail facilities and services which could be reasonably cost-effective if the time periods and frequency of service offered were reduced were identified so that these reduced services could be considered for addition to the "best" primary transit system plan for this future as "specialized" transit service.[7]

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[7] *Reductions in the time periods of service and increases in the headways operated have the potential to affect primary transit cost-effectiveness significantly. The off-peak-period operations of commuter rail service under this future are less*

(footnote continued on next page)

Accordingly, as summarized in Table 274 and shown on Map 111, only the commuter rail route through Racine to Kenosha was retained for further consideration on an all-day and minimum frequency of service basis, as the analyses indicated no other commuter rail route could be expected to meet at least 50 percent of its operating costs on such a basis through farebox revenues. However, those routes which could meet about 50 percent of their operating costs through farebox revenues with reductions in the time periods or frequency of service were cut back and retained for consid-

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(footnote 7 continued)

cost-effective than the peak-period operations. However, limiting commuter rail service to the peak travel periods may be expected to increase the average systemwide proportion of commuter rail operating costs met by farebox revenues only slightly, because, under peak-period-only operation, travel on the commuter rail system may be expected to be reduced to the largely work- and school-related travel generated during the morning peak period. Nevertheless, because travel on the commuter rail system during the peak periods is highly directional, being largely oriented to the Milwaukee central business district in the morning and from the central business district in the afternoon, limiting service in the peak period to the peak direction could allow for a substantial increase in the proportion of commuter rail operating costs met by farebox revenues.

Reducing the frequency of service by increasing maximum headways in the peak periods and peak direction from 30 to 60 minutes could increase the percentage of the systemwide operating cost met by farebox revenues, because such an increase in headways would result in only a small reduction in transit use and a substantial reduction in operating cost. The decrease in ridership would result from the attendant increase in wait time for transit service. First wait times under this study were assumed to approximate one-half of the headway up to a maximum of 10 minutes. Consequently, increases in maximum headways would not affect this wait time. However, all subsequent wait times, which are attendant to transfers, were estimated at one-half of the headway with no upper limit. It should be noted that, by not permitting headways greater than 60 minutes, it was assumed that any decrease in operating costs possible through further headway increases would result in ridership and revenue reductions and a subsequent stabilization or decline in the proportion of operating costs recovered from farebox revenues. The ridership reductions would result from the inconvenient schedule.

Table 271

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Commuter Rail Plan
Ridership		
Primary Element	2,626,500	5,500,095
Total System	62,685,500	71,508,400
Operating and Maintenance Cost		
Primary Element	$ 3,464,400	$15,784,500
Total System	46,323,500	76,548,200
Operating and Maintenance Cost per Passenger		
Primary Element	$1.32	$2.98
Systemwide Average	0.74	1.11
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.16	$0.15
Total System	0.17	0.19
Farebox Revenue		
Primary Element	$ 1,575,900	$ 5,589,600
Total System	24,697,600	31,869,400
Operating Deficit		
Primary Element	$ 1,888,500	$10,194,900
Total System	21,625,900	44,678,800
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	45	35
Total System	53	42
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 944,250	$ 5,097,450
Total System	10,812,950	22,339,400
State (72 percent of nonfederal share of operating deficit)		
Primary Element	679,860	3,670,160
Total System	7,785,320	16,084,370
Local		
Primary Element	264,390	1,427,290
Total System	3,027,630	6,255,030
Local Operating Deficit per Ride		
Primary Element	$0.10	$0.27
Total System	0.05	0.09

[a] The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, or slightly greater than the $10.8 million required to provide 50 percent federal funding of the operating deficit under the base plan, but less than the $22.3 million required to provide such funding under the maximum extent commuter rail system plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.

Source: SEWRPC.

Table 272

COST-EFFECTIVENESS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Commuter Rail Plan
Ridership		
In Design Year	62,685,500	71,508,445
To Design Year	1,238,433,200	1,309,016,800
Capital Cost		
Total to Design Year	$186,198,500	$334,665,700
To Design Year per Passenger	0.15	0.26
To Design Year After Accounting for Useful Life Beyond Design Year	124,606,570	182,522,880
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.14
Operating Cost		
Percent Met by Farebox Revenues in Design Year	53	42
Operating Deficit in Design Year	$ 21,625,900	$ 44,678,800
Operating Deficit per Passenger in Design Year	0.34	0.62
Operating Deficit to Design Year	418,319,800	602,743,000
Operating Deficit to Design Year per Passenger	0.34	0.46
Total Cost		
To Design Year	$604,518,300	$937,408,700
Federal Share	358,118,700	569,104,060
Nonfederal Share	246,399,600	368,304,640
To Design Year per Passenger	0.49	0.72
Federal Share	0.29	0.44
Nonfederal Share	0.20	0.28
To Design Year After Accounting for Useful Life Beyond Design Year	542,926,370	785,265,880
Federal Share	308,845,160	447,389,800
Nonfederal Share	234,081,210	337,876,080
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.44	0.60
Federal Share	0.25	0.34
Nonfederal Share	0.19	0.26

Source: SEWRPC.

eration as additions to the final plan; these routes consisted of those to Oconomowoc, Port Washington, Saukville, and Waukesha, as summarized in Table 274.

Evaluation of Maximum Extent Light Rail Transit System Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is light rail transit. The maximum extent system plan developed for this technology is summarized with respect to its coverage and routes in Chapter III of this report on Maps 60 and 61, and with respect to its operation and station size requirements under the moderate growth scenario-decentralized land use plan alternative future in Tables 275 and 276. Map 53 and Table 111 of Chapter III and Tables 276 and 256 of this chapter provide comparable information for the base, or benchmark, plan used in the study. A discussion of the facilities and services of the primary, express, and local elements of both the maximum extent light rail transit system plan and the base plan is included in Chapter III of this report, and will not be repeated here.

In comparison to the base plan, the maximum extent light rail system plan under this future would entail nearly a three-fold increase in vehicle miles of primary transit service, or 19,900 vehicle miles compared with 7,200 vehicle miles under the base plan. A significant part of this increase would be the result of the extension of primary service into off-peak travel periods during the midday and evenings, as indicated in Tables 257 and 277. The number of bus miles of express and local service

Table 273

OPERATING COST-EFFECTIVENESS OF COMMUTER RAIL ROUTES OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicle Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
Kenosha	234,540	$12,670	4,170	$25,430	50
Waukesha	26,040	1,410	750	4,580	31
Oconomowoc	33,670	1,820	1,320	8,050	23
Saukville	22,940	1,240	1,120	6,830	18
West Bend	40,620	2,190	1,050	6,400	34
Port Washington	48,050	2,590	1,740	10,610	24
Total	405,860	$21,920	10,150	$61,900	35

Source: SEWRPC.

Table 274

RECOMMENDED CHANGES IN THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Recommended Change
1–Port Washington	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods, and possibly peak directions, and increased headways
2–Saukville	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods, and possibly peak directions, and increased headways
3–West Bend	Route to be eliminated
4–Oconomowoc	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods, and possibly peak directions, and increased headways
5–Waukesha	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods, and possibly peak directions, and increased headways

Source: SEWRPC.

operated under this plan to supplement the light rail transit service under this future would be about the same as the number operated under the base plan.

Headways on the primary element of the maximum extent plan under this alternative future would range from 5 to 12 minutes during the peak periods. During the off-peak periods, headways would range from 15 to 20 minutes in the midday period, and from 20 to 60 minutes during the evening. During all periods of the day, light rail transit primary service would operate with single-articulated vehicles.

Transit Utilization: Under the maximum extent light rail transit system plan of the moderate growth scenario-decentralized land use plan alternative future, about 235,000 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 278 and 279. About 109,000, or 47 percent, of these transit trips may be expected to be made on the primary transit system for all or a portion of the trip. Thus, the maximum extent light rail transit system plan envisions that about 5 percent of the total 4.4 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that about 2 percent will be made using primary transit. About 17,000, or 8 percent, more transit trips may be expected to be made under this plan than under the base plan.

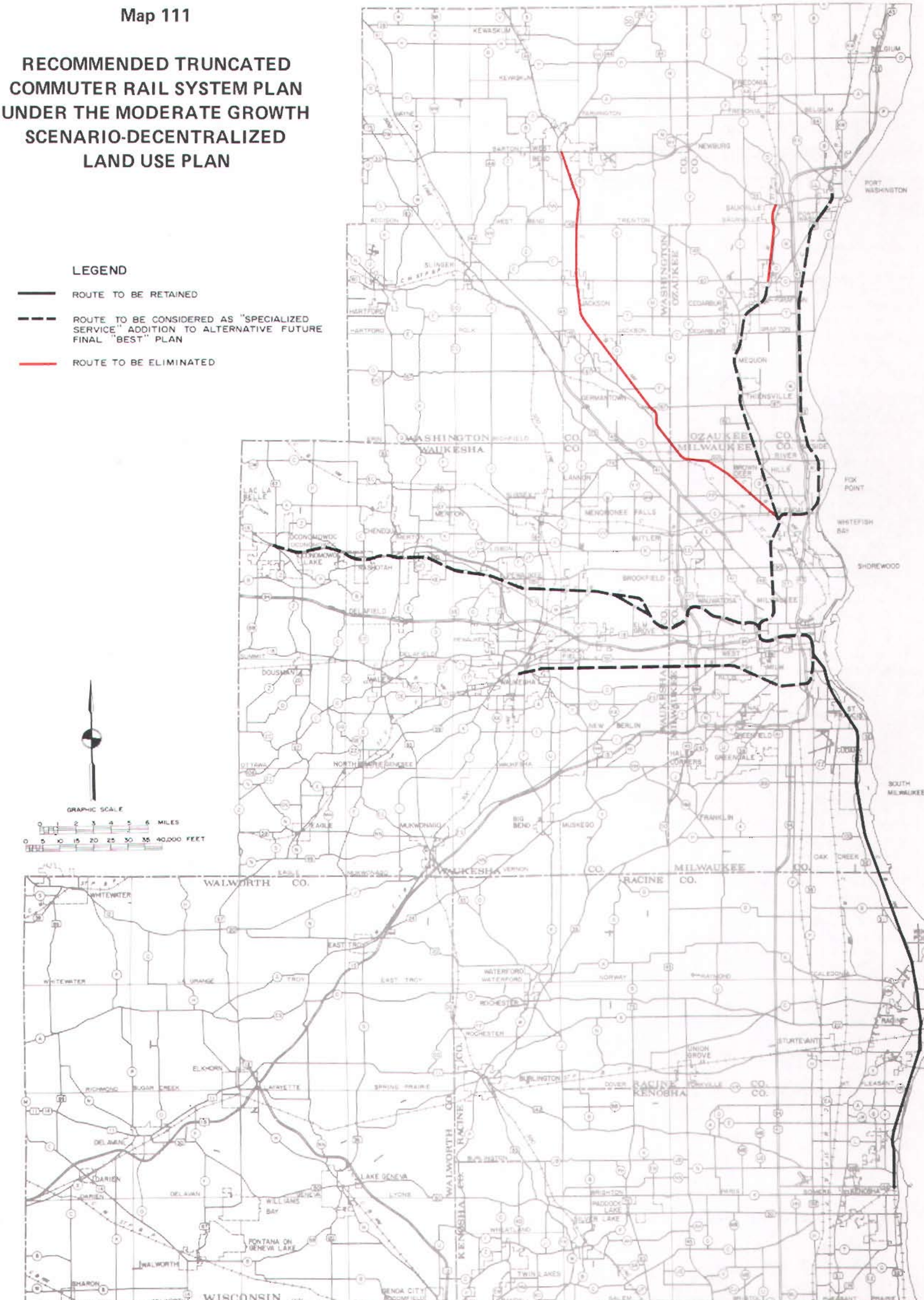
Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent light rail transit system plan and the base system plan are summarized in Table 280. The costs shown include all construction and right-of-way acquisition costs, plus the cost of acquiring and replacing vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 280.

The total capital cost of the base plan is estimated at $186 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain the existing service to the year 2000. About $19 million, or 10 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent light rail transit plan is estimated at $1.1 billion. About $792 million would be required for construction of the light rail guideway, including right-of-way, trackage, electrification, signalization, and system control. About $248 million would be incurred in the purchase of new and replacement of transit vehicles—$115 million of which would be for the purchase of 144 articulated light rail vehicles and about $133 million of which would be for the purchase of 951 conventional buses. The remaining $87 million would be incurred in the construction of park-ride stations and of light rail storage, maintenance, and layover facilities, and the expansion of bus storage and maintenance facilities. About $980 million, or over 87 percent of the total capital cost of the plan, would be attributable to its primary transit element.

Map 111

RECOMMENDED TRUNCATED COMMUTER RAIL SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



The maximum extent commuter rail system plan shown on Map 57 in Chapter III was truncated with the objective of maximizing the number of commuter rail routes for which at least 50 percent of the operating costs could be met with farebox revenues. Only one of the six routes in the maximum extent plan, totaling 66 route miles in length, was proposed to be retained in the truncated plan. However, four of the five routes deleted from the truncated commuter rail plan were recommended to be considered for addition to the final "best" plan recommended for this future as specialized peak-period-only service.

Source: SEWRPC.

Table 275

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (trains per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	W. Broadway and W. Main Street.	City of Waukesha	Proposed	Yes	- -	1	10	49	49	8	8	4	4	12	12	3	3
2	E. Broadway and Pleasant Street	City of Waukesha	Proposed	Yes	- -	1	1	47	47	8	8	4	4	12	12	3	3
3	Lincoln Avenue and Lake Street.	City of Waukesha	Proposed	Yes	- -	1	- -	45	45	8	8	4	4	12	12	3	3
4	Lincoln Avenue and Frederick Street	City of Waukesha	Proposed	Yes	- -	1	1	43	43	8	8	4	4	12	12	3	3
5	CTH A and Pearl Street . .	City of Waukesha	Proposed	Yes	325	1	- -	40	40	8	8	4	4	12	12	3	3
6	Johnson Road	City of New Berlin	Proposed	- -	50	1	- -	37	37	8	8	4	4	12	12	3	3
7	Calhoun Road and Rogers Drive	City of New Berlin	Proposed	Yes	350	1	- -	34	34	8	8	4	4	12	12	3	3
8	Moorland Road and Rogers Drive	City of New Berlin	Proposed	Yes	- -	1	2	32	32	8	8	4	4	12	12	3	3
9	Sunny Slope Road and Honey Lane	City of New Berlin	Proposed	- -	- -	1	- -	30	30	8	8	4	4	12	12	3	3
10	S. 124th Street and Honey Lane	City of New Berlin	Proposed	- -	- -	1	- -	28	28	8	8	4	4	12	12	3	3
11	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	- -	1	5	26	26	8	8	4	4	12	12	3	3
12	S. 98th Street and W. Washington Street . . .	City of West Allis	Proposed	Yes	- -	1	2	23	23	8	8	4	4	12	12	3	3
13	N. 92nd Street and W. Dixon Street	City of Milwaukee	Proposed	Yes	125	1	- -	21	21	8	8	4	4	12	12	3	3
14	N. 84th Street and W. Hawthorne Avenue . .	City of Milwaukee	Proposed	Yes	- -	2	2	18	18	13	12	7	6	18	22	4	5
15	N. 76th Street and W. Fairview Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	17	17	13	12	7	6	18	22	4	5
16	N. 68th Street and W. Fairview Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	16	16	13	12	7	6	18	22	4	5
17	N. Hawley Road and W. Fairview Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	14	14	13	12	7	6	18	22	4	5
18	County Stadium and Mitchell Boulevard	City of Milwaukee	Proposed	Yes	75	2	- -	13	13	13	12	7	6	18	22	4	5
19	County Stadium and N. 44th Street	City of Milwaukee	Proposed	Yes	150	3	- -	11	11	20	17	10	9	26	30	6	7
20	N. 35th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	7	7	23	20	11	10	30	34	7	8
21	N. 27th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	4	6	6	23	20	11	10	30	34	7	8
22	N. 21st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	4	4	23	20	11	10	30	34	7	8
23	N. 16th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	5	3	3	23	20	11	10	30	34	7	8
24	N. 12th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	6	2	2	23	20	11	10	30	34	7	8
25	N. 6th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	4	7	- -	- -	30	27	15	14	40	44	9	10
26	N. Plankinton Avenue and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	10	2	2	12	15	6	7	22	18	5	4
27	N. Broadway Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	8	3	3	12	15	6	7	22	18	5	4
28	N. Jackson Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	7	4	4	12	15	6	7	22	18	5	4
29	N. Jackson Street and E. Kilbourn Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	5	5	12	- -	6	- -	22	- -	5	- -
30	N. Van Buren Street and E. Kilbourn Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	- -	- -	- -	15	- -	7	- -	18	- -	5
31	N. Jackson Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	7	7	12	- -	6	- -	22	- -	5	- -
32	N. Van Buren Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	- -	- -	- -	15	- -	7	- -	18	- -	4
33	N. Astor Street and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	12	15	6	7	22	18	5	4
34	N. Farwell Avenue and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	9	9	12	15	6	7	22	18	5	4
35	N. Farwell Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	2	10	10	12	- -	6	- -	22	- -	5	- -
36	N. Prospect Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	1	- -	- -	- -	15	- -	7	- -	18	- -	4
37	N. Farwell Avenue and E. Kenilworth Place	City of Milwaukee	Proposed	Yes	- -	2	1	12	12	12	15	6	7	22	18	5	4
38	N. Oakland Avenue and E. North Avenue.	City of Milwaukee	Proposed	Yes	- -	2	3	13	13	12	15	6	7	22	18	5	4
39	N. Cambridge Avenue and E. Locust Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	15	15	12	15	6	7	22	18	5	4
40	N. Oakland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	- -	- -	2	1	16	16	12	15	6	7	22	18	5	4

Table 275 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (trains per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
41	N. Maryland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	Yes	- -	2	6	16	16	12	15	6	7	22	18	5	4
42	N. Maryland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	- -	2	4	21	21	12	15	6	7	22	18	5	4
43	N. Oakland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	- -	- -	2	1	22	22	12	15	6	7	22	18	5	4
44	Wisconsin Avenue and Broad Street	Village of Grafton	Proposed	Yes	- -	1	1	52	52	7	7	4	4	10	10	2	2
45	1st Avenue and Maple Street	Village of Grafton	Proposed	Yes	375	1	- -	51	51	7	7	4	4	10	10	2	2
46	Cedar Ridge Drive and Georgetown Drive.	City of Cedarburg	Proposed	Yes	- -	1	1	49	49	7	7	4	4	10	10	2	2
47	STH 143 (Washington Avenue) and Turner Street	City of Cedarburg	Proposed	- -	- -	1	1	47	47	7	7	4	4	10	10	2	2
48	Grant Avenue and Western Road	City of Cedarburg	Proposed	- -	- -	1	1	45	45	7	7	4	4	10	10	2	2
49	STH 57 and CTH C (Pioneer Road).	City of Mequon	Proposed	Yes	350	1	- -	43	43	7	7	4	4	10	10	2	2
50	STH 57 (Main Street) and Freistadt Road	Village of Thiensville	Proposed	Yes	- -	1	1	38	38	7	7	4	4	10	10	2	2
51	STH 57 (Green Bay Road) and STH 67 (Mequon Road)	City of Mequon	Proposed	Yes	125	1	- -	36	36	7	7	4	4	10	10	2	2
52	Garden Drive and W. County Line Road. . .	Village of Brown Deer	Proposed	Yes	- -	1	- -	32	32	7	7	4	4	10	10	2	2
53	N. Deerbrook Terrace and STH 100 (W. Brown Deer Road) . .	Village of Brown Deer	Proposed	Yes	- -	1	1	30	30	7	7	4	4	10	10	2	2
54	N. Cedarburg Road and W. Bradley Road.	Village of Brown Deer	Proposed	- -	- -	1	1	23	28	7	7	4	4	10	10	2	2
55	N. Teutonia Avenue and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	- -	1	2	26	26	7	7	4	4	10	10	2	2
56	N. Sidney Place and W. Mill Road	City of Glendale	Proposed	Yes	175	1	1	24	24	7	7	4	4	10	10	2	2
57	N. Dexter Avenue and W. Silver Spring Drive. . .	City of Glendale	Proposed	Yes	- -	1	1	22	22	7	7	4	4	10	10	2	2
58	N. 20th Street and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	19	19	7	7	4	4	10	10	2	2
59	W. Atkinson Avenue and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	1	15	15	11	14	6	7	20	16	4	3
60	N. 16th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	1	12	12	7	7	4	4	10	10	2	2
61	N. 8th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	9	9	7	7	4	4	10	10	2	2
62	N. 8th Street and W. Burleigh Street.	City of Milwaukee	Proposed	Yes	- -	1	2	8	8	7	- -	4	- -	10	- -	2	- -
63	N. 7th Street and W. Burleigh Street.	City of Milwaukee	Proposed	Yes	- -	1	2	- -	- -	- -	7	- -	4	- -	10	- -	2
64	N. 8th Street and W. Center Street.	City of Milwaukee	Proposed	Yes	- -	1	2	7	7	7	- -	4	- -	10	- -	2	- -
65	N. 7th Street and W. Center Street.	City of Milwaukee	Proposed	Yes	- -	1	2	- -	- -	- -	7	- -	4	- -	10	2	2
66	N. 8th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	5	5	7	- -	4	- -	10	- -	2	- -
67	N. 7th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	- -	- -	- -	7	- -	4	- -	10	- -	2
68	N. 6th Street and W. Walnut Street.	City of Milwaukee	Proposed	Yes	- -	1	2	4	4	7	7	4	4	10	10	2	2
69	N. 6th Street and W. Juneau Avenue.	City of Milwaukee	Proposed	- -	- -	1	2	2	2	7	7	4	4	10	10	2	2
70	N. 6th Street and W. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	2	1	1	7	7	4	4	10	10	2	2
71	N. 6th Street and W. St. Paul Avenue	City of Milwaukee	Proposed	- -	- -	2	2	2	2	15	15	8	8	22	22	5	5
72	S. 6th Street and W. Alexander Street. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	4	4	15	15	8	8	22	22	5	5
73	S. 6th Street and W. National Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	4	- -	- -	- -	15	- -	8	- -	22	- -	5
74	S. 5th Street and W. National Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	4	6	6	15	- -	8	- -	22	- -	5	- -
75	S. 5th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	2	- -	- -	- -	15	- -	8	- -	22	- -	5
76	S. 4th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	15	- -	8	- -	22	- -	5	- -
77	S. 5th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	- -	2	3	- -	- -	- -	15	- -	8	- -	22	- -	5
78	S. 4th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	- -	1	3	9	9	15	- -	8	- -	22	- -	5	- -
79	S. 5th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	- -	- -	- -	15	- -	8	- -	12	- -	5

Table 275 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (trains per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
80	S. 4th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	11	4	15	- -	8	- -	12	- -	5	- -
81	S. Chase Avenue and W. Rosedale Avenue. . . .	City of Milwaukee	Proposed	Yes	375	1	- -	13	6	7	7	4	4	10	10	2	2
82	S. Chase Avenue and W. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	14	8	7	7	4	4	10	10	2	2
83	S. Howell Avenue and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	15	9	7	7	4	4	10	10	2	2
84	S. Howell Avenue and W. Howard Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	17	17	7	7	4	4	10	10	2	2
85	S. Howell Avenue and W. Layton Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	19	19	7	7	4	4	10	10	2	2
86	General Mitchell Field . . .	City of Milwaukee	Proposed	Yes	125	1	2	21	21	7	7	4	4	10	10	2	2
87	S. Howell Avenue and W. College Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	23	23	7	7	4	4	10	10	2	2
88	S. Howell Avenue and W. Marquette Avenue . . .	City of Oak Creek	Proposed	Yes	- -	1	2	27	27	7	7	4	4	10	10	2	2
89	S. Howell Avenue and W. Forest Hill Avenue. . .	City of Oak Creek	Proposed	Yes	- -	1	2	29	29	7	7	4	4	10	10	2	2
90	S. Howell Avenue and W. Ryan Road	City of Oak Creek	Proposed	Yes	150	1	1	32	32	7	7	4	4	10	10	2	2
91	STH 175 (Appleton Avenue) and Menomonee Avenue. . . .	Village of Menomonee Falls	Proposed	Yes	- -	1	2	44	44	8	8	4	4	12	12	3	3
92	STH 175 (Appleton Avenue) and North Hills Drive	Village of Menomonee Falls	Proposed	Yes	250	1	1	42	42	8	8	4	4	12	12	3	3
93	STH 175 (Appleton Avenue) and Parkway Drive	Village of Menomonee Falls	Proposed	Yes	- -	1	- -	36	36	8	8	4	4	12	12	3	3
94	USH 41 (W. Appleton Avenue) and W. Bobolink Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	33	33	8	8	4	4	12	12	3	3
95	Timmerman Field.	City of Milwaukee	Proposed	Yes	325	1	2	32	32	8	8	4	4	12	12	3	3
96	USH 41 (W. Appleton Avenue) and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	29	29	8	8	4	4	12	12	3	3
97	N. 76th Street and W. Appleton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	28	28	8	8	4	4	12	12	3	3
98	N. 68th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	2	1	24	24	12	15	6	7	22	18	5	4
99	Capitol Court Shopping Center.	City of Milwaukee	Proposed	Yes	225	2	2	23	23	12	15	6	7	22	18	5	4
100	W. Fond du Lac Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	2	2	21	21	12	15	6	7	22	18	5	4
101	N. Sherman Boulevard and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	3	2	19	19	9	12	5	6	18	14	4	3
102	N. Sherman Boulevard and W. Fond du Lac Avenue .	City of Milwaukee	Proposed	Yes	- -	2	2	18	18	13	13	7	7	20	20	5	5
103	N. Sherman Boulevard and W. Burleigh Street . .	City of Milwaukee	Proposed	Yes	- -	2	2	17	17	13	13	7	7	20	20	5	5
104	N. Sherman Boulevard and W. Center Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	15	15	13	13	7	7	20	20	5	5
105	N. Sherman Boulevard and W. North Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	3	14	14	13	13	7	7	20	20	5	5
106	N. 40th Street and W. Lisbon Avenue.	City of Milwaukee	Proposed	Yes	- -	2	2	12	12	13	13	7	7	20	20	5	5
107	W. Highland Boulevard and W. McKinley Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	2	11	11	13	13	7	7	20	20	5	5
108	N. 41st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	1	9	9	13	13	7	7	20	20	5	5
109	S. Kinnickinnic Avenue and E. Becher Street . . .	City of Milwaukee	Proposed	Yes	- -	1	3	12	12	7	7	4	4	10	10	2	2
110	S. Bay Street and E. Lincoln Avenue.	City of Milwaukee	Proposed	Yes	200	1	1	14	14	7	7	4	4	10	10	2	2
111	S. Bay Street and E. Russell Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	16	16	7	7	4	4	10	10	2	2
112	S. Nevada Street and S. Kinnickinnic Avenue. .	City of Milwaukee	Proposed	Yes	- -	1	2	17	17	7	7	4	4	10	10	2	2
113	S. Brust Avenue and E. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	18	13	7	7	4	4	10	10	2	2
114	S. Ellen Street and E. Morgan Avenue.	City of Milwaukee	Proposed	- -	- -	1	1	19	19	7	7	4	4	10	10	2	2
115	S. Bombay Avenue and E. Crawford Avenue. . . .	City of St. Francis	Proposed	Yes	100	1	1	21	21	7	7	4	4	10	10	2	2
116	S. Kinnickinnic Avenue and Lunham Avenue . . .	City of St. Francis	Proposed	Yes	- -	1	1	23	23	7	7	4	4	10	10	2	2
117	S. Kinnickinnic Avenue and E. Layton Avenue . .	City of Cudahy	Proposed	Yes	- -	1	2	24	24	7	7	4	4	10	10	2	2
118	S. Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	375	1	1	26	26	7	7	4	4	10	10	2	2
119	Edgar Avenue and E. College Avenue.	City of Cudahy	Proposed	Yes	- -	1	2	28	28	7	7	4	4	10	10	2	2

Table 275 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (trains per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
120	E. Rawson Avenue	City of South Milwaukee	Proposed	Yes	- -	1	1	30	30	7	7	4	4	10	10	2	2
121	Marquette Avenue	City of South Milwaukee	Proposed	Yes	- -	1	2	31	31	7	7	4	4	10	10	2	2
122	S. 9th Avenue and E. Drexel Avenue	City of South Milwaukee	Proposed	Yes	225	1	- -	33	33	7	7	4	4	10	10	2	2
123	Northridge Shopping Center.	City of Milwaukee	Proposed	Yes	175	1	5	39	42	5	5	3	3	8	8	2	2
124	N. 76th Street and W. Bradley Road.	City of Milwaukee	Proposed	Yes	125	1	3	35	38	5	5	3	3	8	8	2	2
125	N. 76th Street and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	- -	1	3	33	36	5	5	3	3	8	8	2	2
126	N. 60th Street and W. Mill Road.	City of Milwaukee	Proposed	Yes	- -	1	2	30	33	5	5	3	3	8	8	2	2
127	N. Sherman Boulevard and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	175	1	2	28	30	5	5	3	3	8	8	2	2
128	N. Sherman Boulevard and W. Villard Avenue . .	City of Milwaukee	Proposed	Yes	- -	1	3	26	29	5	5	3	3	8	8	2	2
129	N. Sherman Boulevard and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	25	27	5	5	3	3	8	8	2	2
130	N. Sherman Boulevard and W. Congress Street . .	City of Milwaukee	Proposed	Yes	- -	1	1	23	26	5	5	3	3	8	8	2	2
131	S. 44th Street and W. National Avenue. . . .	Village of West Milwaukee	Proposed	Yes	- -	1	2	15	17	5	5	3	3	8	8	2	2
132	S. 43rd Street and W. Greenfield Avenue. . .	Village of West Milwaukee	Proposed	Yes	- -	1	1	16	19	5	5	3	3	8	8	2	2
133	S. 43rd Street and W. Burnham Street	Village of West Milwaukee	Proposed	Yes	- -	1	1	17	20	5	5	3	3	8	8	2	2
134	S. 43rd Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	275	1	1	19	21	5	5	3	3	8	8	2	2
135	S. 43rd Street and W. Cleveland Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	- -	20	23	5	5	3	3	8	8	2	2
136	S. 43rd Street and W. Oklahoma Avenue. . .	City of Milwaukee	Proposed	Yes	- -	1	3	22	24	5	5	3	3	8	8	2	2
137	S. 43rd Street and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	23	25	5	5	3	3	8	8	2	2
138	S. 43rd Street and W. Howard Avenue	City of Greenfield	Proposed	Yes	175	1	1	24	27	5	5	3	3	8	8	2	2
139	S. 60th Street and W. Plainfield Avenue . . .	City of Greenfield	Proposed	- -	- -	1	1	27	30	5	5	3	3	8	8	2	2
140	W. Forest Home Avenue and W. Plainfield Avenue	City of Greenfield	Proposed	Yes	- -	1	2	29	31	5	5	3	3	8	8	2	2
141	S. 76th Street and W. Layton Avenue.	City of Greenfield	Proposed	Yes	- -	1	5	32	34	5	5	3	3	8	8	2	2
142	N. 9th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	6	1	1	23	20	11	10	30	34	7	8
143	Southridge Shopping Center.	Village of Greendale	Proposed	Yes	150	1	6	35	38	5	5	3	3	8	8	2	2
144	N. Glenview Avenue and W. Wisconsin Avenue . . .	City of Wauwatosa	Proposed	Yes	- -	1	4	18	18	7	4	3	2	6	10	1	2
145	Milwaukee County General Hospital.	City of Wauwatosa	Proposed	- -	- -	1	5	22	22	7	4	3	2	6	10	1	2
146	County Institutions.	City of Wauwatosa	Proposed	- -	- -	1	5	24	24	7	4	3	2	6	10	1	2
147	N. Swan Boulevard and W. Watertown Plank Road.	City of Wauwatosa	Proposed	Yes	275	1	1	26	26	7	4	3	2	6	10	1	2
148	Mayfair Mall Shopping Center.	City of Wauwatosa	Proposed	Yes	150	1	7	30	30	7	4	3	2	6	10	1	2
149	N. Mayfair Road and W. Center Street.	City of Wauwatosa	Proposed	- -	- -	1	3	32	32	7	4	3	2	6	10	1	2
150	N. Mayfair Road and W. Burleigh Street.	City of Wauwatosa	Proposed	Yes	- -	1	2	34	34	7	4	3	2	6	10	1	2
151	N. Mayfair Road and W. Capitol Drive.	City of Wauwatosa	Proposed	- -	- -	1	2	33	36	7	4	3	2	6	10	1	2
152	W. Lisbon Avenue and W. Capitol Drive.	City of Milwaukee	Proposed	- -	- -	1	2	32	34	4	7	2	3	10	6	2	1
153	N. 92nd Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	30	33	4	7	2	3	10	6	2	1
154	N. 84th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	1	29	32	4	7	2	3	10	6	2	1
155	N. 76th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	3	28	30	4	7	2	3	10	6	2	1
156	N. 35th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	20	22	4	7	2	3	10	6	2	1
157	N. 27th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	19	21	4	7	2	3	10	6	2	1
158	W. Green Bay Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	1	2	19	22	4	7	2	3	10	6	2	1
159	N. Port Washington Road and W. Capitol Drive . . .	City of Milwaukee	Proposed	- -	- -	1	2	20	23	4	7	2	3	10	6	2	1
160	N. Richards Street and E. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	2	22	25	4	7	2	3	10	6	2	1
161	N. Humboldt Boulevard and E. Capitol Drive. . . .	City of Milwaukee	Proposed	Yes	- -	1	2	23	26	4	7	2	3	10	6	2	1
162	Morris Boulevard and E. Menlo Boulevard	Village of Shorewood	Proposed	Yes	- -	1	1	26	26	4	7	2	3	10	6	2	1

Source: SEWRPC.

Table 276

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Light Rail Transit Plan
Primary Element		
Exclusive Guideway Miles		
Subway	- -	- -
Elevated	- -	8.0
At-Grade	- -	94.3
Total	- -	102.3
Shared Guideway Miles		
Freeways	51.5	- -
Surface Arterial Streets	49.5	2.2
Total	101.0	104.5
Route Miles	449	253
Vehicle Miles	7,200	19,880
Vehicle Hours	310	1,040
Vehicles Required	63	131
Trains Required	- -	131
Express and Local Elements		
Route Miles	1,302	1,660
Vehicle Miles	64,820	64,040
Vehicle Hours	4,440	4,180
Vehicles Required	496	514
Total System		
Route Miles	1,755	1,913
Vehicle Miles	72,020	83,920
Vehicle Hours	4,750	5,220
Vehicles Required	559	645
Trains Required	- -	97

Source: SEWRPC.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent light rail transit plan would approximate $226 million. The remaining $902 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal share and the federal share are estimated to total $37 million and $149 million, respectively.

Table 281 presents the estimated design year operating and maintenance costs and farebox revenues of the base and maximum extent light rail transit plans. Under the base plan, operating and maintenance costs may be expected to approximate $46 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent light rail transit plan would increase the total operating and maintenance costs for the Milwaukee area in the year 2000 by about $14 million to a total cost of about $60 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $3 million under the base plan, and $17 million under the maximum extent light rail transit plan. Primary transit system operating and maintenance costs would thus represent about 7 percent of the total operating and maintenance costs expected in the design year for the base plan, and about 29 percent of the total operating and maintenance costs expected in the design year for the maximum extent light rail transit plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.74. For the maximum extent light rail transit system plan, the average operating cost per passenger may be expected to approach $0.91—$0.17, or 23 percent, more than the base plan cost. The average operating cost per passenger mile would also be higher under the maximum extent light rail transit plan, $0.18 compared with $0.17 for the base plan. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.32 and $0.16, respectively, and for the primary element of the maximum extent light rail transit plan, $0.62 and $0.10, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $25 million, expressed in 1979 dollars, compared with about $33 million under the maximum extent light rail transit plan. Under the maximum extent light rail transit alternative, the primary element would be expected to generate about 43 percent, or about $14 million, of the total revenues, compared with 6 percent, or $1.6 million, for the base plan.

The operating deficit in the year 2000 for the maximum extent light rail transit plan would be about $26 million, expressed in 1979 dollars, requiring a subsidy of about $0.41 per passenger. This compares with the base system plan deficit of

Table 277

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	253	253	253	253	253
Vehicle Miles	5,000	5,400	7,340	2,140	19,880
Vehicle Hours	260	280	390	110	1,040
Vehicles Required	89	48	131	29	131
Trains Required	89	48	131	29	131
Express and Local					
Route Miles.	1,660	1,586	1,660	1,558	1,660
Vehicle Miles	14,110	18,670	15,840	15,420	64,040
Vehicle Hours	950	1,210	1,070	950	4,180
Vehicles Required	473	214	514	167	514
Total System					
Route Miles.	1,913	1,839	1,913	1,811	1,913
Vehicle Miles	19,110	24,070	23,180	17,560	83,920
Vehicle Hours	1,210	1,490	1,460	1,060	5,220
Vehicles Required	562	262	645	196	645
Trains Required	89	48	131	29	131

Source: SEWRPC.

Table 278

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Maximum Extent Light Rail Transit Plan		
		Transit Trips			Transit Trips	
	Total Person Trips[a]	Number	Percent of Total Trips	Total Person Trips[a]	Number	Percent of Total Trips
Home-Based Work	1,061,500	57,500	5.4	1,058,700	65,400	6.2
Home-Based Shopping . .	627,900	33,100	5.3	626,800	36,100	5.8
Home-Based Other	1,464,800	67,300	4.6	1,459,600	74,400	5.1
Nonhome Based.	778,800	13,700	1.8	774,500	13,000	1.7
School	454,200	45,800	10.0	454,100	45,800	10.1
Total	4,387,200	217,400	5.0	4,373,700	234,700	5.4

[a] *The difference in the total person trips generated under the maximum extent light rail transit plan and the total person trips generated under the base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been found to be correlated with increased automobile ownership, and greater automobile ownership has been found to be correlated with increased trip generation. The Commission travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.*

Source: SEWRPC.

Table 279

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

	Base Plan				Maximum Extent Light Rail Transit Plan			
	Primary Element		Total System		Primary Element		Total System	
Time of Day	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,300	41.7	46,900	21.6	26,300	24.0	50,500	21.5
Midday	400	3.9	75,900	34.9	31,500	28.8	81,800	34.9
Afternoon . .	5,600	54.4	74,900	34.4	42,400	38.8	80,600	34.3
Evening. . . .	- -	- -	19,700	9.1	9,200	8.4	21,800	9.3
Total	10,300	100.0	217,400	100.0	109,400	100.0	234,700	100.0

Source: SEWRPC.

Table 280

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Light Rail Transit Plan
Guideway Development[b]	$ - -	$ 792,348,000
Station Development[c]	2,468,500	35,698,300
Vehicle Storage and Maintenance Facility Development[c]	18,950,000	51,246,300
Vehicle Acquisition and Replacement[d]	164,780,000	248,340,000
Total	$186,198,500	$1,127,632,600

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent light rail transit plan would be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 through 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and therefore are capable of use beyond the design period.*

[b] *Includes the cost of acquiring about 203 acres of right-of-way for guideway construction, and of acquiring and relocating five residential structures and three-steel lattice electric power transmission towers. This land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—9 acres under the base plan and 64 acres under the maximum extent light rail transit plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses and light rail vehicles used in the system. Both plans assume a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years. Light rail vehicles have an estimated useful life of 30 years.*

Source: SEWRPC.

Table 281

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Light Rail Transit Plan
Ridership		
Primary Element	2,626,500	27,897,000
Total System	62,685,500	64,234,000
Operating and Maintenance Cost		
Primary Element	$ 3,464,400	$17,291,600
Total System	46,323,500	59,634,800
Operating and Maintenance Cost per Passenger		
Primary Element	$1.32	$0.62
Systemwide Average	0.74	0.91
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.16	$0.10
Total System	0.17	0.18
Farebox Revenue		
Primary Element	$ 1,575,900	$14,208,600
Total System	24,697,600	33,200,700
Operating Deficit		
Primary Element	$ 1,888,500	$ 3,083,000
Total System	21,625,900	26,434,100
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	45	82
Total System	53	56
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 944,250	$ 1,541,500
Total System	10,812,950	13,217,050
State (72 percent of nonfederal share of operating deficit)		
Primary Element	679,860	1,109,880
Total System	7,785,320	9,516,280
Local		
Primary Element	264,390	431,620
Total System	3,027,630	3,700,770
Local Operating Deficit per Ride		
Primary Element	$0.10	$0.02
Total System	0.05	0.06

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $10.8 million required to provide 50 percent federal funding of the operating deficits under the base plan, but less than the $13.2 million required to provide such funding under the maximum extent light rail transit plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

about $22 million, or $0.34 per passenger. Farebox revenues would cover about 56 percent of the operating costs under the maximum extent light rail transit plan, and 53 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has, in the past, funded up to 72 percent of the non-federal share.[8] The local share of the public funding requirement of the maximum extent light rail transit plan would be about $3.7 million in the plan design year, and the local funding requirement for the base system would be somewhat less, about $3.0 million.

Development of Truncated Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent light rail transit system plan are summarized in Table 282. The maximum extent light rail transit plan has significantly higher capital costs, both in total and on a per-passenger basis, as well as a greater operating deficit, than does the base plan. However, farebox revenues meet a higher proportion of total operating costs under the light rail transit plan than under the base plan. Consequently, the total cost per passenger to the design year of the maximum extent light rail transit plan is nearly than twice that of the base plan under this future. It was therefore necessary to truncate this maximum extent light rail transit plan.

Some of the increases in capital costs and operating deficits under the maximum extent light rail transit plan can be attributed to the overextension of ser-

[8] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $10.8 million required to provide 50 percent federal funding of the operating deficits under the base plan, but less than the $13.2 million required to provide such funding under the maximum extent light rail transit plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Table 282

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Light Rail Transit Plan
Ridership		
In Design Year	62,685,500	64,234,000
To Design Year	1,238,433,200	1,250,821,200
Capital Cost		
Total to Design Year	$186,198,500	$1,127,632,600
To Design Year per Passenger	0.15	0.90
To Design Year After Accounting for Useful Life Beyond Design Year	124,606,570	583,822,300
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.47
Operating Cost		
Percent Met by Farebox Revenues in Design Year	53	56
Operating Deficit in Design Year	$ 21,625,900	$ 26,434,100
Operating Deficit per Passenger in Design Year	0.34	0.41
Operating Deficit to Design Year	418,319,800	456,785,400
Operating Deficit to Design Year per Passenger	0.34	0.37
Total Cost		
To Design Year	$604,518,300	$1,584,418,000
Federal Share	358,118,700	1,130,498,800
Nonfederal Share	246,399,600	453,919,200
To Design Year per Passenger	0.49	1.27
Federal Share	0.29	0.90
Nonfederal Share	0.20	0.37
To Design Year After Accounting for Useful Life Beyond Design Year	542,926,370	1,040,607,700
Federal Share	308,845,160	695,450,540
Nonfederal Share	234,081,210	345,157,160
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.44	0.84
Federal Share	0.25	0.56
Nonfederal Share	0.19	0.28

Source: SEWRPC.

vice envisioned in this plan.[9] Under the plan, primary transit service on exclusive guideway would be extended into portions of the Milwaukee area not now served; would be expanded into an all-day operation; and would be provided at headways of no more than 30 minutes in the peak period and peak direction and 60 minutes otherwise.

The less cost-effective elements of the primary element of the maximum extent light rail transit system plan with respect to operating costs can, in part, be identified on a route-by-route basis through a determination of what proportion of the operating costs of the routes may be expected to be recovered through farebox revenues. As shown in Table 283, about 82 percent of the total light rail transit primary element operating costs may be expected to be recovered from farebox revenues, and not less than 73 percent of the operating costs for any route will be met by farebox revenues. Therefore, routes should require little modification except possibly over some limited segments.

Another basis for the identification of the less productive elements of the maximum extent light rail transit plan is the operating and capital costs per passenger and per passenger mile carried on segments of the system. Table 284 summarizes the capital and operating costs, and passenger miles carried, for the major segments of the maximum extent light rail transit system, and provides a ranking of the segments in terms of operating cost per passenger mile and capital cost per passenger mile. Map 62 in Chapter III of this report identifies the major segments of the primary transit element of the plan. Maps 112 and 113 show those segments which may be expected to have higher-than-average operating costs and capital costs per passenger mile, respectively, as well as the degree to which such costs may be expected to be exceeded, along a route and between routes. In any consideration of this cost-effectiveness information, it is important to recognize that the outer ends of each route can carry no through traffic, except through connection with a different mode such as a feeder/distributor bus.

[9] *The extension of local and express service under the maximum extent light rail transit plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express (secondary) and local (tertiary) service included in each maximum extent primary transit system plan is in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules were modified, however, to coordinate properly the secondary and teritary service proposed to be provided with the primary service proposed under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered, and should, therefore, not affect a comparison of those alternatives.*

Table 283

OPERATING COST-EFFECTIVENESS OF LIGHT RAIL ROUTES OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicle Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
1–Waukesha/ Milwaukee CBD/UWM	140,720	$11,400	4,455	$15,200	75
2–Cedarburg/Grafton/ Milwaukee CBD/Oak Creek	167,310	13,550	5,445	18,580	73
3–Menomonee Falls/ Milwaukee CBD/ South Milwaukee	164,640	13,340	4,339	14,800	90
4–Crosstown: Northridge/Southridge	116,470	9,440	2,561	8,740	108
5–Loop: Capitol Drive/UWM/ Wisconsin Avenue/Mayfair	98,550	7,980	3,075	10,490	76
Total	687,690	$55,710	19,875	$67,810	82

Source: SEWRPC.

Comparison of the cost-effectiveness of segments of a system can also be made in terms of passenger boardings and deboardings. Table 234 also presents passenger boarding and deboarding volumes by segment and a rank ordering of the segments in terms of operating and capital costs per boarding and deboarding passenger. Maps 114 and 115 show those segments which may be expected to have above average operating and capital costs, respectively, per boarding and deboarding passenger, as well as the degree to which average costs may be expected to be exceeded.

Based on this cost-effectiveness information, the maximum extent light rail transit system plan for this alternative future was truncated. The truncations were made with the objective of reducing system capital cost and operating deficits and bringing the total cost per passenger for a light rail transit plan under this future closer to that of the base plan, while retaining an integrated system. The proposed truncated light rail transit system plan under the moderate growth scenario-decentralized land use plan alternative future is shown on Map 100 in Chapter IV. The changes made in the maximum extent plan to produce the truncated plan are summarized in Table 285. The segments deleted were the less cost-effective segments—that is, those segments which, if deleted, would result in relatively large reductions in system capital costs and operating deficits and relatively small reductions in system ridership. These segments include those extending to the communities of Cedarburg and Grafton from W. Capitol Drive in the City of Milwaukee, those extending to the Village of Menomonee Falls from W. Silver Spring Drive and N. 92nd Street in the City of Milwaukee, those extending to the Cities of West Allis and Waukesha from N. 84th Street and W. Fairview Avenue in the City of Milwaukee, those extending to the City of Oak Creek from General Mitchell Field, those looping from the intersection of W. Appleton Avenue and W. Capitol Drive to the Mayfair Mall Shopping Center, and that segment extending from the City of Cudahy to the City of South Milwaukee. Because of its high capital cost, the segment from S. 5th and W. Becher Streets to the City of St. Francis along E. and S. Bay Street

Table 284

COST-EFFECTIVENESS ANALYSIS OF SEGMENTS OF THE PRIMARY ELEMENT OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Segment Number	Route Number	Transit Ridership						Average Weekday Operating Cost-Effectiveness in Design Year				Total Capital Cost-Effectiveness Over the Design Period			
		Average Weekday Passenger Volume		Total Boarding and Deboarding Passengers	Passenger Miles	Average Weekday Operating Cost in Design Year	Total Capital Cost Over Design Period	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank
		Range	Average												
1	1	2,520- 3,450	3,110	4,360	5,600	$1,180	$12,508,200	$0.21	29	$0.27	12	$2,234	24	$ 2,869	11
2	1	3,860- 3,890	3,880	970	15,510	2,620	27,525,296	0.17	25	2.70	34	1,775	16	28,377	34
3	1	4,510- 4,770	4,630	1,760	18,520	2,620	27,471,984	0.14	22	1.49	32	1,483	15	15,609	32
4	1	6,920- 7,570	7,240	3,710	16,650	1,510	29,653,680	0.09	14	0.41	24	1,781	17	7,993	23
5	1 and 5	10,300-14,090	13,370	6,870	32,090	2,590	37,857,376	0.08	12	0.38	21	1,180	12	5,511	15
6	1 and 5	24,550-24,550	24,550	12,830	14,370	910	10,526,600	0.06	3	0.07	2	733	6	820	3
7	1 and 5	26,640-32,260	28,850	57,940	72,140	4,050	41,326,480	0.06	3	0.07	2	573	3	713	2
8	1 and 5	14,950-23,050	20,170	14,500	14,120	750	6,192,300	0.05	1	0.05	1	439	1	427	1
9	1 and 5	3,000-11,180	7,180	19,350	35,190	5,280	75,958,384	0.15	24	0.27	12	2,159	21	3,925	12
10	2	1,280- 2,610	2,020	2,220	13,550	3,790	42,381,168	0.28	32	1.70	33	3,128	28	19,091	33
11	2	2,870- 3,810	3,330	2,350	13,970	2,380	26,847,792	0.17	25	1.01	30	1,922	19	11,424	28
12	2	4,370- 5,170	4,730	1,590	15,140	1,810	20,533,392	0.12	19	1.14	31	1,356	14	12,914	31
13	2	5,860- 6,460	6,110	2,690	19,550	1,810	22,859,184	0.09	14	0.67	27	1,169	11	8,498	24
14	2	6,650-11,720	9,530	16,680	37,150	2,210	32,492,880	0.06	3	0.13	4	875	8	1,948	5
15	2 and 3	18,440-19,390	19,080	11,950	47,710	2,830	24,075,984	0.06	3	0.24	11	505	2	2,015	6
16	2	6,180- 9,850	8,180	11,790	31,070	2,150	27,944,880	0.07	8	0.18	7	899	9	2,370	8
17	2	430- 3,570	1,530	3,840	8,110	3,000	37,132,288	0.37	34	0.78	28	4,579	32	9,670	25
18	3	720- 2,590	1,730	3,100	8,310	2,720	36,332,480	0.33	33	0.88	29	4,372	31	11,720	29
19	3	4,660- 6,190	5,530	5,790	12,710	1,300	14,606,100	0.10	16	0.22	8	1,149	10	2,523	9
20	3 and 5	9,610-10,460	10,070	5,010	17,110	1,680	13,017,000	0.10	16	0.34	17	761	7	2,598	10
21	3 and 4	14,460-18,060	16,210	25,500	63,220	3,940	37,710,976	0.06	3	0.15	6	597	4	1,479	4
22	3	7,850- 9,610	8,640	4,470	26,790	1,760	55,760,384	0.07	8	0.39	22	2,081	20	12,474	30
23	3	6,410- 7,570	6,810	5,130	17,020	1,420	37,089,872	0.08	12	0.28	14	2,179	23	7,230	20
24	3	910- 4,190	3,280	4,080	9,830	1,700	45,817,280	0.17	25	0.42	25	4,661	33	11,230	27
25	4	3,200- 4,320	3,780	5,020	14,760	1,730	38,503,376	0.12	19	0.34	17	2,609	27	7,670	21
26	4	4,870- 8,120	6,450	6,570	21,300	1,460	39,018,672	0.07	8	0.22	8	1,832	18	5,939	16
27	4	5,860-10,270	9,750	9,380	28,280	1,290	19,049,088	0.05	1	0.14	5	674	5	2,031	7
28	4	3,250- 5,360	3,820	6,800	19,480	2,260	42,171,584	0.12	19	0.33	15	2,165	22	6,202	17
29	5	2,080- 2,370	2,280	2,270	4,330	800	14,578,600	0.18	28	0.35	20	3,367	29	6,422	18
30	5	1,680- 1,680	1,680	2,910	2,520	630	14,649,700	0.25	30	0.22	8	5,813	34	5,034	13
31	5	1,230- 2,050	1,700	1,340	3,060	760	12,977,200	0.25	30	0.57	26	4,241	30	9,684	26
32	5	1,950- 3,580	3,010	2,880	6,630	930	15,597,300	0.14	22	0.33	15	2,353	26	5,416	14
33	5	6,150- 6,750	6,430	1,590	9,650	630	12,655,700	0.07	8	0.40	23	1,311	13	7,960	22
34	5	3,000- 4,580	3,950	3,870	12,250	1,310	27,547,680	0.11	18	0.34	17	2,249	25	7,118	19

Source: SEWRPC.

and the Chicago & North Western's Kenosha Subdivision railway main line on the route connecting to the City of Cudahy was replaced by a segment from S. 5th and W. Becher Streets along Chase Avenue to the former Milwaukee Electric Lines Lakeside Belt Line, and then along that open right-of-way owned by the Wisconsin Electric Power Company and used for trunkline power transmission to the original routing from S. 5th and W. Becher Streets through the City of St. Francis to the Cities of Cudahy and South Milwaukee. The segment from the Milwaukee central business district through the University of Wisconsin-Milwaukee to Capitol Drive and along Capitol Drive to W. Atkinson Avenue in the City of Milwaukee was deleted because of its high capital cost relative to its ridership. Through the elimination of these segments, the capital cost of the primary element of the light rail transit system would decrease from $980 million to about $459 million, and the total cost of the truncated plan would be about $606 million.

Those segments given the highest priority for elimination were Segments 10, 11, 12, and 13 serving northern Milwaukee County and Ozaukee County, and Segments 1, 2, 3, and 18 serving Waukesha County. Segments 31 and 32, providing service along Capitol Drive between Appleton Avenue and Mayfair Road, and Segment 4, providing service to West Allis, were identified as the second set of segments to be deleted. The third set of segments identified to be deleted were those serving General Mitchell Field, the City of Oak Creek, and the City of South Milwaukee, including portions of both Segments 16 and 22 and all of Segments 17 and 24. Segments 9 and 34, serving the University of Wisconsin-Milwaukee campus and the lower east side, were the final two segments identified for deletion.

Evaluation of Maximum Extent Busway System Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is motor buses operating over busways. The maximum extent system plan developed for this technology is summarized with respect to its coverage and routes on Maps 60 and 61 of Chapter III. Its performance under the moderate growth scenario-decentralized land use plan alternative future is summarized in Tables 286 and 287. Map 53 and Table 111 of Chapter III, and Tables 287 and 256 provide comparable information for the base, or benchmark, plan used in the study. A discussion of the facilities and services of the primary, local, and express elements of both the maximum extent busway plan and the base plan is included in Chapter III of this report, and will not be repeated here.

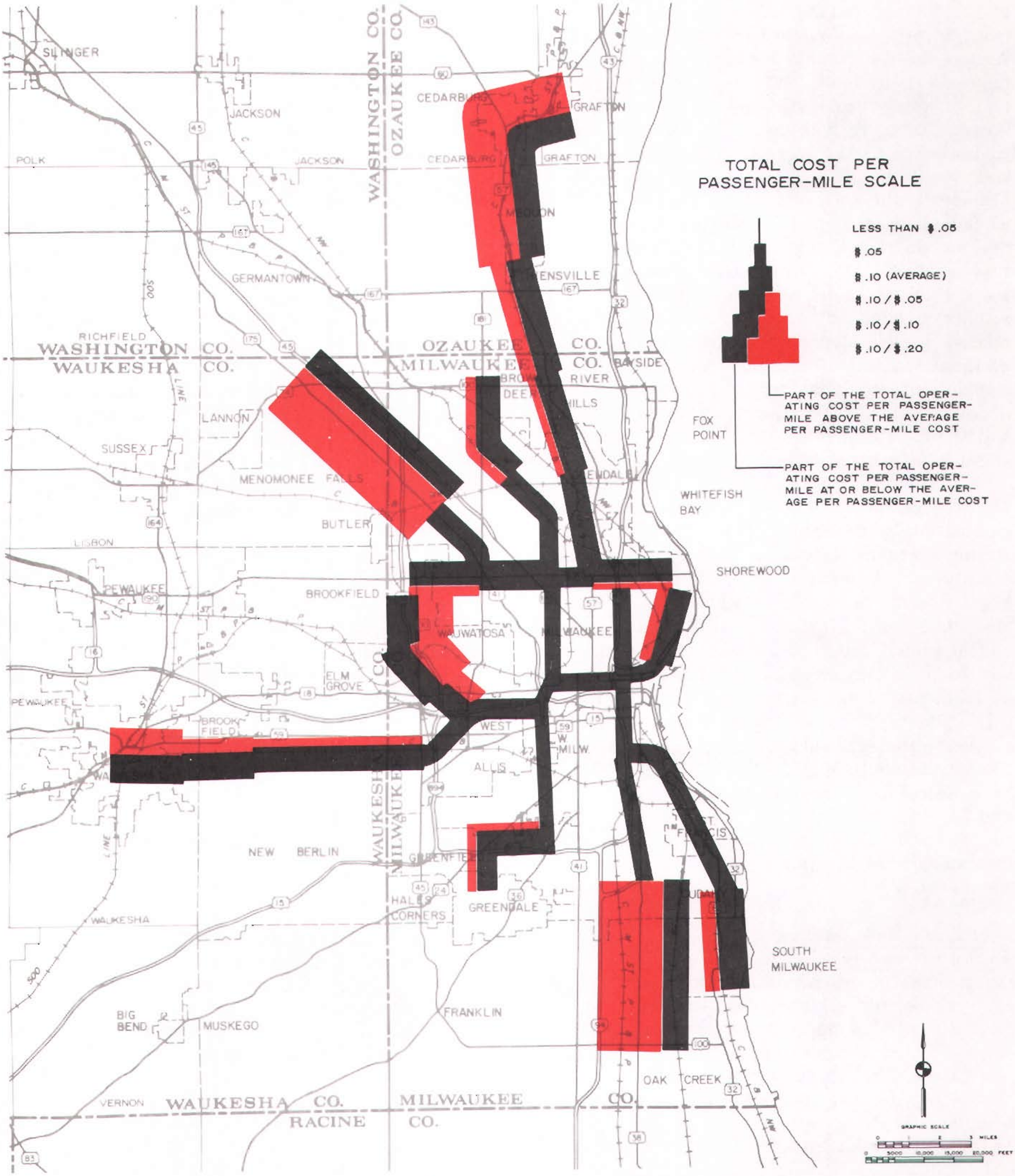
In comparison to the base plan, the maximum extent busway system plan under this future would entail a three-fold increase in vehicle miles of primary transit service, or 21,700 vehicle miles compared with 7,200 vehicle miles under the base plan. A significant part of this increase would be the result of the extension of primary service into off-peak travel periods during the midday and evenings, as indicated in Tables 257 and 288. About the same number of bus miles of express and local service would be operated under this plan as under the base plan on an average weekday.

Headways on the primary element of the maximum extent busway plan under this future would range from 4 to 10 minutes during the peak periods. During the off-peak periods, headways would range from 15 to 20 minutes in the midday period, and from 30 to 50 minutes during the evening.

Transit Utilization: Under the maximum extent busway system plan of the moderate growth scenario-decentralized land use plan alternative future, about 231,600 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 289 and 290. About 94,400, or 41 percent, of these transit trips may be expected to be made on the primary transit system for all or a portion of the trip. Thus, the maximum extent busway system plan envisions that about 5 percent of the total of 4.4 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that about 2 percent will be made using primary transit. About 14,200, or 7 percent, more transit trips may be expected to be made on an average weekday under this plan than under the base plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent busway system plan and the base system plan are summarized in Table 291. The costs shown include all construction costs, plus the costs of right-of-way acquisition and the acquisition and replacement of vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 291.

OPERATING COST PER PASSENGER-MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

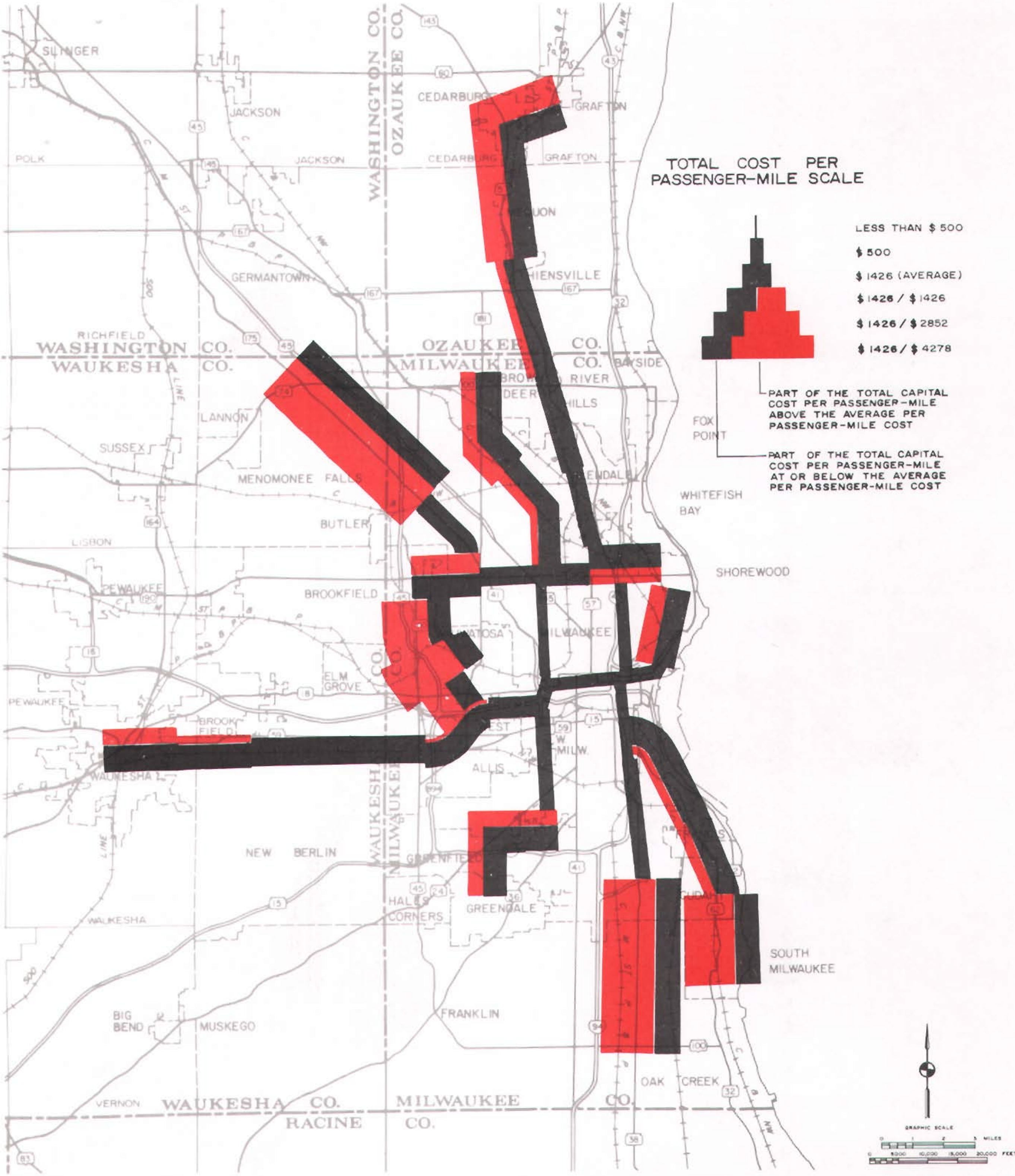


One measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the operating cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average operating cost per passenger mile, as well as the degree to which such average costs may be expected to be exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, for the outer segments of each route, as well as a portion of Route 5 in the City of Wauwatosa, these data suggest an insufficient ridership base to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development in these segments, and the absence of through traffic except by connection with a different mode such as feeder bus or automobile.

Source: SEWRPC.

Map 113

CAPITAL COST PER PASSENGER-MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

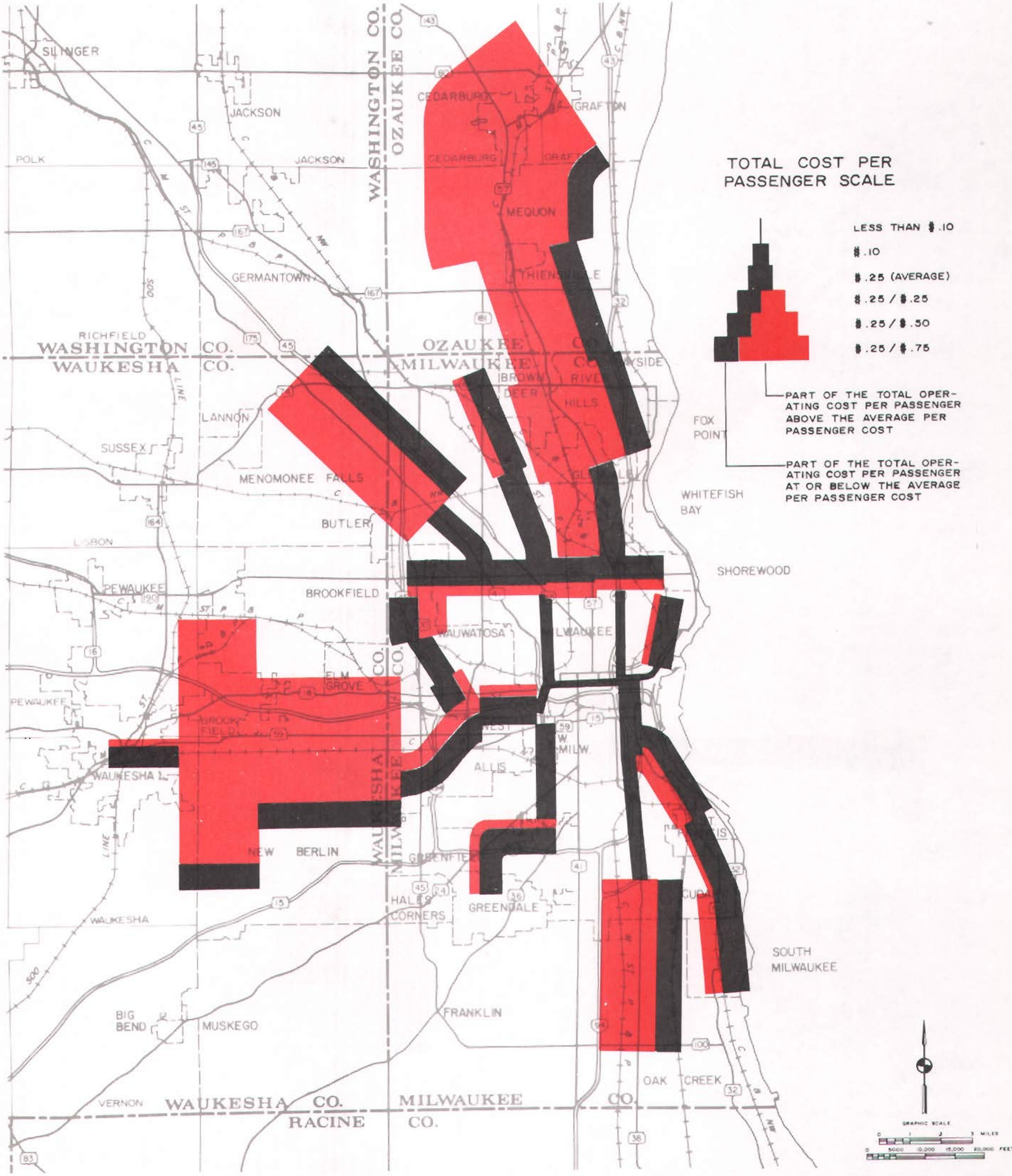


Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the capital cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average capital cost per passenger mile, as well as the degree to which such average costs may be expected to be exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, for the outer segments of each route, as well as portions of Route 5 on the City of Milwaukee's east side and in the City of Wauwatosa, these data suggest an insufficient ridership base to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development in these segments, and the absence of through traffic except by a connection with a different mode such as feeder bus or automobile. To some degree, these inefficiencies are also generated by the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee's east side.

Source: SEWRPC.

Map 114

OPERATING COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

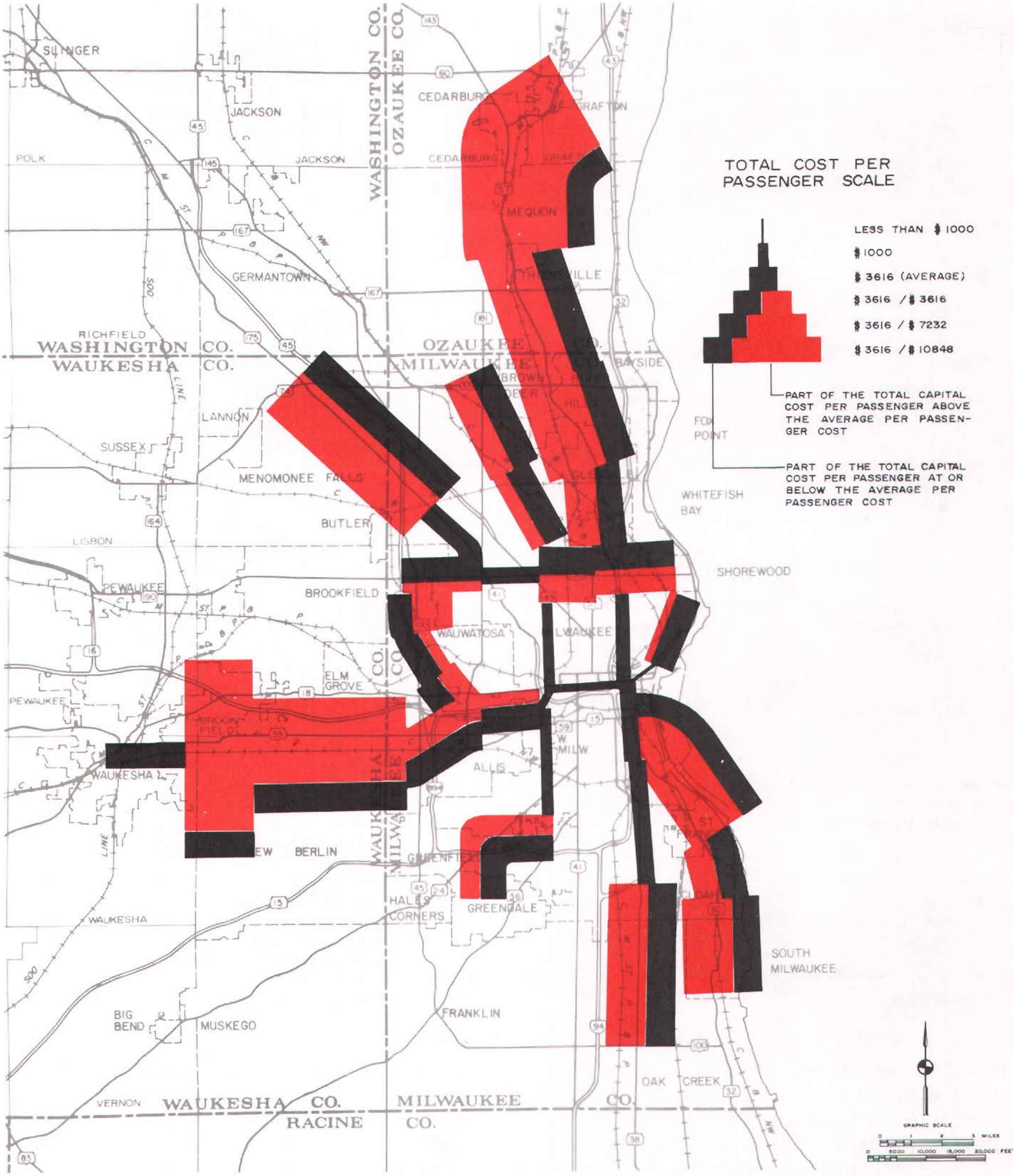


Yet another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the operating cost per boarding and deboarding passenger. This map shows those segments which may be expected to operate at, below, or above the average operating cost per boarding and deboarding passenger, as well as the degree to which such average costs may be expected to be exceeded. As shown on this map, certain system segments within the densely developed areas of Milwaukee County are very cost-effective compared with the remainder of the system, while all segments located within suburban areas outside Milwaukee County are not cost-effective. This is a result of the lower boarding and deboarding passenger volumes in these suburban areas combined with the lengthy distances that the light rail vehicles must operate over.

Source: SEWRPC.

Map 115

CAPITAL COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the capital cost per boarding and deboarding passenger. This map shows those segments which may be expected to operate at, below, or above the average capital cost per boarding and deboarding passenger, as well as the degree to which such average costs may be expected to be exceeded. As shown on this map, certain segments within the densely developed portions of Milwaukee County are very cost-effective compared with the remainder of the system. However, those segments located in Milwaukee County suburbs as well as outside Milwaukee County appear to have an insufficient volume of passenger boardings and deboardings to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development combined with the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee's east side. A noteworthy exception is the segment within the City of Waukesha which, by itself, appears cost-effective, but which nevertheless depends upon a connection to the remainder of the system over two lengthy suburban segments which generate little ridership.

Source: SEWRPC.

Table 285

RECOMMENDED CHANGES IN THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Recommended Change	Reasons
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segment 1	The deletion of Segments 2 and 3 would not logically permit retention of Segment 1
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segments 2 and 3	Segments 2 and 3 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segment 4	Segments 29 and 30 are more cost-effective than Segment 4 and provide for a more logical end-of-route
2—Cedarburg/Milwaukee CBD/ Oak Creek	Eliminate Segments 10, 11, 12, and 13	Segments 10 through 13 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
2—Cedarburg/Milwaukee CBD/ Oak Creek	Eliminate Segment 17	Segment 17 is not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
3—Menomonee Falls/Milwaukee/ South Milwaukee	Eliminate Segment 18	Segment 18 is not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
3—Menomonee Falls/Milwaukee CBD/ South Milwaukee and Cedarburg/ Milwaukee CBD/Oak Creek	Eliminate Segments 22, 24, and part of 16 and 23. Add connector segment between Segments 16 and 23	Segments 17, 22, and 24 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments. Portions of Segments 16 and 23 are deleted for the same reasons. The remainder of Segment 23, which is cost-effective and has significant boardings and deboardings, has been connected to the remainder of the truncated network via the Lakeside Belt Line right-of-way
5—Loop: UWM/Mayfair/Milwaukee CBD	Eliminate Segments 31, 32, and 34	Segments 31, 32, and 34 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
5—Loop: UWM/Mayfair/Milwaukee CBD	Eliminate Segment 9	Segment 9 is not capital cost-effective relative to other segments. Service to UWM would be provided by shuttle service from nearby primary transit stations

Source: SEWRPC.

The total capital cost of the base plan is estimated at $186 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain the existing service to the year 2000. About $19 million, or 12 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent busway system plan is estimated at $734 million. About $481 million would be required for the construction of the busways, including right-of-way, guideways, and preferential intersection treatments. About $190 million would be incurred in the purchase of new and replacement of transit vehicles—$53 million of which would be for the purchase of

Table 286

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	W. Broadway and W. Main Street.	City of Waukesha	Proposed	Yes	- -	1	10	53	53	10	10	4	4	15	15	2	2
2	E. Broadway and Pleasant Street.	City of Waukesha	Proposed	Yes	- -	1	1	51	51	10	10	4	4	15	15	2	2
3	Lincoln Avenue and Lake Street.	City of Waukesha	Proposed	Yes	- -	1	- -	50	50	10	10	4	4	15	15	2	2
4	Lincoln Avenue and Frederick Street	City of Waukesha	Proposed	Yes	- -	1	1	48	48	10	10	4	4	15	15	2	2
5	CTH A and Pearl Street . .	City of Waukesha	Proposed	Yes	325	1	- -	44	44	10	10	4	4	15	15	2	2
6	Johnson Road.	City of New Berlin	Proposed	- -	50	1	- -	41	41	10	10	4	4	15	15	2	2
7	Calhoun Road and Rogers Drive	City of New Berlin	Proposed	Yes	300	1	- -	37	37	10	10	4	4	15	15	2	2
8	Moorland Road and Rogers Drive	City of New Berlin	Proposed	- -	- -	1	2	35	35	10	10	4	4	15	15	2	2
9	Sunny Slope Road and Honey Lane.	City of New Berlin	Proposed	- -	- -	1	- -	33	33	10	10	4	4	15	15	2	2
10	S. 124th Street and Honey Lane.	City of New Berlin	Proposed	- -	- -	1	- -	31	31	10	10	4	4	15	15	2	2
11	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	- -	1	5	28	28	10	10	4	4	15	15	2	2
12	S. 98th Street and W. Washington Street . . .	City of West Allis	Proposed	Yes	- -	1	2	26	26	10	10	4	4	15	15	2	2
13	N. 92nd Street and W. Dixon Street	City of Milwaukee	Proposed	Yes	100	1	- -	23	23	10	10	4	4	15	15	2	2
14	N. 84th Street and W. Hawthorne Avenue . .	City of Milwaukee	Proposed	Yes	- -	2	2	20	20	18	16	7	6	22	27	3	3
15	N. 76th Street and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	19	19	18	16	7	6	22	27	3	3
16	N. 68th Street and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	17	17	18	16	7	6	22	27	3	3
17	N. Hawley Road and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	15	15	18	16	7	6	22	27	3	3
18	County Stadium and Mitchell Boulevard	City of Milwaukee	Proposed	Yes	175	2	- -	14	14	18	16	7	6	22	27	3	3
19	County Stadium and N. 44th Street	City of Milwaukee	Proposed	Yes	125	3	- -	12	12	24	22	10	9	31	36	4	5
20	N. 35th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	8	8	26	24	11	10	32	37	5	5
21	N. 27th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	4	7	7	26	24	11	10	32	37	5	5
22	N. 21st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	5	5	26	24	11	10	32	37	5	5
23	N. 16th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	5	3	3	26	24	11	10	32	37	5	5
24	N. 12th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	6	2	2	26	24	11	10	32	37	5	5
25	N. 6th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	4	7	- -	- -	34	32	15	14	44	49	7	7
26	N. Plankinton Avenue and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	10	2	2	16	18	6	7	27	22	3	3
27	N. Broadway Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	8	3	3	16	18	6	7	27	22	3	3
28	N. Jackson Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	7	4	4	16	18	6	7	27	22	3	3
29	N. Jackson Street and E. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	1	6	6	16	- -	6	- -	27	- -	3	- -
30	N. Van Buren Street and E. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	1	6	6	- -	18	- -	7	- -	22	- -	3
31	N. Jackson Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	7	7	16	- -	6	- -	27	- -	3	- -
32	N. Van Buren Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	7	7	- -	18	- -	7	- -	22	- -	3
33	N. Astor Street and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	16	18	6	7	27	22	3	3
34	N. Farwell Avenue and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	9	9	16	18	6	7	27	22	3	3
35	N. Farwell Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	2	11	11	16	- -	6	- -	27	- -	3	- -
36	N. Prospect Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	1	11	11	- -	18	- -	7	- -	22	- -	3
37	N. Farwell Avenue and E. Kenilworth Place. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	12	12	16	18	6	7	27	22	3	3
38	N. Oakland Avenue and E. North Avenue.	City of Milwaukee	Proposed	Yes	- -	2	3	13	13	16	18	6	7	27	22	3	3
39	N. Cambridge Avenue and E. Locust Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	16	16	16	18	6	7	27	22	3	3
40	N. Oakland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	- -	- -	2	1	24	24	16	18	6	7	27	22	3	3
41	N. Maryland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	Yes	- -	2	6	23	23	16	18	6	7	27	22	3	3

Table 286 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
42	N. Maryland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	--	2	4	19	19	16	18	6	7	27	22	3	3
43	N. Oakland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	--	--	2	1	18	18	16	18	6	7	27	22	3	3
44	Wisconsin Avenue and Broad Street	Village of Grafton	Proposed	Yes	--	1	1	59	59	8	8	4	4	12	12	2	2
45	1st Avenue and Maple Street	Village of Grafton	Proposed	Yes	300	1	--	57	57	8	8	4	4	12	12	2	2
46	Cedar Ridge Drive and Georgetown Drive.	City of Cedarburg	Proposed	--	--	1	1	54	54	8	8	4	4	12	12	2	2
47	STH 143 (Washington Avenue) and Turner Street	City of Cedarburg	Proposed	--	--	1	1	53	53	8	8	4	4	12	12	2	2
48	Grant Avenue and Western Road	City of Cedarburg	Proposed	--	--	1	1	52	52	8	8	4	4	12	12	2	2
49	STH 57 and CTH C (Pioneer Road).	City of Mequon	Proposed	Yes	325	1	--	48	48	8	8	4	4	12	12	2	2
50	STH 57 (Main Street) and Freistadt Road	Village of Thiensville	Proposed	--	--	1	1	42	42	8	8	4	4	12	12	2	2
51	STH 57 (Green Bay Road) and STH 67 (Mequon Road)	City of Mequon	Proposed	Yes	100	1	--	40	40	8	8	4	4	12	12	2	2
52	Garden Drive and W. County Line Road. . .	Village of Brown Deer	Proposed	Yes	--	1	--	36	36	8	8	4	4	12	12	2	2
53	N. Deerbrook Terrace and STH 100 (W. Brown Deer Road) . .	Village of Brown Deer	Proposed	Yes	--	1	1	34	34	8	8	4	4	12	12	2	2
54	N. Cedarburg Road and W. Bradley Road.	Village of Brown Deer	Proposed	--	--	1	1	32	32	8	8	4	4	12	12	2	2
55	N. Teutonia Avenue and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	--	1	2	29	29	8	8	4	4	12	12	2	2
56	N. Sidney Place and W. Mill Road	City of Glendale	Proposed	Yes	175	1	1	27	27	8	8	4	4	12	12	2	2
57	N. Dexter Avenue and W. Silver Spring Drive. . .	City of Glendale	Proposed	Yes	--	1	1	25	25	8	8	4	4	12	12	2	2
58	N. 20th Street and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	2	21	21	8	8	4	4	12	12	2	2
59	W. Atkinson Avenue and W. Capitol Drive	City of Milwaukee	Proposed	Yes	--	1	1	16	16	14	16	6	7	24	19	3	3
60	N. 16th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	1	13	13	8	8	4	4	12	12	2	2
61	N. 8th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	3	10	10	--	8	--	4	--	12	--	2
62	N. 8th Street and W. Burleigh Street.	City of Milwaukee	Proposed	Yes	--	1	2	9	9	8	--	4	--	12	--	2	--
63	N. 7th Street and W. Burleigh Street.	City of Milwaukee	Proposed	Yes	--	1	2	9	9	--	8	--	4	--	12	--	2
64	N. 8th Street and W. Center Street.	City of Milwaukee	Proposed	Yes	--	1	2	7	7	8	--	4	--	12	--	2	--
65	N. 7th Street and W. Center Street.	City of Milwaukee	Proposed	Yes	--	1	2	7	7	--	8	--	4	--	12	--	2
66	N. 8th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	--	1	3	6	6	8	--	4	--	12	--	2	--
67	N. 7th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	--	1	3	6	6	--	8	--	4	--	12	--	2
68	N. 6th Street and W. Walnut Street.	City of Milwaukee	Proposed	Yes	--	1	2	4	4	8	8	4	4	12	12	2	2
69	N. 6th Street and W. Juneau Avenue.	City of Milwaukee	Proposed	--	--	1	2	3	3	8	8	4	4	12	12	2	2
70	N. 6th Street and W. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	--	1	2	1	1	8	8	4	4	12	12	2	2
71	N. 6th Street and W. St. Paul Avenue	City of Milwaukee	Proposed	--	--	2	2	2	2	16	16	8	8	22	22	4	4
72	S. 6th Street and W. Alexander Street. . . .	City of Milwaukee	Proposed	Yes	--	2	1	5	5	16	16	8	8	22	22	4	4
73	S. 6th Street and W. National Avenue. . . .	City of Milwaukee	Proposed	Yes	--	2	4	6	6	--	16	--	8	--	22	--	4
74	S. 5th Street and W. National Avenue. . . .	City of Milwaukee	Proposed	Yes	--	2	4	6	6	--	16	--	8	--	22	--	4
75	S. 5th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	--	2	2	8	8	--	16	--	8	--	22	--	4
76	S. 4th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	--	2	2	8	8	16	--	8	--	22	--	4	--
77	S. 5th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	--	2	3	10	10	--	16	--	8	--	22	--	4
78	S. 4th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	--	2	3	10	10	16	--	8	--	22	--	4	--
79	S. 5th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	--	1	1	12	12	--	16	--	8	--	22	--	4
80	S. 4th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	--	1	1	12	12	16	--	8	--	22	--	4	--
81	S. Chase Avenue and W. Rosedale Avenue. . . .	City of Milwaukee	Proposed	Yes	375	1	--	14	14	8	8	4	4	12	12	2	2

Table 286 (continued)

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (buses per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
82	S. Chase Avenue and W. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	15	15	8	8	4	4	12	12	2	2
83	S. Howell Avenue and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	17	17	8	8	4	4	12	12	2	2
84	S. Howell Avenue and W. Howard Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	18	18	8	8	4	4	12	12	2	2
85	S. Howell Avenue and W. Layton Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	21	21	8	8	4	4	12	12	2	2
86	General Mitchell Field . . .	City of Milwaukee	Proposed	Yes	125	1	2	23	23	8	8	4	4	12	12	2	2
87	S. Howell Avenue and W. College Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	26	26	8	8	4	4	12	12	2	2
88	S. Howell Avenue and W. Marquette Avenue . . .	City of Oak Creek	Proposed	Yes	- -	1	2	33	33	8	8	4	4	12	12	2	2
89	S. Howell Avenue and W. Forest Hill Avenue. . .	City of Oak Creek	Proposed	Yes	- -	1	2	38	38	8	8	4	4	12	12	2	2
90	S. Howell Avenue and W. Ryan Road	City of Oak Creek	Proposed	Yes	150	1	1	44	44	8	8	4	4	12	12	2	2
91	STH 175 (Appleton Avenue) and Menomonee Avenue. . . .	Village of Menomonee Falls	Proposed	Yes	- -	1	2	50	50	8	8	4	4	10	10	2	2
92	STH 175 (Appleton Avenue) and North Hills Drive	Village of Menomonee Falls	Proposed	Yes	200	1	1	47	47	8	8	4	4	10	10	2	2
93	STH 175 (Appleton Avenue) and Parkway Drive	Village of Menomonee Falls	Proposed	Yes	- -	1	- -	40	40	8	8	4	4	10	10	2	2
94	USH 41 (W. Appleton Avenue) and W. Bobolink Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	37	37	8	8	4	4	10	10	2	2
95	Timmerman Field.	City of Milwaukee	Proposed	Yes	300	1	2	34	34	8	8	4	4	10	10	2	2
96	USH 41 (W. Appleton Avenue) and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	32	32	8	8	4	4	10	10	2	2
97	N. 76th Street and W. Appleton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	30	30	8	8	4	4	10	10	2	2
98	N. 68th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	2	1	26	26	14	16	6	7	22	17	3	3
99	Capitol Court Shopping Center.	City of Milwaukee	Proposed	Yes	200	2	2	25	25	14	16	6	7	22	17	3	3
100	W. Fond du Lac Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	2	2	23	23	14	16	6	7	22	17	3	3
101	N. Sherman Boulevard and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	3	2	21	21	12	14	5	6	21	16	3	2
102	N. Sherman Boulevard and W. Fond du Lac Avenue .	City of Milwaukee	Proposed	Yes	- -	2	2	20	20	14	14	7	7	19	19	4	3
103	N. Sherman Boulevard and W. Burleigh Street . .	City of Milwaukee	Proposed	Yes	- -	2	2	18	18	14	14	7	7	19	19	4	3
104	N. Sherman Boulevard and W. Center Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	17	17	14	14	7	7	19	19	4	3
105	N. Sherman Boulevard and W. North Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	3	16	16	14	14	7	7	19	19	4	3
106	N. 40th Street and W. Lisbon Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	14	14	14	14	7	7	19	19	4	3
107	W. Highland Boulevard and W. McKinley Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	2	12	12	14	14	7	7	19	19	4	3
108	N. 41st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	1	10	10	14	14	7	7	19	19	4	3
109	S. Kinnickinnic Avenue and E. Becher Street . . .	City of Milwaukee	Proposed	Yes	- -	1	3	13	13	8	8	4	4	10	10	2	2
110	S. Bay Street and E. Lincoln Avenue.	City of Milwaukee	Proposed	Yes	175	1	1	15	15	8	8	4	4	10	10	2	2
111	S. Bay Street and E. Russell Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	18	18	8	8	4	4	10	10	2	2
112	S. Nevada Street and S. Kinnickinnic Avenue. .	City of Milwaukee	Proposed	Yes	- -	1	2	19	19	8	8	4	4	10	10	2	2
113	S. Brust Avenue and E. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	20	20	8	8	4	4	10	10	2	2
114	S. Ellen Street and E. Morgan Avenue.	City of Milwaukee	Proposed	- -	- -	1	1	22	22	8	8	4	4	10	10	2	2
115	S. Bombay Avenue and E. Crawford Avenue. . . .	City of St. Francis	Proposed	- -	75	1	1	24	24	8	8	4	4	10	10	2	2
116	S. Kinnickinnic Avenue and Lunham Avenue . . .	City of St. Francis	Proposed	Yes	- -	1	1	26	26	8	8	4	4	10	10	2	2
117	S. Kinnickinnic Avenue and E. Layton Avenue . .	City of Cudahy	Proposed	Yes	- -	1	2	28	28	8	8	4	4	10	10	2	2
118	S. Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	300	1	1	30	30	8	8	4	4	10	10	2	2
119	Edgar Avenue and E. College Avenue	City of Cudahy	Proposed	Yes	- -	1	2	32	32	8	8	4	4	10	10	2	2
120	E. Rawson Avenue	City of South Milwaukee	Proposed	Yes	- -	1	1	34	34	8	8	4	4	10	10	2	2
121	Marquette Avenue	City of South Milwaukee	Proposed	Yes	- -	1	2	36	36	8	8	4	4	10	10	2	2

Table 286 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
122	S. 9th Avenue and E. Drexel Avenue	City of South Milwaukee	Proposed	Yes	200	1	- -	37	37	8	8	4	4	10	10	2	2
123	Northridge Shopping Center	City of Milwaukee	Proposed	Yes	175	1	5	42	45	6	6	3	3	9	9	1	2
124	N. 76th Street and W. Bradley Road	City of Milwaukee	Proposed	Yes	100	1	3	38	41	6	6	3	3	9	9	1	2
125	N. 76th Street and W. Good Hope Road	City of Milwaukee	Proposed	Yes	- -	1	3	36	38	6	6	3	3	9	9	1	2
126	N. 60th Street and W. Mill Road	City of Milwaukee	Proposed	Yes	- -	1	2	33	35	6	6	3	3	9	9	1	2
127	N. Sherman Boulevard and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	150	1	2	30	33	6	6	3	3	9	9	1	2
128	N. Sherman Boulevard and W. Villard Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	28	31	6	6	3	3	9	9	1	2
129	N. Sherman Boulevard and W. Hampton Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	27	29	6	6	3	3	9	9	1	2
130	N. Sherman Boulevard and W. Congress Street	City of Milwaukee	Proposed	Yes	- -	1	1	25	28	6	6	3	3	9	9	1	2
131	S. 44th Street and W. National Avenue	Village of West Milwaukee	Proposed	Yes	- -	1	2	16	19	6	6	3	3	9	9	1	2
132	S. 43rd Street and W. Greenfield Avenue	Village of West Milwaukee	Proposed	Yes	- -	1	1	18	20	6	6	3	3	9	9	1	2
133	S. 43rd Street and W. Burnham Street	Village of West Milwaukee	Proposed	Yes	- -	1	1	19	22	6	6	3	3	9	9	1	2
134	S. 43rd Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	250	1	1	21	23	6	6	3	3	9	9	1	2
135	S. 43rd Street and W. Cleveland Avenue	City of Milwaukee	Proposed	Yes	- -	1	- -	23	25	6	6	3	3	9	9	1	2
136	S. 43rd Street and W. Oklahoma Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	25	27	6	6	3	3	9	9	1	2
137	S. 43rd Street and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	27	29	6	6	3	3	9	9	1	2
138	S. 43rd Street and W. Howard Avenue	City of Greenfield	Proposed	Yes	150	1	1	28	30	6	6	3	3	9	9	1	2
139	S. 60th Street and W. Plainfield Avenue	City of Greenfield	Proposed	- -	- -	1	1	31	34	6	6	3	3	9	9	1	2
140	W. Forest Home Avenue and W. Plainfield Avenue	City of Greenfield	Proposed	Yes	- -	1	2	33	35	6	6	3	3	9	9	1	2
141	S. 76th Street and W. Layton Avenue	City of Greenfield	Proposed	Yes	- -	1	5	36	39	6	6	3	3	9	9	1	2
142	N. 9th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	- -	3	6	1	1	26	24	11	10	32	37	5	5
143	Southridge Shopping Center	Village of Greendale	Proposed	Yes	125	1	6	40	42	6	6	3	3	9	9	1	2
144	N. Glenview Avenue and W. Wisconsin Avenue	City of Wauwatosa	Proposed	Yes	- -	1	4	23	23	8	6	3	2	7	12	1	1
145	Milwaukee County General Hospital	City of Wauwatosa	Proposed	- -	- -	1	5	26	26	8	6	3	2	7	12	1	1
146	County Institutions	City of Wauwatosa	Proposed	- -	- -	1	5	27	27	8	6	3	2	7	12	1	1
147	N. Swan Boulevard and W. Watertown Plank Road	City of Wauwatosa	Proposed	Yes	225	1	1	29	29	8	6	3	2	7	12	1	1
148	Mayfair Mall Shopping Center	City of Wauwatosa	Proposed	Yes	150	1	7	33	33	8	6	3	2	7	12	1	1
149	N. Mayfair Road and W. Center Street	City of Wauwatosa	Proposed	- -	- -	1	3	35	35	8	6	3	2	7	12	1	1
150	N. Mayfair Road and W. Burleigh Street	City of Wauwatosa	Proposed	Yes	- -	1	2	37	37	8	6	3	2	7	12	1	1
151	N. Mayfair Road and W. Capitol Drive	City of Wauwatosa	Proposed	- -	- -	1	2	35	38	8	6	3	2	7	12	1	1
152	W. Lisbon Avenue and W. Capitol Drive	City of Milwaukee	Proposed	- -	- -	1	2	34	36	6	8	2	3	12	7	1	1
153	N. 92nd Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	2	32	35	6	8	2	3	12	7	1	1
154	N. 84th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	1	31	33	6	8	2	3	12	7	1	1
155	N. 76th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	3	29	32	6	8	2	3	12	7	1	1
156	N. 35th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	2	21	24	6	8	2	3	12	7	1	1
157	N. 27th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	2	20	22	6	8	2	3	12	7	1	1
158	W. Green Bay Avenue and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	2	20	23	6	8	2	3	12	7	1	1
159	N. Port Washington Road and W. Capitol Drive	City of Milwaukee	Proposed	- -	- -	1	2	21	24	6	8	2	3	12	7	1	1
160	N. Richards Street and E. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	2	23	25	6	8	2	3	12	7	1	1
161	N. Humboldt Boulevard and E. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	2	24	27	6	8	2	3	12	7	1	1
162	Morris Boulevard and E. Menlo Boulevard	Village of Shorewood	Proposed	Yes	- -	1	1	26	29	6	8	2	3	12	7	1	1

Source: SEWRPC.

Table 287

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Busway Plan
Primary Element		
Exclusive Guideway Miles		
Subway	- -	- -
Elevated	- -	8.0
At-Grade	- -	94.3
Total	- -	102.3
Shared Guideway Miles		
Freeways	51.5	- -
Surface Arterial Streets	49.5	2.2
Total	101.0	104.5
Route Miles	449	253
Vehicle Miles	7,200	21,670
Vehicle Hours	310	1,140
Vehicles Required	63	160
Express and Local Elements		
Route Miles	1,302	1,660
Vehicle Miles	64,820	66,390
Vehicle Hours	4,440	4,330
Vehicles Required	496	536
Total System		
Route Miles	1,755	1,913
Vehicle Miles	72,020	88,060
Vehicle Hours	4,750	5,470
Vehicles Required	559	696

Source: SEWRPC.

220 articulated buses, and about $137 million of which would be for the purchase of 977 conventional buses. The remaining $63 million would be required to construct stations and storage, maintenance, and layover facilities. About $582 million, or about 79 percent of the total capital cost, would be attributable to the primary transit element of the plan.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent busway plan can be expected to be approximately $147 million. The remaining $587 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal share and the federal share are estimated to total $37 million and $149 million, respectively.

Table 292 presents the design year operating and maintenance costs and farebox revenues for the base and maximum extent busway plans. Under the base plan, operating and maintenance costs may be expected to approximate $46 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent busway plan would increase the total operating and maintenance costs for the Milwaukee area in the year 2000 by $13 million, to a total cost of $59 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $3 million under the base plan, and $15 million under the maximum extent busway plan. Primary transit system operating and maintenance costs would thus represent about 7 percent of the total operating costs expected in the design year for the base plan, and about 26 percent of the total operating costs expected in the design year for the maximum extent busway plan.

The average operating cost per passenger for the base plan in the design year is estimated at $0.74. For the maximum extent busway system plan, the average operating cost per passenger may be expected to approximate $0.91—$0.17, or 23 percent, more than the base plan cost. The average operating cost per passenger mile would also be higher for the maximum extent busway plan, $0.18 compared with $0.17 for the base plan. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.32 and $0.16, respectively, and for the maximum extent busway system plan, $0.64 and $0.11, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is estimated at $25 million, expressed in 1979 dollars, compared with about $28 million under the maximum extent busway plan. Under the maximum extent busway alternative, the primary transit element could be expected to generate about 43 percent, or about $12.3 million, of the total revenues compared with 6 percent, or $1.6 million, for the base plan.

Table 288

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	253	253	253	253	253
Vehicle Miles	5,970	5,400	8,500	1,800	21,670
Vehicle Hours	320	280	450	90	1,140
Vehicles Required	113	49	160	25	160
Express and Local					
Route Miles.	1,660	1,586	1,660	1,558	1,660
Vehicle Miles	14,570	19,570	16,630	15,620	66,390
Vehicle Hours	980	1,260	1,130	960	4,330
Vehicles Required	480	226	536	168	536
Total System					
Route Miles.	1,913	1,839	1,913	1,811	1,913
Vehicle Miles	20,540	24,970	25,130	17,420	88,060
Vehicle Hours	1,300	1,540	1,580	1,050	5,470
Vehicles Required	593	275	696	193	696

Source: SEWRPC.

Table 289

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Maximum Extent Busway Plan		
		Transit Trips			Transit Trips	
	Total Person Trips[a]	Number	Percent of Total Trips	Total Person Trips[a]	Number	Percent of Total Trips
Home-Based Work	1,061,500	57,500	5.4	1,059,400	64,000	6.0
Home-Based Shopping . .	627,900	33,100	5.3	627,100	35,700	5.7
Home-Based Other	1,464,800	67,300	4.6	1,460,900	73,000	5.0
Nonhome Based.	778,800	13,700	1.8	775,100	13,100	1.7
School	454,200	45,800	10.0	454,100	45,800	10.1
Total	4,387,200	217,400	5.0	4,376,600	231,600	5.3

[a] *The difference in the total person trips generated under the maximum extent busway system plan and total person trips generated under the base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been found to be correlated with increased automobile ownership, and greater automobile ownership has been found to be correlated with increased trip generation. The Commission travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.*

Source: SEWRPC.

Table 290

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Time of Day	Base Plan				Maximum Extent Busway Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,300	41.7	46,900	21.6	23,800	25.2	49,900	21.6
Midday	400	3.9	75,900	34.9	25,400	26.9	80,700	34.8
Afternoon . .	5,600	54.4	74,900	34.4	37,600	39.8	79,600	34.4
Evening. . . .	- -	- -	19,700	9.1	7,600	8.1	21,400	9.2
Total	10,300	100.0	217,400	100.0	94,400	100.0	231,600	100.0

Source: SEWRPC.

Table 291

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Busway Plan
Guideway Development[b]	$ - -	$480,648,800
Station Development[c]	2,468,500	42,565,300
Vehicle Storage and Maintenance Facility Development[c]	18,950,000	20,854,600
Vehicle Acquisition and Replacement[d]	164,780,000	189,580,000
Total	$186,198,500	$733,648,700

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent busway plan will be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 through 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and therefore are capable of use beyond the design period.*

[b] *Includes the cost of acquiring about 203 acres of right-of-way for guideway construction, and of acquiring and relocating five residential structures and three steel lattice electric power transmission towers. This land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—9 acres under the base plan and 60 acres under the maximum extent busway plan. This land is assumed to have a useful life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses used in the system. Both plans assume the availability of a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years.*

Source: SEWRPC.

Table 292

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Busway Plan
Ridership		
Primary Element	2,626,500	24,072,000
Total System	62,685,500	63,860,000
Operating and Maintenance Cost		
Primary Element	$ 3,464,400	$15,416,000
Total System	46,323,500	59,313,100
Operating and Maintenance Cost per Passenger		
Primary Element	$1.32	$0.64
Systemwide Average	0.74	0.91
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.16	$0.11
Total System	0.17	0.18
Farebox Revenue		
Primary Element	$ 1,575,900	$12,280,800
Total System	24,697,600	28,342,500
Operating Deficit		
Primary Element	$ 1,888,500	$ 3,135,200
Total System	21,625,900	30,970,600
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	45	80
Total System	53	48
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 944,250	$ 1,567,600
Total System	10,812,950	15,985,300
State (72 percent of nonfederal share of operating deficit)		
Primary Element	679,860	1,128,670
Total System	7,785,320	11,149,420
Local		
Primary Element	264,390	438,930
Total System	3,027,630	4,335,880
Local Operating Deficit per Ride		
Primary Element	$0.10	$0.02
Total System	0.05	0.07

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $10.8 million required to provide 50 percent federal funding of the operating deficits under the base plan, but less than the $15.5 million required to provide such funding under the maximum extent busway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

The operating deficit in the year 2000 for the maximum extent busway plan would be about $31 million, expressed in 1979 dollars, requiring a subsidy of about $0.48 per passenger. This compares with the base system plan deficit of about $22 million, or $0.34 per passenger. Farebox revenues would cover about 48 percent of the operating costs under the maximum extent busway plan and 53 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has, in the past, funded up to 72 percent of the nonfederal share.[10] The annual local share of the public funding requirement in the design year 2000 would be about $4.3 million for the maximum extent busway system plan and about 30 percent less, $3.0 million, for the base system plan.

Development of Truncated System Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent busway system plan are summarized in Table 293. The maximum extent busway plan has significantly higher capital costs as well as greater operating deficits, both in total and on a per-passenger basis, than does the base plan. However, only a slightly smaller proportion of total operating costs are met through farebox revenues under the maximum extent busway plan than under the base plan. Nevertheless, the total cost per passenger to the design year of the maximum extent busway plan is more than twice that of the base plan under this future. It was therefore necessary to truncate this maximum extent busway system plan.

Some of the increases in the capital costs and operating deficits under the maximum extent busway plan may be attributed to the overextension of

[10] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $10.8 million required to provide 50 percent federal funding of the operating deficits under the base plan, but somewhat less than the $15.5 million required to provide such funding under the maximum extent busway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Table 293

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Busway Plan
Ridership		
In Design Year	62,685,500	63,860,000
To Design Year	1,238,433,200	1,247,829,200
Capital Cost		
Total to Design Year	$186,198,500	$ 733,648,700
To Design Year per Passenger	0.15	0.59
To Design Year After Accounting for Useful Life Beyond Design Year	124,606,570	407,051,590
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.33
Operating Cost		
Percent Met by Farebox Revenues in Design Year	53	48
Operating Deficit in Design Year	$ 21,625,900	$ 30,970,600
Operating Deficit per Passenger in Design Year	0.34	0.48
Operating Deficit to Design Year	418,319,800	493,077,400
Operating Deficit to Design Year per Passenger	0.34	0.40
Total Cost		
To Design Year	$604,518,300	$1,226,726,100
Federal Share	358,118,700	833,457,660
Nonfederal Share	246,399,600	393,268,440
To Design Year per Passenger	0.49	0.99
Federal Share	0.29	0.67
Nonfederal Share	0.20	0.32
To Design Year After Accounting for Useful Life Beyond Design Year	542,926,370	900,128,990
Federal Share	308,845,160	572,179,970
Nonfederal Share	234,081,210	327,949,020
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.44	0.73
Federal Share	0.25	0.46
Nonfederal Share	0.19	0.27

Source: SEWRPC.

service envisioned in this plan.[11] Under this plan, primary transit service on exclusive guideway would be extended into portions of the Milwaukee urbanized area not now served; would be expanded into an all-day operation; and would be provided at headways of no more than 30 minutes in the peak period and peak direction and no more than 60 minutes otherwise.

The cost-effective elements of the primary element of the maximum extent busway system plan with respect to operating costs can, in part, be identified on a route-by-route basis through a determination of what proportion of the operating costs of the routes may be expected to be recovered through farebox revenues. As shown in Table 294, about 80 percent of the total busway primary transit element operating costs may be expected to be recovered from farebox revenues, and not less than 69 percent of the operating costs for any route will be met through farebox revenues. Therefore, routes should require little modification except possibly over some limited segments.

Another basis for the identification of the less productive elements of the maximum extent busway system plan is the operating and capital costs per passenger and per passenger mile carried on segments of the system. Table 295 summarizes the estimated capital and operating costs, and passenger miles carried, for the major segments of the maximum extent busway system, and provides a ranking of the segments in terms of operating costs per passenger mile and capital costs per passenger mile. Map 62 in Chapter III of this report identifies the major segments of the primary transit element of the plan. Maps 116 and 117 show those segments which may be expected to have above average operating costs and capital costs per passenger mile, respectively, as well as the degree to which such average costs may be expected to be exceeded, along a route and between routes. In any consideration of this cost-effectiveness information, it is important to recognize that the outer ends of each route can carry no through traffic, except through connection with a different mode such as a feeder/distributor bus.

The cost-effectiveness of segments of a system can also be compared in terms of passenger boardings and deboardings. Table 295 also presents

[11] *The extension of local and express service under the maximum extent busway plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express (secondary) and local (tertiary) service included in each maximum extent primary transit system plan is in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules have been modified, however, to coordinate properly the secondary and tertiary service proposed to be provided with the primary service proposed under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered, and should, therefore, not affect a comparison of those alternatives.*

Table 294

OPERATING COST-EFFECTIVENESS OF BUSWAY ROUTES OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicles Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
1—Waukesha/ Milwaukee CBD/UWM	120,430	$10,120	4,965	$13,850	73
2—Cedarburg/Grafton/ Milwaukee CBD/Oak Creek	138,240	11,620	6,035	16,840	69
3—Menomonee Falls/ Milwaukee CBD/ South Milwaukee	133,830	11,240	4,505	12,570	89
4—Crosstown: Northridge/Southridge	95,510	8,030	2,720	7,590	106
5—Loop: Capital Drive/UWM/ Wisconsin Avenue/Mayfair	85,070	7,150	3,445	9,610	74
Total	573,080	$48,160	21,670	$60,460	80

Source: SEWRPC.

passenger boarding and deboarding volumes and a rank ordering of the segments in terms of operating and capital costs per boarding and deboarding passenger. Maps 118 and 119 show those segments which may be expected to have above average operating and capital costs, respectively, per boarding and deboarding passenger, as well as the degree to which average costs may be expected to be exceeded.

Based on this cost-effectiveness information, the maximum extent busway system plan for this alternative future was truncated. The truncations were made with the objective of reducing system capital cost and operating deficits and bringing the total cost per passenger for a busway system plan for this future closer to that of the base plan, while retaining an integrated system. The proposed truncated busway system plan under the moderate growth scenario-decentralized land use plan alternative future is shown on Map 100 in Chapter IV. The changes made in the maximum extent plan to reduce the truncated plan are summarized in Table 296. The segments deleted were the less cost-effective segments—that is, segments which, if deleted, would result in relatively large reductions in system capital costs and operating deficits and relatively small reductions in system ridership. These segments consisted of those extending to the communities of Cedarburg and Grafton from W. Capitol Drive in the City of Milwaukee, those extending to the Village of Menomonee Falls from W. Silver Spring Drive and N. 92nd Street in the City of Milwaukee, those extending to the Cities of West Allis and Waukesha from N. 84th Street and W. Fairview Avenue in the City of Milwaukee, those extending to the City of Oak Creek from General Mitchell Field, those looping from the intersection of W. Appleton Avenue and W. Capitol Drive to the Mayfair Mall Shopping Center, and that segment extending from the City of Cudahy to the City of South Milwaukee. Because of its high capital cost, the segment from S. 5th and W. Becher Streets to the City of St. Francis along E. and S. Bay Street and the Chicago & North Western's Kenosha Subdivision railway main line on the route connecting to the City of Cudahy was replaced by a segment from S. 5th and W. Becher Streets along Chase Avenue to the former Milwaukee Electric Lines Lakeside Belt Line, and then along that open right-of-way owned by the Wisconsin Electric Power Company and used for trunkline power transmission to the original routing from S. 5th and W. Becher Streets through the City of St. Francis to the City of Cudahy. The segment from the Milwaukee central busi-

Table 295

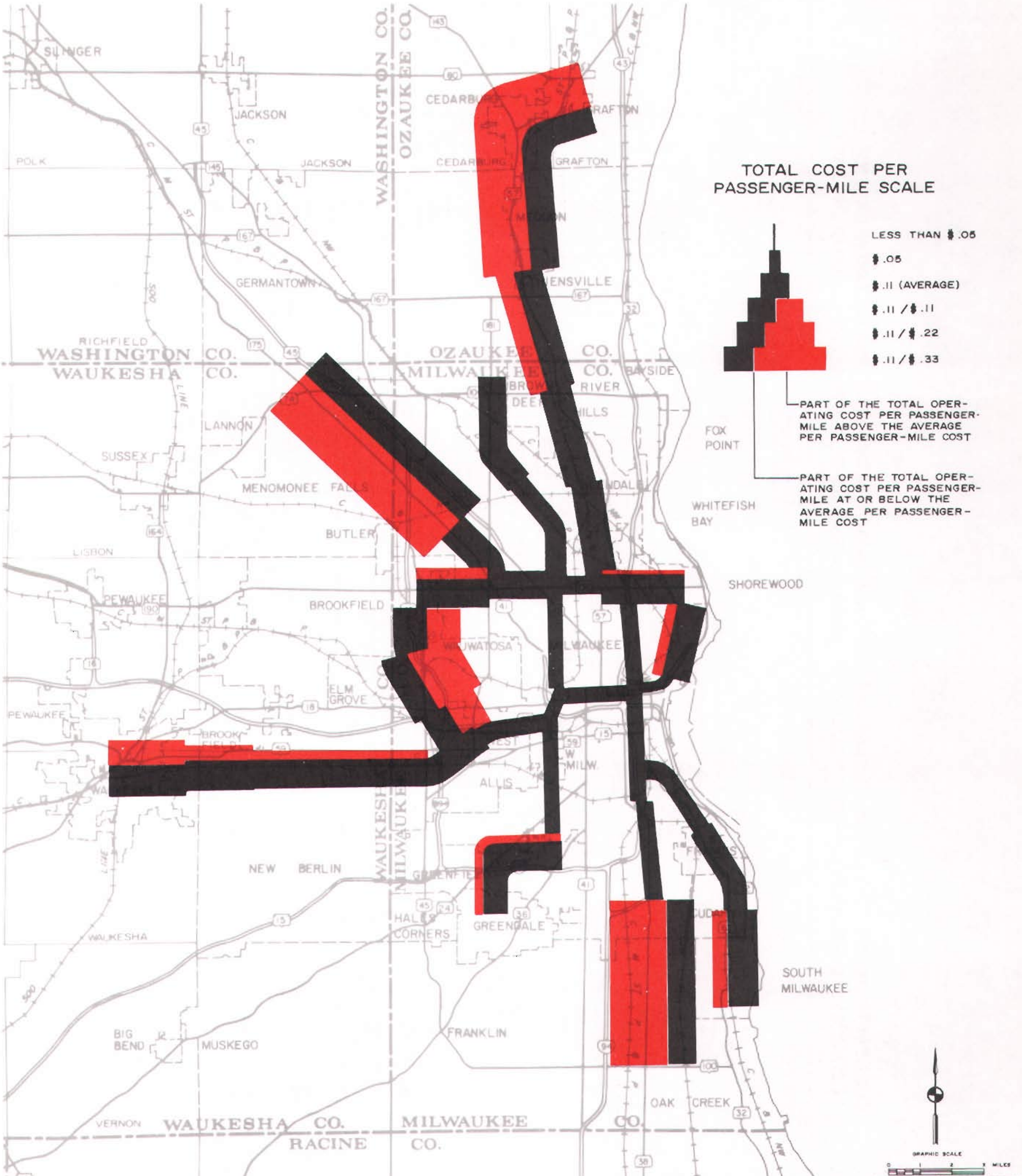
COST-EFFECTIVENESS ANALYSIS OF SEGMENTS OF THE PRIMARY ELEMENT OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

		Transit Ridership						Average Weekday Operating Cost-Effectiveness in Design Year				Total Capital Cost-Effectiveness Over the Design Period			
		Average Weekday Passenger Volume													
Segment Number	Route Number	Range	Average	Total Boarding and Deboarding Passengers	Passenger Miles	Average Weekday Operating Cost in Design Year	Total Capital Cost Over Design Period	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank
1	1	2,280- 3,050	2,750	3,970	4,960	$1,094	$ 5,972,500	$0.22	28	$0.28	14	$1,204	18	$ 1,504	7
2	1	3,370- 3,400	3,390	880	13,540	2,288	11,703,500	0.17	25	2.60	34	864	14	13,299	34
3	1	3,830- 4,030	3,940	1,470	15,770	2,358	11,355,300	0.15	22	1.60	32	720	11	7,725	30
4	1	5,950- 6,380	6,140	3,420	14,120	1,348	18,834,896	0.10	14	0.39	21	1,334	21	5,507	25
5	1 and 5	8,490-11,860	11,230	6,260	26,950	2,275	28,260,768	0.08	9	0.36	17	1,049	16	4,514	18
6	1 and 5	20,190-20,190	20,190	10,100	12,110	721	7,490,900	0.06	2	0.07	2	619	9	742	2
7	1 and 5	21,450-25,420	23,060	31,182	57,640	3,307	27,993,792	0.06	2	0.11	3	486	4	898	4
8	1 and 5	13,740-19,670	17,650	12,260	12,360	643	3,262,100	0.05	1	0.05	1	264	1	266	1
9	1 and 5	2,770-11,330	6,670	18,170	32,710	4,767	50,660,272	0.15	22	0.26	12	1,549	23	2,788	13
10	2	1,020- 2,180	1,670	1,740	11,190	3,330	21,386,064	0.30	32	1.91	33	1,911	28	12,291	33
11	2	2,390- 3,180	2,760	2,040	11,610	2,135	15,384,000	0.18	27	1.05	30	1,325	20	7,541	29
12	2	3,660- 4,210	3,890	1,280	12,440	1,550	6,724,200	0.12	17	1.21	31	541	5	5,253	22
13	2	4,750- 5,060	4,870	2,300	15,590	1,667	12,253,100	0.11	16	0.72	27	786	13	5,327	23
14	2	5,270- 9,720	7,630	13,700	29,760	2,139	16,836,000	0.07	7	0.16	5	566	8	1,230	6
15	2 and 3	15,300-15,860	15,580	9,780	38,950	2,365	11,711,200	0.06	2	0.24	9	302	2	1,204	5
16	2	5,300- 8,290	6,790	9,790	25,800	2,057	18,129,392	0.08	9	0.21	7	703	10	1,852	11
17	2	400- 3,230	1,380	3,490	7,340	2,596	21,950,672	0.35	34	0.74	28	2,991	32	6,289	27
18	3	630- 2,240	1,480	2,740	7,110	2,250	17,989,296	0.32	33	0.82	29	2,530	31	6,565	28
19	3	4,110- 5,330	4,140	5,190	9,530	1,117	9,545,000	0.12	17	0.22	8	1,002	15	1,839	10
20	3 and 5	8,160- 8,880	8,510	4,390	14,470	1,429	7,887,300	0.10	14	0.33	15	545	6	1,797	9
21	3 and 4	12,050-14,280	13,050	21,620	50,910	3,257	19,083,296	0.06	2	0.15	4	375	3	883	3
22	3	6,460- 7,970	7,100	3,820	22,000	1,737	39,740,672	0.08	9	0.45	24	1,806	25	10,403	32
23	3	5,350- 6,260	5,660	4,430	14,160	1,218	26,341,760	0.09	13	0.27	13	1,860	27	5,946	26
24	3	840- 3,630	2,850	3,560	8,560	1,477	33,279,280	0.17	25	0.41	23	3,888	33	9,348	31
25	4	2,930- 3,920	3,440	4,610	13,430	1,555	24,807,872	0.12	17	0.34	16	1,847	26	5,381	24
26	4	4,250- 6,920	5,560	5,840	18,340	1,404	24,109,472	0.08	9	0.24	9	1,315	19	4,128	16
27	4	4,520- 8,340	7,570	7,890	21,950	1,286	12,079,000	0.06	2	0.16	5	550	7	1,531	8
28	4	2,690- 4,220	3,050	5,430	15,560	2,005	26,970,592	0.13	21	0.37	20	1,733	24	4,967	20
29	5	1,620- 2,000	1,880	2,050	3,570	816	7,092,700	0.23	29	0.40	22	1,987	29	3,460	14
30	5	1,430- 1,430	1,430	2,480	2,150	623	8,916,600	0.29	31	0.25	11	4,147	34	3,595	15
31	5	1,050- 1,780	1,470	1,190	2,650	729	5,389,800	0.28	30	0.61	26	2,034	30	4,529	19
32	5	1,700- 2,680	2,600	2,520	5,710	919	6,517,500	0.16	24	0.36	17	1,141	17	2,586	12
33	5	5,420- 5,850	5,620	1,260	8,430	632	6,576,300	0.07	7	0.50	25	780	12	5,219	21
34	5	2,770- 4,470	3,780	3,780	11,710	1,361	15,826,200	0.12	17	0.36	17	1,352	22	4,187	17

Source: SEWRPC.

Map 116

OPERATING COST PER PASSENGER-MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

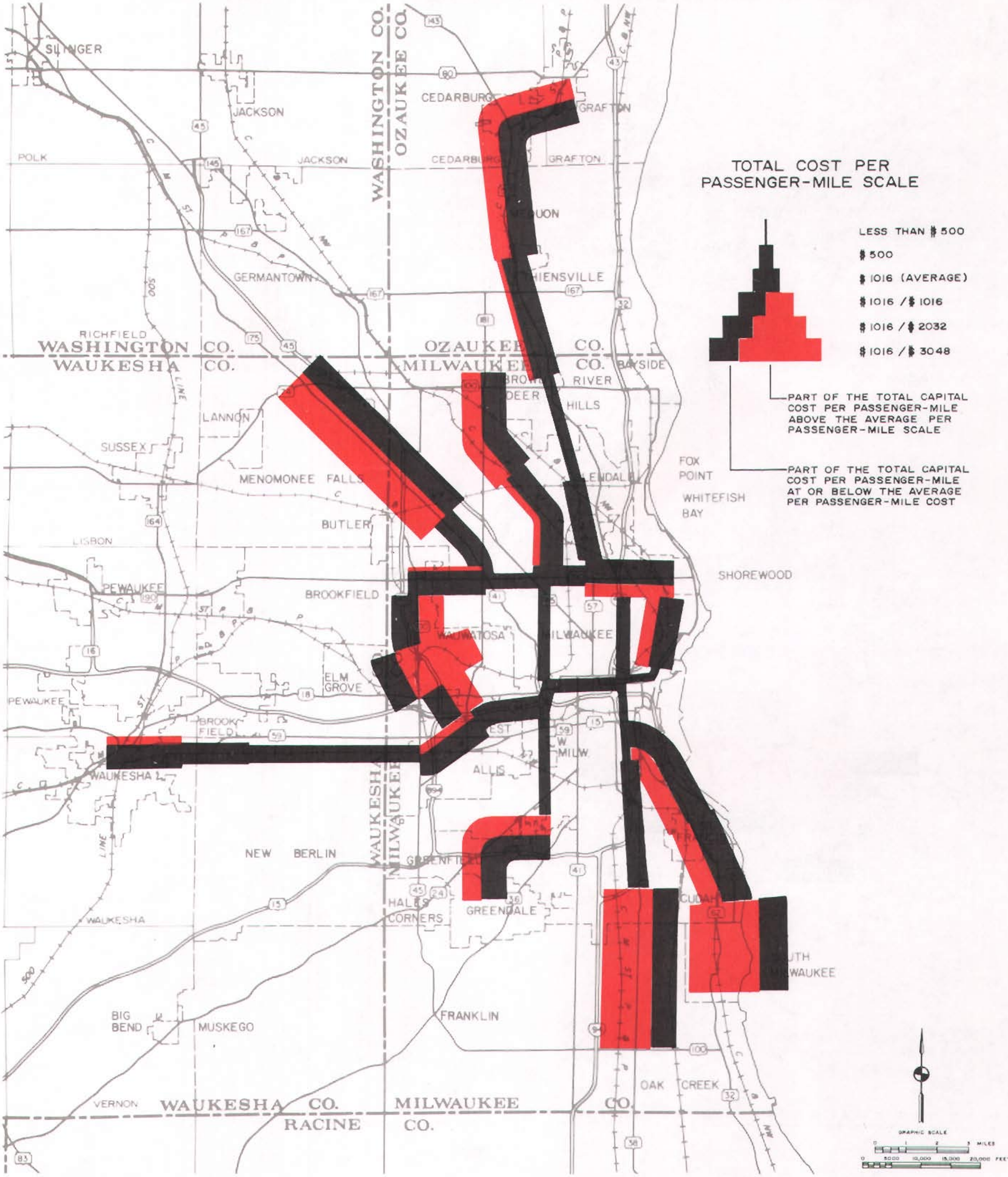


One measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway system plan was the operating cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average operating cost per passenger mile, as well as the degree to which such average costs may be expected to be exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, the data indicate that for the outer segments of each route, as well as portions of Route 5 in the City of Wauwatosa, an insufficient ridership base would exist to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development, and the absence of through traffic except by connection with a different mode such as feeder bus or automobile. To some degree, these inefficiencies are also generated by the lengthy distances of some segments in the suburban areas.

Source: SEWRPC.

Map 117

CAPITAL COST PER PASSENGER-MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

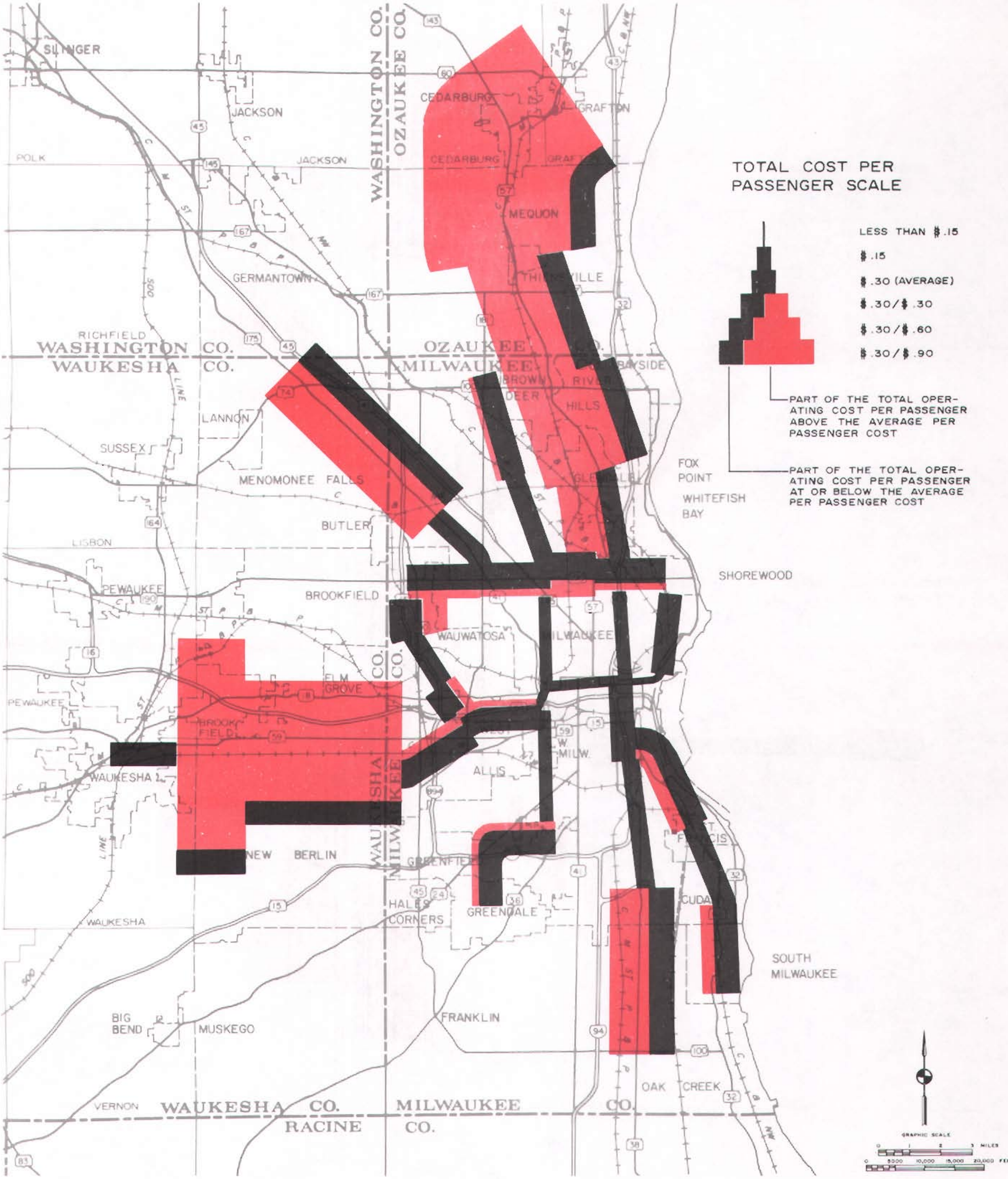


Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway system plan was the capital cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average capital cost per passenger mile, as well as the degree to which such average costs may be expected to be exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, the data indicate that for the outer segments of each route, as well as portions of Route 5 on the City of Milwaukee's east side and in the City of Wauwatosa, an insufficient ridership base would exist to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development, and the absence of through traffic except by a connection with a different mode such as feeder bus or automobile. To some degree, these inefficiencies are also generated by the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee's east side.

Source: SEWRPC.

Map 118

OPERATING COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

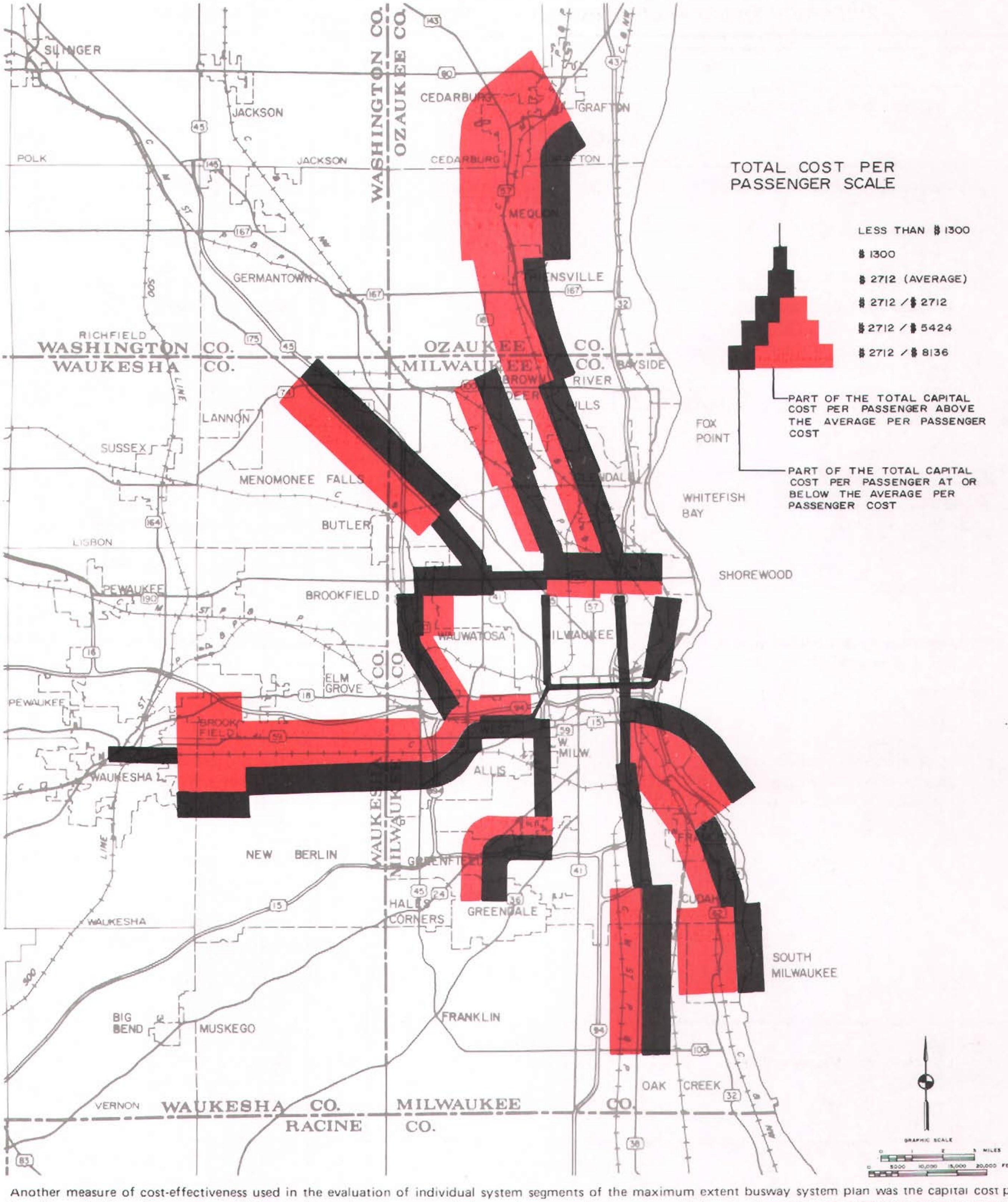


Yet another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway system plan was the operating cost per boarding and deboarding passenger. This map shows those segments which may be expected to operate at, below, or above the average operating cost per boarding and deboarding passenger, as well as the degree to which such average costs may be expected to be exceeded. As shown on this map, certain system segments within densely developed portions of Milwaukee County would be very cost-effective compared with the remainder of the system, while almost all segments located within suburban areas outside Milwaukee County are not cost-effective. This is a result of the lower boarding and deboarding passenger volumes in these suburban areas combined with the lengthy distances that the vehicles must operate over. A noteworthy exception is the segment within the City of Waukesha which, by itself, appears cost-effective, but which nevertheless depends upon a connection to the remainder of the system over two lengthy suburban segments which generate little ridership.

Source: SEWRPC.

Map 119

CAPITAL COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway system plan was the capital cost per boarding and deboarding passenger. This map shows those segments which may be expected to operate at, below, or above the average capital cost per boarding and deboarding passenger, as well as the degree to which such average costs may be expected to be exceeded. As shown on this map, certain segments within the densely developed portions of Milwaukee County would be very cost-effective compared with the remainder of the system. However, those segments located in Milwaukee County suburbs as well as outside Milwaukee County appear to have an insufficient volume of passenger boardings and deboardings to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development combined with the large capital investments necessary for guideway structures and station facilities in some suburban areas.

Source: SEWRPC.

Table 296

RECOMMENDED CHANGES IN THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Route	Recommended Change	Reasons
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segment 1	The deletion of Segments 2 and 3 would not logically permit retention of Segment 1
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segments 2 and 3	Segments 2 and 3 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
1—Waukesha/Milwaukee CBD/UWM	Eliminate Segment 4	Segments 29 and 30 are more cost-effective than Segment 4 and provide for a more logical end-of-route
2—Cedarburg/Milwaukee CBD/Oak Creek	Eliminate Segments 10, 11, 12, and 13	Segments 10 through 13 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
2—Cedarburg/Milwaukee CBD/Oak Creek	Eliminate Segment 17	Segment 17 is not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
3—Menomonee Falls/Milwaukee/ South Milwaukee	Eliminate Segment 18	Segment 18 is not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
3—Menomonee Falls/Milwaukee CBD/ South Milwaukee and Cedarburg/ Milwaukee CBD/Oak Creek	Eliminate Segments 22, 24, and parts of 16 and 23. Add connector segment between Segments 16 and 23	Segments 17, 22, and 24 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments. Portions of Segments 16 and 23 were deleted for the same reasons. The remainder of Segment 23, which is cost-effective and has significant boardings and deboardings, has been connected to the remainder of the truncated network via the Lakeside Belt Line right-of-way
5—Loop: UWM/Mayfair/Milwaukee CBD	Eliminate Segments 31, 32, and 34	Segments 31, 32, and 34 are not capital or operating cost-effective relative to other segments. Also, total boardings and deboardings are low compared with those of other segments
5—Loop: UWM/Mayfair/Milwaukee CBD	Eliminate Segment 9	Segment 9 is not capital cost-effective relative to other segments. Service to UWM would be provided by shuttle service from nearby primary transit stations

Source: SEWRPC.

ness district through the University of Wisconsin-Milwaukee to Capitol Drive and along Capitol Drive to W. Atkinson Avenue in the City of Milwaukee was deleted because of its high capital cost relative to its ridership. Through the elimination of these segments, the capital cost of the primary element of the busway system would decrease from about $582 million to about $279 million, and the total cost of the truncated plan would be about $431 million.

Those segments given the highest priority for elimination were Segments 10, 11, 12, and 13 serving northern Milwaukee County and Ozaukee County, and Segments 1, 2, 3, and 18 serving Waukesha County. Segments 31 and 32, providing service along Capitol Drive between Appleton Avenue and Mayfair Road, and Segment 4, providing service to West Allis, were identified as the second set of segments to be deleted. The third set of segments identified to be deleted were those serving General Mitchell Field, the City of Oak Creek, and the City of South Milwaukee, including portions of both Segments 16 and 22 and all of Segments 17 and 24. Segments 9 and 34, serving the University of Wisconsin-Milwaukee campus and the lower east side, were the final two segments identified for deletion.

EVALUATION AND COMPARISON OF TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS

The fifth and last step in the design, test, and evaluation of alternative primary transit system plans under the moderate growth scenario-decentralized land use plan alternative future was the test and evaluation of the truncated system plans for each alternative primary transit technology, as presented in the previous section of this chapter. Based upon this test and evaluation, a "best" plan for the provision of primary transit service in the Milwaukee area under this alternative future was identified.

The truncated system plans for the bus-on-freeway, light rail transit, and busway alternative primary transit technologies are summarized with respect to their coverage, stations, routes, and operation on Maps 120 and 121, and in Tables 297 through 299. It should be noted that the light rail transit and busway plans, presented in a previous section of this chapter, were further refined for comparative test and evaluation so that the geographic extent of primary transit service provided under each alternative was comparable. Specifically, primary transit bus-on-freeway routes from the truncated bus-on-freeway plan were added to the truncated light rail transit and busway plans in travel corridors where those modal plans did not provide service, but where the bus-on-freeway plan did provide service. Without these further refinements to provide a comparable extent of service between the alternative plans, a comparative evaluation of the alternative plans would have been impossible. Also, each individual plan—light rail transit and busway—would not include primary transit services in some corridors which could reasonably be expected to have such service by the design year, and the costs for which should be accounted for in systems planning. Bus-on-freeway service was added to the other truncated plans to make them composite plans because the bus-on-freeway plan provided greater geographic coverage than any of the other plans, it was the lowest capital cost primary transit alternative, and it represented a continuation and evolutionary extension of existing primary transit service. It should be noted that because the truncated system plan for the commuter rail mode consisted of only one route in a single corridor radiating from downtown Milwaukee to the south to Kenosha, a composite plan was not prepared for this alternative, but rather primary transit commuter rail service in this corridor was compared with service provided by the bus-on-freeway mode. This comparison was intended to determine whether commuter rail services could be recommended over bus-on-freeway facilities and services, the latter providing essentially the same type of long-distance transit service focused on the central business district as commuter rail in this corridor.

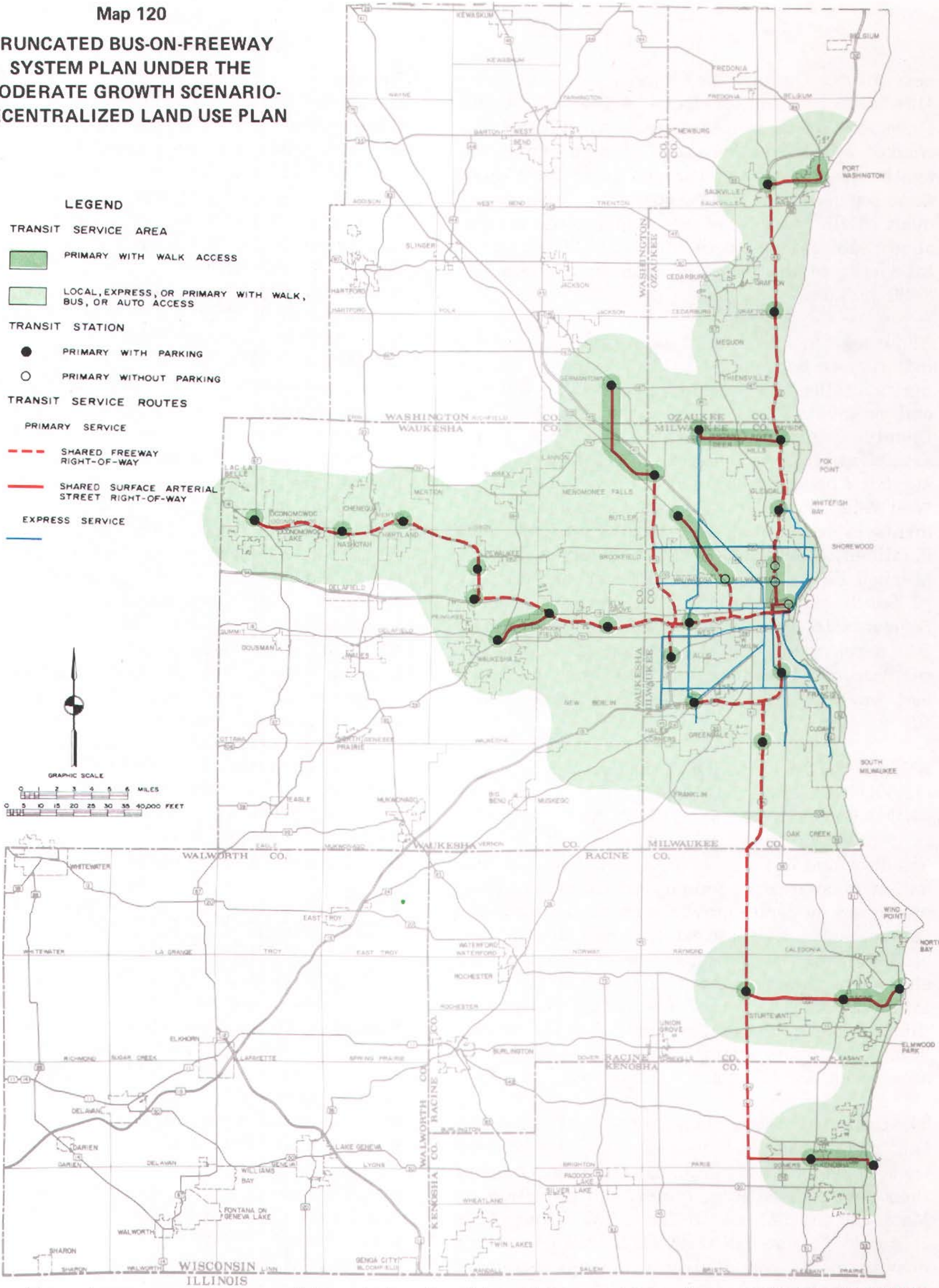
Alternative Primary Transit Plan Evaluation and Comparison—Evaluation of Commuter Rail Service in the South Corridor to Kenosha

As shown on Map 122, bus-on-freeway service in the corridor radiating to the south from the Milwaukee central business district to Kenosha would be provided over the North-South Freeway (IH 94) to the communities of Kenosha, Racine, Oak Creek, South Milwaukee, Cudahy, and St. Francis. Three bus-on-freeway routes totaling 163 route miles would provide this service from a total of seven stations located outside the Milwaukee central business district, all of which would have park-ride lots. Headways on the bus-on-freeway service would range from 8 to 15 minutes in the peak travel periods, and from 20 to 40 minutes in the off-peak travel periods to meet the forecast transit demand.

Commuter rail service would serve the same communities in this corridor along a single route, 66 miles in extent. A total of nine stations would

Map 120

TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



The truncated bus-on-freeway system plan is a carefully cut back version of the maximum extent bus-on-freeway system plan, the cutbacks being made with the objective of creating a more cost-effective system serving a large part of the Milwaukee area. Under the truncated plan, 15 of the 31 routes, totaling 113 miles of line over which 569 round-trip route miles of service would be provided, or about 46 percent of the 246 miles of line and 47 percent of the 1,218 route miles of service provided under the maximum extent plan, were retained. Headways were assumed to remain about the same as under the maximum extent plan, ranging from 8 to 30 minutes during the peak travel periods and 20 to 60 minutes during the off-peak periods. Under the truncated plan, a total of 29 primary transit stations or stops would be served outside the Milwaukee central business district, 26 of which would have park-ride lots. There would be 13 stations within Milwaukee County, 10 of which would have park-ride lots.

Source: SEWRPC.

Table 297

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS ON AN AVERAGE WEEKDAY UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Primary Element				
Exclusive Guideway Miles				
Subway.	- -	- -	- -	- -
Elevated	- -	- -	5.3	5.3
At-Grade.	- -	- -	41.0	41.0
Total	- -	- -	46.3	46.3
Shared Guideway Miles				
Freeways.	51.5	70.6	55.0	53.1
Surface Arterial Streets. . .	49.5	42.1	24.6	20.5
Total	101.0	112.7	79.6	73.6
Stations	20	30	107	107
Route Miles.	449	571	529	525
Vehicle Miles[a]	7,200	22,130	25,020	27,390
Vehicle Hours	310	760	990	1,150
Vehicles Required				
Motor Buses	63	111	75	154
Light Rail Vehicles	- -	- -	63	- -
Trains Required	- -	- -	63	- -
Express and Local Elements				
Route Miles.	1,302	1,811	1,620	1,620
Vehicle Miles	64,820	78,720	69,090	71,690
Vehicle Hours	4,440	5,120	4,550	4,730
Motor Buses Required.	496	694	581	595
Total System				
Route Miles.	1,755	2,382	2,149	2,145
Vehicle Miles	72,020	100,850	94,110	99,080
Vehicle Hours	4,750	5,880	5,540	5,780
Vehicles Required				
Motor Buses	559	805	656	749
Light Rail Vehicles	- -	- -	63	- -
Trains Required	- -	- -	63	- -

[a] *Vehicle miles of travel per average weekday on the bus-on-freeway component of the composite plans are estimated at 16,470 vehicle miles for the composite light rail transit plan and 17,690 vehicle miles for the composite busway plan.*

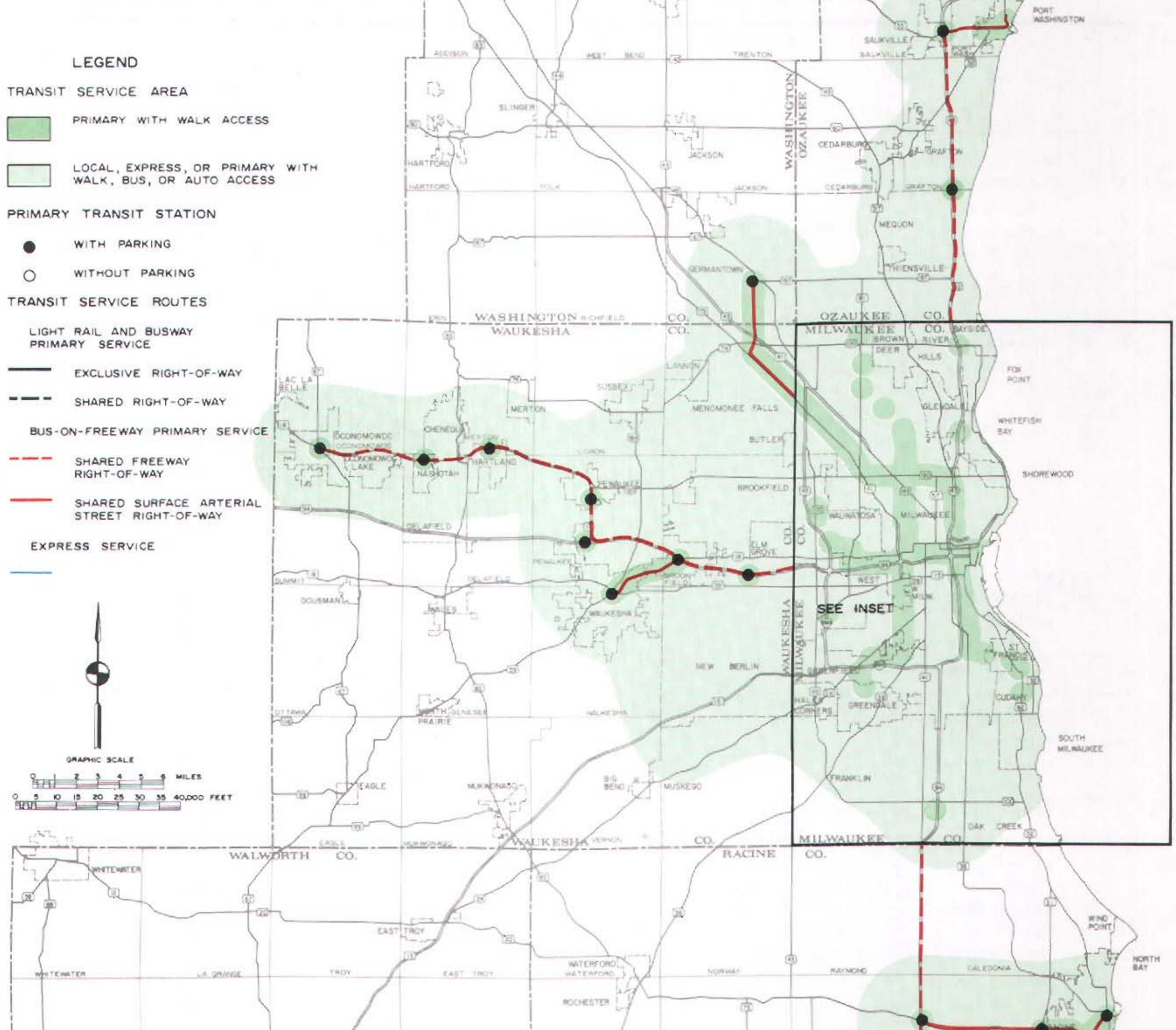
Source: SEWRPC.

be provided along the route, six of which would have park-ride lots. Trains would consist of a locomotive and two coaches in the peak travel periods, and one coach in both the midday and evening off-peak travel periods. Commuter trains would operate at the maximum headways prescribed in the adopted standards—30 minutes in the peak travel periods in the peak direction and 60 minutes otherwise.

The bus-on-freeway service in this corridor may be expected to carry about 42 percent more passengers in the design year than the commuter rail service, as shown in Table 300. Nearly 13,900 passengers may be expected to use the bus-on-freeway service on an average weekday, compared with 9,800 passengers for the commuter rail service. Under both the bus-on-freeway and commuter rail services in this corridor, most of these trips would

Map 121

COMPOSITE LIGHT RAIL TRANSIT AND BUSWAY SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLANS



The composite light rail transit and busway system plans are carefully cut back versions of the maximum extent light rail transit and busway system plans. The cutbacks were made with the objective of creating more cost-effective systems which could still serve a large part of the Milwaukee area. Under the composite plans, fixed guideways would be limited to Milwaukee County. A total of 46 miles of line over which 97 round-trip route miles of service would be provided were retained on three routes, or about 44 percent of the 105 miles of line and about 40 percent of the 253 route miles of service provided under the maximum extent plan. To make this plan comparable to the bus-on-freeway plan, a total of seven bus-on-freeway routes operating over 80 miles of line, and providing an additional 432 route miles of primary service, were added to serve portions of the Milwaukee area that would not be served by the three light rail transit or busway primary transit routes. Headways on the light rail transit system would range from 4 to 10 minutes during the peak travel periods, and from 30 to 60 minutes in the off-peak periods. Bus-on-freeway service would be provided with headways ranging from 9 to 30 minutes during the peak travel periods, and 15 to 30 minutes in the off-peak periods. A total of 108 primary transit stations or stops would be provided, of which 89 stations would serve the light rail transit system and 19 stations would serve the bus-on-freeway service. Of the 108 stations, 15 would have park-ride lots for light rail transit and 18 would have park-ride lots for bus on freeway. A total of 92 stations would be located within Milwaukee County, of which 18 would have park-ride lots.

Source: SEWRPC.

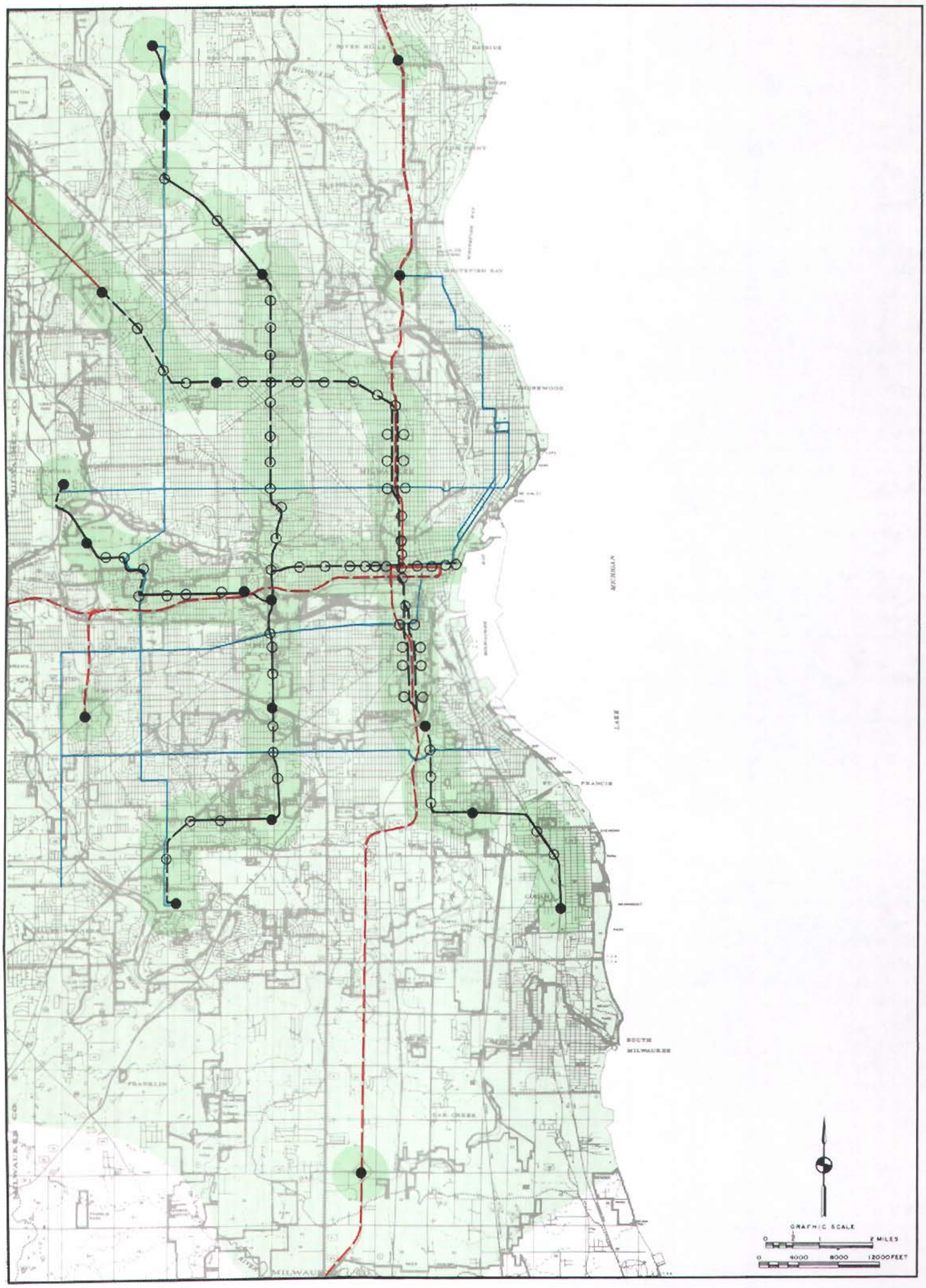

SHOREWOOD
LAKE
MICHIGAN
ST. FRANCIS
CUDAHY
SOUTH MILWAUKEE
FRANKLIN
OAK CREEK
GRAPHIC SCALE
2 MILES
0 4000 8000 12000 FEET

Table 298

TIME-OF-DAY OPERATION OF THE TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Alternative	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Truncated Bus-on-Freeway Plan					
Primary Element					
Route Miles	571	571	571	571	571
Vehicle Miles	5,210	5,610	8,270	3,040	22,130
Vehicle Hours	190	180	290	100	760
Articulated Motor Buses Required	69	35	111	30	111
Express and Local Elements					
Route Miles	1,811	1,737	1,811	1,628	1,811
Vehicle Miles	17,940	21,440	22,950	16,390	78,720
Vehicle Hours	1,190	1,380	1,540	1,010	5,120
Conventional Motor Buses Required	554	243	694	175	694
Total System					
Route Miles	2,382	2,308	2,382	2,199	2,382
Vehicle Miles	23,150	27,050	31,220	19,430	100,850
Vehicle Hours	1,380	1,560	1,830	1,110	5,880
Vehicles Required	623	278	805	205	805
Articulated Motor Buses	69	35	111	30	111
Conventional Motor Buses	554	243	694	175	694
Composite Light Rail Transit Plan					
Primary Element					
Route Miles	529	529	529	529	529
Vehicle Miles	5,850	6,920	9,020	3,230	25,020
Vehicle Hours	240	260	370	120	990
Vehicles Required	94	52	138	35	138
Articulated Light Rail Vehicles	44	23	63	12	63
Articulated Motor Buses	50	29	75	23	75
Trains Required	44	23	63	12	63
Express and Local Elements					
Route Miles	1,620	1,546	1,620	1,518	1,620
Vehicle Miles	15,320	19,610	18,450	15,710	69,090
Vehicle Hours	1,040	1,280	1,260	970	4,550
Conventional Motor Buses Required	499	227	581	166	581
Total System					
Route Miles	2,149	2,075	2,149	2,047	2,149
Vehicle Miles	21,170	26,530	27,470	18,940	94,110
Vehicle Hours	1,280	1,540	1,630	1,090	5,540
Vehicles Required	593	279	719	201	719
Articulated Light Rail Vehicles	44	23	63	12	63
Articulated Motor Buses	50	29	75	23	75
Conventional Motor Buses	499	227	581	166	581
Trains Required	44	23	63	12	63
Composite Busway Plan					
Primary Element					
Route Miles	525	525	525	525	525
Vehicle Miles	6,600	7,490	9,950	3,350	27,390
Vehicle Hours	290	290	390	130	1,100
Articulated Motor Buses Required	107	52	154	33	154
Express and Local Elements					
Route Miles	1,620	1,546	1,620	1,518	1,620
Vehicle Miles	15,350	21,470	18,790	16,080	71,690
Vehicle Hours	1,040	1,400	1,290	990	4,730
Conventional Motor Buses Required	490	246	595	107	595
Total System					
Route Miles	2,145	2,071	2,145	2,043	2,145
Vehicle Miles	21,950	28,960	28,740	19,430	99,080
Vehicle Hours	1,320	1,680	1,660	1,120	5,780
Vehicles Required	597	298	749	200	749
Articulated Motor Buses	107	52	154	33	154
Conventional Motor Buses	490	246	595	107	595

Source: SEWRPC.

Table 299

SUMMARY OF SERVICE AND FACILITY CHARACTERISTICS OF TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

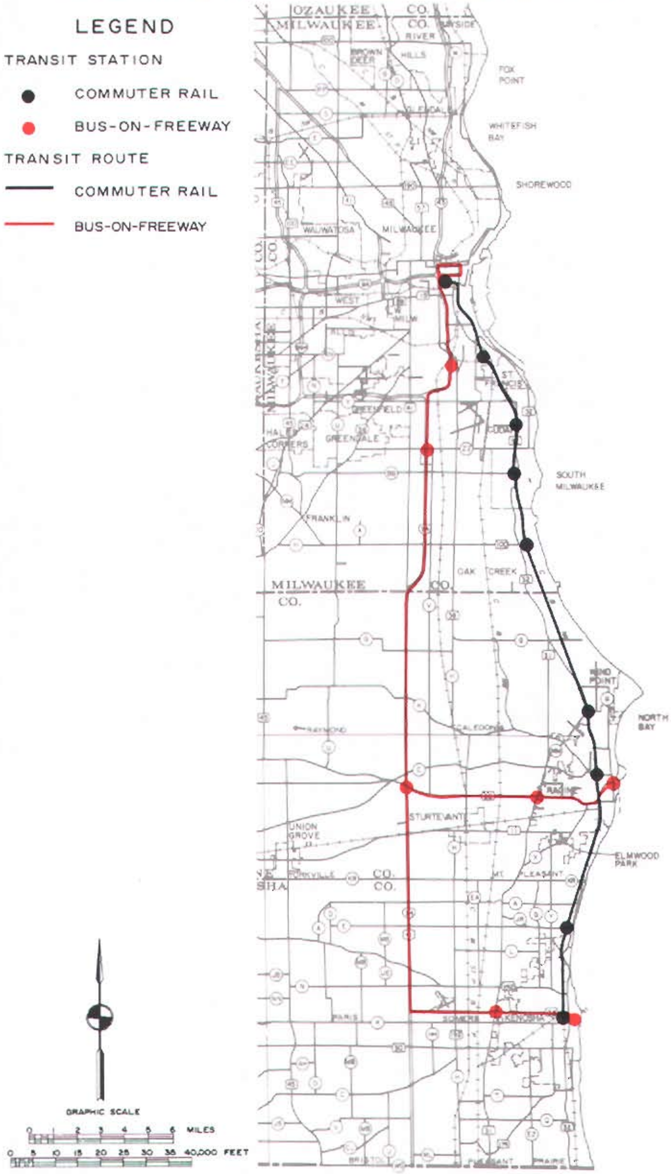
Alternative	Summary of Truncated and Composite Plans
Truncated Bus-on-Freeway Plan	Extent of Service—Expansion of primary service proposed under the maximum extent plan was significantly reduced. Under the truncated plan, only 15 of the 31 routes totaling 569 route miles, or less than 50 percent of the 1,218 route miles in the maximum extent plan, were retained. Frequency of Service—Headways would remain about the same, ranging from 8 to 30 minutes in the peak periods and 20 to 60 minutes in the off-peak periods. Operations—Under the truncated plan, bus miles per average weekday of primary service would be reduced by about 40 percent, from 35,640 miles under the maximum extent plan to 22,130 miles. Bus miles per average weekday of local and express service would decrease by about 5 percent, from about 83,060 miles to about 78,720 miles. Transit Stations—A total of 29 transit stations or stops would be provided outside the maximum central business district, 26 of which would have park-ride lots. Under the truncated plan, there would be 13 stations in Milwaukee County, 10 of which would have park-ride lots.
Composite Light Rail Transit Plan	Extent of Service—Expansion of light rail transit primary service proposed under the maximum extent light rail transit plan was somewhat reduced, limiting light rail service to Milwaukee County. Under the composite plan, three of the five routes totaling 97 route miles, or 40 percent of the 253 route miles in the maximum extent plan, were retained. Two of the routes would extend from the Milwaukee central business district, one providing service between Timmerman Field to the northwest and the communities of St. Francis and Cudahy to the south, and the other terminating at the Mayfair Mall Shopping Center to the west. The third route would be a north-south crosstown route connecting Northridge and Southridge Shopping Centers and passing through the communities of Greendale, Greenfield, Milwaukee, and West Milwaukee. To make this plan comparable to the bus-on-freeway plan, a total of seven bus-on-freeway routes, representing an additional 432 route miles of primary service, would be added to serve the communities of Grafton, Port Washington, and Saukville in Ozaukee County and Bayside, River Hills, and Whitefish Bay in Milwaukee County to the north; the communities of Germantown in Washington County and Menomonee Falls in Waukesha County to the northwest; the communities of Brookfield, Elm Grove, Hartland, Nashotah, Oconomowoc, and Pewaukee in Waukesha County to the west; and the communities of Kenosha and Racine to the south. Frequency of Service—Headways on the light rail transit system would range from 4 to 10 minutes in the peak period and 30 to 60 minutes in the off-peak periods; bus-on-freeway service would be provided with headways ranging from 9 to 30 minutes in the peak period and 15 to 30 minutes in the off-peak periods. Operations—One-car trains would be provided on all three routes in both the peak and off-peak periods. Total vehicle miles per average weekday of primary service would increase by about 25 percent, from 19,880 miles under the maximum extent plan to 25,020 miles, of which 8,550 miles would be provided by light rail transit service and 16,470 miles by bus-on-freeway service. Bus miles of express and local service would increase somewhat, from 64,040 miles under the maximum extent plan to 69,090 miles under the composite plan. Transit Stations—A total of 108 transit stations or stops would be provided, of which 89 stations would be provided on the light rail transit system, and 19 stations on the bus-on-freeway system. Of the 108 stations, 15 would have park-ride lots for light rail transit and 18 would have park-ride lots for bus-on-freeway. A total of 92 stations would be located within Milwaukee County, of which 18 would have park-ride lots.
Composite Busway Plan	Extent of Service—Busway service would be provided over the same three routes as under the composite light rail transit plan. Also, the bus-on-freeway routes are the same as provided under the composite light rail transit plan.[a] Frequency of Service—Headways on the busway system would range from 4 to 10 minutes in the peak period and would be 60 minutes in the off-peak periods; bus-on-freeway service would be provided with headways ranging from 20 to 30 minutes in the peak period and 12 to 30 minutes in the off-peak periods. Operations—Total vehicle miles per average weekday of primary service would increase by about 26 percent—from 21,670 miles under the maximum extent plan to 27,390 miles, of which 9,700 miles would be provided by busway service and 17,690 miles by bus-on-freeway service. Bus miles of express and local service would increase by about 8 percent, from 66,390 miles to 71,690 miles. Transit Stations—The number and location of busway system stations and stops would be the same as under the composite light rail transit plan.

[a] *The design of the composite busway plan provided for certain bus-on-freeway routes to operate over the busway for a portion of their trips, if such routing would not provide a travel time disadvantage. Of the seven bus-on-freeway routes added to the plan, only two routes operating over the North-South Freeway (IH 43) and serving the communities of Bayside, Grafton, Port Washington, River Hills, and Whitefish Bay would meet this criterion. These routes would enter the busway at Locust Street and remain on the busway through downtown Milwaukee.*

Source: SEWRPC.

Map 122

COMPARABLE BUS-ON-FREEWAY AND COMMUTER RAIL ROUTES IN THE SOUTH CORRIDOR TO KENOSHA UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



In an effort to identify elements of the composite commuter rail system plan that may be superior to comparable elements of the truncated bus-on-freeway system plan, commuter rail and bus-on-freeway routes in the corridor between the Milwaukee central business district and the City of Kenosha were examined separately from the remainder of each of the primary transit systems. The bus-on-freeway service shown above is comprised of three routes totaling 163 round-trip route miles, and includes a total of seven stations located outside downtown Milwaukee, all of which would have park-ride lots. The commuter rail service shown above is comprised of 66 round-trip route miles operated over a single alignment of 33 miles in length, and includes a total of nine stations, six of which would have park-ride lots.

Source: SEWRPC.

either terminate or begin in the Milwaukee central business district. Under the bus-on-freeway service, 80 percent, or 10,960 trips, would have one trip end in the Milwaukee central business district, compared with 70 percent, or 6,920 trips, under the commuter rail service.

The net cost of operating and maintaining bus-on-freeway service in this corridor in the design year—that is, the required subsidy or the total operating and maintenance costs less farebox revenues—may be expected to be about $1.8 million, or 53 percent, less than that of the commuter rail service. The net operating and maintenance cost per passenger on the bus-on-freeway service would be about 33 percent that of the commuter rail service. The bus-on-freeway service would require, on the average, a subsidy of $0.46 per passenger, compared with $1.37 per passenger for the commuter rail service. The greater cost-effectiveness of the bus-on-freeway service is also indicated by the fact that it may be expected to recover about 22 percent more of its design year operating and maintenance costs from farebox revenues than the commuter rail service, 69 percent compared with 47 percent.

The capital investment required to provide primary transit service in this corridor, including the cost of all construction, right-of-way acquisition, and the acquisition and replacement of vehicles over the plan design period, would be about 33 percent, or about $7 million, higher for the commuter rail service than for the bus-on-freeway service, as shown in Table 300. The capital cost—that is, the capital investment less the value of the remaining life of the facilities and vehicles at the end of the 20-year plan design period—for the commuter rail service is also expected to be slightly more than that for the bus-on-freeway service in this corridor. The capital cost per passenger in the design year of the bus-on-freeway service would, however, be about 80 percent that of the commuter rail service. Accordingly, it was concluded that bus-on-freeway service would be superior to commuter rail service in this corridor, as it would attract substantially greater ridership and be more cost-effective.

It should be noted that some additional ridership on local and express transit service may be expected in this corridor under the commuter rail plan. Although the commuter rail service would carry 4,100 fewer primary transit trips on an average weekday in the design year than the bus-on-freeway service, some proportion of these trips may be expected to use the express and

Table 300

SUMMARY OF COMPARISON OF THE BUS-ON-FREEWAY AND COMMUTER RAIL ALTERNATIVES IN THE SOUTH CORRIDOR TO KENOSHA UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Evaluative Measure	Bus-on-Freeway Primary Element	Commuter Rail: Primary Element	Commuter Rail: Local and Express Element[a]	Commuter Rail: Total System
Ridership				
Average Weekday Passengers	13,900	9,800	2,300	12,100
Design Year Passengers	3,544,500	2,499,000	667,000	3,166,000
Capital Cost and Investment				
Total Capital Cost to Design Year	$17,158,600	$15,315,800[c]	$1,133,800	$16,449,600
Total Capital Investment to Design Year	30,103,800	37,136,000[c]	2,100,000	39,236,000
Operating Cost				
Operating Cost in Design Year	$ 5,253,000	$ 6,484,650	$ 617,300	$ 7,107,950
Percent of Operating Cost Met by Farebox Revenue in Design Year[b]	69	47	43	46
Net Operating Cost (deficit) in Design Year	1,628,400	3,424,600	350,300	3,774,900
Cost-Effectiveness				
Net Operating Cost per Passenger in Design Year	$0.46	$1.37	$0.52	$1.19
Capital Cost to Design Year per Passenger in Design Year	4.84	6.12	1.70	5.19

[a] *The local and express service ridership and costs in this table represent the additional local and express ridership and cost of the commuter rail plan over the bus-on-freeway plan in this corridor. Based on the traffic assignments attendant to the composite commuter rail plan under the moderate growth scenario-centralized land use plan alternative future, it has been assumed that, of the additional transit trips which would be made on the primary element under the bus-on-freeway plan, 57 percent would be made on the local and express element of the commuter rail plan under this future and, importantly, in the south corridor to Kenosha. It has also been assumed that the operating and capital costs of carrying these local and express transit trips would be based on the proportion of local and express transit trips in the corridor to the total local and express trips that would be expected under a composite commuter rail plan under this future.*

[b] *Fares under both the alternative plans are assumed to increase with general price inflation. The fare for local and express bus service under both plans would remain at $0.50 per ride, expressed in 1979 constant dollars. The primary service fare would remain at $0.60 within Milwaukee County, and would increase with distance from Milwaukee County to between $1.00 and $2.00 at the station at 14th Avenue and 54th Street in the City of Kenosha.*

[c] *The Milwaukee Road has proposed major track rehabilitation work on the railway route identified in this corridor for potential use by commuter rail trains. Should all this track rehabilitation work be completed, the total capital investment would be reduced by $0.9 million to $36.2 million in the Kenosha corridor. As of April 1981, such rehabilitation work had been completed on the Kenosha commuter rail route.*

Source: SEWRPC.

local, as opposed to the primary, transit services. As shown in Table 300, the fact that commuter rail would carry these additional transit trips on local and express transit services does not alter the conclusion that bus-on-freeway service is superior to commuter rail service in this corridor. While the substantial ridership and cost-effectiveness advantages of the bus-on-freeway services in the corridor are reduced somewhat when considering the express and local services as well as the primary services, the disadvantages of the commuter rail services with respect to higher capital cost and higher operating subsidy remain. Consequently, because commuter rail service would not provide an advantage over bus-on-freeway service in this corridor, the systemwide plan evaluation was limited to the bus-on-freeway, light rail, and busway technologies under this future.

Alternative Primary Transit Plan Evaluation and Comparison—Satisfaction of Objectives and Standards

The truncated bus-on-freeway and composite light rail and busway primary transit system plans were evaluated and compared by establishing the degree to which the plans could be expected to meet the adopted primary transit system development objectives.[12] This was determined by scaling each alternative plan against the standards formulated to relate the objectives to specific primary transit system development proposals. So that the evaluative information would be manageable, only those standards which were considered essential to a comparative evaluation of alternative plans and the subsequent selection of a "best" composite plan, were used, as shown in Table 167 in Chapter III of this report.

Table 301 provides a summary of the degree to which each alternative truncated system plan satisfies each of the key standards used and, therefore, the adopted objectives. Also included in the table is the measured attainment of the key standards by the base plan.

It should be noted that, while the primary transit facilities and services under each truncated plan were tested and evaluated in detail, and refined and improved to the maximum extent practicable, the local and express elements of each truncated plan were not. The local and express transit elements of each truncated plan provide the extent of such service recommended under the adopted long-range regional transportation system plan, with modifications made only as necessary to coordinate such service with the primary transit service under each alternative plan. The adopted long-range transportation system plan proposed expansion of local transit service into all areas of contiguous future urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County. Not all of this expanded service may be cost-effective under this alternative future, and such service may thus reduce the cost-effectiveness of the alternative truncated and composite primary transit system plans. Upon selection of a "best" composite plan, the cost-effectiveness of this expanded local and express transit service will be considered and its extent may be truncated, enabling a better comparison of the final primary transit plan to the base plan.

Objective 1—Serve Land Use: The first objective under this study identifies the need for an accessible primary transit system which, through its location, capacity, and design, will effectively serve existing, and promote sound future, land use development. This objective is measured by two standards. One standard measures the degree to which transit accessibility to the Milwaukee central business district is maximized. The other standard measures the degree to which transit accessibility in the Milwaukee area would support the regional land use plan by providing a higher relative accessibility to areas in which high-density development is planned than to areas planned for low-density development or planned to be protected from development.

The standard calling for maximizing transit accessibility to the Milwaukee central business district was measured by determining the overall travel time, including all access, wait, and transfer time, for transit trips to the Milwaukee central business district from all parts of the Milwaukee area, and the travel time for transit trips as an average for the entire Milwaukee area. The average overall travel times of transit trips to the central business district would be about the same for the three truncated or composite plans under this alternative future, ranging from 34 minutes for the light rail transit plan to 35 minutes for the bus-on-freeway and busway plans. The travel contour lines shown on Map 76 in Chapter III for the base plan and on Maps 123 through 125 for the bus-on-freeway, light rail transit, and busway plans indicate the overall transit travel times from each part of the Milwaukee area. Under the base system plan, the various travel time contours form a pattern of concentric rings centered on the Milwaukee central business district, with areas up to 2 miles away being within 20 minutes travel time. Areas up to only 7 miles away in a westerly direction, up to 9 miles away in a northerly direction, and up to 8 miles away in a southerly direction are within 40 minutes travel time. Areas up to 11 miles away in a westerly direction, 13 miles away in a northerly direction, and 10 miles away in a southerly direction are within 60 minutes travel time of downtown Milwaukee. These maps indicate that

[12] *See Chapter II of SEWRPC Planning Report No. 33, A Primary Transit System Plan for the Milwaukee Area.*

Table 301

SUMMARY OF EVALUATION OF THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Evaluative Measure	Base Plan	Alternative: Truncated Bus-on-Freeway Plan	Alternative: Composite Light Rail Transit Plan	Alternative: Composite Busway Plan
Objective No. 1—Serve Land Use				
Accessibility				
Average Overall Travel Time of Transit Trips to the Milwaukee Central Business District (minutes)	35	35	34	35
Objective No. 2—Minimize Cost and Energy Use				
Cost				
Total Public Cost to Design Year (capital cost and operating and maintenance deficit)	$542,926,400	$691,313,400	$862,822,200	$798,761,400
Average Annual Total Public Cost	25,853,600	32,919,700	41,086,800	38,036,200
Capital Cost[a] and Investment				
Capital Cost to Design Year	124,606,600	172,448,000	358,740,800	280,747,400
Average Annual Capital Cost	5,933,620	8,211,800	17,082,900	13,368,900
Capital Investment to Design Year	186,198,500	263,877,500	686,968,300	506,478,100
Average Annual Capital Investment	8,866,600	12,565,600	32,712,800	24,118,000
Operating and Maintenance Cost Deficit (net cost)				
Deficit in Design Year	21,625,900	34,194,100	32,346,100	34,088,300
Deficit to Design Year	418,319,800	518,865,400	504,081,400	518,014,000
Average Annual Deficit	19,919,950	24,707,900	24,003,900	24,667,300
Cost-Effectiveness				
Total Cost to Design Year per Passenger	0.44	0.54	0.68	0.63
Capital Cost to Design Year per Passenger	0.10	0.13	0.28	0.22
Operating Deficit to Design Year per Passenger	0.30	0.35	0.34	0.36
Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year				
Total Transit System	53	48	49	47
Primary Element	45	54	73	66
Energy				
Total Transit System Energy Use to Design Year (million BTU's)	16,407,170	19,368,060	21,435,230	20,788,590
Total Transit Construction Energy Use to Design Year (million BTU's)	1,220,540	1,527,960	3,432,030	3,173,490
Total Transit Operating and Maintenance Energy Use to Design Year (million BTU's)	15,186,630	17,840,100	18,003,200	17,615,100
Total Transit System Energy Use per Passenger Mile Traveled to Design Year (BTU's)	3,250	3,140	3,530	3,440
Total Transit Passenger Miles per Gallon of Diesel Fuel to Design Year (BTU's)	40.9	43.4	38.5	39.6
Dependence on Petroleum-Based Fuel	All trips dependent	All trips dependent	22 percent of transit trips not dependent	All trips dependent
Petroleum-Based Fuel Use by Transit to Design Year (gallons of diesel fuel)	108,687,720	126,769,340	115,355,000	124,767,210
Automobile Propulsion Energy Use in Design Year (gallons of gasoline)	449,600,000	440,800,000	440,800,000	440,800,000

Table 301 (continued)

Evaluative Measure	Alternative: Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Objective Nos. 3 and 5—Provide Appropriate Service and Quick Travel				
Average Weekday Transit Trips				
Total Transit System	217,400	242,100	239,600	238,300
Primary Element	10,300	37,300	83,200	75,500
Proportion of Transit Trips Using Primary Element	0.047	0.154	0.347	0.317
Service Coverage				
Population Served Within a One-Half-Mile Walking Distance of Primary Transit Service	234,200	228,400	394,700	394,700
Population Served Within a Three-Mile Driving Distance of Primary Transit Service	930,400	1,343,400	1,424,700	1,424,700
Jobs Served Within a One-Half-Mile Walking Distance of Primary Transit Service	190,500	206,400	329,000	329,000
Average Speed of Transit Vehicle (mph)				
Primary Element	23	29	25	24
Total System	15	17	17	17
Average Speed of Passenger Travel on Vehicle (mph)				
Primary Element	25	35	26	26
Total System	15	20	19	19
Objective No. 4—Minimize Environmental Impacts				
Community Disruption				
Homes, Businesses, or Industries Taken	None	None	None	None
Land Required (acres)	9	40	145	142
Air Pollutant Emissions—Total Transportation System (Highway and Transit) in Design Year (tons per year)				
Carbon Monoxide	189,027	185,602	185,523	185,732
Hydrocarbons	19,654	19,163	19,156	19,180
Nitrogen Oxides	34,294	33,615	33,646	33,641
Sulfur Oxides	2,656	2,688	2,844	2,688
Particulates	4,480	4,412	4,425	4,416
Objective No. 6—Maximize Safety				
Proportion of Total Person Trips Made on Transit	0.050	0.055	0.055	0.054

[a] *The capital cost of a composite plan is equal to the plan's required capital investment, or total capital outlays necessary over the plan design period, less the value of that investment beyond the plan design period.*

Source: SEWRPC.

transit accessibility to the central business district would be greater under all the truncated and composite plans than under the base plan

The attainment of the other standard under this objective, which calls for adjusting transit accessibility to land use plans, was measured by comparing these contours of central business district transit accessibility to the regional land use plan.[13] The Milwaukee central business district is the most important trip generator in the Milwaukee area, and would, under this alternative future, remain so,

[13] *The regional land use plan recommends a highly centralized land use development pattern. Population and jobs are proposed to be reconcentrated in central Milwaukee County, and new urban development is proposed to occur principally at urban densities along and contiguous to the periphery of existing urban centers (see SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume Two, Alternative and Recommended Plans).*

accounting for over 6 percent of the approximately 4.4 million trips occurring within the Milwaukee area on an average weekday. It would also be the most important transit trip generator, accounting for about 27 percent of the average weekday transit trips under each alternative truncated or composite system plan. As shown on Map 76 in Chapter III and on Maps 123 through 125, all the plans would generally support the adopted regional land use plan.

Objective 2—Cost and Energy: The second objective concerns achievement of a primary transit system which is economical and efficient, satisfying all other objectives at the lowest possible cost. This objective is supported by key standards relating to the minimization of costs and energy consumption, and the maximization of cost-effectiveness. As shown in Table 301, of the three alternative truncated and composite primary transit system plans, the plan with the lowest total cost to the design year under this future, including all capital and net operating and maintenance costs, is the truncated bus-on-freeway plan, which has an estimated total cost of $691 million. The busway plan follows with a total cost of about $799 million, and the most costly plan would be the light rail transit plan, with an estimated total cost of $863 million.

The principal reason for the difference in the costs between the plans is capital cost—that is, the capital investment over the plan design period less the value of the remaining life of the facilities and vehicles at the end of the 20-year plan design period. The capital cost of the light rail transit plan is more than twice that of the bus-on-freeway plan, and the capital cost of the busway plan is over 60 percent more than that of the bus-on-freeway plan. In terms of the total capital investment which would be required over the plan design period, the bus-on-freeway alternative requires less than one-half the investment of the light rail transit and busway plans. The bus-on-freeway plan would require an outlay of about $264 million, while the busway plan would require $506 million and the light rail transit plan would require about $687 million, as shown in Table 302. The light rail transit and busway system plans, however, would be expected to provide an annual net operating and maintenance cost advantage over the bus-on-freeway plan. In the design year, the light rail transit plan would require $1.9 million, or 6 percent, less subsidy than the bus-on-freeway plan. The busway plan would require about $106,000, or less than 1 percent, less subsidy than the bus-on-freeway plan.

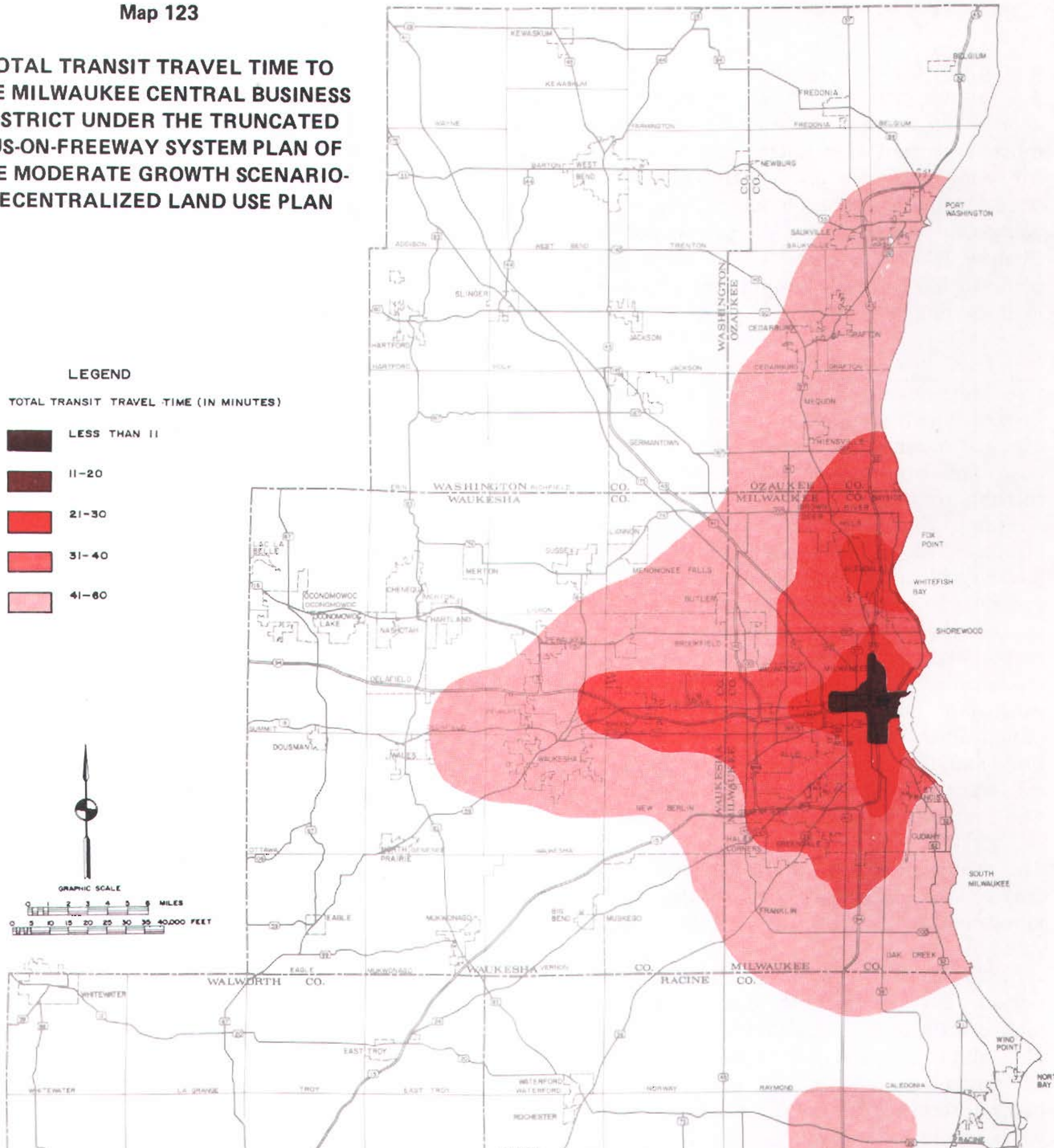
In terms of the cost-effectiveness of the alternative truncated and composite primary transit plans, the total cost per passenger to the design year of the busway plan is about 7 percent lower than under the light rail transit plan, $0.63 per passenger compared with $0.68 per passenger. The total cost per passenger of the bus-on-freeway plan, estimated at $0.54, is somewhat lower than those of the light rail transit and busway plans. The reason for this difference in total cost per passenger between the truncated plans is again the high capital costs of the light rail transit and busway plans. The capital cost per passenger of the light rail transit plan is more than double that of the bus-on-freeway plan, and the capital cost per passenger of the busway plan is about 70 percent greater than that of the bus-on-freeway plan. There is very little difference in the net operating costs per passenger to, or in, the design year between the three truncated plans, as shown in Tables 301 and 303. The light rail transit plan has the lowest net operating cost per passenger over the design period, $0.34, and the busway plan has the highest, $0.36.

Estimates of the total amount of energy that would be used in the implementation of the truncated and composite primary transit plans under this alternative future are set forth in Tables 301 and 304. Over the 20-year design period, the bus-on-freeway plan would consume the least amount of energy, 19,368 billion British Thermal Units (BTU's). The total energy consumption under the busway and light rail transit plans would be expected to be only slightly greater, 20,788 billion BTU's and 21,435 billion BTU's, respectively. The energy consumed per passenger mile traveled would also be the lowest under the bus-on-freeway plan, estimated at 3,140 BTU's, compared with 3,440 and 3,530 BTU's under the composite busway and light rail transit plans, respectively.

The energy used for construction under each plan would be minimal compared to the energy required for operation. Of the three plans, the bus-on-freeway plan would require the least energy for construction—8 percent of the total energy consumption under the plan. Both the light rail transit and busway plans would use 16 percent of the total plan energy for construction. The bus-on-freeway plan would require the most energy for operation, 18,003 billion BTU's to the design year 2000, while the busway plan would require the least, 17,615 billion BTU's. The light rail transit plan would require the least petroleum energy for vehicle propulsion, between 7 and 9 percent less than the other plans, since most of the transit trips made on the primary element of this plan would be

Map 123

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN OF THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

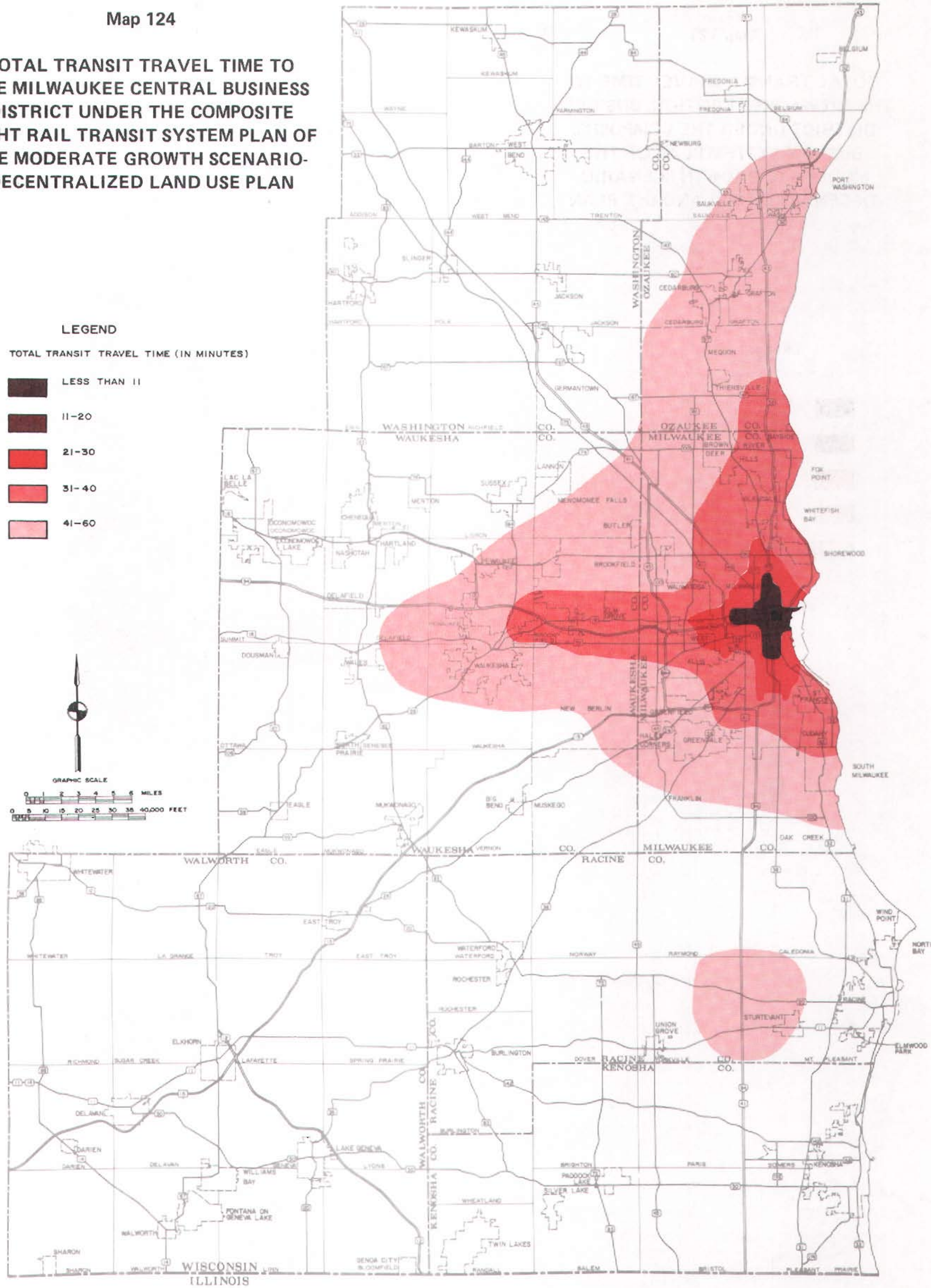


One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the truncated bus-on-freeway plan, the various travel time contours form a disconnected lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south. Areas up to 2 miles away are within 20 minutes travel time, and areas up to 13 miles in a northerly direction, up to 15 miles in a westerly direction, and up to 10 miles in a southerly direction are within 40 minutes travel time of downtown Milwaukee. Areas within 60 minutes travel time extend as far as 27 miles to the north, as far as 22 miles to the west, and as far as 25 miles to the south of downtown Milwaukee.

Source: SEWRPC.

Map 124

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE COMPOSITE LIGHT RAIL TRANSIT SYSTEM PLAN OF THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

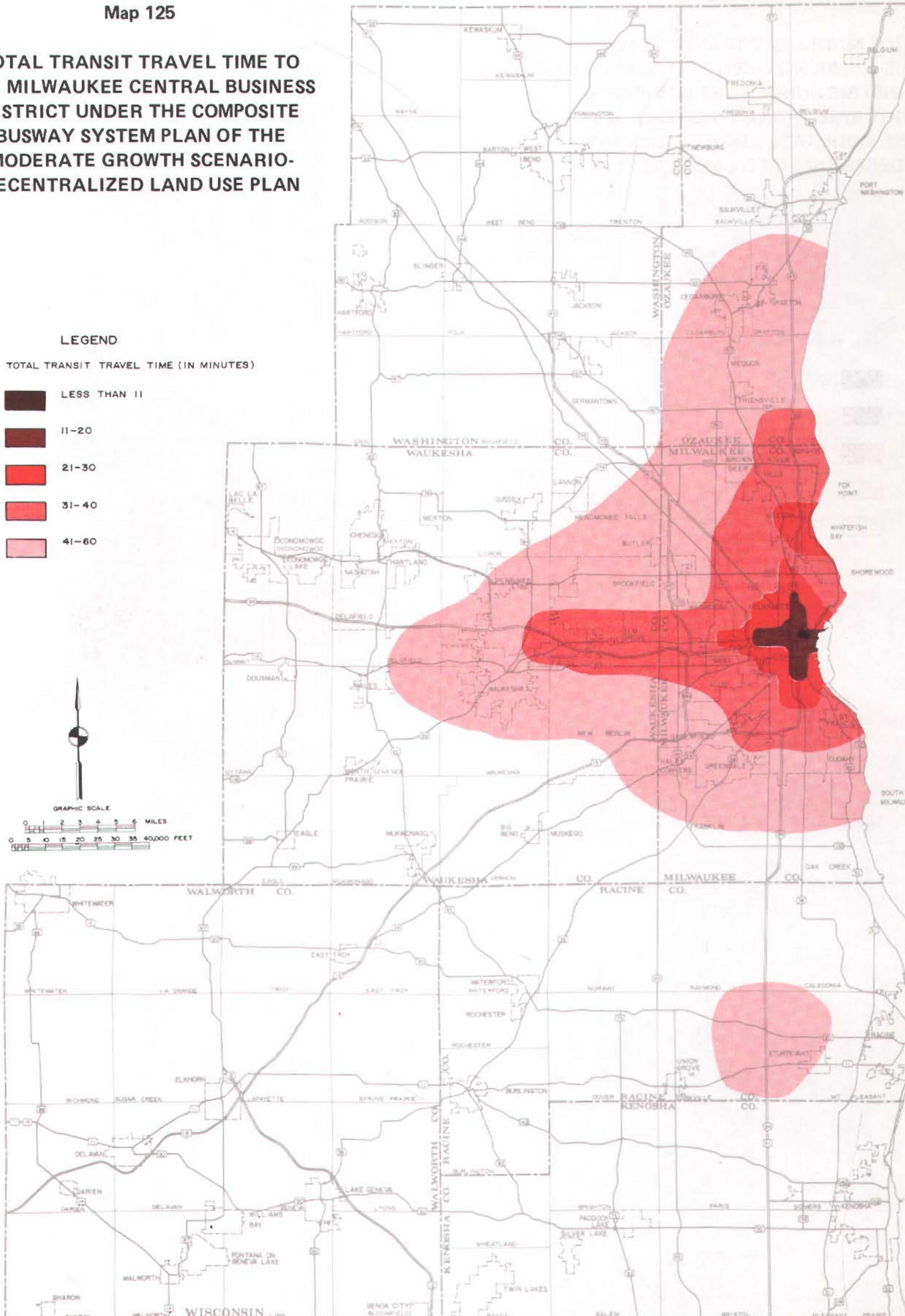


One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the composite light rail transit plan, the various travel time contours form a disconnected lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south, with areas that are up to 2 miles from downtown being within 20 minutes travel time. Areas within 40 minutes travel time extend only 7 miles to the south, but extend up to 13 miles to the north and 15 miles to the west. Areas up to 26 miles in a northerly direction, 22 miles in a westerly direction, and 25 miles in a southerly direction are within 60 minutes travel time of downtown Milwaukee.

Source: SEWRPC.

Map 125

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE COMPOSITE BUSWAY SYSTEM PLAN OF THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN



One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the composite busway system plan, the various travel time contours form a disconnected lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south, with areas that are up to 2 miles from downtown being within 20 minutes travel time. Areas within 40 minutes travel time extend only 7 miles to the south, but 12 miles to the north and 15 miles to the west. Areas up to 21 miles in a northerly direction, 22 miles in a westerly direction, and 24 miles in a southerly direction are within 60 minutes travel time of downtown Milwaukee.

Source: SEWRPC.

Table 302

TOTAL CAPITAL INVESTMENT TO DESIGN YEAR REQUIRED UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Capital Cost Element[a]	Alternative			
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Guideway Development[b]	$ --	$ 14,326,000	$380,284,200	$242,984,200
Station Development[c]	2,468,500	11,406,500	33,398,900	31,237,900
Vehicle Storage and Maintenance Facility Development	18,950,000	22,125,000	34,905,200	21,316,000
Vehicle Acquisition and Replacement[d]	164,780,000	216,020,000	238,380,000	210,940,000
Total	$186,198,500	$263,877,500	$686,968,300	$506,478,100

[a] *It is assumed under this capital cost analysis that the base plan and the alternative truncated and composite primary transit plans would be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 through 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes the cost of acquiring about 70 acres of right-of-way for guideway construction for the light rail transit and busway system plans. The land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years. Also includes the implementation cost of the proposed freeway operational control system in the Milwaukee area, which has a useful life of 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—9 acres under the base plan, 75 acres under the light rail transit plan, 72 acres under the busway system plan, and 40 acres under the bus-on-freeway plan. This land is assumed to have a useful life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement, as necessary, over the 20-year design period of all buses and light rail vehicles used in all elements of the system. All alternative plans under this future are assumed to utilize the entire existing fleet of 640 motor buses, which—in 1980—are assumed to have an average age of 10 years each. Buses are assumed to have an average useful life of 12 years. Light rail vehicles have an estimated useful life of 30 years.*

Source: SEWRPC.

made on electrically propelled vehicles, as opposed to diesel motor buses. Under the the light rail transit plan, more than 22 percent of the transit trips occur on the primary element.[14]

The energy which may be expected to be used in highway travel by automobiles in the plan design year is also expected to be about the same under all three truncated or composite plans, as shown in Table 305. More than 30 times more energy would be used in the plan design year for automobile travel than for transit under this future. Consequently, any petroleum savings of a light rail transit system would represent less than 1 percent of the energy required by the total transportation system, including travel by automobiles.

[14] *Implementation of a light rail transit system in the Milwaukee area can be expected to have an insignificant impact upon existing and future electric power generating requirements within southeastern Wisconsin. Light rail transit system operation can be expected to result in a very small increase in peak demand as well as a negligible increase in total annual power consumption based upon the capacity of the 1980 electric power generating system, and the expanded electric power generating system necessary for other reasons by the plan design year.*

(footnote continued on next page)

Objectives 3 and 5—Provision of Adequate Level of Service and Provision for Quick and Convenient Travel: Two of the primary transit system development objectives can be considered together for this evaluation: Objective No. 3, which calls for a transit system which provides an adequate level of service, and Objective No. 5, which calls for a primary transit system which provides for quick and convenient travel. These two objectives are supported by three key standards: level of transit ridership, number of residents and jobs served, and transit trip speed. The remaining standards under these two objectives either have all been met in the design of the alternative plans or could be met by all the plans if properly implemented.

Of all the standards under these two objectives, the level of transit ridership best represents the level of transit service provided by alternative transit plans. Total transit system ridership under the alternative plans is expected to differ by only 2 percent, ranging from a low of 238,300 trips on an average weekday under the busway plan, to 239,600 trips per average weekday under the light rail transit plan, to a high of 242,100 trips per average weekday under the bus-on-freeway plan. However, significant differences are expected in the number and proportion of trips made on the primary element of the alternative transit system plans. As shown in Tables 306 and 307, the proportion of transit trips made on the primary element is expected to be the highest under the composite light rail transit plan, over 35 percent of the total 239,600 transit trips made on an average weekday under this plan, or 83,200 trips. The second highest primary transit ridership under this future would be on the composite busway plan—about 75,500 trips, or 32 percent of the total transit ridership. The primary element of the bus-on-freeway plan would carry 37,300 trips, or 15 percent of total transit system ridership. Because the total transit system ridership does not vary significantly among the three truncated and composite plans, it can be concluded that the substantial additional ridership on the primary element of the light rail transit and busway plans is comprised of trips which would be expected to use local or express transit services under the bus-on-freeway plan. This assumption is reasonable given the small travel time advantages expected under the light rail transit and busway plans. Express and local services under all the plans are expected to average 17 and 15 mph, respectively, compared with 20 mph under the light rail transit primary element and 18 mph under the busway primary element. These express and local service speeds are about the same as those achieved on the existing transit system, which is to be expected since little additional street and highway traffic congestion is anticipated in the Milwaukee area under this alternative future.

With respect to the standard calling for maximizing the number of jobs and resident population served, the primary elements of the composite

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(footnote 14 continued)

Electric power for the Milwaukee area is supplied by the Wisconsin Electric Power Company (WEPCo), which currently relies on coal-fired power plants for generating more than 95 percent of its electricity. Nuclear power plants provide the remaining electricity generated by WEPCo. According to data acquired by WEPCo in order to plan for future power generation capacity in southeastern Wisconsin, the instantaneous peak demand within the WEPCo service area was 3.3 million kilowatts during the summer season of 1980 and 3.0 million kilowatts during the winter season of 1980. By the year 2000, these peak demands are expected by WEPCo to increase by 40 to 70 percent. The instantaneous peak may be expected to occur between 12:00 p.m. and 4:00 p.m. in the summer and between 5:00 p.m. and 7:00 p.m. in the winter.

The peak power demand for vehicle propulsion for this composite light rail transit system would be approximately 37.0 megawatts during the plan design year 2000. This represents about 1.2 percent of the WEPCo 1980 actual summer and winter peak demands, and less than 1.2 percent of the WEPCo forecast year 2000 peak demands.

The WEPCo also estimates that annual electrical energy use during 1980 totaled 18,701 gigawatt-hours within the WEPCo service area. The total power consumption for vehicle propulsion on the light rail transit system would be approximately 54 million kilowatt-hours during the design year, or substantially less than 1 percent of the estimated total energy consumption for the WEPCo service area in 1980. Electricity necessary for the operation of a light rail transit system is likely to represent an even smaller percentage during the plan design year, since the total amount of power consumption in southeastern Wisconsin is expected by WEPCo to increase by 70 percent by the year 2000.

Table 303

PRIMARY AND TOTAL TRANSIT SYSTEM OPERATING AND MAINTENANCE COSTS IN THE DESIGN YEAR FOR THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

	Alternative			
Cost Element	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Ridership				
Primary Element	2,626,500	9,511,500	21,216,000	19,252,500
Total System	62,685,500	68,903,500	66,572,000	66,464,500
Operating and Maintenance Cost				
Primary Element	$ 3,464,400	$13,527,500	$17,712,300	$17,625,000
Total System	46,323,500	65,577,300	63,394,600	65,026,400
Operating and Maintenance Cost per Passenger				
Primary Element	$1.32	$1.42	$0.83	$0.92
Total System	0.74	0.96	0.95	0.98
Operating and Maintenance Cost per Passenger Mile				
Primary Element	$0.16	$0.09	$0.08	$0.09
Total System	0.17	0.15	0.15	0.16
Farebox Revenue				
Primary Element	$ 1,575,900	$ 7,372,100	$12,859,700	$11,996,500
Total System	24,697,600	31,383,200	31,048,500	30,938,100
Operating Deficit				
Primary Element	$ 1,888,500	$ 6,155,400	$ 4,852,600	$ 5,628,500
Total System	21,625,900	34,194,100	32,346,100	34,088,300
Operating Deficit per Passenger				
Primary Element	$0.72	$0.65	$0.23	$0.29
Total System	0.34	0.50	0.48	0.51
Farebox Revenue as a Percent of Operating and Maintenance Costs				
Primary	45	54	73	68
Total System	53	48	49	48
Public Funding Under Current Program[a]				
Federal (50 percent of operating deficit)				
Primary Element	$ 944,250	$ 3,077,700	$ 2,426,300	$ 2,814,250
Total System	10,812,950	17,097,050	16,173,050	17,044,150
State (72 percent of nonfederal share of operating deficit)				
Primary Element	679,860	2,215,940	1,746,940	2,026,260
Total System	7,785,320	12,309,880	11,644,600	12,271,788
Local				
Primary Element	264,390	861,760	679,360	787,990
Total System	3,027,630	4,787,170	4,528,450	4,772,362
Local Operating Deficit per Ride				
Primary Element	$0.10	$0.09	$0.03	$0.04
Total System	0.05	0.07	0.07	0.07

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $10.8 million required under the base plan, but substantially less than the $17.1 million required under the maximum extent bus-on-freeway plan, the $16.2 million required under the maximum extent light rail transit plan, and the $17.0 million required under the maximum extent busway plan. These amounts of public funding for the respective primary transit system plans would provide 50 percent of federal funding of the operating deficits. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

Table 304

COMPARISON OF TOTAL TRANSIT ENERGY REQUIREMENTS UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Energy Element	Alternative: Base Plan	Alternative: Truncated Bus-on-Freeway Plan	Alternative: Composite Light Rail Transit Plan	Alternative: Composite Busway Plan
Primary Transit Element				
Operating and Maintenance Energy to Design Year (million BTU's)				
Vehicle Propulsion Energy	838,970	2,068,740	3,111,420	2,474,340
Petroleum Fuel Consumed	838,970	2,068,740	1,431,220	2,474,340
Nonpetroleum Fuel Consumed	- -	- -	1,680,200	- -
Station Operation and Maintenance Energy	51,630	109,450	126,700	130,920
Vehicle Maintenance Energy	23,230	71,150	89,110	85,100
Total Operating and Maintenance Energy	913,830	2,249,340	3,327,230	2,690,360
Total System Construction Energy to Design Year (million BTU's)				
Guideway Construction	- -	- -	1,753,560	1,695,000
Vehicle Manufacture	109,140	321,300	628,890	408,510
Total Construction Energy	109,140	321,300	2,382,450	2,103,510
Total System				
Operating and Maintenance Energy to Design Year (million BTU's)				
Vehicle Propulsion Energy	14,781,530	17,240,630	17,368,480	16,968,340
Petroleum Fuel Consumed	14,781,530	17,240,630	15,688,280	16,968,340
Nonpetroleum Fuel Consumed	- -	- -	1,680,200	- -
Station Operation and Maintenance Energy	51,630	109,450	126,700	130,920
Vehicle Maintenance Energy	353,470	490,020	508,020	515,840
Total Operating and Maintenance Energy	15,186,630	17,840,100	18,003,200	17,615,100
Total System Construction Energy to Design Year (million BTU's)				
Guideway Construction	- -	- -	1,753,560	1,695,000
Vehicle Manufacture	1,220,540	1,527,960	1,678,470	1,478,490
Total Construction Energy	1,220,540	1,527,960	3,432,030	3,173,490

Source: SEWRPC.

light rail transit and busway plans would serve the greatest number of residents, about 1.4 million, within a three-mile driving distance of primary transit service, while the primary element of the bus-on-freeway plan would be accessible by driving to about 1.3 million residents. The light rail transit and busway plans would also provide the greatest accessibility to residents within walking distance of primary transit stations and stops—about 394,700 residents, compared with 228,400 residents under the bus-on-freeway plan. Employment served within walking distance would also be greatest under the light rail transit and busway plans, 329,000 jobs compared with 206,400 jobs for the bus-on-freeway plan. All the additional residents and jobs within walking distance of primary transit under the light rail transit and busway plans would be located within the portions of Milwaukee County planned for urban development under the regional land use plan.

Table 305

COMPARISON OF DESIGN YEAR AUTOMOBILE TRAVEL AND ENERGY CONSUMPTION UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Alternative	Automobile Vehicle Miles Traveled in the Design Year (billions)	Automobile Energy Consumption in the Design Year (million BTU's)
Base Plan.	10.04	56,200,000
Truncated Bus-on-Freeway Plan.	9.71	55,100,000
Composite Light Rail Transit Plan	9.72	55,100,000
Composite Busway Plan	9.74	55,200,000

Source: SEWRPC.

The truncated and composite plans are only slightly different with respect to the standard relating to the average speed provided by primary transit. The average vehicle speeds on the primary transit elements of the plans are expected to range from a low of 24 mph under the composite busway plan to 25 mph under the composite light rail transit plan, and to a high of 29 mph under the truncated bus-on-freeway plan. The average vehicle speed on all elements—primary, express, and local—of all of the plans would be expected to be about 17 mph. The average speeds of passenger travel on the primary transit vehicles would range from a high of 35 mph under the bus-on-freeway plan, to 26 mph under the light rail transit and busway plans. Average speeds of passenger travel on vehicles of all service elements of the truncated and composite plans would range from a high of 20 mph under the bus-on-freeway plan to 19 mph under the light rail transit and busway plans. Average speeds of passenger travel are generally higher than vehicle speeds because passengers are typically concentrated on the transit facilities and services of highest speed.

Table 306

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Trip Purpose	Alternative					
	Base Plan			Truncated Bus-on-Freeway Plan		
	Total Person Trips	Transit Trips: Number	Transit Trips: Percent of Total Trips	Total Person Trips	Transit Trips: Number	Transit Trips: Percent of Total Trips
Home-Based Work	1,061,500	57,500	5.4	1,059,600	64,000	6.0
Home-Based Shopping . .	627,900	33,100	5.3	627,500	36,800	5.9
Home-Based Other	1,464,800	67,300	4.6	1,462,600	81,300	5.6
Nonhome Based.	778,800	13,700	1.8	776,600	14,200	1.8
School	454,200	45,800	10.0	454,200	45,800	10.1
Total	4,387,200	217,400	5.0	4,380,500	242,100	5.5

Trip Purpose	Alternative					
	Composite Light Rail Transit Plan			Composite Busway Plan		
	Total Person Trips	Transit Trips: Number	Transit Trips: Percent of Total Trips	Total Person Trips	Transit Trips: Number	Transit Trips: Percent of Total Trips
Home-Based Work	1,059,000	65,300	6.2	1,059,600	64,600	6.1
Home-Based Shopping . .	626,800	36,100	5.8	627,100	35,900	5.7
Home-Based Other	1,460,100	78,500	5.4	1,461,100	78,100	5.3
Nonhome Based.	775,500	13,900	1.8	775,900	13,900	1.8
School	454,200	45,800	10.1	454,200	45,800	10.1
Total	4,375,600	239,600	5.5	4,377,900	238,300	5.4

Source: SEWRPC.

Objective 4—Environmental and Resource Disruption: The fourth objective is to minimize the disruption of existing neighborhood and community development and to minimize deterioration of the natural resource base. This objective is supported by key standards relating to community disruption and air quality.

In terms of community disruption, none of the three alternative truncated or composite primary transit system plans would require the taking of any homes, businesses, or industries. They would, however, require the acquisition of right-of-way for guideway, stations, and maintenance and storage facilities. Of the three truncated and composite primary transit alternatives, both the light rail transit and busway system plans would require the acquisition of more than 140 acres of land, compared with 40 acres under the truncated bus-on-freeway plan.

Tables 301 and 308 set forth the levels of highway and transit air pollutant emissions anticipated under each of the alternative truncated and composite primary transit system plans under this alternative future. All three alternative plans are expected to have similar levels of total transportation system carbon monoxide, hydrocarbon, particulate matter, and nitrogen oxide air pollutant emissions. Transportation-related sulfur oxide emissions are expected to be about 6 percent higher under the light rail transit plan. However, this difference in sulfur oxide emissions represents a difference of less than one-tenth of 1 percent when considered in the context of the total air pollutant emissions forecast from all air pollutant sources in the Region.

Objective 6—Safety: The sixth transportation objective relates to the reduction of accident exposure and the provision of increased travel safety. This

Table 307

PRIMARY AND TOTAL TRANSIT TRIPMAKING BY TIME OF DAY UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

	Alternative							
	Base Plan				Truncated Bus-on-Freeway Plan			
	Primary Element		Total System		Primary Element		Total System	
Time of Day	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,300	41.7	46,900	21.6	8,000	21.4	50,900	21.0
Midday	400	3.9	75,900	34.9	11,200	30.0	85,500	35.3
Afternoon . .	5,600	54.4	74,900	34.4	14,400	38.6	82,700	34.2
Evening. . . .	- -	- -	19,700	9.1	3,700	10.0	23,000	9.5
Total	10,300	100.0	217,400	100.0	37,300	100.0	242,100	100.0

	Alternative							
	Composite Light Rail Transit Plan				Composite Busway Plan			
	Primary Element		Total System		Primary Element		Total System	
Time of Day	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	20,000	24.0	51,100	21.3	18,300	24.2	50,800	21.3
Midday	23,300	28.0	83,900	35.0	20,800	27.5	83,400	35.1
Afternoon . .	33,200	40.0	82,100	34.3	30,200	40.0	81,600	34.2
Evening. . . .	6,700	8.0	22,500	9.4	6,200	8.3	22,400	9.4
Total	83,200	100.0	239,600	100.0	75,500	100.0	238,300	100.0

Source: SEWRPC.

Table 308

COMPARISON OF DESIGN YEAR AIR POLLUTANT EMISSIONS OF THE TRANSIT AND HIGHWAY SYSTEM UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Air Pollutant	Alternative			
	Base Plan (tons per year)	Truncated Bus-on-Freeway Plan (tons per year)	Composite Light Rail Transit Plan (tons per year)	Composite Busway Plan (tons per year)
Primary Element				
Carbon Monoxide	48	128	89	182
Hydrocarbons	5	14	10	20
Nitrogen Oxides	11	33	69	42
Sulfur Oxides	6	20	183	24
Particulate Matter	4	11	26	14
Total Transit System				
Carbon Monoxide	803	1,044	893	1,016
Hydrocarbons	80	105	90	103
Nitrogen Oxides	139	189	206	184
Sulfur Oxides	64	90	245	88
Particulate Matter	37	51	62	51
Total Transportation System				
Carbon Monoxide	189,027	185,602	185,523	185,732
Hydrocarbons	19,654	19,163	19,156	19,180
Nitrogen Oxides	34,294	33,615	33,646	33,641
Sulfur Oxides	2,656	2,688	2,844	2,688
Particulate Matter	4,480	4,412	4,425	4,416

Source: SEWRPC.

objective is supported by two key standards, one measuring the degree to which travel by transit is maximized and the other measuring the degree to which travel on exclusive guideway transit is maximized. Travel by transit is safer than travel by automobile, and travel on exclusive guideway transit is the safest travel by transit because of the lack of conflicts with pedestrian or vehicle traffic.

As indicated in Table 301, the three truncated plans would differ only slightly with respect to travel safety. The proportion of total person trips using transit is about the same under the three truncated and composite plans, and none of the alternatives utilizes fully exclusive guideways with grade separation of all crossing vehicle and pedestrian traffic.

Summary

The comparative evaluation of the alternative truncated or composite primary transit system plans—bus-on-freeway, busway, and light rail transit—indicated that, under the moderate growth scenario-decentralized land use plan alternative future, all the systems may be expected to provide a reasonably comparable high level of primary transit service in the Milwaukee area in the plan design year. As indicated in Table 309, the alternative systems were found to be quite similar with respect to total ridership, public subsidy required, and operating cost-effectiveness. Each system may be expected to attract about the same level of total transit ridership in the area, varying by no more than 3,800 trips, or by about 2 percent, on an average weekday in the plan design year. Also, each system may be expected to entail a similar annual operating and maintenance cost deficit, varying by no more than $2.3 million, or 7 percent, in the plan design year. And, each plan may be expected to recover a similar proportion of the operating and maintenance costs from farebox revenues, between 47 and 49 percent.

Several significant differences between the plans, however, were also revealed by the comparative evaluation. The largest difference was in the capi-

Table 309

KEY DIFFERENCES BETWEEN THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Evaluative Measure	Alternative			
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Objective No. 2—Minimize Cost and Energy Use				
Cost				
Total Public Cost to Design Year (capital cost and operating and maintenance deficit)	$542,926,370	$691,313,400	$862,822,200	$798,761,400
Average Annual Total Public Cost	25,853,600	32,919,700	41,086,800	38,036,200
Capital Cost[a] and Investment				
Capital Cost to Design Year	124,606,570	172,448,000	358,740,800	280,747,400
Average Annual Capital Cost	5,933,620	8,211,800	17,082,900	13,368,900
Capital Investment to Design Year	186,198,500	263,877,500	686,968,300	506,478,100
Average Annual Capital Investment	8,866,600	12,565,600	32,712,800	24,118,000
Operating and Maintenance Cost Deficit (net cost)				
Deficit in Design Year	21,625,900	34,194,100	32,346,100	34,088,300
Deficit to Design Year	418,319,800	518,865,400	504,081,400	518,014,000
Average Annual Deficit	19,919,950	24,707,900	24,003,900	24,667,300
Cost-Effectiveness				
Total Cost to Design Year per Passenger	0.44	0.54	0.68	0.63
Capital Cost to Design Year per Passenger	0.10	0.13	0.28	0.22
Operating Deficit to Design Year per Passenger	0.30	0.35	0.34	0.36
Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year				
Total Transit System	53	48	49	47
Primary Element	45	54	73	66
Energy				
Dependence on Petroleum-Based Fuel	All trips dependent	All trips dependent	22 percent of transit trips not dependent	All trips dependent
Petroleum-Based Fuel Use by Public Transit to Design Year (gallons of diesel fuel)	108,687,720	126,769,340	115,355,000	124,767,210
Objective Nos. 3 and 5—Provide Appropriate Service and Quick Travel				
Average Weekday Transit Trips				
Total Transit System	217,400	242,100	239,600	238,300
Primary Element	10,300	37,300	83,200	75,500
Service Coverage				
Population Served Within a One-Half-Mile Walking Distance of Primary Transit Service	234,200	228,400	394,700	394,700
Population Served Within a Three-Mile Driving Distance of Primary Transit Service	930,400	1,343,400	1,424,700	1,424,700
Jobs Served Within a One-Half-Mile Walking Distance of Primary Transit Service	190,500	206,400	329,000	329,000
Average Speed of Transit Vehicle (mph)				
Primary Element	23	29	25	24
Total System	15	17	17	17
Average Speed of Passenger Travel on Vehicle (mph)				
Primary Element	25	35	26	26
Total System	15	20	20	19
Objective No. 4—Minimize Environmental Impacts				
Community Disruption				
Land Required (acres)	9	40	145	142

[a] *The capital cost of a composite plan is equal to the plan's required capital investment, or total capital outlays necessary over the plan design period, less the value of that investment beyond the plan design period.*

Source: SEWRPC.

tal cost attendant to the plans, which ranged from a low of about $172 million for the bus-on-freeway plan to a high of $358 million for the composite light rail transit plan. Other differences noted included the degree of accessibility to jobs and resident population, the amount of ridership on the primary element, and the degree of use of, and dependence on, petroleum-based fuel (see Table 309).

Because this evaluative information does not clearly identify the best of the alternative composite plans under this alternative future, the key advantages and disadvantages of the alternative plans were comparatively analyzed. This analysis was done by arranging the alternative plans in order of increasing total cost over the plan design period, and performing successive comparisons of pairs of the plans beginning with a comparison of the plan of lowest total cost—the truncated bus-on-freeway plan—and the next least costly plan—the composite busway plan. The plan of this pair which was determined to be better on a system-wide basis was then compared to the most costly plan—the composite light rail transit plan—and the best system plan so identified. This successive comparison of alternative plans is not unlike incremental economic plan evaluation techniques, which have long been used to establish whether the marginal benefits of alternative plans exceed their additional costs over the cost of other alternative plans.

Comparison of Composite Busway and Truncated Bus-on-Freeway Plans: The composite busway plan would entail $107.5 million, or 16 percent, more total cost over the plan design period than the truncated bus-on-freeway plan. However, it would have a number of advantages over the bus-on-freeway plan. The most significant of these advantages, as listed in Table 310, would be the greater accessibility provided to jobs and residents in the Milwaukee area and the greater number of transit trips made on the primary element of the transit system. About 73 percent, or 166,300, more people, and 59 percent, or 122,600, more jobs, all within Milwaukee County, may be expected to be within walking distance of primary transit facilities under the composite busway plan. Nearly 38,200, or 100 percent, more transit trips may be expected to be made on the primary element of the busway plan. All these additional trips made on the primary element of the composite busway plan may be expected to be made under the bus-on-freeway plan as well, but on the local and express elements of that plan. These transit trips would, therefore, receive a lower level of service, averaging about three mph slower over the vehicle portion of the trips and requiring an average of three more minutes per transit trip. However, because the bus-on-freeway plan would provide a much faster primary element than the busway plan, overall transit travel would be about one mph faster on the vehicle portion of the trip under the bus-on-freeway plan, saving about one minute per transit trip.

One other advantage of the composite busway plan is that, at the end of the plan design period, it would be more efficient than the truncated bus-on-freeway plan with respect to the proportion of operating and maintenance costs recovered from farebox revenues on the primary element of the system. The primary element of the busway plan may be expected to recover nearly 12 percent more of its operating costs from farebox revenues in the plan design year.

These operating and maintenance cost efficiencies, however, are offset by the principal disadvantage of the busway plan, its additional capital costs. The busway plan would entail $108.3 million, or 63 percent, more capital costs over the plan design period than the bus-on-freeway plan, and would require $243 million, or 92 percent, more capital investment over the plan design period. Thus, the total cost of the busway plan would be more than $107 million, or 16 percent, more than that of the bus-on-freeway plan. Also, the total cost per passenger of the busway plan over the plan design period would be $0.09, or 17 percent, more than that of the bus-on-freeway plan. In addition, the bus-on-freeway plan may be expected to attract 3,800, or 2 percent, more transit trips from auto mobiles than the busway plan on an average weekday in the plan design period. Nearly all this additional transit tripmaking would consist of trips to and from the Milwaukee central business district. Increased use of transit to the central business district may be expected under the bus-on-freeway plan because its service to the central business district would be faster, operating directly from outlying areas with no or few intermediate stops.

The disadvantages of the busway plan outweigh its advantages over the bus-on-freeway plan. Although the primary element of the busway plan would require less operating subsidy than the primary element of the bus-on-freeway plan, its capital cost would offset this advantage. Moreover, the bus-on-freeway plan may be expected to divert slightly

Table 310

KEY ADVANTAGES AND DISADVANTAGES OF THE COMPOSITE BUSWAY SYSTEM PLAN IN COMPARISON TO THE TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Factor	Advantage	Disadvantage
Cost	Primary element revenues recover 12 percent more operating costs in design year	$107.5 million, or 16 percent, more total cost over plan design period $108.3 million, or 63 percent, more capital cost—that is, the capital investment less the value of the remaining life of the facilities at the end of the 20-year plan design period $242.6 million, or 92 percent, more capital investment required over design period $0.09, or 17 percent, more total cost per passenger over design period
Accessibility	166,300, or 73 percent, more resident population within walking distance 122,600, or 59 percent, more jobs within walking distance	- -
Transit Ridership	38,200, or 100 percent, more primary transit trips on an average weekday in design year	3,800, or 2 percent, fewer total transit trips on an average weekday in design year
Disruption	- -	102 acres, or nearly four times, more land required for system development

Source: SEWRPC.

more automobile travel to the use of public transit. Accordingly, it was concluded that the truncated bus-on-freeway plan was, as a system, a superior alternative to the composite busway plan. Therefore, the last of the composite plans, the composite light rail transit plan, was compared to the bus-on-freeway plan.

<u>Comparison of the Composite Light Rail Transit and Truncated Bus-on-Freeway Plans:</u> The total cost of the composite light rail transit plan would be $172 million, or 25 percent, more than the total cost of the bus-on-freeway plan. The light rail transit plan would, however, have a number of important advantages over the bus-on-freeway plan, as indicated in Table 311. The primary transit facilities under the light rail transit plan would be accessible within walking distance to nearly 73 percent more of the resident population and 59 percent more of the jobs in the Milwaukee area. Partially for this reason, nearly 45,900 more transit trips may be expected to be made on the primary element of the light rail transit plan on an average weekday in the design year than on the primary element of the bus-on-freeway plan. However, under the bus-on-freeway plan, these additional trips would not be diverted to the private automobile, but rather would be made on the local or express elements of the plan. These trips would average about four mph slower over the on-vehicle portion of the trip, and would require an average of five additional minutes per trip. However, because the bus-on-freeway plan would provide a much faster primary element than the light rail transit plan, on-vehicle transit travel would be about one mph faster under this plan, saving about one minute per transit trip.

The composite light rail transit plan would have some important advantages with respect to energy use as it would be based on an electrically propelled primary transit system. It would, therefore, use 9 percent less petroleum-based fuels for transit system propulsion over the plan design period than

Table 311

KEY ADVANTAGES AND DISADVANTAGES OF THE COMPOSITE LIGHT RAIL TRANSIT SYSTEM PLAN IN COMPARISON TO THE TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Factor	Advantage	Disadvantage
Cost	\$1.9 million, or 6 percent, less operating subsidy required in design year Total transit system revenues recover 1 percent more operating costs, and primary element revenues recover 19 percent more operating costs, in design year	\$171.5 million, or 25 percent, more total cost over design period \$186.3 million, or 108 percent, more capital cost over design period \$423 million, or 160 percent, more capital investment over design period \$0.14, or 26 percent, more total cost per passenger over design period
Accessibility	166,300, or 73 percent, more resident population within walking distance 122,600, or 59 percent, more jobs within walking distance	- -
Transit Ridership	45,900, or 123 percent, more primary transit trips on an average weekday in design year	2,500, or 1 percent, fewer total transit trips on an average weekday in plan design year
Energy	9 percent savings in petroleum-based fuel used for transit system propulsion over plan design period (less than 1 percent savings in area automobile petroleum-based fuel use over plan design period) 52,700, or 22 percent, of transit trips made partially or totally on transit vehicles not dependent on petroleum-based fuels	- -
Disruption	- -	105 acres, or more than three times, more land required for system development

Source: SEWRPC.

the bus-on-freeway plan. Such savings, however, would represent less than 1 percent of the total petroleum-based fuel which may be expected to be used in the Milwaukee area over the plan design period by automobile travel. Perhaps more importantly, the use of electricity for propulsion of the light rail transit system would enable nearly 52,700 transit trips on an average weekday, or 22 percent of all transit tripmaking, to be made on a transit system which is not dependent on petroleum-based fuels.

The composite light rail transit plan would also be expected to be more cost-effective at the end of the plan design period with respect to operating and maintenance costs. The light rail transit plan may be expected to require \$1.9 million, or 6 percent, less operating subsidy in the plan design year than the bus-on-freeway plan. Total transit system revenues may be expected to recover 1 percent more of the operating and maintenance costs under the light rail transit plan than under the bus-on-freeway plan, and farebox revenues may be expected to recover 19 percent more of the operating and maintenance costs of the primary element of the light rail transit plan than of the primary element of the bus-on-freeway plan in the design year.

These annual operating cost savings would be offset by the substantially greater capital cost of the light rail transit plan. This high capital cost is the principal disadvantage of the light rail transit plan, making it the most costly of the alternative plans to implement. The capital cost of the light rail transit plan would be about $186 million, or 108 percent, more than that of the bus-on-freeway plan. The capital investment required to implement the plan over the plan design period would be about $423 million, or 160 percent, more than would be required for the bus-on-freeway plan. Consequently, the light rail transit plan would require about $0.14, or 26 percent, more capital investment per passenger carried than the bus-on-freeway plan. Other disadvantages of the light rail transit plan are that it would require more land for system development and that it would attract about 2,500, or 1 percent, fewer total transit trips on an averge weekday in the design year than the bus-on-freeway plan. About five acres more land would be needed for the right-of-way for the light rail transit fixed guideway and for the additional stops and stations of the light rail transit plan. Marginally fewer transit trips may be expected to be attracted to the light rail transit system because some parts of the primary element of the bus-on-freeway system are expected to provide faster trips to the downtown area, operating on a very limited or nonstop mode, unlike the scheduled-stop light rail transit system. Nearly all the additional transit trips which could be expected to be made under the bus-on-freeway plan would be made to the Milwaukee central business district, the focal point of primary transit service under that plan.

Thus, it was concluded that the tangible advantages of a light rail transit plan over a comparable bus-on-freeway plan in the Milwaukee area under the moderate growth scenario-decentralized land use plan alternative future would be small compared to the additional costs entailed. The anticipated operating and maintenance cost efficiencies of the light rail transit plan are offset over the plan design period by the additional capital costs. In addition, a light rail transit system, despite its greater cost, cannot be expected to divert substantially more trips from automobiles to public transit than a bus-on-freeway system and, therefore, cannot be expected to provide any substantial incremental benefits with respect to motor fuel consumption or air pollutant emissions. The service provided by the light rail transit plan is not expected to attract more transit trips than comparable bus-on-freeway service, even though it would make primary transit accessible to 73 percent more residents and 59 percent more jobs in the Milwaukee area, and would have about 40 percent faster average vehicle speeds than comparable local or express transit services under the bus-on-freeway plan. This is because the primary element of the bus-on-freeway plan would be expected to operate at speeds nearly 40 percent faster than the comparable light rail transit primary element because of the limited stop or nonstop operation involved. This higher level of primary transit service under the bus-on-freeway plan means that, even though more transit users may be expected to use primary transit service under the light rail transit plan, the overall speed of transit trips under the plans would not differ significantly.

There are other possible benefits to a light rail transit system plan which require consideration. But it must be recognized that these benefits are, to a great extent, intangible, and there is uncertainty as to the degree to which these benefits can be attained. These benefits include environmental impacts, land use development impacts, operation in an energy emergency, reliability of operation, safety of operation, and rider preference.

Environmental Impacts: There are some localized environmental advantages to a light rail transit plan. Electrically propelled light rail vehicles produce no air pollutant emissions in the corridors in which they operate, although the central coal-fired power plants from which they would primarily draw their power in the Milwaukee area would emit air pollutants. Diesel motor buses, on the other hand, emit approximately one-half the carbon monoxide and hydrocarbons and about six times the nitrogen oxides that automobiles do. There would be no significant areawide differences in the total pollutant emissions expected under the light rail transit and motor bus plans because Milwaukee area automobile traffic and pollutant emissions would be about the same under each plan and may be expected to dominate any pollutant emissions. Moreover, light rail transit may be expected to have significant air quality benefits only in areas of concentrated transit traffic, particularly the Milwaukee central business district, where the level of such traffic may approach that of automobile traffic. Specifically, under the light rail transit plan, up to 150 fewer diesel motor buses can be expected to operate over the transit mall in the downtown area during peak travel hours.

Noise reduction is another advantage of light rail transit, but again, this benefit will be apparent only in those parts of the Milwaukee central business district where transit vehicle volumes will approach automobile volumes. Several components of light rail transit serve to make light rail vehicles quieter than automobiles or diesel motor buses. These components include electric propulsion, welded rail, constant tension overhead catenary, and resilient wheels. A typical diesel motor bus has a greater noise level than an automobile, ranging between 72 dbA and 82 dbA at 25 feet when cruising, and 82 dbA and 96 dbA at 25 feet when accelerating in traffic. The noise level of an automobile will typically range from 62 dbA to 90 dbA at 25 feet, depending upon whether the vehicle is cruising or accelerating. Average noise levels for light rail vehicles are 62 dbA to 76 dbA between 0 and 20 mph and 76 dbA to 82 dbA between 20 and 50 mph. Again, light rail transit may have a significant impact on noise levels only along the proposed Wisconsin Avenue transit mall, which would be used exclusively by transit traffic. Under the light rail transit plan, up to 150 fewer diesel motor buses would be utilizing the transit mall during the peak travel hours, being replaced by 36 light rail vehicles.

Land Development and Redevelopment: Another important intangible benefit of a light rail transit plan is its possible impact on urban land development and redevelopment. Light rail transit, or any transit mode requiring fixed guideways, has a purported potential to stimulate land development and redevelopment because it represents a long-term commitment to high-quality public transit service in a corridor, and because it may be expected to provide, through its exclusive guideway, significantly improved accessibility to areas surrounding its stations. Because light rail transit would require a greater capital investment, and its guideway could not be as easily converted to other uses, light rail transit has been purported as having greater land development impacts than busways. Light rail transit has also been purported to have greater potential for land development than busways because it would operate at higher speeds and provide greater accessibility. Because little additional automobile traffic congestion is expected under this alternative future, the accessibility provided by the bus-on-metered freeway system plan may be expected to be quite similar to that provided by the light rail transit plan. The supposition that light rail transit will provide a land development inducement because it represents a permanent public commitment to the provision of a high level of transit service in a corridor can be weighed against recent studies of the influence of fixed guideway facilities on land development in United States cities. These studies indicate that for rail transit to influence the distribution of new development and redevelopment, an entire set of conditions must be satisfied.[15] These conditions include the presence of economic forces which support substantial land use development and redevelopment; the existence of a strong demand for such development and redevelopment in the urban area; the attractiveness of sites surrounding rail transit stations in terms of ease of access, utility and other urban services, physical features, and social characteristics; the existence of a public land use policy which encourages such development and redevelopment through coordinated tax policies, infrastructure supply, and land use controls, as well as local neighborhood approval; the presence of land near the stations which is available or which can be readily assembled for development; and the provision of a new transportation advantage through improvements in transit travel accessibility. Because the satisfaction of all these conditions in the Milwaukee area is unlikely, and because the degree of transportation advantage to be provided by a light rail transit system is very similar to that provided by a bus-on-metered freeway system, the ability of the light rail transit plan to induce development in the Milwaukee area must be concluded to be uncertain.

The implementation of a light rail transit plan would, nevertheless, have a greater short-term economic impact on the Region than implementation of any of the other alternative plans considered. A light rail transit system would require the construction of fixed facilities, including railway trackage, power transmission and distribution facilities, stations, and storage and maintenance facilities, resulting in a significant increase of activity, albeit temporary, in the local economy. The additional income from construction wages may be expected to result in additional expenditures for retail goods, and in the purchase of construction materials and services which would create additional business for suppliers, material handlers, and contractors.

Energy: The light rail transit plan would have a significant advantage with respect to energy use only under a severe petroleum shortage, as all the

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[15] *See U. S. Department of Transportation, Land Use Impacts of Rapid Transit: Implications of Recent Experience, Final Report, August 1977.*

transit alternatives under this future would use about the same amount of energy, and even about the same amount of petroleum-based fuel. This is because average weekday energy use by automobiles would dominate energy use by transit, and the levels of automobile travel may be expected to be about the same under all the alternative transit plans. Light rail transit has an advantage under a severe petroleum shortage because the electrical energy it uses would probably not be affected, and the system would therefore have the potential for expanded service. The expansion of such service, however, may be difficult in an emergency situation as vehicles for any additional service may be difficult to obtain quickly. Furthermore, it must be recognized that during a severe petroleum shortage, motor fuels may be expected to be rationed between all motor vehicles, with priority being given to public transit vehicles. Since public transit would use less than one-third the petroleum expected to be used by automobiles under the bus-on-metered freeway plan, it is only reasonable to expect that sufficient fuel for transit will be made available under any petroleum fuel shortfall. Therefore, a light rail transit system may have little advantage over a motor bus system in the event of an emergency petroleum shortage.

Reliability: Public transit service which is provided over fixed guideways is considered to be more reliable than such service provided over public roadways shared with other traffic. Light rail transit or busway systems, particularly to the extent that these modes utilize exclusive rights-of-way, should not be affected to any significant degree by traffic congestion, traffic accidents, or street and utility repairs, which are common on public arterial street rights-of-way. Also, operational problems caused by inclement weather—especially snow and ice—may be expected to be less severe than such problems on systems operating over public streets. Light rail transit fixed guideways which are located within public street rights-of-way, however—either in median areas, in reserved lanes, or in mixed traffic—may be expected to be affected by all these problems to the extent that the guideway is not separated from the adjacent motor vehicle traffic and from cross traffic at intersections. In addition, all rail transit modes suffer from the potential for an entire guideway segment to lose service should a single vehicle or train break down or become involved in an accident since, unlike rubber-tired motor vehicles, light rail vehicles cannot be steered around obstructions. Service disruptions can also occur from power outages, a breakdown in the overhead power distribution system, and such emergencies as fires which may require hose lines to be placed across trackage.

Safety: Safety may be expected to be greater under the light rail transit plan than under the motor bus-on-freeway plan because of the extensive use of dedicated street right-of-way, in addition to signals at crossings which provide preferential treatment for the light rail vehicles. In addition, if high-level boarding platforms are used, boarding and deboarding accidents, which are among the most common types of accidents in current day transit operations, would be significantly reduced.

Rider Preference: Proponents of light rail transit systems argue that transit passengers prefer rail transit services over motor bus transit services and will therefore make greater use of the rail services. This argument is based on the contention that there is something about the light rail transit mode which makes it intrinsically more attractive than other primary transit modes even if the levels of service provided are the same. This attraction is usually described in terms of ride quality or comfort, and image. It is probably true that there is a certain fascination with light rail transit technology as there is with other rail-related modes for moving people. This interest appears to stem either from interest in railways as a leisure-time activity, or from an historical perspective inasmuch as light rail transit technology is often equated with street railway technology reminiscent of the "good old days." In this respect, it should be noted that the historic conversion of street railway lines to electric trolley bus and motor bus lines in Milwaukee was received with expressions of great public joy and increased levels of ridership on the converted lines. There is also a feeling on the part of some light rail transit proponents that the implementation of a light rail transit system will assist in promoting Milwaukee as the center of an important and progressive major metropolitan area.

However, because the degree to which these intangible benefits can actually be attained must be regarded as uncertain, and because the development of a light rail transit system would require more than twice as much capital cost over the design period while attracting about the same total transit ridership as the bus-on-freeway plan, it was concluded that the bus-on-freeway plan was the superior plan of the alternatives considered under the moderate growth scenario-decentralized land use plan alternative future.

SUMMARY AND CONCLUSIONS

This chapter documents the results of the design, test, and evaluation of system plans for four alternative primary transit modes—bus on metered freeway, bus on busway, light rail transit, and commuter rail—under one of the two futures which lie between the most optimistic and pessimistic futures for transit use in the Milwaukee area over the next 20 years. This alternative future, one of four under which these four primary transit modes have been analyzed in this study, envisions moderate regional population and economic growth, a decentralized land use pattern, and a substantial increase in energy costs.

The alternative system plans prepared for each of these primary transit technologies were carefully designed to serve the corridors of heaviest travel demand in the Milwaukee area effectively and, to the maximum extent practicable, use available facilities and rights-of-way. Considerations in defining the major travel corridors to be served by the primary transit facilities included the locations of existing and proposed regional activity centers, future concentrations of travel desire lines, future concentrations of arterial streets with heavy traffic volumes and congestion, and concentrations of heavily used transit routes. The available facilities and rights-of-way considered in plan design included freeways and their medians, shoulders, and nonroadway rights-of-way; active and abandoned railways and their rights-of-way; former electric interurban and street railway rights-of-way; and the medians and parking lanes of arterial streets having at least three lanes in each direction. Following the identification of the major travel corridors best served by primary transit, and the selection of specific alignments for each alternative primary transit mode from among the facility and right-of-way options in each corridor, system plans were developed for each mode, including the identification of routes, stops, and stations.

The test and evaluation of these maximum extent alternative modal system plans indicated the need to truncate the facilities and services postulated under each of the primary transit mode alternatives in order to provide reasonably cost-effective system plans. Three of the four modal system plans required substantial truncation: the bus-on-busway, light rail transit, and bus-on-freeway plans. With respect to the commuter rail plan, it was determined that only one route in a single corridor radiating from downtown Milwaukee to the south to Kenosha would have the potential to provide cost-effective primary transit service under this future. Analysis of comparable commuter rail and bus-on-freeway services in the corridor revealed that bus-on-freeway would be superior to the alternative commuter rail service, attracting substantially greater ridership and being more cost-effective in the plan design year.

Testing of the truncated bus-on-freeway plan and of the composite light rail and busway system plans—in which the service provided by these modes was supplemented in certain corridors by bus-on-freeway facilities in order to provide comparable areawide coverage of primary transit service—indicated that all these alternative truncated and composite primary transit system plans could be expected to work well in the design year 2000, providing a reasonably similar high level of primary transit service. The alternative systems were found to be quite similar with respect to total ridership, required annual public subsidy of operating and maintenance costs, operating and maintenance cost-effectiveness, and overall level of service. Each system was expected to result in about the same level of total transit use in the area—specifically, between 238,300 and 242,100 trips on an average weekday in the plan design year. In addition, each system was expected to entail a similar annual operating and maintenance cost deficit, between $32 and $34 million in the plan design year, and to recover a similar proportion of the design year operating and maintenance costs from farebox revenues, between 47 and 49 percent. Finally, each plan was expected to result in about the same average overall speed of travel for transit trips on the total transit system in the design year, between 18 and 20 mph.

The analyses indicated that substantially more transit trips may be expected to be made on the primary element of the light rail transit and busway plans; 83,200 and 75,500 weekday trips, respectively, compared with 37,300 trips under the bus-on-freeway plan. These additional trips, however, may be expected to be made under the bus-on-freeway plan as well, but on the local and express elements of that plan at a lower level of service; that is, at speeds of about 15 mph compared with 24 mph on the light rail transit and busway primary elements. The overall level of service provided to all transit trips made on the bus-on-freeway plan, however, may be expected to be about the same as under the light rail transit and busway plans because the bus-on-freeway plan would provide a faster trip of about 29 mph on the primary elements.

There are significant differences in the capital investment and capital costs attendant to the implementation of the alternative plans. (Capital investment is defined as the total outlay of funds for guideway, station, and support facility construction and vehicle acquisition necessary to implement a plan over the plan design period, and indicates total capital resources required for plan implementation. Capital cost is defined as the capital investment less the value of the remaining life of facilities and vehicles beyond the plan design period, and indicates the true capital cost of plan implementation over the plan design period.) The bus-on-freeway plan was found to require the least capital outlay over the plan design period, $264 million. The other two plans, busway and light rail transit, were found to require substantially more capital investment, $506 and $687 million, respectively, as they would both require new fixed guideway constructon. Because of the expected 30-year life of any new guideways to be constructed, and the relatively longer life of rail transit vehicles, the differences in capital costs between the plans over the design period, while substantial, were considerably less than the differences in capital investment. The bus-on-freeway plan was found to have the lowest capital cost of $172 million. The busway and light rail transit plans were found to entail capital costs of $281 million and $359 million, respectively.

The differences in capital costs between the plans may be expected to dominate the small differences found in annual operating and maintenance cost subsidy. The bus-on-freeway plan was found to have the lowest total public cost to the plan design year of $691 million, or $0.54 per passenger to the design year, based on two assumptions: first, that each plan would be implemented incrementally over the plan design period and that an equal capital expenditure would be made in each year over the 20-year plan design period, and second, that the annual operating and maintenance cost subsidy would increase linearly from the current level of about $19 million to the plan design year level of between $32 and $34 million. The busway plan was found to have a total public cost to the design year of $799 million, or $0.63 per passenger to the design year; and the light rail transit plan was found to have a total public cost to the design year of $863 million, or $0.68 per passenger to the design year. Thus, the light rail transit plan would entail about 26 percent more total public costs over the design period than the bus-on-freeway plan.

Certain intangible benefits, however, would support development of the higher cost light rail transit plan. These include environmental advantages, advantages in shaping land use development and redevelopment, energy advantages, travel safety advantages, and advantages in reliability of operation. The light rail transit plan was determined to have some environmental advantages with respect to air pollution and noise within the specific corridors, although total areawide transportation system air pollutant emissions and noise generation would not differ significantly under any of the transit system plans, because automobile and truck traffic and attendant air pollution and noise would be nearly the same under all of the transit plans. Within specific corridors and areas, however, the light rail vehicles would emit no air pollutants, such emissions occurring at a remotely located central power generating station. A bus would, however, emit air pollutants locally, releasing about one-half the carbon monoxide and hydrocarbons as an automobile and six times the nitrogen oxides. Also, a bus may be expected to generate about 20 percent more noise than a light rail vehicle, and about 5 to 15 percent more noise than an automobile. The principal noise and air pollution impacts may be expected to be effected in the Milwaukee central business district, where transit traffic volumes would be significant. Specifically, on the proposed Wisconsin Avenue transit mall, the light rail transit plan would result in the replacement of up to 150 buses during peak hours with 36 one-car trains of articulated light rail vehicles.

All transit guideway alternatives may have a potential to attract, and thereby guide and shape, land use development and redevelopment, because they represent a public commitment to high-quality transit service and would increase transit travel accessibility. Light rail transit is considered by some to have a greater potential to effect development than the bus-on-freeway and bus-on-busway alternatives because it represents the greatest permanent public commitment to a high level of transit service in a specific location, and because its exclusive guideway and electrically propelled vehicles should provide the greatest increase in transit travel accessibility. However, the analyses indicated that the light rail transit system plan would provide about the same accessibility as the bus-on-freeway plan. Moreover, there are other factors which affect land development and redevelopment which could offset the land development potential of light rail transit. These factors are the presence of economic forces which support substantial land use development and redevelopment; the existence of a strong demand for such development and redevelopment in the urban area; the attractiveness of sites surrounding rail transit stations in terms of ease of access, utility and other urban services, physical features, and social characteristics; the existence of a public land use policy which encourages such development and redevelopment through coordinated tax policies, infrastructure supply, and appropriate land use controls, as well as local neighborhood and community acceptance and approval; the presence of land near the stations which is available, or which can be readily assembled, for development; and the provision of a new transportation advantage through improvements in transit travel accessibility. Thus, the increased land development potential of light rail transit must be considered to be uncertain at best.

The analyses indicated that the light rail transit plan may be expected to effect little savings of petroleum use over the other alternative plans considered because it would not result in significantly less automobile use than any of the other alternatives, and automobile energy use dominates transit energy use. The use of electricity by light rail transit may, however, be regarded as a significant advantage in the event of a serious petroleum shortage, because the electrical energy it uses would not be affected and the system would have the potential for expanding service. The expansion of light rail transit service may, however, be difficult in an emergency situation as vehicles for additional service may be difficult to obtain quickly.

Also, because they would be provided over fixed guideways, light rail transit or bus-on-busway transit service would be considered to be more reliable than transit service provided over public roadways shared with other traffic. Light rail transit or bus-on-busway transit, particularly to the extent that these modes utilize exclusive rights-of-way, should not be affected to any significant degree by traffic congestion, traffic accidents, or street and utility repairs, which are common on public arterial street rights-of-way. Also, operational problems caused by inclement weather—especially snow and ice—may be expected to be less severe than such problems on public streets. Light rail transit fixed guideways which are located within public street rights-of-way, however—either in median areas, in reserved lanes, or in mixed traffic—may be expected to be affected by all these problems to the extent that the guideway is not separated from adjacent motor vehicle traffic and from cross traffic at intersections. In addition, light rail transit suffers from the potential for an entire guideway segment to lose service should a single vehicle or train break down or become involved in an accident since, unlike rubber-tired motor vehicles, light rail vehicles cannot be steered around obstructions. Service disruptions can also occur from power outages, a breakdown in the overhead power distribution system, and such emergencies as fires which may require hose lines to be placed across trackage.

The safety of the light rail transit plan may be expected to be greater than that of the motor bus-on-freeway plan because of the extensive use of dedicated street right-of-way in addition to signals at crossings which provide preferential treatment for the light rail vehicles. In addition, if high-level boarding platforms are used, it may be expected that boarding and deboarding accidents, which are among the most common types of accidents in current day transit operations, would be significantly reduced. In addition, the massive structure of a light rail vehicle offers more protection to passengers than a bus in the event of vehicle-to-vehicle and vehicle-to-fixed object collisions.

The light rail transit plan would also have an advantage with respect to operating and maintenance cost-effectiveness or efficiency as it would have the smallest necessary public subsidy in the plan design year, although the other plans would have only slightly higher subsidies. In the design year, the light rail transit plan would require $1.9 million, or 6 percent, less subsidy than the bus-on-freeway plan, and $1.7 million, or 5 percent, less subsidy than the busway plan.

However, even when considered together, these intangible benefits supporting the development of the higher cost light rail transit plan probably do not outweigh the capital cost difference between that plan and the bus-on-freeway plan. Therefore, because the bus-on-freeway plan would attract the highest transit ridership of the plans and would have the lowest total public cost over the plan design period, the bus-on-freeway plan was recommended as the best plan under this alternative future.

It should be noted that the bus-on-freeway plan recommended under this future is a unique plan involving the provision of primary transit service over an operationally controlled freeway system. The resulting high-speed, nonstop or limited stop rapid transit service over those freeways would provide a very high level of service, a service supplemented by coordinated express and local feeder bus service. Labor productivity of the system would be enhanced by the use of high-capacity articulated buses. Only substantial additional automobile traffic congestion in the Milwaukee area, which is not expected under this alternative future, would give the exclusive fixed guideway alternative plans a level-of-service advantage over the recommended bus-on-freeway alternative.

It is important to note that the recommended bus-on-freeway plan represents a significant improvement over the present transit system. It will, however, be necessary to implement each component of the recommended plan if the level of service and cost-effectiveness of the bus-on-freeway alternative is to approach that of the busway and light rail transit alternatives. One of these improvements is the emphasis on carrying a significant proportion of the total transit trips on primary and secondary or express lines, and not on tertiary lines. Only with emphasis on faster primary and secondary lines which are more labor-efficient and attractive to travelers, and only with the use of high-capacity articulated buses which are more labor-efficient, will the bus-on-freeway plan approach the alternative fixed guideway plans in number of trips carried and cost-effectiveness. A particularly important improvement required under the bus-on-freeway plan is extensive preferential treatment for transit vehicles—specifically, the areawide freeway traffic management system.

The implementation of a freeway traffic management system would require ramp meters to be constructed at freeway entrance ramps throughout the Milwaukee area, including all of Milwaukee County, substantial parts of Waukesha and Ozaukee Counties, and parts of Washington and Racine Counties. This extensive ramp metering would be essential to attainment of the free-flowing operation of the area freeway system envisioned under the bus-on-freeway plan. Under the plan, it is envisioned that the freeway traffic management system would exercise sufficient constraint on freeway access to ensure uninterrupted freeway traffic flow and operating speeds of at least 40 to 45 mph over essentially all of the freeway system in the Milwaukee area during average weekday peak travel periods.

A limited freeway traffic management system implemented incrementally by the Wisconsin Department of Transportation since 1969 is in operation today in central Milwaukee County. The system consists of ramp meters and corresponding freeway traffic detectors at 20 freeway entrance ramps in central Milwaukee County. This limited system was originally operated primarily to facilitate the smooth entry of vehicles into the traffic stream on the most heavily congested freeway segments in the central area of Milwaukee County. This original objective has been broadened to include reducing total freeway traffic volumes by restricting access. While providing important benefits in promoting the safer and smoother flow of traffic near entrance ramps, this system would not attain the high level of freeway operation envisioned under the bus-on-freeway plan, particularly under this alternative future which envisions substantial growth in total regional travel. The access at the limited number of freeway entrance ramps located on congested freeway segments which are now metered would have to be severely constrained to attain the level of freeway operation envisioned under the bus-on-freeway plan. Only with an areawide system of ramp meters and attendant control of freeway access would the envisioned freeway operation be practically attainable.

It should be recognized in this respect that there are obstacles to expanding the present limited freeway traffic management system. The Regional Planning Commission's Intergovernmental Coordinating and Advisory Committee on Transportation System Planning and Programming for the Milwaukee Urbanized Area has refused to include the installation of any further ramp meters in the transportation improvement program for southeastern Wisconsin, and recommended in the transportation systems management plan for the Milwaukee area (see SEWRPC Community Assistance Planning Report No. 21, A Transportation Systems Management Plan for the Kenosha, Milwaukee, and Racine Urbanized Areas in Southeastern Wisconsin: 1978) that a prospectus for a preliminary engineering study of an areawide freeway traffic management system be prepared prior to endorsement by the Committee of any further implementation of such a system.[16] The study was to provide recommen-

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[16] *An areawide freeway traffic management system was also recommended for implementation under the Commission's long-range regional transportation system plan (see SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume Two, Alternative and Recommended Plans).*

dations concerning the extent of freeway ramp metering and attendant preferential motor bus access to the freeway system in the greater Milwaukee area; the speeds and volumes to which the area freeway system should be controlled; and, importantly, the degree of metering which would be necessary at each on-ramp to achieve those freeway speeds and volumes. The study was to address the potential costs and benefits of freeway traffic management, assessing resultant freeway and surface arterial street congestion and travel speeds, freeway entrance ramp queues and the impacts of such queues on connecting surface arterial streets, and the equity as well as costs of freeway traffic management.

On March 26, 1979, the prospectus for the required preliminary engineering study was completed by the Commission staff and unanimously approved by the steering committee created by the Commission to guide the preparation of the prospectus. The prospectus was approved by the Commission itself on June 7, 1979. However, funding for the conduct of the study recommended in the prospectus has not been obtained to date. As a consequence, the Intergovernmental Coordinating and Advisory Committee on Transportation System Planning and Programming for the Milwaukee Urbanized Area did not in 1980 and 1981 approve the installation of any additional ramp meters in the Milwaukee area.

The areawide freeway traffic management system would have to consist of an interconnected system of ramp meters throughout the Milwaukee area, a centralized control computer system governing operation of the ramp meters, surveillance equipment, changeable message signs, lane control signals, and entrance ramp reconstruction for transit vehicle bypass lanes. The capital investment required for such a system, consisting of an estimated total of 166 ramp-meter locations, has been estimated to total $14.5 million in 1979 dollars. The operation and maintenance of such an areawide system, including building maintenance, computer maintenance, staff salaries, and the operation and maintenance of the ramp meters, has been estimated to cost $870,000 annually in 1979 dollars. All these costs have been included in the bus-on-freeway plan.

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Chapter VI

ALTERNATIVE PRIMARY TRANSIT SYSTEM PLAN COMPARISON AND EVALUATION FOR THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN ALTERNATIVE FUTURE

INTRODUCTION

This chapter describes the design, test, and evaluation of primary transit alternatives under the stable or declining growth scenario-centralized land use plan alternative future. This alternative future is one of the two futures which lie between the most optimistic and pessimistic futures for transit use in the Milwaukee area considered in this planning effort. The stable or declining growth scenario-centralized land use plan future assumes a declining level of population and a stable level of economic activity within the Region; a moderate increase in the cost of motor fuel, and, as a result of increases in the motor fuel efficiency of automobile travel, a decrease in the out-of-pocket cost of automobile travel; and a continuation of population lifestyle trends, with increases in female labor force participation and decreases in household size. New urban development under this alternative future is assumed to take place in accordance with a centralized land use plan and would therefore occur primarily at medium densities along the full periphery of, and outward from, existing urban centers. Salient aspects of this alternative future are summarized in Table 312, and are described in greater detail in a companion document to this report, SEWRPC Technical Report No. 25, Alternative Futures for Southeastern Wisconsin.

Alternative primary transit system plans for this future were designed, tested, and evaluated utilizing the six-step procedure described in Chapter II of this report. The first step in this process was the identification of the maximum extent of the corridors to be considered for the provision of primary transit facilities and services. This step was readily accomplished because it had been concluded earlier in the study that the two extreme futures considered under the study had essentially the same seven maximum extent corridors. It could therefore be reasonably assumed that these corridors were the maximum extent of primary transit facilities and services to be considered under any intermediate future.

In the second step of the plan design, test, and evaluation process under this future, preferred alternative alignments were selected within each of the corridors for each of the modes: bus on freeway, commuter rail, busway, and light rail transit.[1] Because it had been established that the preferred alternative alignments would be the same under both of the two extreme futures—as the costs of the alternative alignments and their relative travel speeds would not vary between the futures, and as the relative magnitude of accessibility to employment and resident population of the preferred and alternative alignments in the seven corridors was determined not to vary significantly between the two extreme futures—it was concluded that these same preferred alignments should be used to test alternative primary transit system plans under this future.

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[1] *Maximum extent corridors were also defined for heavy rail rapid transit under the moderate growth scenario-centralized land use plan alternative future, the most optimistic future of the four considered and the first for which alternative primary transit plans were designed, tested, and evaluated under this study. Under the moderate growth scenario-centralized land use plan alternative future, specific heavy rail rapid transit alignments were selected within each of the corridors of major travel demand, and a maximum extent system plan was quantitatively tested and evaluated. When comparing the heavy rail mode with the light rail mode, the test and evaluation showed the heavy rail rapid transit mode as receiving a similar proportion of operating and maintenance costs from farebox revenues, but carrying less ridership and requiring more than twice the capital cost. Accordingly, heavy rail rapid transit was eliminated from further consideration as an alternative primary transit mode and was not considered under the three less optimistic futures postulated in this study.*

Table 312

CHARACTERISTICS OF THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN ALTERNATIVE FUTURE

Key External Factors		
Energy	**Economic Conditions**	**Population Lifestyles**
Oil price to converge with world oil price, which will increase at 2 percent annual rate to $39 per barrel in the year 2000 (1979 dollars) Petroleum-based motor fuel to increase to $1.50 per gallon by the year 2000 (1979 dollars) Assumes no major or continuing disruptions in oil supply High degree of conservation in all sectors resulting in increase in energy use of 2 percent or less per year Average automobile fuel efficiency of 32.0 miles per gallon	Region is considered to have relatively low attractiveness and competitiveness Small per capita and minimal household income increase as a result of low attractiveness and competitiveness of Region, but an increased proportion of the population is of work force age, and there is increased labor force participation	Female labor force participation increases to 65 to 70 percent and total labor force participation is 70 to 75 percent A continuation of below replacement fertility rates by the year 2000 Average household size continues to decline

Attendant Regional Change	
Economic Activity of Region in the Year 2000	**Population of Region in the Year 2000**
887,000 jobs Manufacturing . . . . 30 percent Services . . . . 41 percent Other . . . . 29 percent Income of $23,700 per household in 1979 dollars (11 percent increase since 1970, or a 0.3 percent annual rate of increase) Income of $9,500 per capita in 1979 dollars (46 percent increase since 1970, or a 1.3 percent annual rate of increase)	1,688,400 persons 26.8 percent—0-19 years of age 60.6 percent—20-64 years of age 12.6 percent—65 years of age or older 673,600 households Average household size of 2.3 persons

Land Use Plan				
Urban Growth and Density	**Population Distribution**		**Employment Distribution**	
Occurs primarily at medium residential densities along the periphery of, and outward from, existing urban centers	Milwaukee County		Milwaukee County	
	Population	830,000 persons	Employment	552,300 jobs
	Percent Change from 1970	- 21.3	Percent Change from 1970	8.1
Existing developed portions of Milwaukee generally maintain residential density existing in 1970	Percent Change from 1978	- 13.0	Percent Change from 1978	- 1.8
	Outlying County Population (Ozaukee, Washington, Waukesha)	480,000 persons	Outlying County Employment (Ozaukee, Washington, Waukesha)	181,900 jobs
	Percent Change from 1970	37.2	Percent Change from 1970	72.6
	Percent Change from 1978	8.2	Percent Change from 1978	28.6

Source: SEWRPC.

In the third step of the plan design, test, and evaluation process under this future, maximum extent system plans for each primary transit mode were formulated by combining the preferred alignments into a system, and the routes, stations, and maintenance and storage facility needs for each mode were identified. Again, it was concluded that the same system plan design considerations that applied to the two extreme futures applied to this future, and, consequently, the maximum extent system plans under all three futures are the same.

In the fourth step of the plan design, test, and evaluation process under this future, the maximum extent system plans were subject to test and evaluation using traffic simulation model studies. Based upon this evaluation of the maximum extent system plans, truncated plans for each mode were developed. Those facilities and services shown by the test and evaluation of the maximum extent plans to be unproductive were deleted from these truncated versions of the maximum extent system plans. The truncated system plans were then tested, evaluated, and compared.

In the fifth step of the process, a best system plan was synthesized for this alternative future. That plan was a combination of the truncated plans tested and compared for the various modes. This best plan for the stable or declining growth scenario-centralized land use plan alternative future was then used along with the best plans for the other three alternative futures in the sixth and final step of the process—the development of a recommended primary transit system plan for the Milwaukee area. This recommended plan consisted of two tiers, a "lower tier" and an "upper tier."

The lower tier, intended for immediate implementation, is comprised of those elements of the alternative primary transit system plans which appeared in the best plans selected for three or four of the alternative futures and which, therefore, could be considered robust and viable under the full range of possible futures and under greatly varying future conditions. The upper tier consisted of those elements which appeared in the best plans selected for only one or two of the futures. Implementation of facilities in the upper tier is intended to be postponed for a period of time, until the need for the facilities can be better established. Available rights-of-way for such facilities were, however, intended to be preserved in order to retain maximum flexibility for future primary transit development.

EVALUATION OF ALTERNATIVE PRIMARY TRANSIT SYSTEM PLANS

The definition of the maximum extent network of corridors under this future, as well as the selection of the preferred alignments within the corridors of those networks and the combination of these preferred alignments into system plans, was accomplished without significant analysis as it had earlier been established in the study that the same corridors, alignments, and system plans could be defined for the two extreme futures under the study. Accordingly, the first major step of the stable or declining growth scenario-centralized land use plan was the design, test, and evaluation of the maximum extent system plans for each of the modes. Because these plans were maximum extent plans which proposed to extend service beyond what could be considered reasonably warranted limits, the initial evaluation of the plans was confined to a few selected, basic measures of the service provided, the potential utilization, and the costs entailed—measures which consisted of a small, but important, subset of the primary transit system development objectives and standards adopted under the study.

Evaluation of Maximum Extent Bus-on-Freeway System Plan

One of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is that of buses operating over operationally controlled freeways. The maximum extent system plan developed for this technology is summarized with respect to its coverage and routes in Chapter III of this report on Map 52 and in Table 108, and is summarized with respect to its performance under this future in Tables 313, 314, and 315. Map 53 and Table 111 of Chapter III and Tables 314, 316, and 317 provide comparable information for the base, or benchmark, plan used in the study. A description of the facilities and services of the primary, express, and local elements of both the maximum extent bus-on-freeway system plan and of the base plan was included in Chapter III of this report and will not be repeated here. Only those characteristics of the maximum extent system plan which vary between the alternative futures, such as the frequency of service provided to meet demand, will be discussed.

Headways on the bus-on-freeway primary transit routes under this future would generally range from 10 to 30 minutes during the peak travel

Table 313

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	IH 43 and STH 33	Village of Saukville	Proposed	Yes	100	1	- -	47	44	2	2	1	1	2	2	1	1
2	IH 43 and CTH Q	Town of Grafton	Proposed	Yes	75	1	1	40	37	2	2	1	1	2	2	1	1
3	S. 1st Avenue and Wisconsin Avenue	Village of Grafton	Proposed	Yes	50	1	1	51	48	2	2	1	1	2	2	1	1
4	IH 43 and CTH C	Town of Grafton	Existing	Yes	50	1	- -	37	34	2	2	1	1	2	2	1	1
5	Cedarburg Road and Highland Road	City of Mequon	Existing	Yes	200	1	1	46	43	2	2	1	1	3	3	1	1
6	IH 43 and Mequon Road . .	City of Mequon	Proposed	Yes	75	1	1	32	29	2	2	1	1	3	3	1	1
7	N. 76th Street and W. Brown Deer Road . . .	City of Milwaukee	Proposed	Yes	150	1	5	38	35	4	4	2	2	5	5	2	2
8	IH 43 and Brown Deer Road	Village of River Hills	Existing	Yes	250	1	2	28	25	4	4	2	2	5	5	2	2
9	N. Teutonia Avenue and W. Florist Avenue . .	City of Milwaukee	Proposed	Yes	50	1	1	42	39	2	2	1	1	3	3	1	1
10	IH 43 and W. Silver Spring Drive . . .	Village of Glendale	Existing	Yes	200	4	7	22	19	11	11	5	5	13	3	5	5
11	IH 43 and W. Locust Street	City of Milwaukee	Proposed	Yes	- -	3	4	16	14	4	4	2	2	5	5	2	2
12	IH 43 and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	5	4	13	12	15	15	7	7	18	18	7	7
13	W. Appleton Avenue and W. Silver Spring Drive . . .	City of Milwaukee	Proposed	Yes	125	1	1	37	34	4	4	2	2	5	5	2	2
14	W. North Avenue and W. Lisbon Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	21	18	4	4	2	2	5	5	2	2
15	W. Main Street and W. Washington Street . . .	City of West Bend	Proposed	Yes	40	1	- -	83	78	2	2	1	1	2	2	1	1
16	S. Main Street and W. Paradise Drive	City of West Bend	Proposed	Yes	160	1	- -	75	70	2	2	1	1	2	2	1	1
17	USH 45 and STH 60	Town of Polk	Proposed	Yes	50	1	- -	66	61	2	2	1	1	2	2	1	1
18	USH 45 and USH 145 . . .	Town of Polk	Proposed	Yes	30	1	- -	57	52	2	2	1	1	2	2	1	1
19	Pilgrim Road and Mequon Road	Village of Germantown	Proposed	Yes	50	1	1	46	41	2	2	1	1	2	2	1	1
20	USH 41 and Main Street . .	Village of Menomonee Falls	Proposed	Yes	75	2	1	40	35	4	4	2	2	4	4	2	2
21	N. 107th Street and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	100	1	3	38	33	2	2	1	1	2	2	1	1
22	N. Calhoun Road and W. Capitol Drive	City of Brookfield	Proposed	Yes	150	1	1	40	35	3	3	2	2	3	3	2	2
23	N. 124th Street and W. Capitol Drive	City of Wauwatosa	Proposed	Yes	100	1	3	35	30	3	3	2	2	3	3	2	2
24	USH 45 and W. Watertown Plank Road	City of Wauwatosa	Existing	Yes	225	2	2	28	24	4	4	3	3	4	4	3	3
25	S. Main Street and E. Wisconsin Avenue . . .	City of Oconomowoc	Proposed	Yes	10	1	- -	71	67	2	2	1	1	2	2	1	1
26	E. Summit Avenue and Pabst Road	City of Oconomowoc	Proposed	Yes	10	1	- -	64	60	2	2	1	1	2	2	1	1
27	Summit Avenue and Delafield Road	Town of Summit	Existing	Yes	50	1	- -	59	55	2	2	1	1	2	2	1	1
28	Lakeland Road and STH 16	Village of Nashotah	Existing	Yes	30	1	- -	63	59	2	2	1	1	2	2	1	1
29	STH 83 and IH 94	City of Delafield	Proposed	Yes	40	1	- -	50	46	2	2	1	1	2	2	1	1
30	Merton Avenue and STH 16	Village of Hartland	Proposed	Yes	40	1	- -	56	52	2	2	1	1	2	2	1	1
31	Main Street and USH 16 . .	Village of Pewaukee	Proposed	Yes	50	1	1	46	42	2	2	1	1	2	2	1	1
32	Grandview Boulevard and IH 94	City of Waukesha	Proposed	Yes	125	1	1	43	39	2	2	2	2	2	2	2	2
33	N. Barstow Street and W. Main Street	City of Waukesha	Proposed	Yes	50	1	1	44	40	2	2	1	1	2	2	1	1
34	N. Barker Road and W. Blue Mound Road . . .	Town of Brookfield	Existing	Yes	250	1	1	34	30	2	2	1	1	2	2	1	1
35	N. Moorland Road and IH 94	City of Brookfield	Proposed	Yes	75	3	2	30	26	6	6	3	3	6	6	3	3
36	N. 84th Street and IH 94 . .	City of Milwaukee	Proposed	Yes	150	9	2	22	18	19	19	10	10	19	19	10	10
37	Cemetery Access Road and IH 94	City of Milwaukee	Proposed	Yes	- -	1	- -	20	16	4	4	3	3	4	4	3	3
38	N. 3rd Street and W. Wisconsin Avenue . . .	City of Milwaukee	Existing	Yes	- -	29	23	- -	- -	76	75	41	41	98	99	39	39
39	USH 45 and W. National Avenue	City of West Allis	Proposed	Yes	175	1	4	24	20	3	3	2	2	6	6	2	2
40	S. 43rd Street and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	75	1	1	30	27	3	3	1	1	3	3	1	1
41	S. 44th Street and W. National Avenue	Village of West Milwaukee	Proposed	Yes	- -	1	2	20	17	3	3	1	1	3	3	1	1
42	S. 108th Street and STH 15	City of Greenfield	Existing	Yes	360	1	3	30	27	2	2	2	2	4	4	2	2

Table 313 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
43	W. Loomis Road and W. Rawson Avenue	City of Franklin	Proposed	Yes	75	1	1	37	33	2	2	2	2	2	2	2	2
44	S. 76th Street and W. Cold Spring Road . . .	City of Greenfield	Proposed	Yes	150	1	2	29	26	2	2	1	1	5	5	1	1
45	W. Loomis Road and W. Grange Avenue.	Village of Greendale	Proposed	Yes	- -	1	2	29	26	2	2	2	2	2	2	2	2
46	S. 27th Street and IH 894.	City of Milwaukee	Proposed	Yes	250	1	3	25	22	2	2	2	2	5	5	2	2
47	STH 15 and STH 20	Town of East Troy	Proposed	Yes	20	1	- -	74	70	2	2	1	1	2	2	1	1
48	STH 83 and STH 15	Town of Mukwonago	Existing	Yes	75	1	- -	65	61	2	2	1	1	2	2	1	1
49	CTH F and STH 15.	Town of Vernon	Existing	Yes	70	1	- -	55	51	2	2	1	1	2	2	1	1
50	Racine Avenue and STH 15	City of New Berlin	Existing	Yes	140	1	- -	49	45	2	2	1	1	2	2	1	1
51	S. Moorland Road and STH 15	City of New Berlin	Proposed	Yes	60	1	2	43	39	2	2	1	1	2	2	1	1
52	6th Avenue and 56th Street.	City of Kenosha	Existing	Yes	60	1	6	72	69	2	2	2	2	4	4	1	1
53	STH 31 and 52nd Avenue.	City of Kenosha	Proposed	Yes	200	1	1	58	55	2	2	2	2	4	4	1	1
54	Wisconsin Avenue and 6th Street.	City of Racine	Proposed	Yes	40	1	8	66	63	2	2	2	2	4	4	1	1
55	STH 31 and 12th Street . .	Town of Mt. Pleasant	Proposed	Yes	175	1	1	54	51	2	2	2	2	4	4	1	1
56	IH 94 and STH 20	Town of Mt. Pleasant	Proposed	Yes	200	1	- -	44	41	2	2	2	2	4	4	1	1
57	IH 94 and Ryan Road . . .	City of Oak Creek	Proposed	Yes	225	1	2	30	27	3	3	1	1	3	3	1	1
58	Nicholson Avenue and E. Rawson Avenue	City of Oak Creek	Proposed	Yes	200	1	1	31	28	3	3	1	1	4	4	1	1
59	IH 94 and W. College Avenue.	City of Milwaukee	Existing	Yes	425	4	4	26	23	6	6	4	4	10	10	2	2
60	IH 94 and W. Holt Avenue	City of Milwaukee	Existing	Yes	240	1	3	21	20	5	5	2	2	8	8	2	2
61	S. Lake Drive and E. Lunham Avenue	City of Cudahy	Proposed	Yes	100	1	- -	28	27	3	2	1	1	2	3	1	1

Source: SEWRPC.

periods. During the off-peak travel periods, headways would generally range from 20 to 60 minutes in both the midday and evening travel periods. Consequently, four times more bus miles of primary transit service would be provided under the maximum extent plan under the stable or declining growth scenario-centralized land use plan alternative future than under the base plan. A significant part of this difference would result from the extension of primary service into off-peak travel periods during the midday and evening, as indicated in Tables 315 and 317. About 30 percent more bus miles of express and local service operated would be provided under the maximum extent plan than under the base plan—about 79,000 bus miles on an average weekday, compared with 60,000.

Transit Utilization: Under the maximum extent bus-on-freeway system plan of the stable or declining growth scenario-centralized land use plan, about 242,000 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 318 and 319. About 37,000, or 15 percent of these transit trips, may be expected to utilize the primary transit system for all or a portion of the trip. Thus, the maximum extent bus-on-freeway plan envisions that almost 7 percent of the total of 3.6 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made on public transit, and that about 1 percent will be made on primary transit. More than 26,000, or about 12 percent, more transit trips may be expected under this

Table 314

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Bus-on-Freeway Plan
Primary Element		
Exclusive Guideway Miles		
Subway	- -	- -
Elevated	- -	- -
At-Grade	- -	- -
Total	- -	- -
Shared Guideway Miles		
Freeways	51.5	163.6
Surface Arterial Streets	49.5	81.9
Total	101.0	245.5
Route Miles	449	1,218
Vehicle Miles	7,010	32,110
Vehicle Hours	298	1,150
Vehicles Required	59	156
Trains Required	- -	- -
Express and Local Elements		
Route Miles	1,302	1,823
Vehicle Miles	60,230	78,570
Vehicle Hours	4,156	5,040
Vehicles Required	474	660
Total System		
Route Miles	1,755	3,041
Vehicle Miles	67,240	110,480
Vehicle Hours	4,454	6,190
Vehicles Required	533	816
Trains Required	- -	- -

Source: SEWRPC.

plan than under the base plan. Nearly all of this increased transit use would be on the primary transit element of the plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent bus-on-freeway system plan and the base system plan are summarized in Table 320. The costs shown include all construction costs, plus the cost of right-of-way acquisition and the acquisition and replacement of vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 320.

The total capital cost of the base plan is estimated at $181 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses in order to maintain the existing service to the year 2000. About $19 million, or 10 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent bus-on-freeway plan is estimated at $274 million. About $14 million, or about 5 percent of this cost, would be required to implement a freeway operational control system in the Milwaukee urbanized area. About $224 million would be incurred in the purchase of new and replacement of transit vehicles—$65 million of which would be for the purchase of 270 articulated buses, and $159 million of which would be for the purchase of 1,137 conventional buses. The remaining $36 million would be required to construct park-ride stations and to expand bus storage and maintenance facilities. About $96 million, or 35 percent of the total capital cost of the plan, would be required for its primary transit element.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent bus-on-freeway plan can be expected to approximate $55 million. The remaining $219 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal share and the federal share are estimated to total $36 million and $145 million, respectively.

Table 321 presents the annual operating and maintenance costs and farebox revenues anticipated for the design year of the base and maximum extent bus-on-freeway plans. Under the base plan, operating and maintenance costs may be expected to approximate $41 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent bus-on-freeway plan would increase the total operating and maintenance costs for the Milwaukee area in the year 2000 by about

Table 315

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	1,218	1,197	1,218	1,141	1,218
Vehicle Miles	7,970	8,980	9,950	5,210	32,110
Vehicle Hours	290	310	370	180	1,150
Vehicles Required	130	69	156	61	156
Express and Local					
Route Miles.	1,823	1,749	1,823	1,646	1,823
Vehicle Miles	19,030	20,060	21,980	17,300	78,570
Vehicle Hours	1,250	1,270	1,460	1,060	5,040
Vehicles Required	552	227	660	180	660
Total System					
Route Miles.	3,041	2,946	3,041	2,787	3,041
Vehicle Miles	27,000	29,040	31,930	22,510	110,480
Vehicle Hours	1,540	1,580	1,830	1,240	6,190
Vehicles Required	682	296	816	241	816

Source: SEWRPC.

$25 million over the base plan, to a total cost of $66 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $3 million under the base plan, and $18 million under the maximum extent bus-on-freeway plan. Primary transit system operating and maintenance costs would thus represent nearly 8 percent of the total operating and maintenance costs expected in the design year for the base plan, and about 26 percent of the total operating and maintenance costs expected in the design year for the maximum extent bus-on-freeway plan.

The average operating and maintenance cost per passenger for the base plan in the plan design year is estimated at $0.65. For the maximum extent bus-on-freeway plan, the average cost per passenger may be expected to approach $0.98—$0.33, or 51 percent, more than the base plan cost. The average operating and maintenance cost per passenger mile would be about 11 percent greater under the maximum extent bus-on-freeway plan alternative, $0.20, compared with $0.18 for the base plan. The average operating and maintenance cost per passenger and per passenger mile for the primary element of the base plan would be $1.23 and $0.15, respectively, and for the primary element of the maximum extent bus-on-freeway plan, $1.86 and $0.15, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $25 million in 1979 dollars, compared with about $30 million under the maximum extent bus-on-freeway plan. Under the maximum extent bus-on-freeway alternative, the primary transit element could be expected to generate about 20 percent, or $6 million, of the total revenues, compared with 6 percent, or $1.5 million, for the base plan.

The operating deficit in the year 2000 for the maximum extent bus-on-freeway plan would be about $36 million, expressed in 1979 dollars, requiring a subsidy of about $0.52 per passenger. This compares with the base system plan deficit of about $16 million, or $0.26 per passenger. Farebox revenues would cover about 45 percent of operating costs under the maximum extent bus-on-freeway plan, and 61 percent of such costs under the base plan.

Table 316

CHARACTERISTICS OF TRANSIT STATIONS FOR THE BASE SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	N. 76th Street and W. Brown Deer Road	City of Milwaukee	Existing[a]	Yes	200	1	3	38	--	6	3	--	--	3	7	--	--
2	N. Green Bay Road and W. Brown Deer Road	Village of Brown Deer	Existing[a]	Yes	125	2	--	32	--	6	3	--	--	3	7	--	--
3	IH 43 and W. Brown Deer Road	Village of River Hills	Existing	Yes	300	1	1	25	24	6	3	2	2	3	7	--	--
4	N. Teutonia Avenue and W. Florist Avenue	City of Milwaukee	Existing[a]	Yes	60	1	1	30	--	2	--	--	--	--	3	--	--
5	IH 43 and W. Silver Spring Drive	Village of Glendale	Existing	Yes	190	2	6	22	19	4	2	2	2	2	7	--	--
6	W. Appleton Avenue and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	100	1	1	37	--	6	2	--	--	3	3	--	--
7	W. North Avenue and W. Lisbon Avenue	City of Milwaukee	Proposed	Yes	--	1	2	21	--	6	2	--	--	3	3	--	--
8	N. 107th Street and W. Good Hope Road	City of Milwaukee	Proposed	Yes	140	1	--	36	--	3	2	--	--	2	3	--	--
9	N. 124th Street and W. Capitol Drive	City of Wauwatosa	Existing[a]	Yes	225	1	1	33	--	4	2	--	--	3	4	--	--
10	USH 45 and W. Watertown Plank Road	City of Wauwatosa	Existing	Yes	200	1	2	26	--	5	--	--	--	--	7	--	--
11	N. Clinton Street and W. Madison Street	City of Waukesha	Existing	Yes	50	1	1	52	--	2	--	--	--	--	2	--	--
12	N. Barker Road and W. Blue Mound Road	Town of Brookfield	Existing	Yes	250	1	--	38	--	2	--	--	--	--	2	--	--
13	N. 3rd Street and W. Wisconsin Avenue	City of Milwaukee	Existing	Yes	--	16	21	--	--	60	29	2	2	30	62	--	--
14	S. 108th Street and W. Cleveland Avenue	City of West Allis	Existing[a]	Yes	250	1	3	29	--	4	3	--	--	2	4	--	--
15	S. 108th Street and STH 15	City of Greenfield	Existing	Yes	360	1	2	30	--	3	2	--	--	2	3	--	--
16	S. 76th Street and W. Cold Spring Road	City of Greenfield	Existing[a]	Yes	250	1	1	29	--	4	3	--	--	3	3	--	--
17	IH 94 and W. Ryan Road	City of Oak Creek	Proposed	Yes	100	1	--	30	--	3	--	--	--	--	3	--	--
18	IH 94 and W. College Avenue	City of Milwaukee	Existing	Yes	425	1	2	26	--	3	--	--	--	--	5	--	--
19	IH 94 and W. Holt Avenue	City of Milwaukee	Existing	Yes	240	1	2	21	--	4	4	--	--	4	4	--	--
20	S. Lake Drive and E. Lunham Avenue	City of Cudahy	Proposed	Yes	150	1	--	28	--	5	3	--	--	3	3	--	--

[a]*Station is currently, and would continue to be, part of a privately owned shopping center parking lot.*

Source: SEWRPC.

Table 317

TIME-OF-DAY OPERATION OF THE BASE SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles	449	45	449	--	449
Vehicle Miles	3,220	390	3,400	--	7,010
Vehicle Hours	136	15	147	--	298
Vehicles Required	56	3	59	--	59
Express and Local					
Route Miles	1,284	1,071	1,302	953	1,302
Vehicle Miles	150,020	15,320	18,200	11,690	60,230
Vehicle Hours	1,053	1,044	1,292	767	4,156
Vehicles Required	384	179	474	120	474
Total System					
Route Miles	1,733	1,116	1,751	953	1,751
Vehicle Miles	18,240	15,710	21,600	11,690	67,240
Vehicle Hours	1,189	1,059	1,439	767	4,454
Vehicles Required	440	182	533	120	533

Source: SEWRPC.

Table 318

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Maximum Extent Bus-on-Freeway Plan		
		Transit Trips			Transit Trips	
	Total Person Trips[a]	Number	Percent of Total Trips	Total Person Trips[a]	Number	Percent of Total Trips
Home-Based Work	962,700	80,500	8.4	962,800	91,800	9.5
Home-Based Shopping . .	506,900	28,000	5.4	506,000	33,300	6.6
Home-Based Other	1,131,100	56,800	5.0	1,127,400	66,000	5.9
Nonhome Based.	692,300	10,000	1.4	689,500	10,000	1.5
School	348,300	40,000	11.6	348,300	40,600	11.7
Total	3,641,300	215,900	5.9	3,634,000	241,700	6.7

[a] *The difference in the total person trips generated under the maximum extent bus-on-freeway plan and the total person trips generated under the base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been found to be correlated with increased automobile ownership, and greater automobile ownership has been found to be correlated with increased trip generation. The Commission travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.*

Source: SEWRPC.

Table 319

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Time of Day	Base Plan				Maximum Extent Bus-on-Freeway Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,700	47.0	52,100	24.1	10,300	27.9	57,400	23.8
Midday	300	3.0	68,800	31.9	8,900	24.2	77,800	32.2
Afternoon . .	5,000	50.0	75,800	35.1	14,700	39.8	84,400	34.9
Evening. . . .	- -	- -	19,200	8.9	3,000	8.1	22,100	9.1
Total	10,000	100.0	215,900	100.0	36,900	100.0	241,700	100.0

Source: SEWRPC.

Table 320

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Bus-on-Freeway Plan
Guideway Development[b]	$ --	$ 14,326,000
Station Development[c]	2,886,300	12,966,800
Vehicle Storage and Maintenance Facility Development[c]	18,225,000	22,450,000
Vehicle Acquisition and Replacement[d]	159,740,000	223,980,000
Total	$180,851,300	$273,722,800

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent bus-on-freeway plan would be implemented incrementally from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 to 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes for the bus-on-freeway plan the implementation cost of the proposed freeway operational control system in the Milwaukee area, which has an estimated useful life of 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—12 acres under the base plan and 34 acres under the maximum extent bus-on-freeway plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses used in the system. Both plans assume the availability of a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years.*

Source: SEWRPC.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has, in the past, funded up to 72 percent of the non-federal share.[2] The annual local share of the public funding requirement in the year 2000 would be about $5.1 million for the maximum extent bus-on-freeway system, and somewhat less, $2.2 million, for the base system.

Development of Truncated Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent bus-on-freeway system plan are summarized in Table 322. The maximum extent bus-on-freeway system plan has higher capital costs and greater operating deficits, both in total and on a per-passenger basis, than does the base plan. In addition, farebox revenues under the maximum extent bus-on-freeway system plan cover a much smaller proportion of operating costs in the plan design year than do such revenues under the base plan, particularly with respect to its primary element.

Most of the increases in the cost and decreases in the cost-effectiveness of the maximum extent bus-on-freeway system plan can be attributed to the overextension of primary transit service envi-

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[2] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, greater than the $8.0 million required to provide 50 percent federal funding of the operating deficits under the base plan, but somewhat less than the $18 million required to provide such funding under the maximum extent bus-on-freeway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Table 321

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Bus-on-Freeway Plan
Ridership		
Primary Element	2,550,000	9,409,500
Total System	62,261,000	68,801,500
Operating and Maintenance Cost		
Primary Element	$ 3,129,000	$17,505,800
Total System	40,507,100	66,142,300
Operating and Maintenance Cost per Passenger		
Primary Element	$1.23	$1.86
Systemwide Average	0.65	0.98
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.15	$0.15
Total System	0.18	0.20
Farebox Revenue		
Primary Element	$ 1,530,000	$ 6,079,200
Total System	24,518,300	30,021,600
Operating Deficit		
Primary Element	$ 1,599,000	$11,426,600
Total System	15,988,800	36,120,700
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	49	35
Total System	61	45
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 799,500	$ 5,713,300
Total System	7,914,400	18,060,350
State (72 percent of nonfederal share of operating deficit)		
Primary Element	575,640	4,113,580
Total System	5,755,970	13,003,450
Local		
Primary Element	223,860	1,599,720
Total System	2,238,430	5,056,900
Local Operating Deficit per Ride		
Primary Element	$0.09	$0.17
Total System	0.04	0.07

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.0 million required to provide 50 percent federal funding of the operating deficits under the base plan, but considerably less than the $18.1 million required to provide such funding under the maximum extent bus-on-freeway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

sioned in this plan.[3] Under the maximum extent plan, primary transit service would be extended into large areas of the Region not now served. In addition, it would be expanded into an all-day operation, and it would be provided with headways of no more than 30 minutes in the peak travel periods in the peak direction and of no more than 60 minutes otherwise. Thus, the primary

Table 322

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Bus-on-Freeway Plan
Ridership		
In Design Year	62,261,000	68,801,500
To Design Year	1,235,037,200	1,287,361,200
Capital Cost		
Total to Design Year	$180,851,300	$273,722,800
To Design Year per Passenger	0.15	0.21
To Design Year After Accounting for Useful Life Beyond Design Year	119,819,100	173,830,600
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.14
Operating Cost		
Percent Met by Farebox Revenues in Design Year	61	45
Operating Deficit in Design Year	$ 15,988,800	$ 36,120,700
Operating Deficit per Passenger in Design Year	0.26	0.52
Operating Deficit to Design Year	373,223,000	534,278,200
Operating Deficit to Design Year per Passenger	0.30	0.42
Total Cost		
To Design Year	$554,074,300	$808,001,000
Federal Share	331,292,500	486,117,340
Nonfederal Share	222,781,800	321,883,660
To Design Year per Passenger	0.45	0.63
Federal Share	0.27	0.38
Nonfederal Share	0.18	0.25
To Design Year After Accounting for Useful Life Beyond Design Year	493,042,100	708,108,800
Federal Share	282,466,800	406,203,580
Nonfederal Share	210,575,300	301,905,220
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.40	0.56
Federal Share	0.23	0.32
Nonfederal Share	0.17	0.24

Source: SEWRPC.

[3] *The extension of local and express service under the maximum extent bus-on-freeway plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express (secondary) and local (tertiary) service included in each maximum extent primary transit system plan is basically in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules were modified, however, to coordinate properly the secondary and tertiary service proposed to be provided with the primary service proposed under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered, and should, therefore, not affect a comparison of those alternatives.*

Table 323

OPERATING COST-EFFECTIVENESS OF BUS-ON-FREEWAY ROUTES OF THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicles Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
1—Port Washington	14,209	$ 722	1,844	$ 3,587	20
2—Cedarburg	9,850	500	1,140	2,218	23
3—Mequon	7,728	393	1,040	2,023	29
4—Brown Deer	23,527	1,195	1,285	2,500	48
5—River Hills	9,459	481	1,146	2,229	22
6—Northwest Side	20,563	1,044	1,042	2,027	52
7—Wauwatosa	3,471	176	1,208	2,350	7
8—West Bend	8,782	446	1,822	3,544	13
9—Germantown	6,953	353	1,274	2,478	14
10—Menomonee Falls	4,962	252	1,215	2,363	11
11—Menomonee Falls	16,753	851	1,125	2,188	39
12—Brookfield	13,324	677	1,046	2,035	33
13—Milwaukee County Institutions/UWM	422	21	524	1,019	2
14—Oconomowoc/Pewaukee	9,340	474	1,666	3,241	15
15—Oconomowoc/Delafield	9,194	467	1,728	3,361	14
16—Waukesha	15,288	777	945	1,838	42
17—East Troy	18,786	954	1,815	3,531	27
18—Hales Corners	13,331	677	1,106	2,151	31
19—Greenfield	9,669	491	778	1,513	32
20—West Allis	12,203	620	783	1,523	41
21—Stadium	3,978	202	434	844	24
22—Franklin	8,076	410	896	1,743	24
23—Kenosha	90,872	4,616	2,643	5,141	90
24—Racine	82,940	4,213	2,394	4,657	90
25—Oak Creek/Ryan Road	16,209	823	812	1,580	52
26—Oak Creek/Rawson Avenue	11,601	589	853	1,659	36
27—South Side/UWM	915	46	473	920	5
28—South Side/College Avenue	1,999	102	276	537	19
29—South Side/IH 894	8,291	421	840	1,634	26
30—South Side/Holt Avenue	11,351	577	675	1,313	44
31—Cudahy	5,239	266	464	903	29
Total	469,285	$23,840	35,292	$68,650	35

Source: SEWRPC.

transit service proposed would be a true transit service, available for tripmaking of all purposes. The cost-effectiveness of the routes on which bus-on-freeway service would be extended can be identified through a determination of what proportion of the operating costs of the routes may be expected to be recovered through farebox revenues. As shown in Table 323, only four of the routes under the maximum extent plan are expected to meet more than one-half of their operating costs through farebox revenues.

To reduce operating deficits and increase the proportion of primary transit operating costs met by farebox revenues, it was necessary to truncate the maximum extent bus-on-freeway plan. In order to do so while maintaining a framework of true primary transit service in the Milwaukee area, and, importantly, to assure reasonable comparability between all primary transit alternatives tested, this truncation was limited to reductions in the extent of service provided. Nevertheless, those bus-on-freeway facilities and services which could be reasonably cost-effective if the time periods and frequency of service offered were reduced were identified so that these reduced services could be considered for addition to the "best" primary transit system plan for this future as "specialized" transit service.[4]

Accordingly, with the objective of reducing bus-on-freeway operating deficits by increasing the proportion of bus-on-freeway operating costs met by farebox revenues to at least 50 percent, the maximum extent bus-on-freeway system plan was truncated as set forth in Table 324 and shown on Map 126. Each bus-on-freeway route for which farebox revenues were not expected to approach 50 percent of operating costs on an all-day and minimum frequency basis was cut back. However, those routes which could be expected to meet 50 percent of their operating costs through farebox revenues with reductions in time periods or frequency of service were identified for consideration later in the study, and are summarized in Table 324.

Evaluation of Maximum Extent Commuter Rail System Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is commuter rail. The maximum extent system plan developed for this technology is summarized with respect to its coverage and routes in Chapter III of this report on Map 57 and in Table 122, and is summarized with respect to its operation under this future in Tables 325 through 327. Map 53 and Table 111 of Chapter III and Tables 326, 316, and 317 provide comparable information for the base, or benchmark, plan used in the study. A description of the facilities and services of the primary, express, and local elements of both the maximum extent commuter rail plan and the base plan is provided in Chapter III of this report and will not be repeated here. Only those characteristics of the maximum extent commuter rail plan which vary between the futures, specifically, the provision of service to meet demand, will be discussed.

Under this alternative future, headways on the commuter rail primary transit element were assumed to be one-half hour in the peak period in the peak direction, and every hour otherwise. Commuter rail trains would consist of a locomotive and one coach, except on the route through Racine to Kenosha, where trains of two coaches would be used during the peak periods. Under the maximum extent commuter rail plan for this future, there would be 7,400 vehicle miles of primary transit service—

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[4] *Reductions in the time periods of service and increases in the headways operated have the potential to affect primary transit cost-effectiveness significantly. The off-peak-period operations of bus-on-freeway service under this future are less cost-effective than the peak-period operations. However, limiting bus-on-freeway service to the peak travel periods may be expected to increase only slightly the average systemwide proportion of bus-on-freeway operating costs met by farebox revenues, because under peak-period-only operation, travel on the bus-on-freeway system may be expected to be reduced to the primarily work- and school-related travel generated during the morning peak period. Nevertheless, because travel on the bus-on-freeway system during the peak periods is highly directional, being largely oriented to the Milwaukee central business district in the morning and from the central business district in the afternoon, limiting service in the peak period to the peak direction could be expected to double the proportion of bus-on-freeway operating costs met by farebox revenues. This conclusion assumes the use of satellite storage facilities for the limited number of peak-period buses required to serve the most outlying stations. Under such an arrangement, drivers would have to report to, and leave work from, the outlying stations. Otherwise, the extent of deadhead bus miles required for such a peak-period and peak-direction operation would be inconsistent with the average operating cost per revenue bus mile used to estimate the costs of bus alternatives under this study.*

To reduce the frequency of service, maximum headways in the peak periods and the peak direction were increased from 30 to 60 minutes with only a relatively small reduction in transit use and a substantial reduction in operating cost. The decrease in ridership would result from the attendant increase in wait time for transit service. First wait times under this study were assumed to approximate one-half of the headway up to a maximum of 10 minutes. Consequently, the increases in maximum headway would not affect this wait time. However, all subsequent wait times, which are attendant to transfers, were estimated at one-half of the headway with no upper limit. It should be noted that, by not permitting headways greater than 60 minutes, it was assumed that any decrease in operating costs possible through further headway increases would result in ridership and revenue reductions and a subsequent stabilization or decline in the proportion of operating costs recovered from farebox revenues. The ridership reductions would result from the inconvenient schedule.

Table 324

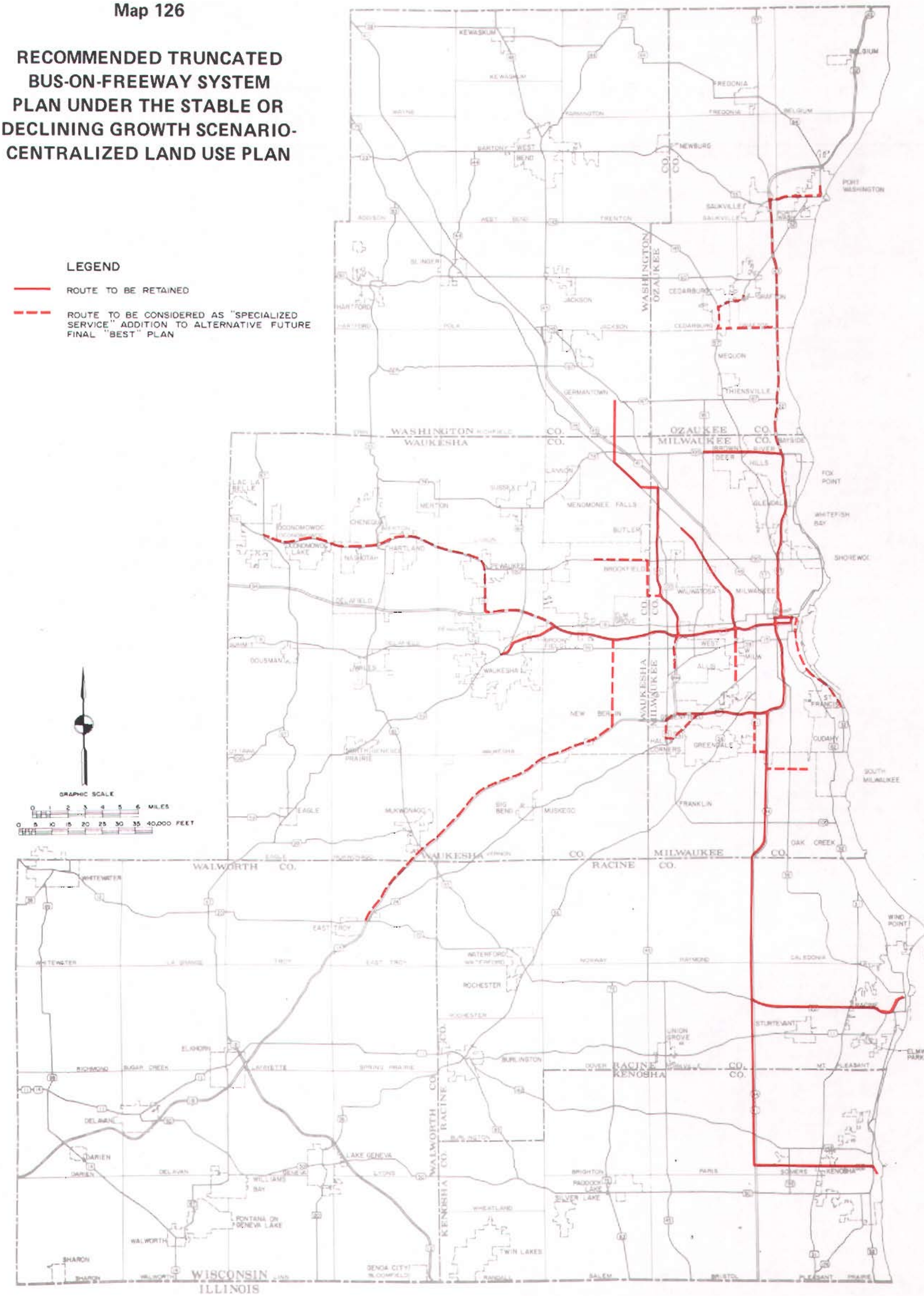
RECOMMENDED CHANGES IN THE MAXIMUM EXTENT BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Recommended Change
1—Port Washington	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
2—Cedarburg	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
3—Mequon	Route to be eliminated
5—River Hills	Route to be cut back to park-ride lot at the North-South Freeway (IH 43) and W. Silver Spring Drive
7—Wauwatosa	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways. Also, feeder loop operating over W. Burleigh Street and N. Mayfair Road to park-ride lot at Zoo Freeway (USH 45) and W. Watertown Plank Road to be dropped. Express service to N. Glenview Avenue to be cut back
8—West Bend	Route to be eliminated
9—Germantown, and 10, and 11—Menomonee Falls	Routes to be combined into one route
12—Brookfield	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
13—Milwaukee County Institutions/UWM	Route to be eliminated
14—Oconomowoc/Pewaukee	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
15—Oconomowoc/Delafield	Route to be eliminated
17—East Troy	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and peak directions, and possibly increased headways
18—Hales Corners	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
20—West Allis	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
21—Stadium	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
22—Franklin	Route to be eliminated
26—Oak Creek/Rawson Avenue	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
27—South Side/UWM	Route to be eliminated
28—South Side/College Avenue	Route to be eliminated
29—South Side/IH 894	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
30—South Side/Holt Avenue	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways
31—Cudahy	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods and possibly increased headways

Source: SEWRPC.

Map 126

RECOMMENDED TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



The maximum extent bus-on-freeway system plan shown on Map 52 in Chapter III was truncated with the objective of maximizing the number of bus-on-freeway primary transit routes for which 50 percent of the operating costs could be met with farebox revenues. A total of 9 of the 31 routes in the maximum extent plan, totaling 365 route miles in length, were proposed to be retained in the truncated plan. Thirteen of the 23 routes proposed to be deleted from the truncated plan were recommended to be considered for addition to the final "best" plan recommended for this future as specialized peak-period-only service.

Source: SEWRPC.

Table 325

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (trains per period)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	N. Maple Street and W. Grand Avenue	City of Port Washington	Proposed	Yes	30	1	--	55	55	6	3	6	6	3	6	4	4
2	IH 43 and CTH C	Town of Grafton	Proposed	Yes	25	1	--	44	44	6	3	6	6	3	6	4	4
3	IH 43 and Mequon Road	City of Mequon	Proposed	Yes	40	1	1	38	38	6	3	6	6	3	6	4	4
4	Rexleigh Drive and E. Brown Deer Road	Village of Bayside	Proposed	Yes	--	1	2	32	32	6	3	6	6	3	6	4	4
5	Railroad Street and Dekora Street	Village of Saukville	Proposed	Yes	30	1	--	58	58	6	3	6	6	3	6	4	4
6	11th Avenue and North Street	Village of Grafton	Proposed	Yes	60	1	1	51	51	6	3	6	6	3	6	4	4
7	Cardinal Avenue and Pioneer Road	City of Cedarburg	Proposed	Yes	150	1	1	44	44	6	3	6	6	3	6	4	4
8	Main Street and Friestadt Road	Village of Thiensville	Proposed	Yes	40	1	1	39	39	6	3	6	6	3	6	4	4
9	Baehr Road and Donges Bay Road	City of Mequon	Proposed	Yes	40	1	1	34	34	6	3	6	6	3	6	4	4
10	Deerbrook Trail and W. Brown Deer Road	Village of Brown Deer	Proposed	Yes	75	1	1	29	29	6	3	6	6	3	6	4	4
11	N. Teutonia Avenue and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	125	3	2	22	22	18	9	18	18	9	18	12	12
12	N. 34th Street and W. Capitol Drive	City of Milwaukee	Proposed	Yes	--	3	2	17	17	18	9	18	18	9	18	12	12
13	N. 30th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	--	3	2	13	13	18	9	18	18	9	18	12	12
14	N. 44th Street and W. Blue Mound Road	City of Milwaukee	Proposed	Yes	--	4	1	6	6	24	12	24	24	12	24	16	16
15	N. 5th Street and W. St. Paul Avenue	City of Milwaukee	Existing	Yes	--	6	3	--	--	36	18	36	36	18	36	24	24
16	Island Drive and E. Washington Street	City of West Bend	Proposed	Yes	20	1	--	64	64	6	3	6	6	3	6	4	4
17	N. Center Street and Main Street	Village of Jackson	Proposed	Yes	75	1	--	53	53	6	3	6	6	3	6	4	4
18	S. Country Aire Drive and Mequon Road	Village of Germantown	Proposed	Yes	50	1	1	42	42	6	3	6	6	3	6	4	4
19	N. 107th Street and W. Brown Deer Road	City of Milwaukee	Proposed	Yes	60	1	2	35	35	6	3	6	6	3	6	4	4
20	N. 68th Street and W. Bradley Road	City of Milwaukee	Proposed	Yes	75	1	1	29	29	6	3	6	6	3	6	4	4
21	S. Main Street and Collins Street	City of Oconomowoc	Proposed	Yes	25	1	--	62	62	6	3	6	6	3	6	4	4
22	Sawyer Road and USH 16	Town of Oconomowoc	Proposed	Yes	--	1	--	55	55	6	3	6	6	3	6	4	4
23	Lakeland Road and CTH PP	Village of Nashotah	Proposed	Yes	30	1	--	50	50	6	3	6	6	3	6	4	4
24	Cottonwood Avenue and Pawling Avenue	Village of Hartland	Proposed	Yes	75	1	--	45	45	6	3	6	6	3	6	4	4
25	W. Wisconsin Avenue and Capitol Drive	Village of Pewaukee	Proposed	Yes	75	1	1	38	38	6	3	6	6	3	6	4	4
26	Duplainville Road and Marjean Lane	Town of Pewaukee	Proposed	Yes	100	1	1	32	32	6	3	6	6	3	6	4	4
27	N. Brookfield Road and River Road	City of Brookfield	Proposed	Yes	50	1	1	27	27	6	3	6	6	3	6	4	4
28	Legion Drive and Watertown Plank Road	Village of Elm Grove	Proposed	Yes	75	1	1	19	19	6	3	6	6	3	6	4	4
29	N. 75th Street and W. State Street	City of Wauwatosa	Proposed	Yes	40	1	4	12	12	6	3	6	6	3	6	4	4
30	N. Barstow Street and Cutler Street	City of Waukesha	Proposed	Yes	75	1	1	46	46	6	3	6	6	3	6	4	4
31	Pearl Street and CTH A	Town of Waukesha	Proposed	Yes	125	1	--	40	40	6	3	6	6	3	6	4	4
32	S. Moorland Road and Honey Lane	City of New Berlin	Proposed	Yes	50	1	2	33	33	6	3	6	6	3	6	4	4
33	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	50	1	4	26	26	6	3	6	6	3	6	4	4
34	S. 70th Street and Dickinson Street	City of Milwaukee	Proposed	Yes	--	1	1	19	19	6	3	6	6	3	6	4	4
35	S. 27th Street and W. Dakota Street	City of Milwaukee	Proposed	Yes	--	1	4	12	12	6	3	6	6	3	6	4	4
36	14th Avenue and 54th Street	City of Kenosha	Existing	Yes	75	1	1	63	63	6	3	6	6	3	6	4	4
37	STH 32 and CTH E	Town of Somers	Proposed	Yes	125	1	1	57	57	6	3	6	6	3	6	4	4

Table 325 (continued)

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (trains per period)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning		Midday		Afternoon		Evening	
										In	Out	In	Out	In	Out	In	Out
38	Memorial Drive and State Street.	City of Racine	Proposed	Yes	100	1	1	45	45	6	3	6	6	3	6	4	4
39	STH 32 and Three Mile Road.	Town of Caledonia	Proposed	Yes	150	1	1	39	39	6	3	6	6	3	6	4	4
40	5th Avenue and E. Ryan Road	City of Oak Creek	Proposed	Yes	75	1	2	29	29	6	3	6	6	3	6	4	4
41	13th Avenue and E. Rawson Avenue	City of South Milwaukee	Proposed	Yes	--	1	2	22	22	6	3	6	6	3	6	4	4
42	Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	75	1	2	18	18	6	3	6	6	3	6	4	4
43	Brust Avenue and E. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	2	10	10	6	3	6	6	3	6	4	4

Source: SEWRPC.

a 5 percent increase over the level of service provided in the base plan. The number of express and local service bus miles operated would increase by about 38 percent over the number envisioned in the base plan, from about 60,230 to about 82,850 bus miles on an average weekday.

Transit Utilization: Under the maximum extent commuter rail system plan for the stable or declining growth scenario-centralized land use plan alternative future, 230,500 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 328 and 329. About 11,000, or 5 percent, of these transit trips may be expected to utilize the primary transit system for all or a portion of the trip. Thus, the maximum extent commuter rail system plan envisions that about 6 percent of the total of 3.6 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that less than 1 percent will be made using primary transit. Only 1,000 more transit trips may be expected to be made on the primary element of the commuter rail plan than on the primary element of the base plan on an average weekday. About 15,000, or 7 percent, more total transit trips may be expected under the commuter rail plan than under the base plan. Almost all this difference would occur on the local and express elements of the plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent commuter rail system plan and the base system plan are summarized in Table 330. The costs shown include all track rehabilitation and construction costs, plus the cost of all locomotive and passenger coach, and supporting bus, acquisition and replacement, as needed, over the plan design period. Most capital items required to implement the plan would have useful lives beyond the 20-year plan design period, as noted in Table 330.

The total capital cost of the base plan is estimated at $181 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain existing service to the year 2000. About $19 million, or 10 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent commuter rail plan is estimated at $305 million. About 37 percent of the total cost, or $113 million, would be required for the primary transit element of the plan.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal

Table 326

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Commuter Rail Plan
Primary Element		
Exclusive Guideway Miles		
Subway	- -	- -
Elevated	- -	- -
At-Grade	- -	157.3
Total	- -	157.3[a]
Shared Guideway Miles		
Freeways	51.5	- -
Surface Arterial Streets	49.5	- -
Total	101.0	- -
Route Miles	449	354
Vehicle Miles	7,010	7,382
Vehicle Hours	298	220
Vehicles Required	59	42
Trains Required	- -	36
Express and Local Elements		
Route Miles	1,302	1,853
Vehicle Miles	60,230	82,850
Vehicle Hours	4,156	5,270
Vehicles Required	474	730
Total System		
Route Miles	1,755	2,207
Vehicle Miles	67,240	90,230
Vehicle Hours	4,454	5,490
Vehicles Required	533	772
Trains Required	- -	36

[a]*Although commuter rail operation is designated in this table as being over an exclusive guideway, commuter trains would, in fact, operate over railway trackage shared with freight trains.*

Source: SEWRPC.

share of the total capital cost of the maximum extent commuter rail plan can be expected to approximate $61 million. The remaining $344 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal share and the federal share are estimated to total $36 million and $145 million, respectively.

Table 331 presents the annual operating and maintenance costs and farebox revenues anticipated for the design year of the base and maximum extent commuter rail plans. Under the base plan, operating and maintenance costs may be expected to approximate $41 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent commuter rail plan would increase the total operating and maintenance costs by $21 million, to a total cost of $62 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $3 million under the base plan, and $11 million under the maximum extent commuter rail plan. Primary transit system operating and maintenance costs would thus represent 8 percent of the total operating and maintenance costs expected in the design year of the base plan, and 17 percent of the total operating and maintenance costs expected in the design year of the maximum extent commuter rail plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.65. For the maximum extent commuter rail plan, the average cost per passenger may be expected to approach $0.95—$0.30, or 46 percent, more than the base plan cost. The average operating cost per passenger mile would be somewhat greater under the maximum extent commuter rail plan, $0.23, than under the base plan, $0.18. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.23 and $0.15, respectively, and for the maximum extent commuter rail plan would be $3.81 and $0.25, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $25 million, expressed in 1979 dollars, compared with $28 million under the maximum extent commuter rail plan. Under the commuter rail alternative, the primary element may be expected to generate about 9 percent, or $2.4 million, of the total revenues, compared with 6 percent, or $1.5 million, under the base plan.

The operating deficit in the year 2000 for the maximum extent commuter rail plan would be about $34 million, expressed in 1979 dollars, requiring a subsidy of about $0.51 per passenger. This compares with the base system plan deficit of about $16 million, or $0.26 per passenger. Farebox revenues could cover 45 percent of the oper-

Table 327

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	354	354	354	354	354
Vehicle Miles	1,890	2,188	1,890	1,414	7,382
Vehicle Hours	50	70	50	50	220
Vehicles (coaches) Required.	42	18	42	18	42
Trains Required	36	18	36	18	36
Express and Local					
Route Miles.	1,853	1,775	1,853	1,672	1,853
Vehicle Miles	20,710	20,560	24,260	17,320	82,850
Vehicle Hours	1,380	1,190	1,630	1,070	5,270
Vehicles Required	625	243	730	191	730
Total System					
Route Miles.	2,207	2,129	2,207	2,026	2,207
Vehicle Miles	22,600	22,750	26,150	18,730	90,230
Vehicle Hours	1,430	1,260	1,680	1,120	5,490
Vehicles Required	667	261	772	209	772
Trains Required	36	18	36	18	36

Source: SEWRPC.

ating costs under the maximum extent commuter rail plan and 61 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has, in the past, funded up to 72 percent of the nonfederal share.[5] The annual local share of the public funding requirement in the year 2000 would be about $4.8 million for the maximum extent commuter rail plan. The local funding requirement for the base system would be somewhat less—$2.2 million.

Development of Truncated Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent commuter rail system plan are summarized in Table 332. The maximum extent commuter rail system plan may be expected to have higher capital costs and greater operating deficits, both in total and on a per-passenger basis, than the base plan. In addition, the farebox revenues under the maximum extent commuter rail system plan may be expected to cover a much smaller proportion of operating costs in the plan design year than would such revenues under the base plan, particularly with respect to its primary element.

[5] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.0 million required to provide 50 percent federal funding of the operating deficit under the base plan, but somewhat less than the $17.0 million required to provide such funding under the maximum extent commuter rail plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Table 328

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Maximum Extent Commuter Rail Plan		
	Total Person Trips	Transit Trips: Number	Transit Trips: Percent of Total Trips	Total Person Trips	Transit Trips: Number	Transit Trips: Percent of Total Trips
Home-Based Work	962,700	80,500	8.4	963,100	86,100	8.9
Home-Based Shopping . .	506,900	28,000	5.5	506,400	31,900	6.3
Home-Based Other	1,131,100	56,800	5.0	1,129,000	61,900	5.5
Nonhome Based.	692,300	10,000	1.4	690,300	10,000	1.4
School	348,300	40,600	11.6	348,300	40,600	10.9
Total	3,641,300	215,900	5.9	3,637,100	230,500	6.3

Source: SEWRPC.

Table 329

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Time of Day	Base Plan				Maximum Extent Commuter Rail Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,700	47.0	52,100	24.1	3,400	30.9	54,800	23.8
Midday	300	3.0	68,800	31.9	2,600	23.6	74,300	32.2
Afternoon . .	5,000	50.0	75,800	35.1	4,000	36.4	80,600	35.0
Evening. . . .	--	--	19,200	8.9	1,000	9.1	20,800	9.0
Total	10,000	100.0	215,900	100.0	11,000	100.0	230,500	100.0

Source: SEWRPC.

Most of the increases in the cost and decreases in the cost-effectiveness of the maximum extent commuter rail system plan can be attributed to the overextension of primary transit service envisioned in this plan.[6] Under the maximum extent plan, pri-

[6] *The extension of local and express service under the maximum extent commuter rail plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express (secondary) and local (tertiary) service included in each maximum extent primary transit system plan is basically in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules were modified, however, to coordinate properly the secondary and tertiary service proposed to be provided with the primary service proposed under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered, and should, therefore, not affect a comparison of those alternatives.*

Table 330

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Commuter Rail Plan
Guideway Development	$ - -	$ 34,536,900[d]
Station Development[b]	2,886,300	8,324,800
Vehicle Storage and Maintenance Facility Development[b]	18,225,000	26,795,400
Vehicle Acquisition and Replacement[c]	159,740,000	235,810,000
Total	$180,851,300	$305,467,100

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent commuter rail plan would be implemented incrementally from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 to 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—12 acres under the base plan and 23 acres under the maximum extent commuter rail plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[c] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses and commuter rail vehicles used in all elements of the system: primary, express, and local. Both plans assume a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years. Commuter rail coaches and locomotives have an estimated useful life of 30 years.*

[d] *The Milwaukee Road has proposed major track rehabilitation work on some of the railway line segments herein considered for potential use by commuter trains. Should all of this track rehabilitation work be completed, the capital investment necessary for guideway development of the maximum extent commuter rail system would be reduced by $12,274,000 to $22,262,900. As of April 1981, such rehabilitation work in the amount of $3,454,000 had been completed by the Milwaukee Road during the 1980 and 1981 working seasons.*

Source: SEWRPC.

mary transit service would be extended into large areas of the Region not now served. In addition, it would be expanded into an all-day operation, and it would be provided at headways of no more than 30 minutes during the peak travel periods in the peak direction and 60 minutes otherwise. Thus, the primary transit service proposed would be a true transit service, available for tripmaking of all purposes. The cost-effectiveness of the routes on which commuter rail service would be extended can be identified through a determination of what proportion of the operating costs of the routes may be expected to be recovered through farebox revenues. As shown in Table 333, under the maximum extent plan only the route to Kenosha may be expected to meet about one-half of its operating costs through farebox revenues. All of the other routes are expected to meet less than 20 percent of their operating costs through farebox revenues.

To reduce operating deficits and increase the proportion of primary transit operating costs met by farebox revenues, it was necessary to truncate the maximum extent commuter rail plan. In order to do so while maintaining a framework of true primary transit service in the Milwaukee area, and, importantly, to assure reasonable comparability between all primary transit alternatives tested, this truncation was limited to reductions in the extent of service provided. Nevertheless, those commuter rail facilities and services which could be reasonably cost-effective if the time periods and

Table 331

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Commuter Rail Plan
Ridership		
Primary Element	2,550,000	2,805,000
Total System	62,261,000	66,460,000
Operating and Maintenance Cost		
Primary Element	$ 3,129,000	$10,676,900
Total System	40,507,100	62,093,900
Operating and Maintenance Cost per Passenger		
Primary Element	$1.23	$3.81
Systemwide Average	0.65	0.95
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.15	$0.25
Total System	0.18	0.23
Farebox Revenue		
Primary Element	$ 1,530,000	$ 2,402,100
Total System	24,518,300	28,078,700
Operating Deficit		
Primary Element	$ 1,599,000	$ 8,274,800
Total System	15,988,800	34,015,200
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	49	23
Total System	61	45
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 799,500	$ 4,137,400
Total System	7,994,400	17,007,600
State (72 percent of nonfederal share of operating deficit)		
Primary Element	575,600	2,978,900
Total System	5,756,000	12,245,500
Local		
Primary Element	233,900	1,158,500
Total System	2,238,400	4,762,100
Local Operating Deficit per Ride		
Primary Element	$0.09	$0.41
Total System	0.04	0.07

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, greater than the $8.0 million required to provide 50 percent federal funding of the operating deficits under the base plan, but considerably less than the $17.0 million required to provide such funding under the maximum extent commuter rail system plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

frequency of service offered were reduced were identified so that these reduced services could be considered for addition to the "best" primary transit system plan for this future as "specialized" transit service.[7]

Table 332

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Commuter Rail Plan
Ridership		
In Design Year	62,261,000	66,460,000
To Design Year	1,235,037,200	1,268,629,200
Capital Cost		
Total to Design Year	$180,851,300	$305,467,100
To Design Year per Passenger	0.15	0.24
To Design Year After Accounting for Useful Life Beyond Design Year	119,819,100	260,209,900
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.21
Operating Cost		
Percent Met by Farebox Revenues in Design Year	61	45
Operating Deficit in Design Year	$ 15,988,800	$ 34,015,200
Operating Deficit per Passenger in Design Year	0.26	0.51
Operating Deficit to Design Year	373,223,000	517,434,200
Operating Deficit to Design Year per Passenger	0.30	0.41
Total Cost		
To Design Year	$554,074,300	$822,901,300
Federal Share	331,292,500	503,090,780
Nonfederal Share	222,781,800	319,810,520
To Design Year per Passenger	0.45	0.65
Federal Share	0.27	0.39
Nonfederal Share	0.18	0.26
To Design Year After Accounting for Useful Life Beyond Design Year	493,042,100	777,644,100
Federal Share	282,466,800	466,885,000
Nonfederal Share	210,575,300	310,759,100
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.40	0.62
Federal Share	0.23	0.37
Nonfederal Share	0.17	0.25

Source: SEWRPC.

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[7] *Reductions in the time periods of service and increases in the headways operated have the potential to affect primary transit cost-effectiveness significantly. The off-peak-period operations of commuter rail service under this future are less cost-effective than the peak-period operations. However, limiting commuter rail service to the peak travel periods may be expected to increase the average systemwide proportion of commuter rail operating costs met by farebox revenues only slightly, because under such a peak-period-only operation, travel on the commuter rail system*

(footnote continued on next page)

Table 333

OPERATING COST-EFFECTIVENESS OF COMMUTER RAIL ROUTES OF THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicle Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
Kenosha	93,290	$5,230	1,920	$10,890	48
Waukesha	14,660	820	749	4,250	19
Oconomowoc	14,880	830	1,319	7,480	11
Saukville	8,240	460	1,121	6,350	7
West Bend	18,820	1,060	1,049	5,950	18
Port Washington.	18,270	1,020	1,224	6,940	15
Total	168,160	$9,420	7,382	$41,870	23

Source: SEWRPC.

(footnote 7 continued)

may be expected to be reduced to the largely work- and school-related travel carried during the morning peak period. Nevertheless, because travel on the commuter rail system during the peak periods is highly directional, being largely oriented to the Milwaukee central business district in the morning and from the central business district in the afternoon, limiting service in the peak period to the peak direction could allow for a substantial increase in the proportion of commuter rail operating costs met by farebox revenues. Reducing the frequency of service by increasing maximum headways in the peak periods and peak direction from 30 to 60 minutes could increase the percentage of the systemwide operating cost met by farebox revenues, because such an increase in headways would result in only a small reduction in transit use and a substantial reduction in operating cost. The decrease in ridership would result from the attendant increase in wait time for transit service. First wait times under this study were assumed to approximate one-half of the headway up to a maximum of 10 minutes. Consequently, increases in maximum headways would not affect this wait time. However, all subsequent wait times, which are attendant to transfers, were estimated at one-half of the headway with no upper limit. It should be noted that, by not permitting headways greater than 60 minutes, it was assumed that any decrease in operating costs possible through further headway increases would result in ridership and revenue reductions and a subsequent stabilization or decline in the proportion of operating costs recovered from farebox revenues. The ridership reductions would result from the inconvenient schedule.

Accordingly, as summarized in Table 334 and shown on Map 127, only the proposed commuter rail route to Kenosha was retained for further consideration on an all-day and minimum frequency of service basis, as the analyses indicated that this route could be expected to meet nearly 50 percent of its operating costs on such a basis through farebox revenues. However, those routes which could meet about 50 percent of their operating costs through farebox revenues with reductions in time periods or frequency of service were cut back and retained for consideration as additions to the final plan; these routes consisted of those to Oconomowoc, Saukville, and Waukesha, as summarized in Table 334.

Evaluation of Maximum Extent Light Rail Transit System Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is light rail transit. The maximum extent system plan developed for this technology is summarized with respect to its coverage and routes in Chapter III of this report on Maps 60 and 61, and with respect to its operation and station size requirements under the stable or declining growth scenario-centralized land use plan alternative future in Tables 335 and 336. Map 53 and Table 111 of Chapter III and Tables 336 and 316 of this chapter provide comparable information for the base, or benchmark, plan used in the study. A discussion of the facilities and services of the primary, express, and local elements of both the maximum extent light rail transit system plan and the base plan is included in Chapter III of this report, and will not be repeated here.

In comparison to the base plan, the maximum extent light rail system plan under this future would entail about a two-fold increase in vehicle miles of primary transit service, or 15,000 vehicle miles compared with 7,000 vehicle miles under the base plan. A significant part of this increase would be the result of the extension of primary service into off-peak travel periods during the midday and evenings, as indicated in Tables 317 and 337. About 4 percent more bus miles of express and local service would be operated under this plan than under the base plan to supplement the light rail transit service under this future—about 62,900 bus miles on an average weekday, compared with 60,200 under the base plan.

Headways on the light rail transit primary routes of the maximum extent plan under this alternative future would range from 5 to 12 minutes during the peak periods. During the off-peak periods, headways would range from 30 to 60 minutes during both the midday period and the evening. During all periods of the day, light rail transit primary service would operate with one-car trains of single-articulated vehicles.

Transit Utilization: Under the maximum extent light rail transit system plan of the stable or declining growth scenario-centralized land use plan alternative future, about 227,200 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 338 and 339. About 83,900, or 37 percent of these transit trips, may be expected to be made on the primary transit system for all or a portion of the trip. Thus, the maximum extent light rail transit system plan envisions that about 6 percent of the total 3.6 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that about 2 percent will be made using primary transit. About 11,000, or 5 percent, more transit trips may be expected to be made under this plan than under the base plan.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent light rail transit system plan and the base system plan are summarized in Table 340. The costs shown include all construction and right-of-way acquisition costs, plus the cost of acquiring and replacing vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 340.

Table 334

RECOMMENDED CHANGES IN THE MAXIMUM EXTENT COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Recommended Change
1—Port Washington	Route to be eliminated
2—Saukville	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods, and possibly peak directions, and increased headways
3—West Bend	Route to be eliminated
4—Oconomowoc	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods, and possibly peak directions, and increased headways
5—Waukesha	Route to be truncated but retained for consideration as addition to final plan, with service limited to peak periods, and possibly peak directions, and increased headways

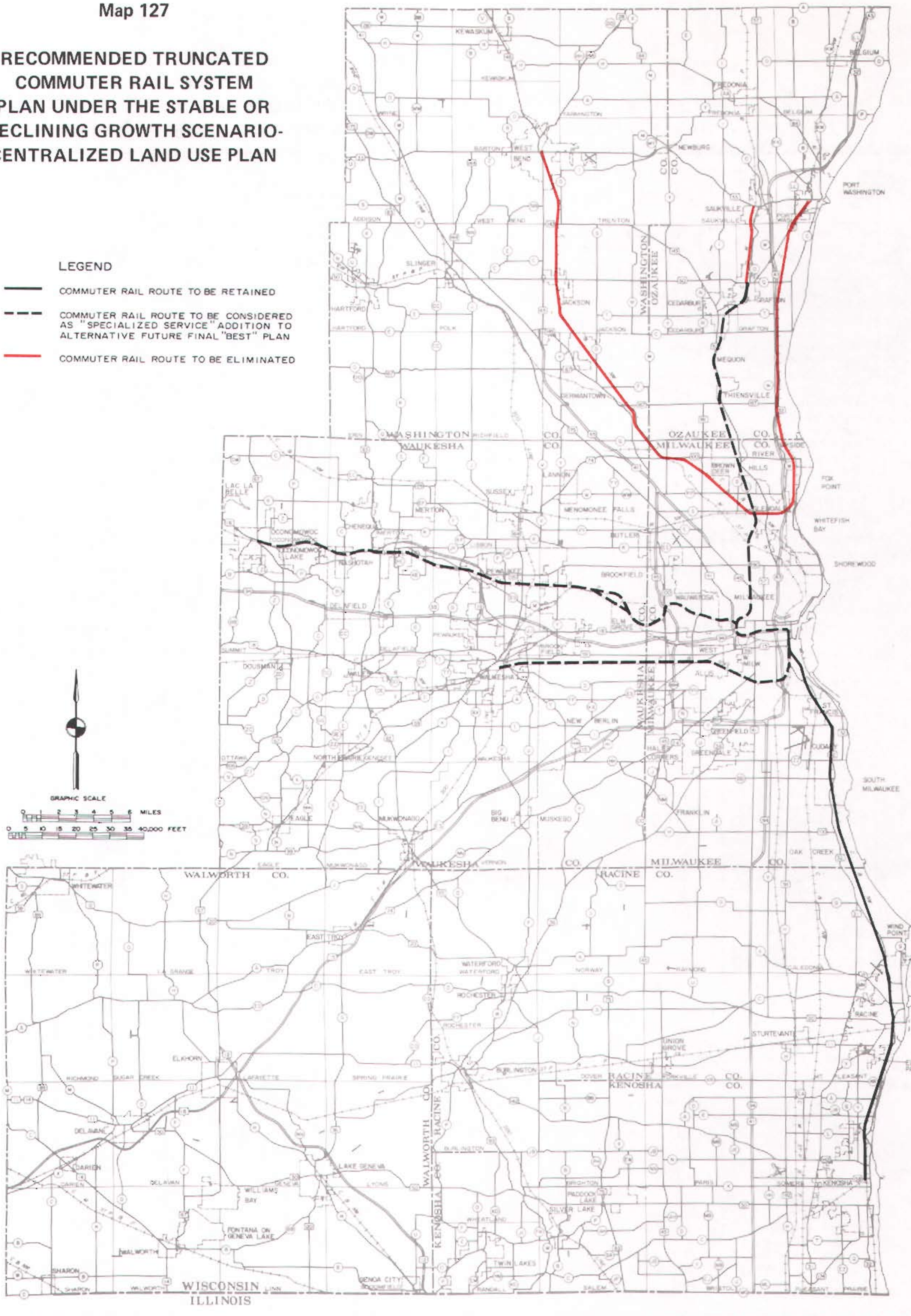
Source: SEWRPC.

The total capital cost of the base plan is estimated at $181 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain the existing service to the year 2000. About $19 million, or 10 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent light rail transit plan is estimated at $1.1 billion. About $792 million would be required for construction of the light rail guideway, including right-of-way, trackage, electrification, signalization, and system control. About $233 million would be incurred in the purchase of new and replacement of transit vehicles—$100 million of which would be for the purchase of 117 articulated light rail vehicles and about $133 million of which would be for the

Map 127

RECOMMENDED TRUNCATED COMMUTER RAIL SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



The maximum extent commuter rail system plan shown on Map 57 in Chapter III was truncated with the objective of maximizing the number of commuter rail routes for which at least 50 percent of the operating costs could be met with farebox revenues. Only one of the six routes in the maximum extent plan, totaling 66 route miles in length, was proposed to be retained in the truncated plan. However, three of the five routes deleted from the truncated commuter rail plan were recommended to be considered for addition to the final "best" plan recommended for this future as specialized peak-period-only service.

Source: SEWRPC.

Table 335

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (trains per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	W. Broadway and W. Main Street	City of Waukesha	Proposed	Yes	--	1	10	49	49	9	9	2	2	12	12	2	2
2	E. Broadway and Pleasant Street	City of Waukesha	Proposed	Yes	--	1	1	47	47	9	9	2	2	12	12	2	2
3	Lincoln Avenue and Lake Street	City of Waukesha	Proposed	Yes	--	1	--	45	45	9	9	2	2	12	12	2	2
4	Lincoln Avenue and Frederick Street	City of Waukesha	Proposed	Yes	--	1	1	43	43	9	9	2	2	12	12	2	2
5	CTH A and Pearl Street	City of Waukesha	Proposed	Yes	400	1	--	40	40	9	9	2	2	12	12	2	2
6	Johnson Road	City of New Berlin	Proposed	--	125	1	--	37	37	9	9	2	2	12	12	2	2
7	Calhoun Road and Rogers Drive	City of New Berlin	Proposed	Yes	200	1	--	34	34	9	9	2	2	12	12	2	2
8	Moorland Road and Rogers Drive	City of New Berlin	Proposed	Yes	--	1	2	32	32	9	9	2	2	12	12	2	2
9	Sunny Slope Road and Honey Lane	City of New Berlin	Proposed	--	--	1	--	30	30	9	9	2	2	12	12	2	2
10	S. 124th Street and Honey Lane	City of New Berlin	Proposed	--	--	1	--	28	28	9	9	2	2	12	12	2	2
11	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	--	1	5	26	26	9	9	2	2	12	12	2	2
12	S. 98th Street and W. Washington Street	City of West Allis	Proposed	Yes	--	1	2	23	23	9	9	2	2	12	12	2	2
13	N. 92nd Street and W. Dixon Street	City of Milwaukee	Proposed	Yes	175	1	--	21	21	9	9	2	2	12	12	2	2
14	N. 84th Street and W. Hawthorne Avenue	City of Milwaukee	Proposed	Yes	--	2	2	18	18	17	14	3	3	17	22	3	3
15	N. 76th Street and W. Fairview Avenue	City of Milwaukee	Proposed	Yes	--	2	1	17	17	17	14	3	3	17	22	3	3
16	N. 68th Street and W. Fairview Avenue	City of Milwaukee	Proposed	Yes	--	2	1	16	16	17	14	3	3	17	22	3	3
17	N. Hawley Road and W. Fairview Avenue	City of Milwaukee	Proposed	Yes	--	2	1	14	14	17	14	3	3	17	22	3	3
18	County Stadium and Mitchell Boulevard	City of Milwaukee	Proposed	Yes	200	2	--	13	13	17	14	3	3	17	22	3	3
19	County Stadium and N. 44th Street	City of Milwaukee	Proposed	Yes	175	3	--	11	11	22	19	4	4	25	30	4	4
20	N. 35th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	--	3	3	7	7	24	21	5	5	25	30	5	5
21	N. 27th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	--	3	4	6	6	24	21	5	5	25	30	5	5
22	N. 21st Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	--	3	3	4	4	24	21	5	5	25	30	5	5
23	N. 16th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	--	3	5	3	3	24	21	5	5	25	30	5	5
24	N. 12th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	--	3	6	2	2	24	21	5	5	25	30	5	5
25	N. 6th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	--	4	7	--	--	31	28	6	6	33	38	6	6
26	N. Plankinton Avenue and E. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	--	2	10	2	2	14	17	3	3	22	17	3	3
27	N. Broadway Street and E. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	--	2	8	3	3	14	17	3	3	22	17	3	3
28	N. Jackson Street and E. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	--	2	7	4	4	14	17	3	3	22	17	3	3
29	N. Jackson Street and E. Kilbourn Avenue	City of Milwaukee	Proposed	Yes	--	1	1	5	5	14	--	3	--	22	--	3	--
30	N. Van Buren Street and E. Kilbourn Avenue	City of Milwaukee	Proposed	Yes	--	1	1	--	--	--	17	--	3	--	17	--	3
31	N. Jackson Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	--	2	1	7	7	14	--	3	--	22	--	3	--
32	N. Van Buren Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	--	2	1	--	--	--	17	--	3	--	17	--	3
33	N. Astor Street and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	--	2	2	8	8	14	17	3	3	22	17	3	3
34	N. Farwell Avenue and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	--	2	1	9	9	14	17	3	3	22	17	3	3
35	N. Farwell Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	--	2	2	10	10	14	--	3	--	22	--	3	--
36	N. Prospect Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	--	2	1	--	--	--	17	--	3	--	17	--	3
37	N. Farwell Avenue and E. Kenilworth Place	City of Milwaukee	Proposed	Yes	--	2	1	12	12	14	17	3	3	22	17	3	3
38	N. Oakland Avenue and E. North Avenue	City of Milwaukee	Proposed	Yes	--	2	3	13	13	14	17	3	3	22	17	3	3
39	N. Cambridge Avenue and E. Locust Street	City of Milwaukee	Proposed	Yes	--	2	2	15	15	14	17	3	3	22	17	3	3
40	N. Oakland Avenue and E. Kenwood Boulevard	City of Milwaukee	Proposed	Yes	--	2	1	16	16	14	17	3	3	22	17	3	3
41	N. Maryland Avenue and E. Kenwood Boulevard	City of Milwaukee	Proposed	Yes	--	2	6	16	16	14	17	3	3	22	17	3	3

Table 335 (continued)

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (trains per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning		Midday		Afternoon		Evening	
										In	Out	In	Out	In	Out	In	Out
42	N. Maryland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	- -	2	4	21	21	14	17	3	3	22	17	3	3
43	N. Oakland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	22	22	14	17	3	3	22	17	3	3
44	Wisconsin Avenue and Broad Street	Village of Grafton	Proposed	Yes	- -	1	1	52	52	7	7	1	1	8	8	1	1
45	1st Avenue and Maple Street	Village of Grafton	Proposed	Yes	150	1	- -	51	51	7	7	1	1	8	8	1	1
46	Cedar Ridge Drive and Georgetown Drive	City of Cedarburg	Proposed	Yes	- -	1	1	49	49	7	7	1	1	8	8	1	1
47	STH 143 (Washington Avenue) and Turner Street	City of Cedarburg	Proposed	- -	- -	1	1	47	47	7	7	1	1	8	8	1	1
48	Grant Avenue and Western Road	City of Cedarburg	Proposed	- -	- -	1	1	45	45	7	7	1	1	8	8	1	1
49	STH 57 and CTH C (Pioneer Road).	City of Mequon	Proposed	Yes	150	1	- -	43	43	7	7	1	1	8	8	1	1
50	STH 57 (Main Street) and Freistadt Road	Village of Thiensville	Proposed	Yes	- -	1	1	38	38	7	7	1	1	8	8	1	1
51	STH 57 (Green Bay Road) and STH 67 (Mequon Road)	City of Mequon	Proposed	Yes	100	1	- -	36	36	7	7	1	1	8	8	1	1
52	Garden Drive and W. County Line Road. . .	Village of Brown Deer	Proposed	Yes	- -	1	- -	32	32	7	7	1	1	8	8	1	1
53	N. Deerbrook Terrace and STH 100 (W. Brown Deer Road) . .	Village of Brown Deer	Proposed	Yes	- -	1	1	30	30	7	7	1	1	8	8	1	1
54	N. Cedarburg Road and W. Bradley Road.	Village of Brown Deer	Proposed	Yes	- -	1	1	23	28	7	7	1	1	8	8	1	1
55	N. Teutonia Avenue and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	- -	1	2	26	26	7	7	1	1	8	8	1	1
56	N. Sidney Place and W. Mill Road	City of Glendale	Proposed	Yes	175	1	1	24	24	7	7	1	1	8	8	1	1
57	N. Dexter Avenue and W. Silver Spring Drive. . .	City of Glendale	Proposed	Yes	- -	1	1	22	22	7	7	1	1	8	8	1	1
58	N. 20th Street and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	19	19	7	7	1	1	8	8	1	1
59	W. Atkinson Avenue and W. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	1	15	15	12	15	2	2	18	13	2	2
60	N. 16th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	1	12	12	7	7	1	1	8	8	1	1
61	N. 8th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	9	9	7	7	1	1	8	8	1	1
62	N. 8th Street and W. Burleigh Street.	City of Milwaukee	Proposed	Yes	- -	1	2	8	8	7	- -	1	- -	8	- -	1	- -
63	N. 7th Street and W. Burleigh Street.	City of Milwaukee	Proposed	Yes	- -	1	2	- -	- -	- -	7	- -	1	- -	8	- -	1
64	N. 8th Street and W. Center Street	City of Milwaukee	Proposed	Yes	- -	1	2	7	7	7	- -	1	- -	8	- -	1	- -
65	N. 7th Street and W. Center Street	City of Milwaukee	Proposed	Yes	- -	1	2	- -	- -	- -	7	- -	1	- -	8	- -	1
66	N. 8th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	5	5	7	- -	1	- -	8	- -	1	- -
67	N. 7th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	- -	1	3	- -	- -	- -	7	- -	1	- -	8	- -	1
68	N. 6th Street and W. Walnut Street.	City of Milwaukee	Proposed	Yes	- -	1	2	4	4	7	7	1	1	8	8	1	1
69	N. 6th Street and W. Juneau Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	2	2	7	7	1	1	8	8	1	1
70	N. 6th Street and W. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	2	1	1	7	7	1	1	8	8	1	1
71	N. 6th Street and W. St. Paul Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	2	2	14	14	3	3	16	16	3	3
72	S. 6th Street and W. Alexander Street. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	4	4	14	14	3	3	16	16	3	3
73	S. 6th Street and W. National Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	4	- -	- -	- -	14	- -	3	- -	16	- -	3
74	S. 5th Street and W. National Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	4	6	6	14	- -	3	- -	16	- -	3	- -
75	S. 5th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	2	- -	- -	- -	14	- -	3	- -	16	- -	3
76	S. 4th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	14	- -	3	- -	16	- -	3	- -
77	S. 5th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	- -	2	3	- -	- -	- -	14	- -	3	- -	16	- -	3
78	S. 4th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	- -	1	3	9	9	14	- -	3	- -	16	- -	3	- -
79	S. 5th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	- -	- -	- -	7	- -	1	- -	8	- -	1
80	S. 4th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	11	4	7	- -	1	- -	8	- -	1	- -
81	S. Chase Avenue and W. Rosedale Avenue. . . .	City of Milwaukee	Proposed	Yes	300	1	- -	13	6	7	7	1	1	8	8	1	1

Table 335 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (trains per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
82	S. Chase Avenue and W. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	2	14	8	7	7	1	1	8	8	1	1
83	S. Howell Avenue and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	--	1	2	15	9	7	7	1	1	8	8	1	1
84	S. Howell Avenue and W. Howard Avenue	City of Milwaukee	Proposed	Yes	--	1	2	17	17	7	7	1	1	8	8	1	1
85	S. Howell Avenue and W. Layton Avenue.	City of Milwaukee	Proposed	Yes	--	1	2	19	19	7	7	1	1	8	8	1	1
86	General Mitchell Field . . .	City of Milwaukee	Proposed	Yes	125	1	2	21	21	7	7	1	1	8	8	1	1
87	S. Howell Avenue and W. College Avenue.	City of Milwaukee	Proposed	Yes	--	1	2	23	23	7	7	1	1	8	8	1	1
88	S. Howell Avenue and W. Marquette Avenue . . .	City of Oak Creek	Proposed	Yes	--	1	2	27	27	7	7	1	1	8	8	1	1
89	S. Howell Avenue and W. Forest Hill Avenue. . .	City of Oak Creek	Proposed	Yes	--	1	2	29	29	7	7	1	1	8	8	1	1
90	S. Howell Avenue and W. Ryan Road	City of Oak Creek	Proposed	Yes	150	1	1	32	32	7	7	1	1	8	8	1	1
91	STH 175 (Appleton Avenue) and Menomonee Avenue. . . .	Village of Menomonee Falls	Proposed	Yes	--	1	2	44	44	7	7	1	1	8	8	1	1
92	STH 175 (Appleton Avenue) and North Hills Drive	Village of Menomonee Falls	Proposed	Yes	175	1	1	42	42	7	7	1	1	8	8	1	1
93	STH 175 (Appleton Avenue) and Parkway Drive	Village of Menomonee Falls	Proposed	Yes	--	1	--	36	36	7	7	1	1	8	8	1	1
94	USH 41 (W. Appleton Avenue) and W. Bobolink Avenue	City of Milwaukee	Proposed	Yes	--	1	2	33	33	7	7	1	1	8	8	1	1
95	Timmerman Field.	City of Milwaukee	Proposed	Yes	225	1	2	32	32	7	7	1	1	8	8	1	1
96	USH 41 (W. Appleton Avenue) and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	2	29	29	7	7	1	1	8	8	1	1
97	N. 76th Street and W. Appleton Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	3	28	28	7	7	1	1	8	8	1	1
98	N. 68th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	--	2	1	24	24	12	15	2	2	18	13	2	2
99	Capitol Court Shopping Center.	City of Milwaukee	Proposed	Yes	250	2	2	23	23	12	15	2	2	18	13	2	2
100	W. Fond du Lac Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	--	2	2	21	21	12	15	2	2	18	13	2	2
101	N. Sherman Boulevard and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	--	3	2	19	19	12	20	3	3	24	19	3	3
102	N. Sherman Boulevard and W. Fond du Lac Avenue .	City of Milwaukee	Proposed	Yes	--	2	2	18	18	12	12	3	3	14	14	3	3
103	N. Sherman Boulevard and W. Burleigh Street . .	City of Milwaukee	Proposed	Yes	--	2	2	17	17	12	12	3	3	14	14	3	3
104	N. Sherman Boulevard and W. Center Street . . .	City of Milwaukee	Proposed	Yes	--	2	2	15	15	12	12	3	3	14	14	3	3
105	N. Sherman Boulevard and W. North Avenue. . .	City of Milwaukee	Proposed	Yes	--	2	3	14	14	12	12	3	3	14	14	3	3
106	N. 40th Street and W. Lisbon Avenue.	City of Milwaukee	Proposed	Yes	--	2	2	12	12	12	12	3	3	14	14	3	3
107	W. Highland Boulevard and W. McKinley Avenue . . .	City of Milwaukee	Proposed	Yes	--	2	2	11	11	12	12	3	3	14	14	3	3
108	N. 41st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	--	2	1	9	9	12	12	3	3	14	14	3	3
109	S. Kinnickinnic Avenue and E. Becher Street . . .	City of Milwaukee	Proposed	Yes	--	1	3	12	12	7	7	2	2	8	8	2	2
110	S. Bay Street and E. Lincoln Avenue.	City of Milwaukee	Proposed	Yes	175	1	1	14	14	7	7	2	2	8	8	2	2
111	S. Bay Street and E. Russell Avenue	City of Milwaukee	Proposed	Yes	--	1	1	16	16	7	7	2	2	8	8	2	2
112	S. Nevada Street and S. Kinnickinnic Avenue. .	City of Milwaukee	Proposed	Yes	--	1	2	17	17	7	7	2	2	8	8	2	2
113	S. Brust Avenue and E. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	2	18	13	7	7	2	2	8	8	2	2
114	S. Ellen Street and E. Morgan Avenue.	City of Milwaukee	Proposed	--	--	1	1	19	19	7	7	2	2	8	8	2	2
115	S. Bombay Avenue and E. Crawford Avenue. . . .	City of St. Francis	Proposed	Yes	100	1	1	21	21	7	7	2	2	8	8	2	2
116	S. Kinnickinnic Avenue and Lunham Avenue . . .	City of St. Francis	Proposed	Yes	--	1	1	23	23	7	7	2	2	8	8	2	2
117	S. Kinnickinnic Avenue and E. Layton Avenue . .	City of Cudahy	Proposed	Yes	--	1	2	24	24	7	7	2	2	8	8	2	2
118	S. Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	275	1	1	26	26	7	7	2	2	8	8	2	2
119	Edgar Avenue and E. College Avenue.	City of Cudahy	Proposed	Yes	--	1	2	28	28	7	7	2	2	8	8	2	2
120	E. Rawson Avenue	City of South Milwaukee	Proposed	Yes	--	1	1	30	30	7	7	2	2	8	8	2	2
121	Marquette Avenue	City of South Milwaukee	Proposed	Yes	--	1	2	31	31	7	7	2	2	8	8	2	2

Table 335 (continued)

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (trains per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
122	S. 9th Avenue and E. Drexel Avenue	City of South Milwaukee	Proposed	Yes	250	1	--	33	33	7	7	2	2	8	8	2	2
123	Northridge Shopping Center.	City of Milwaukee	Proposed	Yes	275	1	5	39	42	5	5	1	1	6	6	1	1
124	N. 76th Street and W. Bradley Road.	City of Milwaukee	Proposed	Yes	125	1	3	35	38	5	5	1	1	6	6	1	1
125	N. 76th Street and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	--	1	3	33	36	5	5	1	1	6	6	1	1
126	N. 60th Street and W. Mill Road.	City of Milwaukee	Proposed	Yes	--	1	2	30	33	5	5	1	1	6	6	1	1
127	N. Sherman Boulevard and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	175	1	2	28	30	5	5	1	1	6	6	1	1
128	N. Sherman Boulevard and W. Villard Avenue . .	City of Milwaukee	Proposed	Yes	--	1	3	26	29	5	5	1	1	6	6	1	1
129	N. Sherman Boulevard and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	2	25	27	5	5	1	1	6	6	1	1
130	N. Sherman Boulevard and W. Congress Street . .	City of Milwaukee	Proposed	Yes	--	1	1	23	26	5	5	1	1	6	6	1	1
131	S. 44th Street and W. National Avenue. . . .	Village of West Milwaukee	Proposed	Yes	--	1	2	15	17	5	5	1	1	6	6	1	1
132	S. 43rd Street and W. Greenfield Avenue. . .	Village of West Milwaukee	Proposed	Yes	--	1	1	16	19	5	5	1	1	6	6	1	1
133	S. 43rd Street and W. Burnham Street	Village of West Milwaukee	Proposed	Yes	--	1	1	17	20	5	5	1	1	6	6	1	1
134	S. 43rd Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	225	1	1	19	21	5	5	1	1	6	6	1	1
135	S. 43rd Street and W. Cleveland Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	--	20	23	5	5	1	1	6	6	1	1
136	S. 43rd Street and W. Oklahoma Avenue. . .	City of Milwaukee	Proposed	Yes	--	1	3	22	24	5	5	1	1	6	6	1	1
137	S. 43rd Street and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	--	1	2	23	25	5	5	1	1	6	6	1	1
138	S. 43rd Street and W. Howard Avenue	City of Greenfield	Proposed	Yes	175	1	1	24	27	5	5	1	1	6	6	1	1
139	S. 60th Street and W. Plainfield Avenue . . .	City of Greenfield	Proposed	--	--	1	1	27	30	5	5	1	1	6	6	1	1
140	W. Forest Home Avenue and W. Plainfield Avenue	City of Greenfield	Proposed	Yes	--	1	2	29	31	5	5	1	1	6	6	1	1
141	S. 76th Street and W. Layton Avenue.	City of Greenfield	Proposed	Yes	--	1	5	32	34	5	5	1	1	6	6	1	1
142	N. 9th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	--	3	6	1	1	24	21	5	5	25	30	5	5
143	Southridge Shopping Center.	Village of Greendale	Proposed	Yes	150	1	6	35	38	5	5	1	1	6	6	1	1
144	N. Glenview Avenue and W. Wisconsin Avenue . . .	City of Wauwatosa	Proposed	Yes	--	1	4	18	18	8	5	1	1	10	5	1	1
145	Milwaukee County General Hospital.	City of Wauwatosa	Proposed	--	--	1	5	22	22	8	5	1	1	10	5	1	1
146	County Institutions.	City of Wauwatosa	Proposed	--	--	1	5	24	24	8	5	1	1	10	5	1	1
147	N. Swan Boulevard and W. Watertown Plank Road.	City of Wauwatosa	Proposed	Yes	200	1	1	26	26	8	5	1	1	10	5	1	1
148	Mayfair Mall Shopping Center.	City of Wauwatosa	Proposed	Yes	125	1	7	30	30	8	5	1	1	10	5	1	1
149	N. Mayfair Road and W. Center Street.	City of Wauwatosa	Proposed	Yes	--	1	3	32	32	5	8	1	1	5	10	1	1
150	N. Mayfair Road and W. Burleigh Street.	City of Wauwatosa	Proposed	Yes	--	1	2	34	34	5	8	1	1	5	10	1	1
151	N. Mayfair Road and W. Capitol Drive.	City of Wauwatosa	Proposed	Yes	--	1	2	33	36	5	8	1	1	5	10	1	1
152	W. Lisbon Avenue and W. Capitol Drive.	City of Milwaukee	Proposed	--	--	1	2	32	34	5	8	1	1	5	10	1	1
153	N. 92nd Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	--	1	2	30	33	5	8	1	1	5	10	1	1
154	N. 84th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	--	1	1	29	32	5	8	1	1	5	10	1	1
155	N. 76th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	--	1	3	28	30	5	8	1	1	5	10	1	1
156	N. 35th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	--	1	2	20	22	5	8	1	1	5	10	1	1
157	N. 27th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	--	1	2	19	21	5	8	1	1	5	10	1	1
158	W. Green Bay Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	--	1	2	19	22	5	3	1	1	5	10	1	1
159	N. Port Washington Road and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	--	1	2	20	23	5	3	1	1	5	10	1	1
160	N. Richards Street and E. Capitol Drive	City of Milwaukee	Proposed	Yes	--	1	2	22	25	5	3	1	1	5	10	1	1
161	N. Humboldt Boulevard and E. Capitol Drive. . . .	City of Milwaukee	Proposed	Yes	--	1	2	23	26	5	3	1	1	5	10	1	1
162	Morris Boulevard and E. Menlo Boulevard	Village of Shorewood	Proposed	Yes	--	1	1	26	26	5	3	1	1	5	10	1	1

Source: SEWRPC.

Table 336

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Light Rail Transit Plan
Primary Element		
Exclusive Guideway Miles		
Subway	- -	- -
Elevated	- -	8.0
At-Grade	- -	94.3
Total	- -	102.3
Shared Guideway Miles		
Freeways	51.5	- -
Surface Arterial Streets	49.5	2.2
Total	101.0	104.5
Route Miles	449	253
Vehicle Miles	7,010	14,970
Vehicle Hours	298	750
Vehicles Required	59	114
Trains Required	- -	114
Express and Local Elements		
Route Miles	1,302	1,660
Vehicle Miles	60,230	62,900
Vehicle Hours	4,156	4,120
Vehicles Required	474	530
Total System		
Route Miles	1,755	1,913
Vehicle Miles	67,240	77,870
Vehicle Hours	4,454	4,870
Vehicles Required	533	627
Trains Required	- -	114

Source: SEWRPC.

purchase of 959 conventional buses. The remaining $82 million would be incurred in the construction of park-ride stations and of light rail storage, maintenance, and layover facilities, and the expansion of bus storage and maintenance facilities. About $960 million, or over 87 percent of the total capital cost of the plan, would be attributable to its primary transit element.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent light rail transit plan would approximate $221 million. The remaining $886 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal share and the federal share are estimated to total $36 million and $145 million, respectively.

Table 341 presents the estimated design year operating and maintenance costs and farebox revenues of the base and maximum extent light rail transit plans. Under the base plan, operating and maintenance costs may be expected to approximate $41 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent light rail transit plan would increase the total operating and maintenance costs for the Milwaukee area in the year 2000 by about $11 million to a total cost of about $52 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $3 million under the base plan, and $13 million under the maximum extent light rail transit plan. Primary transit system operating and maintenance costs would thus represent about 8 percent of the total operating and maintenance costs expected in the design year for the base plan, and about 25 percent of the total operating and maintenance costs expected in the design year for the maximum extent light rail transit plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.65. For the maximum extent light rail transit system plan, the average operating cost per passenger may be expected to approach $0.81—$0.16, or 25 percent, more than the base plan cost. The average operating cost per passenger mile would also be higher under the maximum extent light rail transit plan, $0.21, compared with $0.18 for the base plan. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.23 and $0.15, respectively, and for the primary element only of the maximum extent light rail transit plan, $0.59 and $0.12, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is $25 million, expressed in

Table 337

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	354	253	253	253	253
Vehicle Miles	5,290	2,010	6,320	1,350	14,970
Vehicle Hours	260	100	320	70	750
Vehicles Required	96	18	114	18	114
Trains Required	96	18	114	18	114
Express and Local					
Route Miles.	1,660	1,586	1,660	1,558	1,660
Vehicle Miles	14,230	17,470	15,600	15,600	62,900
Vehicle Hours	960	1,140	1,060	960	4,120
Vehicles Required	478	205	513	168	530
Total System					
Route Miles.	1,913	1,839	1,913	1,811	1,913
Vehicle Miles	19,520	19,480	21,920	16,950	77,870
Vehicle Hours	1,220	1,240	1,380	1,030	4,870
Vehicles Required	574	223	627	186	627
Trains Required	96	18	114	18	114

Source: SEWRPC.

1979 dollars, compared with about $27 million under the maximum extent light rail transit plan. Under the maximum extent light rail transit alternative, the primary transit element would be expected to generate about 38 percent, or about $10 million, of the total revenues, compared with 6 percent, or $1.5 million, for the base plan.

The operating deficit in the year 2000 for the maximum extent light rail transit plan would be about $25 million, expressed in 1979 dollars, requiring a subsidy of about $0.39 per passenger. This compares with the base system plan deficit of about $16 million, or $0.26 per passenger. Farebox revenues would cover about 53 percent of the operating costs under the maximum extent light rail transit plan, and 61 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has, in the past, funded up to 72 percent of the non-federal share.[8] The local share of the public funding requirement of the maximum extent light rail transit plan would be about $3.4 million in the plan design year, and the local funding requirement for the base system would be somewhat less, about $2.2 million.

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[8] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.0 million required to provide 50 percent federal funding of the operating deficits under the base plan, but less than the $12 million required to provide such funding under the maximum extent light rail transit plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Table 338

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

	Base Plan			Maximum Extent Light Rail Transit Plan		
		Transit Trips			Transit Trips	
Trip Purpose	Total Person Trips[a]	Number	Percent of Total Trips	Total Person Trips[a]	Number	Percent of Total Trips
Home-Based Work	962,700	80,500	8.4	962,900	92,300	9.6
Home-Based Shopping . .	506,900	28,000	5.5	505,200	28,800	5.7
Home-Based Other	1,131,100	56,800	5.0	1,124,300	56,700	5.0
Nonhome Based.	692,300	10,000	1.4	687,000	8,800	1.3
School	348,300	40,600	11.6	348,400	40,600	11.5
Total	3,641,300	215,900	5.9	3,627,800	227,200	6.3

[a] *The difference in the total person trips generated under the maximum extent light rail transit plan and the total person trips generated under the base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been found to be correlated with increased automobile ownership, and greater automobile ownership has been found to be correlated with increased trip generation. The Commission travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.*

Source: SEWRPC.

Table 339

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

	Base Plan				Maximum Extent Light Rail Transit Plan			
	Primary Element		Total System		Primary Element		Total System	
Time of Day	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,700	47.0	52,100	24.1	28,600	34.1	56,400	24.8
Midday	300	3.0	68,800	31.9	11,600	13.8	70,600	31.1
Afternoon . .	5,000	50.0	75,800	35.1	38,300	45.7	80,100	35.3
Evening. . . .	- -	- -	19,200	8.9	5,400	6.4	20,100	8.8
Total	10,000	100.0	215,900	100.0	83,900	100.0	227,200	100.0

Source: SEWRPC.

Development of Truncated Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent light rail transit system plan are summarized in Table 342. The maximum extent light rail transit plan has significantly higher capital costs, both in total and on a per-passenger basis, as well as a greater operating deficit, than does the base plan. In addition, farebox revenues meet a smaller proportion of total operating costs under the light rail transit plan than under the base plan. Consequently, the total cost per passenger to the design year of the maximum extent light rail transit plan is more than twice that of the base plan under this future. It was therefore necessary to truncate this maximum extent light rail transit plan.

Table 340

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Light Rail Transit Plan
Guideway Development[b]	$ --	$ 792,348,000
Station Development[c]	2,886,300	31,940,600
Vehicle Storage and Maintenance Facility Development[c]	18,225,000	49,736,100
Vehicle Acquisition and Replacement[d]	159,740,000	232,860,000
Total	$180,851,300	$1,106,884,700

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent light rail transit plan will be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 through 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes the cost of acquiring about 203 acres of right-of-way for guideway construction, and of acquiring and relocating five residential structures and three steel lattice electric power transmission towers. This land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—12 acres under the base plan and 61 acres under the maximum extent light rail transit plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses and light rail vehicles used in the system. Both plans assume a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years. Light rail vehicles have an estimated useful life of 30 years.*

Source: SEWRPC.

Some of the increases in capital costs and operating deficits under the maximum extent light rail transit plan can be attributed to the overextension of service envisioned in this plan.[9] Under the plan, primary transit service on exclusive guideway would be extended into portions of the Milwaukee area not now served; would be expanded into an all-day operation; and would be provided at headways of no more than 30 minutes in the peak period and peak direction and no more than 60 minutes otherwise.

The less cost-effective elements of the primary element of the maximum extent light rail transit system plan with respect to operating costs can, in part, be identified on a route-by-route basis through a determination of what proportion of the operating costs of the routes may be expected to be

[9] *The extension of local and express service under the maximum extent light rail transit plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express (secondary) and local (tertiary) service included in each maximum extent primary transit system plan is in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules were modified, however, to coordinate properly the secondary and tertiary service proposed to be provided with the primary service proposed in the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered, and should, therefore, not affect a comparison of those alternatives.*

Table 341

PRIMARY AND TOTAL TRANSIT SYSTEM OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Light Rail Transit Plan
Ridership		
Primary Element.	2,550,000	21,394,400
Total System.	62,261,000	62,951,500
Operating and Maintenance Cost		
Primary Element.	$ 3,129,000	$12,716,900
Total System.	40,507,100	51,752,600
Operating and Maintenance Cost per Passenger		
Primary Element.	$1.23	$0.59
Systemwide Average	0.65	0.81
Operating and Maintenance Cost per Passenger Mile		
Primary Element.	$0.15	$0.12
Total System.	0.18	0.21
Farebox Revenue		
Primary Element.	$ 1,530,000	$10,480,000
Total System.	24,518,300	27,179,500
Operating Deficit		
Primary Element.	$ 1,599,000	$ 2,236,900
Total System.	15,988,800	24,573,100
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element.	49	82
Total System.	61	53
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 799,500	$ 1,118,450
Total System	7,994,400	12,286,550
State (72 percent of nonfederal share of operating deficit)		
Primary Element	575,640	805,280
Total System	5,755,970	8,846,320
Local		
Primary Element	223,860	313,170
Total System	2,238,430	3,440,230
Local Operating Deficit per Ride		
Primary Element.	$0.09	$0.01
Total System.	0.04	0.05

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.0 million required to provide 50 percent federal funding of the operating deficits under the base plan, but slightly less than the $12.3 million required to provide such funding under the maximum extent light rail transit plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

recovered through farebox revenues. As shown in Table 343, about 82 percent of the total light rail transit primary element operating costs may be expected to be recovered from farebox revenues, and not less than 68 percent of the operating costs for any route will be met by farebox revenues. Therefore, routes should require little modification except possibly over some limited segments.

Table 342

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Light Rail Transit Plan
Ridership		
In Design Year.	62,261,000	62,951,500
To Design Year	1,235,037,200	1,240,561,200
Capital Cost		
Total to Design Year	$180,851,300	$1,106,884,700
To Design Year per Passenger . . .	0.15	0.89
To Design Year After Accounting for Useful Life Beyond Design Year	119,819,100	577,865,600
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.47
Operating Cost		
Percent Met by Farebox Revenues in Design Year	61	53
Operating Deficit in Design Year .	$ 15,988,800	$ 24,573,100
Operating Deficit per Passenger in Design Year	0.26	0.39
Operating Deficit to Design Year .	373,223,000	441,897,400
Operating Deficit to Design Year per Passenger.	0.30	0.36
Total Cost		
To Design Year	$554,074,300	$1,548,782,100
Federal Share.	331,292,500	1,106,456,500
Nonfederal Share.	222,781,800	442,325,600
To Design Year per Passenger . . .	0.45	1.25
Federal Share.	0.27	0.89
Nonfederal Share.	0.18	0.36
To Design Year After Accounting for Useful Life Beyond Design Year	493,042,100	1,019,763,000
Federal Share	282,466,800	683,241,200
Nonfederal Share.	210,575,300	336,521,800
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.40	0.83
Federal Share	0.23	0.56
Nonfederal Share.	0.17	0.27

Source: SEWRPC.

Another basis for the identification of the less productive elements of the maximum extent light rail transit plan is the operating and capital costs per passenger and per passenger mile carried on segments of the system. Table 344 summarizes the capital and operating costs, and passenger miles carried, for the major segments of the maximum extent light rail transit system, and provides a ranking of the segments in terms of operating cost per passenger mile and capital cost per passenger mile. Map 62 in Chapter III of this report identifies the major segments of the primary transit element of the plan. Maps 128 and 129 show those segments which may be expected to have higher-than-average operating costs and capital costs per passenger mile, respectively, as well as the degree to which such costs may be expected to be exceeded, along a route and between routes. In any consideration

Table 343

OPERATING COST-EFFECTIVENESS OF LIGHT RAIL ROUTES OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicle Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
1–Waukesha/ Milwaukee CBD/UWM	88,390	$ 8,780	3,852	$12,830	68
2–Cedarburg/Grafton/ Milwaukee CBD/Oak Creek	82,140	8,160	3,608	12,020	68
3–Menomonee Falls/ Milwaukee CBD/ South Milwaukee	104,890	10,420	3,144	10,470	100
4–Crosstown: Northridge/Southridge	68,600	6,810	1,694	5,640	121
5–Loop: Capitol Drive/UWM/ Wisconsin Avenue/Mayfair	69,850	6,940	2,677	8,910	78
Total	413,870	$41,110	14,975	$49,870	82

Source: SEWRPC.

of this cost-effectiveness information, it is important to recognize that the outer ends of each route can carry no through traffic, except through connection with a different mode such as a feeder/distributor bus.

Comparison of the cost-effectiveness of segments of a system can also be made in terms of passenger boardings and deboardings. Table 344 also presents passenger boarding and deboarding volumes by segment and a rank ordering of the segments in terms of operating and capital costs per boarding and deboarding passenger. Maps 130 and 131 show those segments which may be expected to have above average operating and capital costs, respectively, per boarding and deboarding passenger, as well as the degree to which average costs are exceeded.

Based on this cost-effectiveness information, the maximum extent light rail transit system plan for this alternative future was truncated. The truncations were made with the objective of reducing system capital cost and operating deficits and bringing the total cost per passenger for a light rail transit plan under this future closer to that of the base plan, while retaining an integrated system. The proposed truncated light rail transit system plan under the stable or declining growth scenario-centralized land use plan alternative future is shown on Map 100 in Chapter IV. The changes made in the maximum extent plan to produce the truncated plan are summarized in Table 285 in Chapter V, as this plan would require the same changes as the light rail transit plan under the moderate growth scenario-decentralized land use plan alternative future. The segments deleted were the less cost-effective segments—that is, those segments which, if deleted, would result in relatively large reductions in system capital costs and operating deficits and relatively small reductions in system ridership. These segments include those extending to the communities of Cedarburg and Grafton from W. Capitol Drive in the City of Milwaukee, those extending to the Village of Menomonee Falls from W. Silver Spring Drive

Table 344

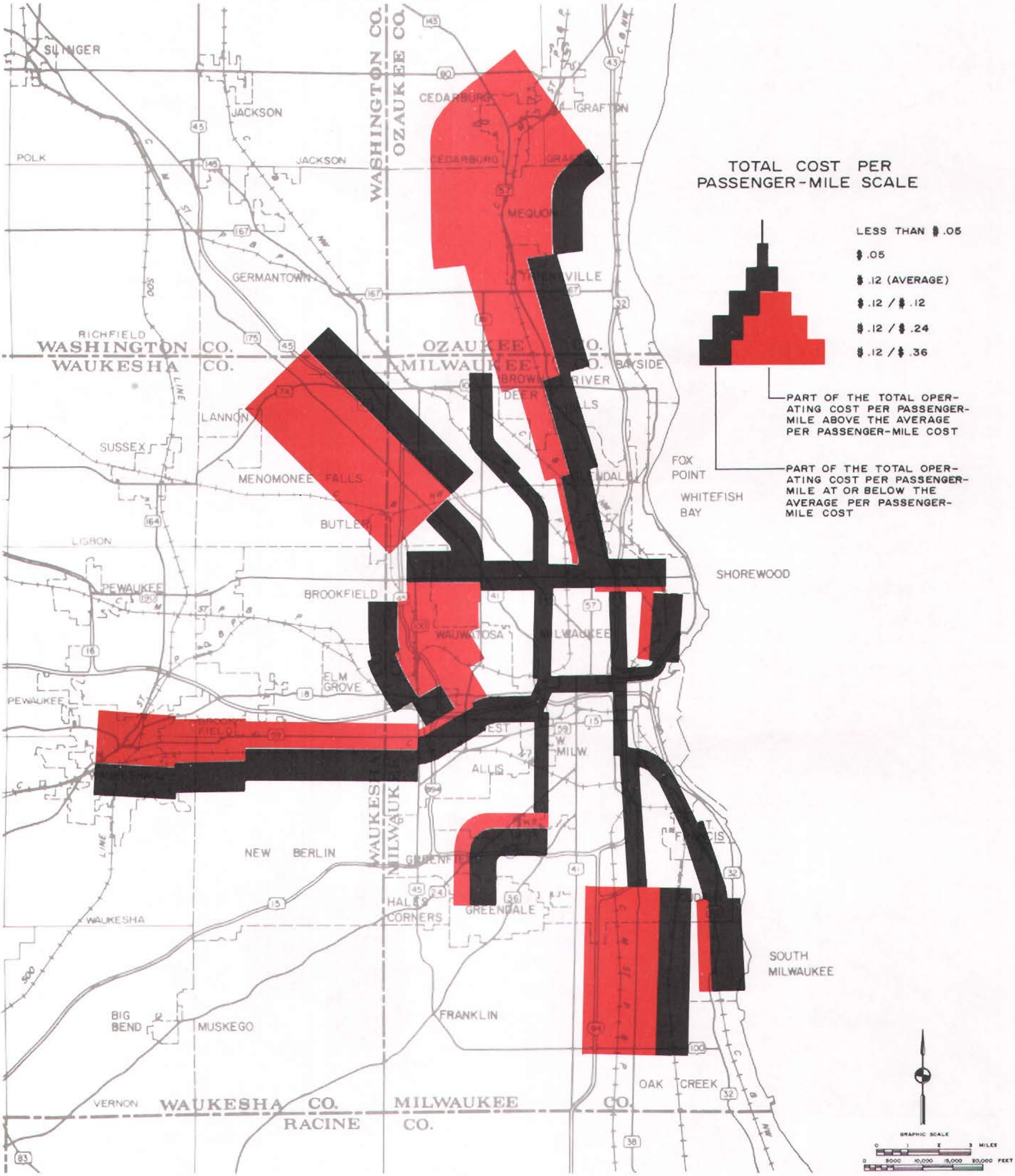
COST-EFFECTIVENESS ANALYSIS OF SEGMENTS OF THE PRIMARY ELEMENT OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Segment Number	Transit Ridership							Average Weekday Operating Cost-Effectiveness in Design Year				Total Capital Cost-Effectiveness Over the Design Period			
	Route Number	Average Weekday Passenger Volume		Total Boarding and Deboarding Passengers	Passenger Miles	Average Weekday Operating Cost in Design Year	Total Capital Cost Over Design Period	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank	Cost per Passenger Mile	Rank	Cost per Boarding and Deboarding Passenger	Rank
		Range	Average												
1	1	1,600- 1,730	1,670	2,710	3,000	$1,000	$12,536,200	$0.33	28	$0.37	18	$ 4,179	24	$ 4,626	12
2	1	1,870- 1,990	1,940	1,490	7,750	2,210	28,039,680	0.29	27	1.48	33	3,618	22	18,819	30
3	1	2,260- 2,500	2,380	1,550	9,510	2,210	27,317,184	0.23	25	1.43	31	2,872	16	17,624	29
4	1	3,640- 4,180	3,880	2,740	8,930	1,270	29,705,968	0.14	18	0.46	25	3,327	18	10,842	22
5	1 and 5	5,860- 9,160	8,330	8,120	19,990	2,190	37,467,072	0.11	14	0.27	11	1,874	10	4,614	11
6	1 and 5	16,000-16,000	16,000	7,040	9,600	720	10,282,100	0.07	6	0.10	3	1,071	5	1,461	3
7	1 and 5	18,150-24,220	20,980	37,530	52,450	3,240	39,850,480	0.06	2	0.09	2	760	3	1,062	2
8	1 and 5	11,810-19,340	16,610	13,290	11,630	640	6,014,000	0.06	2	0.05	1	517	1	452	1
9	1 and 5	2,240-10,000	5,360	15,450	26,260	4,470	74,753,984	0.17	20	0.29	13	2,847	15	4,838	13
10	2	450- 710	600	800	4,050	2,450	40,156,384	0.60	34	3.06	34	9,915	33	50,195	34
11	2	780- 1,170	1,010	1,080	4,260	1,540	25,596,592	0.36	29	1.43	31	6,009	28	23,701	33
12	2	1,520- 1,860	1,680	940	5,360	1,170	19,978,496	0.22	24	1.24	30	3,727	23	21,254	32
13	2	2,530- 2,930	2,640	1,950	8,460	1,170	22,304,880	0.14	18	0.60	26	2,637	14	11,438	23
14	2	3,380- 7,220	5,510	10,100	21,490	1,430	31,725,184	0.07	6	0.14	5	1,476	8	3,141	8
15	2 and 3	11,680-12,430	12,170	9,220	30,420	1,910	23,018,576	0.06	2	0.21	9	757	2	2,497	5
16	2	2,950- 5,770	4,440	7,240	16,860	1,390	27,003,488	0.08	10	0.19	7	1,602	9	3,730	10
17	2	370- 2,100	880	2,340	4,640	1,940	36,200,896	0.42	32	0.83	28	7,802	31	15,470	27
18	3	380- 1,180	830	1,670	4,000	1,920	34,965,888	0.48	33	0.15	29	8,741	32	20,938	31
19	3	2,530- 3,630	3,200	4,380	7,360	920	13,854,100	0.13	16	0.21	9	1,882	11	3,163	9
20	3 and 5	5,810- 6,550	6,200	4,180	10,540	1,290	12,214,000	0.12	15	0.31	15	1,159	6	2,922	7
21	3 and 4	9,010-11,250	10,040	16,240	39,140	2,670	35,545,264	0.07	6	0.16	6	908	4	2,189	4
22	3	4,930- 6,500	5,620	3,730	17,420	1,240	54,832,368	0.07	6	0.33	16	3,148	17	14,700	26
23	3	3,980- 4,690	4,230	3,570	10,570	1,000	36,251,280	0.09	11	0.28	12	3,430	20	10,154	20
24	3	1,030- 2,770	2,260	2,885	6,770	1,200	45,020,384	0.18	21	0.42	23	6,650	29	15,605	28
25	4	2,460- 3,040	2,740	3,770	10,700	1,120	37,956,272	0.10	13	0.30	14	3,547	21	10,068	19
26	4	3,320- 5,690	4,450	4,940	14,690	950	38,076,096	0.06	2	0.19	7	2,592	13	7,708	15
27	4	2,870- 6,160	5,460	7,190	15,830	830	18,390,784	0.05	1	0.12	4	1,162	7	2,558	6
28	4	1,310- 2,510	1,560	3,470	7,940	1,460	40,798,192	0.18	21	0.42	23	5,138	26	11,757	24
29	5	1,250- 1,470	1,380	1,820	2,630	680	13,850,900	0.26	26	0.37	18	5,267	27	7,610	14
30	5	890- 890	890	1,610	1,330	540	14,123,700	0.41	31	0.34	17	10,619	34	8,772	17
31	5	720- 1,190	990	1,060	1,780	650	12,491,800	0.37	30	0.61	27	7,018	30	11,785	25
32	5	123- 1,930	1,800	2,020	3,950	790	16,829,888	0.20	23	0.39	21	4,261	25	8,332	16
33	5	3,800- 4,330	3,910	1,410	5,870	540	13,505,000	0.09	11	0.38	20	2,301	12	9,578	18
34	5	2,240- 3,170	2,800	2,860	8,690	1,120	29,271,072	0.13	16	0.39	21	3,368	19	10,235	21

Source: SEWRPC.

Map 128

OPERATING COST PER PASSENGER-MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

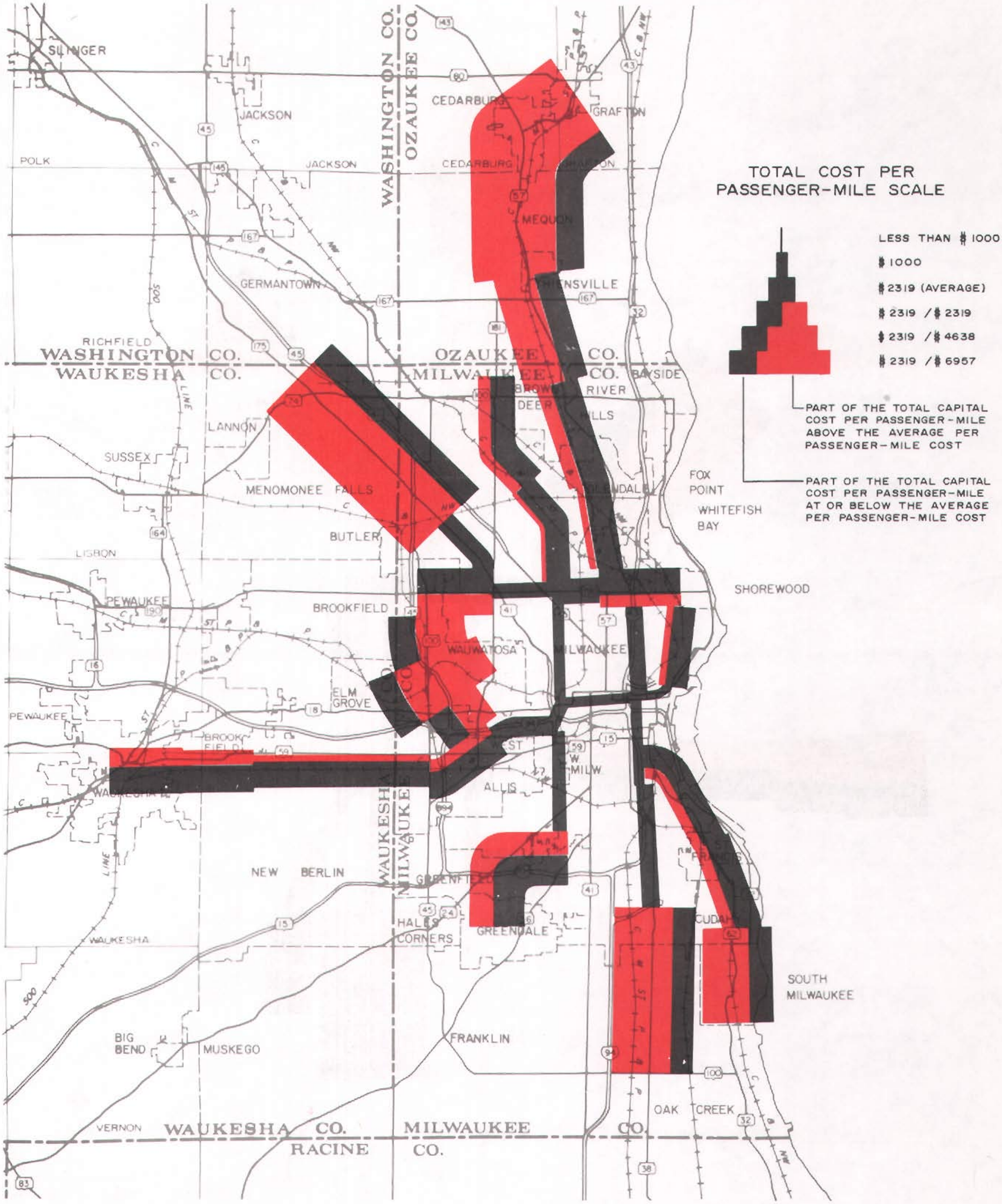


One measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the operating cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average operating cost per passenger mile, as well as the degree to which such average costs may be expected to be exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, for the outer segments of each route, as well as a portion of Route 5 in the City of Wauwatosa, these data suggest an insufficient ridership base to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development in these segments, and the absence of through traffic except by connection with a different mode such as feeder bus or automobile.

Source: SEWRPC.

Map 129

CAPITAL COST PER PASSENGER-MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

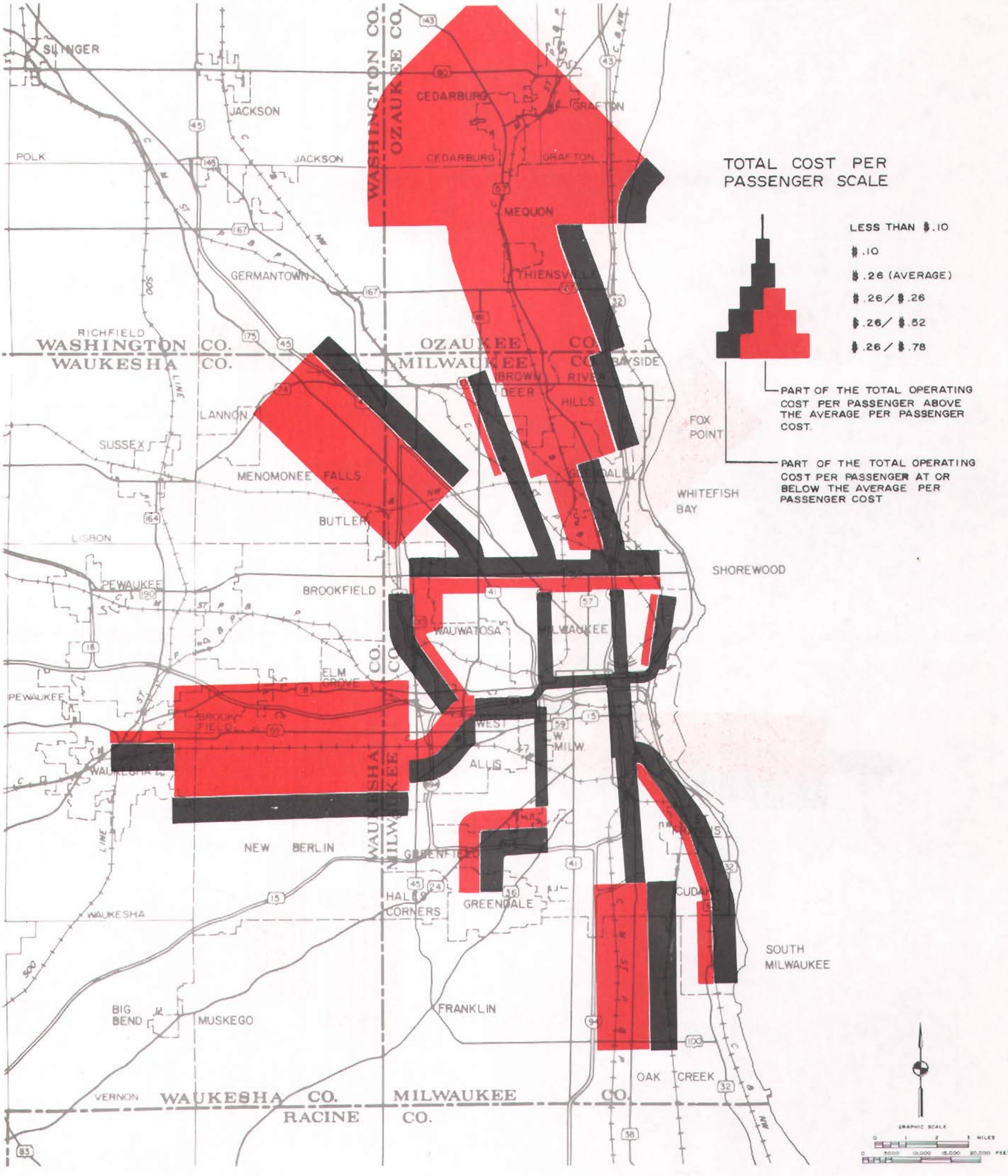


Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the capital cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average capital cost per passenger mile, as well as the degree to which such average costs may be expected to be exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, for the outer segments of each route, as well as portions of Route 5 on the City of Milwaukee's east side and in the City of Wauwatosa, these data suggest an insufficient ridership base to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development in these segments, and the absence of through traffic except by a connection with a different mode such as feeder bus or automobile. To some degree, these inefficiencies are also generated by the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee's east side.

Source: SEWRPC.

Map 130

OPERATING COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

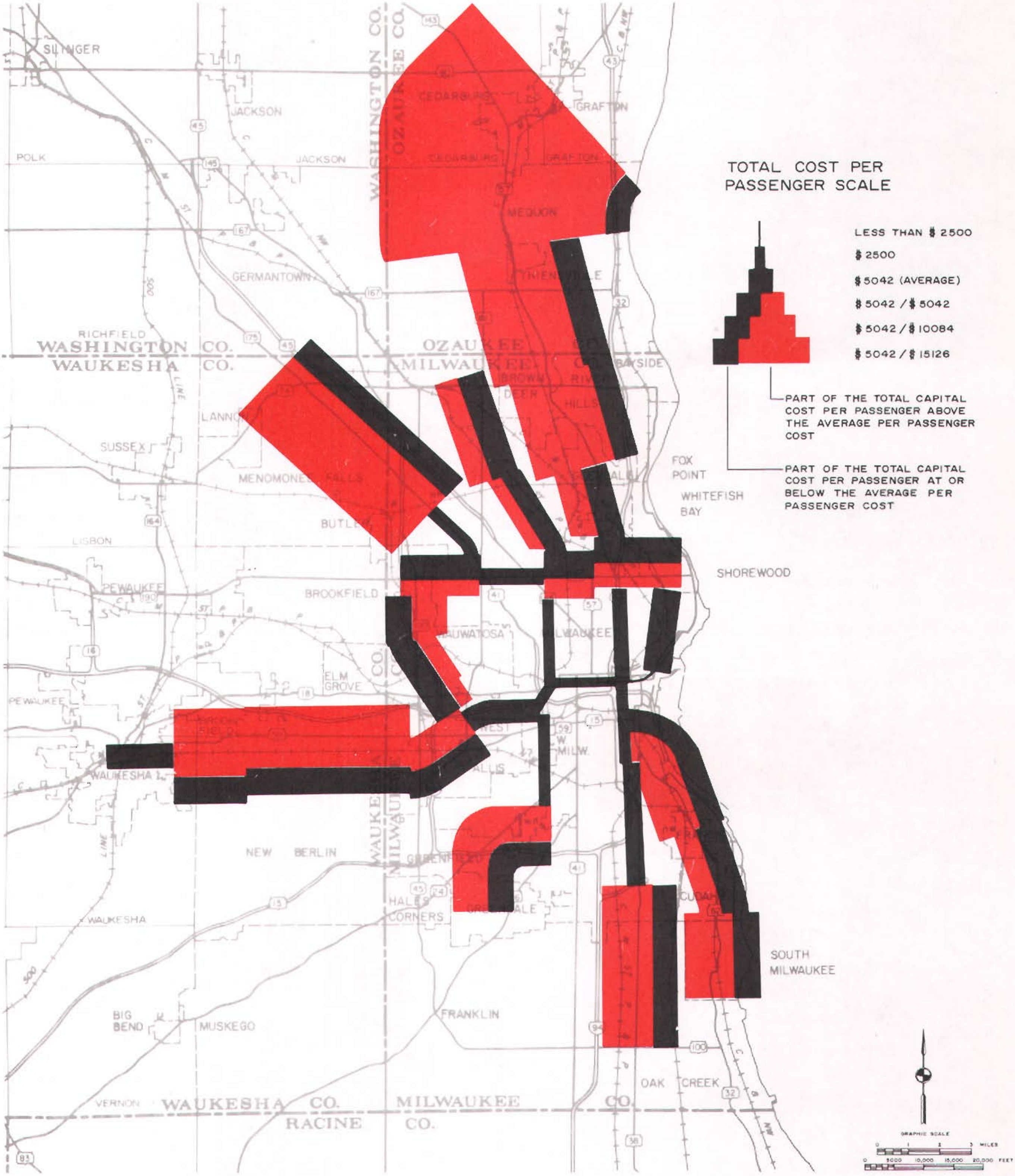


Yet another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan was the operating cost per boarding and deboarding passenger. This map shows those segments which may be expected to operate at, below, or above the average operating cost per boarding and deboarding passenger, as well as the degree to which such average costs may be expected to be exceeded. As shown on this map, certain system segments within the densely developed areas of Milwaukee County are very cost-effective compared with the remainder of the system, while all segments located within suburban areas outside Milwaukee County are not cost-effective. This is a result of the lower boarding and deboarding passenger volumes in these suburban areas combined with the lengthy distances that the light rail vehicles must operate over.

Source: SEWRPC.

Map 131

CAPITAL COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT LIGHT RAIL TRANSIT SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent light rail transit plan is the capital cost per boarding and deboarding passenger. This map shows those segments which may be expected to operate at, below, or above the average capital cost per boarding and deboarding passenger, as well as the degree to which such average costs may be expected to be exceeded. As shown on this map, certain segments located in Milwaukee County suburbs as well as outside Milwaukee County appear to have an insufficient volume of passenger boardings and deboardings to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development combined with the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee's east side. A noteworthy exception is the segment within the City of Waukesha which, by itself, appears cost-effective, but which nevertheless depends upon a connection to the remainder of the system over two lengthy suburban segments which generate little ridership.

Source: SEWRPC.

and N. 92nd Street in the City of Milwaukee, those extending to the Cities of West Allis and Waukesha from N. 84th Street and W. Fairview Avenue in the City of Milwaukee, those extending to the City of Oak Creek from General Mitchell Field, those looping from the intersection of W. Appleton Avenue and W. Capitol Drive to the Mayfair Mall Shopping Center, and that segment extending from the City of Cudahy to the City of South Milwaukee. Because of its high capital cost, the segment from S. 5th and W. Becher Streets to the City of St. Francis along E. and S. Bay Street and the Chicago & North Western's Kenosha Subdivision railway main line on the route connecting to the City of Cudahy was replaced by a segment from S. 5th and W. Becher Streets along Chase Avenue to the former Milwaukee Electric Lines Lakeside Belt Line, and then along that open right-of-way owned by the Wisconsin Electric Power Company and used for trunkline power transmission to the original routing from S. 5th and W. Becher Streets through the City of St. Francis to the City of Cudahy. The segment from the Milwaukee central business district through the University of Wisconsin-Milwaukee to Capitol Drive and along Capitol Drive to W. Atkinson Avenue in the City of Milwaukee was deleted because of its high capital cost relative to its ridership. Through the elimination of these segments, the capital cost of the primary element of the light rail transit system would decrease from $960 million to about $446 million, and the total cost of the truncated plan would be about $593 million.

Those segments given the highest priority for elimination were Segments 10, 11, 12, and 13 serving northern Milwaukee County and Ozaukee County, and Segments 1, 2, 3, and 18 serving Waukesha County. Segments 31 and 32, providing service along Capitol Drive between Appleton Avenue and Mayfair Road, and Segment 4, providing service to West Allis, were identified as the second set of segments to be deleted. The third set of segments identified to be deleted were those serving General Mitchell Field, the City of Oak Creek, and the City of South Milwaukee, including portions of both Segments 16 and 22 and all of Segments 17 and 24. Segments 9 and 34, serving the University of Wisconsin-Milwaukee campus and the lower east side, were the final two segments identified for deletion.

Evaluation of Maximum Extent Busway System Plan

Another of the primary transit technologies potentially applicable in the Milwaukee area over the next 20 years is motor buses operating over busways. The maximum extent system plan developed for this technology is summarized with respect to its coverage and routes on Maps 60 and 61 of Chapter III. Its performance under the stable or declining growth scenario-centralized land use plan alternative future is summarized in Tables 345 and 346. Map 53 and Table 111 of Chapter III, and Tables 346 and 316 provide comparable information for the base, or benchmark, plan used in the study. A description of the facilities and services of the primary, local, and express elements of both the maximum extent busway plan and the base plan is included in Chapter III of this report, and will not be repeated here.

In comparison to the base plan, the maximum extent busway system plan under this future would entail more than a two-fold increase in vehicle miles of primary transit service, 17,300 vehicle miles compared with 7,000 vehicle miles under the base plan. A significant part of this increase would be the result of the extension of primary service into off-peak travel periods during the midday and evenings, as indicated in Tables 317 and 347. About 7 percent more bus miles of express and local service would be operated under this plan than under the base plan, 64,600 bus miles on an average weekday as opposed to 60,200 bus miles for the base plan.

Headways on the primary transit routes of the maximum extent busway plan under this future would range from four to eight minutes during the peak periods. During the off-peak periods, headways would range from 30 to 60 minutes in the midday and during the evening.

Transit Utilization: Under the maximum extent busway system plan of the stable or declining growth scenario-centralized land use plan alternative future, about 224,800 trips may be expected to be made on public transit in the Milwaukee area on an average weekday in the plan design year, as shown in Tables 348 and 349. About 72,900, or 32 percent, of these transit trips may be expected to be made on the primary transit system for all or a portion of the trip. Thus, the maximum extent busway system plan envisions that about 6 percent of the total of 3.6 million person trips which may be expected to be made in the greater Milwaukee area in the plan design year will be made using public transit, and that about 2 percent will be made using primary transit. About 8,900, or 4 percent, more transit trips may be expected to be made on an average weekday under this plan than under the base plan.

Table 345

PRIMARY TRANSIT STATIONS FOR THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
1	W. Broadway and W. Main Street.	City of Waukesha	Proposed	Yes	- -	1	10	53	53	10	10	2	2	15	15	1	2
2	E. Broadway and Pleasant Street.	City of Waukesha	Proposed	- -	- -	1	1	51	51	10	10	2	2	15	15	1	2
3	Lincoln Avenue and Lake Street.	City of Waukesha	Proposed	Yes	- -	1	- -	50	50	10	10	2	2	15	15	1	2
4	Lincoln Avenue and Frederick Street	City of Waukesha	Proposed	- -	- -	1	1	48	48	10	10	2	2	15	15	1	2
5	CTH A and Pearl Street . .	City of Waukesha	Proposed	Yes	375	1	- -	44	44	10	10	2	2	15	15	1	2
6	Johnson Road.	City of New Berlin	Proposed	- -	125	1	- -	41	41	10	10	2	2	15	15	1	2
7	Calhoun Road and Rogers Drive	City of New Berlin	Proposed	Yes	275	1	- -	37	37	10	10	2	2	15	15	1	2
8	Moorland Road and Rogers Drive	City of New Berlin	Proposed	Yes	- -	1	2	35	35	10	10	2	2	15	15	1	2
9	Sunny Slope Road and Honey Lane.	City of New Berlin	Proposed	- -	- -	1	- -	33	33	10	10	2	2	15	15	1	2
10	S. 124th Street and Honey Lane.	City of New Berlin	Proposed	- -	- -	1	- -	31	31	10	10	2	2	15	15	1	2
11	S. 108th Street and Manor Park Drive	City of West Allis	Proposed	Yes	- -	1	5	28	28	10	10	2	2	15	15	1	2
12	S. 98th Street and W. Washington Street . . .	City of West Allis	Proposed	Yes	- -	1	2	26	26	10	10	2	2	15	15	1	2
13	N. 92nd Street and W. Dixon Street	City of Milwaukee	Proposed	Yes	100	1	- -	23	23	10	10	2	2	15	15	1	2
14	N. 84th Street and W. Hawthorne Avenue . .	City of Milwaukee	Proposed	Yes	- -	2	2	20	20	20	17	3	3	22	27	2	3
15	N. 76th Street and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	19	19	20	17	3	3	22	27	2	3
16	N. 68th Street and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	17	17	20	17	3	3	22	27	2	3
17	N. Hawley Road and W. Fairview Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	15	15	20	17	3	3	22	27	2	3
18	County Stadium and Mitchell Boulevard	City of Milwaukee	Proposed	Yes	200	2	- -	14	14	20	17	3	3	22	27	2	3
19	County Stadium and N. 44th Street	City of Milwaukee	Proposed	Yes	150	3	- -	12	12	30	27	4	4	29	34	3	4
20	N. 35th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	8	8	28	25	4	4	30	35	3	4
21	N. 27th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	4	7	7	28	25	4	4	30	35	3	4
22	N. 21st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	3	5	5	28	25	4	4	30	35	3	4
23	N. 16th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	5	3	3	28	25	4	4	30	35	3	4
24	N. 12th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	3	6	2	2	28	25	4	4	30	35	3	4
25	N. 6th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	4	7	- -	- -	37	34	5	5	40	45	4	5
26	N. Plankinton Avenue and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	10	2	2	17	20	3	3	27	22	3	2
27	N. Broadway Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	8	3	3	17	20	3	3	27	22	3	2
28	N. Jackson Street and E. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	7	4	4	17	20	3	3	27	22	3	2
29	N. Jackson Street and E. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	1	6	6	17	- -	3	- -	27	- -	3	- -
30	N. Van Buren Street and E. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	- -	1	1	6	6	- -	20	- -	3	- -	22	- -	2
31	N. Jackson Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	7	7	17	- -	3	- -	27	- -	3	- -
32	N. Van Buren Street and E. Juneau Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	7	7	- -	20	- -	3	- -	22	- -	2
33	N. Astor Street and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	8	8	17	20	3	3	27	22	3	2
34	N. Farwell Avenue and E. Ogden Avenue	City of Milwaukee	Proposed	Yes	- -	2	1	9	9	17	20	3	3	27	22	3	2
35	N. Farwell Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	2	11	11	17	- -	3	- -	27	- -	3	- -
36	N. Prospect Avenue and E. Brady Street	City of Milwaukee	Proposed	Yes	- -	2	1	11	11	- -	20	- -	3	- -	22	- -	2
37	N. Farwell Avenue and E. Kenilworth Place. . . .	City of Milwaukee	Proposed	Yes	- -	2	1	12	12	17	20	3	3	27	22	3	2
38	N. Oakland Avenue and E. North Avenue.	City of Milwaukee	Proposed	Yes	- -	2	3	13	13	17	20	3	3	27	22	3	2
39	N. Cambridge Avenue and E. Locust Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	16	16	17	20	3	3	27	22	3	2
40	N. Oakland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	Yes	- -	2	1	24	24	17	20	3	3	27	22	3	2

Table 345 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
41	N. Maryland Avenue and E. Kenwood Boulevard . .	City of Milwaukee	Proposed	Yes	--	2	6	23	23	17	20	3	3	27	22	3	2
42	N. Maryland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	--	2	4	19	19	17	20	3	3	27	22	3	2
43	N. Oakland Avenue and E. Hartford Avenue	City of Milwaukee	Proposed	Yes	--	2	1	18	18	17	20	3	3	27	22	3	2
44	Wisconsin Avenue and Broad Street	Village of Grafton	Proposed	Yes	--	1	1	59	59	9	9	1	1	10	10	1	1
45	1st Avenue and Maple Street	Village of Grafton	Proposed	--	125	1	--	57	57	9	9	1	1	10	10	1	1
46	Cedar Ridge Drive and Georgetown Drive	City of Cedarburg	Proposed	--	--	1	1	54	54	9	9	1	1	10	10	1	1
47	STH 143 (Washington Avenue) and Turner Street	City of Cedarburg	Proposed	--	--	1	1	53	53	9	9	1	1	10	10	1	1
48	Grant Avenue and Western Road	City of Cedarburg	Proposed	--	--	1	1	52	52	9	9	1	1	10	10	1	1
49	STH 57 and CTH C (Pioneer Road).	City of Mequon	Proposed	Yes	125	1	--	48	48	9	9	1	1	10	10	1	1
50	STH 57 (Main Street) and Freistadt Road	Village of Thiensville	Proposed	Yes	--	1	1	42	42	9	9	1	1	10	10	1	1
51	STH 57 (Green Bay Road) and STH 67 (Mequon Road)	City of Mequon	Proposed	--	75	1	--	40	40	9	9	1	1	10	10	1	1
52	Garden Drive and W. County Line Road. . .	Village of Brown Deer	Proposed	--	--	1	--	36	36	9	9	1	1	10	10	1	1
53	N. Deerbrook Terrace and STH 100 (W. Brown Deer Road) . .	Village of Brown Deer	Proposed	Yes	--	1	1	34	34	9	9	1	1	10	10	1	1
54	N. Cedarburg Road and W. Bradley Road.	Village of Brown Deer	Proposed	--	--	1	1	32	32	9	9	1	1	10	10	1	1
55	N. Teutonia Avenue and W. Good Hope Road . . .	City of Milwaukee	Proposed	--	--	1	2	29	29	9	9	1	1	10	10	1	1
56	N. Sidney Place and W. Mill Road	City of Glendale	Proposed	Yes	150	1	1	27	27	9	9	1	1	10	10	1	1
57	N. Dexter Avenue and W. Silver Spring Drive. . .	City of Glendale	Proposed	Yes	--	1	1	25	25	9	9	1	1	10	10	1	1
58	N. 20th Street and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	2	21	21	9	9	1	1	10	10	1	1
59	W. Atkinson Avenue and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	--	1	1	16	16	16	19	2	2	22	17	2	2
60	N. 16th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	1	13	13	9	9	1	1	10	10	1	1
61	N. 8th Street and W. Atkinson Avenue . . .	City of Milwaukee	Proposed	Yes	--	1	3	10	10	--	9	--	1	--	10	--	1
62	N. 8th Street and W. Burleigh Street.	City of Milwaukee	Proposed	Yes	--	1	2	9	9	9	--	1	--	10	--	1	--
63	N. 7th Street and W. Burleigh Street.	City of Milwaukee	Proposed	--	--	1	2	9	9	--	9	--	1	--	10	--	1
64	N. 8th Street and W. Center Street.	City of Milwaukee	Proposed	Yes	--	1	2	7	7	9	--	1	--	10	--	1	--
65	N. 7th Street and W. Center Street.	City of Milwaukee	Proposed	Yes	--	1	2	7	7	--	9	--	1	--	10	--	1
66	N. 8th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	--	1	3	6	6	9	--	1	--	10	--	1	--
67	N. 7th Street and W. North Avenue	City of Milwaukee	Proposed	Yes	--	1	3	6	6	--	9	--	1	--	10	--	1
68	N. 6th Street and W. Walnut Street.	City of Milwaukee	Proposed	Yes	--	1	2	4	4	9	9	1	1	10	10	1	1
69	N. 6th Street and W. Juneau Avenue.	City of Milwaukee	Proposed	--	--	1	2	3	3	9	9	1	1	10	10	1	1
70	N. 6th Street and W. Kilbourn Avenue. . . .	City of Milwaukee	Proposed	Yes	--	1	2	1	1	9	9	1	1	10	10	1	1
71	N. 6th Street and W. St. Paul Avenue	City of Milwaukee	Proposed	--	--	2	2	2	2	17	17	2	2	18	18	2	2
72	S. 6th Street and W. Alexander Street. . . .	City of Milwaukee	Proposed	Yes	--	2	1	5	5	17	17	2	2	18	18	2	2
73	S. 6th Street and W. National Avenue. . . .	City of Milwaukee	Proposed	--	--	2	4	6	6	--	17	--	2	--	18	--	2
74	S. 5th Street and W. National Avenue. . . .	City of Milwaukee	Proposed	Yes	--	2	4	6	6	--	17	--	2	--	18	--	2
75	S. 5th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	--	2	2	8	8	--	17	--	2	--	18	--	2
76	S. 4th Street and W. Greenfield Avenue. . .	City of Milwaukee	Proposed	Yes	--	2	2	8	8	17	--	2	--	18	--	2	--
77	S. 5th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	--	2	3	10	10	--	17	--	2	--	18	--	2
78	S. 4th Street and W. Mitchell Street	City of Milwaukee	Proposed	Yes	--	2	3	10	10	17	--	2	--	18	--	2	--
79	S. 5th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	--	1	1	12	12	--	9	--	1	--	10	--	1
80	S. 4th Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	--	1	1	12	12	9	--	1	--	10	--	1	--
81	S. Chase Avenue and W. Rosedale Avenue. . . .	City of Milwaukee	Proposed	Yes	250	1	--	14	14	9	9	1	1	10	10	1	1

Table 345 (continued)

Station Number	Location		Facilities and Services					Travel Time to Milwaukee CBD (minutes)		Frequency of Service (buses per hour)							
	Intersection	Civil Division	Status	Shelter	Parking Spaces	Connecting Primary Routes	Connecting Express or Local Routes	Peak	Off-Peak	Morning		Midday		Afternoon		Evening	
										In	Out	In	Out	In	Out	In	Out
82	S. Chase Avenue and W. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	15	15	9	9	1	1	10	10	1	1
83	S. Howell Avenue and W. Morgan Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	17	17	9	9	1	1	10	10	1	1
84	S. Howell Avenue and W. Howard Avenue	City of Milwaukee	Proposed	Yes	- -	1	2	18	18	9	9	1	1	10	10	1	1
85	S. Howell Avenue and W. Layton Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	21	21	9	9	1	1	10	10	1	1
86	General Mitchell Field . . .	City of Milwaukee	Proposed	Yes	100	1	2	23	23	9	9	1	1	10	10	1	1
87	S. Howell Avenue and W. College Avenue.	City of Milwaukee	Proposed	Yes	- -	1	2	26	26	9	9	1	1	10	10	1	1
88	S. Howell Avenue and W. Marquette Avenue . . .	City of Oak Creek	Proposed	Yes	- -	1	2	33	33	9	9	1	1	10	10	1	1
89	S. Howell Avenue and W. Forest Hill Avenue. . .	City of Oak Creek	Proposed	- -	- -	1	2	38	38	9	9	1	1	10	10	1	1
90	S. Howell Avenue and W. Ryan Road	City of Oak Creek	Proposed	- -	100	1	1	44	44	9	9	1	1	10	10	1	1
91	STH 175 (Appleton Avenue) and Menomonee Avenue. . . .	Village of Menomonee Falls	Proposed	- -	- -	1	2	50	50	8	8	1	1	8	8	1	1
92	STH 175 (Appleton Avenue) and North Hills Drive	Village of Menomonee Falls	Proposed	Yes	150	1	1	47	47	8	8	1	1	8	8	1	1
93	STH 175 (Appleton Avenue) and Parkway Drive	Village of Menomonee Falls	Proposed	- -	- -	1	- -	40	40	8	8	1	1	8	8	1	1
94	USH 41 (W. Appleton Avenue) and W. Bobolink Avenue	City of Milwaukee	Proposed	- -	- -	1	2	37	37	8	8	1	1	8	8	1	1
95	Timmerman Field.	City of Milwaukee	Proposed	Yes	200	1	2	34	34	8	8	1	1	8	8	1	1
96	USH 41 (W. Appleton Avenue) and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	32	32	8	8	1	1	8	8	1	1
97	N. 76th Street and W. Appleton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	30	30	8	8	1	1	8	8	1	1
98	N. 68th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	2	1	26	26	15	18	2	2	20	15	2	2
99	Capitol Court Shopping Center.	City of Milwaukee	Proposed	Yes	200	2	2	25	25	15	18	2	2	20	15	2	2
100	W. Fond du Lac Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	2	2	23	23	15	18	2	2	20	15	2	2
101	N. Sherman Boulevard and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	3	2	21	21	17	20	3	3	19	14	3	3
102	N. Sherman Boulevard and W. Fond du Lac Avenue .	City of Milwaukee	Proposed	Yes	- -	2	2	20	20	18	18	2	2	15	15	2	2
103	N. Sherman Boulevard and W. Burleigh Street . .	City of Milwaukee	Proposed	Yes	- -	2	2	18	18	18	18	2	2	15	15	2	2
104	N. Sherman Boulevard and W. Center Street . . .	City of Milwaukee	Proposed	Yes	- -	2	2	17	17	18	18	2	2	15	15	2	2
105	N. Sherman Boulevard and W. North Avenue. . .	City of Milwaukee	Proposed	Yes	- -	2	3	16	16	18	18	2	2	15	15	2	2
106	N. 40th Street and W. Lisbon Avenue	City of Milwaukee	Proposed	Yes	- -	2	2	14	14	18	18	2	2	15	15	2	2
107	W. Highland Boulevard and W. McKinley Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	2	12	12	18	18	2	2	15	15	2	2
108	N. 41st Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	Yes	- -	2	1	10	10	18	18	2	2	15	15	2	2
109	S. Kinnickinnic Avenue and E. Becher Street . . .	City of Milwaukee	Proposed	Yes	- -	1	3	13	13	8	8	1	1	8	8	1	1
110	S. Bay Street and E. Lincoln Avenue.	City of Milwaukee	Proposed	Yes	150	1	1	15	15	8	8	1	1	8	8	1	1
111	S. Bay Street and E. Russell Avenue	City of Milwaukee	Proposed	Yes	- -	1	1	18	18	8	8	1	1	8	8	1	1
112	S. Nevada Street and S. Kinnickinnic Avenue. .	City of Milwaukee	Proposed	Yes	- -	1	2	19	19	8	8	1	1	8	8	1	1
113	S. Brust Avenue and E. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	20	20	8	8	1	1	8	8	1	1
114	S. Ellen Street and E. Morgan Avenue.	City of Milwaukee	Proposed	- -	- -	1	1	22	22	8	8	1	1	8	8	1	1
115	S. Bombay Avenue and E. Crawford Avenue. . . .	City of St. Francis	Proposed	- -	75	1	1	24	24	8	8	1	1	8	8	1	1
116	S. Kinnickinnic Avenue and Lunham Avenue . . .	City of St. Francis	Proposed	Yes	- -	1	1	26	26	8	8	1	1	8	8	1	1
117	S. Kinnickinnic Avenue and E. Layton Avenue . .	City of Cudahy	Proposed	Yes	- -	1	2	28	28	8	8	1	1	8	8	1	1
118	S. Whitnall Avenue and E. Grange Avenue	City of Cudahy	Proposed	Yes	225	1	1	30	30	8	8	1	1	8	8	1	1
119	Edgar Avenue and E. College Avenue	City of Cudahy	Proposed	Yes	- -	1	2	32	32	8	8	1	1	8	8	1	1
120	E. Rawson Avenue	City of South Milwaukee	Proposed	Yes	- -	1	1	34	34	8	8	1	1	8	8	1	1
121	Marquette Avenue	City of South Milwaukee	Proposed	Yes	- -	1	2	36	36	8	8	1	1	8	8	1	1

Table 345 (continued)

Station Number	Location: Intersection	Location: Civil Division	Facilities and Services: Status	Facilities and Services: Shelter	Facilities and Services: Parking Spaces	Facilities and Services: Connecting Primary Routes	Facilities and Services: Connecting Express or Local Routes	Travel Time to Milwaukee CBD (minutes): Peak	Travel Time to Milwaukee CBD (minutes): Off-Peak	Frequency of Service (buses per hour): Morning In	Morning Out	Midday In	Midday Out	Afternoon In	Afternoon Out	Evening In	Evening Out
122	S. 9th Avenue and E. Drexel Avenue	City of South Milwaukee	Proposed	Yes	225	1	- -	37	37	8	8	1	1	8	8	1	1
123	Northridge Shopping Center.	City of Milwaukee	Proposed	Yes	200	1	5	42	45	10	10	1	1	7	7	1	1
124	N. 76th Street and W. Bradley Road.	City of Milwaukee	Proposed	Yes	100	1	3	38	41	10	10	1	1	7	7	1	1
125	N. 76th Street and W. Good Hope Road . . .	City of Milwaukee	Proposed	Yes	- -	1	3	36	38	10	10	1	1	7	7	1	1
126	N. 60th Street and W. Mill Road	City of Milwaukee	Proposed	Yes	- -	1	2	33	35	10	10	1	1	7	7	1	1
127	N. Sherman Boulevard and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	125	1	2	30	33	10	10	1	1	7	7	1	1
128	N. Sherman Boulevard and W. Villard Avenue . .	City of Milwaukee	Proposed	Yes	- -	1	3	28	31	10	10	1	1	7	7	1	1
129	N. Sherman Boulevard and W. Hampton Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	2	27	29	10	10	1	1	7	7	1	1
130	N. Sherman Boulevard and W. Congress Street . .	City of Milwaukee	Proposed	Yes	- -	1	1	25	28	10	10	1	1	7	7	1	1
131	S. 44th Street and W. National Avenue	Village of West Milwaukee	Proposed	Yes	- -	1	2	16	19	10	10	1	1	7	7	1	1
132	S. 43rd Street and W. Greenfield Avenue. . .	Village of West Milwaukee	Proposed	Yes	- -	1	1	18	20	10	10	1	1	7	7	1	1
133	S. 43rd Street and W. Burnham Street	Village of West Milwaukee	Proposed	Yes	- -	1	1	19	22	10	10	1	1	7	7	1	1
134	S. 43rd Street and W. Lincoln Avenue	City of Milwaukee	Proposed	Yes	175	1	1	21	23	10	10	1	1	7	7	1	1
135	S. 43rd Street and W. Cleveland Avenue . . .	City of Milwaukee	Proposed	- -	- -	1	- -	23	25	10	10	1	1	7	7	1	1
136	S. 43rd Street and W. Oklahoma Avenue . . .	City of Milwaukee	Proposed	Yes	- -	1	3	25	27	10	10	1	1	7	7	1	1
137	S. 43rd Street and W. Morgan Avenue	City of Milwaukee	Proposed	- -	- -	1	2	27	29	10	10	1	1	10	10	1	1
138	S. 43rd Street and W. Howard Avenue	City of Greenfield	Proposed	Yes	150	1	1	28	30	10	10	1	1	10	10	1	1
139	S. 60th Street and W. Plainfield Avenue . . .	City of Greenfield	Proposed	- -	- -	1	1	31	34	10	10	1	1	10	10	1	1
140	W. Forest Home Avenue and W. Plainfield Avenue	City of Greenfield	Proposed	Yes	- -	1	2	33	35	10	10	1	1	10	10	1	1
141	S. 76th Street and W. Layton Avenue.	City of Greenfield	Proposed	- -	- -	1	5	36	39	10	10	1	1	10	10	1	1
142	N. 9th Street and W. Wisconsin Avenue . . .	City of Milwaukee	Proposed	- -	- -	3	6	1	1	28	25	4	4	30	35	3	4
143	Southridge Shopping Center.	Village of Greendale	Proposed	Yes	125	1	6	40	42	10	10	1	1	10	10	1	1
144	N. Glenview Avenue and W. Wisconsin Avenue . . .	City of Wauwatosa	Proposed	Yes	- -	1	4	23	23	10	7	1	1	7	12	1	1
145	Milwaukee County General Hospital.	City of Wauwatosa	Proposed	- -	- -	1	5	26	26	10	7	1	1	7	12	1	1
146	County Institutions.	City of Wauwatosa	Proposed	- -	- -	1	5	27	27	10	7	1	1	7	12	1	1
147	N. Swan Boulevard and W. Watertown Plank Road.	City of Wauwatosa	Proposed	Yes	175	1	1	29	29	10	7	1	1	7	12	1	1
148	Mayfair Mall Shopping Center.	City of Wauwatosa	Proposed	Yes	100	1	7	33	33	10	7	1	1	7	12	1	1
149	N. Mayfair Road and W. Center Street.	City of Wauwatosa	Proposed	- -	- -	1	3	35	35	10	7	1	1	7	12	1	1
150	N. Mayfair Road and W. Burleigh Street.	City of Wauwatosa	Proposed	Yes	- -	1	2	37	37	10	7	1	1	7	12	1	1
151	N. Mayfair Road and W. Capitol Drive.	City of Wauwatosa	Proposed	- -	- -	1	2	35	38	10	7	1	1	7	12	1	1
152	W. Lisbon Avenue and W. Capitol Drive.	City of Milwaukee	Proposed	- -	- -	1	2	34	36	7	10	1	1	12	7	1	1
153	N. 92nd Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	32	35	7	10	1	1	12	7	1	1
154	N. 84th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	1	31	33	7	10	1	1	12	7	1	1
155	N. 76th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	3	29	32	7	10	1	1	12	7	1	1
156	N. 35th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	21	24	7	10	1	1	12	7	1	1
157	N. 27th Street and W. Capitol Drive.	City of Milwaukee	Proposed	Yes	- -	1	2	20	22	7	10	1	1	12	7	1	1
158	W. Green Bay Avenue and W. Capitol Drive . . .	City of Milwaukee	Proposed	Yes	- -	1	2	20	23	7	10	1	1	12	7	1	1
159	N. Port Washington Road and W. Capitol Drive . . .	City of Milwaukee	Proposed	- -	- -	1	2	21	24	7	10	1	1	12	7	1	1
160	N. Richards Street and E. Capitol Drive	City of Milwaukee	Proposed	Yes	- -	1	2	23	25	7	10	1	1	12	7	1	1
161	N. Humboldt Boulevard and E. Capitol Drive. . . .	City of Milwaukee	Proposed	Yes	- -	1	2	24	27	7	10	1	1	12	7	1	1
162	Morris Boulevard and E. Menlo Boulevard	Village of Shorewood	Proposed	Yes	- -	1	1	26	29	7	10	1	1	12	7	1	1

Source: SEWRPC.

Table 346

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Maximum Extent Busway Plan
Primary Element		
Exclusive Guideway Miles		
Subway	- -	- -
Elevated	- -	8.0
At-Grade	- -	94.3
Total	- -	102.3
Shared Guideway Miles		
Freeways	51.5	- -
Surface Arterial Streets	49.5	2.2
Total	101.0	104.5
Route Miles	449	253
Vehicle Miles	7,010	17,330
Vehicle Hours	298	920
Vehicles Required	59	144
Trains Required	- -	- -
Express and Local Elements		
Route Miles	1,302	1,660
Vehicle Miles	60,230	64,580
Vehicle Hours	4,156	4,180
Vehicles Required	474	526
Total System		
Route Miles	1,755	1,913
Vehicle Miles	67,240	81,910
Vehicle Hours	4,454	5,100
Vehicles Required	533	670
Trains Required	- -	- -

Source: SEWRPC.

Costs: Estimates of the total capital costs that would be incurred in the development of the maximum extent busway system plan and the base system plan are summarized in Table 350. The costs shown include all construction costs, plus the costs of right-of-way acquisition and the acquisition and replacement of vehicles, as needed, over the plan design period. Most capital items required to implement the plan have useful lives beyond the 20-year plan design period, as noted in Table 350.

The total capital cost of the base plan is estimated at $181 million. Most of this cost would be required to purchase buses for the proposed short-range service expansion within Milwaukee County and to replace buses to maintain the existing service to the year 2000. About $19 million, or 10 percent of the total capital cost, would be required for the primary transit element.

The total capital cost of the maximum extent busway system plan is estimated at $720 million. About $481 million would be required for the construction of the busways, including right-of-way, guideways, and preferential intersection treatments. About $181 million would be incurred in the purchase of new and replacement of transit vehicles—$48 million of which would be for the purchase of 198 articulated buses, and about $133 million of which would be for the purchase of 953 conventional buses. The remaining $58 million would be required to construct stations and storage, maintenance, and layover facilities. About $572 million, or about 79 percent of the total capital cost, would be attributable to the primary transit element of the plan.

Under current funding programs, all capital expense items are eligible for up to 80 percent federal funding. Based upon this formula, the nonfederal share of the total capital cost of the maximum extent busway plan can be expected to be approximately $144 million. The remaining $576 million would constitute the federal share of the capital cost under the Urban Mass Transportation Administration (UMTA) Sections 3 and 5 funding programs. Under the base plan, the nonfederal share and the federal share are estimated to total $36 million and $145 million, respectively.

Table 351 presents the design year operating and maintenance costs and farebox revenues for the base and maximum extent busway plans. Under the base plan, operating and maintenance costs may be expected to approximate $41 million in the design year for both primary transit and local and express bus service in the Milwaukee area. Implementation of the maximum extent busway plan would increase the total operating and maintenance costs for the Milwaukee area in the year 2000 by $11 million, to a total cost of $52 million. The cost of operating and maintaining the primary transit system in the design year may be expected to approximate $3 million under the base plan, and $12 million under the maximum extent busway plan. Primary transit system operating and maintenance costs would thus represent about 8 percent

Table 347

TIME-OF-DAY OPERATION OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Element	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Primary					
Route Miles.	253	253	253	253	253
Vehicle Miles	6,540	2,020	7,550	1,220	17,330
Vehicle Hours	350	110	400	60	920
Vehicles Required	124	19	144	17	144
Express and Local					
Route Miles.	1,660	1,586	1,660	1,558	1,660
Vehicle Miles	14,860	17,830	16,100	15,790	64,580
Vehicle Hours	1,000	1,160	1,050	970	4,180
Vehicles Required	492	209	526	169	526
Total System					
Route Miles.	1,913	1,839	1,913	1,811	1,913
Vehicle Miles	21,400	19,850	23,650	17,010	81,910
Vehicle Hours	1,350	1,270	1,450	1,030	5,100
Vehicles Required	616	228	670	186	670

Source: SEWRPC.

of the total operating costs expected in the design year for the base plan, and about 23 percent of the total operating costs expected in the design year for the maximum extent busway plan.

The average operating cost per passenger for the base plan in the plan design year is estimated at $0.65. For the maximum extent busway system plan, the average operating cost per passenger may be expected to approximate $0.83—$0.18, or 28 percent, more than the base plan cost. The average operating cost per passenger mile would also be higher for the maximum extent busway plan, $0.22, compared with $0.18 for the base plan. The average operating cost per passenger and per passenger mile for the primary element of the base plan would be $1.23 and $0.15, respectively, and for the maximum extent busway system plan, $0.64 and $0.13, respectively.

The total annual farebox revenue which may be expected to be generated in the plan design year under the base plan is estimated at $25 million, expressed in 1979 dollars, compared with about $27 million under the maximum extent busway plan. Under the maximum extent busway alternative, the primary transit element could be expected to generate about 34 percent, or about $9.1 million, of the total revenues, compared with 6 percent, or $1.5 million, for the base plan.

The operating deficit in the year 2000 for the maximum extent busway plan would be about $25 million, expressed in 1979 dollars, requiring a subsidy of about $0.40 per passenger. This compares with the base system plan deficit of about $16 million, or $0.26 per passenger. Farebox revenues would cover about 52 percent of the operating costs under the maximum extent busway plan and 61 percent of such costs under the base plan.

Under current operating assistance programs, the federal government may be expected to fund 50 percent of the operating deficit up to the total urbanized area apportionment, and the State has, in the past, funded up to 72 percent of the non-

Table 348

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Trip Purpose	Base Plan			Maximum Extent Busway Plan		
		Transit Trips			Transit Trips	
	Total Person Trips[a]	Number	Percent of Total Trips	Total Person Trips[a]	Number	Percent of Total Trips
Home-Based Work	962,700	80,500	8.4	963,100	90,200	9.4
Home-Based Shopping . .	506,900	28,000	5.5	505,600	28,600	5.7
Home-Based Other	1,131,100	56,800	5.0	1,125,800	56,400	5.0
Nonhome Based.	692,300	10,000	1.4	687,900	9,000	1.3
School	348,300	40,600	11.6	348,400	40,600	11.7
Total	3,641,300	215,900	5.9	3,630,800	224,800	6.2

[a] *The difference in the total person trips generated under the maximum extent busway system plan and total person trips generated under the base plan may be attributed to the effect of the level of transit service on household automobile ownership, and the effect of automobile ownership on trip generation. Lower levels of transit service have been found to be correlated with increased automobile ownership, and greater automobile ownership has been found to be correlated with increased trip generation. The Commission travel simulation models reflect these relationships between level of transit service, automobile ownership, and trip generation, as well as the relationships of these factors to household size, level of income, and residential density. The small differences in total person trip generation between these plans, however, are not significant in the evaluation of the alternative transit plans under this study.*

Source: SEWRPC.

Table 349

PRIMARY AND TOTAL TRANSIT SYSTEM TRIPMAKING BY TIME OF DAY FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Time of Day	Base Plan				Maximum Extent Busway Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,700	47.0	52,100	24.1	25,700	35.3	55,600	24.7
Midday	300	3.0	68,800	31.9	8,800	12.1	70,100	31.2
Afternoon . .	5,000	50.0	75,800	35.1	34,000	46.6	79,200	35.2
Evening. . . .	- -	- -	19,200	8.9	4,400	6.0	19,900	8.9
Total	10,000	100.0	215,900	100.0	72,900	100.0	224,800	100.0

Source: SEWRPC.

Table 350

TOTAL CAPITAL EXPENDITURES TO DESIGN YEAR REQUIRED FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Capital Cost[a]	Base Plan	Maximum Extent Busway Plan
Guideway Development[b]	$ --	$480,648,800
Station Development[c]	2,886,300	37,355,000
Vehicle Storage and Maintenance Facility Development[c]	18,225,000	20,829,800
Vehicle Acquisition and Replacement[d]	159,740,000	180,940,000
Total	$180,851,300	$719,773,600

[a] *It is assumed under this capital cost analysis that both the base plan and the maximum extent busway plan would be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 through 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and therefore are capable of use beyond the design period.*

[b] *Includes the cost of acquiring about 203 acres of right-of-way for guideway construction, and of acquiring and relocating five residential structures and three steel lattice electric power transmission towers. This land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—12 acres under the base plan, and 52 acres under the maximum extent busway plan. This land is assumed to have a useful life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement as necessary over the 20-year design period of all buses used in the system. Both plans assume the availability of a fleet of 640 buses with an average age of 10 years in 1980. Buses are assumed to have an average useful life of 12 years.*

Source: SEWRPC.

federal share.[10] The annual local share of the public funding requirement in the design year 2000 would be about $3.5 million for the maximum extent busway system plan and about 36 percent less, $2.2 million, for the base system plan.

Development of Truncated System Plan: The results of the traffic assignments to, and attendant evaluation of, the maximum extent busway system plan are summarized in Table 352. The maximum extent busway plan has significantly higher capital costs as well as greater operating deficits, both in total and on a per-passenger basis, than does the base plan. In addition, farebox revenues meet a smaller proportion of total operating costs under the maximum extent busway plan than under the

[10] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.0 million required to provide 50 percent federal funding of the operating deficits under the base plan, but somewhat less than the $12.5 million required to provide such funding under the maximum extent busway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Table 351

PRIMARY AND TOTAL TRANSIT SYSTEM DESIGN YEAR OPERATING AND MAINTENANCE COSTS FOR THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Busway Plan
Ridership		
Primary Element	2,550,000	18,589,500
Total System	62,261,000	62,640,500
Operating and Maintenance Cost		
Primary Element	$ 3,129,000	$11,806,500
Total System	40,507,100	51,884,800
Operating and Maintenance Cost per Passenger		
Primary Element	$1.23	$0.64
Systemwide Average	0.65	0.83
Operating and Maintenance Cost per Passenger Mile		
Primary Element	$0.15	$0.13
Total System	0.18	0.22
Farebox Revenue		
Primary Element	$ 1,530,000	$ 9,098,400
Total System	24,518,300	26,807,000
Operating Deficit		
Primary Element	$ 1,599,000	$ 2,708,100
Total System	15,988,800	25,077,800
Farebox Revenue as a Percent of Operating and Maintenance Costs		
Primary Element	49	77
Total System	61	52
Public Funding Under Current Program[a]		
Federal (50 percent of operating deficit)		
Primary Element	$ 799,500	$ 1,354,050
Total System	7,994,400	12,538,900
State (72 percent of nonfederal share of operating deficit)		
Primary Element	575,640	974,920
Total System	5,755,970	9,028,010
Local		
Primary Element	233,860	379,130
Total System	2,238,430	3,510,890
Local Operating Deficit per Ride		
Primary Element	$0.09	$0.02
Total System	0.04	0.05

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, greater than the $8.0 million required to provide 50 percent federal funding of the operating deficits under the base plan, but less than the $12.5 million required to provide such funding under the maximum extent busway plan. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

base plan. Consequently, the total cost per passenger to the design year of the maximum extent busway extent plan is more than twice that of the base plan under this future. It was therefore necessary to truncate this maximum extent busway system plan.

Some of the increases in the capital costs and operating deficits under the maximum extent busway plan may be attributed to the overextension of service envisioned in this plan.[11] Under the plan, primary transit service on exclusive guideway would be extended into portions of the Milwaukee urbanized area not now served; would be expanded into an all-day operation; and would be provided at headways of no more than 30 minutes in the peak period and peak direction and no more than 60 minutes otherwise.

The cost-effective elements of the primary element of the maximum extent busway system plan with respect to operating costs can, in part, be identified on a route-by-route basis through a determination of what proportion of the operating costs of the routes may be expected to be recovered through farebox revenues. As shown in Table 353, about 77 percent of the total busway primary transit element operating costs may be expected to be recovered from farebox revenues, and not less than 58 percent of the operating costs for any route will be met through farebox revenues. Therefore, routes should require little modification except possibly over some limited segments.

Another basis for the identification of the less productive elements of the maximum extent busway system plan is the operating and capital costs per passenger and per passenger mile carried on segments of the system. Table 354 summarizes the estimated capital and operating costs, and passenger miles carried, for the major segments of the maximum extent busway system, and provides

[11] *The extension of local and express service under the maximum extent busway plan and all other plans also contributes to this increase in cost and decrease in cost-effectiveness. The express (secondary) and local (tertiary) service included in each maximum extent primary transit system plan is in accord with the adopted long-range regional transportation system plan. The local and express routes and schedules have been modified, however, to coordinate properly the secondary and tertiary service proposed to be provided with the primary service proposed under the different primary transit alternatives. Any further refinements in the extent of the secondary or tertiary service should equally affect the cost of each primary transit alternative considered, and should, therefore, not affect a comparison of those alternatives.*

Table 352

COST-EFFECTIVENESS COMPARISON OF THE BASE SYSTEM PLAN AND MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Cost Element	Base Plan	Maximum Extent Busway Plan
Ridership		
In Design Year	62,261,000	62,640,500
To Design Year	1,235,037,200	1,238,073,200
Capital Cost		
Total to Design Year	$180,851,300	$ 719,773,600
To Design Year per Passenger	0.15	0.58
To Design Year After Accounting for Useful Life Beyond Design Year	119,819,100	399,377,700
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.10	0.32
Operating Cost		
Percent Met by Farebox Revenues in Design Year	61	52
Operating Deficit in Design Year	$ 15,988,800	$ 25,066,800
Operating Deficit per Passenger in Design Year	0.26	0.40
Operating Deficit to Design Year	373,223,000	445,847,000
Operating Deficit to Design Year per Passenger	0.30	0.36
Total Cost		
To Design Year	$554,074,300	$1,165,620,600
Federal Share	331,292,500	798,742,380
Nonfederal Share	222,781,800	366,878,220
To Design Year per Passenger	0.45	0.94
Federal Share	0.27	0.64
Nonfederal Share	0.18	0.30
To Design Year After Accounting for Useful Life Beyond Design Year	493,042,100	845,224,700
Federal Share	282,466,800	542,425,700
Nonfederal Share	210,575,300	302,799,000
To Design Year per Passenger After Accounting for Useful Life Beyond Design Year	0.40	0.68
Federal Share	0.23	0.44
Nonfederal Share	0.17	0.24

Source: SEWRPC.

a ranking of the segments in terms of operating costs per passenger mile and capital costs per passenger mile. Map 62 in Chapter III of this report identifies the major segments of the primary transit element of the plan. Maps 132 and 133 show those segments which may be expected to have above average operating costs and capital costs per passenger mile, respectively, as well as the degree to which such average costs may be expected to be exceeded, along a route and between routes. In any consideration of this cost-effectiveness information, it is important to recognize that the outer ends of each route can carry no through traffic, except through connection with a different mode such as a feeder/distributor bus.

The cost-effectiveness of segments of a system can also be compared in terms of passenger boardings and deboardings. Table 354 also presents passenger boarding and deboarding volumes and a rank ordering of the segments in terms of operating and capital costs per boarding and deboarding passenger. Maps 134 and 135 show those segments which may be expected to have above average operating and capital costs, respectively, per boarding and deboarding passenger, as well as the degree to which average costs may be expected to be exceeded.

Based on this cost-effectiveness information, the maximum extent busway system plan for this alternative future was truncated. The truncations were made with the objective of reducing system capital cost and operating deficits and bringing the total cost per passenger for a busway system plan for this future closer to that of the base plan, while retaining an integrated system. The proposed truncated busway system plan under the stable or declining growth scenario-centralized land use plan alternative future is shown on Map 100 in Chapter IV. The changes made in the maximum extent plan to reduce the truncated plan are summarized in Table 296 in Chapter V, as the plan would require the same changes as would the busway plan under the moderate growth scenario-decentralized land use plan alternative future. The segments deleted were the less cost-effective segments—that is, were segments which, if deleted, would result in relatively large reductions in system capital costs and operating deficits and relatively small reductions in system ridership. These segments consist of those extending to the communities of Cedarburg and Grafton from W. Capitol Drive in the City of Milwaukee, those extending to the Village of Menomonee Falls from W. Silver Spring Drive and N. 92nd Street in the City of Milwaukee, those extending to the Cities of West Allis and Waukesha from N. 84th Street and W. Fairview Avenue in the City of Milwaukee, those extending to the City of Oak Creek from General Mitchell Field, those looping from the intersection of W. Appleton Avenue and W. Capitol Drive to the Mayfair Mall Shopping Center, and that segment extending from the City of Cudahy to the City of South Milwaukee. Because of its high capital cost, the segment from S. 5th and W. Becher Streets to the City of St. Francis along E. and S. Bay Street and the Chicago & North Western's Kenosha Subdivision railway main line on the route connecting to the City of Cudahy was replaced by a segment from S. 5th and W. Becher Streets along Chase Avenue to the former Milwaukee Electric Lines

Table 353

OPERATING COST-EFFECTIVENESS OF BUSWAY ROUTES OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Route	Passenger Miles of Travel	Farebox Revenue	Vehicles Miles of Travel	Operating Cost	Percent of Operating Cost Met by Farebox Revenue
1—Waukesha/ Milwaukee CBD/UWM	76,190	$ 7,850	4,454	$11,900	66
2—Cedarburg/Grafton/ Milwaukee CBD/Oak Creek	67,790	6,990	4,527	12,100	58
3—Menomonee Falls/ Milwaukee CBD/ South Milwaukee	82,920	8,550	3,144	8,400	102
4—Crosstown: Northridge/Southridge	57,770	5,960	1,931	5,160	116
5—Loop: Capital Drive/UWM/ Wisconsin Avenue/Mayfair	61,410	6,330	3,272	8,740	72
Total	346,080	$35,680	17,328	$46,300	77

Source: SEWRPC.

Lakeside Belt Line, and then along that open right-of-way owned by the Wisconsin Electric Power Company and used for trunkline power transmission to the original routing from S. 5th and W. Becher Streets through the City of St. Francis to the City of Cudahy. The segment from the Milwaukee central business district through the University of Wisconsin-Milwaukee to Capitol Drive and along Capitol Drive to W. Atkinson Avenue in the City of Milwaukee was deleted because of its high capital cost relative to its ridership. Through the elimination of these segments, the capital cost of the primary element of the busway system would decrease from about $572 million to about $274 million, and the total cost of the truncated plan would be about $422 million.

Those segments given the highest priority for elimination were Segments 10, 11, 12, and 13 serving northern Milwaukee County and Ozaukee County, and Segments 1, 2, 3, and 18 serving Waukesha County. Segments 31 and 32, providing service along Capitol Drive between Appleton Avenue and Mayfair Road, and Segment 4, providing service to West Allis, were identified as the second set of segments to be deleted. The third set of segments identified to be deleted were those serving General Mitchell Field, the City of Oak Creek, and the City of South Milwaukee, including portions of both Segments 16 and 22 and all of Segments 17 and 24. Segments 9 and 34, serving the University of Wisconsin-Milwaukee campus and the lower east side, were the final two segments identified for deletion.

EVALUATION AND COMPARISON OF TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS

The fifth and last step in the design, test, and evaluation of alternative primary transit system plans under the stable or declining growth scenario-centralized land use plan alternative future was the test and evaluation of the truncated system plans for each alternative primary transit technology, as presented in the previous section of this chapter. Based upon this test and evaluation, a "best" composite plan for the provision of primary transit service in the Milwaukee area under this alternative future was identified.

Table 354

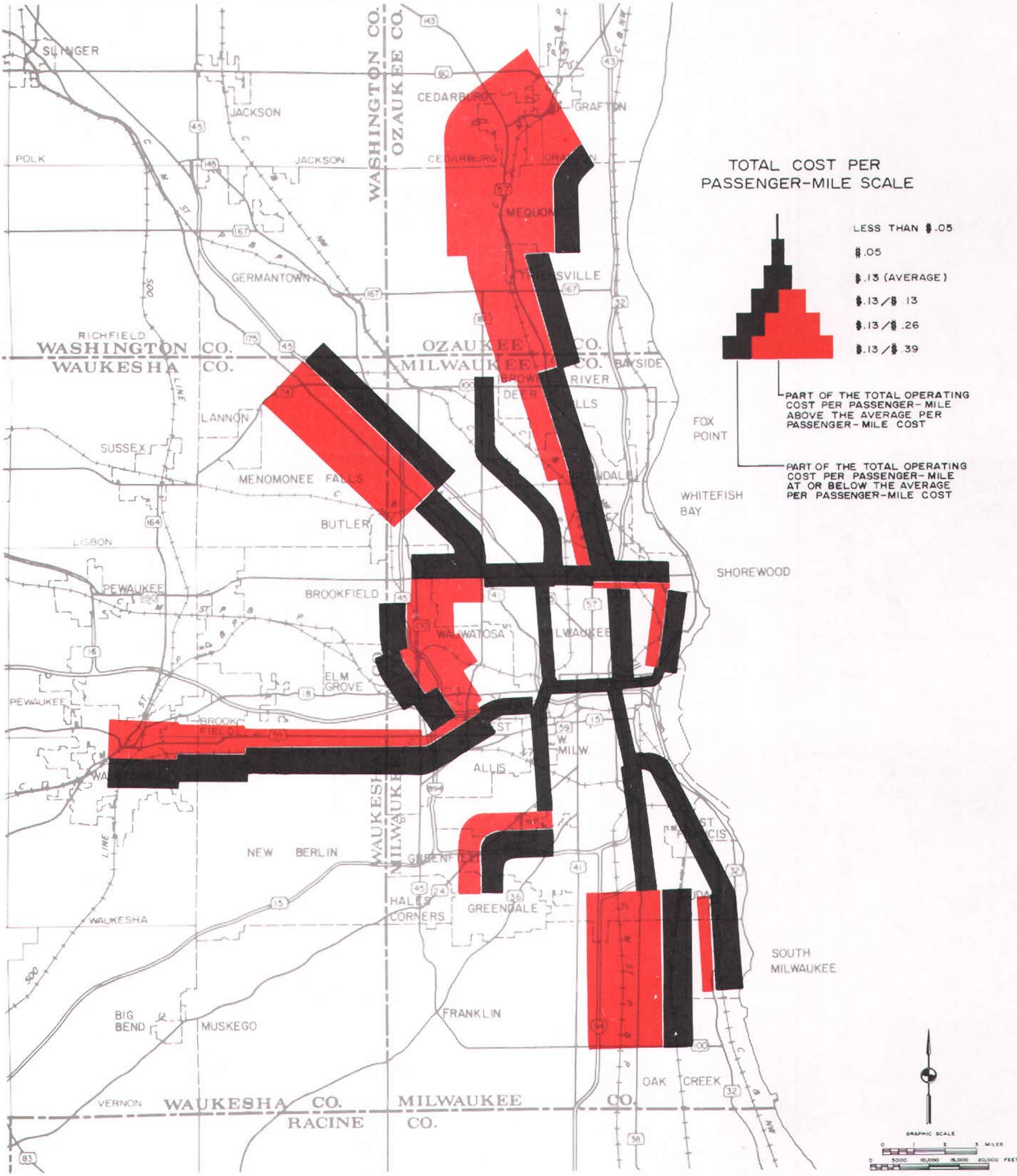
COST-EFFECTIVENESS ANALYSIS OF SEGMENTS OF THE PRIMARY ELEMENT OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Segment Number	Route Number	Transit Ridership: Average Weekday Passenger Volume: Range	Transit Ridership: Average Weekday Passenger Volume: Average	Transit Ridership: Total Boarding and Deboarding Passengers	Transit Ridership: Passenger Miles	Transit Ridership: Average Weekday Operating Cost in Design Year	Transit Ridership: Total Capital Cost Over Design Period	Average Weekday Operating Cost-Effectiveness in Design Year: Cost per Passenger Mile	Rank	Average Weekday Operating Cost-Effectiveness in Design Year: Cost per Boarding and Deboarding Passenger	Rank	Total Capital Cost-Effectiveness Over the Design Period: Cost per Passenger Mile	Rank	Total Capital Cost-Effectiveness Over the Design Period: Cost per Boarding and Deboarding Passenger	Rank
1	1	1,490- 1,590	1,540	2,570	2,780	$ 918	$ 5,957,000	$0.33	27	$0.36	15	$2,143	21	$ 2,313	10
2	1	1,670- 1,780	1,730	1,400	6,920	1,917	12,342,200	0.28	26	1.37	30	1,784	15	8,816	26
3	1	1,960- 2,090	2,070	1,370	8,280	1,979	11,282,900	0.24	24	1.44	31	1,363	11	8,236	24
4	1	3,180- 3,600	3,360	2,490	7,730	1,128	18,827,700	0.15	18	0.46	22	2,436	22	7,561	22
5	1 and 5	4,950- 7,860	7,130	4,970	17,110	1,937	28,409,500	0.11	12	0.39	17	1,660	14	5,716	19
6	1 and 5	13,480-13,480	13,480	7,850	8,090	573	7,551,700	0.07	2	0.07	2	933	8	962	3
7	1 and 5	14,730-19,190	15,950	37,630	39,870	2,597	27,973,200	0.07	2	0.07	2	702	4	743	2
8	1 and 5	10,900-16,440	14,510	11,190	10,160	543	3,259,700	0.05	1	0.05	1	321	1	291	1
9	1 and 5	2,160- 8,610	5,000	15,120	24,520	4,087	50,715,280	0.17	19	0.27	11	2,068	20	3,354	12
10	2	400- 570	500	920	3,360	2,379	20,153,500	0.71	34	2.59	34	5,998	32	21,906	34
11	2	630- 860	830	930	3,480	1,526	14,076,400	0.44	30	1.64	33	4,045	28	15,136	33
12	2	1,260- 1,450	1,330	720	4,260	1,107	6,525,200	0.26	25	1.54	32	1,532	12	9,063	27
13	2	2,050- 2,280	2,070	1,690	6,610	1,225	11,939,400	0.19	21	0.72	27	1,806	16	7,065	21
14	2	2,660- 5,630	4,660	10,140	18,150	1,596	16,539,500	0.09	8	0.16	6	911	6	1,631	6
15	2 and 3	9,590-10,260	9,950	7,630	24,870	1,642	11,383,300	0.07	2	0.22	8	458	2	1,492	5
16	2	2,570- 4,920	3,710	6,220	14,080	1,516	17,088,700	0.11	12	0.24	10	1,214	10	2,747	11
17	2	330- 1,860	650	2,090	3,470	1,845	21,362,100	0.53	33	0.88	28	6,156	33	10,221	28
18	3	320- 1,020	720	1,500	3,450	1,517	17,308,500	0.44	30	1.01	29	5,017	30	11,539	30
19	3	2,250- 3,090	2,400	4,230	5,520	769	8,926,400	0.14	16	0.18	7	1,617	13	2,110	8
20	3 and 5	5,030- 5,670	5,360	3,680	9,110	1,099	7,766,100	0.12	15	0.30	13	852	5	2,110	8
21	3 and 4	7,610- 8,940	8,120	16,550	31,650	2,227	18,366,500	0.07	2	0.13	4	580	3	1,110	4
22	3	3,990- 5,230	4,480	3,340	13,900	1,275	39,340,300	0.09	8	0.38	16	2,830	24	11,779	31
23	3	3,170- 3,780	3,380	3,070	8,450	842	25,777,500	0.10	10	0.27	11	3,051	25	8,397	25
24	3	930- 2,250	1,880	2,435	5,640	1,029	33,007,800	0.18	20	0.42	18	5,852	31	13,556	32
25	5	2,280- 2,800	2,540	3,510	9,890	1,107	24,720,900	0.11	12	0.32	14	2,500	23	7,043	20
26	4	2,950- 5,040	3,960	4,470	13,070	1,022	23,659,300	0.08	7	0.23	9	1,810	17	5,293	15
27	4	2,240- 5,180	4,360	6,140	12,630	947	11,508,400	0.07	2	0.15	5	911	6	1,874	7
28	4	1,070- 1,990	1,250	2,490	6,390	1,409	26,575,000	0.22	22	0.57	25	4,159	29	10,673	29
29	5	990- 1,250	1,150	1,660	2,190	732	6,857,500	0.33	27	0.44	20	3,131	26	4,131	14
30	5	750- 750	750	1,070	1,120	549	8,559,300	0.49	32	0.51	24	7,642	34	7,999	23
31	5	680- 1,060	890	950	1,600	649	5,415,400	0.41	29	0.68	26	3,385	27	5,700	18
32	5	950- 1,700	1,590	1,860	3,490	819	6,541,400	0.23	23	0.44	20	1,874	19	3,517	13
33	5	3,560- 3,930	3,730	1,160	5,600	562	6,599,600	0.10	10	0.48	23	1,179	9	5,689	17
34	5	2,130- 3,250	2,790	2,890	8,640	1,221	15,838,800	0.14	16	0.42	18	1,833	18	5,481	16

Source: SEWRPC.

Map 132

OPERATING COST PER PASSENGER-MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

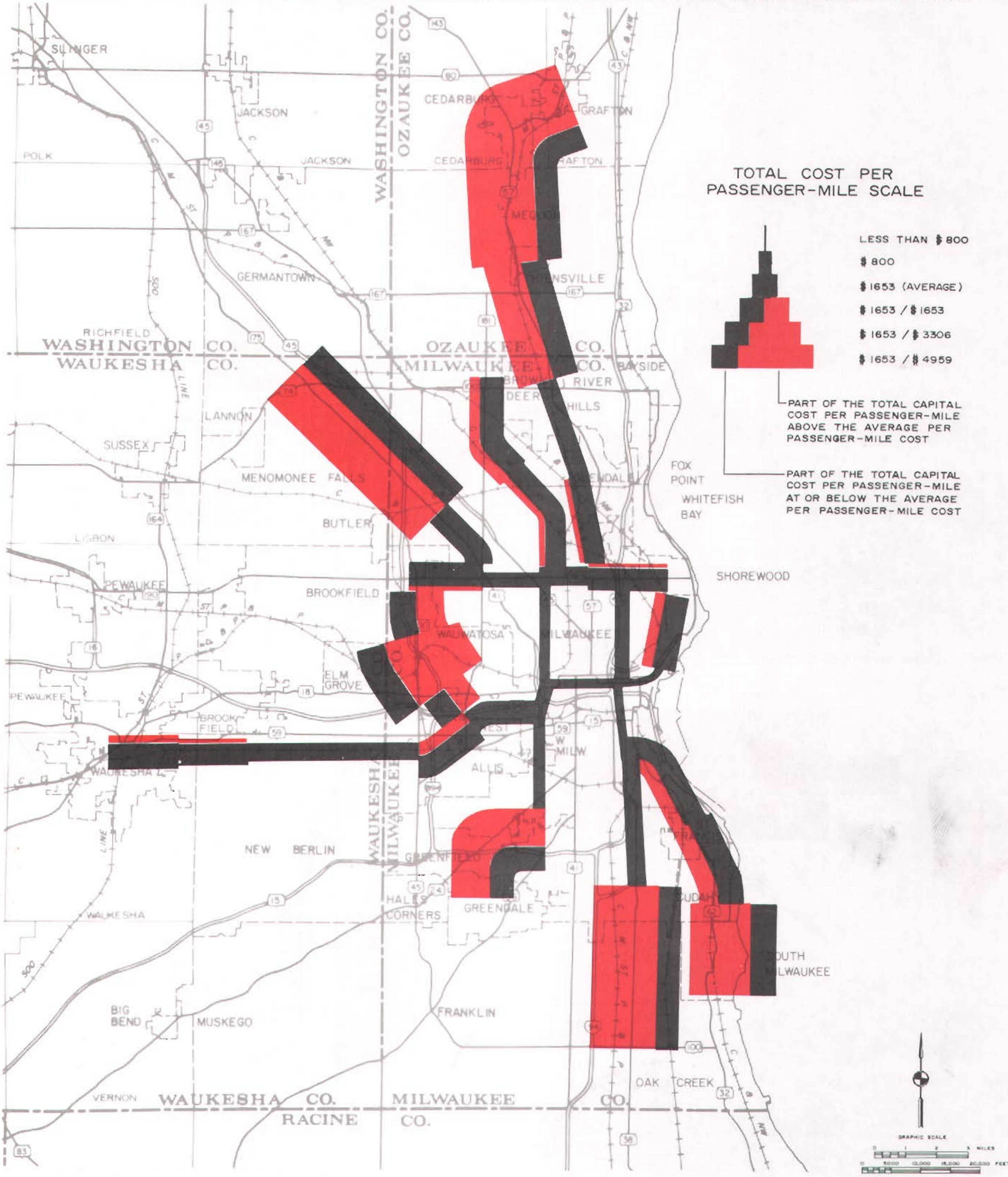


One measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway system plan was the operating cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average operating cost per passenger mile, as well as the degree to which such average costs may be expected to be exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, the data indicate that for the outer segments of each route, as well as portions of Route 5 in the City of Wauwatosa, an insufficient ridership base would exist to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development, and the absence of through traffic except by connection with a different mode such as feeder bus or automobile. To some degree, these inefficiencies are also generated by the lengthy distances of some segments in the suburban areas.

Source: SEWRPC.

Map 133

CAPITAL COST PER PASSENGER-MILE COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

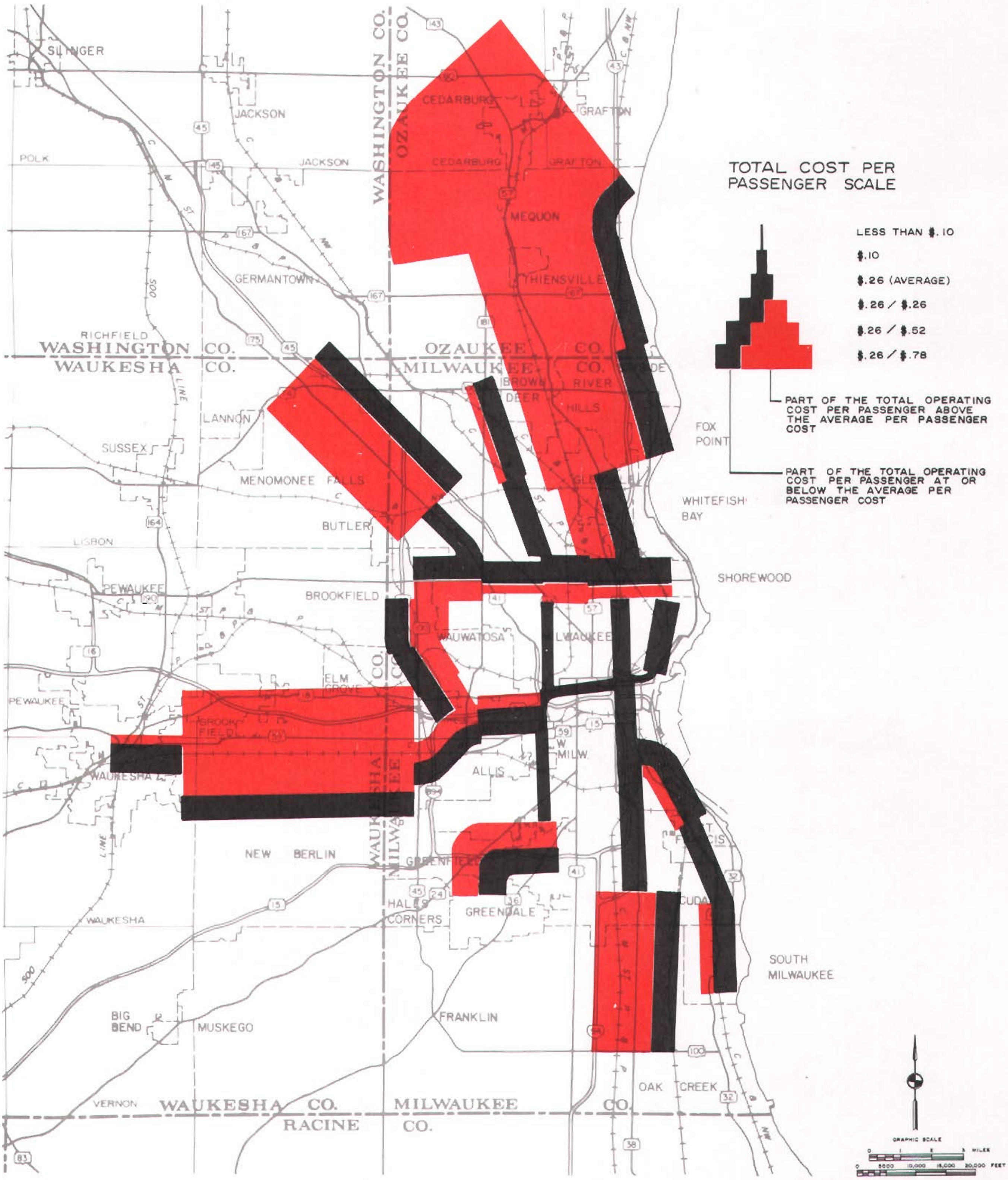


Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway system plan was the capital cost per passenger mile. This map shows those segments which may be expected to operate at, below, or above the average capital cost per passenger mile, as well as the degree to which such average costs may be expected to be exceeded. Compared with those segments located within the densely developed areas of Milwaukee County, the data indicate that for the outer segments of each route, as well as portions of Route 5 on the City of Milwaukee's east side and in the City of Wauwatosa, an insufficient ridership base would exist to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development, and the absence of through traffic except by a connection with a different mode such as feeder bus or automobile. To some degree, these inefficiencies are also generated by the large capital investments necessary for guideway structures and station facilities in some suburban areas and on Milwaukee's east side.

Source: SEWRPC.

Map 134

OPERATING COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

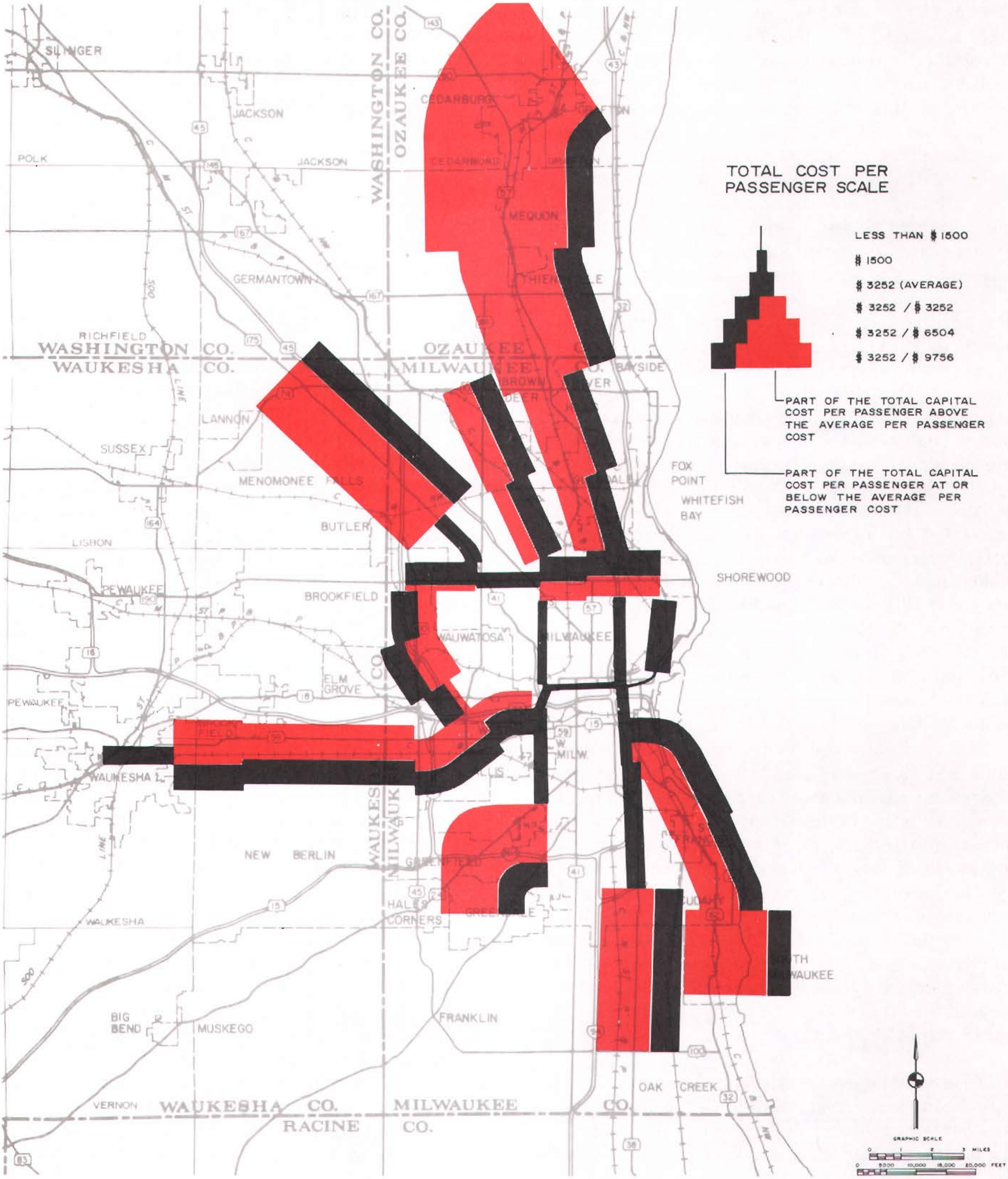


Yet another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway system plan was the operating cost per boarding and deboarding passenger. This map shows those segments which may be expected to operate at, below, or above the average operating cost per boarding and deboarding passenger, as well as the degree to which such average costs may be expected to be exceeded. As shown on this map, certain system segments within densely developed portions of Milwaukee County would be very cost-effective compared with the remainder of the system, while almost all segments located within suburban areas outside Milwaukee County are not cost-effective. This is a result of the lower boarding and deboarding passenger volumes in these suburban areas combined with the lengthy distances that the vehicles must operate over.

Source: SEWRPC.

Map 135

CAPITAL COST PER TOTAL BOARDING AND DEBOARDING PASSENGER COST-EFFECTIVENESS OF THE MAXIMUM EXTENT BUSWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



Another measure of cost-effectiveness used in the evaluation of individual system segments of the maximum extent busway system plan is the capital cost per boarding and deboarding passenger. This map shows those segments which may be expected to operate at, below, or above the average capital cost per boarding and deboarding passenger, as well as the degree to which such average costs may be expected to be exceeded. As shown on this map, certain segments within the densely developed portions of Milwaukee County would be very cost-effective compared with the remainder of the system. However, most segments located in Milwaukee County suburbs as well as outside Milwaukee County appear to have an insufficient volume of passenger boardings and deboardings to support fixed guideway development. This lower ridership is a consequence of the less intensive urban development combined with the large capital investments necessary for guideway structures and station facilities in some suburban areas. A noteworthy exception is the segment within the City of Waukesha which, by itself, appears cost-effective, but which nevertheless depends upon a connection to the remainder of the system over two lengthy suburban segments which generate little ridership.

Source: SEWRPC.

The truncated system plans for the bus-on-freeway, light rail transit, and busway alternative primary transit technologies are summarized with respect to their coverage, stations, routes, and operation on Maps 136 and 137, and in Tables 355 through 357. It should be noted that the truncated light rail transit and busway plans, presented in the previous section of this chapter, were further refined for comparative test and evaluation so that the geographic extent of primary transit service provided under each alternative was comparable. Specifically, primary transit bus-on-freeway routes from the truncated bus-on-freeway plan were added to the truncated light rail transit and busway plans in travel corridors where those modal plans did not provide service, but where the bus-on-freeway plan did provide service. Without these further refinements to provide a comparable extent of service between the alternative plans, a comparative evaluation of the alternative plans would have been impossible. Also, each individual plan—light rail transit and busway—would not include primary transit services in some corridors which could reasonably be expected to have such service by the design year, and the costs for which should be accounted for in systems planning. Bus-on-freeway service was added to the other truncated plans to make them composite plans because the bus-on-freeway plan provided greater geographic coverage than any of the other plans, it was the lowest capital cost primary transit alternative, and it represented a continuation and evolutionary extension of existing primary transit service. It should be noted that because the truncated system plan for the commuter rail mode consisted of only one route in a single corridor radiating from downtown Milwaukee to the south to Kenosha, a composite plan was not prepared for this alternative, but rather primary transit commuter rail service in this corridor was compared with service provided by the bus-on-freeway mode. This comparison was intended to determine whether commuter rail services could be recommended over bus-on-freeway facilities and services, the latter providing essentially the same type of long-distance transit service focused on the central business district as commuter rail in this corridor.

Alternative Primary Transit Plan Evaluation and Comparison—Evaluation of Commuter Rail Service in the South Corridor to Kenosha

As shown on Map 138, bus-on-freeway service in the corridor radiating to the south from the Milwaukee central business district to Kenosha would be provided over the North-South Freeway (IH 94) to the communities of Kenosha, Racine, Oak Creek, South Milwaukee, Cudahy, and St. Francis. Three bus-on-freeway routes totaling 179 route miles would provide this service from a total of seven stations located outside the Milwaukee central business district, all of which would have park-ride lots. Headways on the bus-on-freeway service would range from 12 to 30 minutes in the peak travel periods, and from 40 to 60 minutes in the off-peak travel periods to meet the forecast transit demand.

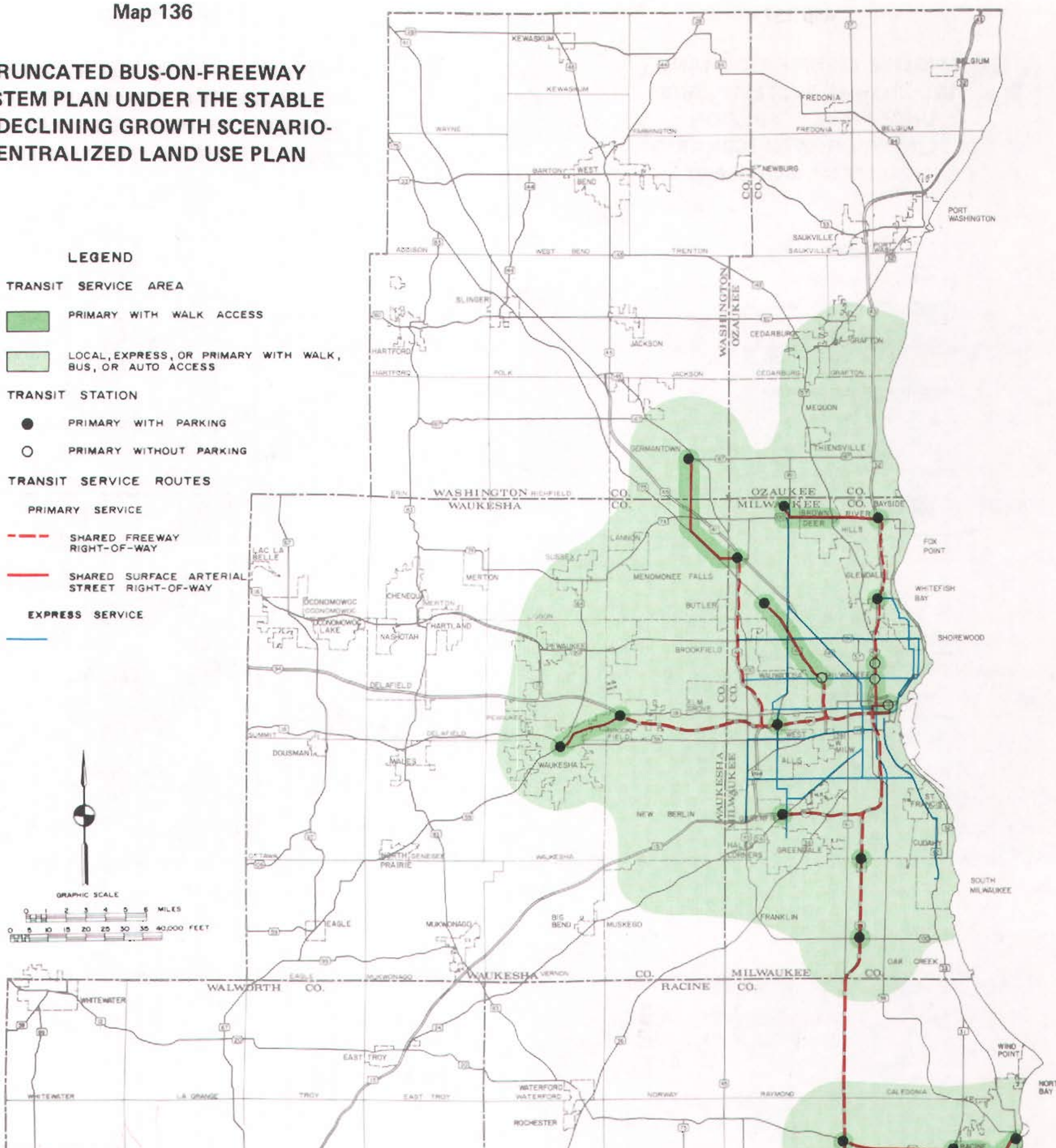
Commuter rail service would serve the same communities in this corridor along a single route, 66 miles in extent. A total of nine stations would be provided along the route, six of which would have park-ride lots. Trains would consist of a locomotive and two coaches in the peak travel periods, and one coach in both the midday and evening off-peak travel periods. Commuter trains would operate at the maximum headways prescribed in the adopted standards—30 minutes in the peak travel periods in the peak direction and 60 minutes otherwise.

The bus-on-freeway service in this corridor may be expected to carry about 84 percent more passengers in the design year than the commuter rail service, as shown in Table 358. Nearly 8,300 passengers may be expected to use the bus-on-freeway service on an average weekday, compared with 4,500 passengers for the commuter rail service. Under both the bus-on-freeway and commuter rail services in this corridor, most of these trips would either terminate or begin in the Milwaukee central business district. Under the bus-on-freeway service, 73 percent, or 6,040 trips, would have one trip end in the Milwaukee central business district, compared with 66 percent, or 3,000 trips, under the commuter rail service.

The net cost of operating and maintaining commuter rail service in this corridor in the design year—that is, the required subsidy or the total operating and maintenance costs less farebox revenues—may be expected to be about $303,900, or 16 percent, less than that of the bus-on-freeway service. However, the net operating and maintenance cost per passenger on the bus-on-freeway service would be about 65 percent that of the commuter rail service. The bus-on-freeway service would require, on the average, a subsidy of $0.90 per passenger, compared with $1.39 per passenger for the commuter rail service. The greater cost-effectiveness of the bus-on-freeway service is also indicated by the fact that it may be expected to recover about 4 percent more of its design year operating and maintenance costs from farebox revenues than the commuter rail service, 46 percent compared with 42 percent.

Map 136

TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

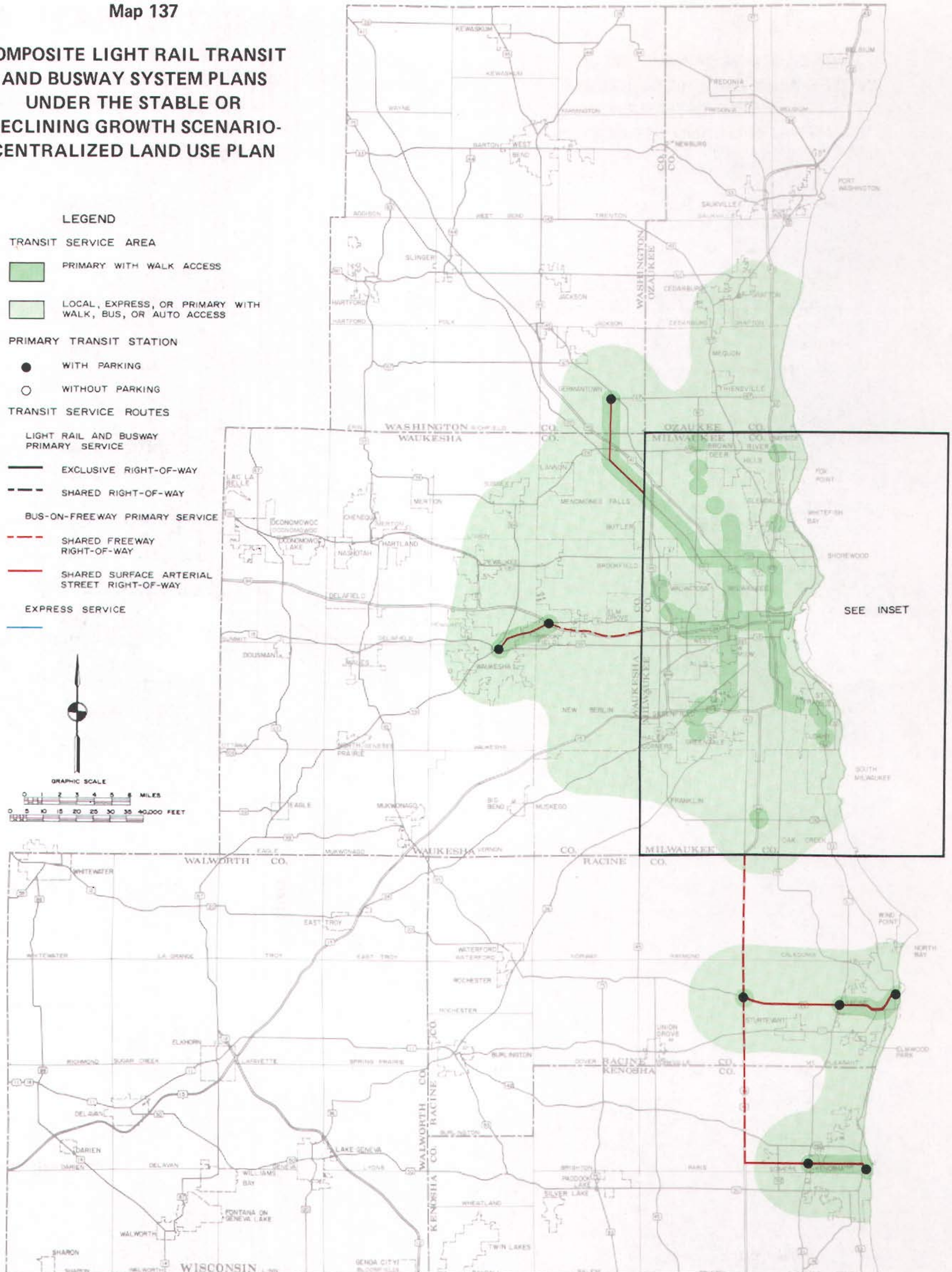


The truncated bus-on-freeway system plan is a carefully cut back version of the maximum extent bus-on-freeway system plan, the cutbacks being made with the objective of creating a more cost-effective system serving a large part of the Milwaukee area. Under the truncated plan, 9 of the 31 routes, totaling 113 miles of line over which 365 round-trip route miles of service would be provided, or about 46 percent of the 246 miles of line and 30 percent of the 1,218 route miles of service provided under the maximum extent plan, were retained. Headways were assumed to remain about the same as under the maximum extent plan, ranging from 10 to 30 minutes during the peak travel periods and 30 to 60 minutes during the off-peak periods. Under the truncated plan, a total of 20 primary transit stations or stops would be served outside the Milwaukee central business district, 17 of which would have park-ride lots. There would be 12 stations within Milwaukee County, 9 of which would have park-ride lots.

Source: SEWRPC.

Map 137

COMPOSITE LIGHT RAIL TRANSIT AND BUSWAY SYSTEM PLANS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



The composite light rail transit and busway system plans are carefully cut back versions of the maximum extent light rail transit and busway system plans. The cutbacks were made with the objective of creating more cost-effective systems which could still serve a large part of the Milwaukee area. Under the composite plans, fixed guideways would be limited to Milwaukee County. A total of 46 miles of line over which 97 round-trip route miles of service would be provided were retained on three routes, or about 44 percent of the 105 miles of line and about 38 percent of the 253 route miles of service provided under the maximum extent plan. To make this plan comparable to the bus-on-freeway plan, a total of 6 bus-on-freeway routes operating over 80 miles of line, and providing an additional 276 route miles of primary service, were added to serve portions of the Milwaukee area that would not be served by the three light rail transit or busway primary transit routes. Headways on the light rail transit system would range from 4 to 10 minutes during the peak travel periods, and from 30 to 60 minutes in the off-peak periods. Bus-on-freeway service would be provided with headways ranging from 10 to 30 minutes during the peak travel periods, and 40 to 60 minutes in the off-peak periods. A total of 100 primary transit stations or stops would be provided, of which 89 stations would serve the light rail transit system and 11 stations would serve the bus-on-freeway service. Of the 100 stations, 15 would have park-ride lots for light rail transit and 11 would have park-ride lots for bus on freeway. A total of 92 stations would be located within Milwaukee County, of which 18 would have park-ride lots.

Source: SEWRPC.

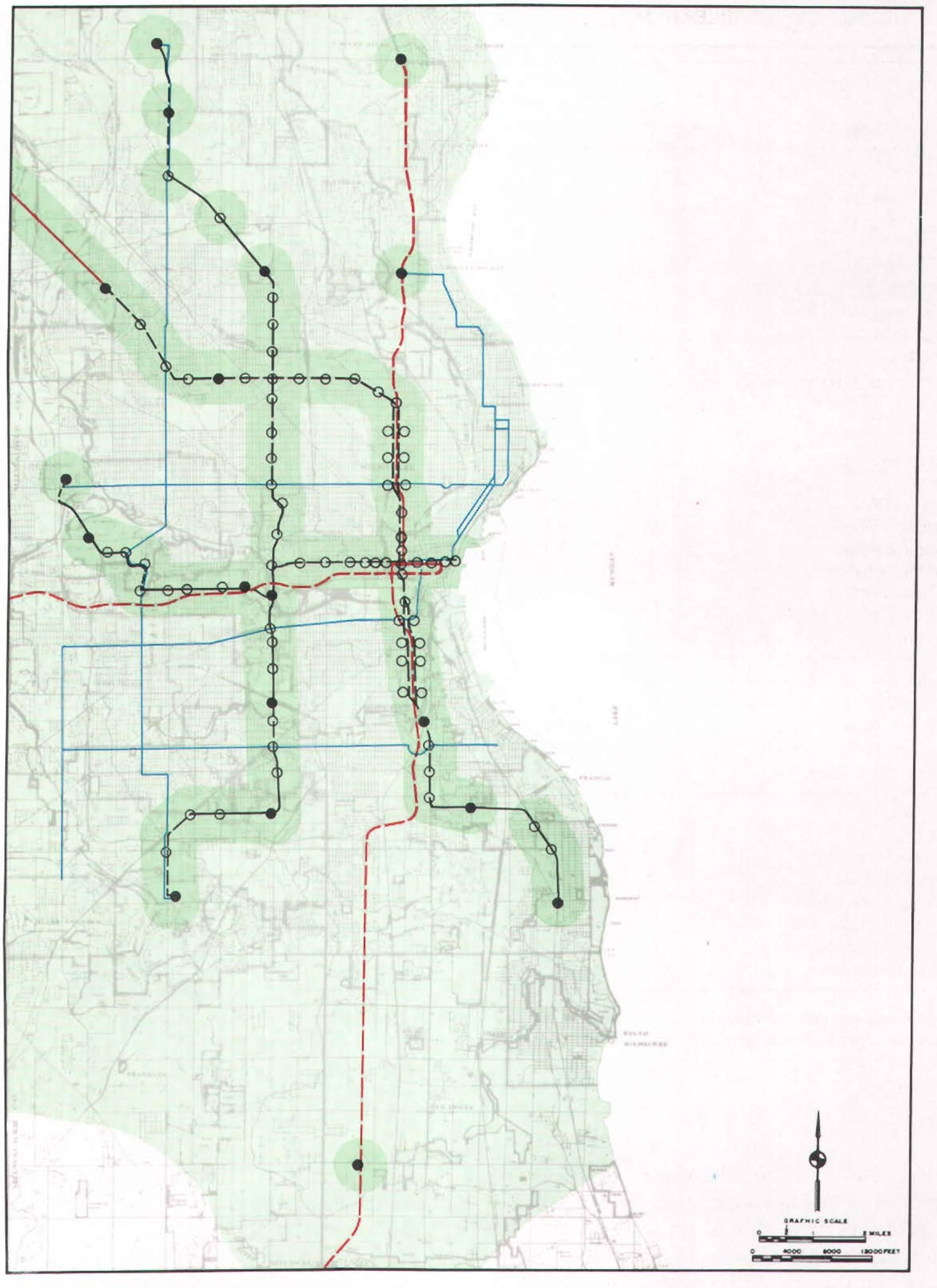


Table 355

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS ON AN AVERAGE WEEKDAY UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Characteristic	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Primary Element				
Exclusive Guideway Miles				
Subway.	- -	- -	- -	- -
Elevated	- -	- -	5.3	5.3
At-Grade	- -	- -	41.0	41.0
Total	- -	- -	46.3	46.3
Shared Guideway Miles				
Freeways.	51.5	70.6	55.0	53.1
Surface Arterial Streets. . .	49.5	42.1	24.6	20.5
Total	101.0	112.7	79.6	73.6
Stations	20	21	100	100
Route Miles.	449	365	373	370
Vehicle Miles[a]	7,010	13,300	13,780	14,700
Vehicle Hours	300	470	580	650
Vehicles Required				
Motor Buses	59	63	30	100
Light Rail Vehicles	- -	- -	52	- -
Trains Required	- -	- -	52	- -
Express and Local Elements				
Route Miles.	1,302	1,811	1,620	1,620
Vehicle Miles	60,230	72,630	63,880	68,990
Vehicle Hours	4,160	4,730	4,230	4,550
Motor Buses Required.	474	630	549	572
Total System				
Route Miles.	1,755	2,176	1,993	1,990
Vehicle Miles	67,240	85,930	77,660	83,690
Vehicle Hours	4,460	5,200	4,810	5,200
Vehicles Required				
Motor Buses	533	693	579	672
Light Rail Vehicles	- -	- -	52	- -
Trains Required	- -	- -	52	- -

[a] *Vehicle miles of travel per average weekday on the bus-on-freeway component of the truncated and composite plans are estimated at 7,460 vehicle miles for the composite light rail transit plan and 7,500 vehicle miles for the composite busway plan.*

Source: SEWRPC.

The capital investment required to provide primary transit service in this corridor, including the cost of all construction, right-of-way acquisition, and the acquisition and replacement of vehicles over the plan design period, would be about 45 percent, or about $8 million, higher for the commuter rail service than for the bus-on-freeway service, as shown in Table 358. The capital cost—that is, the capital investment less the value of the remaining life of the facilities and vehicles at the end of the 20-year plan design period—for the commuter rail service is also expected to be slightly higher than that for the bus-on-freeway service in this corridor. The capital cost per passenger in the design year of the bus-on-freeway service would be about 50 percent that of the commuter rail service. Accordingly, it

Table 356

TIME-OF-DAY OPERATION OF THE TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Morning Peak	Midday Off-Peak	Afternoon Peak	Evening Off-Peak	Total
Truncated Bus-on-Freeway Plan					
Primary Element					
Route Miles	365	365	365	365	365
Vehicle Miles	3,570	3,390	4,680	1,660	13,300
Vehicle Hours	130	110	170	60	470
Articulated Motor Buses Required	50	19	63	17	63
Express and Local Elements					
Route Miles	1,811	1,737	1,811	1,628	1,811
Vehicle Miles	18,140	18,220	21,010	15,260	72,630
Vehicle Hours	1,200	1,180	1,410	940	4,730
Conventional Motor Buses Required	556	212	630	164	630
Total System					
Route Miles	2,176	2,102	2,176	1,993	2,176
Vehicle Miles	21,710	21,610	25,690	16,920	85,930
Vehicle Hours	1,330	1,290	1,580	1,000	5,200
Vehicles Required	606	231	693	181	693
Articulated Motor Buses	50	19	63	17	63
Conventional Motor Buses	556	212	630	164	630
Composite Light Rail Transit Plan					
Primary Element					
Route Miles	373	373	373	373	373
Vehicle Miles	4,300	2,680	5,090	1,710	13,780
Vehicle Hours	190	100	220	70	580
Vehicles Required	72	20	82	19	82
Articulated Light Rail Vehicles	46	8	52	7	52
Articulated Motor Buses	26	12	30	12	30
Trains Required	46	8	52	7	52
Express and Local Elements					
Route Miles	1,620	1,546	1,620	1,518	1,620
Vehicle Miles	14,980	17,170	17,230	14,500	63,880
Vehicle Hours	1,020	1,130	1,180	900	4,230
Conventional Motor Buses Required	487	197	549	155	549
Total System					
Route Miles	1,993	1,919	1,993	1,891	1,993
Vehicle Miles	19,280	19,850	22,320	16,210	77,660
Vehicle Hours	1,210	1,230	1,400	970	4,810
Vehicles Required	559	217	631	174	631
Articulated Light Rail Vehicles	46	8	52	7	52
Articulated Motor Buses	26	12	30	12	30
Conventional Motor Buses	487	197	549	155	549
Trains Required	46	8	52	7	52
Composite Busway Plan					
Primary Element					
Route Miles	370	370	370	370	370
Vehicle Miles	4,810	2,510	5,750	1,630	14,700
Vehicle Hours	230	90	270	60	650
Articulated Motor Buses Required	82	33	100	19	100
Express and Local Elements					
Route Miles	1,620	1,546	1,620	1,518	1,620
Vehicle Miles	16,020	18,960	18,140	15,870	68,990
Vehicle Hours	1,090	1,240	1,240	980	4,550
Conventional Motor Buses Required	519	215	572	161	572
Total System					
Route Miles	1,990	1,916	1,990	1,888	1,990
Vehicle Miles	20,830	21,470	23,890	17,500	83,690
Vehicle Hours	1,320	1,330	1,510	1,040	5,200
Vehicles Required	601	248	672	180	672
Articulated Motor Buses	82	33	100	19	100
Conventional Motor Buses	519	215	572	161	572

Source: SEWRPC.

Table 357

SUMMARY OF SERVICE AND FACILITY CHARACTERISTICS OF TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Summary of Truncated and Composite Plans
Truncated Bus-on-Freeway Plan	Extent of Service—Expansion of primary service proposed under the maximum extent plan was significantly reduced. Under the truncated plan, only 9 of the 31 routes totaling 365 round-trip route miles, or 30 percent of the 1,218 round-trip route miles in the maximum extent plan, were retained. Frequency of Service—Headways would remain about the same, ranging from 10 to 30 minutes in the peak periods and 40 to 60 minutes in the off-peak periods. Operations—Under the truncated plan, bus miles per average weekday of primary service would be reduced by about 60 percent, from 32,110 miles under the maximum extent plan to 13,300 miles. Bus miles per average weekday of local and express service would decrease by about 8 percent, from about 78,570 miles to about 72,630 miles. Transit Stations—A total of 20 transit stations or stops would be provided outside the Milwaukee central business district, 17 of which would have park-ride lots. Under the truncated plan, there would be 12 stations in Milwaukee County, 9 of which would have park-ride lots.
Composite Light Rail Transit Plan	Extent of Service—Expansion of light rail transit primary service proposed under the maximum extent light rail transit plan was somewhat reduced under the composite plan, limiting light rail transit service to Milwaukee County. Under the composite plan, three of the five routes totaling 97 route miles, or 38 percent of the 253 route miles in the maximum extent plan, were retained. Two of the routes would extend from the Milwaukee central business district, one providing service between Timmerman Field to the northwest and the communities of St. Francis and Cudahy to the south, and the other terminating at the Mayfair Mall Shopping Center to the west. The third route would be a north-south crosstown route connecting Northridge and Southridge Shopping Centers and passing through the communities of Greendale, Greenfield, Milwaukee, and West Milwaukee. To make this plan comparable to the bus-on-freeway plan, a total of six bus-on-freeway routes, representing an additional 276 route miles of primary service, would be added to serve the communities of Bayside and River Hills in Milwaukee County to the north; the communities of Menomonee Falls in Waukesha County and Germantown in Washington County to the northwest; the City of Waukesha to the west; and the communities of Kenosha and Racine to the south. Frequency of Service—Headways on the light rail transit system would range from 4 to 10 minutes in the peak period and 30 to 60 minutes in the off-peak periods; bus-on-freeway service would be provided with headways ranging from 10 to 30 minutes in the peak period and 40 to 60 minutes in the off-peak periods. Operations—One-car trains would be provided on all three routes in both the peak and off-peak travel periods. Total vehicle miles per average weekday of primary service would decrease by about 8 percent, from 14,970 miles under the maximum extent plan to 13,780 miles, of which 6,320 miles would be provided by light rail service and 7,460 miles by bus-on-freeway service. Bus miles of express and local service would increase somewhat, from 62,900 miles under the maximum extent plan to 63,880 miles under the composite plan. Transit Stations—A total of 100 transit stations or stops would be provided, of which 89 stations would be provided on the light rail transit system, and 11 stations on the bus-on-freeway system. Of the 100 stations, 15 would have park-ride lots for light rail transit and 11 would have park-ride lots for bus-on-freeway. A total of 92 stations would be located within Milwaukee County, of which 18 would have park-ride lots.
Composite Busway Plan	Extent of Service—Busway service would be provided over the same three routes as under the composite light rail transit plan. Also, the bus-on-freeway routes are the same as those provided under the composite light rail transit plan.[a] Frequency of Service—Headways on the busway system would range from 4 to 9 minutes in the peak period and 40 to 60 minutes in the off-peak periods; bus-on-freeway service would be provided with headways ranging from 9 to 28 minutes in the peak period and 40 to 55 minutes in the off-peak periods. Operations—Total vehicle miles per average weekday of primary service would decrease by about 15 percent—from 17,330 miles under the maximum extent plan to 14,700 miles, of which 7,200 miles would be provided by busway service and 7,500 miles by bus-on-freeway service. Bus miles of express and local service per average weekday would increase somewhat, from 64,580 miles to 68,990 miles. Transit Stations—The number and location of busway system stations and stops would be the same as under the composite light rail transit plan.

[a] *The design of the composite busway plan provided for certain bus-on-freeway routes to operate over the busway for a portion of their trips, if such routing would not provide a travel time disadvantage. Of the five bus-on-freeway routes added to the plan, only the route operating over the North-South Freeway (IH 43) and serving the communities of Bayside and River Hills would meet this criterion. This route would enter the busway at Locust Street and remain on the busway through downtown Milwaukee.*

Source: SEWRPC.

Map 138

COMPARABLE BUS-ON-FREEWAY AND COMMUTER RAIL ROUTES IN THE SOUTH CORRIDOR TO KENOSHA UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

In an effort to identify elements of the composite commuter rail system plan that may be superior to comparable elements of the truncated bus-on-freeway system plan, commuter rail and bus-on-freeway routes in the corridor between the Milwaukee central business district and the City of Kenosha were examined separately from the remainder of each of the primary transit systems. The bus-on-freeway service shown above is comprised of three routes totaling 179 round-trip route miles, and includes a total of seven stations located outside downtown Milwaukee, all of which would have park-ride lots. The commuter rail service shown above is comprised of 66 round-trip route miles operated over a single alignment of 33 miles in length, and includes a total of nine stations, six of which would have park-ride lots.

Source: SEWRPC.

was concluded that bus-on-freeway service would be superior to commuter rail service in this corridor, as it would attract substantially greater ridership and be more cost-effective. These advantages of the bus-on-freeway service outweigh the small additional public operating subsidy necessary to provide this service.

It should be noted that some additional ridership on local and express transit service may be expected in this corridor under the commuter rail plan. Although the commuter rail service would carry 3,800 fewer primary transit trips on an average weekday in the design year than the bus-on-freeway service, some proportion of these trips may be expected to use the express and local, as opposed to the primary, transit services. As shown in Table 358, the fact that commuter rail would carry these additional transit trips on local and express transit services does not alter the conclusion that bus-on-freeway service is superior to commuter rail service in this corridor. While the substantial ridership and cost-effectiveness advantages of the bus-on-freeway services are reduced somewhat when considering the express and local services as well as the primary services, the advantages of the commuter rail services with respect to operating subsidy are eliminated, with both alternatives requiring about the same subsidy in the design year. Consequently, because commuter rail service would not provide an advantage over bus-on-freeway service in this corridor, the systemwide plan evaluation was limited to the bus-on-freeway, light rail, and busway technologies under this future.

Alternative Primary Transit Plan Evaluation and Comparison—Satisfaction of Objectives and Standards

The truncated bus-on-freeway and composite light rail and busway primary transit system plans were evaluated and compared by establishing the degree to which the plans could be expected to meet the adopted primary transit system development objectives.[12] This was determined by scaling each alternative plan against the standards formulated to relate the objectives to specific primary transit system development proposals. So that the evaluative information would be manageable, only those

[12] *See Chapter II of SEWRPC Planning Report No. 33, A Primary Transit System Plan for the Milwaukee Area.*

Table 358

SUMMARY OF COMPARISON OF THE BUS-ON-FREEWAY AND COMMUTER RAIL ALTERNATIVES IN THE SOUTH CORRIDOR TO KENOSHA UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Evaluative Measure	Bus-on-Freeway Primary Element	Commuter Rail Primary Element	Commuter Rail Local and Express Element[a]	Commuter Rail Total System
Ridership				
Average Weekday Passengers	8,300	4,500	2,170	6,670
Design Year Passengers	2,116,500	1,147,500	629,300	1,776,800
Capital Cost and Investment				
Total Capital Cost to Design Year	$10,210,400	$11,243,600[c]	$1,067,500	$12,311,100
Total Capital Investment to Design Year	17,859,400	26,425,400[c]	1,941,000	28,366,400
Operating Cost				
Operating Cost in Design Year	$ 3,534,800	$ 2,777,000	$ 520,000	$ 3,297,000
Percent of Operating Cost Met by Farebox Revenue in Design Year[b]	46	42	49	44
Net Operating Cost (deficit) in Design Year	1,895,150	1,591,250	265,200	1,856,450
Cost-Effectiveness				
Net Operating Cost per Passenger in Design Year	$0.90	$1.39	$0.41	$1.04
Capital Cost to Design Year per Passenger in Design Year	4.82	9.80	1.70	6.93

[a] The local and express service ridership and costs in this table represent the additional local and express ridership and cost of the commuter rail plan over the bus-on-freeway plan in this corridor. Based on the traffic assignments attendant to the composite commuter rail plan under the moderate growth scenario-centralized land use plan alternative future, it has been assumed that of the additional transit trips which would be made on the primary element under the bus-on-freeway plan, 57 percent would be made on the local and express element of the commuter rail plan under this future and, importantly, in the south corridor to Kenosha. It has also been assumed that the operating and capital costs of carrying these local and express transit trips would be based on the proportion of local and express transit trips in the corridor to the total local and express trips that would be expected under a composite commuter rail plan under this future.

[b] Fares under both the alternative plans are assumed to increase with general price inflation. The fare for local and express bus service under both plans would remain at $0.50 per ride, expressed in 1979 constant dollars. The primary service fare would remain at $0.60 within Milwaukee County, and would increase with distance from Milwaukee County to between $1.00 and $2.00 at the station at 14th Avenue and 54th Street in the City of Kenosha.

[c] The Milwaukee Road has proposed major track rehabilitation work on the railway route identified in this corridor for potential use by commuter rail trains. Should all this track rehabilitation work be completed, the total capital investment would be reduced by $0.9 million to $25.5 million in the Kenosha corridor. As of April 1981, such rehabilitation work had been completed on the Kenosha commuter rail route.

Source: SEWRPC.

standards which were considered essential to a comparative evaluation of alternative plans and the subsequent selection of a "best" composite plan were used, as shown in Table 167 in Chapter III of this report.

Table 359 provides a summary of the degree to which each alternative truncated system plan satisfies each of the key standards used and, therefore, the adopted objectives. Also included in the table is the measured attainment of the key standards by the base plan.

It should be noted that, while the primary transit facilities and services under each truncated plan were tested and evaluated in detail, and refined and improved to the maximum extent practicable, the local and express elements of each truncated plan

Table 359

SUMMARY OF EVALUATION OF THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Evaluative Measure	Alternative: Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Objective No. 1—Serve Land Use				
Accessibility				
Average Overall Travel Time of Transit Trips to the Milwaukee Central Business District (minutes)	34	34	33	33
Objective No. 2—Minimize Cost and Energy Use				
Cost				
Total Public Cost to Design Year (capital cost and operating and maintenance deficit)	$493,042,100	$603,060,000	$775,703,000	$727,150,000
Average Annual Total Public Cost	23,478,200	28,717,150	36,938,300	34,626,200
Capital Cost[a] and Investment				
Capital Cost to Design Year	119,819,100	158,150,000	351,363,900	283,220,900
Average Annual Capital Cost	5,705,700	7,530,950	16,731,600	13,486,700
Capital Investment to Design Year	180,851,300	225,928,500	634,755,700	478,082,100
Average Annual Capital Investment	8,611,950	10,758,500	30,226,400	22,765,800
Operating and Maintenance Cost Deficit (net cost)				
Deficit in Design Year	15,988,800	24,949,200	22,378,600	24,826,600
Deficit to Design Year	373,223,000	444,910,000	424,340,000	443,930,000
Average Annual Deficit	17,772,500	21,186,200	20,206,700	21,139,500
Cost-Effectiveness				
Total Cost to Design Year per Passenger	0.40	0.48	0.62	0.58
Capital Cost to Design Year per Passenger	0.10	0.12	0.28	0.23
Operating Deficit to Design Year per Passenger	0.30	0.35	0.34	0.36
Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year				
Total Transit System	61	53	55	53
Primary Element	49	48	78	71
Energy				
Total Transit System Energy Use to Design Year (million BTU's)	15,901,220	17,851,980	19,531,520	19,329,100
Total Transit Construction Energy Use to Design Year (million BTU's)	1,163,820	1,329,060	3,181,920	3,034,260
Total Transit Operating and Maintenance Energy Use to Design Year (million BTU's)	14,737,400	16,522,920	16,349,600	16,294,840
Total Transit System Energy Use per Passenger Mile Traveled to the Design Year (BTU's)	3,420	3,490	3,940	3,890
Total Transit Passenger Miles per Gallon of Diesel Fuel to Design Year (BTU's)	39.8	39.0	34.5	34.9
Dependence on Petroleum-Based Fuel	All trips dependent	All trips dependent	21 percent of transit trips not dependent	All trips dependent
Petroleum-Based Fuel Use by Transit to Design Year (gallons of diesel fuel)	106,105,800	118,551,250	107,739,200	116,971,470
Automobile Propulsion Energy Use in Design Year (gallons of gasoline)	314,400,000	309,600,000	309,600,000	310,400,000

Table 359 (continued)

Evaluative Measure	Alternative: Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Objective Nos. 3 and 5—Provide Appropriate Service and Quick Travel				
Average Weekday Transit Trips				
Total Transit System	215,900	228,500	224,800	223,700
Primary Element	10,000	22,500	57,300	50,300
Proportion of Transit Trips Using Primary Element	0.05	0.10	0.25	0.22
Service Coverage				
Population Served Within a One-Half-Mile Walking Distance of Primary Transit Service	203,000	163,200	319,400	319,400
Population Served Within a Three-Mile Driving Distance of Primary Transit Service	775,100	881,700	1,047,200	1,047,200
Jobs Served Within a One-Half-Mile Walking Distance of Primary Transit Service	205,700	194,000	337,600	337,600
Average Speed of Transit Vehicle (mph)				
Primary Element	23	28	24	23
Total System	15	16	16	16
Average Speed of Passenger Travel on Vehicle (mph)				
Primary Element	25	33	24	23
Total System	15	18	17	17
Objective No. 4—Minimize Environmental Impacts				
Community Disruption				
Homes, Businesses, or Industries Taken	None	None	None	None
Land Required (acres)	12	20	113	110
Air Pollutant Emissions—Total Transportation System (Highway and Transit) in Design Year (tons per year)				
Carbon Monoxide	154,784	152,507	152,484	152,677
Hydrocarbons	153,333	15,046	15,047	15,068
Nitrogen Oxides	27,488	27,034	27,065	27,071
Sulfur Oxides	2,306	2,292	2,406	2,294
Particulates	3,717	3,673	3,680	3,675
Objective No. 6—Maximize Safety				
Proportion of Total Person Trips Made on Transit	0.059	0.063	0.062	0.062

[a] *The capital cost of a composite plan is equal to the plan's required capital investment, or total capital outlays necessary over the plan design period, less the value of that investment beyond the plan design period.*

Source: SEWRPC.

were not. The local and express transit elements of each truncated plan provide the extent of such service recommended under the adopted long-range regional transportation system plan, with modifications made only as necessary to coordinate such service with the primary transit service under each alternative plan. The adopted long-range transportation system plan proposed expansion of local transit service into all areas of contiguous future urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County. Not all of this expanded service may be cost-effective under this alternative future, and such service may thus reduce the cost-effectiveness of the alternative truncated and composite primary transit system plans. Upon selection of a "best" composite plan, the cost-effectiveness of this expanded local and express transit service will be considered and its extent may be truncated, enabling a better comparison of the final primary transit plan to the base plan.

Objective 1—Serve Land Use: The first objective under this study identifies the need for an accessible primary transit system which, through its location, capacity, and design, will effectively serve existing, and promote sound future, land use development. This objective is measured by two standards. One standard measures the degree to which transit accessibility to the Milwaukee central business district is maximized. The other standard measures the degree to which transit accessibility in the Milwaukee area would support the regional land use plan by providing a higher relative accessibility to areas in which high-density development is planned than to areas planned for low-density development or planned to be protected from development.

The standard calling for maximizing transit accessibility to the Milwaukee central business district was measured by determining the overall travel time, including all access, wait, and transfer time, for transit trips to the Milwaukee central business district from all parts of the Milwaukee area, and the travel time for transit trips as an average for the entire Milwaukee area. The average overall travel times of transit trips to the central business district would be about the same for the three truncated or composite plans under this alternative future, ranging from 33 minutes for the light rail transit and busway plans to 34 minutes for the bus-on-freeway plan. The travel time contour lines shown on Map 76 in Chapter III for the base plan and on Maps 139 through 141 for the bus-on-freeway, light rail transit, and busway plans indicate the overall transit travel times from each part of the Milwaukee area. These maps indicate that transit accessibility to the central business district would be greater under all the truncated and composite plans than under the base plan.

The attainment of the other standard under this objective, which calls for adjusting transit accessibility to land use plans, was measured by comparing these contours of central business district transit accessibility to the regional land use plan.[13]

[13] *The regional land use plan recommends a highly centralized land use development pattern. Population and jobs are proposed to be reconcentrated in central Milwaukee County, and new urban development is proposed to occur principally at urban densities along and contiguous to the periphery of existing urban centers (see SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume Two, Alternative and Recommended Plans).*

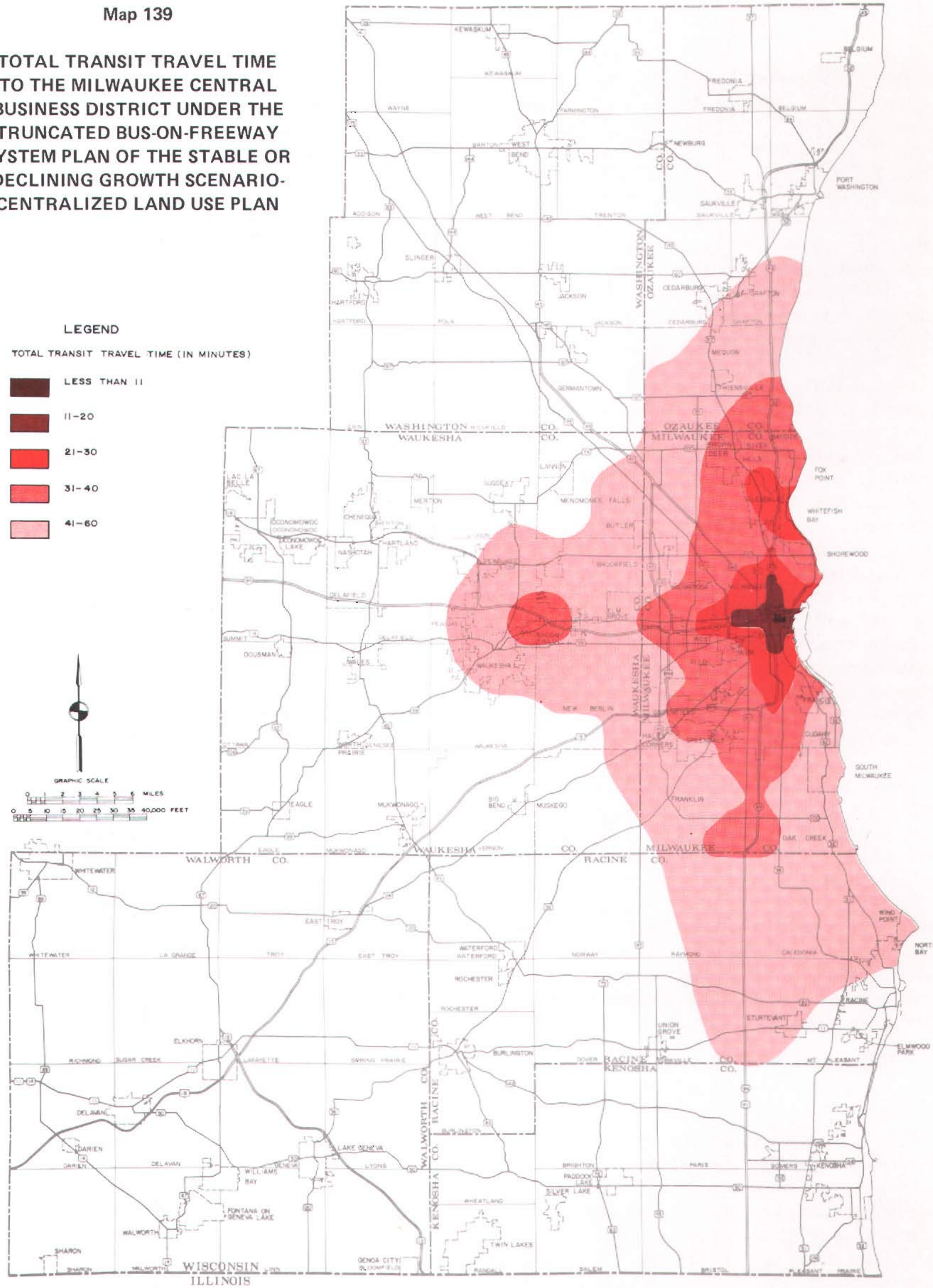
The Milwaukee central business district is the most important trip generator in the Milwaukee area, and would, under this alternative future, remain so, accounting for over 6 percent of the approximately 3.6 million trips occurring within the Milwaukee area on an average weekday. It would also be the most important transit trip generator, accounting for about 27 percent of the average weekday transit trips under each alternative truncated or composite system plan. As shown on Map 76 in Chapter III and on Maps 139 through 141, all the plans would generally support the adopted regional land use plan.

Objective 2—Cost and Energy: The second objective concerns achievement of a primary transit system which is economical and efficient, satisfying all other objectives at the lowest possible cost. This objective is supported by key standards relating to the minimization of costs and energy consumption, and the maximization of cost-effectiveness. As shown in Table 359, of the three alternative truncated and composite primary transit system plans, the plan with the lowest total cost to the design year under this future, including all capital and net operating and maintenance costs, is the truncated bus-on-freeway plan, which has an estimated total cost of $603 million. The busway plan follows with a total cost of $727 million, and the most costly plan would be the light rail transit plan, with an estimated total cost of $776 million.

The principal reason for the difference in the costs between the plans is capital cost—that is, the capital investment over the plan design period less the value of the remaining life of the facilities and vehicles at the end of the 20-year plan design period. The capital cost of the light rail transit plan is more than twice that of the bus-on-freeway plan, and the capital cost of the busway plan is about 80 percent more than that of the bus-on-freeway plan. In terms of the total capital investment which would be required over the plan design period, the bus-on-freeway alternative requires less than one-half the investment of the light rail transit and busway plans. The bus-on-freeway plan would require an outlay of about $226 million, while the busway plan would require $478 million and the light rail transit plan would require about $635 million, as shown in Table 360. The light rail transit and busway system plans, however, would be expected to provide an annual net operating and maintenance cost advantage over the bus-on-freeway plan. In the design year, the light rail transit plan would require $2.5 million, or 10 percent, less subsidy than the bus-on-freeway

Map 139

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN OF THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

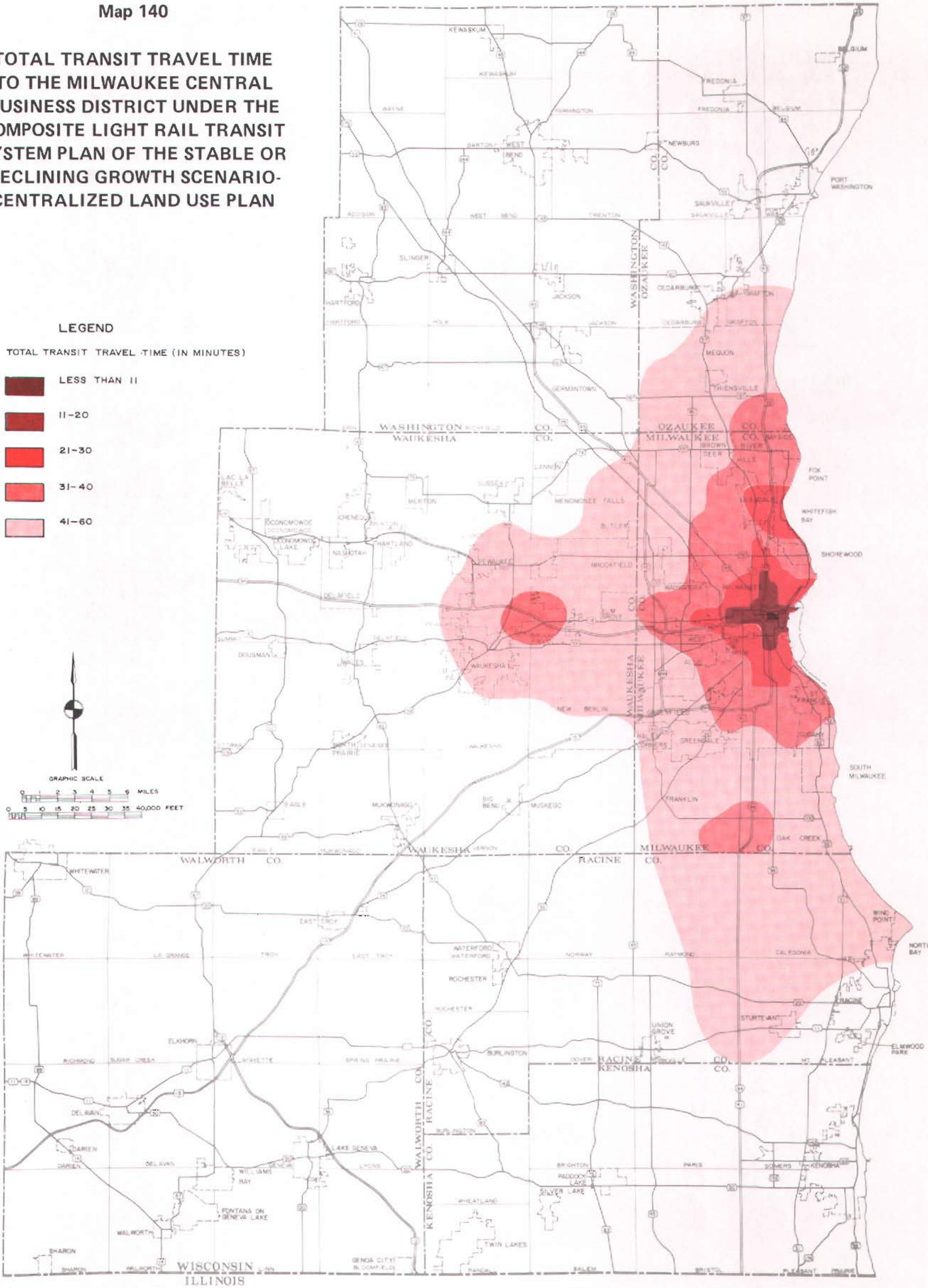


One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the truncated bus-on-freeway plan, the various travel time contours form a disconnected lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south. Areas up to 2 miles away are within 20 minutes travel time, and areas up to 13 miles in a northerly and southerly direction and up to 15 miles in a westerly direction are within 40 minutes travel time of downtown Milwaukee. Areas within 60 minutes travel time extend as far as 20 miles to the north, 19 miles to the west, and 24 miles to the south of downtown Milwaukee.

Source: SEWRPC.

Map 140

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE COMPOSITE LIGHT RAIL TRANSIT SYSTEM PLAN OF THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

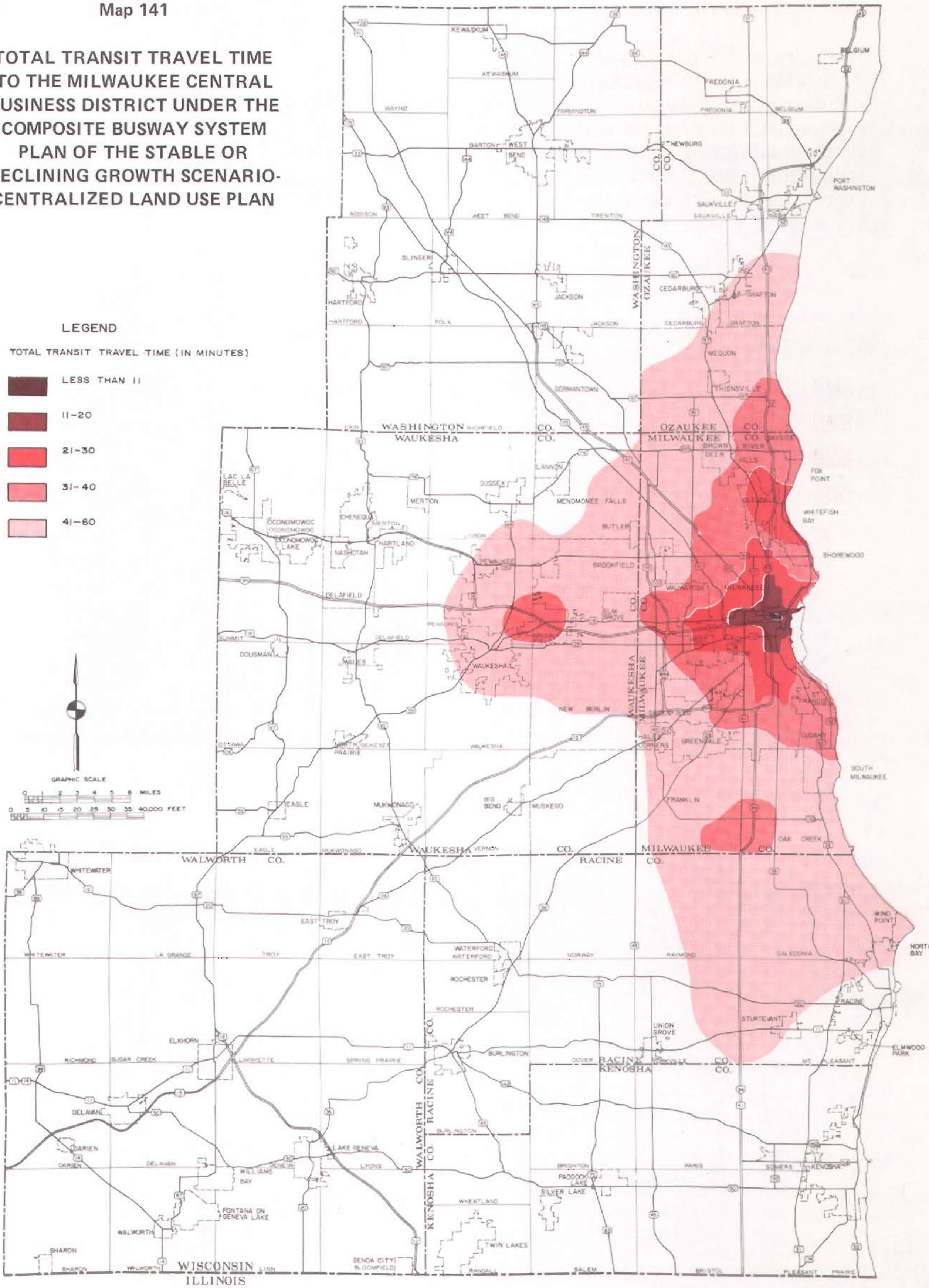


One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the composite light rail transit plan, the various travel time contours form a disconnected lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south, with areas that are up to 2 miles from downtown being within 20 minutes travel time. Areas within 40 minutes travel time extend up to 13 miles to the north and south and 15 miles to the west. Areas up to 20 miles in a northerly direction, 18 miles in a westerly direction, and 24 miles in a southerly direction are within 60 minutes travel time of downtown Milwaukee.

Source: SEWRPC.

Map 141

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE COMPOSITE BUSWAY SYSTEM PLAN OF THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN



One of the standards utilized in the evaluation of each of the primary transit system plans calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time contour lines. Under the composite busway system plan, the various travel time contours form a disconnected lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south, with areas that are up to 2 miles from downtown being within 20 minutes travel time. Areas within 40 minutes travel time extend up to 12 miles to the north, 15 miles to the west, and 13 miles to the south. Areas up to 18 miles in a northerly direction, 19 miles in a westerly direction, and 24 miles in a southerly direction are within 60 minutes travel time of downtown Milwaukee.

Source: SEWRPC.

Table 360

TOTAL CAPITAL INVESTMENT TO DESIGN YEAR REQUIRED UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Capital Cost Element[a]	Alternative			
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Guideway Development[b]	$ --	$ 14,326,000	$380,284,200	$242,984,200
Station Development[c]	2,886,300	5,992,500	22,728,900	26,115,900
Vehicle Storage and Maintenance Facility Development	18,225,000	19,050,000	31,142,600	19,282,000
Vehicle Acquisition and Replacement[d]	159,740,000	186,560,000	200,600,000	189,700,000
Total	$180,851,300	$225,928,500	$634,755,700	$478,082,100

[a] *It is assumed under this capital cost analysis that the base plan and the alternative truncated and composite primary transit plans would be incrementally implemented from 1985 to 2000. The capital costs shown in this table are those required to develop and maintain the system over the 20-year plan design period from 1980 through 2000. Portions of nearly all the elements of the plan have useful lives extending beyond the design period and are therefore capable of use beyond the design period.*

[b] *Includes the cost of acquiring about 70 acres of right-of-way for guideway construction for the light rail transit and busway system plans. This land is assumed to have a useful life of 100 years. The useful life of the guideway is estimated at 30 years. Also includes the implementation cost of the proposed freeway operational control system in the Milwaukee area, which has a useful life of 30 years.*

[c] *Includes the cost of acquiring land for stations and storage and maintenance facilities as necessary—12 acres under the base plan, 40 acres under the light rail and busway system plans, 20 acres under the bus-on-freeway plan, and 90 acres under the commuter rail plan. This land is assumed to have a life of 100 years. The useful life of station facilities is estimated at 30 years.*

[d] *This capital cost category includes the cost of acquisition and replacement, as necessary, over the 20-year design period of all buses and light rail vehicles used in all elements of the system. All alternative plans under this future are assumed to utilize the entire existing fleet of 640 motor buses, which—in 1980—are assumed to have an average age of 10 years each. Buses are assumed to have an average useful life of 12 years. Light rail vehicles have an estimated useful life of 30 years.*

Source: SEWRPC.

plan. The busway plan would require about $123,000 million, or 1 percent, less subsidy than the bus-on-freeway plan.

In terms of the cost-effectiveness of the alternative truncated and composite primary transit plans, the total cost per passenger to the design year of the busway plan is about 6 percent lower than that of the light rail transit plan, $0.58 per passenger compared with $0.62 per passenger. The total cost per passenger of the bus-on-freeway plan, estimated at $0.48, is somewhat lower than those of the light rail transit and busway plans. The reason for this difference in total cost per passenger between the truncated plans is again the high capital costs of the light rail transit and busway plans. The capital cost per passenger of the light rail transit and busway plans is about twice that of the bus-on-freeway plan. There is very little difference in the net operating costs per passenger to, or in, the design year between the three truncated plans, as shown in Tables 359 and 361. The light rail transit plan has the lowest net operating cost per passenger over the design period, $0.34, and the busway has the highest, $0.36.

Estimates of the total amount of energy that would be used in the implementation of the truncated and composite primary transit plans under this alternative future are set forth in Tables 359 and 362. Over the 20-year design period, the bus-on-freeway plan would consume the least amount of energy, 17,852 billion British Thermal Units (BTU's). The total energy consumption under the busway and light rail transit plans would be expected to be only slightly greater, 19,329 billion

Table 361

PRIMARY AND TOTAL TRANSIT SYSTEM OPERATING COSTS IN THE DESIGN YEAR FOR THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

	Alternative			
Cost Element	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Ridership				
Primary Element	2,550,000	5,737,500	14,611,500	12,826,500
Total System	62,261,000	65,477,500	63,186,500	63,503,500
Operating and Maintenance Cost				
Primary Element	$ 3,129,000	$ 7,729,100	$10,079,400	$ 9,937,700
Total System	40,507,100	52,803,200	49,723,300	52,753,000
Operating and Maintenance Cost per Passenger				
Primary Element	$1.23	$1.35	$0.69	$0.77
Total System	0.65	0.81	0.78	0.85
Operating and Maintenance Cost per Passenger Mile				
Primary Element	$0.15	$0.10	$0.10	$0.10
Total System	0.18	0.18	0.18	0.20
Farebox Revenue				
Primary Element	$ 1,530,000	$ 3,694,100	$ 7,826,000	$ 7,031,600
Total System	24,518,300	27,854,000	27,344,700	27,926,400
Operating Deficit				
Primary Element	$ 1,599,000	$ 4,035,000	$ 2,253,400	$ 2,906,100
Total System	15,988,800	24,949,200	22,378,600	24,826,600
Operating Deficit per Passenger				
Primary Element	$0.63	$0.70	$0.15	$0.23
Total System	0.26	0.38	0.35	0.39
Farebox Revenue as a Percent of Operating and Maintenance Costs				
Primary	49	48	78	71
Total System	61	53	55	53
Public Funding Under Current Program[a]				
Federal (50 percent of operating deficit)				
Primary Element	$ 799,500	$ 2,017,500	$ 1,126,700	$ 1,453,050
Total System	7,914,400	12,474,600	11,189,300	12,413,300
State (72 percent of nonfederal share of operating deficit)				
Primary Element	575,640	1,452,600	811,220	1,046,200
Total System	5,755,970	8,981,710	8,056,300	8,937,580
Local				
Primary Element	223,860	564,900	315,480	406,850
Total System	2,238,430	3,492,890	3,133,000	3,475,720
Local Operating Deficit per Ride				
Primary Element	$0.09	$0.10	$0.02	$0.03
Total System	0.04	0.05	0.05	0.05

[a] *The maximum federal operating assistance funding allotment for the Milwaukee area for the year 1979 was $11.6 million in 1979 dollars, more than the $8.0 million required under the base plan, but substantially less than the $18.1 million required under the maximum extent bus-on-freeway plan, and slightly less than the $12.3 million required under the maximum extent light rail transit plan and the $12.5 million required under the maximum extent busway plan. These amounts of public funding for the respective primary transit system plans would provide 50 percent of federal funding of the operating deficits. Great uncertainty is involved in any estimation of the possible federal and state shares of operating deficits, as these shares are subject to changing legislative action over the plan design period. Even at this time, the Governor has proposed changing the state share of the operating deficit funding to 25 percent of the total operating cost of urban transit systems.*

Source: SEWRPC.

Table 362

COMPARISON OF TOTAL TRANSIT ENERGY REQUIREMENTS UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Energy Element	Alternative			
	Base Plan	Truncated Bus-on-Freeway Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Primary Transit Element				
Operating and Maintenance Energy to Design Year (million BTU's)				
Vehicle Propulsion Energy	826,290	1,387,820	2,036,600	1,496,050
Petroleum Fuel Consumed	826,290	1,387,820	712,800	1,496,050
Nonpetroleum Fuel Consumed	- -	- -	1,323,800	- -
Station Operation and Maintenance Energy	50,900	73,450	74,620	79,150
Vehicle Maintenance Energy	22,910	47,830	54,780	51,470
Total Operating and Maintenance Energy	900,100	1,509,100	2,166,000	1,626,670
Total System Construction Energy to Design Year (million BTU's)				
Guideway Construction	- -	- -	1,753,560	1,695,000
Vehicle Manufacture	104,040	211,140	414,480	299,880
Total Construction Energy	104,040	211,140	2,168,040	1,994,880
Total System				
Operating and Maintenance Energy to Design Year (million BTU's)				
Vehicle Propulsion Energy	14,430,390	16,122,970	15,976,330	15,908,120
Petroleum Fuel Consumed	14,430,390	16,122,970	14,652,530	15,908,120
Nonpetroleum Fuel Consumed	- -	- -	1,323,800	- -
Station Operation and Maintenance Energy	50,900	73,450	74,620	79,150
Vehicle Maintenance Energy	256,110	326,500	298,650	307,570
Total Operating and Maintenance Energy	14,737,400	16,522,920	16,349,600	16,294,840
Total System Construction Energy to Design Year (million BTU's)				
Guideway Construction	- -	- -	1,753,560	1,695,000
Vehicle Manufacture	1,163,820	1,329,060	1,428,360	1,339,260
Total Construction Energy	1,163,820	1,329,060	3,181,920	3,034,260

Source: SEWRPC.

BTU's and 19,531 billion BTU's, respectively. The energy consumed per passenger mile traveled to the design year 2000 would also be the lowest under the bus-on-freeway plan, estimated at 3,490 BTU's, compared with 3,890 and 3,940 BTU's under the composite busway and light rail transit plans, respectively.

The energy used for construction under each plan would be minimal compared to the energy required for operation. Of the three plans, the bus-on-freeway plan would require the least energy for construction—7 percent of the total energy consumption under the plan. Both the light rail transit and busway plans would use 16 percent of the total plan energy for construction. The bus-on-freeway plan would require the most energy for operation, 16,523 billion BTU's to the design year 2000, while the busway plan would require the least, 16,294 billion BTU's. The light rail transit plan would require the least petroleum energy for vehicle propulsion, between 7 and 9 percent less than the other plans, since most of the transit trips made on the primary element of this plan would be made on electrically propelled vehicles, as opposed to diesel motor buses. Under the light rail transit plan, more than 21 percent of the transit trips occur on the primary element.[14]

The energy which may be expected to be used in highway travel by automobiles in the plan design year is also expected to be about the same under all three truncated or composite plans, as shown in Table 363. More than 30 times more energy would be used in the plan design year for automobile travel than for transit under this future. Consequently, any petroleum savings of a light rail transit system would represent less than 1 percent of the energy required by the total transportation system, including travel by automobiles.

Objectives 3 and 5—Provision of Adequate Level of Service and Provision for Quick and Convenient Travel: Two of the primary transit system development objectives can be considered together for this evaluation: Objective No. 3, which calls for a transit system which provides an adequate level of service, and Objective No. 5, which calls for a primary transit system which provides for quick and convenient travel. These two objectives are supported by three key standards: level of transit ridership, number of residents and jobs served, and transit trip speed. The remaining standards under these two objectives either have all been met in the design of the alternative plans or could be met by all the plans if properly implemented.

Of all the standards under these two objectives, the level of transit ridership best represents the level of transit service provided by alternative transit plans. Total transit system ridership under the alternative plans is expected to differ by only 3 percent, ranging from a low of 223,700 trips on an average weekday under the busway plan, to 228,500 trips per average weekday under the bus-on-freeway plan. However, significant differences are expected in the number and proportion of trips made on the primary element of the alternative transit system plans. As shown in Tables 364 and 365, the proportion of transit trips made on the primary element is expected to be the highest under the composite light rail transit plan, over 25 percent of the total 224,800 transit trips made on an average weekday under this plan, or 57,300 trips. The second highest primary transit ridership under this future would be on the composite busway plan—about 50,300 trips, or 22 percent of

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[14] *Implementation of a light rail transit system in the Milwaukee area can be expected to have an insignificant impact upon existing and future electric power generating requirements within southeastern Wisconsin. Light rail transit system operation can be expected to result in a very small increase in peak demand as well as a negligible increase in total annual power consumption based upon the capacity of the 1980 electric power generating system, and the expanded electric power generating system necessary for other reasons by the plan design year.*

Electric power for the Milwaukee area is supplied by the Wisconsin Electric Power Company (WEPCo), which currently relies on coal-fired power plants for generating more than 95 percent of its electricity. Nuclear power plants provide the remaining electricity generated by WEPCo. According to data acquired by WEPCo in order to plan for future power generation capacity in southeastern Wisconsin, the instantaneous peak demand within the WEPCo service area was 3.3 million kilowatts during the summer season of 1980 and 3.0 million kilowatts during the winter season of 1980. By the year 2000, these peak demands are expected by WEPCo to increase by 40 to 70 percent. The instantaneous peak may be expected to occur between 12:00 p.m. and 4:00 p.m. in the summer and between 5:00 p.m. and 7:00 p.m. in the winter.

The peak power demand for vehicle propulsion on this composite light rail transit system would be approximately 27.4 megawatts during the plan design year 2000. This represents about 0.9 percent of the WEPCo 1980 actual summer and winter peak demands, and less than 0.9 percent of the WEPCo forecast year 2000 peak demands.

The WEPCo also estimates that annual electrical energy use during 1980 totaled 18,701 gigawatt-hours within the WEPCo service area. The total power consumption for vehicle propulsion on the light rail transit system would be approximately 40 million kilowatt-hours during the design year, or substantially less than 1 percent of the estimated total energy consumption for the WEPCo service area in 1980. Electricity necessary for the operation of a light rail transit system is likely to represent an even smaller percentage during the plan design year, since the total amount of power consumption in southeastern Wisconsin is expected by WEPCo to increase by 70 percent by the year 2000.

Table 363

COMPARISON OF DESIGN YEAR AUTOMOBILE TRAVEL AND ENERGY CONSUMPTION UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Alternative	Automobile Vehicle Miles Traveled in the Design Year (billions)	Automobile Energy Consumption in the Design Year (million BTU's)
Base Plan.	8.72	39,300,000
Truncated Bus-on-Freeway Plan.	8.52	38,700,000
Composite Light Rail Transit Plan	8.53	38,700,000
Composite Busway Plan	8.54	38,800,000

Source: SEWRPC.

the total transit ridership. The primary element of the bus-on-freeway plan would carry 22,500 trips, or 10 percent of total transit system ridership. Because the total transit system ridership does not vary significantly among the three truncated and composite plans, it can be concluded that the substantial additional ridership on the primary element of the light rail transit and busway plans is comprised of trips which would be expected to use local or express transit services under the bus-on-freeway plan. This assumption is reasonable given the small travel time advantages expected under the light rail transit and busway plans. Express and local services under all the plans are expected to average 17 and 14 mph, respectively, compared with 20 mph under the light rail transit primary element and 18 mph under the busway primary element. These express and local service speeds are about the same as those achieved on the existing transit system, which is to be expected since little additional street and highway traffic congestion is anticipated in the Milwaukee area under this alternative future.

With respect to the standard calling for maximizing the number of jobs and resident population served, the primary elements of the composite light rail transit and busway plans would serve the greatest number of residents, about 1.0 million, within a three-mile driving distance of primary transit service, while the primary element of the bus-on-freeway plan would be accessible by driving to about 88,200 residents. The light rail transit and busway plans would also provide the greatest accessibility to residents within walking distance of primary transit stations and stops—about 319,400 residents, compared with 163,200 residents under the bus-on-freeway plan. Employment served within walking distance would also be greatest under the light rail transit and busway plans, 337,600 jobs, compared with 194,000 jobs for the bus-on-freeway plan. All the additional residents and jobs within walking distance of primary transit under the light rail transit and busway plans would be located within the portions of Milwaukee County planned for urban development under the regional land use plan.

The truncated and composite plans are only slightly different with respect to the standard relating to the average speed provided by primary transit. The average vehicle speeds on the primary elements of the plans are expected to range from a low of 23 mph under the composite busway plan to 24 mph under the composite light rail transit plan, and to a high of 28 mph under the truncated bus-on-freeway plan. The average vehicle speed on all elements—primary, express, and local—of all of the plans would be expected to be about 16 mph. The average speeds of passenger travel on the primary transit vehicles would range from a high of 33 mph under the bus-on-freeway plan to 24 mph under the light rail transit plan, and to a low of 23 mph under the busway plan. Average speeds of passenger travel on all service elements of the truncated and composite plans would range from a high of 18 mph under the bus-on-freeway plan to 17 mph under the light rail transit and busway plans. Average speeds of passenger travel are generally higher than vehicle speeds because passengers are typically concentrated on the transit facilities and services of highest speed.

Objective 4—Environmental and Resource Disruption: The fourth objective is to minimize the disruption of existing neighborhood and community development and to minimize deterioration of the natural resource base. This objective is supported by key standards relating to community disruption and air quality.

In terms of community disruption, none of the three alternative truncated or composite primary transit system plans would require the taking of any homes, businesses, or industries. They would,

Table 364

TRANSIT TRIPMAKING BY PURPOSE IN THE MILWAUKEE AREA UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

	Alternative					
	Base Plan			Truncated Bus-on-Freeway Plan		
		Transit Trips			Transit Trips	
Trip Purpose	Total Person Trips	Number	Percent of Total Trips	Total Person Trips	Number	Percent of Total Trips
Home-Based Work	962,700	80,500	8.4	962,900	87,200	9.0
Home-Based Shopping . .	506,900	28,000	5.4	506,400	30,400	6.0
Home-Based Other	1,131,100	56,800	5.0	1,128,600	60,700	5.4
Nonhome Based.	692,300	10,000	1.4	690,100	9,600	1.4
School	348,300	40,600	11.6	348,300	40,600	11.6
Total	3,641,300	215,900	5.9	3,636,300	228,500	6.3

	Alternative					
	Composite Light Rail Transit Plan			Composite Busway Plan		
		Transit Trips			Transit Trips	
Trip Purpose	Total Person Trips	Number	Percent of Total Trips	Total Person Trips	Number	Percent of Total Trips
Home-Based Work	962,700	87,900	9.1	962,800	86,800	9.0
Home-Based Shopping . .	505,700	29,000	5.7	506,100	29,000	5.7
Home-Based Other	1,126,000	58,200	5.2	1,127,500	58,200	5.2
Nonhome Based.	688,800	9,100	1.3	689,600	9,100	1.3
School	348,300	40,600	11.6	348,300	40,600	11.6
Total	3,631,500	224,800	6.2	3,634,300	223,700	6.2

Source: SEWRPC.

however, require the acquisition of right-of-way for guideway, stations, and maintenance and storage facilities. Of the three truncated and composite primary transit alternatives, both the light rail transit and busway system plans would require the acquisition of more than 100 acres of land, compared with 20 acres under the truncated bus-on-freeway plan.

Tables 359 and 366 set forth the levels of highway and transit air pollutant emissions anticipated under each of the alternative truncated and composite primary transit system plans under this alternative future. All three truncated plans are expected to have similar levels of total transportation system carbon monoxide, hydrocarbon, particulate matter, and nitrogen oxide air pollutant emissions. Transportation-related sulfur oxide emissions are expected to be about 5 percent higher under the light rail transit plan. However, this difference in sulfur oxide emissions represents a difference of less than one-tenth of 1 percent when considered in the context of the total air pollutant emissions forecast from all air pollutant sources in the Region.

Objective 6—Safety: The sixth transportation objective relates to the reduction of accident exposure and the provision of increased travel safety. This objective is supported by two key standards, one measuring the degree to which travel by transit is maximized and the other measuring the degree to which travel on exclusive guideway transit is maximized. Travel by transit is safer than travel

Table 365

PRIMARY AND TOTAL TRANSIT TRIPMAKING BY TIME OF DAY UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Time of Day	Alternative							
	Base Plan				Truncated Bus-on-Freeway Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	4,700	47.0	52,100	24.1	6,100	27.2	54,900	24.0
Midday	300	3.0	68,800	31.9	5,300	23.5	72,900	31.9
Afternoon . .	5,000	50.0	75,800	35.1	8,800	39.1	80,100	35.0
Evening. . . .	- -	- -	19,200	8.9	2,300	10.2	20,600	9.1
Total	10,000	100.0	215,900	100.0	22,500	100.0	228,500	100.0

Time of Day	Alternative							
	Composite Light Rail Transit Plan				Composite Busway Plan			
	Primary Element		Total System		Primary Element		Total System	
	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total	Transit Trips	Percent of Total
Morning . . .	19,600	34.2	54,900	24.4	17,300	34.4	54,500	24.4
Midday	7,500	13.1	70,800	31.5	6,700	13.3	70,600	31.6
Afternoon . .	26,700	46.6	79,000	35.2	23,200	46.1	78,600	35.1
Evening. . . .	3,500	6.1	20,100	8.9	3,100	6.2	20,000	8.9
Total	57,300	100.0	224,800	100.0	50,300	100.0	223,700	100.0

Source: SEWRPC.

by automobile, and travel on exclusive guideway transit is the safest travel by transit because of the lack of conflicts with pedestrian or vehicle traffic.

As indicated in Table 359, the three truncated plans would differ only slightly with respect to travel safety. The proportion of total person trips using transit is about the same under the three truncated and composite plans, and none of the alternatives utilizes fully exclusive guideways with grade separation of all crossing vehicle and pedestrian traffic.

Summary

The comparative evaluation of the alternative truncated or composite primary transit system plans—bus-on-freeway, busway, and light rail transit—indicated that, under the stable or declining growth scenario-centralized land use plan alternative future, all the systems may be expected to provide a reasonably comparable high level of primary transit service in the Milwaukee area in the plan design year. As indicated in Table 367, the alternative systems were found to be quite similar with respect to total ridership, public subsidy required, and operating cost-effectiveness. Each system may be expected to attract about the same level of total transit ridership in the area, varying by no more than 4,800 trips, or by about 2 percent, on an average weekday in the plan design year. Also, each system may be expected to entail a similar annual operating and maintenance cost deficit, varying by no more than $2.5 million, or 12 percent, in the plan design year. And, each plan

Table 366

COMPARISON OF DESIGN YEAR AIR POLLUTANT EMISSIONS OF THE TRANSIT AND HIGHWAY SYSTEM UNDER THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS OF THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

	Alternative			
Air Pollutant	Base Plan (tons per year)	Truncated Bus-on-Freeway Plan (tons per year)	Composite Light Rail Transit Plan (tons per year)	Composite Busway Plan (tons per year)
Primary Element				
Carbon Monoxide	41	68	36	86
Hydrocarbons	4	7	4	9
Nitrogen Oxides	9	17	43	20
Sulfur Oxides.	6	10	130	12
Particulate Matter	3	6	16	7
Total Transit System				
Carbon Monoxide	741	914	780	886
Hydrocarbons	73	91	78	89
Nitrogen Oxides	128	161	170	159
Sulfur Oxides.	60	75	187	74
Particulate Matter	34	43	49	42
Total Transportation System				
Carbon Monoxide	154,784	152,507	152,484	152,677
Hydrocarbons	15,333	15,046	15,047	15,068
Nitrogen Oxides	27,488	27,034	27,065	27,071
Sulfur Oxides.	2,306	2,292	2,406	2,294
Particulate Matter	3,717	3,673	3,680	3,675

Source: SEWRPC.

may be expected to recover a similar proportion of the operating and maintenance costs from farebox revenues, between 53 and 55 percent.

Several significant differences between the plans, however, were also revealed by the comparative evaluation. The largest difference was in the capital cost attendant to the plans, which ranged from a low of about $158 million for the bus-on-freeway plan to $283 million for the composite busway plan, to a high of $351 million for the composite light rail transit plan. Other differences noted included the degree of accessibility to jobs and resident population, the amount of ridership on the primary element, and the degree of use of, and dependence on, petroleum-based fuel (see Table 367).

Because this evaluative information does not clearly identify the best of the alternative composite plans under this alternative future, the key advantages and disadvantages of the alternative plans were comparatively analyzed. This analysis was done by arranging the alternative plans in order of increasing total cost over the plan design period, and performing successive comparisons of pairs of the plans beginning with a comparison of the plan of lowest total cost—the truncated bus-on-freeway plan—and the next least costly plan—the composite busway plan. The plan of this pair which was determined to be better on a systemwide basis was then compared to the most costly plan—the composite light rail transit plan—and the best system plan so identified. This successive comparison of alternative plans is not unlike incremental economic plan evaluation techniques, which have long been used to establish whether the marginal benefits of alternative plans exceed their additional costs over the cost of other alternative plans.

Comparison of Composite Busway and Truncated Bus-on-Freeway Plans: The composite busway plan would entail $124.1 million, or 20 percent, more

Table 367

KEY DIFFERENCES BETWEEN THE BASE SYSTEM PLAN AND TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Evaluative Measure	Alternative			
	Base Plan	Truncated Bus-on-Plan	Composite Light Rail Transit Plan	Composite Busway Plan
Objective No. 2—Minimize Cost and Energy Use				
Cost				
Total Public Cost to Design Year (capital cost and operating and maintenance deficit)	$493,042,100	$603,060,000	$775,703,000	$727,150,000
Average Annual Total Public Cost	23,478,200	28,717,150	36,938,300	34,626,200
Capital Cost[a] and Investment				
Capital Cost to Design Year	119,819,100	158,150,000	351,363,900	283,220,900
Average Annual Capital Cost	5,705,700	7,530,950	16,731,600	13,486,700
Capital Investment to Design Year	180,851,300	225,928,500	634,755,700	478,082,100
Average Annual Capital Investment	8,611,950	10,758,500	30,226,400	22,765,800
Operating and Maintenance Cost Deficit (net cost)				
Deficit in Design Year	15,988,800	24,949,200	22,378,600	24,826,600
Deficit to Design Year	373,223,000	444,910,000	424,340,000	443,930,000
Average Annual Deficit	17,772,500	21,186,200	20,206,700	21,139,500
Cost-Effectiveness				
Total Cost to Design Year per Passenger	0.40	0.48	0.62	0.58
Capital Cost to Design Year per Passenger	0.10	0.12	0.28	0.23
Operating Deficit to Design Year per Passenger	0.30	0.35	0.34	0.36
Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year				
Total Transit System	61	53	55	53
Primary Element	49	48	78	71
Energy				
Dependence on Petroleum-Based Fuel	All trips dependent	All trips dependent	21 percent of trips not dependent	All trips dependent
Petroleum-Based Fuel Use by Public Transit to Design Year (gallons of diesel fuel)	106,105,800	118,551,250	107,739,200	116,971,470
Objective Nos. 3 and 5—Provide Appropriate Service and Quick Travel				
Average Weekday Transit Trips				
Total Transit System	215,900	228,500	224,800	223,700
Primary Element	10,000	22,500	57,300	50,300
Service Coverage				
Population Served Within a One-Half-Mile Walking Distance of Primary Transit Service	203,000	163,200	319,400	319,400
Population Served Within a Three-Mile Driving Distance of Primary Transit Service	775,100	881,700	1,047,200	1,047,200
Jobs Served Within a One-Half-Mile Walking Distance of Primary Transit Service	205,700	194,000	337,600	337,600
Average Speed of Transit Vehicle (mph)				
Primary Element	23	28	24	23
Total System	15	16	16	16
Average Speed of Passenger Travel on Vehicle (mph)				
Primary Element	25	33	24	23
Total System	15	18	17	17
Objective No. 4—Minimize Environmental Impacts				
Community Disruption				
Land Required (acres)	12	20	110	110

[a] *The capital cost of a composite plan is equal to the plan's required capital investment, or total capital outlays necessary over the plan design period, less the value of that investment beyond the plan design period.*

Source: SEWRPC.

Table 368

KEY ADVANTAGES AND DISADVANTAGES OF THE COMPOSITE BUSWAY SYSTEM PLAN IN COMPARISON TO THE TRUNCATED BUSWAY-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Factor	Advantage	Disadvantage
Cost	Primary element revenues recover 23 percent more operating costs in design year	\$124.1 million, or 20 percent, more total cost over plan design period \$125 million, or 80 percent, more capital cost—that is, the capital investment less the value of the remaining life of the facilities at the end of the 20-year plan design period \$252.2 million, or 110 percent, more capital investment required over design period \$0.10, or 21 percent, more total cost per passenger over design period
Accessibility	156,200, or 96 percent, more resident population within walking distance 143,600, or 74 percent, more jobs within walking distance	- -
Transit Ridership	27,800, or nearly 125 percent, more primary transit trips on an average weekday in design year	4,800, or 2 percent, fewer total transit trips on an average weekday in design year
Disruption	- -	90 acres, or five times, more land required for system development

Source: SEWRPC.

total cost over the plan design period than the truncated bus-on-freeway plan. However, it would have a number of advantages over the bus-on-freeway plan. The most significant of these advantages, as listed in Table 368, would be the greater accessibility provided to jobs and residents in the Milwaukee area and the greater number of transit trips made on the primary element of the transit system. About 156,200, or 96 percent, more people and 143,600, or 74 percent, more jobs—all within Milwaukee County—may be expected to be within walking distance of primary transit facilities under the composite busway plan. Nearly 27,800, or 125 percent, more transit trips may be expected to be made on the primary element of the busway plan. All these additional trips made on the primary element of the composite busway plan may be expected to be made under the bus-on-freeway plan as well, but on the local and express elements of that plan. These transit trips would, therefore, receive a lower level of service, averaging about three mph slower over the vehicle portion of the trips and requiring an average of four more minutes per transit trip. However, because the bus-on-freeway plan would provide a much faster primary element than the busway plan, overall transit travel would be about one mph faster on the vehicle portion of the trip under the bus-on-freeway plan, saving about one minute per transit trip.

One other advantage of the composite busway plan is that, at the end of the plan design period, it would be more efficient than the truncated bus-on-freeway plan with respect to the proportion of operating and maintenance costs recovered from farebox revenues on the primary element of the system. The primary element of the busway plan may be expected to recover nearly 23 percent more of its operating costs from farebox revenues in the plan design year.

These operating and maintenance cost efficiencies, however, are offset by the principal disadvantage of the busway plan, its additional capital costs. The busway plan would entail \$125 million, or

80 percent, more capital costs over the plan design period than the bus-on-freeway plan, and would require $252 million, or 110 percent, more capital investment over the plan design period. Thus, the total cost of the busway plan would be $124 million, or 20 percent, more than that of the bus-on-freeway plan. Also, the total cost per passenger of the busway plan over the plan design period would be $0.10, or 21 percent, more than that of the bus-on-freeway plan. In addition, the bus-on-freeway plan may be expected to attract 4,800, or 2 percent, more transit trips from automobiles than the busway plan on an average weekday in the plan design period. Nearly all this additional transit tripmaking would consist of trips to and from the Milwaukee central business district. Increased use of transit to the central business district may be expected under the bus-on-freeway plan because its service to the central business district would be faster, operating directly from outlying areas with no or few intermediate stops.

The disadvantages of the busway plan outweigh its advantages over the bus-on-freeway plan. Although the primary element of the busway plan would recover more of its operating cost from farebox revenues than the primary element of the bus-on-freeway plan, its capital cost would offset this advantage. Moreover, the bus-on-freeway plan may be expected to divert slightly more automobile travel to the use of public transit. Accordingly, it was concluded that the truncated bus-on-freeway plan was, as a system, a superior alternative to the composite busway plan. Therefore, the last of the composite plans, the composite light rail transit plan, was compared to the bus-on-freeway plan.

Comparison of the Composite Light Rail Transit and Truncated Bus-on-Freeway Plans: The total cost of the composite light rail transit plan would be $173 million, or 29 percent, more than the total cost of the bus-on-freeway plan. The light rail transit plan would, however, have a number of important advantages over the bus-on-freeway plan, as indicated in Table 369. The primary transit facilities under the light rail transit plan would be accessible within walking distance to about 96 percent more of the resident population and 74 percent more of the jobs in the Milwaukee area. Partially for this reason, nearly 34,800 more transit trips may be expected to be made on the primary element of the light rail transit plan on an average weekday in the design year than on the primary element of the bus-on-freeway plan. However, under the bus-on-freeway plan, these additional trips would not be diverted to the private automobile, but rather would be made on the local or express elements of the plan. These trips would average about five mph slower over the on-vehicle portion of the trip, and would require an average of six additional minutes per trip. However, because the bus-on-freeway plan would provide a much faster primary element than the light rail transit plan, on-vehicle transit travel would be about one mph faster under this plan, saving about one minute per transit trip.

The composite light rail transit plan would have some important advantages with respect to energy use as it would be based on an electrically propelled primary transit system. It would, therefore, use 9 percent less petroleum-based fuels for transit system propulsion over the plan design period than the bus-on-freeway plan. Such savings, however, would represent less than 1 percent of the total petroleum-based fuel which may be expected to be used in the Milwaukee area over the plan design period by automobile travel. Perhaps more importantly, the use of electricity for propulsion of the light rail transit system would enable nearly 47,200 transit trips on an average weekday, or 21 percent of all transit tripmaking, to be made on a transit system which is not dependent on petroleum-based fuels.

The composite light rail transit plan would also be expected to be more cost-effective at the end of the plan design period with respect to operating and maintenance costs. The light rail transit plan may be expected to require $2.6 million, or 10 percent, less operating subsidy in the plan design year than the bus-on-freeway plan. Total transit system revenues may be expected to recover 2 percent more of the operating and maintenance costs under the light rail transit plan than under the bus-on-freeway plan, and farebox revenues may be expected to recover 30 percent more of the operating and maintenance costs of the primary element of the light rail transit plan than of the primary element of the bus-on-freeway plan in the design year.

These annual operating cost savings would be offset by the substantially greater capital cost of the light rail transit plan. This high capital cost is the principal disadvantage of the light rail transit plan, making it the most costly of the alternative plans to implement. The capital cost of the light rail transit plan would be about $143 million, or 122 percent, more than that of the bus-on-freeway plan. The capital investment required to implement the plan over the plan design period would be

Table 369

KEY ADVANTAGES AND DISADVANTAGES OF THE COMPOSITE LIGHT RAIL TRANSIT SYSTEM PLAN IN COMPARISON TO THE TRUNCATED BUS-ON-FREEWAY SYSTEM PLAN UNDER THE STABLE OR DECLINING GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Factor	Advantage	Disadvantage
Cost	$2.6 million, or 10 percent, less operating subsidy required in design year Total transit system revenues recover 2 percent more operating costs, and primary element revenues recover 30 percent more operating costs, in design year	$172.7 million, or 29 percent, more total cost over design period $143.2 million, or 122 percent, more capital cost over design period $408.9 million, or 181 percent, more capital investment over design year $0.14, or 29 percent, more total cost per passenger over design period
Accessibility	156,200, or 96 percent, more resident poplation within walking distance 143,600, or 74 percent, more jobs within walking distance	- -
Transit Ridership	34,800, or 155 percent, more primary transit trips on an average weekday in design year	3,700, or 2 percent, fewer total transit trips on an average weekday in plan design year
Energy	9 percent savings in petroleum-based fuel used for transit system propulsion over plan design period (less than 1 percent savings in area automobile petroleum-based fuel use over plan design period) 47,200, or 21 percent, of transit trips made partially or totally on transit vehicles not dependent on petroleum-based fuels	- -
Disruption	- -	90 acres, or five times, more land required for system development

Source: SEWRPC.

about $409 million, or 181 percent, more than would be required for the bus-on-freeway plan. Consequently, the light rail transit plan would require about $0.14, or 29 percent, more capital investment per passenger carried than the bus-on-freeway plan. Other disadvantages of the light rail transit plan are that it would require more land for system development and that it would attract about 3,700, or 2 percent, fewer total transit trips on an averge weekday in the design year than the bus-on-freeway plan. About 90 acres more land would be needed for the right-of-way for the light rail transit fixed guideway and for the additional stops and stations of the light rail transit plan. Marginally fewer transit trips may be expected to be attracted to the light rail transit system because some parts of the primary element of the bus-on-freeway system are expected to provide faster trips to the downtown area, operating on a very limited or nonstop mode, unlike the scheduled-stop light rail transit system. Nearly all the additional transit trips which could be expected to be made under the bus-on-freeway plan would be made to the Milwaukee central business district, the focal point of primary transit service under that plan.

Thus, it was concluded that the tangible advantages of a light rail transit plan over a comparable bus-on-freeway plan in the Milwaukee area under the stable or declining growth scenario-centralized land use plan alternative future would be small compared to the additional costs entailed. The anticipated operating and maintenance cost efficiencies of the light rail transit plan are offset over the plan design period by the additional capital costs. In addition, a light rail transit system, despite its greater cost, cannot be expected to divert substantially more trips from automobiles to public transit than a bus-on-freeway system and, therefore, cannot be expected to provide any substantial incremental benefits with respect to motor fuel consumption or air pollutant emissions. The service provided by the light rail transit plan is not expected to attract more transit trips than comparable bus-on-freeway service, even though it would make primary transit accessible to 96 percent more residents and 75 percent more jobs in the Milwaukee area, and would have about 40 percent faster average vehicle speeds than comparable local or express transit services under the bus-on-freeway plan. This is because the primary element of the bus-on-freeway plan would be expected to operate at speeds nearly 40 percent faster than the comparable light rail transit primary element because of the limited stop or nonstop operation involved. This higher level of primary transit service under the bus-on-freeway plan means that, even though more transit users may be expected to use primary transit service under the light rail transit plan, the overall speed of transit trips under the plans would not differ significantly.

There are other possible benefits to a light rail transit system plan which require consideration. But it must be recognized that most of these benefits are, to a great extent, intangible, and there is uncertainty as to the degree to which these benefits can be attained. These benefits include environmental impacts, land use development impacts, operation in an energy emergency, reliability of operation, safety of operation, and rider preference.

Environmental Impacts: There are some localized environmental advantages to a light rail transit plan. Electrically propelled light rail vehicles produce no air pollutant emissions in the corridors in which they operate, although the central coal-fired power plants from which they would primarily draw their power in the Milwaukee area would emit air pollutants. Diesel motor buses, on the other hand, emit approximately one-half the carbon monoxide and hydrocarbons and about six times the nitrogen oxides that automobiles do. There would be no significant areawide differences in the total pollutant emissions expected under the light rail transit and motor bus plans because Milwaukee area automobile traffic and pollutant emissions would be about the same under each plan and may be expected to dominate any pollutant emissions. Moreover, light rail transit may be expected to have significant air quality benefits only in areas of concentrated transit traffic, particularly the Milwaukee central business district, where the level of such traffic may approach that of automobile traffic. Specifically, under the light rail transit plan, up to 100 fewer diesel motor buses can be expected to operate over the transit mall in the downtown area during peak travel hours.

Noise reduction is another advantage of light rail transit, but again, this benefit will be apparent only in those parts of the Milwaukee central business district where transit vehicle volumes will approach automobile volumes. Several components of light rail transit serve to make light rail vehicles quieter than automobiles or diesel motor buses. These components include electric propulsion, welded rail, constant tension overhead catenary, and resilient wheels. A typical diesel motor bus has a greater noise level than an automobile, ranging between 72 dbA and 82 dbA at 25 feet when cruising, and 82 dbA and 96 dbA at 25 feet when accelerating in traffic. The noise level of an automobile will typically range from 62 dbA to 90 dbA at 25 feet, depending upon whether the vehicle is cruising or accelerating. Average noise levels for light rail vehicles are 62 dbA to 76 dbA between 0 and 20 mph and 76 dbA to 82 dbA between 20 and 50 mph. Again, light rail transit may have a significant impact on noise levels only along the proposed Wisconsin Avenue transit mall, which would be used exclusively by transit traffic. Under the light rail transit plan, up to 100 fewer diesel motor buses would be utilizing the transit mall during the peak travel hours, being replaced by 36 light rail vehicles.

Land Development and Redevelopment: Another important intangible benefit of a light rail transit plan is its possible impact on urban land development and redevelopment. Light rail transit, or any transit mode requiring fixed guideways, has a purported potential to stimulate land development and redevelopment because it represents a long-term commitment to high-quality public transit service in a corridor, and because it may be expected to provide, through its exclusive guideway, significantly improved accessibility to areas surrounding its stations. Because light rail transit would require a greater capital investment, and its guideway could not be as easily converted to other uses, light rail transit has been purported as having greater land development impacts than busways. Light rail transit has also been purported to have greater potential for land development than busways because it would operate at higher speeds and provide greater accessibility. Because little additional automobile traffic congestion is expected under this alternative future, the accessibility provided by the bus-on-metered freeway system plan may be expected to be quite similar to that provided by the light rail transit plan. The supposition that light rail transit will provide a land development inducement because it represents a permanent public commitment to the provision of a high level of transit service in a corridor can be weighed against recent studies of the influence of fixed guideway facilities on land development in United States cities. These studies indicate that for rail transit to influence the distribution of new development and redevelopment, an entire set of conditions must be satisfied.[15] These conditions include the presence of economic forces which support substantial land use development and redevelopment; the existence of a strong demand for such development and redevelopment in the urban area; the attractiveness of sites surrounding rail transit stations in terms of ease of access, utility and other urban services, physical features, and social characteristics; the existence of a public land use policy which encourages such development and redevelopment through coordinated tax policies, infrastructure supply, and appropriate land use controls, as well as local neighborhood approval; the presence of land near the stations which is available or which can be readily assembled for development; and the provision of a new transportation advantage through improvements in transit travel accessibility. Because the satisfaction of all these conditions in the Milwaukee area is unlikely, and because the degree of transportation advantage to be provided by a light rail transit system is very similar to that provided by a bus-on-metered freeway system, the ability of the light rail transit plan to induce development in the Milwaukee area must be concluded to be uncertain.

[15] *See U. S. Department of Transportation, Land Use Impacts of Rapid Transit: Implications of Recent Experience, Final Report, August 1977.*

The implementation of a light rail transit plan would, nevertheless, have a greater short-term economic impact on the Region than implementation of any of the other alternative plans considered. A light rail transit system would require the construction of fixed facilities, including railway trackage, power transmission and distribution facilities, stations, and storage and maintenance facilities, resulting in a significant increase of activity, albeit temporary, in the local economy. The additional income from construction wages may be expected to result in additional expenditures for retail goods, and in the purchase of construction materials and services which would create additional business for suppliers, material handlers, and contractors.

Energy: The light rail transit plan would have a significant advantage with respect to energy use only under a severe petroleum shortage, as all the transit alternatives under this future would use about the same amount of energy, and even about the same amount of petroleum-based fuel. This is because average weekday energy use by automobiles would dominate energy use by transit, and the levels of automobile travel may be expected to be about the same under all the alternative transit plans. Light rail transit would have an advantage under a severe petroleum shortage because the electrical energy it uses would probably not be affected, and the system would therefore have the potential for expanded service. The expansion of such service, however, may be difficult in an emergency situation as vehicles for any additional service may be difficult to obtain quickly. Furthermore, it must be recognized that during a severe petroleum shortage, motor fuels may be expected to be rationed between all motor vehicles, with priority being given to public transit vehicles. Since public transit would use less than one-third the petroleum expected to be used by automobiles under the bus-on-metered freeway plan, it is only reasonable to expect that sufficient fuel for transit will be made available under any petroleum fuel shortfall. Therefore, a light rail transit system may have little advantage over a motor bus system in the event of an emergency petroleum shortage.

Reliability: Public transit service which is provided over fixed guideways is considered to be more reliable than such service provided over public roadways shared with other traffic. Light rail transit or busway systems, particularly to the extent that these modes utilize exclusive rights-of-way, should not be affected to any significant degree by traffic congestion, traffic accidents, or street and utility repairs, which are common on public arterial street rights-of-way. Also, operational problems caused by inclement weather—especially snow and ice—may be expected to be less severe than such problems on systems operating over public streets. Light rail transit fixed guideways which are located within public street rights-of-way, however—either in median areas, in reserved lanes, or in mixed traffic—may be expected to be affected by all these problems to the extent that the guideway is not separated from the adjacent motor vehicle traffic and from cross traffic at intersections. In addition, all rail transit modes suffer from the potential for an entire guideway segment to lose service should a single vehicle or train break down or become involved in an accident since, unlike rubber-tired motor vehicles, light rail vehicles cannot be steered around obstructions. Service disruptions can also occur from power outages, a breakdown in the overhead power distribution system, and such emergencies as fires which may require hose lines to be placed across trackage.

Safety: Safety may be expected to be greater under the light rail transit plan than under the motor bus-on-freeway plan because of the extensive use of dedicated street right-of-way, in addition to signals at crossings which provide preferential treatment for the light rail vehicles. In addition, if high-level boarding platforms are used, boarding and deboarding accidents, which are among the most common types of accidents in current day transit operations, would be significantly reduced.

Rider Preference: Proponents of light rail transit systems argue that transit passengers prefer rail transit services over motor bus transit services and will therefore make greater use of the rail services. This argument is based on the contention that there is something about the light rail transit mode which makes it intrinsically more attractive than other primary transit modes even if the levels of service provided are the same. This attraction is usually described in terms of ride quality or comfort, and image. It is probably true that there is a certain fascination with light rail transit technology as there is with other rail-related modes for moving people. This interest appears to stem either from interest in railways as a leisure-time activity, or from an historical perspective inasmuch as light rail transit technology is often equated with street railway technology reminiscent of the "good old days." In this respect, it should be noted that the historic conversion of street railway lines to electric trolley bus and motor bus lines in Milwaukee was received with expressions of great public joy and increased levels of ridership on the converted lines. There is also a feeling on the part of some light rail transit proponents that the implementation of a light rail transit system will assist in promoting Milwaukee as the center of an important and progressive major metropolitan area.

However, because the degree to which these intangible benefits can actually be attained must be regarded as uncertain, and because the development of a light rail transit system would require more than twice as much capital cost over the design period while attracting about the same total transit ridership as the bus-on-freeway plan, it was concluded that the bus-on-freeway plan was the superior plan of the alternatives considered under the stable or declining growth scenario-centralized land use plan alternative future.

SUMMARY AND CONCLUSIONS

This chapter documents the results of the design, test, and evaluation of system plans for four alternative primary transit modes—bus-on-metered freeway, bus on busway, light rail transit, and commuter rail—under one of the two futures which lie between the most optimistic and pessimistic futures for transit use in the Milwaukee area over the next 20 years. This alternative future, one of four under which these four primary transit modes have been analyzed in this study, envisions declining regional population and little economic growth, a centralized land use pattern, and a moderate increase in energy cost, but an actual decrease in the out-of-pocket cost of automobile travel due to increased efficiency in automobile fuel utilization.

The alternative system plans prepared for each of these primary transit technologies were carefully designed to serve the corridors of heaviest travel demand in the Milwaukee area effectively and, to the maximum extent practicable, use available facilities and rights-of-way. Considerations in defining the major travel corridors to be served by the primary transit facilities included the locations of existing and proposed regional activity centers, future concentrations of travel desire lines, future concentrations of arterial streets with heavy traffic volumes and congestion, and concentrations of heavily used transit routes. The available facilities and rights-of-way considered in plan design included freeways and their medians, shoulders, and nonroadway rights-of-way; active and abandoned railways and their rights-of-way; former electric interurban and street railway rights-of-way;

and the medians and parking lanes of arterial streets having at least three lanes in each direction. Following the identification of the major travel corridors best served by primary transit, and the selection of specific alignments for each alternative primary transit mode from among the facility and right-of-way options in each corridor, system plans were developed for each mode, including the identification of routes, stops, and stations.

The test and evaluation of these maximum extent alternative modal system plans indicated the need to truncate the facilities and services postulated under each of the primary transit mode alternatives in order to provide reasonably cost-effective system plans. Three of the four modal system plans required substantial truncation: the bus-on-busway, light rail transit, and bus-on-freeway plans. With respect to the commuter rail plan, it was determined that only one route in a single corridor radiating from downtown Milwaukee to the south to Kenosha would have the potential to provide cost-effective primary transit service under this future. Analysis of comparable commuter rail and bus-on-freeway services in the corridor revealed that bus-on-freeway service would be superior to the alternative commuter rail service, attracting substantially greater ridership and being more cost-effective in the plan design year.

Testing of the truncated bus-on-freeway plan and of the composite light rail and busway system plans—in which the service provided by these modes was supplemented in certain corridors by bus-on-freeway facilities in order to provide comparable areawide coverage of primary transit service—indicated that all these alternative truncated and composite primary transit system plans could be expected to work well in the design year 2000, providing a reasonably similar high level of primary transit service. The alternative systems were found to be quite similar with respect to total ridership, required annual public subsidy of operating and maintenance costs, operating and maintenance cost-effectiveness, and overall level of service. Each system was expected to result in about the same level of total transit use in the area—specifically, between 223,700 and 228,500 trips on an average weekday in the plan design year. In addition, each system was expected to entail a similar annual operating and maintenance cost deficit, between $22 and $25 million in the plan design year, and to recover a similar proportion of the design year operating and maintenance costs from farebox revenues, between 53 and 55 percent. Finally, each plan was expected to result in about the same average overall speed of travel for transit trips on the total transit system in the design year, between 17 and 18 mph.

The analyses indicated that substantially more transit trips may be expected to be made on the primary element of the light rail transit and busway plans; 57,300 and 50,300 weekday trips, respectively, compared with 22,500 trips under the bus-on-freeway plan. These additional trips, however, may be expected to be made on transit under the bus-on-freeway plan as well, but on the local and express elements of that plan at a lower level of service; that is, at speeds of about 15 mph compared with 24 mph on the light rail transit and busway primary elements. The overall level of service provided to all transit trips made on the bus-on-freeway plan, however, may be expected to be about the same as under the light rail transit and busway plans because the bus-on-freeway plan would provide a faster trip of about 28 mph on the primary elements.

There are significant differences in the capital investment and capital costs attendant to the implementation of the alternative plans. (Capital investment is defined as the total outlay of funds for guideway, station, and support facility construction and vehicle acquisition necessary to implement a plan over the plan design period, and indicates total capital resources required for plan implementation. Capital cost is defined as the capital investment less the value of the remaining life of facilities and vehicles beyond the plan design period, and indicates the true capital cost of plan implementation over the plan design period.) The bus-on-freeway plan was found to require the least capital outlay over the plan design period, $226 million. The other two plans, busway and light rail transit, were found to require substantially more capital investment, $438 and $675 million, respectively, as they would both require new fixed guideway constructon. Because of the expected 30-year life of any new guideways to be constructed, and the relatively longer life of rail transit vehicles, the differences in capital costs between the plans over the design period, while substantial, were considerably less than the differences in capital investment. The bus-on-freeway plan was found to have the lowest capital cost of $158 million. The busway and light rail transit plans were found to entail capital costs of $283 million and $351 million, respectively.

The differences in capital costs between the plans may be expected to dominate the small differences found in annual operating and maintenance cost subsidy. The bus-on-freeway plan was found to have the lowest total public cost to the plan design year of $603 million, or $0.48 per passenger to the design year, based on two assumptions: first, that each plan would be implemented incrementally over the plan design period and that an equal capital expenditure would be made in each year over the 20-year plan design period, and second, that the annual operating and maintenance cost subsidy would increase linearly from the current level of about $19 million to the plan design year level of between $22 and $25 million. The busway plan was found to have a total public cost to the design year of $727 million, or $0.58 per passenger to the design year; and the light rail transit plan was found to have a total public cost to the design year of $776 million, or $0.62 per passenger to the design year. Thus, the light rail transit plan would entail about 30 percent more total public costs over the design period than the bus-on-freeway plan.

Certain intangible benefits, however, would support development of the higher cost light rail transit plan. These include environmental advantages, advantages in shaping land use development and redevelopment, energy advantages, travel safety advantages, and advantages in reliability of operation. The light rail transit plan was determined to have some environmental advantages with respect to air pollution and noise within the specific corridors, although total areawide transportation system air pollutant emissions and noise generation would not differ significantly under any of the transit system plans, because automobile and truck traffic and attendant air pollution and noise would be nearly the same under all of the transit plans. Within specific corridors and areas, however, the light rail vehicles would emit no air pollutants, such emissions occurring at a remotely located central power generating station. A bus would, however, emit air pollutants locally, releasing about one-half the carbon monoxide and hydrocarbons as an automobile and six times the nitrogen oxides. Also, a bus may be expected to generate about 20 percent more noise than a light rail vehicle, and about 5 to 15 percent more noise than an automobile. The principal noise and air pollution impacts may be expected to be effected in the Milwaukee central business district, where transit traffic volumes would be significant. Specifically, on the proposed Wisconsin Avenue transit mall, the light rail transit plan would result in the replacement of up to 100 buses during peak hours with 36 one-car trains of articulated light rail vehicles.

All transit guideway alternatives may have a potential to attract, and thereby guide and shape, land use development and redevelopment, because they represent a public commitment to high-quality transit service and would increase transit travel accessibility. Light rail transit is considered by some to have a greater potential to effect development than the bus-on-freeway and bus-on-busway alternatives because it represents the greatest permanent public commitment to a high level of transit service in a specific location, and because its exclusive guideway and electrically propelled vehicles should provide the greatest increase in transit travel accessibility. However, the analyses indicated that the light rail transit system plan would provide about the same accessibility as the bus-on-freeway plan. Moreover, there are other factors which affect land development and redevelopment which could offset the land development potential of light rail transit. These factors are the presence of economic forces which support substantial land use development and redevelopment; the existence of a strong demand for such development and redevelopment in the urban area; the attractiveness of sites surrounding rail transit stations in terms of ease of access, utility and other urban services, physical features, and social characteristics; the existence of a public land use policy which encourages such development and redevelopment through coordinated tax policies, infrastructure supply, and appropriate land use controls, as well as local neighborhood and community acceptance and approval; the presence of land near the stations which is available, or which can be readily assembled, for development; and the provision of a new transportation advantage through improvements in transit travel accessibility. Thus, the increased land development potential of light rail transit must be considered to be uncertain at best.

The analyses indicated that the light rail transit plan may be expected to effect little savings of petroleum use over the other alternative plans considered because it would not result in significantly less automobile use than any of the other alternatives, and automobile energy use dominates transit energy use. The use of electricity by light rail transit may, however, be regarded as a significant advantage in the event of a serious petroleum shortage, because the electrical energy it uses would not be affected and the system would have the potential for expanding service. The expansion of light rail transit service may, however, be difficult in an emergency situation as vehicles for additional service may be difficult to obtain quickly.

Also, because they would be provided over fixed guideways, light rail transit or bus-on-busway transit service would be considered to be more reliable than transit service provided over public roadways shared with other traffic. Light rail transit or bus-on-busway transit, particularly to the extent that these modes utilize exclusive rights-of-way, should not be affected to any significant degree by traffic congestion, traffic accidents, or street and utility repairs, which are common on public arterial street rights-of-way. Also, operational problems caused by inclement weather—especially snow and ice—may be expected to be less severe than such problems on public streets. Light rail transit fixed guideways which are located within public street rights-of-way, however—either in median areas, in reserved lanes, or in mixed traffic—may be expected to be affected by all these problems to the extent that the guideway is not separated from adjacent motor vehicle traffic and from cross traffic at intersections. In addition, light rail transit suffers from the potential for an entire guideway segment to lose service should a single vehicle or train break down or become involved in an accident since, unlike rubber-tired motor vehicles, light rail vehicles cannot be steered around obstructions. Service disruptions can also occur from power outages, a breakdown in the overhead power distribution system, and such emergencies as fires which may require hose lines to be placed across trackage.

The safety of the light rail transit plan may be expected to be greater than that of the motor bus-on-freeway plan because of the extensive use of dedicated street right-of-way in addition to signals at crossings which provide preferential treatment for the light rail vehicles. In addition, if high-level boarding platforms are used, it may be expected that boarding and deboarding accidents, which are among the most common types of accidents in current day transit operations, would be significantly reduced. In addition, the massive structure of a light rail vehicle offers more protection to passengers than a bus in the event of vehicle-to-vehicle and vehicle-to-fixed object collisions.

The light rail transit plan would also have an advantage with respect to operating and maintenance cost-effectiveness or efficiency as it would have the smallest necessary public subsidy in the plan design year, although the other plans would have only slightly higher subsidies. In the design year, the light rail transit plan would require \$2.5 million, or 10 percent, less subsidy than the bus-on-freeway plan, and \$2.4 million, or 9 percent, less subsidy than the busway plan.

However, even when considered together, these intangible benefits supporting the development of the higher cost light rail transit plan probably do not outweigh the capital cost difference between that plan and the bus-on-freeway plan. Therefore, because the bus-on-freeway plan would attract the highest transit ridership of the plans and would have the lowest total public cost over the plan design period, the bus-on-freeway plan was recommended as the best plan under this alternative future.

It should be noted that the bus-on-freeway plan recommended under this future is a unique plan involving the provision of primary transit service over an operationally controlled freeway system. The resulting high-speed, nonstop or limited stop rapid transit service over those freeways would provide a very high level of service, a service supplemented by coordinated express and local feeder bus service. Labor productivity of the system would be enhanced by the use of high-capacity articulated buses. Only substantial additional automobile traffic congestion in the Milwaukee area, which is not expected under this alternative future, would give the exclusive fixed guideway alternative plans a level-of-service advantage over the recommended bus-on-freeway alternative.

It is important to note that the recommended bus-on-freeway plan represents a significant improvement over the present transit system. It will, however, be necessary to implement each component of the recommended plan if the level of service and cost-effectiveness of the bus-on-freeway alternative is to approach that of the busway and light rail transit alternatives. One of these improvements is the emphasis on carrying a significant proportion of the total transit trips on primary and secondary or express lines, and not on tertiary lines. Only with emphasis on faster primary and secondary lines which are more labor-efficient and attractive to travelers, and only with the use of high-capacity articulated buses which are more labor-efficient, will the bus-on-freeway plan approach the alternative fixed guideway plans in number of trips carried and cost-effectiveness. A particularly important improvement required under the bus-on-freeway plan is extensive preferential treatment for transit vehicles—specifically, the areawide freeway traffic management system.

The implementation of a freeway traffic management system would require ramp meters to be constructed at freeway entrance ramps throughout the Milwaukee area, including all of Milwaukee County, substantial parts of Waukesha and Ozaukee Counties, and parts of Washington and Racine Counties. This extensive ramp metering would be essential to attainment of the free-flowing operation of the area freeway system envisioned under the bus-on-freeway plan. Under the plan, it is envisioned that the freeway traffic management system would exercise sufficient constraint on freeway access to ensure uninterrupted freeway traffic flow and operating speeds of at least 40 to 45 mph over essentially all of the freeway system in the Milwaukee area during average weekday peak travel periods.

A limited freeway traffic management system implemented incrementally by the Wisconsin Department of Transportation since 1969 is in operation today in central Milwaukee County. The system consists of ramp meters and corresponding freeway traffic detectors at 20 freeway entrance ramps in central Milwaukee County. This limited system was originally operated primarily to facilitate the smooth entry of vehicles into the traffic stream on the most heavily congested freeway segments in the central area of Milwaukee County. This original objective has been broadened to include reducing total freeway traffic volumes by restricting access. While providing important benefits in promoting the safer and smoother flow of traffic near entrance ramps, this system would not attain the high level of freeway operation envisioned under the bus-on-freeway plan, particularly under this alternative future which envisions growth in total regional travel. The access at the limited number of freeway entrance ramps located on congested freeway segments which are now metered would have to be severely constrained to attain the level of freeway operation envisioned under the bus-on-freeway plan. Only with an areawide system of ramp meters and attendant control of freeway access would the envisioned freeway operation be practically attainable.

It should be recognized in this respect that there are obstacles to expanding the present limited freeway traffic management system. The Regional Planning Commission's Intergovernmental Coordinating and Advisory Committee on Transportation System Planning and Programming for the Milwaukee Urbanized Area has refused to include the installation of any further ramp meters in the transportation improvement program for southeastern Wisconsin, and recommended in the transportation systems management plan for the Milwaukee area (see SEWRPC Community Assistance Planning Report No. 21, A Transportation Systems Management Plan for the Kenosha, Milwaukee, and Racine Urbanized Areas in Southeastern Wisconsin: 1978) that a prospectus for a preliminary engineering study of an areawide freeway traffic management system be prepared prior to endorsement by the Committee of any further implementation of such a system.[16] The study was to provide recommendations concerning the extent of freeway ramp metering and attendant preferential motor bus access to the freeway system in the greater Milwaukee area; the speeds and volumes to which the area freeway system should be controlled; and, importantly, the degree of metering which would be necessary at each on-ramp to achieve those freeway speeds and volumes. The study was to address the potential costs and benefits of freeway traffic management, assessing resultant freeway and surface arterial street congestion and travel speeds, freeway entrance ramp queues and the impacts of such queues on connecting surface arterial streets, and the equity as well as costs of freeway traffic management.

On March 26, 1979, the prospectus for the required preliminary engineering study was completed by the Commission staff and unanimously approved by the steering committee created by the Commission to guide the preparation of the prospectus. The prospectus was approved by the Commission itself on June 7, 1979. However, funding for the conduct of the study recommended in the prospectus has not been obtained to date. As a consequence, the Intergovernmental Coordinating and

[16] *An areawide freeway traffic management system was also recommended for implementation under the Commission's long-range regional transportation system plan (see SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume Two, Alternative and Recommended Plans).*

Advisory Committee on Transportation System Planning and Programming for the Milwaukee Urbanized Area did not in 1980 and 1981 approve the installation of any additional ramp meters in the Milwaukee area.

The areawide freeway traffic management system would have to consist of an interconnected system of ramp meters throughout the Milwaukee area, a centralized control computer system governing operation of the ramp meters, surveillance equipment, changeable message signs, lane control signals, and entrance ramp reconstruction for transit vehicle bypass lanes. The capital investment required for such a system, consisting of an estimated total of 166 ramp-meter locations, has been estimated to total $14.5 million in 1979 dollars. The operation and maintenance of such an areawide system, including building maintenance, computer maintenance, staff salaries, and the operation and maintenance of the ramp meters, has been estimated to cost $870,000 annually in 1979 dollars. All these costs have been included in the bus-on-freeway plan.

Chapter VII

SUMMARY AND RECOMMENDATIONS

INTRODUCTION

The design, test, and evaluation of alternative transit system plans, and the synthesis of recommendations for transit system development from such design, test, and evaluation, are perhaps the most critical steps in any transit system planning effort. It is in these steps that the degree to which agreed-upon transit system development objectives can be met by alternative transit system plans is determined and compared, and the recommendations for adoption and implementation of the plan which best meets the objectives are prepared.

The design, test, and comparative evaluation of alternative transit system plans was more extensive and complex, and the formulation of recommendations was more difficult, under this primary transit systems alternatives analysis than under most transportation planning studies. This was because this analysis was based not upon a single forecast of probable future conditions, but rather upon a number of alternative futures carefully selected to represent the range of future conditions affecting transit needs and use which may be reasonably expected to occur within the Region over the plan design period. Under this approach, the performance of alternative transit system plans was evaluated under four sets of future conditions. This was done so that those primary transit alternatives that performed well under a wide range of future conditions could be identified and differentiated from those alternatives which performed well under only a few or a single set of future conditions. In this way, a "robust" primary transit system plan could be formulated which may be expected to remain viable under greatly varying future development conditions within the Region.

The four alternative futures under which alternative transit system plans were tested and evaluated were summarized in the previous chapters of this report and are documented in greater detail in SEWRPC Technical Report No. 25, Alternative Futures for Southeastern Wisconsin. The four futures range from a future under which conditions may be expected to be particularly optimistic for primary transit system development and use to a future under which such conditions may be expected to be particularly pessimistic for such development and use, as shown in Table 370. Conditions under the most optimistic future—termed the moderate growth scenario-centralized land use plan alternative future—include moderate growth in regional population and economic activity levels, a centralized land use pattern, continued real increases in energy cost and in the cost of automobile ownership and operation, and some motor fuel availability problems. Conditions under the most pessimistic future—termed the stable or declining growth scenario-decentralized land use plan alternative future—include a slight decline in regional population levels, little regional economic growth, continued decentralization of urban development in the Region, and only minor real increases in energy costs, which, when coupled with anticipated increases in average automobile energy efficiency, would lead to a decline in the real cost of automobile travel. Between these two extreme futures, two other futures, termed the moderate growth scenario-decentralized land use plan alternative future and the stable or declining growth scenario-centralized land use plan alternative future, were developed.

This chapter provides a summary of the design and test of alternative primary transit system plans under these four alternative futures, and documents the key findings of the evaluation and comparison of these alternative plans with respect to the anticipated attainment of the adopted transit system development objectives. Based on that comparative evaluation, recommendations for primary transit system development for the Milwaukee area are set forth.

DESIGN OF ALTERNATIVE PRIMARY TRANSIT SYSTEM PLANS

In order to ensure that no primary transit technology option was overlooked in the study, the alternative primary transit system plans were initially designed and tested for all primary transit technologies determined to be proven and available for application in the Milwaukee area over the next two decades. As described in SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology, five alternative pri-

Table 370

ALTERNATIVE FUTURES: KEY EXTERNAL FACTORS, ATTENDANT REGIONAL CHANGE, AND LAND USE PLANS

Key External Factor	Moderate Growth Scenario	Stable or Declining Growth Scenario
Energy		
The future cost and availability of energy, particularly of petroleum	Oil price to converge with world oil price, which will increase at 5 percent annual rate to $72 per barrel in the year 2000 (1979 dollars) Petroleum-based motor fuel to increase to $2.30 per gallon by the year 2000 (1979 dollars) Assumes some potential for major and continuing disruptions in oil supply	Oil price to converge with world oil price, which will increase at 2 percent annual rate to $39 per barrel in the year 2000 (1979 dollars) Petroleum-based motor fuel to increase to $1.50 per gallon by the year 2000 (1979 dollars) Assumes no major or continued disruptions in oil supply
The degree to which energy conservation measures are implemented, particularly with respect to the automobile	Low degree of conservation in all sectors, resulting in increase in energy use of 3 percent Automobile fuel efficiency of 27.5 miles per gallon	High degree of conservation in all sectors, resulting in increase in energy use of 2 percent or less Automobile fuel efficiency of 32 miles per gallon
Population Lifestyles		
The degree to which the changing role of women affects the composition of the labor force	Female labor force increases to 50 to 55 percent and total labor force participation is 60 to 65 percent	Female labor force increases to 65 to 70 percent and total labor force participation is 70 to 75 percent
The future change in fertility rates	A continuation of below-replacement-level fertility rates during the next decade, followed by an increase to replacement level by the year 2000	A continuation of below-replacement-level fertility rates to the year 2000
The future change in household sizes	Average household size stabilizes	Average household size continues to decline
Economic Conditions		
The degree to which the Region will be able to compete with other areas of the nation for the preservation and expansion of its economic base	Region is considered to have relatively high attractiveness and competitiveness	Region is considered to have relatively low attractiveness and competitiveness
The future change of real income	Per capita and household income increase envisioned as a result of the attractiveness and competitiveness of Region, an increased proportion of the population being of work force age, and increased population labor force participation	Per capita increase likely but no household income increase envisioned as a result of the lack of attractiveness and competitiveness of Region, but increased proportion of the population is of work force age, and there is increased population labor force participation
Attendant Regional Change	**Moderate Growth Scenario**	**Stable or Declining Growth Scenario**
Population of the Region in Year 2000		
Size	2,219,300 persons	1,688,400 persons
Age Distribution	29.2 percent—0-19 years of age 58.5 percent—20-64 years of age 12.3 percent—65 years of age or older	26.8 percent—0-19 years of age 60.6 percent—20-64 years of age 12.6 percent—65 years of age or older
Number of Households	681,100 to 739,400	673,600 to 750,600
Household Size	Average of 2.9 to 3.1 persons	Average of 2.2 to 2.5 persons
Economic Activity of Region in Year 2000		
Employment	1,016,000 jobs	887,000 jobs
Structure	Manufacturing. . . . 32 percent Services. . . . . 40 percent Other . . . . 28 percent	Manufacturing. . . . 30 percent Services. . . . . 41 percent Other . . . . 29 percent
Personal Income	$29,600 to $32,000 per household in 1979 dollars (38 to 50 percent increase over 1970, or a 1.1 to 1.4 percent annual rate of increase) $10,000 per capita in 1979 dollars (54 percent increase over 1970, or a 1.4 percent annual rate of increase)	$21,400 to $23,700 per household in 1979 dollars (0 to 11 percent increase over 1970, or a 0.0 to 0.3 percent annual rate of increase) $9,500 per capita in 1979 dollars (46 percent increase over 1970, or a 1.3 percent annual rate of increase)

Table 370 (continued)

Land Use Plan Characteristics	Moderate Growth Scenario		Stable or Declining Growth Scenario	
Urban Growth and Density	Centralized Plan	Decentralized Plan	Centralized Plan	Decentralized Plan
New Urban Residential Land	Occurs primarily at medium residential densities along the periphery of, and outward from, existing urban centers	Occurs primarily at suburban residential densities in a diffused pattern in areas proximate to, and removed from, existing urban centers	Occurs primarily at medium residential densities along the periphery of, and outward from, existing urban centers	Occurs primarily at suburban residential densities in a diffused pattern in areas proximate to, and removed from, existing urban centers
Urban Density	Existing developed portions of Milwaukee County generally maintain residential density existing in 1970	Existing developed portions of Milwaukee may decrease in residential density between 1970 and 2000	Existing developed portions of Milwaukee County generally maintain residential density existing in 1970	Existing developed portions of Milwaukee may decrease in residential density between 1970 and 2000
Population Distribution				
Milwaukee County	1,049,600 persons	898,500 persons	830,000 persons	700,000 persons
Percent Change from 1970	- 0.4	- 14.8	- 21.3	- 33.6
Percent Change from 1978	10.0	- 5.8	- 13.0	- 26.6
Outlying Counties (Ozaukee, Washington, Waukesha)	677,600 persons	786,700 persons	480,000 persons	605,000 persons
Percent Change from 1970	93.8	125.0	37.2	73.1
Percent Change from 1978	52.8	77.4	8.2	36.4
Employment Distribution				
Milwaukee County	593,600 jobs	523,400 jobs	552,300 jobs	525,300 jobs
Percent Change from 1970	16.2	2.4	8.1	2.8
Percent Change from 1978	5.6	- 6.9	- 1.8	- 6.6
Outlying Counties (Ozaukee, Washington, Waukesha)	231,400 jobs	274,800 jobs	181,900 jobs	206,900 jobs
Percent Change from 1970	119.5	160.7	72.6	96.3
Percent Change from 1978	63.6	94.3	28.6	46.3

Source: SEWRPC.

mary transit technologies were found to have potential for such application and therefore to warrant the preparation of plans under this study: 1) motor bus on freeways, 2) motor bus on busways, 3) light rail transit, 4) heavy rail rapid transit, and 5) commuter rail.[1]

In order to ensure that the potential for primary transit service to be provided to any part of the greater Milwaukee area was not overlooked under the study, maximum extent alternative system plans were initially designed for each of these five primary transit technologies which served all corridors of major travel demand and which utilized

[1] *Electric trolley bus on busways was also identified as a proven and available primary transit technology. However, separate alternative system plans were not prepared for this technology because the inventory of the state-of-the-art of transit technology established that any electric trolley bus-on-busway plan could be expected to be quite similar in performance to the diesel motor bus-on-busway plans and light rail transit plans to be prepared under the study, essentially providing some advantages and some disadvantages of each of these two*

(footnote continued on next page)

all available facilities and rights-of-way for primary transit use. The corridors of major travel demand were defined by considering the locations of existing and proposed regional activity centers, probable future concentrations of travel desire lines, probable future concentrations of arterial streets with heavy traffic volumes and congestion, and existing heavily used transit routes. The available facilities and rights-of-way considered in this maximum extent system plan design included freeways and their medians, shoulders, and nonroadway rights-of-way; active and abandoned railways and associated rights-of-way; former electric interurban and street railway rights-of-way; and the medians and parking lanes of arterial streets having at least three lanes in each direction.

The resultant maximum extent networks of potential corridors for each alternative primary transit technology were developed into system plans in sufficient detail to permit test and evaluation by application of travel and traffic simulation models. For each alternative network, both physical and operational configurations were prepared. The design of the physical configuration involved selecting specific alignments for each alternative primary transit technology from among the available facility and right-of-way options in each potential maximum extent corridor. The design of the operational plan involved identifying routes, stops, and stations for each technology on each of the selected alignments.

The resultant maximum extent system plans for motor bus on freeway, light rail transit, motor bus on busway, heavy rail rapid transit, and commuter rail in the Milwaukee area are shown on Maps 52, 60, 72, and 55, respectively, of Chapter III of this report. Shown on Map 53 of Chapter III of this report is the base plan which was used in the study as a benchmark against which the performance of the alternative plans could be measured.

Base Plan

The base plan envisions no long-range primary transit improvement in the Milwaukee area. It is comprised of the existing Milwaukee area transit system, and of those short-range improvements to that system recommended in the Milwaukee County five-year transit development program adopted by the Milwaukee County Board in September 1980. It should be noted that reevaluation of this adopted plan began in 1981, with the other alternative plans being considered proposing fewer facilities and services. Primary transit service under the base plan would be provided by conventional motor buses—possibly supplemented by articulated motor buses—operating nonstop over existing freeways in mixed traffic on routes between outlying park-ride lots and the Milwaukee central business district. A total of 16 such primary transit routes with a combined length of 449 miles, and with 20 stations, would be provided under the base plan, with only a single route providing service

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(footnote 1 continued)

modes. Therefore, it was determined that electric trolley bus-on-busway operation should be considered further as a potential primary transit alternative in the Milwaukee area only if the evaluation of the alternative transit plans prepared for the other five proven alternative primary transit modes resulted in the recommendation that a motor bus-on-busway plan be implemented.

An electric trolley bus-on-busway plan may be expected to have about the same operating costs as a motor bus-on-busway plan and a light rail transit plan; somewhat greater capital costs than a motor bus-on-busway plan (5 to 10 percent) but substantially lower capital costs than a light rail plan (15 to 20 percent); about the same ridership as a motor bus-on-busway plan and marginally less ridership than a light rail plan; and about the same operating cost-effectiveness as a motor bus-on-busway or light rail transit plan.

The performance of the electric trolley bus and motor bus plans may be expected to be similar because the only major difference between these two modes is the trolley bus mode's requirement for an overhead electrical power distribution system. This requirement significantly increases the capital costs of the electric trolley bus system. On the other hand, it does make the trolley bus independent of petroleum-based motor fuels, eliminates the emission of air pollutants along the guideways, and reduces the noise associated with vehicle operation. In all other respects, electric trolley bus and motor bus performance are similar, particularly with regard to average operating speed and typical vehicle size and passenger-carrying capacity.

outside Milwaukee County.[2] Under the range of future conditions tested, average speeds on the routes would range from 19 to 24 miles per hour (mph), and service headways would range from 5 to 30 minutes during the peak periods. No evening off-peak-period bus-on-freeway service would be provided, and midday off-peak-period bus-on-freeway service would be limited to one route with headways ranging from 15 to 30 minutes. The service area of the supporting local transit system would be limited to Milwaukee County, and seven secondary, or limited-stop express, bus routes with a combined length of about 300 route miles would be provided to supplement the high-speed primary transit service. The tertiary, or local, transit system would consist of 43 routes having a combined length of about 1,000 route miles. Under the range of future conditions tested, the base plan would entail the provision of between 59,300 and 94,800 bus miles of transit service on an average weekday, requiring a fleet of between 576 and 900 buses. Under the base plan, the current fares are assumed to increase with general price inflation. The fare would thus remain at $0.50 per ride, expressed in constant 1979 dollars, for local and express bus service. The primary service fare would remain at $0.60 within Milwaukee County, and would increase with distance from Milwaukee County to $1.25 from the City of Waukesha--the limit of primary service under the base plan.

Maximum Extent Fixed Guideway Plans--Light Rail Transit, Busway, and Heavy Rail Rapid Transit

The maximum extent light rail transit, busway, and heavy rail rapid transit system plans would provide primary transit service throughout Milwaukee County and into outlying counties, including routes to the City of Waukesha and the Village of Menomonee Falls in Waukesha County, and to the City of Cedarburg and Village of Grafton in Ozaukee County. Under the maximum extent busway and light rail transit system plans, five routes totaling 253 route miles in length and having 162 stations or stops would operate over 104 miles of guideway. Stops on the guideway would typically be spaced approximately one-quarter mile apart in the central business district, one-half mile apart in areas of high-density urban development, and one mile apart in areas of medium-density urban development. Nearly all the guideway facilities, 97 miles, or 92 percent, would be located on surface alignments, with the remaining 7 miles, or 8 percent, located on elevated structure. The rights-of-way for most of the light rail and bus guideway facilities—about 51.7 miles, or 49 percent—would be located in medians, reserved lanes, and malls within public street rights-of-way. Another 31.4 miles, or 30 percent, would be located along former electric interurban railway rights-of-way presently owned by the Wisconsin Electric Power Company; 11.9 miles, or 11 percent, would be located along active railway rights-of-way; 1.6 miles, or 2 percent, would be located along cleared freeway rights-of-way of the Stadium Freeway-South and Park Freeway-East corridors; and 0.5 mile, or less than 1 percent, would be located along abandoned railway rights-of-way. The remaining 7 percent, or 7.4 miles of guideway, would be located on other publicly owned lands over a distance of 3.6 miles, and on privately owned lands over a distance of 3.8 miles. Nearly all this light rail and motor bus guideway would, as a result, be exclusive, as only transit vehicles would operate over the newly constructed facilities and rights-of-way except for a distance of 2.2 miles, where operation in mixed traffic would be necessary. Very little of the guideway would be grade-separated, however, as intersections with public streets would be provided along the entire length of the bus and light rail guideway. The

[2] *During the design, test, and evaluation of rapid transit alternatives for the Milwaukee area, transit service was extended from Milwaukee County into Waukesha County on seven routes. Four of these routes provided bus-on-freeway service from the Milwaukee central business district to the communities of Menomonee Falls, Brookfield, Oconomowoc, and Mukwonago in Waukesha County. The remaining three routes were extensions of existing local routes operated by the Milwaukee County Transit System, extending service over W. Blue Mound Road to the Brookfield Square Shopping Center, over N. 124th Street to the Village of Butler in Waukesha County, and over W. Greenfield Avenue and Moorland Road to the New Berlin Industrial Park. Local transit service was also initiated on 10 routes in the City of Waukesha. After six months, service to the Village of Butler was terminated, and after seven months service to the New Berlin Industrial Park was terminated because of insufficient ridership.*

transit vehicles would, however, be provided with preferential treatment at all such intersections through traffic signalization.

The light rail transit vehicles used on the five routes would be electrically propelled, bi-directional, and articulated, and would have average speeds of about 20 mph. Headways during the peak periods would range from 7 to 20 minutes, with some service being provided by two articulated vehicle trains. During the off-peak periods, headways would range from 10 to 60 minutes in the midday, and 15 to 60 minutes during the evening, with all routes operating with single-articulated vehicles. Under the range of future conditions tested, the maximum extent light rail transit plan would entail the provision of between 72,200 and 105,300 vehicle miles of transit service, with a fleet ranging from 97 light rail vehicles and 481 buses to 182 light rail vehicles and 634 buses.

Under the maximum extent light rail transit plans and all the other maximum extent plans, the current fares are assumed to increase with general price inflation. The fare under these plans would thus remain at $0.50 per ride, expressed in constant 1979 dollars, for local and express bus service. Similarly, the primary service fare would remain at $0.60 within Milwaukee County, and would increase with distance from Milwaukee County. These fares would range between $1.00 and $1.40 at the outer limits of the future urbanized area, and between $1.80 and $2.20 at the extreme limits of service on the maximum extent bus-on-freeway and commuter rail plan routes.

On the five busway routes that would use articulated high-capacity buses, average speeds would be about 18.5 mph. During the peak periods headways would range from 3 to 8 minutes, and during the off-peak periods would range from 10 to 60 minutes in the midday and 20 to 60 minutes during the evening. Under the range of future conditions tested, the maximum extent busway plan would entail the provision of between 77,300 and 111,900 bus miles of transit service, requiring a fleet of between 646 and 880 buses.

The maximum extent light rail and busway transit system plans, and all the other maximum extent system plans, also envision complementary expansion and improvement of the local and express transit system elements. Local transit service would be extended into all contiguous areas of urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County. Also, local transit service would be expanded in the off-peak travel periods, particularly in the evening. Express transit service would be expanded to complement the primary elements of the maximum extent system plans, serving those high-density areas not directly served by the primary transit elements of the maximum extent transit system plans.

The maximum extent heavy rail rapid transit system plan would consist of about 104 miles of guideway, over which five routes, totaling 215 miles in length and having 87 stations or stops, would operate. Stops would typically be spaced one-half mile apart in the central business district, one-mile apart in areas of high-density urban development, and two miles apart in areas of medium-density urban development. Most of the heavy rail guideway, 55.5 miles, or 54 percent, would be on elevated structure. Another 41.5 miles, or 40 percent, would be on fully grade-separated surface alignments, and the remaining 6.7 miles, or 6 percent, would be in subways. About 39.2 miles, or 39 percent of the heavy rail guideway, would be located within public street rights-of-way; about 21.6 miles, or 20 percent, would be located along active mainline railway rights-of-way; about 20.2 miles, or 19 percent, would be located along former electric interurban railway rights-of-way presently owned by the Wisconsin Electric Power Company; about 13.6 miles, or 13 percent, would be located along active and cleared freeway rights-of-way; and about 1.9 miles, or 2 percent, would be located along abandoned mainline railway rights-of-way. The remaining 7 percent, or 7.2 miles of guideway, would be located on other publicly owned lands for a distance of 3.9 miles, and on privately owned lands for a distance of 3.3 miles.

Average speeds on the five heavy rail rapid transit routes would be about 32 mph, with all service being provided by trains of two electrically propelled vehicles permanently coupled together. Headways during the peak periods would range from 10 to 30 minutes. During the off-peak periods, headways would range from 30 to 45 minutes in the midday, and 30 to 45 minutes during the evening. The maximum extent heavy rail plan would entail the provision of 95,500 vehicle miles of transit service, requiring a fleet of 66 heavy rail vehicles and 656 buses.

Maximum Extent Bus-on-Freeway and Commuter Rail Plans

The maximum extent bus-on-freeway and commuter rail plans would provide a greater areal extent of primary transit service than the maximum extent bus-on-busway, light rail transit, and heavy rail rapid transit plans because the bus-on-freeway and commuter rail transit technologies would be able to utilize existing facilities to extend primary transit service throughout the Region. Under both plans, service would be extended to the south to the City of Kenosha in Kenosha County, to the west to the City of Waukesha and the City of Oconomowoc in Waukesha County, to the northwest to the City of West Bend in Washington County, and to the north to the Cities of Port Washington and Cedarburg and Village of Grafton in Ozaukee County. In addition, service would be extended to the southwest to the Village of East Troy in Walworth County under the bus-on-freeway plan.

The maximum extent bus-on-freeway plan would consist of 31 routes totaling 1,218 route miles in length and having a total of 61 stations or stops. Under the plan, articulated, high-capacity buses would operate in primary transit service primarily over existing and proposed freeways between outlying park-ride lots and the Milwaukee central business district. Bus routes from park-ride lots in Milwaukee County to the central business district would be operated with a limited number of intermediate stops, as necessary, to connect and coordinate with feeder express and local bus service, thus providing access to major travel generators other than the Milwaukee central business district. Primary transit bus routes originating at locations outside Milwaukee County but within the existing or future Milwaukee urbanized area would generally serve two outlying park-ride lots prior to proceeding in an essentially nonstop mode of operation to the Milwaukee central business district. Primary transit bus routes originating at locations outside the Milwaukee urbanized area would have stops at two to five outlying park-ride lots prior to proceeding in an essentially nonstop mode of operation to the central business district. The park-ride lots would be located, to the extent practicable, within or near freeway interchanges to minimize travel times. Within the Milwaukee central business district, all primary transit bus routes would operate as such routes do today—that is, over E. and W. Wisconsin Avenue for a distance of about two miles with stops approximately every one-quarter mile.

The Milwaukee area freeways over which buses would operate in primary transit service under the maximum extent bus-on-freeway plan would be operationally controlled during peak travel periods.[3] All freeway on-ramps in the Milwaukee urbanized area would be ramp metered to restrain automobile and truck access to the freeways during peak travel periods. The ramp meters would be operated through a central control system which would continuously measure traffic volumes on those portions of the freeway system needed for transit service through an interconnected series of traffic-sensing devices. As traffic volumes would approach the levels beyond which operating speeds may be expected to deteriorate, fewer automobiles and trucks would be permitted to enter the freeway system. Sufficient constraint would be exercised to ensure uninterrupted traffic flow and operating speeds of at least 40 mph on otherwise congested freeways. Therefore, average speeds on the bus-on-freeway routes, including all stops, would range between 24 and 28 mph. Headways during peak periods would range from 6 to 30 minutes. During the off-peak periods, headways would range from

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[3] *The preparation of plans for bus-on-freeway alternatives which would operate over reserved lanes on freeways or in mixed traffic on uncontrolled freeways was also considered under the study, but was dismissed. Plans for reserved lane bus-on-freeway systems were not prepared because it was determined through inventories of freeway facilities and rights-of-way that buses operating over operationally controlled freeways in the Milwaukee area could provide the same preferential-freeway-treatment benefits systemwide at a lower cost and with less disruption of automobile and truck traffic, and with greater safety. Also considered in this determination to consider only a bus-on-freeway system with operational control of freeways was that a freeway operational control system was already partially in place in the Milwaukee area, and its improvement and expansion—principally for its automobile and truck travel benefits—had been programmed for implementation by the Wisconsin Department of Transportation, and was recommended under the Commission's adopted long-range and short-range regional transportation system plans.*

15 to 60 minutes in both the midday and evening travel periods. Under the range of future conditions tested, the maximum extent bus-on-freeway plan would entail the provision of between 110,100 and 153,100 bus miles of transit service, requiring a fleet of between 738 and 1,096 buses.

The maximum extent commuter rail plan would consist of six routes between outlying areas of the Region and the Milwaukee central business district. The routes would total 354 miles in length and would operate over 157 miles of railway. The six routes would include all mainline railway trackage in the Region connecting the Milwaukee central business district with concentrations of residential development and other travel generators. A total of 43 stops would be made on the routes, and the average speed on the routes would be about 31 mph. Service headways in the peak period would be every one-half hour in the peak direction and every hour in the nonpeak direction, and in off-peak periods would be every hour. Trains would generally consist of a locomotive and one or two coaches except on the route to the Racine and Kenosha areas, where trains of up to six coaches would be used during the peak periods. The maximum extent commuter rail plan would entail the provision of between 82,150 and 134,600 vehicle miles of transit service, and a fleet ranging from 42 commuter rail coaches and 645 buses to 90 coaches and 1,023 buses.

TEST AND EVALUATION OF MAXIMUM EXTENT PRIMARY TRANSIT SYSTEM PLANS

The test and evaluation of these initially designed maximum extent system plans was limited to selected measures of transit ridership, cost, and cost-effectiveness, because the maximum extent plans, by design, included transit facilities and services and transit technologies which were unlikely to be fully warranted. Consideration was given particularly to the average total cost per passenger carried by each maximum extent plan and the proportion of maximum extent plan design year costs met by farebox revenues, as shown in Table 371. The maximum extent plans were considered cost-effective if their total cost per passenger approximated that of the base plan, and if the individual primary transit routes of the plans—and the plans as a system, including local and express elements—recovered at least one-half of estimated design year operating and maintenance costs from farebox revenues. A total of 21 maximum extent plans were tested and evaluated for cost-effectiveness, including the base plan and each alternative maximum extent plan under each alternative future except the maximum extent heavy rail rapid transit plan. The maximum extent heavy rail rapid transit plan was tested only under the most optimistic future for transit needs and use.

Those elements of the maximum extent plans determined through this test and evaluation not to be cost-effective were eliminated from further consideration under the study. The resulting truncated plans were subsequently tested and comparatively evaluated to provide the basis for formulating the study recommendations.

Maximum Extent Bus-on-Metered Freeway Plan

The test and evaluation of the maximum extent bus-on-metered freeway system plans established that only under the most optimistic future conditions could a maximum extent bus-on-metered freeway plan be expected to meet the key objectives. That is, only under the moderate growth scenario-centralized land use plan alternative future could the maximum extent plan as a system be expected to meet at least 50 percent of its operating and maintenance costs from farebox revenues, and could the capital, net operating and maintenance, and total costs per passenger be expected not to differ significantly from those of the base plan. Under the other three more pessimistic alternative futures, it was determined that between 16 and 24 of the bus-on-metered freeway routes would not meet about one-half of their design year operating and maintenance costs from farebox revenues, and that these routes should therefore not be considered for inclusion in the final plan. However, even with the removal of the inefficient routes from the maximum extent system plans, the bus-on-metered freeway plans still constituted a system under all futures, as the remaining routes under each future provided service in most major travel corridors of the Milwaukee area. Maps 54 in Chapter III, 94 in Chapter IV, 110 in Chapter V, and 126 in Chapter VI show the extent of the truncation of the maximum extent bus-on-metered freeway plans determined necessary under each alternative future to result in a more cost-effective set of bus-on-freeway plans.

Maximum Extent Light Rail Transit and Busway Plans

It was found that the maximum extent light rail transit and busway plans could be expected to perform well in terms of operating and maintenance cost-effectiveness, meeting no less than 64 percent of operating and maintenance costs from farebox revenues in the design year on any route under even the most pessimistic future. However, the combined capital and operating and maintenance costs of the maximum extent plans, expressed both in total and on per-passenger basis, were determined to be significantly higher than those of the base plan under all four futures, principally because of the significantly higher capital cost per passenger of the light rail transit and busway plans. Accordingly, the maximum extent light rail and busway system plans were truncated with the objective of reducing system capital costs and bringing the total cost per passenger closer to that of the base plan. In truncating the maximum extent system plans under each alternative future, the segments deleted were those which the plan test indicated would, if deleted, provide the largest reductions in system capital costs and operating deficits and the smallest reductions in system ridership. As shown on Map 67 in Chapter III for the moderate growth scenario-centralized land use plan alternative future and on Map 100 in Chapter IV for the other three alternative futures, the light rail and busway facilities that were initially proposed under the maximum extent plans were significantly truncated, with the remaining facilities serving only the central portion of Milwaukee County under all four futures.

Maximum Extent Commuter Rail Plans

The test and evaluation of the maximum extent commuter rail plans under each alternative future demonstrated that commuter rail would not be viable as a primary transit mode under all of the alternative futures. Indeed, only under the most optimistic future for transit use in the Milwaukee area was it found that commuter rail could provide viable, all-day service on any route other than the route to the Racine and Kenosha areas, as shown on Map 59 in Chapter III of this report. Under the most optimistic future, routes to the north to Grafton and to the west to Oconomowoc, as well as the route to Racine and Kenosha, were found to have the potential to meet 50 percent of the annual operating and maintenance costs from farebox revenues. Under the two futures considered to be intermediate with respect to potential transit need and use—the stable or declining growth scenario-centralized land use plan alternative future and the moderate growth scenario-decentralized land use plan alternative future—only the commuter rail route to the Racine and Kenosha areas was expected to meet the cost-effectiveness standard. Under the least optimistic future for transit use, no commuter rail route was expected to be able to meet at least one-half of its operating costs from farebox revenues and, therefore, no further consideration was given to the commuter rail mode under this most pessimistic alternative future.

Maximum Extent Heavy Rail Rapid Transit Plan

Through test and evaluation of the maximum extent heavy rail rapid transit plan under the most optimistic future for transit needs and use, it was determined that heavy rail would entail substantially greater capital costs than any of the other primary transit alternatives, and that its high speed and high capacity could not be efficiently utilized in the Milwaukee area for at least the next two decades. The analyses clearly established that the transit travel demand in all of the major travel corridors of the Milwaukee area, even under the most optimistic future for transit use, would be insufficient to permit cost-effective heavy rail service headways—headways that are short enough to promote high utilization. The analyses indicated that the inconvenience of the necessarily longer headways would outweigh the vehicle operating speed advantages of heavy rail in attracting transit ridership, the heavy rail plan being found to carry between 7,000 and 11,000, or 2 to 3 percent, fewer passenger trips on an average weekday than the light rail and busway alternatives. In addition, the capital cost of the heavy rail alternative, because of its need for a fully grade-separated exclusive right-of-way, was more than two-and-one-half times that of the comparable light rail plan, and three-and-one-half times that of the comparable busway plan. It was accordingly determined that heavy rail should not be tested under the more pessimistic alternative futures, and that it should be eliminated from further consideration as a possible mode for the provision of primary transit service in the Milwaukee area under this study.

Implications of the Test and Evaluation of the Maximum Extent Plans

The test and evaluation of the maximum extent system plans provided information vital to the sound development of study recommendations by identifying those elements of the maximum extent plans which were not viable under the alternative futures postulated. Based on this test and evaluation, heavy rail rapid transit was eliminated from further consideration under the study as it was shown to be not viable under even the most optimistic future for transit need and use considered in the study.

Table 371

SUMMARY OF EVALUATION OF THE BASE SYSTEM PLAN AND ALTERNATIVE MAXIMUM EXTENT PRIMARY TRANSIT SYSTEM PLANS UNDER EACH SCENARIO-LAND USE PLAN

Scenario	Alternative					
	Base Plan	Bus-on-Freeway Plan	Commuter Rail Plan	Light Rail Transit Plan	Busway Plan	Heavy Rail Rapid Transit Plan
Moderate Growth Scenario-Centralized Land Use Plan						
Public Transit Ridership						
Passenger Trips per Average Weekday	326,800	387,900	372,100	357,800	353,500	346,600
Cost						
Total Cost						
Total Cost to Design Year	$579,742,000	$832,269,800	$868,415,300	$1,120,900,000	$938,394,490	$2,048,414,900
Capital Cost						
Total Capital Cost to Design Year	148,842,000	221,249,800	210,245,300	628,160,000	442,054,490	1,572,378,300
Total Capital Investment to Design Year	233,328,700	356,443,700	401,852,100	1,231,138,000	771,162,200	2,930,538,000
Net Operating and Maintenance Cost (deficit)						
Total Deficit in Design Year	23,198,300	45,713,000	51,607,600	30,928,100	31,378,700	28,840,500
Total Deficit to Design Year	430,900,000	611,020,000	658,170,000	492,740,000	496,340,000	476,036,600
Cost-Effectiveness						
Cost to Design Year per Passenger						
Total Cost to Design Year per Passenger	0.39	0.52	0.54	0.73	0.62	1.35
Capital Cost to Design Year per Passenger	0.10	0.14	0.13	0.41	0.29	1.04
Operating Deficit to Design Year per Passenger	0.29	0.38	0.41	0.32	0.33	0.31
Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year						
Total Transit System	62	53	49	59	58	60
Primary Element	56	54	41	88	86	74
Moderate Growth Scenario-Decentralized Land Use Plan						
Public Transit Ridership						
Passenger Trips per Average Weekday	217,400	256,700	245,100	234,700	231,600	--
Cost						
Total Cost						
Total Cost to Design Year	$542,926,370	$770,816,100	$785,265,880	$1,040,607,700	$ 900,128,990	--
Capital Cost						
Total Capital Cost to Design Year	124,606,570	180,135,500	182,522,880	583,822,300	407,051,590	--
Total Capital Investment to Design Year	186,198,500	286,385,500	334,665,700	1,127,632,600	733,648,700	--
Net Operating and Maintenance Cost (deficit)						
Total Deficit in Design Year	21,625,900	43,171,000	44,678,800	26,434,100	30,970,600	--
Total Deficit to Design Year	418,319,800	590,680,600	602,743,000	456,785,400	493,077,400	--
Cost-Effectiveness						
Cost to Design Year per Passenger						
Total Cost to Design Year per Passenger	0.44	0.59	0.60	0.84	0.73	--
Capital Cost to Design Year per Passenger	0.10	0.14	0.14	0.47	0.33	--
Operating Deficit to Design Year per Passenger	0.34	0.45	0.46	0.37	0.40	--
Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year						
Total Transit System	53	43	42	56	48	--
Primary Element	45	48	35	82	80	--

Table 371 (continued)

Scenario	Alternative					
	Base Plan	Bus-on-Freeway Plan	Commuter Rail Plan	Light Rail Transit Plan	Busway Plan	Heavy Rail Rapid Transit Plan
Stable or Declining Growth						
Scenario-Centralized Land Use Plan						
Public Transit Ridership						
Passenger Trips per Average Weekday	215,900	241,700	230,500	227,200	224,800	- -
Cost						
Total Cost						
Total Cost to Design Year.	$493,042,100	$708,108,800	$777,644,100	$1,019,763,000	$ 845,224,700	- -
Capital Cost						
Total Capital Cost to Design Year	119,819,100	173,830,600	260,209,900	577,865,600	399,377,700	- -
Total Capital Investment to Design Year	180,851,300	273,722,800	305,467,100	1,106,884,700	719,773,600	- -
Net Operating and Maintenance Cost (deficit)						
Total Deficit in Design Year	15,988,800	36,120,700	34,015,200	24,573,100	25,066,800	- -
Total Deficit to Design Year	373,223,000	534,278,200	517,434,200	441,897,400	445,847,000	- -
Cost-Effectiveness						
Cost to Design Year per Passenger						
Total Cost to Design Year per Passenger	0.40	0.56	0.62	0.83	0.68	- -
Capital Cost to Design Year per Passenger	0.10	0.14	0.21	0.47	0.32	- -
Operating Deficit to Design Year per Passenger	0.30	0.42	0.41	0.36	0.36	- -
Percent of Operating and Maintenance Cost						
Met by Farebox Revenue in the Design Year						
Total Transit System	61	45	45	53	52	- -
Primary Element	49	35	22	82	77	- -
Stable or Declining Growth Scenario-						
Decentralized Land Use Plan						
Public Transit Ridership						
Passenger Trips per Average Weekday	169,400	193,100	183,200	180,000	178,300	- -
Cost						
Total Cost						
Total Cost to Design Year.	$483,703,200	$688,398,600	$679,440,000	$1,016,911,000	$ 855,484,300	- -
Capital Cost						
Total Capital Cost to Design Year	107,761,000	155,958,000	158,285,100	563,200,000	393,968,500	- -
Total Capital Investment to Design Year	161,597,700	252,706,300	284,576,100	1,080,881,200	709,158,500	- -
Net Operating and Maintenance Cost (deficit)						
Total Deficit in Design Year	16,328,700	35,891,000	34,480,300	26,049,800	27,025,400	- -
Total Deficit to Design Year	375,942,200	532,440,600	521,155,000	453,711,000	461,515,800	- -
Cost-Effectiveness						
Cost to Design Year per Passenger						
Total Cost to Design Year per Passenger	0.43	0.58	0.59	0.90	0.76	- -
Capital Cost to Design Year per Passenger	0.10	0.13	0.14	0.50	0.35	- -
Operating Deficit to Design Year per Passenger	0.33	0.45	0.45	0.40	0.41	- -
Percent of Operating and Maintenance Cost						
Met by Farebox Revenue in the Design Year						
Total Transit System	54	45	39	45	44	- -
Primary Element	49	27	19	79	67	- -

Source: SEWRPC.

Commuter rail was shown to be a viable alternative as a system only under the most optimistic of futures considered in the study. While the route to the Racine and Kenosha areas was found to be viable under two of the intermediate futures, no commuter rail route was found to be viable under the most pessimistic future.

The bus-on-freeway, light rail transit, and busway alternatives were shown to be viable under the full range of alternative futures considered. Moreover, nearly the same extent of light rail transit and busway facilities and services—a truncated, five corridor system of between 97 and 103 route miles in extent with service confined to Milwaukee County—was determined to be feasible under both the most optimistic and pessimistic futures.

The evaluation indicated that nearly all the maximum extent system routes for the bus-on-metered freeway mode would be viable under the most optimistic future. Only under the other three futures were some bus-on-metered freeway routes shown not to be cost-effective and thus recommended for elimination.

Those elements of the maximum extent system plans for each transit technology thus identified as being viable were combined into truncated system plans of reasonable, cost-effective facilities and services under each alternative future. These truncated system plans were subsequently further tested, evaluated, and compared under each alternative future to provide a basis for the study recommendations. A total of 13 truncated system plans were tested, evaluated, and compared, including bus-on-metered freeway, busway, and light rail transit plans under all the alternative futures and a commuter rail plan under only the most optimistic future.

The truncated light rail transit, busway, and commuter rail plans were modified prior to final test and evaluation so that the geographic extent of the primary transit service provided under each of these alternatives was comparable to that provided under the more extensive bus-on-metered freeway plan under each alternative future. The modifications consisted of adding primary transit bus-on-metered freeway routes to the truncated light rail transit, busway, and commuter rail plans in those travel corridors in which light rail transit, busway, and commuter rail facilities were not proposed, but where the bus-on-metered freeway plan would provide service. Without these modifications the comparison of the alternative truncated plans would have been more difficult, as the alternatives would not have provided similar areal coverage. The composite system plans for the light rail transit and busway technologies are shown on Map 75 in Chapter III for the moderate growth scenario-centralized land use plan alternative future, Map 121 in Chapter V for the moderate growth scenario-decentralized land use plan alternative future, Map 137 in Chapter VI for the stable or declining growth scenario-centralized land use plan alternative future, and Map 106 in Chapter IV for the stable or declining growth scenario-decentralized land use plan alternative future.

The composite system plan for the truncated commuter rail plan of three routes under the moderate growth scenario-centralized land use plan alternative future is shown on Map 74 in Chapter III. Composite plans were not prepared for commuter rail under any other alternative future. No commuter rail route was found viable under the most pessimistic future. Under the two intermediate futures, the truncated system plan for commuter rail consisted of only one route in a single corridor radiating south from the Milwaukee central business district to the Racine and Kenosha areas. Therefore, primary transit commuter rail service in this corridor was compared directly with service under the truncated bus-on-freeway system plan on a corridor basis.

TEST AND EVALUATION OF TRUNCATED AND COMPOSITE PRIMARY TRANSIT SYSTEM PLANS

The truncated and composite alternative primary transit system plans were subject to further test and comparative evaluation under each alternative future. Objectives considered in those evaluations included transit system cost and ridership, accessibility, level of service, energy consumption, and environmental impacts, including air pollution and community disruption. In addition, to the extent possible the evaluation considered certain intangible implications of the alternative plans which could not be quantitatively measured with any reasonable degree of certainty.

The evaluation of the three primary transit alternatives which the analyses indicated could perform as systems under all four alternative futures—

bus on metered freeway, bus on busway, and light rail transit—indicated that these three alternatives could, in addition, be expected to work well in the Milwaukee area under each of the alternative futures, as indicated in Tables 168 in Chapter III, 241 in Chapter IV, 301 in Chapter V, and 359 in Chapter VI of this report. Under the wide range of future conditions considered, these three alternatives were determined to have the potential to provide essentially identical levels of service, to attract similar levels of ridership, to result in similar annual operating and maintenance cost subsidy requirements, and to have similar systemwide energy consumption and environmental impacts.

Under the moderate growth scenario-centralized land use plan alternative future, the expected level of transit use in the Milwaukee area under the bus-on-metered freeway, bus-on-busway, and light rail transit plans in the plan design year was found to range from about 373,000 to about 379,000 trips per average weekday, with the largest number of transit trips being made under the bus-on-metered freeway plan and the smallest number made under the bus-on-busway plan. Operating and maintenance costs under this future were determined to require a subsidy ranging from about $35 million to about $38 million per year in the design year under the three plans, with the light rail plan incurring the smallest operating deficit and the bus-on-freeway plan incurring the largest deficit. Each of the three plans was also shown to be expected to recover nearly the same proportion of operating and maintenance costs from farebox revenues, between 56 and 59 percent, with the light rail plan being the most efficient and the bus-on-freeway plan being the least efficient of the plans.

The differences in the design year performance of these three alternative plans were found to be even smaller under each of the more pessimistic futures. Under the most pessimistic alternative future, the stable or declining growth scenario-decentralized land use plan future, the level of transit use under the three plans is expected to differ by less than 2 percent, ranging from about 177,000 passenger trips per average weekday in the plan design year under the busway plan to about 180,000 passenger trips under the bus-on-freeway plan. Under the moderate growth scenario-decentralized land use plan intermediate future, the level of transit use of the three plans is expected to range from about 238,000 to about 242,000 passenger trips per average weekday; and under the stable or declining growth scenario-centralized land use plan intermediate future, the level of transit use under the three plans is expected to range from about 224,000 to about 228,000 average weekday passenger trips.

The public subsidy required for transit operating and maintenance costs in the design year was also found to differ little between these three plans under the three more pessimistic alternative futures. The necessary public subsidies were found to range from a high of between $32 and $34 million under the moderate growth scenario-decentralized land use plan alternative future, to a low of between $22 and $26 million under the other two pessimistic futures. The proportion of operating and maintenance costs met by farebox revenues under the three plans was also found to be similar under the three more pessimistic futures, ranging from 53 to 54 percent under the moderate growth scenario-decentralized land use plan intermediate future, and from 46 to 49 percent under the other two more pessimistic futures.

Other aspects of the performance of these three alternative truncated and composite plans may also be expected to be similar, including air pollutant emissions, community disruption, and energy consumption. Considering all energy consumption attendant to implementation of the truncated bus-on-metered freeway, bus-on-busway, and light rail transit system plans, including energy required for construction as well as operation and maintenance over the 21-year design period, the bus-on-metered freeway plan was determined to require the least total energy consumption—from about 17 trillion British Thermal Units (BTU's) under the most pessimistic future to about 25 trillion BTU's under the most optimistic future.[4] The total energy consumption under the bus-on-busway and light rail transit plans was determined to be not more than 10 percent greater, ranging from about 18 trillion BTU's to about 27 trillion BTU's. The light rail transit plan, however, would require the least petroleum-based motor fuel—between 5 and 8 percent less than required by the bus-on-busway plan, and 8 and 11 percent less than required by the bus-on-

[4] *The equivalent energy use of the bus-on-freeway system plan over the 21-year plan design period is estimated to be about 182 million gallons of diesel fuel, or about one million tons of coal.*

metered freeway plan—as between 21 and 27 percent of the transit trips under the light rail plan may be expected to be made on electrically propelled vehicles. This savings in petroleum-based motor fuel, however—which would range from between 5 and 18 million gallons over the 20-year plan implementation period—would represent less than a 1 percent savings in petroleum-based motor fuel use by the total transportation system in the Milwaukee area. This is because levels of automobile tripmaking and travel are expected to be about the same under all three alternative transit plans, and to be at least 12 times greater than levels of transit tripmaking and travel in the Milwaukee area. Therefore, any savings in petroleum-based motor fuel through the use of electrically propelled transit vehicles will be dominated by petroleum-based fuel use for automobile travel.[5]

The only significant measurable difference found between the bus-on-metered freeway, bus on busway, and light rail transit alternative plans was the capital investment and capital costs attendant to their implementation.[6] The bus-on-metered freeway plan was determined to require the least capital investment over the plan design period of the three plans, ranging from $203 million under the most pessimistic future, the stable or declining growth scenario-decentralized land use plan future, to $341 million under the most optimistic future, the moderate growth scenario-centralized land use plan future. The greater capital investment was required under the most optimistic future for the purchase of transit vehicles to serve the larger demand for transit service under this future. The busway and light rail transit alternatives were found to require substantially more capital investment, primarily because they would require extensive new guideway construction. The capital investment required for implementation of the bus-on-busway plan was estimated to range from $453 million under the most pessimistic alternative future to $627 million under the most optimistic alternative future, and the capital investment required for the light rail transit plan was estimated to range from $607 million under the most pessimistic future to $834 million under the most optimistic future.

Because of the expected 30-year life of the guideways to be constructed under the bus on busway and light rail transit plans, and the relatively longer life of rail vehicles, the differences in capital costs between the bus-on-freeway plan and the busway and light rail transit plans over the design period, while substantial, were found to be considerably less than the differences in capital investment. The bus-on-metered freeway plan was found to have the lowest capital costs under each alternative future, ranging from $144 million to $223 million. The capital costs of the busway and light rail transit plans were estimated to range from $268 million to $347 million and from $336 million to $436 million, respectively. For each plan, the lowest capital cost was attendant to the most pessimistic future, and the highest capital cost was attendant to the most optimistic future.

The bus-on-metered freeway plan was also found to have the lowest total public cost, including both capital and net operating and maintenance costs, under each of the four alternative futures, ranging from $594 million to $774 million.[7] The

[5] *It should be noted that implementation of the composite light rail transit system plan in the Milwaukee area would result in the consumption of between 35 and 87 million kilowatt-hours of electricity in the plan design year 2000, and would place a peak power demand of between 25 and 60 megawatts on the electric power generating system in the plan design year. Based upon the electric power generating system demands in the year 2000 forecast by the Wisconsin Electric Power Company (WEPCo), these light rail system power requirements would represent less than 2 percent of the forecast year 2000 peak power demands in the WEPCo service area, and less than 1 percent of the forecast year 2000 total electric power consumption in the WEPCo service area.*

[6] *Capital investment is defined as the total outlay of funds for guideway, station, and support facility construction and vehicle acquisition necessary to implement a plan over the plan design period, and indicates total capital resources required for plan implementation. Capital cost is defined as the capital investment less the value of the remaining life of facilities and vehicles beyond the plan design period, and indicates the true capital expenditures required for plan implementation over the plan design period.*

[7] *Estimates of total public cost for each plan were based first on the assumption that each plan would be implemented incrementally over the plan design period, and that an equal capital expenditure would thus be made during each year over the 21-year design period, and second on the assumption that the annual operating and maintenance cost subsidy would increase linearly from the current level of about $19 million to the plan design year level.*

bus-on-busway plan was found to have the next highest total public cost, ranging from $709 to $883 million. The highest total public cost could be expected to be incurred under the light rail transit plans—from $771 million to $964 million. Again, the lowest total cost for each plan may be expected to be incurred under the most pessimistic future for transit use, and the highest cost under the most optimistic future. On a per-passenger-trip basis, the bus-on-metered freeway plan had the lowest total public cost, including capital costs and net operating and maintenance costs, of the three plans, approximating between $0.47 and $0.52 over the 21-year plan design period, compared with between $0.57 and $0.62 for the bus-on-busway plan and between $0.62 and $0.68 for the light rail transit plan. It should be noted that for each plan, the lowest total average cost per passenger over the plan design period was incurred under the most optimistic future for transit use, and the highest cost was incurred under the most pessimistic future.

The results of the test and evaluation of the maximum extent plans revealed the fourth primary transit alternative, commuter rail, to be viable as a system only under the most optimistic future conditions. Furthermore, the test and evaluation indicated that commuter rail would not be a viable alternative at all under the most pessimistic future conditions, and that it would be viable under the intermediate future conditions only in a single route that extends south from the Milwaukee central business district to the Racine and Kenosha areas. The test and evaluation of commuter rail as a truncated system under the most optimistic future and as a single route under the two intermediate futures indicated that commuter rail would entail slightly lower capital costs than comparable bus-on-metered freeway facilities and service, but would result in somewhat lower transit ridership and somewhat higher annual public subsidies of operating and maintenance costs. Consequently, commuter rail would be a less cost-effective alternative. As shown in Table 168 in Chapter III, under the most optimistic future, the moderate growth scenario-centralized land use plan future, the commuter rail system plan would entail nearly 4 percent less capital cost than the bus-on-metered freeway plan, or $215 million compared with $223 million. Under this commuter rail plan, however, about 12,500, or 3 percent, less transit trips would be carried on an average weekday than under the bus-on-freeway plan, and about $1.9 million, or 5 percent, more public subsidy would be required for operating and maintenance costs in the design year. Therefore, the commuter rail plan would cost about $7 million more than the bus-on-freeway plan under this alternative future, and would cost about $0.03 more per passenger trip. Both of these figures, however, represent differences of less than 1 percent.

The extent of the differences between the bus-on-metered freeway plan and the commuter rail plan is shown in Table 372 for all three corridors in the commuter rail plan under the moderate growth scenario-centralized land use plan future, and for the Racine-Kenosha corridor under the intermediate, moderate growth scenario-decentralized land use plan future and the most pessimistic alternative, the stable or declining growth scenario-decentralized land use plan future. While the differences between the plans under the moderate growth scenario-centralized land use plan alternative future are not large in absoute terms in any of the three corridors, they are large in proportionate terms, particularly in the Port Washington and Oconomowoc-to-Milwaukee corridors, and indicate that the bus-on-freeway plan is the most cost-effective plan of the two. Similarly, comparison of the bus-on-freeway and commuter rail services in the Milwaukee-to-Racine and Kenosha corridor under the moderate growth scenario-decentralized land use plan and stable or declining growth scenario-centralized land use plan alternative futures indicates relatively small differences between the bus-on-freeway and commuter rail alternatives except with respect to cost-effectiveness, or the capital costs and operating and maintenance costs per passenger trip.

Assessment of Intangible Benefits of Alternative Primary Transit System Plans

Also considered in the evaluation of the alternative truncated and composite primary transit system plans were any intangible, or uncertain and unquantifiable, differences between the plans. All of these differences would support public investment in the light rail transit plan, but some would support public investment in the fixed guideway transit plans for busways or commuter rail as well. The intangible benefits considered included the potential for public transit to influence land development and redevelopment; the potential for continued and expanded public transit operation during a severe petroleum energy shortage; the potential for public transit to reduce the localized environmental impacts of public transit; the potential for public transit to increase the reliability and safety of public transit operations; and rider preference for rail transit service over motor bus transit service.

Table 372

CORRIDOR COMPARISON OF EVALUATIVE MEASURES FOR THE BUS-ON-FREEWAY AND COMMUTER RAIL ALTERNATIVES

Evaluative Measure	Moderate Growth Scenario-Centralized Land Use Plan									Moderate Growth Scenario-Decentralized Land Use Plan			Stable or Declining Growth Scenario-Centralized Land Use Plan		
	Port Washington Corridor			Oconomowoc Corridor			Racine-Kenosha Corridor			Racine-Kenosha Corridor			Racine-Kenosha Corridor		
		Commuter Rail			Commuter Rail			Commuter Rail			Commuter Rail			Commuter Rail	
	Bus on Freeway	Primary Element	Total Transit Service	Bus on Freeway	Primary Element	Total Transit Service	Bus on Freeway	Primary Element	Total Transit Service	Bus on Freeway	Primary Element	Total Transit Service	Bus on Freeway	Primary Element	Total Transit Service
Ridership															
Average Weekday Passengers	16,000	5,700	11,500	10,500	4,400	7,800	21,700	13,200	18,000	13,900	9,800	12,100	8,300	4,500	6,670
Design Year Passengers	4,088,000	1,457,000	2,689,000	2,689,000	1,117,000	2,103,000	5,532,000	3,376,000	4,768,000	3,544,500	2,499,000	3,166,000	2,116,500	1,147,500	1,776,800
Capital Cost and Investment															
Total Capital Cost to Design Year	$13,637,400	$11,257,700	$13,927,800	$ 9,362,100	$ 8,402,600	$ 9,967,800	$17,070,200	$16,000,000	$18,118,500	$17,158,600	$15,315,800	$16,449,600	$10,210,400	$11,243,600	$12,311,100
Total Capital Investment to Design Year	24,657,200	28,348,000	32,486,700	17,019,000	21,878,000	24,304,100	30,270,600	40,900,000	44,751,800	30,103,800	37,136,000	39,236,000	17,859,400	26,425,400	28,366,400
Operating Cost															
Operating Cost in Design Year	$ 4,119,600	$ 2,473,200	$ 3,720,000	$ 3,356,000	$ 2,503,200	$ 3,234,100	$ 8,175,000	$ 6,617,400	$ 7,781,200	$ 5,253,000	$ 4,772,600	$ 5,345,900	$ 3,534,800	$ 2,677,500	$ 3,197,500
Percent of Operating Cost Met by Farebox Revenue in the Design Year	66	48	50	61	42	45	63	60	59	69	64	62	46	44	45
Net Operating Cost (deficit) in the Design Year	1,384,200	1,287,000	1,848,800	1,323,400	1,440,400	1,769,700	3,000,500	2,663,100	3,189,500	1,628,400	1,662,600	2,012,900	1,895,150	1,491,750	1,756,950
Cost-Effectiveness															
Net Operating Cost per Passenger in the Design Year	$0.33	$0.88	$0.59	$0.49	$1.29	$0.84	$0.54	$0.78	$0.67	$0.46	$0.67	$0.64	$0.90	$1.30	$0.99
Capital Cost to Design Year per Passenger in the Design Year	3.30	7.70	4.40	3.50	7.50	4.70	3.10	4.70	3.80	4.84	6.12	5.19	4.82	9.80	6.93

Source: SEWRPC.

Perhaps the most important of these intangible benefits considered was the potential for public transit to influence urban land development and redevelopment. All transit alternatives which have a fixed guideway and fixed station facilities provide visible evidence of a long-term public commitment to the continued provision of high-quality transit service. Moreover, by providing relatively high-speed service on the fixed guideways, such alternatives generally provide improved accessibility to the land uses adjacent to the guideways. Such alternatives are, therefore, generally considered to have the potential to attract, and thereby guide and shape, urban land use development and redevelopment. Such potential is of great importance, as it would permit public transit to be used to meet land use development objectives, as well as transportation development objectives, through the promotion of sound land use development and the inducement of urban development in desired locations.

Light rail transit is considered by some to have a greater potential to influence land development than bus-on-freeway, bus-on-busway, and commuter rail alternatives for four reasons. First, light rail transit is considered to represent a greater public commitment to the continued provision of a high level of transit service, as it requires the greatest public investment for implementation of these four modes. Second, light rail is considered to represent the most permanent public commitment to a high level of transit service from among these four modes because the investment in its guideway cannot be as readily adapted for other uses. Third, light rail transit is considered to be the least objectionable alternative with respect to local environmental impacts. And fourth, light rail transit exclusive guideways and electrically propelled vehicles are considered to provide the greatest increase in the level of transit service over the levels provided by the other alternatives.

It must be noted in this respect, however, that the analyses made under this study indicated that a light rail system in the Milwaukee area would provide about the same level of service and accessibility as a bus-on-metered freeway or a bus-on-busway system. Moreover, studies of the land development impacts of fixed guideway transit have indicated that there are a number of other factors which affect urban land development and redevelopment, and that the presence of any one of these other factors is at least as important to whether a transit facility will, in fact, influence land development as the particular transit technology concerned. These other factors include the presence of economic forces which support substantial land use development and redevelopment; the existence of a strong demand for such development and redevelopment in the urban area; the attractiveness of sites surrounding transit stations in terms of ease of access, utilities, and other urban facilities and services, physical features, and social characteristics; the existence of a public land use policy which encourages such development and redevelopment through coordinated tax policies, infrastructure supply, and appropriate land use controls, as well as local neighborhood and community acceptance and approval; and the presence of land near the stations which is available, or which can be readily assembled, for development. Consequently, it may be concluded that any increased land development potential of light rail transit over other transit alternatives must be considered uncertain at best. And yet, it can also be concluded that the potential benefits are large; the evolution of a more desirable land use pattern in southeastern Wisconsin, such as that postulated in the adopted regional land use plan—which seeks to centralize land use development to the greatest extent practicable—could serve to protect the environment and natural resources of the Region; preserve and revitalize the City of Milwaukee; and reduce the public and private costs of land development and supporting facilities and services, including public transit.

Another significant, though intangible, advantage of electrically propelled light rail transit which was considered was its potential not to be directly and adversely affected by a serious petroleum shortage and, in fact, to be readily expanded to limits imposed by safe minimum headways and vehicle fleet size. The limitations of this advantage were also recognized. First, it was recognized that any substantial expansion of light rail transit operation during a petroleum energy emergency situation would be difficult because of the lengthy lead time necessary for the manufacture of new vehicles and vehicle components. Second, it was recognized that the composite light rail transit system plans considered for the Milwaukee area could accommodate only about one-fourth of the transit trips in the Milwaukee area, with the remaining trips having to be made on diesel motor buses in travel corridors where light rail facilities were not provided. Under the composite light rail transit plan, petroleum-based fuels would be expected to account for about 80 percent of the energy used by the transit operations on an average weekday in the design year. Finally, it was determined that the operation of transit alternatives which are not electrically propelled need not be severely curtailed during a petroleum shortage as motor fuels could be expected to be rationed under such a shortage, with priority given to public transit.

Another intangible advantage of light rail transit which was considered was its potential to minimize the localized environmental impacts of transit operations. Light rail transit vehicles emit no air pollutants along the routes of operation, as such associated emissions are released at remotely located central electric power generating stations. Diesel motor buses, on the other hand, release about one-half the carbon monoxide and hydrocarbons, six times the nitrogen oxides, and about three times the particulate matter as an automobile along the routes of operation. In addition, a diesel motor bus may be expected to generate about 20 percent more noise than a light rail transit vehicle, and about 5 to 15 percent more noise than an automobile.

The potential air and noise reduction benefits, however, would be very localized, since the air pollutant emission levels and noise levels of automobiles and trucks dominate those of transit vehicles on a systemwide basis. Air pollutant emission levels and noise levels would, therefore, be nearly the same under all alternative transit plans. Moreover, even within specific corridors, the differences between diesel motor buses and light rail transit vehicles were considered to be relatively insignificant, given that the primary transit vehicles would be operated at 3- to 60-minute headways, and given the presence of other urban noise, such as motor vehicle traffic surrounding primary transit facilities provided over medians or reserved lanes on surface streets. It was therefore concluded that only in the central business district of Milwaukee could any significant differences in transit noise and air pollution be expected between the alternative transit plans. In the central business district, transit traffic volumes would be significant compared to automobile and truck traffic volumes. On the proposed Wisconsin Avenue transit mall only transit vehicle traffic would be permitted, and transit vehicle traffic volumes would be substantial. Under the most optimistic alternative future, the composite light rail transit system plan would replace the 150 to 200 buses called for by the busway, bus on freeway, and commuter rail alternatives during peak travel periods with 33 two-car trains of light rail vehicles. Under the most pessimistic alternative future, between 75 and 100 diesel motor buses would be replaced with 36 one-car trains of light rail vehicles.

An intangible advantage attributed to all fixed guideway—light rail transit, bus on busway, and commuter rail—public transit was that it is generally considered to be more reliable than public transit provided over arterial streets in mixed traffic. This is because fixed guideway public transit should not be as readily affected by traffic congestion, traffic accidents, or street and utility repairs. Also, operational problems caused by inclement weather—especially snow and ice—may be expected to be less severe than such problems for buses operated on public streets. It was noted, however, that any motor bus or light rail fixed guideways located within arterial street medians or reserved lanes have some potential to be affected by traffic problems, and that all the fixed guideway transit alternatives could be affected by vehicle traffic at at-grade intersections. In addition, all rail transit modes were noted as having the potential for an entire guideway segment to lose service should a single vehicle or train break down or become involved in an accident since, unlike rubber-tired motor vehicles, rail vehicles cannot be steered around obstructions. Light rail transit service disruptions were noted as also having the potential to occur from power outages and breakdowns in the overhead power distribution system.

The potentially greater safety of the three composite system plans requiring fixed guideways was also identified as an intangible advantage over the truncated bus-on-freeway system plan. This safety advantage stems from the extensive use of dedicated rights-of-way under these plans, in addition to the preferential treatment granted these systems at at-grade intersections. Boarding and deboarding accidents, which are among the most common types of accidents in current day transit operations, would be significantly reduced under the composite light rail transit plan if high-level boarding platforms were used at stations. Light rail transit and commuter rail vehicles also offer greater protection to passengers in the event of vehicle-to-vehicle and vehicle-to-fixed object collisions than do motor buses because of the overall larger size and stronger structural design of the frame and body of the rail vehicles.

Another intangible advantage attributed to all fixed guideway public transit was the belief of proponents of light rail·transit and commuter rail that transit passengers prefer rail transit services to equivalent motor bus transit services. The basis of this argument is that there is something about rail transit which makes it intrinsically more attractive than the diesel motor bus transit modes, even if the levels of service provided are the same. This attraction is usually described in terms of ride quality, comfort, or image.

All these intangible benefits for fixed guideway primary transit, but particularly for light rail transit, were thoughtfully considered by the Advisory Committee in comparing the alternative plans, even though these benefits could not be precisely quantified and, in some cases, the degree to which any benefit could actually be attained was regarded as uncertain and controversial. These intangible benefits were discussed at the Advisory Committee meetings, and members of the Committee raised a number of other subjective considerations as well. Whether these additional subjective considerations would have a significant impact on the operations, efficiency, and practicality of any one of the alternative primary transit system plans was also unknown, thus making their potential impacts speculative. These considerations included the effect of labor disruptions, the impact of the potential deterioration of the highway system through deferred maintenance, the effect of widespread emergency situations, the effect of Milwaukee area climatic conditions, the long-range usefulness of the transit alternatives in view of advances in technology, the effect of current land use decentralization trends, and the probability of implementation of the alternatives.

It was concluded that insofar as the operation of transit vehicles is concerned, service under all of the alternative plans would be equally prone to labor disruptions as all transit vehicle operators can be expected to be represented by labor agreements. Should supervisory personnel be required to continue operations during a strike, then light rail transit or commuter rail, which have a higher level of productivity in terms of passengers per operator and can be assembled into trains, may have an advantage.

With regard to the consideration of the future deterioration of the existing arterial street and highway system, in recent years, revenues for highway operation and maintenance have declined as highway operation and maintenance costs have increased. If highway maintenance continued to be deferred, and if highway activities such as winter snow and ice control operations were reduced, the level of primary transit service which could be provided by the bus-on-metered freeway plan, which is dependent upon the arterial street and highway system, would be reduced significantly relative to that which could be provided by the fixed guideway primary transit alternatives.

With regard to the potential for the primary transit alternatives to respond to a widespread emergency situation resulting either from a natural or man-made catastrophe, it was recognized that under such extreme conditions, the most versatile vehicle would be the diesel motor bus, as it would be equipped with an on-board propulsion unit and would not require a fixed guideway. Public transit systems without on-board propulsion units, such as light rail transit, would be susceptible to a single malfunction, or to a failure in, or interruption of, their power generation or distribution systems. Also, all rail primary transit modes would be restricted to providing service over fixed guideway facilities, and would be susceptible to failure of such guideways. Self-propelled motor vehicles would thus have a distinct advantage in terms of versatility, as they could operate between virtually any origin and destination over any roadway surface—either paved or unpaved—as well as maneuver around obstructions or unpassable roadway segments. However, under the most extreme conditions the rail primary transit modes and the bus-on-busway mode would have the advantage of being able to move large numbers of people quickly over their guideway without interference from motor vehicle traffic.

Climatic conditions were also suggested as having some differential effects on the primary transit alternatives. Extreme summer and winter temperatures—both of which occur in the Milwaukee area—can be expected to increase the tendency for mechanical, pneumatic, and hydraulically operated transit components and subsystems to perform erratically or not at all. For example, very hot summer temperatures may overtax the capabilities of air-conditioning units on transit vehicles, while very cold winter temperatures may cause fuel line and coolant system problems. For the Milwaukee area, winter weather conditions present greater potential problems than do summer weather conditions. Of the primary transit alternatives, any that use electrically propelled vehicles have an advantage with repect to winter weather conditions. Because such vehicles use electric traction motors instead of internal combustion engines for propulsion—and therefore don't require engine coolant systems and pneumatic braking systems as do diesel motor buses—vehicle start-up, interior heating, and overall operation is smoother; there is less chance for component failure; and indoor storage of vehicles is not mandatory. Also, electric propulsion requires fewer mechanical assemblies which incorporate moving parts.

Rail transit systems also have an advantage over other systems with respect to winter conditions in that they tend to function better during periods of severe snow and ice storms because of the positive vehicle guidance and better vehicle traction of such systems. Also, any transit alternatives that would use exclusive guideways, including buses on busways, would not be subject to interference from traffic congestion resulting from adverse winter weather conditions. It must be noted, however, that all the primary transit alternatives can be expected to perform well under the climatic conditions common to the Milwaukee area. The advantages cited for light rail transit and other fixed guideway transit during severe winter weather conditions can be expected to increase their relative reliability only slightly.

The Advisory Committee's concern over the long-term usefulness of the different primary transit alternatives—their usefulness over many decades rather than simply the 21-year plan design period—was determined to be valid, because the amortization or "useful life" periods of major components of the fixed guideway primary transit alternatives are 30 to 50 years. A major factor in any consideration of the useful life of components is the potential for technological improvements. Only those primary transit alternatives determined to be proven and readily available for implementation as a system in the Milwaukee area during the next two decades were considered applicable to this study. Transit technologies conceptually having potential advantages over proven technologies, but not expected to become practically available for the provision of primary transit service within the next two decades, were dismissed from further consideration. Should these exotic technologies become practicable in the future, certain elements of the proven primary transit technologies could be adapted to the new technologies. As reported in SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology, the light rail transit and busway system plans would have the greatest potential to be readily adapted to unproven, future technologies because most of these technologies would require guideways on exclusive rights-of-way. However, even though some new primary transit technology may become available in the future, it cannot be concluded at this time that any futuristic primary transit technology will be significantly more efficient or economical than any proven primary transit technology during and well beyond the plan design period for this study.

Improvements in automotive technology over the next several decades may also be expected to have some impact on the long-range usefulness of the primary transit alternatives, either by increasing or decreasing demand for public transit. The effect on demand will be dependent upon future technological change, as it may affect the cost of automobile ownership and operation, the safety of automobile travel, and other factors.

The energy source used by the primary transit alternatives should also be considered as a factor in their long-range usefulness. The use of petroleum represents a withdrawal from a fixed and limited supply which is projected to decline in availability in the 21st century. At that time, public transit may require an energy source other than petroleum-based fuels, and thus conversion to electric propulsion or some other technology may be necessary. A system based on electric propulsion would require a greater capital cost than petroleum-based transit. Selection of a light rail transit plan at this time, then, could be seen as the selection of the inevitable system at the inevitable higher cost—that is, unless there is an advance in the technology of transit propulsion.

Another subjective consideration raised by the advisory committee was the need to consider the viability of the different primary transit alternatives should the outward movement of predominantly middle- and upper-income white families from the central parts of the transit service area continue. Some aspects of a continuation of this trend are reflected in the test and evaluation of alternative primary transit plans under the range of futures considered under this study. This test and evaluation indicated that such a future would have the same impact on each of the alternative primary transit technologies. One of the alternative futures envisions the decline of population in Milwaukee County to a level of 700,000 people and no real increase in average household income in the County. It was determined that under this future, bus on freeway, light rail transit, and bus-on-busway plans could all be expected to perform reasonably well, attracting similar levels of ridership, providing similar levels of service, and requiring similar levels of public subsidy of operating and maintenance costs. However, the level of ridership and the proportion of public transit operating and maintenance costs which could be met by farebox revenues under all these plans would be less under this future than under any of the other alternative futures.

A final intangible factor which must be considered in the selection of a recommended plan from among the alternative plans is the potential acceptance of the recommended plan by the concerned elected officials. Only if a considerable degree of such acceptance exists will the recommended plan be implemented, and its anticipated benefits achieved. A plan which is only marginally better than others but has a lesser chance of being implemented should perhaps be considered a less desirable plan. Indeed, in methods used in corporate and military decision-making which have in the past been adapted to regional planning by the Regional Planning Commission, such explicit consideration of the uncertainty of plan implementation occurs in the selection of a best plan. The bus-on-metered freeway plan may have a particular disadvantage in attaining the acceptance of public elected officials necessary to its implementation. The bus-on-metered freeway plan proposes that extensive preferential treatment be provided for transit vehicles principally through implementation of an areawide freeway traffic management system. This system is envisioned as exercising sufficient constraint on freeway access to ensure uninterrupted freeway traffic flow and operating speeds of at least 40 mph over the Milwaukee area freeway system during weekday peak travel periods.

The implementation of this freeway traffic management system would require significant expansion of the limited freeway traffic management system in operation today at 21 freeway entrance ramps in central Milwaukee County, as only with an areawide system of ramp meters and attendant control of freeway access would the envisioned freeway operation be practically attainable. Freeway entrance ramp meters would need to be constructed at freeway entrance ramps throughout the Milwaukee area, including all of Milwaukee County, substantial parts of Waukesha and Ozaukee Counties, and parts of Washington and Racine Counties, and these meters would have to be operated as an integrated system designed to maintain high operating speeds on the freeway system.

However, for the last two years the Regional Planning Commission's Intergovernmental Coordinating and Advisory Committee on Transportation System Planning and Programming for the Milwaukee Urbanized Area has refused to approve the inclusion of the installation of any further ramp meters in the annual transportation improvement programs for southeastern Wisconsin, thereby effectively denying the use of federal funds for the expansion of the freeway traffic management system. Moreover, a preliminary engineering study recommended by that Committee to be conducted prior to its endorsement of any further implementation of such a system has not progressed beyond completion of a prospectus in 1979, as required funding for the conduct of the study has not been available to date.

Test and Evaluation of a Bus-on-Unmetered Freeway Alternative: Consequently, the study Advisory Committee requested that the implications of removing the freeway operational control system element from the bus-on-freeway alternative be determined. In direct response to this request, a quantitative test, evaluation, and comparison of metered and unmetered bus-on-freeway alternative system plans for the Milwaukee area was conducted for the moderate growth scenario-centralized land use plan alternative future, because freeway operational control under this future may be expected to have the greatest effect on freeway operating speeds, transit ridership, and attendant evaluative considerations.

The results of the quantitative test, evaluation, and comparison of bus-on-freeway plans with and without freeway operational control under this future are summarized in Table 373. The table indicates that although peak-direction bus-on-freeway operating speeds during peak travel periods would be significantly affected, as would peak-travel-period bus-on-freeway ridership, peak-travel-period total transit system ridership would only be marginally affected, since the majority of public transit trips under either alternative would be made on local and express transit services which have been assumed to be largely unaffected by freeway operational control. The validity of this assumption, however, can only be determined through a preliminary engineering study of areawide freeway traffic management in the Milwaukee area. In addition, all-day, bus-on-freeway ridership would be only somewhat affected, and all-day total transit system ridership would be insignificantly affected because off-peak-travel period primary, express, and local transit operating speeds, and therefore off-peak transit ridership, would not be

Table 373

EVALUATION OF BUS-ON-METERED FREEWAY AND BUS-ON-UNMETERED FREEWAY ALTERNATIVE PRIMARY TRANSIT SYSTEM PLANS UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN

Evaluative Measure	Truncated Bus-on-Metered Freeway Plan	Truncated Bus-on-Unmetered Freeway Plan
Objective No. 1—Serve Land Use		
Accessibility		
Average Overall Travel Time of Transit Trips to the Milwaukee Central Business District (minutes)	34	36
Objective No. 2—Minimize Cost and Energy Use		
Cost		
Total Public Cost to Design Year (capital cost and operating and maintenance deficit)	$774,474,000	$759,865,500
Average Annual Total Public Cost	36,879,700	36,184,100
Capital Cost[a]		
Capital Cost to Design Year	222,980,000	209,300,000
Average Annual Capital Cost	10,618,100	9,966,700
Capital Investment to Design Year	341,200,000	322,034,500
Average Annual Capital Investment	16,247,600	15,335,000
Operating and Maintenance Cost Deficit (net cost)		
Deficit in Design Year	38,272,600	38,148,800
Deficit to Design Year	551,494,000	550,565,500
Average Annual Deficit	26,261,600	26,217,400
Cost-Effectiveness		
Total Cost to Design Year per Passenger	0.48	0.48
Capital Cost to Design Year per Passenger	0.14	0.13
Operating Deficit to DesignYear per Passenger	0.34	0.35
Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year		
Total Transit System	58	57
Primary Element	60	58
Energy		
Total Transit System Energy Use to Design Year (million BTU's)	24,749,880	22,978,580
Total Transit Construction Energy Use to Design Year (million BTU's)	1,914,560	1,896,180
Total Transit Operating and Maintenance Energy Use to Design Year (million BTU's)	22,835,320	21,082,400
Total Transit Passenger Miles per Gallon of Diesel Fuel to Design Year (BTU's)	45.2	47.9
Dependence on Petroleum-Based Fuel	All trips dependent	All trips dependent
Petroleum-Based Fuel Use by Transit to Design Year (gallons of diesel fuel)	161,649,000	149,240,500
Automobile Propulsion Energy Use in Design Year (gallons of gasoline)	395,200,000	395,600,000

Table 373 (continued)

Evaluative Measure	Truncated Bus-on-Metered Freeway Plan	Truncated Bus-on-Unmetered Freeway Plan
Objective Nos. 3 and 5—Provide Appropriate Service and Quick Travel		
Average Weekday Transit Use in Design Year		
Total Transit System		
All Day	378,600	374,500
Peak Periods	206,600	202,500
Primary Element		
All Day	75,100	71,000
Peak Periods	44,900	40,800
Service Coverage		
Population Served Within a One-Half-Mile Walking Distance of Primary Transit Service	373,500	373,500
Population Served Within a Three-Mile Driving Distance of Primary Transit Service	1,620,700	1,620,700
Jobs Served Within a One-Half-Mile Walking Distance of Primary Transit Service	293,600	293,600
Average Speed of Transit Vehicle (mph)		
Primary Element		
All Day for Total System	29	27
Peak Periods and Peak Direction for Typical Trip	31	26
Total System	18	17
Average Speed of Passenger Travel on Vehicle (mph)		
Primary Element	34	31
Total System	21	20
Objective No. 4—Minimize Environmental Impacts		
Community Disruption		
Homes, Businesses, or Industries Taken	None	None
Land Required (acres)	70	70
Air Pollutant Emissions—Total Transportation System (Highway and Transit) in Design Year (tons per year)		
Carbon Monoxide	167,368	167,522
Hydrocarbons	16,887	16,901
Nitrogen Oxides	29,988	30,015
Sulfur Oxides	2,502	2,504
Particulates	4,018	4,020
Objective No. 6—Maximize Safety		
Proportion of Total Person Trips Made on Transit	0.086	0.085

[a] *The capital cost of a composite plan is equal to the plan's required capital investment, or total capital outlays necessary over the plan design period, less the value of that investment beyond the plan design period.*

Source: SEWRPC.

directly affected by the presence or absence of peak-period freeway operational control.

Specifically, this quantitative test and evaluation indicated that without the implementation of an areawide freeway traffic management system, the bus-on-freeway plan under the moderate growth scenario-centralized land use plan alternative future would entail peak-travel-period motor bus speeds of 30 mph or less on the East-West Freeway (IH 94) between the Marquette and Zoo Interchanges, and of 30 to 40 mph on two- to four-mile segments of the North-South Freeway (IH 43 and IH 94) and Zoo Freeway (USH 45) and Airport Freeways (IH 894 and USH 45) which connect to this segment of the East-West Freeway at the Marquette and Zoo Interchanges. This compares with speeds of at least 40 mph over these freeway segments if the freeway system were operationally controlled.

Thus, the peak-travel-period performance of the bus-on-freeway plan may be expected to decline significantly without operational control. The average speed of primary transit in-vehicle travel for a typical peak-period trip may be expected to decline by about five mph, or 15 percent. Average weekday primary transit ridership during the peak travel period in the design year may accordingly be expected to decline by about 9 percent during each of the peak periods, or about 1,400 trips in the morning peak period and 2,700 trips in the afternoon peak period. However, because only about 21 percent of the peak-period ridership on the total transit system in the design year may be expected to be made on the primary element of the bus-on-freeway alternative, with the remainder being made on local and express elements, total transit system ridership during the peak travel periods may be expected to decline by only 2 percent. On an all-day basis, including off-peak travel periods—during which freeway operational control can be expected to have little impact—average weekday primary transit ridership may be expected to decline by only about 6 percent, and total average weekday transit system ridership may be expected to decline by about 1 percent.

It may be concluded from these analyses that neither the performance of a bus-on-freeway plan in the Milwaukee area with respect to systemwide level-of-service, ridership, operating and maintenance cost-effectiveness, and capital costs, nor the plan's implications for Milwaukee area total transportation system energy use, air pollutant and noise emissions, or travel safety, should be significantly affected by removal of the freeway traffic management system element from the bus-on-freeway plan. A more precise determination of the benefits of freeway traffic management will require detailed analyses in a preliminary engineering study. Conversely, these analyses indicate that implementation of an areawide freeway traffic management system may be expected to affect the level of primary transit service and ridership to the Milwaukee central business district significantly. The analyses indicated that lack of an areawide freeway traffic management system would result in 4,100 fewer trips being made on primary transit to and from the Milwaukee central business district on an average weekday, a decline of about 9 percent from the level expected under a bus-on-metered freeway plan. All these trips may be expected to continue to be made to the central business district during peak travel periods, but by automobiles instead of transit. This difference in the amount of automobile travel to the Milwaukee central business district is equivalent to the capacity of one lane of central business district surface arterial in the morning peak travel hour and two lanes of central business district surface arterials in the evening peak travel hour. The effect of this additional automobile travel on Milwaukee central business district traffic congestion can be determined only through more detailed analyses in a preliminary engineering study of freeway traffic management.

Implications of the Results of the Test and Evaluation of the Truncated and Composite Alternative Plans

Further test and evaluation of the three primary transit technologies which the test and evaluation of the maximum extent plans revealed would be feasible as truncated systems under the full range of alternative futures indicated that all three of these technologies—bus-on-metered freeway, bus on busway, and light rail transit—would perform equally well in the Milwaukee area over the plan design period. These three alternatives were determined to have the potential to provide equal levels of service, attract similar levels of ridership, require similar operating and maintenance cost subsidies, and result in similar total energy consumption and environmental impacts under the wide range of future conditions considered.

The only significant measurable difference between these three alternatives was determined to be the capital costs attendant to their implementation and, therefore, their total public costs. The bus-on-metered freeway plan was determined to entail substantially less capital cost over the plan design period than the bus-on-busway and light rail transit plans, ranging from $144 million under the most pessimistic future, the stable or declining growth scenario-decentralized land use plan future, to $223 million under the most optimistic future, the moderate growth scenario-centralized land use plan future. The busway and light rail transit alternatives were found to entail between 1.5 and 2.5 times as much capital cost, because they would require extensive new guideway construction. The capital costs of the bus-on-busway plan were estimated to range from $268 million under the most pessimistic future to $347 million under the most optimistic future; and the capital costs of the light rail transit plan were estimated to range from $336 million under the most pessimistic future to $436 million under the most optimistic future.

Therefore, the bus-on-metered freeway plan was also found to be the plan with the least total public cost under each of the four alternative futures, including both capital costs and operating and maintenance cost subsidies, ranging from $594 million to $774 million over the plan design period. The bus-on-busway plan was found to entail the next highest total public cost, ranging from $709 to $883 million, or between 14 and 19 percent more than the bus-on-freeway alternative. The highest total public cost may be expected to be incurred under the light rail transit plan, estimated to range from $771 million to $964 million, or between 25 and 30 percent more than the cost of the bus-on-freeway alternative.

The fourth primary transit alternative, commuter rail, was found to be viable as a system only under the most optimistic future conditions, not to be viable at all under the most pessimistic future conditions, and to be viable only for a single route extending south from the Milwaukee central business district to the Cities of Racine and Kenosha under intermediate future conditions. Further test and evaluation of commuter rail indicated that it would entail slightly lower capital costs than comparable bus-on-metered freeway facilities and service, but would result in somewhat lower transit ridership and somewhat higher annual public subsidies of operating and maintenance costs. Consequently, it would be a less cost-effective alternative, particularly with respect to operating and maintenance costs. Under the most optimistic future, the moderate growth scenario-centralized land use plan alternative future, a truncated commuter rail system plan was found to entail nearly 4 percent less capital cost than the bus-on-metered freeway plan, or $215 million compared with $223 million. This commuter rail plan, however, would carry about 12,500, or 3 percent, fewer transit passenger trips on an average weekday than the bus-on-metered freeway plan, and would require about $1.9 million, or 5 percent, more public subsidy of operating and maintenance costs in the design year. Comparison of the bus-on-metered freeway and commuter rail services in the Milwaukee to Racine and Kenosha corridor under the intermediate futures, the moderate growth scenario-decentralized land use plan and stable or declining growth scenario-centralized land use plan futures, similarly indicated the relatively small differences between the two alternatives except with respect to capital costs and operating and maintenance cost subsidies per passenger, both of which were higher under the commuter rail alternative.

As much as the bus-on-metered freeway alternative was found to dominate the other primary transit alternatives with respect to costs over the plan design period, the other alternatives—particularly light rail transit—were determined to dominate the bus-on-metered freeway alternative with respect to the intangible implications of primary transit performance. It was concluded from this assessment that light rail transit, bus on busway, and commuter rail would all probably have a greater, although uncertain and unmeasurable, potential to influence land development and redevelopment, and would possibly provide a more reliable and safe public transit system and be less subject to the adverse affects of future highway system deterioration from deferred maintenance. Also, because of their potentially high passenger-carrying capacity per operator, both light rail transit and commuter rail were found to have an advantage with respect to operation during labor disruptions, and both light rail transit and bus on busways were determined to have greater long-range usefulness as they would require acquisition of rights-of-way and construction of guideways which are essential to more advanced, but still unproven, futuristic transit technologies. Light rail transit alone, because of its electric propulsion, was determined to have an advantage with respect to operation in Milwaukee's winter climate, the greatest potential to continue and expand operations during a petroleum-based fuel shortage, and perhaps the greatest long-term usefulness given the prospects for reduced domestic and world petroleum production in the 21st century. Light rail transit was also concluded to have perhaps the greatest potential to influence land development and redevelopment because it would require the most permanent, least disruptive, and greatest public commitment to high-quality transit in a corridor of all the transit alternatives.

The only intangible advantage of the bus-on-metered freeway alternative was its potential to provide the best services under widespread emergency conditions, specifically because its operations would not be restricted to fixed guideways and, like the busway and commuter rail alternatives, it would not be susceptible to a single power stoppage. One intangible disadvantage of the bus-on-metered freeway alternative was also identified: the uncertainty regarding its acceptance by elected officials prior to implementation and thereby attainment of its potential benefits. The bus-on-metered freeway plan assumes the implementation of an areawide freeway traffic management system. Expansion of the presently limited freeway traffic management system, however, has not progressed in recent years, although recommended in adopted short- and long-range regional transportation system plans. Quantitative test and evaluation indicated that without the implementation of an areawide freeway traffic management system to provide preferential treatment for buses on area freeways, design year transit passenger trips under the bus-on-metered freeway plan would decline somewhat; however, the decline may be expected to have little impact systemwide. Under the moderate growth scenario-centralized land use plan future—the future under which the greatest impact on transit use may be expected—this decline was expected to total about 4,100 trips per average weekday on the bus-on-metered freeway primary transit element, or about 9 percent of peak-period primary transit system ridership, about 6 percent of all-day primary transit system ridership, and only about 1 percent of all-day Milwaukee area transit system ridership. In conclusion, then, the analyses indicated that the level of service and use of bus-on-freeway service to the Milwaukee central business district may be expected to be significantly affected by the implementation of an areawide freeway traffic management system.

DEVELOPMENT OF A RECOMMENDED PRIMARY TRANSIT SYSTEM PLAN FOR THE MILWAUKEE AREA

The last step in the six-step planning process applied in the Milwaukee area primary transit system alternatives analysis was the formulation of a recommended primary transit system plan for adoption and implementation. The formulation of the recommended plan was based upon consideration of the performance and cost of the alternative primary transit system plans considered under each alternative future, and of the intangible benefits of each alternative plan as summarized in the previous section of this chapter.

The quantitative evaluation indicated that three of the primary transit system alternatives—bus on metered freeway, bus on busway, and light rail transit—could in general be expected to function equally well in the Milwaukee area under a wide range of alternative futures, providing essentially identical levels of service, attracting very similar levels of ridership, possessing similar design year operating and maintenance cost subsidy requirements, and having similar systemwide energy consumption and environmental impacts. The bus-on-metered freeway plan, however, was determined to entail substantially less capital cost than the bus-on-busway and light rail transit plans, the bus-on-busway plan requiring between $124 and $203 million, or between 85 and 90 percent, more capital cost over the plan design period, and the light rail transit plan requiring between $192 and $213 million, or between 95 and 135 percent, more capital cost.

The commuter rail primary transit alternative was shown to be infeasible under the most pessimistic alternative future conditions for transit use in the Milwaukee area, and to be feasible only along a single route extending south from the Milwaukee central business district to the Cities of Racine and Kenosha under intermediate alternative future conditions. Only under the most optimistic alternative future conditions was commuter rail shown to be feasible as a system. Moreover, it was determined that as a system under those optimistic future conditions, and as a single route under the intermediate future conditions, commuter rail could not be expected to perform as well as the other primary transit alternatives, resulting in somewhat lower transit ridership and requiring somewhat higher design year public operating and maintenance cost subsidies. However, it was determined that the commuter rail alternative could be expected to entail the lowest capital cost of all of the primary transit alternatives considered, requiring somewhat less capital cost than the bus-on-metered freeway alternative.

The remaining primary transit alternative considered, heavy rail rapid transit, was determined to entail substantially greater capital costs and total costs than any of the other primary transit alternatives considered. Moreover, it was determined that the high speed and high capacity of this alternative could not be effectively utilized in the Milwaukee area for at least the next two decades.

Thus, based on the quantitative evaluation of the primary transit alternatives considered, the bus-on-metered freeway plan was shown to be the best alternative. It would have comparable performance to, but significant capital cost advantages over, the light rail transit and bus-on-busway alternatives. In addition, it would have a slight performance and cost-effectiveness advantage over the commuter rail alternative and would be capable of performing well under even the most pessimistic of future conditions, although it would have a slight capital cost disadvantage.

Based on the consideration of the intangible factors involved, the fixed guideway modes—especially light rail transit—were concluded to possess a number of advantages over a bus-on-metered freeway plan. Table 374 summarizes the 13 intangible benefits and subjective considerations which were carefully considered by the Advisory Committee and which are discussed earlier in this chapter with respect to the degree each benefit is associated with the development of each of the fixed guideway modes. It was concluded that implementation of the busway or commuter rail modes could be supported to some degree by nine of the intangible benefits or considerations. Implementation of the light rail transit mode, however, could be supported by all of the intangible benefits, as well as, to some degree, by all of the subjective considerations. To some extent, many of these advantages were concluded to be shared by the alternative plans which incorporate the commuter rail and busway modes. However, if a final plan is recommended which is based at least partially upon the benefits of these intangible advantages, then light rail transit technology will have been concluded to offer the greatest opportunities with respect to real, but intangible, benefits.

Commission Staff Recommendations to Study Advisory Committee for Milwaukee Area Primary Transit System Development

Based on this quantitative evaluation and assessment of intangible factors, the Commission staff determined that it could present to the study advisory committee two options together with the base plan for consideration as the concluding recommendations of the study. One option presented by the Commission staff to the committee was for the committee to conclude that the measurable and more certain advantages of the bus-on-metered freeway alternative outweighed the intangible advantages of the other alternatives, and for the committee to recommend a bus-on-metered freeway system plan for the Milwaukee area. The other option was for the study advisory committee to conclude that the intangible advantages of the light rail transit alternative and of commuter rail facilities and services in the corridor between the Milwaukee and Racine and Kenosha areas sufficiently outweighed the quantifiable and more certain advantages of the bus-on-metered freeway alternative.

Under this second option, the primary transit plan recommendations would be divided into a lower and upper tier. The lower tier of the plan recommendations would propose implementation of a basic bus-on-metered freeway system plan, but including a light rail transit facility in the northwest corridor of the Milwaukee area between the Milwaukee central business district and northwestern Milwaukee County. This northwest corridor was shown through light rail transit system plan test and evaluation to have the highest potential for light rail transit development in the Milwaukee area. The most heavily used local and express bus service in the Milwaukee area is presently operated within this corridor. Also, it is the major corridor in the Milwaukee area within which an existing or proposed freeway is not available to provide direct bus-on-freeway primary transit service. The remainder of the lower tier would consist of bus-on-metered freeway facilities and services. However, in each of the four corridors other than the northwest corridor indicated by the quantitative test and evaluation to be feasible for light rail transit under the wide range of alternative future conditions considered, and in the corridor between the Milwaukee and Racine and Kenosha areas shown to be feasible for commuter rail, the routing and park-ride lot locations of the bus-on-metered freeway services recommended for implementation in the lower tier of the plan would be modified as necessary to be consistent with a possible eventual conversion to light rail transit or commuter rail operation as appropriate. And, to ensure that no action would be taken to foreclose the possible future development of light rail transit and commuter rail facilities, such facilities would be included in the upper tier of the plan. However, as facilities in the upper tier of the plan, they would not be recommended for implementation. Also, the conversion of the concerned bus-on-metered freeway service to light rail transit or commuter rail operation in these corridors would be considered only after the development of an initial light rail transit line in the northwest corridor, and demonstration of the intangible benefits attendant to the implementation and operation of light rail transit in that corridor.

Table 374

SUMMARY OF INTANGIBLE BENEFITS ATTENDANT TO FIXED GUIDEWAY RAPID TRANSIT FACILITIES

Benefit or Consideration	Rapid Transit Mode		
	Light Rail Transit	Busway	Commuter Rail
Intangible Benefits			
Ability to influence land development and redevelopment	●	O	O
Continued operation during severe petroleum shortage	●		
Reduce localized adverse environmental impacts	●		
Increased public transit reliability	●	●	●
Increased public transit safety	●	O	●
Rider preference	O		O
Other Subjective Considerations			
Operation during labor disruptions	O		O
Importance in light of possible deferred highway maintenance	●	●	●
Operation during widespread emergency situations	O	●	O
Local climatic conditions	●	O	O
Usefulness with respect to long-range advances in transit technology	O	O	
Impact of current land use decentralization trends	O	O	
Probability of implementation	O	O	O

LEGEND

● Benefit or consideration appears to definitely support this transit mode.
O Benefit or consideration may support this transit mode.

Source: SEWRPC.

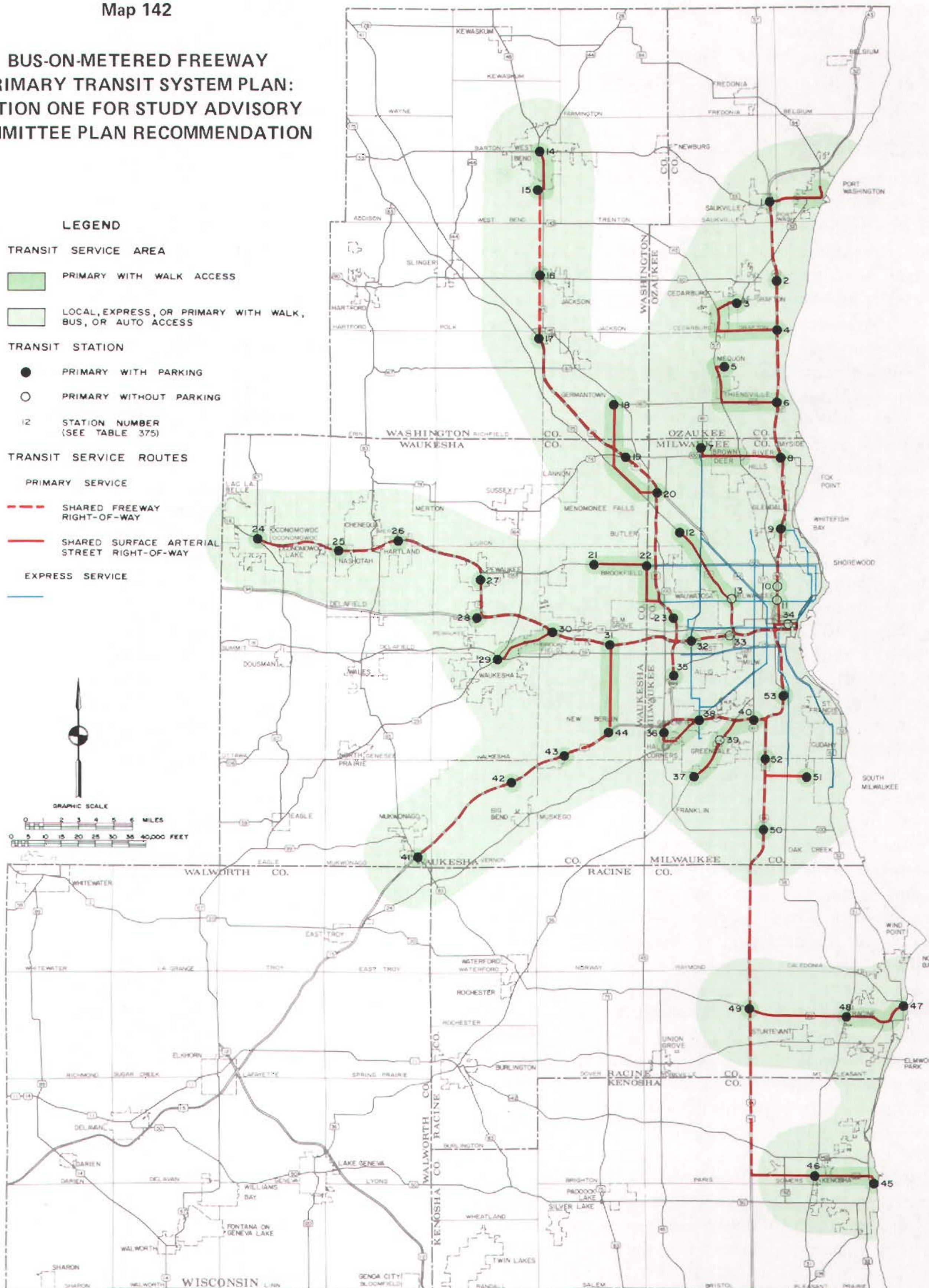
These two options for primary transit plan selection and adoption are further discussed in the following paragraphs.

Option One—Recommendation for Development of a Bus-on-Metered Freeway System Plan: The Commission staff determined that one of the two options that could be presented to the study advisory committee for consideration was a bus-on-metered freeway system plan for the Milwaukee area. Selection of this option by the committee would mean that it had concluded that the intangible—uncertain and unquantifiable—benefits attendant to development of the higher cost light rail transit and bus-on-busway plans do not outweigh the capital cost differences between these plans and the bus-on-metered freeway alternative. It would also mean that the committee had concluded that the intangible advantages of the commuter rail alternative are also insufficient to outweigh the performance and cost-effectiveness advantages of the bus-on-metered freeway alternative—in particular, to outweigh the advantage of the bus-on-metered freeway alternative of being able to perform well under even the most pessimistic of possible future conditions for transit use in the Region.

The bus-on-metered freeway facilities and services constituting the system plan under this option are shown on Map 142. The bus-on-metered freeway routes and stations included in this plan are those that the quantitative evaluations indicated would provide cost-effective service throughout the day at maximum headways of 30 minutes during peak travel periods and 60 minutes during off-peak travel periods under the moderate growth scenario-centralized land use plan alternative future—the most optimistic of the alternatives considered. This plan would, in fact, be the truncated bus-on-metered freeway plan that was tested and evaluated under that most optimistic future, but with some adjustments in the supporting secondary (express) and tertiary (local) transit service. This extent of facilities and services can be recommended because even under the stable or declining growth scenario-decentralized land use plan future—the most pessimistic future for transit use in the Milwaukee area—all of the bus-on-metered freeway services would be viable during at least the peak travel periods, if not on an all-day basis. Also, those facilities and services included in this bus-on-metered freeway plan but found to be cost-effective under only the most optimistic future

Map 142

BUS-ON-METERED FREEWAY PRIMARY TRANSIT SYSTEM PLAN: OPTION ONE FOR STUDY ADVISORY COMMITTEE PLAN RECOMMENDATION



Two options were recommended by the Commission staff to the study advisory committee for possible selection as the best plan for primary transit system development in the Milwaukee area. One option was a bus-on-metered freeway system plan, all the components of which would be recommended for implementation over a 20-year planning period. In selecting this option, the advisory committee would be in effect concluding that the intangible benefits potentially attendant to the higher cost fixed guideway modes of light rail transit and bus on busway do not outweigh the capital cost differences between these plans and the bus-on-metered freeway alternative, and that the intangible benefits of the commuter rail alternative are insufficient to outweigh the performance and cost-effectiveness advantages of the bus-on-metered freeway alternative. Under this option, the bus-on-metered freeway primary transit system plan would consist of 24 routes totaling 955 route miles in length and having a total of 53 stations, 47 of which would have park-ride lots. Of the 53 stations, 22 would be located within Milwaukee County, of which 16 would have park-ride facilities. All bus-on-metered freeway routes would be operated between outlying park-ride lots and the Milwaukee central business district over existing and proposed metered freeways using high-capacity articulated motor buses. It is envisioned that this primary transit system plan would be implemented in stages over the plan design period as public transit needs and ridership warrant facility and service expansion, and as financial resources become available.

Source: SEWRPC.

conditions would be staged to be implemented last, and then only if future conditions in the Milwaukee area were found to approximate the most optimistic conditions for transit use.

Plan Description: The recommended bus-on-metered freeway primary transit system plan calls for the expansion of the existing system of routes of buses operating over freeways, the expansion of all bus-on-freeway service to all-day weekday service at maximum headways of 30 minutes in peak travel periods and 60 minutes in off-peak travel periods, and the provision of extensive preferential treatment for buses operating in primary transit use. As shown on Map 142, the bus-on-metered freeway system plan would expand primary transit service within Milwaukee County, and extend service to the south to the Cities of Racine and Kenosha in Racine and Kenosha Counties, to the southwest to the Village of Mukwonago in Waukesha County, to the northwest to the City of West Bend in Washington County, and to the north to the City of Port Washington in Ozaukee County.

The primary transit system plan would consist of 24 bus-on-freeway routes totaling 955 route miles in length and having a total of 53 stations, 47 of which would have park-ride lots. Twenty-two of the 53 stations and 16 of the park-ride lots would be located in Milwaukee County. Under the plan, high-capacity articulated buses would operate in primary transit service primarily over existing and proposed metered freeways between outlying park-ride lots and the Milwaukee central business district. Bus routes from park-ride lots in Milwaukee County to the central business district would be operated with a limited number of intermediate stops, as necessary, to connect and coordinate with feeder express and local bus service, and to provide access to major travel generators other than the Milwaukee central business district.

Primary transit bus routes originating at locations outside Milwaukee County but within the Milwaukee urbanized area would generally serve two outlying park-ride lots prior to proceeding in an essentially nonstop mode of operation to the Milwaukee central business district. Primary transit bus routes originating at locations outside the Milwaukee urbanized area would have stops at two to five outlying park-ride lots prior to proceeding in an essentially nonstop mode of operation to the central business district. The park-ride lots would be located, to the extent practicable, within or near freeway interchanges to minimize travel times. Within the Milwaukee central business district, all primary transit bus routes would be operated over E. and W. Wisconsin Avenue for a distance of about two miles, with stops approximately every one-quarter mile. Wisconsin Avenue would be converted to a mall for the exclusive use of public transit vehicles between N. 10th Street and N. Prospect Avenue—a distance of about 1.3 miles.

The Milwaukee area freeways over which the buses in primary transit service would operate under this bus-on-metered freeway plan would be operationally controlled during peak travel periods, requiring the expansion of the present limited freeway traffic management system serving central Milwaukee County to an areawide system. All freeway on-ramps in the Milwaukee urbanized area would need to be ramp-metered to restrain automobile and truck access to the freeways during peak travel periods. The ramp meters would need to be operated through a central control system which would continuously measure traffic volumes on those portions of the freeway system needed for transit service through an interconnected series of traffic-sensing devices. As freeway traffic volumes approached the levels beyond which freeway operating speeds may be expected to deteriorate, fewer automobiles and trucks would be permitted to enter the freeway system. Sufficient constraint would be exercised to ensure uninterrupted freeway traffic flow and operating speeds of at least 40 mph on all freeway segments, including otherwise congested segments. Consequently, average speeds on the bus-on-freeway routes, including all stops, would range between 19 and 35 mph.

This bus-on-metered freeway system plan also envisions complementary expansion and improvement of the express and local elements of the Milwaukee area transit system. Five additional express, or limited-stop, routes would be provided in addition to the seven routes included in the base plan—only three of which were actually in operation in 1980. These twelve express routes would operate in a coordinated manner with the expanded bus-on-freeway primary transit system. The local transit system element in the Milwaukee area would be extended where cost-effective under the bus-on-freeway plan into all contiguous areas of urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County.

Primary Transit Plan Staging: This bus-on-metered freeway primary transit system plan would be implemented in stages over the plan design period, not only because the extent of primary transit service proposed in the plan must evolve gradually over the planning period as financial resources become available, but also because only if public transit needs and ridership increase as anticipated will the proposed bus-on-metered freeway facilities and services warrant expansion to the extent envisioned in the plan. It is proposed that this plan be implemented in three stages. Those proposals of the plan which are the most certain to be needed and which have been identified as the most cost-effective would be implemented in the first stage. This stage would include all those bus-on-metered freeway facilities and services which were shown to work well under the full range of alternative future conditions considered. As shown on Map 143 and in Tables 375 and 376, these routes and stations are those of the truncated bus-on-metered freeway plan tested and evaluated under the stable or declining growth scenario-decentralized land use plan alternative future—the most pessimistic of the alternative futures.

Under this first stage of plan implementation, primary transit service would be provided on seven routes totaling 317 route miles between downtown Milwaukee and Brown Deer to the north; Menomonee Falls, and Germantown to the northwest; West Allis, Brookfield, and Waukesha to the west; Greenfield and Greendale to the southwest; and Oak Creek, Racine, and Kenosha to the south. The service to the communities of Menomonee Falls and Germantown to the northwest and Racine and Kenosha to the south would represent extensions of existing bus-on-freeway service. All of the other bus-on-freeway primary transit service under this first stage of plan implementation would represent an expansion of the bus-on-freeway service presently provided from peak-period service only to midday and evening off-peak-period service as well.

Under the first stage of plan implementation, a total of 18 transit stations would be provided outside the Milwaukee central business district, 15 of which would have park-ride lots. Fifteen of these 18 stations and 12 of the 15 park-ride lots are not part of the present bus-on-freeway system. Ten of the 18 stations would be located in Milwaukee County, 7 of which would have park-ride facilities. It is also recommended that the Wisconsin Avenue transit mall and the areawide freeway traffic management system be implemented as part of the first stage of this plan.

If warranted, the second stage of implementation of the plan would include those bus-on-freeway facilities and services which would be expected to work well under the intermediate future conditions for the Milwaukee area, but not under the most pessimistic conditions. The second stage facilities and services would be implemented only after the first stage facilities and services had been implemented, and then only if it appeared that future conditions in the Milwaukee area were progressing toward those considered under this study to be intermediate with respect to future transit needs and use—that is, those postulated under either of the two intermediate alternative futures: the stable or declining growth scenario-centralized land use plan future or the moderate growth scenario-decentralized land use plan future.

As shown on Map 144, seven additional bus-on-freeway routes, representing 252 route miles of service, would be added to the bus-on-freeway primary transit system under this second stage of plan implementation. This second stage of the plan would extend bus-on-freeway service to the communities of Saukville, and Port Washington. In addition, it would increase bus-on-freeway service to the communities of Whitefish Bay, Glendale, West Allis, Oak Creek, Oconomowoc, Nashotah, Hartland, Pewaukee, and Waukesha over that provided under the first stage of the plan. Twelve transit stations in addition to those existing after implementation of the first stage of the plan would be required under the second stage, all of which would have park-ride lots. Four of these additional stations would be located in Milwaukee County. Thus, implementation of the second stage of the plan would result in an extent of bus-on-metered freeway facilities and services equivalent to that proposed under the truncated bus-on-freeway plans tested and evaluated under the intermediate stable or declining growth scenario-centralized land use plan and moderate growth scenario-decentralized land use plan futures.

The remaining 10 routes of this bus-on-metered freeway plan, which would be implemented under the third and final stage of development, are those routes which would be expected to work well only if future conditions in the Milwaukee area approach those considered to be the most optimistic for transit needs and use over the plan design period, as shown on Map 145. These 10 routes would provide an additional 386 route miles of service. This third stage of the plan would extend bus-on-freeway service to the communities of Mequon, Thiensville, Cedarburg, and Grafton in Ozaukee County; Hales Corners, Franklin, and South Milwaukee in Milwaukee County; West Bend and Jackson in Washington County; and Mukwonago, Big Bend, Muskego, New Berlin, and Butler in Waukesha County. It would also expand bus-on-freeway service provided under the second stage of plan implementation to the communities of Wauwatosa, Menomonee Falls, Brookfield, and Greendale.

An additional 22 transit stations would be provided with these routes, 20 of which would have park-ride lots. Seven of these stations and 5 of these park-ride lots would be located in Milwaukee

County. These additional facilities and services would be implemented only after the first two stages of recommendations had been implemented, and only if it appeared that conditions in the Milwaukee area were progressing toward those considered under this study to be the most optimistic with respect to future transit needs and use. This third stage of plan implementation would include all bus-on-freeway facilities and services in the truncated bus-on-freeway plan tested under the moderate growth scenario-centralized land use plan alternative future.

Option Two—Recommendation of a Two-Tier System Plan: The other option presented by the Commission staff to the study advisory committee was a two-tier plan. The lower tier of the plan would recommend implementation of all the bus-on-freeway facilities and services of the other option recommended by the staff except in the northwest corridor of the Milwaukee area, where a light rail transit facility would be recommended for implementation. In addition, in those four Milwaukee area corridors other than the northwest corridor within which quantitative test and evaluation had indicated light rail transit would work well under the full range of future conditions, and in the corridor between the Milwaukee and Racine and Kenosha areas shown to be feasible for commuter rail, the bus-on-freeway facilities recommended for implementation under the lower tier of the plan would be modified as necessary to permit eventual upgrading to light rail transit or commuter rail operation as appropriate. These light rail transit and commuter rail facilities would comprise an upper tier of the plan. The bus and rail facilities in that upper tier would not be recommended for immediate implementation; rather, the upper tier would be intended to assure that actions were not taken to foreclose their possible implementation in the future.

Selection of this option by the study advisory committee would mean that it had concluded that the intangible benefits attendant to the higher cost light rail transit alternative sufficiently outweigh the significant capital cost advantage of the bus-on-metered freeway alternative and the capital cost advantage of a bus-on-busway alternative to warrant development of a light rail transit facility in the northwest corridor of Milwaukee County. Selection of this option would also indicate that the study advisory committee considered very important the potential of light rail transit to operate during a motor fuel shortage and to operate in the very long-term future, when petroleum-based motor fuels may be expected to become scarce and quite costly. And perhaps even more importantly, it would indicate that the committee considered the potential of light rail transit to shape urban land use development and redevelopment to be of great importance.

Through the inducement of sound land use development by public transit, a land use pattern such as the centralized land use pattern postulated in the adopted regional land use plan could be encouraged to evolve in southeastern Wisconsin. Such a centralized land use pattern would require a reversal of the trend of diffused, low-density land development which has been prevalent in the Region since the 1950's. It would represent a reversal in the population out-migration in Milwaukee County and a return to the land use and population densities of the late 1960's and early 1970's in central Milwaukee County, when the resident population of that County peaked. Also, it would represent a return to the historic development trends that were evident within the Region prior to 1950, with new urban development occurring at high and medium densities largely in concentric rings outward from, and generally along, the full periphery of the established urban centers of the Region.

One of the benefits of a more centralized land use pattern is that it would better provide for the restoration of deteriorated urban areas and the conservation of stable urban areas than would a decentralized land use pattern. Such restoration and conservation would conserve substantial public and private financial resources by maximizing the use of sound existing buildings and urban improvements, including streets, sidewalks, and lighting; sewer and water mains and laterals; and gas, electric, and telephone lines. It would also provide for the preservation and revitalization of the central city of the Region. The preservation and revitalization of existing developed urban areas of the Region would also reduce the need for new urban development and the attendant conversion of agricultural and other open lands to urban use. Among the potential adverse environmental impacts associated with the expansion of urban development are the loss of wetlands, woodlands, and wildlife habitat areas; the loss of prime agricultural lands; an increase in storm water runoff and flood flows in streams and watercourses; an increase in soil erosion and attendant sedimentation in streams and lakes during the land development process; an increase in pollutant loadings in surface waters and groundwaters; and an increase in air pollution.

Also, if the new urban development is diffused, as has been the case in recent years in the Region, it would tend to break up economical farm units and create urban enclaves which cannot be effici-

Map 143

SERVICES PROPOSED FOR THE FIRST STAGE OF A BUS-ON-METERED FREEWAY SYSTEM PLAN FOR THE MILWAUKEE AREA

LEGEND

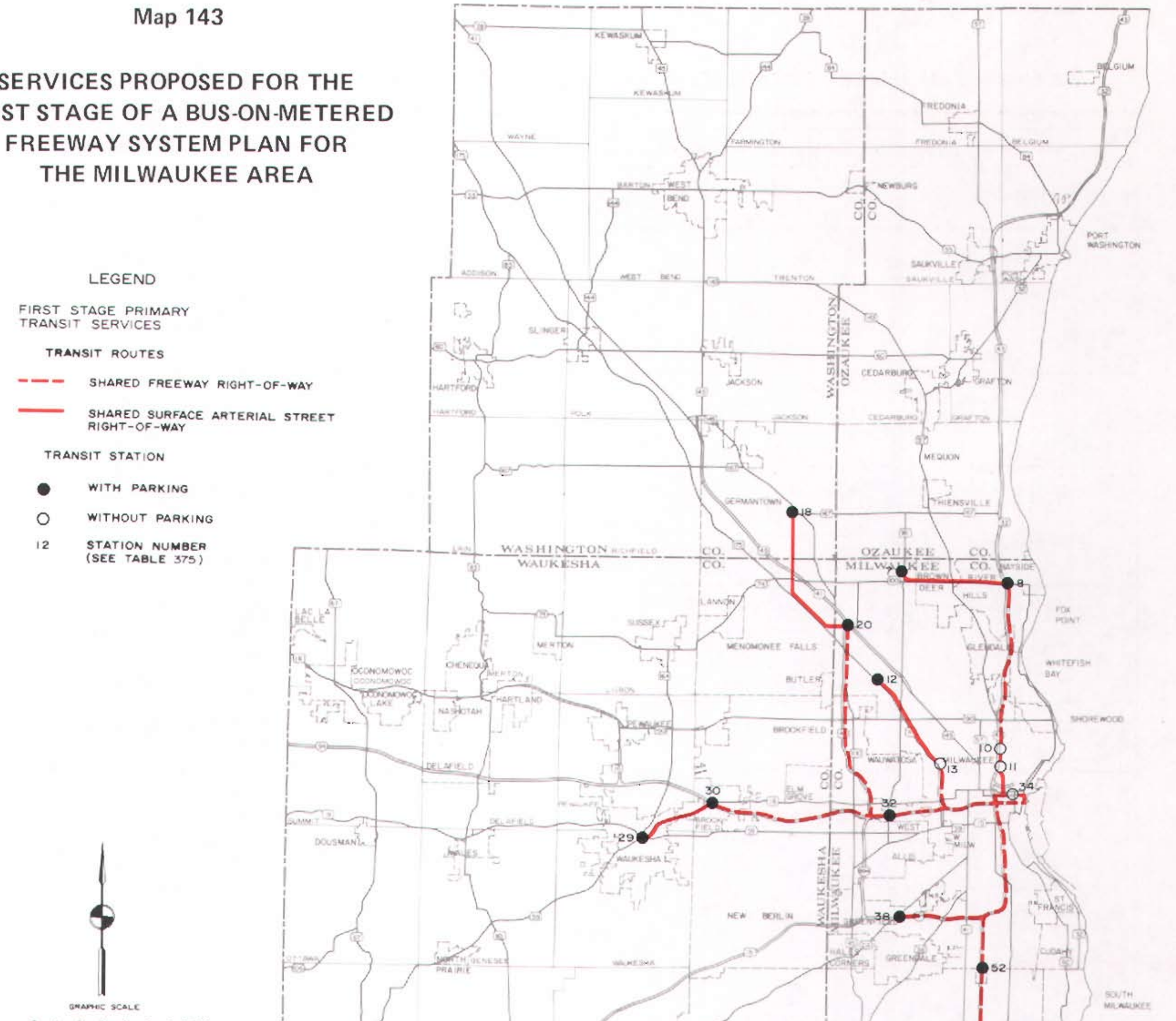
FIRST STAGE PRIMARY TRANSIT SERVICES

TRANSIT ROUTES

- SHARED FREEWAY RIGHT-OF-WAY
- SHARED SURFACE ARTERIAL STREET RIGHT-OF-WAY

TRANSIT STATION

- WITH PARKING
- WITHOUT PARKING
- 12 STATION NUMBER (SEE TABLE 375)



Under the first of the two options considered by the study advisory committee for selection as the primary transit system plan for the Milwaukee area, a bus-on-metered freeway system would be developed over the plan design period in three stages. During the first stage of plan implementation, the existing system of motor buses operating over freeways would be expanded from operation during weekday peak travel periods only to all-day operation at minimum headways of 30 minutes in peak travel periods and 60 minutes in off-peak travel periods. In addition, extensive preferential treatment would be provided for buses operating in primary transit service through the development of an areawide freeway traffic management system and a transit mall in downtown Milwaukee. Primary transit service would be provided on seven routes totaling 317 route miles, and would include a total of 18 transit stations outside the Milwaukee central business district, of which 15 would have park-ride lots. Of these 18 stations, 10 would be located in Milwaukee County, 7 of which would have park-ride facilities. All the service improvements recommended to be carried out during the first stage of implementation of the plan were shown by the plan test and evaluation to work well under even the most pessimistic future for transit use and development in the Region.

Source: SEWRPC.

Table 375

STAGING OF IMPLEMENTATION OF BUS-ON-METERED FREEWAY SYSTEM PLAN ROUTES

Bus-on-Freeway Routes Recommended for Implementation Under the First Stage of the Recommended Plan		
Route	Station Number	Stations
4—Brown Deer	7	N. 76th Street and W. Brown Deer Road
	8	IH 43 and W. Brown Deer Road
	10	IH 43 and W. Locust Street
	11	IH 43 and W. North Avenue
	34	N. 3rd Street and W. Wisconsin Avenue
6—Northwest Side	12	W. Appleton Avenue and W. Silver Spring Drive
	13	W. North Avenue and W. Lisbon Avenue
	34	N. 3rd Street and W. Wisconsin Avenue
9—Germantown/Menomonee Falls	18	N. Pilgrim Road and W. Mequon Road
	20	STH 175 and W. Good Hope Road
	32	N. 84th Street and IH 94
	34	N. 3rd Street and W. Wisconsin Avenue
13—Waukesha	29	N. Barstow Street and W. Main Street
	30	N. Barker Road and W. Blue Mound Road
	32	N. 84th Street and IH 94
	34	N. 3rd Street and W. Wisconsin Avenue
16—Greenfield	38	S. 76th Street and W. Cold Spring Road
	34	N. 3rd Street and W. Wisconsin Avenue
19—Kenosha	45	6th Avenue and 56th Street
	46	STH 31 and 52nd Avenue
	52	IH 94 and W. College Avenue
	34	N. 3rd Street and W. Wisconsin Avenue
20—Racine	47	Wisconsin Avenue and 6th Street
	48	STH 31 and 12th Street
	49	IH 94 and STH 20
	52	IH 94 and W. College Avenue
	34	N. 3rd Street and W. Wisconsin Avenue
Bus-on-Freeway Routes Recommended for Implementation Under the Second Stage of the Recommended Plan		
Route	Station Number	Stations or Stops
1—Port Washington	1	IH 43 and STH 33
	2	IH 43 and CTH Q
	9	IH 43 and W. Silver Spring Drive
	11	IH 43 and W. North Avenue
	34	N. 3rd Street and W. Wisconsin Avenue
5—River Hills	9	IH 43 and W. Silver Spring Drive
	11	IH 43 and W. North Avenue
	34	N. 3rd Street and W. Wisconsin Avenue
11—Oconomowoc	24	S. Main Street and E. Wisconsin Avenue
	25	Lakeland Road and STH 16
	26	Merton Avenue and STH 16
	27	Main Street and USH 16
	31	N. Moorland Road and IH 94
	32	N. 84th Street and IH 94
	34	N. 3rd Street and W. Wisconsin Avenue
12—Pewaukee	28	Grandview Boulevard and IH 94
	31	N. Moorland Road and IH 94
	32	N. 84th Street and IH 94
	34	N. 3rd Street and W. Wisconsin Avenue
17—West Allis	35	USH 45 and W. National Avenue
	34	N. 3rd Street and W. Wisconsin Avenue
21—Oak Creek/Ryan Road	50	IH 94 and Ryan Road
	34	N. 3rd Street and W. Wisconsin Avenue
24—South Side/Holt Avenue	53	IH 94 and W. Holt Avenue
	34	N. 3rd Street and W. Wisconsin Avenue

Table 375 (continued)

Bus-on-Freeway Routes Recommended for Implementation Under the Third Stage of the Recommended Plan		
Route	Station Number	Stations
2—Cedarburg/Grafton	3	S. 1st Avenue and Wisconsin Avenue
	4	IH 43 and CTH C
	9	IH 43 and W. Silver Spring Drive
	11	IH 43 and W. North Avenue
	34	N. 3rd Street and W. Wisconsin Avenue
3—Mequon	5	Cedarburg Road and Highland Road
	6	IH 43 and Mequon Road
	9	IH 43 and W. Silver Spring Drive
	11	IH 43 and W. North Avenue
	34	N. 3rd Street and W. Wisconsin Avenue
7—Wauwatosa	23	USH 45 and W. Watertown Plank Road
	33	Cemetery Access Road and IH 94
	34	N. 3rd Street and W. Wisconsin Avenue
8—West Bend	14	S. Main Street and W. Washington Avenue
	15	S. Main Street and Paradise Avenue
	16	USH 45 and STH 60
	17	USH 45 and USH 145
	19	USH 41 and Main Street
	32	N. 84th Street and IH 94
	34	N. 3rd Street and W. Wisconsin Avenue
10—Brookfield	21	N. Calhoun Road and W. Capitol Drive
	22	N. 124th Street and W. Capitol Drive
	32	N. 84th Street and IH 94
	34	N. 3rd Street and W. Wisconsin Avenue
14—Mukwonago	41	STH 83 and STH 15
	42	CTH F and STH 15
	43	Racine Avenue and STH 15
	44	S. Moorland Road and STH 15
	31	N. Moorland Road and IH 94
	32	N. 84th Street and IH 94
	34	N. 3rd Street and W. Wisconsin Avenue
15—Hales Corners	36	S. 108th Street and STH 15
	34	N. 3rd Street and W. Wisconsin Avenue
18—Franklin	37	W. Loomis Road and W. Rawson Avenue
	39	W. Loomis Road and W. Grange Avenue
	40	S. 27th Street and IH 894
	34	N. 3rd Street and W. Wisconsin Avenue
22—Oak Creek/Rawson Avenue	51	Nicholson Avenue and E. Rawson Avenue
	34	N. 3rd Street and W. Wisconsin Avenue
23—South Side/College Avenue	52	College Avenue and IH 94
	34	N. 3rd Street and W. Wisconsin Avenue

Source: SEWRPC.

ently served with basic urban services. This "urban sprawl" type of development typically relies on septic tanks which, if placed on improper soils or if poorly maintained and malfunctioning, can contribute to the pollution of surface water and contaminate groundwater underlying the Region.

Finally, the more centralized land use pattern will result in a more efficient, economical, and environmentally sound transportation system in the Region. This has been shown in previous Commission transportation planning efforts and in this Milwaukee area primary transit system alternatives analysis. A decentralized land use pattern in the Southeastern Wisconsin Region has been shown consistently to result in higher levels of motor fuel consumption for transportation, higher levels of vehicle miles of travel, greater air pollutant emissions by the transportation system, and a less efficient public transit system.

Table 376

STAGING OF IMPLEMENTATION OF BUS-ON-METERED FREEWAY SYSTEM PLAN STATIONS

Bus-on-Freeway Stations Recommended for Implementation Under the First Stage of the Recommended Plan

Station Number	Intersection	Civil Division	Status	Passenger Facilities	
				Shelter	Parking
7	N. 76th Street and W. Brown Deer Road.	City of Milwaukee	Proposed	Yes	Yes
8	IH 43 and Brown Deer Road	Village of River Hills	Existing	Yes	Yes
10	IH 43 and W. Locust Street	City of Milwaukee	Proposed	Yes	No
11	IH 43 and W. North Avenue	City of Milwaukee	Proposed	Yes	No
12	W. Appleton Avenue and W. Silver Spring Drive . .	City of Milwaukee	Proposed	Yes	Yes
13	W. North Avenue and W. Lisbon Avenue.	City of Milwaukee	Proposed	Yes	No
18	Pilgrim Road and Mequon Road	Village of Germantown	Proposed	Yes	Yes
20	N. 107th Street and W. Good Hope Road	City of Milwaukee	Proposed	Yes	Yes
29	N. Barstow Street and W. Main Street	City of Waukesha	Proposed	Yes	Yes
30	N. Barker Road and W. Blue Mound Road.	Town of Brookfield	Existing	Yes	Yes
32	N. 84th Street and IH 94.	City of Milwaukee	Proposed	Yes	Yes
34	N. 3rd Street and W. Wisconsin Avenue	City of Milwaukee	Existing	Yes	No
38	S. 76th Street and W. Cold Spring Road	City of Greenfield	Proposed	Yes	Yes
45	6th Avenue and 56th Street	City of Kenosha	Proposed	Yes	Yes
46	STH 31 and 52nd Avenue	City of Kenosha	Proposed	Yes	Yes
47	Wisconsin Avenue and 6th Street	City of Racine	Proposed	Yes	Yes
48	STH 31 and 12th Street	Town of Mt. Pleasant	Proposed	Yes	Yes
49	IH 94 and STH 20	Town of Mt. Pleasant	Proposed	Yes	Yes
52	IH 94 and W. College Avenue	City of Milwaukee	Existing	Yes	Yes

Bus-on-Freeway Stations Recommended for Implementation Under the Second Stage of the Recommended Plan

Station Number	Intersection	Civil Division	Status	Passenger Facilities	
				Shelter	Parking
1	IH 43 and STH 33	Village of Saukville	Proposed	Yes	Yes
2	IH 43 and CTH Q.	Town of Grafton	Proposed	Yes	Yes
9	IH 43 and W. Silver Spring Drive	Village of Glendale	Existing	Yes	Yes
24	S. Main Street and E. Wisconsin Avenue	City of Oconomowoc	Proposed	Yes	Yes
25	Lakeland Road and STH 16	Village of Nashotah	Existing	Yes	Yes
26	Merton Avenue and STH 16.	Village of Hartland	Proposed	Yes	Yes
27	Main Street and USH 16	Village of Pewaukee	Proposed	Yes	Yes
28	Grandview Boulevard and IH 94	City of Waukesha	Proposed	Yes	Yes
31	N. Moorland Road and IH 94	City of Brookfield	Proposed	Yes	Yes
35	USH 45 and W. National Avenue	City of West Allis	Proposed	Yes	Yes
50	IH 94 and Ryan Road	City of Oak Creek	Proposed	Yes	Yes
53	IH 94 and W. Holt Avenue.	City of Milwaukee	Existing	Yes	Yes

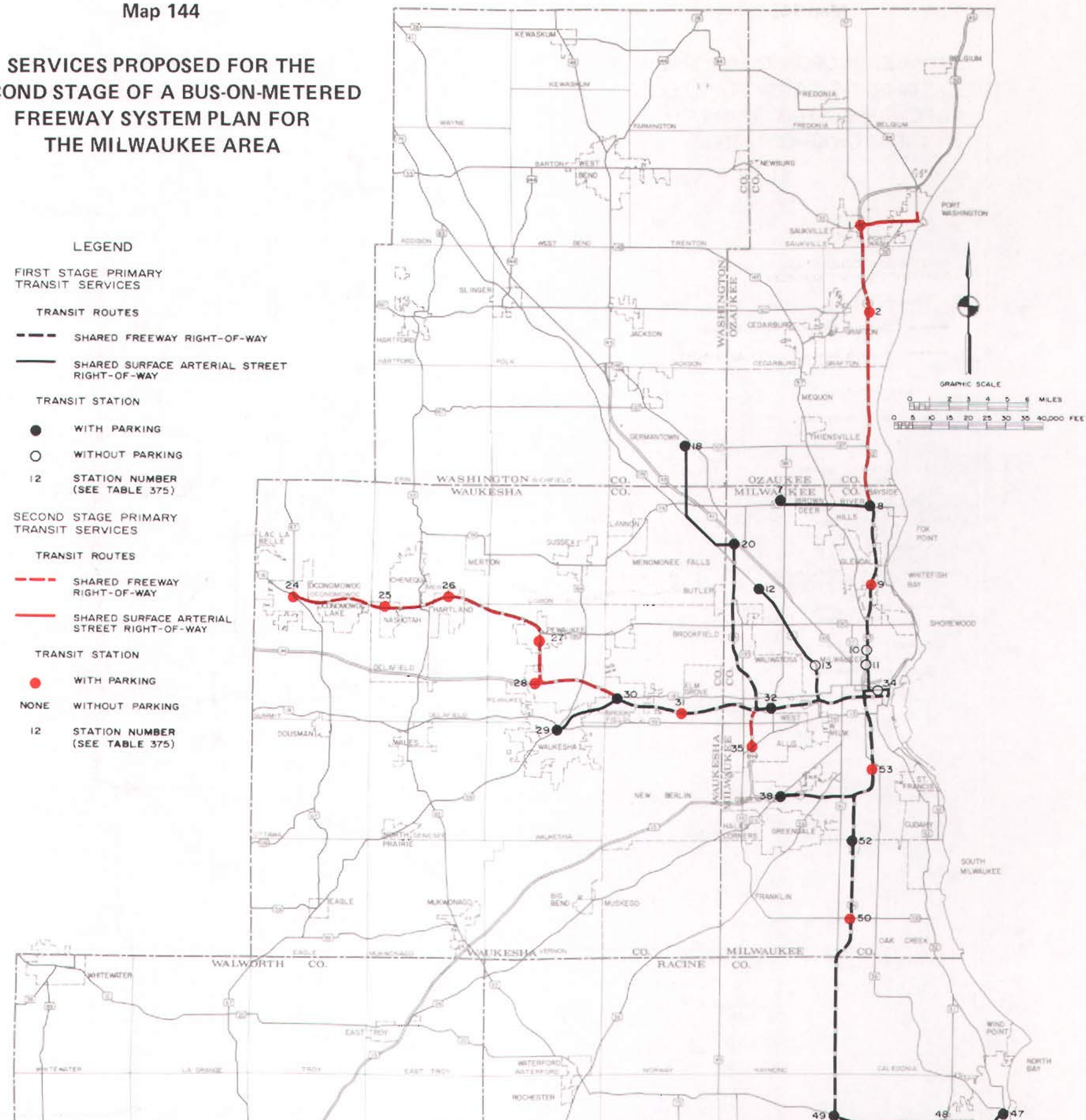
Bus-on-Freeway Stations Recommended for Implementation Under the Third Stage of the Recommended Plan

Station Number	Intersection	Civil Division	Status	Passenger Facilities	
				Shelter	Parking
3	S. 1st Avenue and Wisconsin Avenue	Village of Grafton	Proposed	Yes	Yes
4	IH 43 and CTH C	Town of Grafton	Existing	Yes	Yes
5	Cedarburg Road and Highland Road	City of Mequon	Existing	Yes	Yes
6	IH 43 and Mequon Road.	City of Mequon	Proposed	Yes	Yes
14	N. Main Street and W. Washington Street	City of West Bend	Proposed	Yes	Yes
15	S. Main Street and W. Paradise Drive	City of West Bend	Proposed	Yes	Yes
16	USH 45 and STH 60	Town of Polk	Proposed	Yes	Yes
17	USH 45 and USH 145	Town of Polk	Proposed	Yes	Yes
19	USH 41 and Main Street	Village of Menomonee Falls	Proposed	Yes	Yes
21	N. Calhoun Road and W. Capitol Drive.	City of Brookfield	Proposed	Yes	Yes
22	N. 124th Street and W. Capitol Drive.	City of Wauwatosa	Proposed	Yes	Yes
23	USH 45 and W. Watertown Plank Road	City of Wauwatosa	Existing	Yes	Yes
33	Cemetery Access Road and IH 94.	City of Milwaukee	Proposed	Yes	No
36	S. 108th Street and STH 15	City of Greenfield	Existing	Yes	Yes
37	W. Loomis Road and W. Rawson Avenue	City of Franklin	Proposed	Yes	Yes
39	W. Loomis Road and W. Grange Avenue	Village of Greendale	Proposed	Yes	No
40	S. 27th Street and IH 894	City of Milwaukee	Proposed	Yes	Yes
41	STH 83 and STH 15	Town of Mukwonago	Existing	Yes	Yes
42	CTH F and STH 15.	Town of Vernon	Existing	Yes	Yes
43	Racine Avenue and STH 15	City of New Berlin	Existing	Yes	Yes
44	S. Moorland Road and STH 15	City of New Berlin	Proposed	Yes	Yes
51	Nicholson Avenue and E. Rawson Avenue.	City of Oak Creek	Proposed	Yes	Yes

Source: SEWRPC.

Map 144

SERVICES PROPOSED FOR THE SECOND STAGE OF A BUS-ON-METERED FREEWAY SYSTEM PLAN FOR THE MILWAUKEE AREA

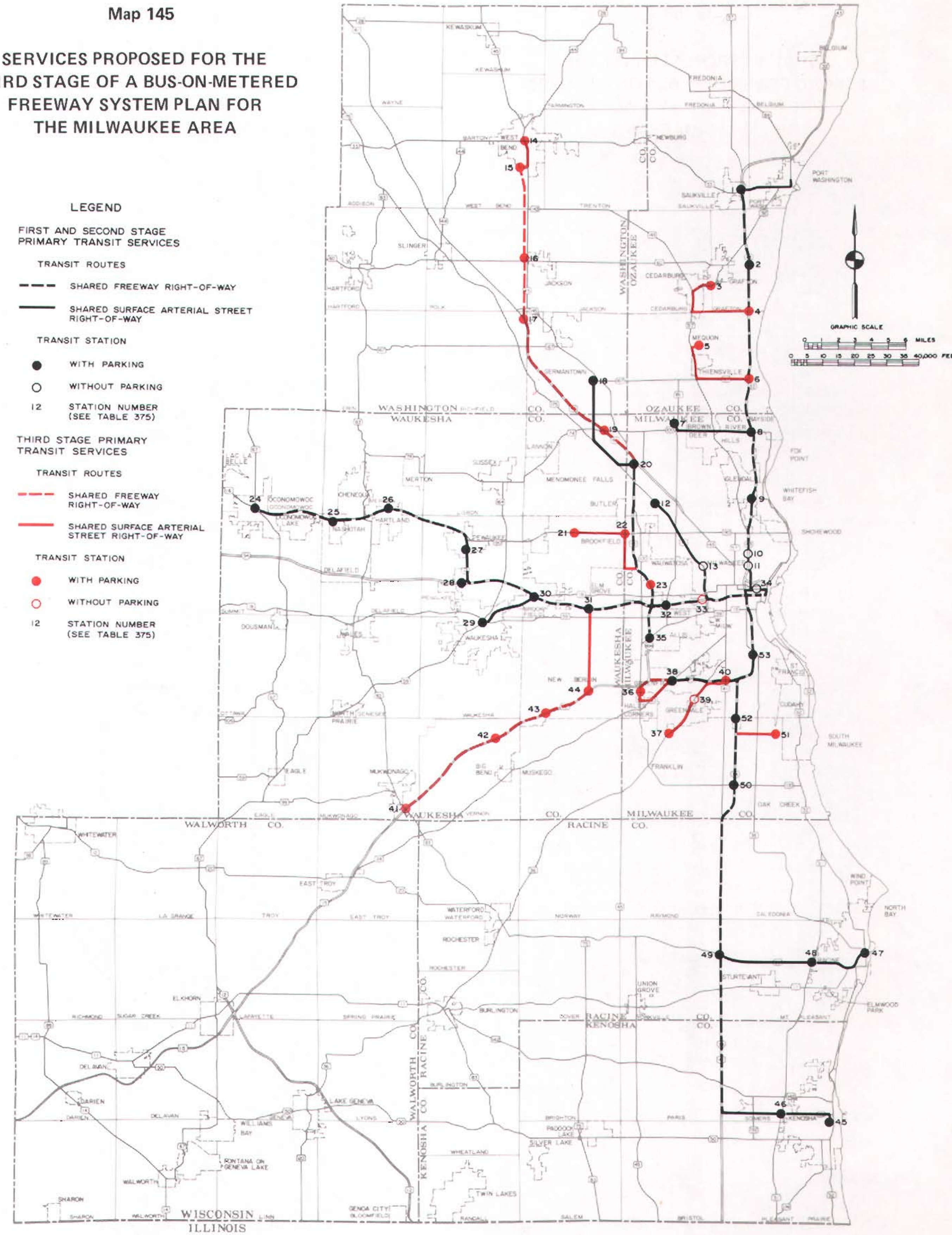


Under the first of the two options considered by the study advisory committee for selection as the best primary transit system plan for the Milwaukee area, a bus-on-metered freeway system would be developed over the plan design period in three stages. During the second stage of plan implementation, primary transit service to some communities served under the first stage of this plan would be increased, and service would be provided to additional communities not served by primary transit service under the first stage. The expansion of facilities and services under the second stage would be contingent upon future conditions in the Milwaukee area progressing toward those postulated under either of the two intermediate alternative futures. This stage would encompass the addition of seven primary transit routes to the system implemented under the first stage. Representing 252 additional route miles, this service would include a total of 12 additional transit stations, all of which would have park-ride lots. Of these 12 stations, 4 would be located within Milwaukee County.

Source: SEWRPC.

Map 145

SERVICES PROPOSED FOR THE THIRD STAGE OF A BUS-ON-METERED FREEWAY SYSTEM PLAN FOR THE MILWAUKEE AREA



Under the first of the two options considered by the study advisory committee for selection as the best primary transit system plan for the Milwaukee area, a bus-on-metered freeway system would be developed over the plan design period in three stages. During the third stage of plan implementation, primary transit service to some communities served under the first and second stages of this plan would be increased, and service would be further expanded to communities not served by primary transit service under the first or second stages. The expansion of facilities and services under the third stage would be contingent upon future conditions in the Milwaukee area progressing toward those considered to be the most optimistic for transit needs and utilization over the plan design period. This stage would encompass the addition of 10 primary transit routes to the system as it would exist following the complete implementation of the second stage. Representing 386 additional route miles over the second-stage system, this service would include a total of 22 additional transit stations over those provided under the second stage, 20 of which would have park-ride lots. Of these 22 stations, 7 would be located within Milwaukee County, 5 of which would have park-ride lots.

Source: SEWRPC.

Plan Description: The primary transit system plan recommended for adoption and implementation under this option is shown on Maps 146 and 147. Under the lower tier of the plan, a light rail transit facility would be operated in the northwest corridor, since light rail transit was shown to work well in this corridor under the full range of alternative future conditions considered under this study. The lower tier of the plan would also include, except in the northwest corridor, all those bus-on-freeway facilities and services which may be expected to provide cost-effective service throughout the day under the most optimistic alternative future for transit use—the moderate growth scenario-centralized land use plan alternative future. This extent of facilities and services can be recommended for implementation because even under the stable or declining growth scenario-decentralized land use plan alternative future—the most pessimistic future for transit in the Milwaukee area—all these bus-on-metered freeway services would be viable at least during the peak travel periods. Also, those bus-on-freeway facilities and services included in the plan but established as cost-effective only under most optimistic future conditions will be staged to be implemented last, and then only if future conditions in the Milwaukee area are found over time to approximate the most optimistic conditions for transit use.

Under this lower tier of the plan, the locations of the routes and park-ride lots of these bus-on-freeway services would be modified as necessary to permit the ready conversion to light rail transit operation in four corridors, and to commuter rail operation in the Milwaukee-Racine-Kenosha corridor, under the upper tier of this plan, as shown on Map 148. These four light rail transit corridors include all those corridors, except the northwest corridor, within which it was established that light rail transit would work well under the full range of alternative future conditions considered in the study. No actions would be proposed to be taken to implement this upper tier of recommendations other than those required to ensure that the concerned facilities could be developed at some time in the future, and that any bus-on-freeway facilities and services implemented in the corridors are adaptable to the possible eventual conversion to rail transit operation. Implementation of the upper-tier light rail transit and commuter rail recommendations would occur only following the recommended implementation of light rail transit in the northwest corridor, and following a determination, based on that implementation, of the extent to which the intangible benefits of rail transit, particularly with respect to land development and redevelopment, were being achieved.

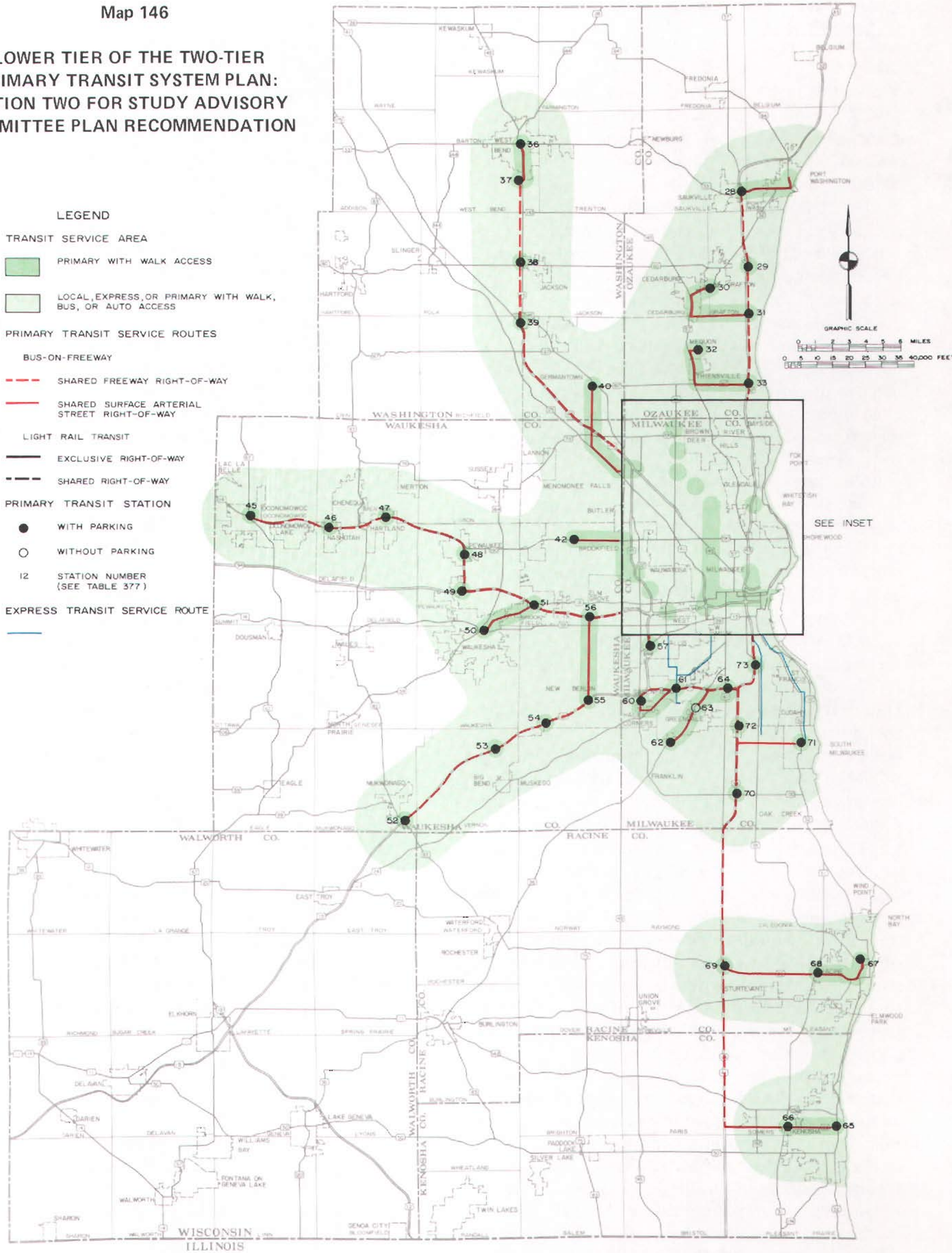
Thus, the lower tier of the primary transit system plan recommended under this option for the Milwaukee area, as shown on Map 146, calls for the construction and operation of a light rail transit facility in the Milwaukee northwest corridor, the expansion of the existing system of routes of buses operating over freeways in all other Milwaukee area corridors, the expansion of all primary transit service from weekday peak-period service to all-day weekday service at maximum headways of 30 minutes in peak travel periods and of 60 minutes in off-peak travel periods, and the provision of extensive preferential treatment for buses operating in primary transit service. It also calls for all new bus-on-freeway facilities and services to be implemented so as to permit possible eventual conversion to light rail operation in four additional corridors and to commuter rail operation in the Milwaukee-Racine-Kenosha corridor, as shown on Map 147.

The light rail transit facility in the northwest corridor would extend through the City of Milwaukee from its central business district westerly along W. Wisconsin Avenue to N. 44th Street, and then north across the Menomonee River Valley to N. Sherman Boulevard. The facility would then extend along N. Sherman Boulevard to W. Silver Spring Drive, and thence northwesterly to the Northridge Shopping Center. The facility would have a length of about 14.3 miles, of which about 11.8 miles would be located on the surface and about 2.5 miles would be on elevated structure. All of the guideway would be constructed for exclusive light rail transit use. At-grade intersections with public streets, would be located along the guideway, but the light rail vehicles would receive preferential treatment at these intersections through traffic signalization. A total of 27 stations, 3 of which would have park-ride lots, would be provided along the guideway. The stations would be located approximately one-quarter mile apart in the central business district, one-half mile apart in other high-density development areas, and one mile apart in medium-density development areas. Average speeds on the route would be about 20 mph. Headways during the peak periods would range from 4 to 12 minutes, with some service being provided by trains of two articulated light rail vehicles. During the off-peak periods, headways would range from 12 to 60 minutes, both in the midday and the evening travel periods, with all service being provided by trains made up of a single-articulated vehicle.

The bus-on-metered freeway facilities and services recommended for implementation under the lower tier of plan would expand primary transit service

Map 146

LOWER TIER OF THE TWO-TIER PRIMARY TRANSIT SYSTEM PLAN: OPTION TWO FOR STUDY ADVISORY COMMITTEE PLAN RECOMMENDATION



LEGEND

TRANSIT SERVICE AREA

- PRIMARY WITH WALK ACCESS
- LOCAL, EXPRESS, OR PRIMARY WITH WALK, BUS, OR AUTO ACCESS

PRIMARY TRANSIT SERVICE ROUTES

BUS-ON-FREEWAY

- SHARED FREEWAY RIGHT-OF-WAY
- SHARED SURFACE ARTERIAL STREET RIGHT-OF-WAY

LIGHT RAIL TRANSIT

- EXCLUSIVE RIGHT-OF-WAY
- SHARED RIGHT-OF-WAY

PRIMARY TRANSIT STATION

- ● WITH PARKING
- ○ WITHOUT PARKING
- 12 STATION NUMBER (SEE TABLE 377)

EXPRESS TRANSIT SERVICE ROUTE

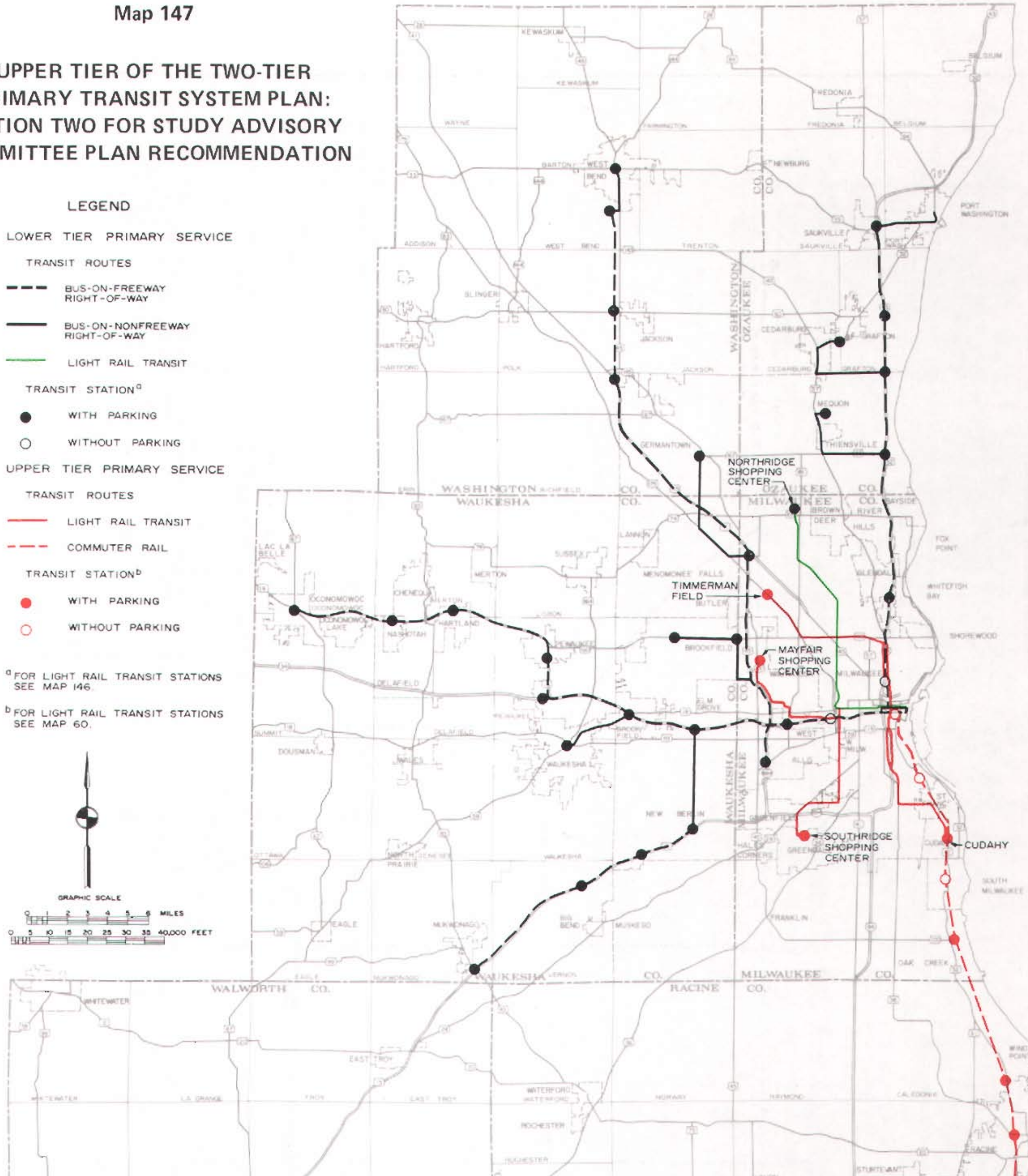
Two options were recommended by the Commission staff to the study advisory committee for possible selection as the best plan for primary transit system development in the Milwaukee area. The second option was a two-tiered system plan, of which only the lower tier would be recommended for immediate implementation. The purpose of the upper tier would be to help avoid actions which would foreclose options concerning primary transit system development in the area. The lower tier of the plan would provide for the development of a system of bus-on-metered freeway lines, except in the northwest corridor of Milwaukee County, within which a light rail facility would be developed. The lower-tier bus-on-freeway facilities and services would, however, be structured so that the service could be readily converted to light rail operation in four additional corridors and to commuter rail operation in the corridor between the Milwaukee and Racine and Kenosha areas, as recommended in the upper tier of the plan. The light rail transit facility recommended for implementation as part of the lower tier of the plan would consist of a single route of 14.3 miles in length within the northwest corridor. The facility would have a total of 27 stations, all of which would be located within Milwaukee County, and 3 of which would have park-ride lots. Service would be provided by one- or two-car trains of electrically propelled articulated light rail vehicles. Bus-on-metered freeway facilities and services under the lower tier would be expanded over those of the present system to consist of 22 routes of all-day operation totaling 900 route miles and having a total of 46 stations, 43 of which would have park-ride lots. Of the 46 stations, 16 would be located within Milwaukee County, of which 13 would have park-ride facilities. High-capacity articulated diesel motor buses would be used to provide the recommended bus-on-freeway service, which would be implemented in stages over the plan design period.

Source: SEWRPC.

MEQUON
OZAUKEE CO.
MILWAUKEE CO.
RIVER HILLS
BAYSIDE
BROWN DEER
FOX POINT
GLENDALE
WHITEFISH BAY
SHOREWOOD
MILWAUKEE
WAUWATOSA
WEST MILWAUKEE
GREENFIELD
WHITEFISH BAY
MILWAUKEE BAY
GRAPHIC SCALE
1 MILE
0 2000 4000 6000 8000 FEET

Map 147

UPPER TIER OF THE TWO-TIER PRIMARY TRANSIT SYSTEM PLAN: OPTION TWO FOR STUDY ADVISORY COMMITTEE PLAN RECOMMENDATION

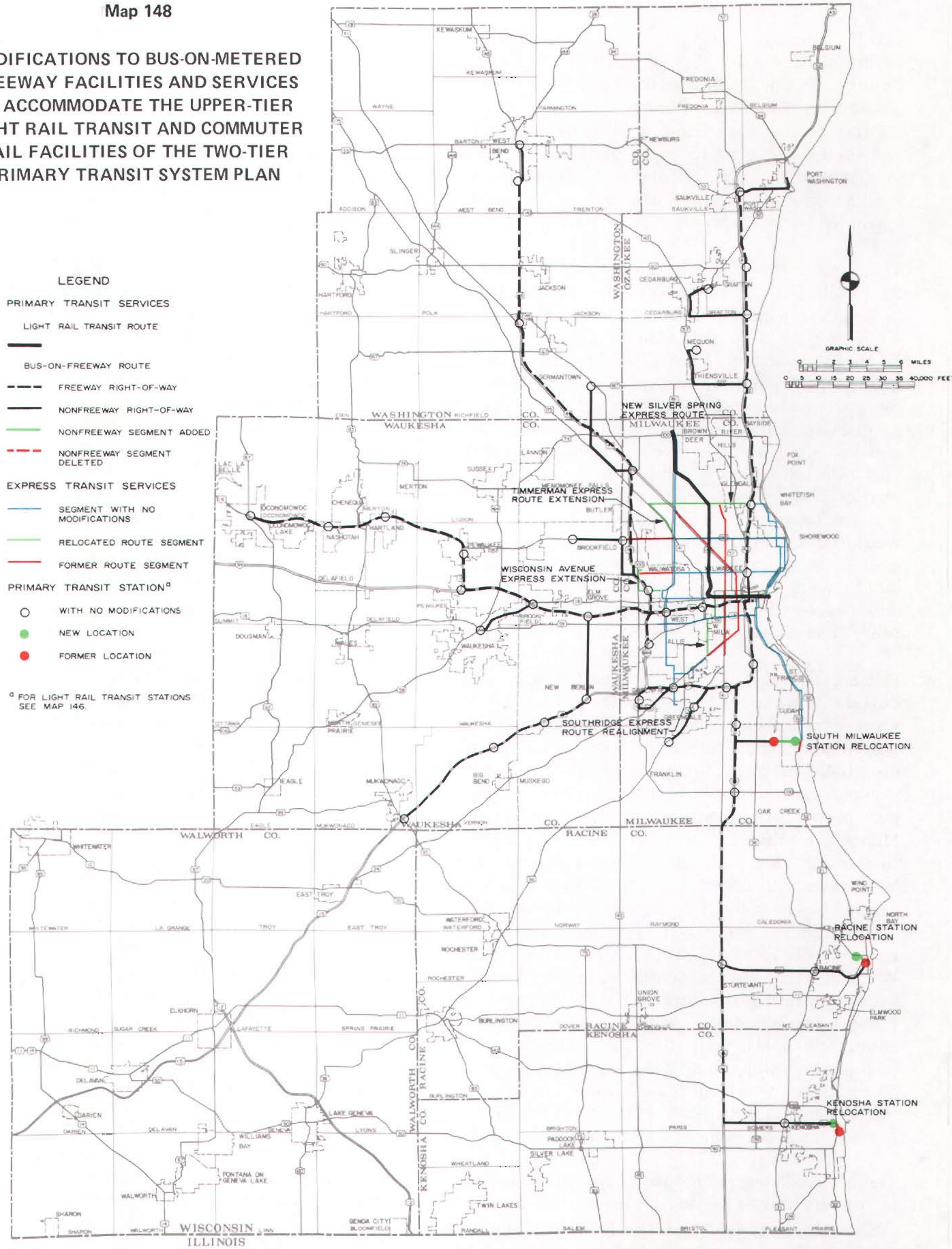


Under the second of the two options considered by the study advisory committee for selection as the best primary transit system plan for the Milwaukee area, only the lower of two tiers would be recommended for immediate implementation. Under the lower tier of this plan, a system of bus-on-metered freeway facilities and services would be developed except in the northwest corridor of Milwaukee County, within which a light rail facility would be developed. The lower-tier bus-on-freeway facilities and services would be developed so as to permit the ready eventual conversion to light rail operation in four additional corridors and to commuter rail operation in the corridor between the Milwaukee and Racine and Kenosha areas. These four additional light rail transit routes include all those routes other than the one in the northwest corridor which the plan test and evaluation efforts indicated had potential to work well under a full range of alternative conditions. The one commuter rail route in the upper tier of the plan is the only route shown by the plan test and evaluation to have the potential to work well under more than the most optimistic future conditions considered. Implementation of these light rail and commuter rail routes would occur only following the development of the light rail transit line in the northwest corridor and a determination, based on the experience with that line, of the extent to which the intangible benefits of rail transit were being achieved, particularly with respect to the shaping of land development and redevelopment. The four light rail transit routes in the upper tier of the plan would entail an additional 34.2 miles of fixed guideway, all located within Milwaukee County. These facilities would include an additional 63 stations, of which 12 would have park-ride lots. The single commuter rail facility in the upper tier of the plan would consist of a route 33.1 miles in length and would have 9 stations, 7 of which have park-ride lots. Of these 9 stations, 5 would be located within Milwaukee County, 3 of which would have park-ride facilities.

Source: SEWRPC.

Map 148

MODIFICATIONS TO BUS-ON-METERED FREEWAY FACILITIES AND SERVICES TO ACCOMMODATE THE UPPER-TIER LIGHT RAIL TRANSIT AND COMMUTER RAIL FACILITIES OF THE TWO-TIER PRIMARY TRANSIT SYSTEM PLAN



Under the two-tier primary transit system plan option considered by the study advisory committee, the lower tier would entail implementation of a single light rail transit route and 22 bus-on-metered freeway routes. These 22 routes and supporting express bus services would be structured to permit eventual ready conversion to light rail transit or commuter rail operation as proposed in the upper tier of this option. As shown on this map, the major modifications of these bus-on-metered freeway facilities and services to permit eventual upgrading would include: 1) relocation of the bus-on-freeway terminal in the City of Kenosha from 6th Avenue and 56th Street to 14th Avenue and 54th Street; 2) relocation of the bus-on-freeway terminal in the City of Racine from Wisconsin Avenue and 6th Street to Memorial Drive and State Street; 3) relocation of the bus-on-freeway terminal in the City of Oak Creek from S. Nicholson and E. Rawson Avenues to 13th and E. Rawson Avenues in the City of South Milwaukee; 4) replacement of portions of express routes along S. 16th Street, W. Forest Home Avenue, and S. Layton Boulevard with a new express route originating at the University of WisconsinMilwaukee and extending through the Milwaukee central business district to the Southridge Shopping Center in the Village of Greendale via W. Wisconsin Avenue, S. 35th and 43rd Streets, W. Forest Home Avenue, and S. 76th Street; 5) extension of the express route along W. Wisconsin Avenue from the Milwaukee County Institutions grounds to the Mayfair Mall Shopping Center along W. Watertown Plank and N. Mayfair Roads; 6) realignment of the express route along W. Capitol Drive west of W. Appleton Avenue such that it terminates at Timmerman Field instead of at N. 124th Street; and 7) deletion of the express routes along N. 17th Street, W. Fond du Lac Avenue, and N. 27th Street, with service to the areas situated at the northerly reaches of these routes provided by a new express route along W. Silver Spring Drive between N. Port Washington Road and Timmerman Field. The first, second, and third modifications would accommodate the possible future upgrading of bus-on-freeway service between the Cities of Milwaukee, Racine, and Kenosha to commuter rail service, and the fourth and fifth modifications would better accommodate the possible future conversion of certain primary and secondary motor bus facilities and services to light rail transit in the southwest and west corridors, respectively. The sixth and seventh modifications reflect the possible implementation of another light rail transit facility between downtown Milwaukee and Timmerman Field within the north corridor.

Source: SEWRPC.

within Milwaukee County, and extend service to the south to the City of Kenosha in Kenosha County, to the southwest to the Village of Mukwonago in Waukesha County, to the northwest to the City of West Bend in Washington County, and to the north to the City of Port Washington in Ozaukee County. Throughout the entire Milwaukee area, bus-on-freeway service would be expanded to an all-day service.

This bus-on-freeway element would consist of 22 bus-on-freeway routes totaling 900 route miles in length and having a total of 46 stations, 43 of which would have park-ride lots. Sixteen of the 46 stations would be located in Milwaukee County, 13 of which would have park-ride lots. Under the plan, articulated, high-capacity buses would operate in primary transit service primarily over existing and proposed metered freeways between outlying park-ride lots and the Milwaukee central business district. Bus routes from park-ride lots in Milwaukee County to the central business district would be operated with a limited number of intermediate stops, as necessary, to connect and coordinate with feeder express and local bus service, and to provide access to major travel generators other than the Milwaukee central business district.

Primary transit bus routes originating at locations outside Milwaukee County but within the Milwaukee urbanized area would generally serve two outlying park-ride lots prior to proceeding in an essentially nonstop mode of operation to the Milwaukee central business district. Primary transit bus routes originating at locations outside the Milwaukee urbanized area would have stops at two to five outlying park-ride lots prior to proceeding in an essentially nonstop mode of operation to the central business district. The park-ride lots would be located, to the extent practicable, within or near freeway interchanges to minimize travel times. Within the Milwaukee central business district, all primary transit bus routes would be operated over E. and W. Wisconsin Avenue for a distance of about two miles, with stops approximately every one-quarter mile; and Wisconsin Avenue would be converted to a mall for exclusive use by public transit vehicles between N. 10th Street and N. Prospect Avenue—a distance of about 1.3 miles.

The Milwaukee area freeways over which the buses in primary transit service would operate would be operationally controlled during peak travel periods, requiring the expansion of the present limited freeway traffic management system serving central Milwaukee County to an areawide system. All freeway on-ramps in the Milwaukee urbanized area would need to be ramp-metered to restrain automobile and truck access to the freeways during peak travel periods. The ramp meters would need to be operated through a central control system which would continuously measure traffic volumes on those portions of the freeway system needed for transit service through an interconnected series of traffic-sensing devices. As freeway traffic volumes approached the levels beyond which freeway operating speeds may be expected to deteriorate, fewer automobiles and trucks would be permitted to enter the freeway system. Sufficient constraint would be exercised to ensure uninterrupted freeway traffic flow and operating speeds of at least 40 mph on all freeway segments, including otherwise congested freeway segments. Consequently, average speeds on the bus-on-freeway routes, including all stops, would range between 19 and 35 mph.

This plan also envisions complementary expansion and improvement of the express and local elements of the Milwaukee area transit system. Three additional express, or limited-stop, routes would be provided in addition to the seven routes included in the base plan—only three of which were actually in operation in 1980. These 10 express routes would operate in a coordinated manner with the light rail and bus-on-metered freeway primary transit system. Under the plan, the local transit system element in the Milwaukee area would be extended where cost-effective into all contiguous areas of urban development, including all of northern and most of southern Milwaukee County, southern Ozaukee County, southeastern Washington County, and eastern Waukesha County.

Under the upper tier of the plan, four additional light rail transit routes, or corridors, are planned, along with one commuter rail corridor. The light rail facilities and services would be located on four routes in four corridors extending from the Milwaukee central business district. One route would extend about 9.4 miles from the intersection of N. 6th Street and W. Wisconsin Avenue north along N. 6th Street and the one-way pair of N. 7th and N. 8th Streets through Milwaukee's near north side. The route would then proceed in a northwesterly direction along W. Atkinson Avenue, W. Capitol Drive, and W. Appleton Avenue, terminating at Timmerman Field. A second route would extend from the intersection of N. 6th Street and W. Wisconsin Avenue south across the 6th Street viaduct, along the one-way pair of S. 4th and S. 5th Streets. The route would then continue along S. Chase and S. Howell Avenues, turning in an easterly direction following the former Milwaukee Electric Lines Lakeside Belt Line right-of-way to S. Kinnickinnic Avenue. At S. Kinnickinnic Avenue, the route would proceed along the Chicago & North Western's railway right-of-way through the City of

Cudahy, terminating at S. Whitnall Avenue. The third route would, as in the northwest corridor, extend from downtown Milwaukee along W. Wisconsin Avenue to N. 44th Street, where it would turn in a southerly direction passing Milwaukee County Stadium. The route would proceed along the cleared right-of-way of the Stadium Freeway-South extension through the City of West Milwaukee, continuing south along S. 43rd Street before proceeding southwesterly along the former Milwaukee Electric Lines Lakeside Belt Line right-of-way, W. Forest Home Avenue, and S. 76th Street and terminating at the Southridge Shopping Center in the Village of Greendale. The last route would extend from downtown Milwaukee along W. Wisconsin Avenue to S. 44th Street, as in the routes to the Northridge and Southridge Shopping Centers, would pass Milwaukee County Stadium, and would then continue in a westerly direction along the former Milwaukee Electric Lines Local Rapid Transit Line as far west as N. Glenview Avenue. The route would then proceed in a northwesterly direction through the Milwaukee County Institutions grounds, terminating at the Mayfair Mall Shopping Center in the City of Wauwatosa.

These four light rail transit routes would entail an additional 34.2 miles of guideway, of which 30 miles, or 88 percent, would be on surface alignment and 4.2 miles, or 12 percent, would be on elevated structure. All this additional guideway, except about one mile, or less than 3 percent, would be exclusively for light rail transit use. A total of 63 stations would be provided along the guideway, of which 12 would have park-ride lots. Station spacing would be the same as along the facility in the northwest corridor. Average speeds along these four additional corridors would, as in the northwest corridor, be about 20 mph. Service headways during the peak periods would be about 5 to 12 minutes, with some service being provided by two-car trains. Headways would range from about 8 to 20 minutes during both the midday and evening off-peak travel periods.

Commuter rail service, radiating to the south from the Milwaukee central business district to Kenosha, would be provided under the upper tier of the plan over track owned and operated by the Chicago & North Western Transportation Company. Commuter rail service would be provided to the communities of St. Francis, Cudahy, South Milwaukee, Oak Creek, Racine, and Kenosha. Under the two-tier system plan option, commuter rail service was concluded by the Advisory Committee to be preferable in the long term to bus-on-freeway service in this corridor for two principal reasons. First, the implementation of such service between Milwaukee and Kenosha could—through proper integration with the existing commuter rail service between Kenosha and Chicago—contribute to the development of improved interregional passenger transportation services in the Milwaukee-Chicago intercity corridor. Secondly, the individual corridor analysis performed for this corridor indicated that the operating cost-effectiveness of this commuter rail route was very comparable to the combined operating cost-effectiveness of the bus-on-freeway routes serving this corridor.[8] This consideration plus the benefits attributable to the intangible advantages of a rail transit facility were felt to be important enough to recommend commuter rail service under the upper tier of the two-tier system plan option.

A total of nine stops would be made along this 66-mile route. Speeds on the route would average 32 mph, and headways would be every half-hour in the peak direction during the peak periods and every hour otherwise. Trains would consist of a locomotive and between two and five coaches during the peak periods, and a locomotive and between one and three coaches during the off-peak periods.

Primary Transit Plan Staging: The lower tier of this primary transit system plan is proposed to be implemented in stages over the plan design period. The development of the primary transit service proposed in the plan, if recommended, must evolve gradually over the planning period as financial resources become available, because the plan requires fairly substantial increases in both public capital and operating and maintenance cost subsidies over the plan design period. The staging of the plan is necessary also because only if public transit needs and ridership increase as anticipated will the plan's facilities and services warrant expansion to the extent envisioned. It should be noted that no staging is proposed for the upper tier of the plan, because it is not recommended for implementation. Its implementation is to be considered only following the implementation of the lower

[8] *In the truncated/composite plan analysis, the percent of operating cost met by farebox revenues for the bus-on freeway services and the commuter rail services, respectively, was: 63 and 60 percent under the moderate growth scenario-centralized land use plan alternative future; 69 and 47 percent under the moderate growth scenario-decentralized land use plan alternative future; and 46 and 42 percent under the stable or declining growth scenario-centralized land use plan alternative future. The corridor analysis was not performed for the stable or declining growth scenario-decentralized land use plan alternative future.*

tier of the plan, and following an assessment of the intangible benefits attained by the light rail transit element of the plan's lower tier.

Light Rail Transit Element: The recommended light rail facility in the northwest corridor is proposed to be developed in three stages: preliminary engineering, final design, and construction. The preliminary engineering stage will consist of in-depth study, including an environmental impact analysis of variations in such characteristics of the recommended light rail facility as horizontal and vertical alignment, the location and sizing of stations and park-ride lots, vehicle selection, storage and maintenance needs, and the staging of guideway construction in order to determine the best way to implement the recommended light rail facility in this corridor. Map 149 shows one possible staging of the guideway construction. It was developed based primarily upon existing development and transit ridership in the northwest corridor. The first stage from approximately N. Prospect Avenue to W. Silver Spring Drive would have a length of about 9.5 miles and would entail a guideway construction capital investment of about $92.3 million. The second stage would extend the guideway to the Northridge Shopping Center at N. 76th Street and W. Brown Deer Road. It would have a length of about 4.8 miles, and would entail a guideway construction capital investment of about $49.1 million.

The preliminary engineering stage will also include in-depth analysis of the potential for light rail transit to induce sound land development and redevelopment along the facility corridor. This analysis will include consideration of those factors of which, according to recent studies, must be present in order for rail transit to influence land development and redevelopment. These factors include the presence of economic forces and a strong demand for land development and redevelopment in the area; the attractiveness of sites surrounding potential light rail transit stations in terms of ease of access, utilities, and other urban facilities and services, physical features, and social characteristics; the existence of a public land use policy which encourages land development and redevelopment along the corridor through coordinated tax policies, infrastructure supply, and appropriate land use controls, as well as local neighborhood and community acceptance and approval; and the presence of land near the stations which is available, or which can be readily assembled, for development. Only if it is concluded from this preliminary engineering phase of the study that light rail transit will, indeed, have a high probability of inducing sound land development and redevelopment in the northwest corridor would actual construction of the light rail transit facility in the corridor proceed.

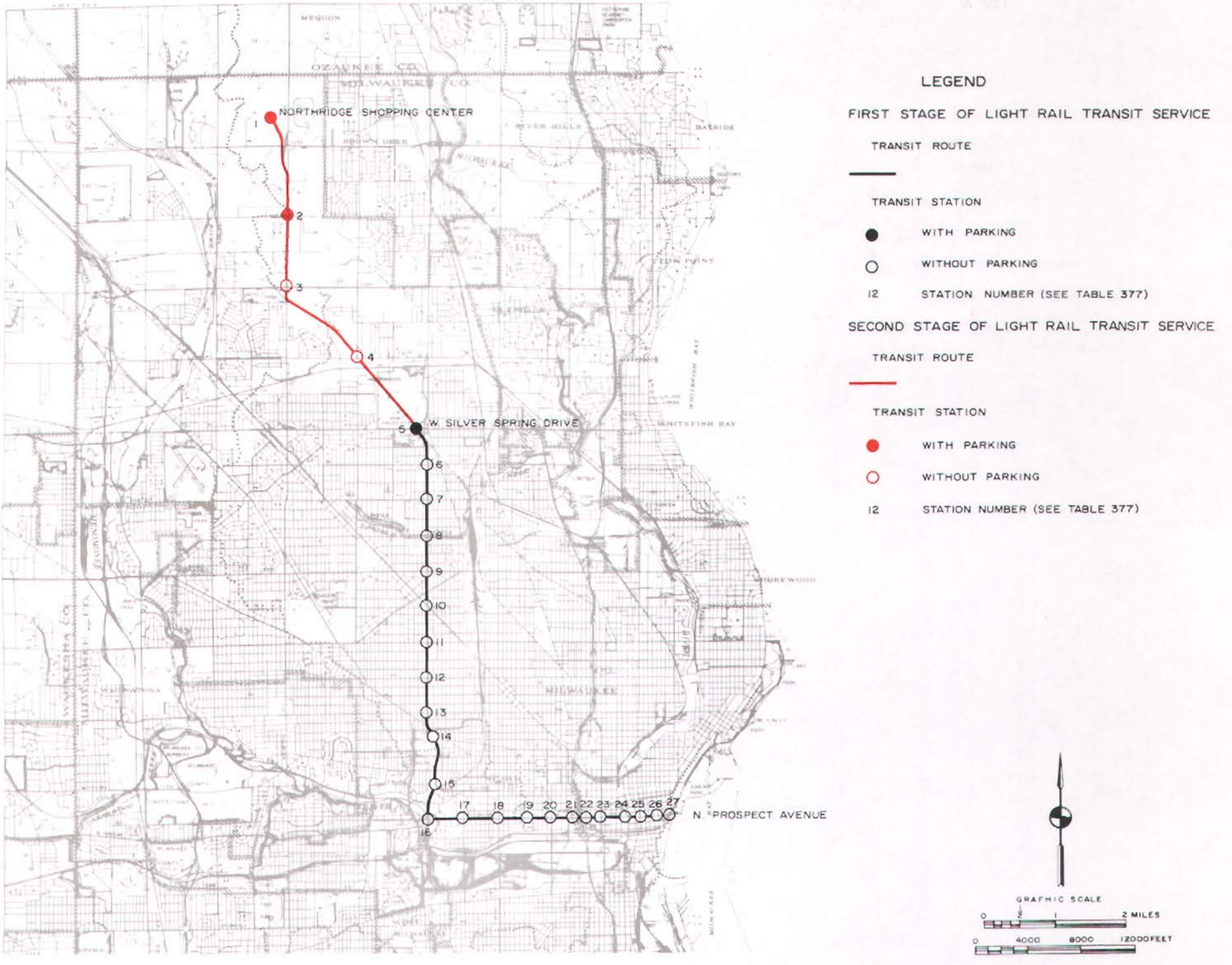
Upon acceptance of the preliminary engineering report by the governmental units and agencies affected, the final design phase would be initiated. This work would be carried out either by the staff of one or more of the governmental units or agencies involved or by a consulting firm retained by those governmental units or agencies. Starting with the solution to the problem at hand as set forth in the final, approved version of the preliminary engineering phase, the final design phase would move toward the development of detailed construction plans and specifications needed to implement the recommended solution. The plans and specifications would be carried to sufficient detail not only to permit potential contractors to submit bids for the project, but also to permit those contractors actually to construct the recommended works. Engineers retained to carry out the final phase may also have responsibility for securing the necessary permits and other approvals from regulatory and review agencies, for providing supervisory and inspection services during the actual construction process, and for certifying to the governmental units and agencies involved that the construction is carried out in accordance with the design provisions and specifications. Construction, the third and final phase of implementation necessary prior to the operation of a light rail transit facility in the northwest corridor, would then begin.

Bus-on-Freeway Element: It is proposed that the bus-on-freeway element of this plan, if recommended, be implemented in three stages. Those proposals of the plan which are the most certain to be needed and cost-effective are to be implemented in the first stage. This stage would include all those bus-on-metered freeway facilities and services which were shown to work well under the full range of future conditions in the Milwaukee area, as shown on Map 150 and in Tables 377 and 378. The bus-on-freeway routes and stations under this plan are those of the truncated bus-on-freeway plan tested and evaluated under the most pessimistic future, the stable or declining growth scenario-decentralized land use plan future, but modified to include a light rail transit facility in the northwest corridor and to be adaptable to the possible future conversion to light rail transit or commuter rail operation as proposed in the upper tier of the plan.

Under this first stage of plan implementation, bus-on-freeway primary transit service would be provided on five routes totaling 262 route miles

Map 149

POSSIBLE STAGING OF IMPLEMENTATION OF THE LIGHT RAIL ELEMENT OF THE LOWER TIER OF THE TWO-TIER PRIMARY TRANSIT SYSTEM ELEMENT



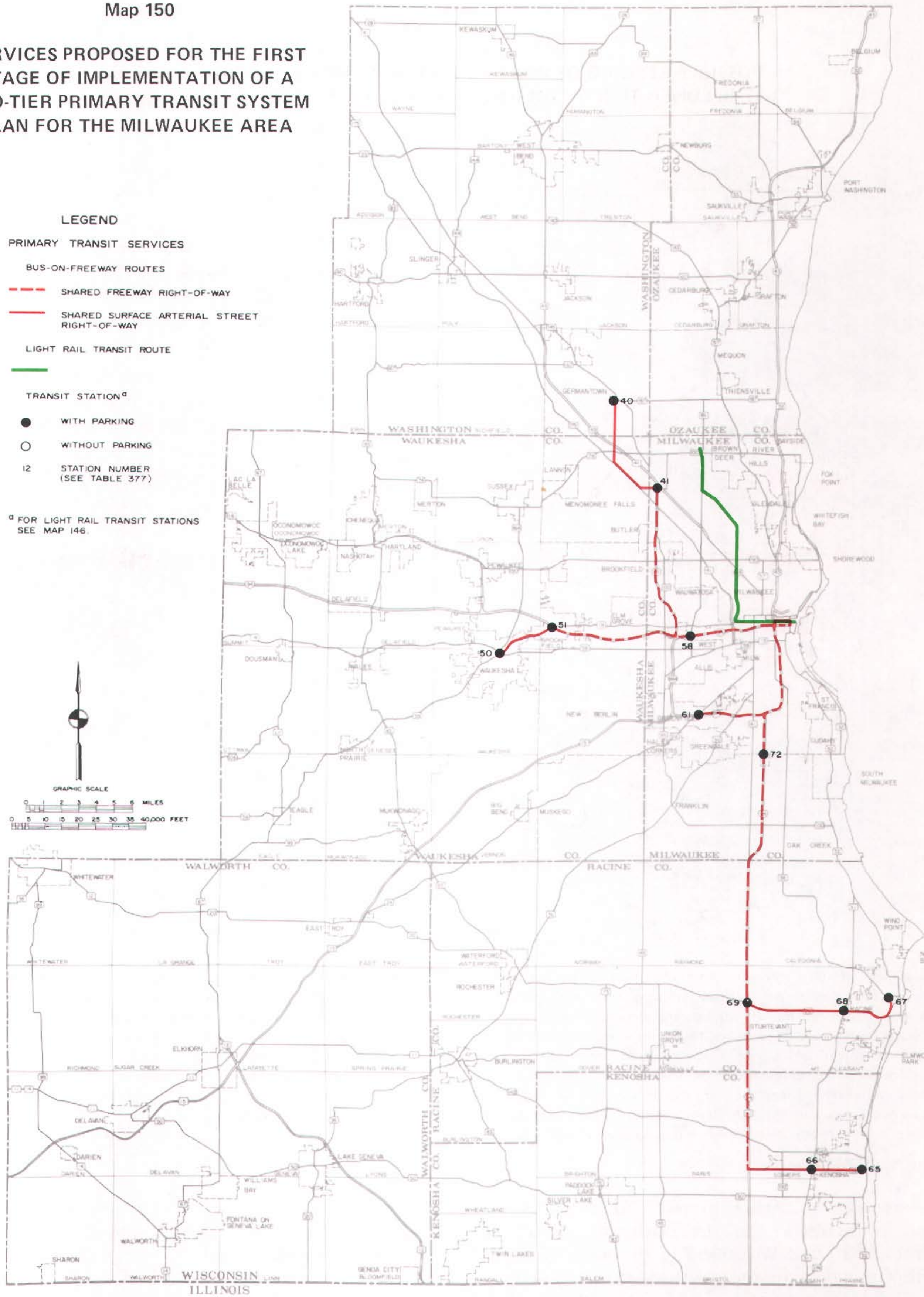
The lower tier of the two-tier alternative plan option for the development of primary transit service in the Milwaukee area proposes that a primary transit system be developed that includes both light rail transit and bus-on-metered freeway facilities and services. The recommended lower-tier light rail transit facilities and services, a single route in the northwest corridor of the Milwaukee area, would be implemented in three phases: preliminary engineering, final design, and construction. In the first phase, preliminary engineering, the staging of implementation of this light rail transit facility would be considered. Shown on this map is one possible staging which was developed based primarily upon the existing land development and transit ridership in the northwest corridor. The first stage from approximately N. Prospect Avenue to W. Silver Spring Drive would have a length of about 9.5 miles and would entail a guideway construction capital investment of about $92.3 million. The second stage would extend the light rail facility to the Northridge Shopping Center at approximately N. 76th Street and W. Brown Deer Road. It would have a length of about 4.8 miles and would entail a guideway construction capital investment of about $49.1 million.

Source: SEWRPC.

between downtown Milwaukee, Menomonee Falls, and Germantown to the northwest; West Allis, Brookfield, and Waukesha to the west; Greenfield and Greendale to the southwest; and Oak Creek, Racine, and Kenosha to the south. The service to the communities of Menomonee Falls and Germantown to the northwest and Racine and Kenosha to the south would represent an extension of existing bus-on-freeway service. All the other bus-on-freeway primary transit service under this first stage of plan implementation would represent an expansion of the bus-on-freeway service presently provided from peak-period service only to midday and evening off-peak-period service as well.

Map 150

SERVICES PROPOSED FOR THE FIRST STAGE OF IMPLEMENTATION OF A TWO-TIER PRIMARY TRANSIT SYSTEM PLAN FOR THE MILWAUKEE AREA



The lower tier of the two-tier alternative plan option for the development of primary transit service in the Milwaukee area proposes that a primary transit system be developed that includes both light rail transit and bus-on-metered freeway facilities and services. Implementation of the single light rail transit route in Milwaukee's northwest corridor would occur in three phases: preliminary engineering, final design, and facility construction. Implementation of bus-on-freeway operations would occur in three stages, the first of which is shown on this map. The first stage would include those bus-on-freeway services which were shown to work well under the full range of future conditions expected to occur in the Milwaukee area. Service would be provided on five routes totaling 262 route miles and including 12 transit stations outside the Milwaukee central business district, all of which have park-ride lots. Of the 12 stations, 4 would be located within Milwaukee County, all of which have park-ride facilities. It is also recommended that, under this plan option, the areawide freeway traffic management system be implemented as part of this stage.

Source: SEWRPC.

Table 377

STAGING OF IMPLEMENTATION OF LIGHT RAIL TRANSIT AND BUS-ON-FREEWAY ROUTES UNDER THE TWO-TIER SYSTEM PLAN

Primary Transit Routes Recommended for Implementation Under the First Stage of the Two-Tier System Plan		
Light Rail Transit Service		
Route	Station Number	Stations
Milwaukee-Northridge Shopping Center	1	Northridge Shopping Center
	2	N. 76th Street and W. Bradley Road
	3	N. 76th Street and W. Good Hope Road
	4	N. 60th Street and W. Mill Road
	5	N. Sherman Boulevard and W. Silver Spring Drive
	6	N. Sherman Boulevard and W. Villard Avenue
	7	N. Sherman Boulevard and W. Hampton Avenue
	8	N. Sherman Boulevard and W. Congress Street
	9	N. Sherman Boulevard and W. Capitol Drive
	10	N. Sherman Boulevard and W. Fond du Lac Avenue
	11	N. Sherman Boulevard and W. Burleigh Street
	12	N. Sherman Boulevard and W. Center Street
	13	N. Sherman Boulevard and W. North Avenue
	14	N. 40th Street and W. Lisbon Avenue
	15	W. Highland Boulevard and W. Vliet Street
	16	N. 44th Street and W. Wisconsin Avenue
	17	N. 35th Street and W. Wisconsin Avenue
	18	N. 27th Street and W. Wisconsin Avenue
	19	N. 21st Street and W. Wisconsin Avenue
	20	N. 16th Street and W. Wisconsin Avenue
	21	N. 12th Street and W. Wisconsin Avenue
	22	N. 9th Street and W. Wisconsin Avenue
	23	N. 6th Street and W. Wisconsin Avenue
	24	N. 2nd Street and E. Wisconsin Avenue
	25	N. Broadway and E. Wisconsin Avenue
	26	N. Jackson Street and E. Wisconsin Avenue
	27	N. Prospect Avenue and E. Wisconsin Avenue

Bus-on-Freeway Service		
Route	Station Number	Stations
7—Germantown/Menomonee Falls	40	N. Pilgrim Road and W. Mequon Road
	41	STH 175 and W. Good Hope Road
	58	N. 84th Street and IH 94
	24	N. 2nd Street and W. Wisconsin Avenue
11—Waukesha	50	N. Barstow Street and W. Main Street
	51	N. Barker Road and W. Blue Mound Road
	58	N. 84th Street and IH 94
	24	N. 2nd Street and W. Wisconsin Avenue
14—Greenfield	61	S. 76th Street and W. Cold Spring Road
	24	N. 2nd Street and W. Wisconsin Avenue
17—Kenosha	65	14th Avenue and 54th Street
	66	STH 31 and 52nd Avenue
	72	IH 94 and W. College Avenue
	24	N. 2nd Street and W. Wisconsin Avenue
18—Racine	67	Memorial Drive and State Street
	69	IH 94 and STH 20
	72	IH 94 and W. College Avenue
	24	N. 2nd Street and W. Wisconsin Avenue

Table 377 (continued)

Bus-on-Freeway Routes Recommended for Implementation Under the Second Stage of the Two-Tier System Plan		
Route	Station Number	Stations
1—Port Washington	28	IH 43 and STH 33
	29	IH 43 and CTH Q
	34	IH 43 and W. Silver Spring Drive
	35	IH 43 and W. North Avenue
	24	N. 2nd Street and W. Wisconsin Avenue
4—River Hills	34	IH 43 and W. Silver Spring Drive
	35	IH 43 and W. North Avenue
	24	N. 2nd Street and W. Wisconsin Avenue
9—Oconomowoc	45	S. Main Street and E. Wisconsin Avenue
	46	Lakeland Road and STH 16
	47	Merton Avenue and STH 16
	48	Main Street and USH 16
	56	N. Moorland Road and IH 94
	58	N. 84th Street and IH 94
	24	N. 2nd Street and W. Wisconsin Avenue
10—Pewaukee	49	Grandview Boulevard and IH 94
	56	N. Moorland Road and IH 94
	58	N. 84th Street and IH 94
	24	N. 2nd Street and W. Wisconsin Avenue
15—West Allis	57	USH 45 and W. National Avenue
	24	N. 2nd Street and W. Wisconsin Avenue
19—Oak Creek/Ryan Road	70	IH 94 and Ryan Road
	24	N. 2nd Street and W. Wisconsin Avenue
22—South Side/Holt Avenue	73	IH 94 and W. Holt Avenue
	24	N. 2nd Street and W. Wisconsin Avenue

Bus-on-Freeway Routes Recommended for Implementation Under the Third Stage of the Two-Tier System Plan		
Route	Station Number	Stations
2—Cedarburg/Grafton	30	S. 1st Avenue and Wisconsin Avenue
	31	IH 43 and CTH C
	34	IH 43 and W. Silver Spring Drive
	35	IH 43 and W. North Avenue
	24	N. 2nd Street and W. Wisconsin Avenue
3—Mequon	32	Cedarburg Road and Highland Road
	33	IH 43 and Mequon Road
	34	IH 43 and W. Silver Spring Drive
	35	IH 43 and W. North Avenue
	24	N. 2nd Street and W. Wisconsin Avenue
5—Wauwatosa	44	USH 45 and W. Watertown Plank Road
	59	Cemetery Access Road and IH 94
	24	N. 2nd Street and W. Wisconsin Avenue
6—West Bend	36	S. Main Street and W. Washington Avenue
	37	S. Main Street and Paradise Avenue
	38	USH 45 and STH 60
	39	USH 45 and USH 145
	58	N. 84th Street and IH 94
	24	N. 2nd Street and W. Wisconsin Avenue

Table 377 (continued)

Bus-on-Freeway Routes Recommended for Implementation Under the Third Stage of the Two-Tier System Plan		
Route	Station Number	Stations
8—Brookfield	42 43 58 24	N. Calhoun Road and W. Capitol Drive N. 124th Street and W. Capitol Drive N. 84th Street and IH 94 N. 2nd Street and W. Wisconsin Avenue
12—Mukwonago	52 53 54 55 56 58 24	STH 83 and STH 15 CTH F and STH 15 Racine Avenue and STH 15 S. Moorland Road and STH 15 N. Moorland Road and IH 94 N. 84th Street and IH 94 N. 2nd Street and W. Wisconsin Avenue
13—Hales Corners	60 24	S. 108th Street and STH 15 N. 2nd Street and W. Wisconsin Avenue
16—Franklin	62 63 64 24	W. Loomis Road and W. Rawson Avenue W. Loomis Road and W. Grange Avenue S. 27th Street and IH 894 N. 2nd Street and W. Wisconsin Avenue
20—Oak Creek/Rawson Avenue	71 24	13th Avenue and E. Rawson Avenue N. 2nd Street and W. Wisconsin Avenue
21—South Side/College Avenue	72 24	College Avenue and IH 94 N. 2nd Street and W. Wisconsin Avenue

Source: SEWRPC.

Under the first stage of plan implementation, a total of 12 bus-on-freeway transit stations would be provided outside the Milwaukee central business district, all of which would have park-ride lots. Ten of these 12 stations, all of which would have park-ride lots, are not part of the present bus-on-freeway system. Four of the 12 stations would be located in Milwaukee County, all of which would have park-ride facilities. It is also recommended that the areawide freeway traffic management system be implemented as part of the first stage of the recommended plan.

If recommended, the second stage of implementation of the plan would include those bus-on-freeway facilities and services which would be expected to work well under the intermediate future conditions for the Milwaukee area, but not under the most pessimistic conditions. These facilities and services would be implemented only after the first stage of recommendations had been implemented, and then only if it appeared that future conditions in the Milwaukee area were progressing toward those considered under this study to be intermediate with respect to future transit needs and use—that is, those postulated under either of the two intermediate alternative futures: the stable or declining growth scenario-centralized land use plan future or the moderate growth scenario-decentralized land use plan future.

As shown on Map 151, seven additional bus-on-freeway routes, representing 252 route miles of service, would be added to the primary transit system under this second stage of plan implementation. This second stage of the plan would extend bus-on-freeway service to the communities of Saukville and Port Washington. In addition, it would increase bus-on-freeway service to the communities of Whitefish Bay, Glendale, West Allis, Oak Creek, Oconomowoc, Nashotah, Hartland, Pewaukee, and Waukesha over that provided under the first stage of the plan. Thirteen transit stations in addition to those existing after implementation of the first stage of the plan would be required under the second stage, 12 of which would have park-ride lots. Five of these additional stations would be located in Milwaukee County, four of which would have park-ride facilities. Thus, implementation of the second stage of the plan would result in an

Table 378

STAGING OF IMPLEMENTATION OF LIGHT RAIL TRANSIT AND BUS-ON-FREEWAY STATIONS UNDER THE TWO-TIER SYSTEM PLAN

Primary Transit Stations Recommended for Implementation Under the First Stage of the Two-Tier System Plan

Light Rail Transit Service

Station Number	Intersection	Civil Division	Status	Passenger Facilities	
				Shelter	Parking
1	Northridge Shopping Center	City of Milwaukee	Proposed	Yes	Yes
2	N. 76th Street and W. Bradley Road	City of Milwaukee	Proposed	Yes	Yes
3	N. 76th Street and W. Good Hope Road	City of Milwaukee	Proposed	Yes	No
4	N. 60th Street and W. Mill Road	City of Milwaukee	Proposed	Yes	No
5	N. Sherman Boulevard and W. Silver Spring Drive	City of Milwaukee	Proposed	Yes	Yes
6	N. Sherman Boulevard and W. Villard Avenue	City of Milwaukee	Proposed	Yes	No
7	N. Sherman Boulevard and W. Hampton Avenue	City of Milwaukee	Proposed	Yes	No
8	N. Sherman Boulevard and W. Congress Street	City of Milwaukee	Proposed	Yes	No
9	N. Sherman Boulevard and W. Capitol Drive	City of Milwaukee	Proposed	Yes	No
10	N. Sherman Boulevard and W. Fond du Lac Avenue	City of Milwaukee	Proposed	Yes	No
11	N. Sherman Boulevard and W. Burleigh Street	City of Milwaukee	Proposed	Yes	No
12	N. Sherman Boulevard and W. Center Street	City of Milwaukee	Proposed	Yes	No
13	N. Sherman Boulevard and W. North Avenue	City of Milwaukee	Proposed	Yes	No
14	N. 40th Street and W. Lisbon Avenue	City of Milwaukee	Proposed	Yes	No
15	W. Highland Boulevard and W. Vliet Street	City of Milwaukee	Proposed	Yes	No
16	N. 41st Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	No
17	N. 35th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	No
18	N. 27th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	No
19	N. 21st Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	No
20	N. 16th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	No
21	N. 12th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	No
22	N. 9th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	No
23	N. 6th Street and W. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	No
24	N. 2nd Street and E. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	No
25	N. Broadway and E. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	No
26	N. Jackson Street and E. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	No
27	N. Prospect Avenue and E. Wisconsin Avenue	City of Milwaukee	Proposed	Yes	No

Bus-on-Freeway Service

Station Number	Intersection	Civil Division	Status	Passenger Facilities	
				Shelter	Parking
40	Pilgrim Road and Mequon Road	Village of Germantown	Proposed	Yes	Yes
41	N. 107th Street and W. Good Hope Road	City of Milwaukee	Proposed	Yes	Yes
50	N. Barstow Street and W. Main Street	City of Waukesha	Proposed	Yes	Yes
51	N. Barker Road and W. Blue Mound Road	Town of Brookfield	Existing	Yes	Yes
58	N. 84th Street and IH 94	City of Milwaukee	Proposed	Yes	Yes
61	S. 76th Street and W. Cold Spring Road	City of Greenfield	Proposed	Yes	Yes
65	14th Avenue and 54th Street	City of Kenosha	Existing	Yes	Yes
66	STH 31 and 52nd Avenue	City of Kenosha	Proposed	Yes	Yes
67	Memorial Drive and State Street	City of Racine	Proposed	Yes	Yes
68	STH 31 and 12th Street	Town of Mt. Pleasant	Proposed	Yes	Yes
69	IH 94 and STH 20	Town of Mt. Pleasant	Proposed	Yes	Yes
72	IH 94 and W. College Avenue	City of Milwaukee	Existing	Yes	Yes

Table 378 (continued)

Bus-on-Freeway Stations Recommended for Implementation Under the Second Stage of the Two-Tier System Plan					
Station Number	Intersection	Civil Division	Status	Passenger Facilities	
				Shelter	Parking
28	IH 43 and STH 33	Village of Saukville	Proposed	Yes	Yes
29	IH 43 and CTH Q	Town of Grafton	Proposed	Yes	Yes
34	IH 43 and W. Silver Spring Drive	Village of Glendale	Existing	Yes	Yes
35	IH 43 and W. North Avenue	City of Milwaukee	Proposed	Yes	No
45	S. Main Street and E. Wisconsin Avenue	City of Oconomowoc	Proposed	Yes	Yes
46	Lakeland Road and STH 16	Village of Nashotah	Existing	Yes	Yes
47	Merton Avenue and STH 16	Village of Hartland	Proposed	Yes	Yes
48	Main Street and USH 16	Village of Pewaukee	Proposed	Yes	Yes
49	Grandview Boulevard and IH 94	City of Waukesha	Proposed	Yes	Yes
56	N. Moorland Road and IH 94	City of Brookfield	Proposed	Yes	Yes
57	USH 45 and W. National Avenue	City of West Allis	Proposed	Yes	Yes
70	IH 94 and Ryan Road	City of Oak Creek	Proposed	Yes	Yes
73	IH 94 and W. Holt Avenue	City of Milwaukee	Proposed	Yes	Yes

Bus-on-Freeway Stations Recommended for Implementation Under the Third Stage of the Two-Tier System Plan					
Station Number	Intersection	Civil Division	Status	Passenger Facilities	
				Shelter	Parking
30	S. 1st Avenue and Wisconsin Avenue	Village of Grafton	Proposed	Yes	Yes
31	IH 43 and CTH C	Town of Grafton	Existing	Yes	Yes
32	Cedarburg Road and Highland Road	City of Mequon	Existing	Yes	Yes
33	IH 43 and Mequon Road	City of Mequon	Proposed	Yes	Yes
36	N. Main Street and W. Washington Street	City of West Bend	Proposed	Yes	Yes
37	S. Main Street and W. Paradise Drive	City of West Bend	Proposed	Yes	Yes
38	USH 45 and STH 60	Town of Polk	Proposed	Yes	Yes
39	USH 45 and USH 145	Town of Polk	Proposed	Yes	Yes
42	N. Calhoun Road and W. Capitol Drive	City of Brookfield	Proposed	Yes	Yes
43	N. 124th Street and W. Capitol Drive	City of Wauwatosa	Proposed	Yes	Yes
44	USH 45 and W. Watertown Plank Road	City of Wauwatosa	Existing	Yes	Yes
59	Cemetery Access Road and IH 94	City of Milwaukee	Proposed	Yes	No
60	S. 108th Street and STH 15	City of Greenfield	Existing	Yes	Yes
62	W. Loomis Road and W. Rawson Avenue	City of Franklin	Proposed	Yes	Yes
63	W. Loomis Road and W. Grange Avenue	Village of Greendale	Proposed	Yes	No
64	S. 27th Street and IH 894	City of Milwaukee	Proposed	Yes	Yes
52	STH 83 and STH 15	Town of Mukwonago	Existing	Yes	Yes
53	CTH F and STH 15	Town of Vernon	Existing	Yes	Yes
54	Racine Avenue and STH 15	City of New Berlin	Existing	Yes	Yes
55	S. Moorland Road and STH 15	City of New Berlin	Proposed	Yes	Yes
71	13th Avenue and E. Rawson Avenue	City of Oak Creek	Proposed	Yes	Yes

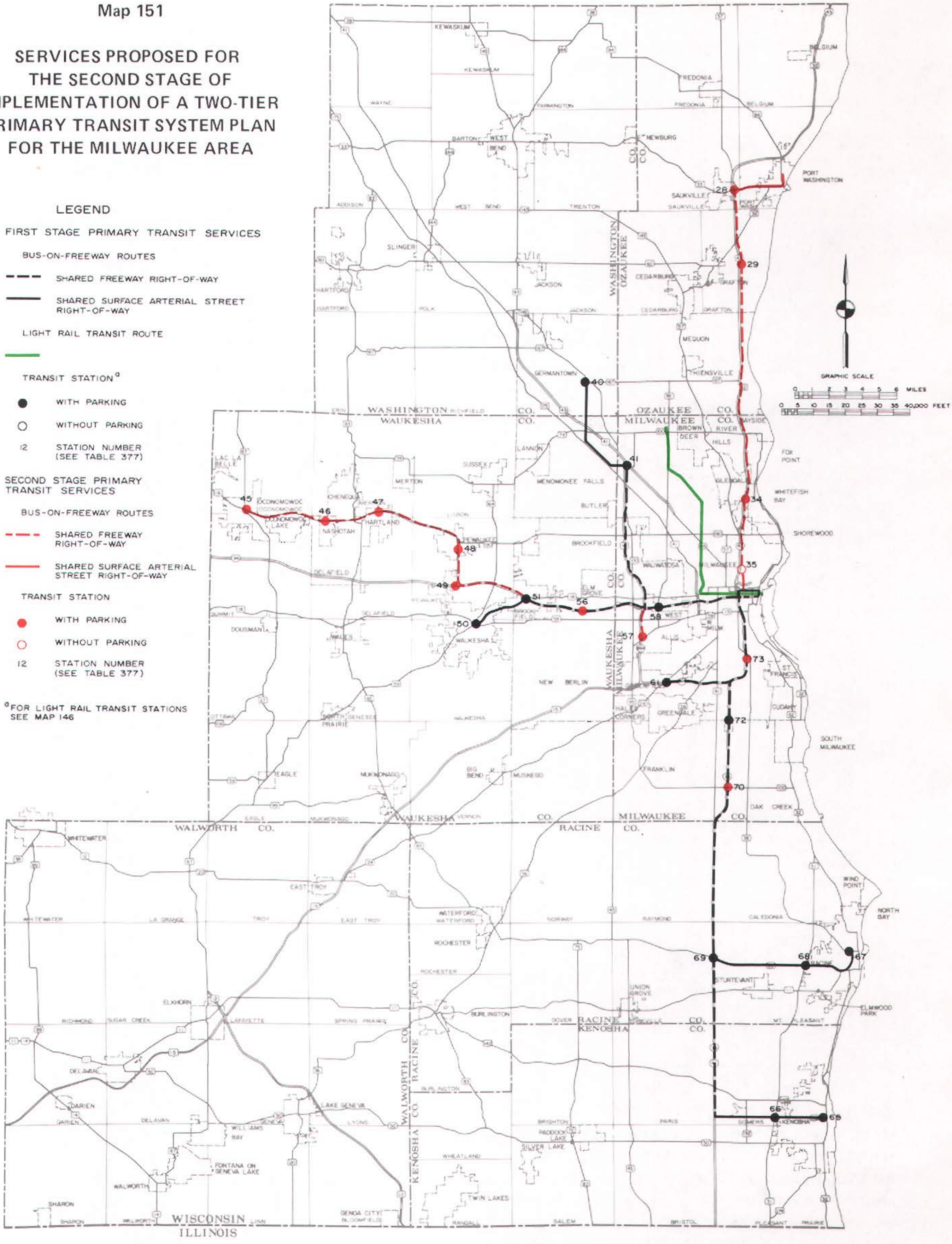
Source: SEWRPC.

extent of bus-on-metered freeway facilities and services equivalent to those of the bus-on-freeway truncated plans tested and evaluated under the intermediate stable or declining growth scenario-centralized land use plan future and moderate growth scenario-decentralized land use plan future, but modified to include a light rail transit facility in the northwest corridor and to be adaptable to the possible conversion to light rail transit or commuter rail.

The remaining 10 routes of this bus-on-metered freeway element of the plan, which would be implemented under the third and final stage of the plan, are those routes which would be expected to work well only if future conditions in the Milwaukee area approach those considered to be the most optimistic for transit needs and use over the plan design period. As shown on Map 152, these 10 routes would represent an additional 386 route miles of service. This third stage of the plan would

Map 151

SERVICES PROPOSED FOR THE SECOND STAGE OF IMPLEMENTATION OF A TWO-TIER PRIMARY TRANSIT SYSTEM PLAN FOR THE MILWAUKEE AREA



The lower tier of the two-tier alternative plan option for the development of primary transit service in the Milwaukee area proposes that a primary transit system be developed that includes both light rail transit and bus-on-metered freeway facilities and services. Implementation of the single light rail transit route in Milwaukee's northwest corridor would occur over three phases: preliminary engineering, final design, and actual facility construction. Implementation of bus-on-freeway operations would occur in three stages, the second of which is shown on this map. The second stage would include those bus-on-freeway services which were shown to work well under either of the two intermediate alternative futures postulated for the Milwaukee area under this study. Service would be provided on seven additional routes, adding 252 route miles to the system as developed under the first stage, and including 13 additional transit stations, outside the Milwaukee central business district, 12 of which would have park-ride lots. Of the 13 stations, 5 would be located within Milwaukee County, 4 of which would have park-ride facilities.

Source: SEWRPC.

Map 152

SERVICES PROPOSED FOR THE THIRD STAGE OF IMPLEMENTATION OF A TWO-TIER PRIMARY TRANSIT SYSTEM PLAN FOR THE MILWAUKEE AREA

LEGEND

FIRST AND SECOND STAGE PRIMARY TRANSIT SERVICES

BUS-ON-FREEWAY ROUTES

SHARED FREEWAY RIGHT-OF-WAY

SHARED SURFACE ARTERIAL STREET RIGHT-OF-WAY

LIGHT RAIL TRANSIT ROUTE

TRANSIT STATION[a]

WITH PARKING

WITHOUT PARKING

12 STATION NUMBER (SEE TABLE 377)

THIRD STAGE PRIMARY TRANSIT SERVICES

BUS-ON-FREEWAY ROUTES

SHARED FREEWAY RIGHT-OF-WAY

SHARED SURFACE ARTERIAL STREET RIGHT-OF-WAY

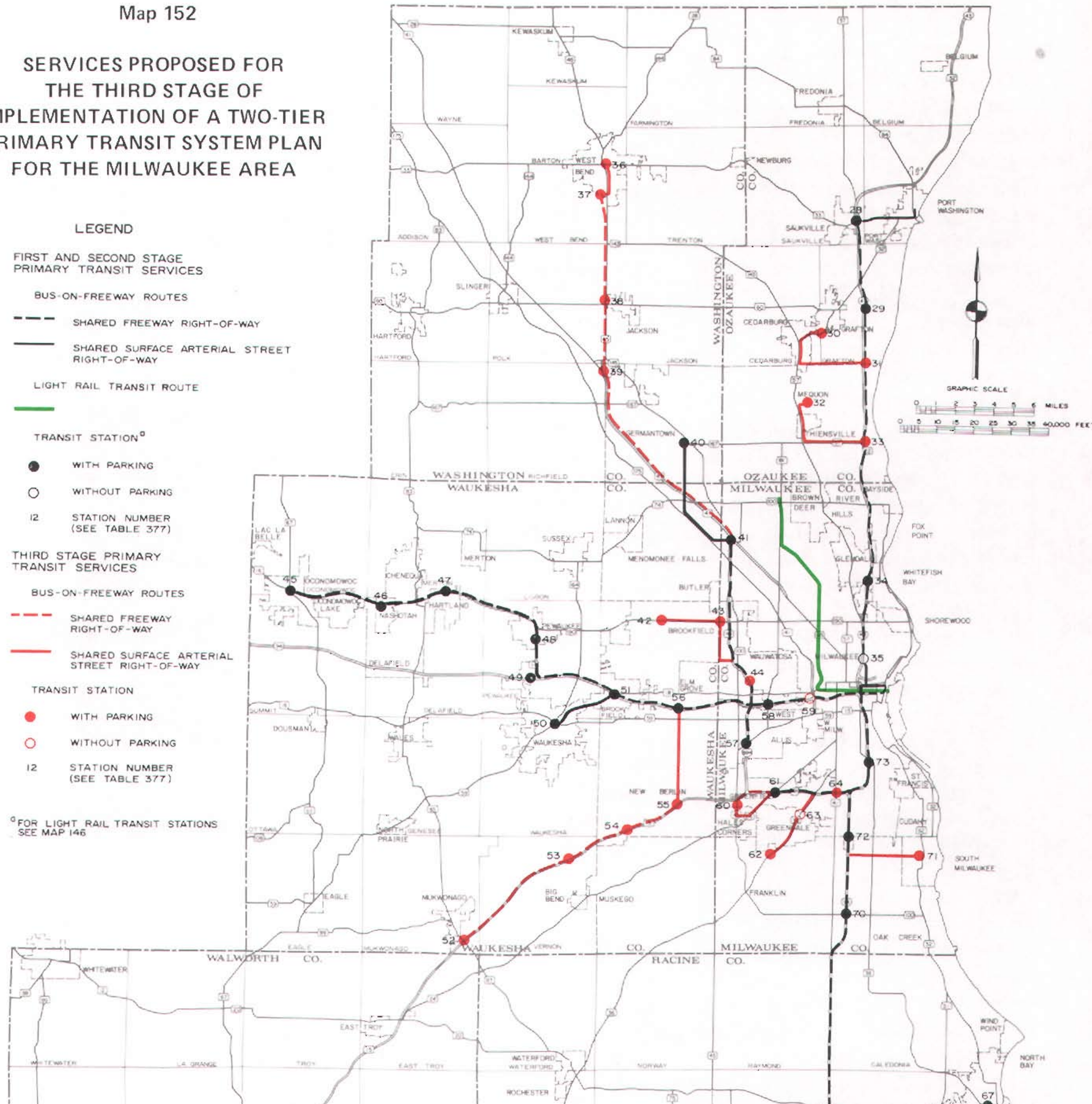
TRANSIT STATION

WITH PARKING

WITHOUT PARKING

12 STATION NUMBER (SEE TABLE 377)

[a] FOR LIGHT RAIL TRANSIT STATIONS SEE MAP 146



The lower tier of the two-tier alternative plan option for the development of primary transit service in the Milwaukee area proposes that a primary transit system be developed that includes both light rail transit and bus-on-metered freeway facilities and services. Implementation of the single light rail transit route in Milwaukee's northwest corridor would occur over three phases: preliminary engineering, final design, and facility construction. Implementation of bus-on-metered freeway operations would occur in three stages, the third of which is shown on this map. The third stage would include those bus-on-freeway services which were shown to work well only if future conditions in the Milwaukee area approach those considered to be the most optimistic for transit use over the plan design period. Under this final stage of plan implementation, service would be provided on 10 additional routes, adding 386 route miles to the system as developed under the second stage, and including 21 additional transit stations outside the Milwaukee central business district, 19 of which would have park-ride lots. Of the 21 stations, 7 would be located within Milwaukee County, 5 of which would have park-ride facilities.

Source: SEWRPC.

extend bus-on-freeway service to the communities of Mequon, Thiensville, Cedarburg, and Grafton in Ozaukee County; West Bend and Jackson in Washington County; Mukwonago, Big Bend, Muskego, New Berlin, and Butler in Waukesha County; and Hales Corners, Franklin, and South Milwaukee in Milwaukee County. It would also expand bus-on-freeway service provided under the second stage of plan implementation to the communities of Wauwatosa, Menomonee Falls, Brookfield, and Greendale. An additional 21 transit stations would be provided with these routes, 19 of which would have park-ride lots. Seven of these stations and 5 of these park-ride lots would be located in Milwaukee County. These additional facilities and services would be implemented only after the first two stages of recommendations had been implemented, and only if it appeared that conditions in the Milwaukee area were progressing toward those considered under this study to be the most optimistic with respect to future transit needs and use. This third stage of plan implementation would include all bus-on-freeway facilities and services in the truncated bus-on-freeway plan tested and evaluated under the moderate growth scenario-centralized land use plan alternative future, but modified to include a light rail transit facility in the northwest corridor and to be adaptable to the possible future conversion to light rail transit or commuter rail as appropriate.

Performance and Cost of the Two Primary Transit Plan Options

In the following section of this chapter, the performance and cost of each of the two options which the Commission staff determined could be recommended for adoption as the long-range primary transit system plan for the Milwaukee area are presented. This comparison of the performance and cost of these two plan options is based upon the degree to which the plans could be expected to meet the primary transit system development objectives adopted early in the study, and includes consideration of cost and ridership, as well as of accessibility, level of service, energy consumption, and environmental impacts, including air pollution and community disruption. In addition, the comparison, to the extent possible, considers the intangible implications of the plan options which could not be quantitatively measured with any degree of certainty.

Table 379 provides a summary of the degree to which each of the two primary transit options meets the adopted objectives, and compares this performance to that of a base plan. The base plan consists of the existing transit system together with presently planned short-range improvements as adopted by the Milwaukee County Board on September 10, 1980. This comparison to the base plan is intended to make apparent the advantages of the long-range improvement of transit service, as well as of the costs attendant to such improvement.

The two plan options provide substantial improvements and increases in transit service over the base system plan. As shown on Maps 142 and 146, the two recommended plan options call for the expansion of primary transit service within Milwaukee County, and the extension of service to the south to the Cities of Racine and Kenosha; to the southwest to the Village of Mukwonago in Waukesha County; to the northwest to the City of West Bend in Washington County; and to the north to the City of Port Washington in Ozaukee County. In addition, both of the improvement plans would expand primary transit service beyond operation during the weekday peak travel periods to all-day weekday service at maximum headways of 30 minutes in peak travel periods and 60 minutes in off-peak travel periods. The plans also recommend a higher level of primary transit service through the provision of extensive preferential treatment for transit vehicles.

The number of primary transit route miles of service under the recommended plan options increases from the 450 miles under the base plan to nearly 800 route miles under the stable or declining growth scenario-decentralized land use plan alternative future, and to nearly 1,000 route miles under the moderate growth scenario-centralized land use plan alternative future, as shown in Table 380. The number of vehicle miles of primary transit service under the recommended plan options would increase five-fold under the most optimistic future for transit use in the Milwaukee area, and would more than double under the most pessimistic future.

Both recommended plan options also envision complementary expansion and improvement of the express and local elements of the Milwaukee area transit system. Five additional express, or limited-stop, routes would be provided in addition to the seven routes included in the base plan—only three of which were actually in operation in 1980. These 12 express routes would operate in a coordinated manner with the expanded primary transit system. The local transit system element in the Milwaukee area would be extended where cost-effective into contiguous areas of urban development, including northern and southern Milwaukee County and parts of southern Ozaukee County, southeastern Washington County, and eastern Waukesha County. Route miles of express and local service operated would increase from about 1,300 miles under the base plan to between 1,400 and 1,500 miles under the recommended plan options--the lower total under the pessimistic stable or declining growth scenario-decentralized land use plan alternative future, and the higher total under the optimistic moderate growth scenario-centralized land use plan alternative future. Vehicle miles of express and local service operated would increase from the base plan level only under the more optimistic future, and then only by 5 percent from the base plan level of 85,000 miles on an average weekday to about 90,000 bus miles under the two recommended plan options.

Objective 1 Serve Land Use

The first objective under this study identified the need for an accessible primary transit system which, through its location, capacity, and design, will effectively serve existing, and promote sound future, land use development. This objective was measured by two standards. One standard measured the degree to which transit accessibility to the Milwaukee central business district would be maximized. The other standard measured the degree to which transit accessibility in the Milwaukee area would support the regional land use plan by providing a higher relative accessibility to areas in which high- and medium-density urban development is planned than to areas planned for low-density urban development or planned to be protected from urban development.

The standard calling for maximizing transit accessibility to the Milwaukee central business district was measured by determining the overall travel time, including all access, wait, and transfer time, for transit trips to the Milwaukee central business district from all parts of the Milwaukee area, and the travel times for transit trips as an average for the entire Milwaukee area. The average overall travel times of transit trips to the central business district were determined to be about the same under the two recommended plan options and under the base plan, ranging from 34 minutes under the bus-on-freeway and two-tier plans to 35 minutes under the base plan. However, this similarity is due in large part to the shorter average trips to the central business district expected to be made under the base plan. Transit speed and accessibility to the central business district would be significantly increased under both plan options compared to the base plan, as shown on Maps 76 and 77 in Chapter III and Map 153, which show overall transit travel times from each part of the Milwaukee area to the central business district through travel time contour lines.

The attainment of the other standard under this objective, which calls for adjusting transit accessibility to land use plans, was measured by comparing these contours of central business district transit accessibility to the regional land use plan.[9] The Milwaukee central business district is the most important trip generator in the Milwaukee area and would, under the range of alternative futures, remain so, accounting for over 6 percent of the approximately 4.4 million trips expected to be made within the Milwaukee area on an average weekday under the optimistic moderate growth scenario-centralized land use plan alternative future, and for 5 percent of the approximately 3.6 million trips expected to be made under the pessimistic stable or declining growth scenario-decentralized land use plan alternative future. It would also be the singularly most important transit trip generator, accounting for about 25 percent of the average weekday transit trips made under each alternative plan. As shown on Maps 76 and 77 in Chapter III and Map 153, all the plans would generally support the adopted regional land use plan through provision of a good accessibility pattern.

Objective 2—Cost and Energy

The second objective concerns the provision of a rapid transit system which is economical and efficient, satisfying all other objectives at the lowest possible cost. This objective is supported by key standards relating to the minimization of costs and energy consumption, and the maximization of cost-effectiveness. As shown in Table 379, the base plan would, as expected, have the lowest total public cost, including all capital and net operating and maintenance costs. The total public cost of the

[9] *The regional land use plan recommends a highly centralized land use development pattern. Population and jobs are proposed to be reconcentrated in central Milwaukee County, and new urban development is proposed to occur principally at urban densities along and contiguous to the periphery of existing urban centers (see SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume Two, Alternative and Recommended Plans).*

Table 379

SUMMARY OF EVALUATION OF THE BASE SYSTEM PLAN, BUS-ON-METERED FREEWAY SYSTEM PLAN, AND LOWER TIER OF THE TWO-TIER SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN AND STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

	Alternative					
	Base Plan		Bus-on-Metered Freeway Plan		Lower Tier of the Two-Tier System Plan	
	Optimistic Scenario	Pessimistic Scenario	Optimistic Scenario	Pessimistic Scenario	Optimistic Scenario	Pessimistic Scenario
Evaluative Measure	Moderate Growth-Centralized Land Use Plan	Stable or Declining Growth-Decentralized Land Use Plan	Moderate Growth-Centralized Land Use Plan	Stable or Declining Growth-Decentralized Land Use Plan	Moderate Growth-Centralized Land Use Plan	Stable or Declining Growth-Decentralized Land Use Plan
Objective No. 1—Serve Land Use						
Accessibility						
Average Overall Travel Time of Transit Trips to the Milwaukee Central Business District (minutes)	35	35	34	34	34	34
Objective No. 2—Minimize Cost and Energy Use						
Cost						
Total Public Cost to Design Year (capital cost and operating and maintenance deficit)	$579,742,000	$483,703,200	$722,873,900	$567,486,900	$812,880,000	$619,931,500
Average Annual Total Public Cost	27,606,600	23,033,500	34,422,600	27,023,100	38,708,600	29,520,500
Capital Cost						
Capital Cost to Design Year	148,840,000	107,761,000	214,323,900	160,906,900	306,300,000	217,931,500
Average Annual Capital Cost	7,087,600	5,131,500	10,205,900	7,662,200	14,585,700	10,377,700
Capital Investment to Design Year	233,328,700	161,597,700	329,729,600	229,867,300	470,700,000	364,526,300
Average Annual Capital Investment	11,110,900	7,695,100	15,701,400	10,946,000	22,414,300	17,358,400
Operating and Maintenance Deficit (net cost)						
Deficit in Design Year	23,198,300	16,328,700	32,904,700	20,158,500	32,658,400	19,481,200
Deficit to Design Year	430,900,000	375,942,200	508,550,000	406,580,000	506,580,000	402,000,000
Average Annual Deficit	20,519,000	17,902,000	24,216,700	19,360,900	24,122,900	19,142,900
Cost-Effectiveness						
Total Public Cost to Design Year per Passenger	0.39	0.43	0.46	0.50	0.52	0.54
Capital Cost to Design Year per Passenger	0.10	0.10	0.14	0.14	0.20	0.19
Operating Deficit to Design Year per Passenger	0.29	0.33	0.32	0.36	0.32	0.35
Total Public Cost to Design Year per Passenger Mile	0.10	0.11	0.09	0.12	0.10	0.13
Capital Cost to Design Year per Passenger Mile	0.03	0.03	0.03	0.03	0.04	0.05
Operating Deficit to Design Year per Passenger Mile	0.07	0.08	0.06	0.09	0.06	0.08
Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year						
Total Transit System	62	53	61	52	61	52
Primary Element	56	49	60	45	63	47
Energy						
Total Transit System Energy Use to Design Year (million BTU's)	20,278,020	15,037,280	22,305,100	16,120,900	23,213,700	16,551,300
Total Transit Construction Energy Use to Design Year (million BTU's)	1,498,400	1,044,480	1,840,100	1,335,200	2,414,700	1,875,800
Total Transit Operating and Maintenance Energy Use to Design Year (million BTU's)	18,779,620	13,992,800	20,465,000	14,785,700	20,799,000	14,675,500
Total Transit System Energy Use per Passenger Mile Traveled to Design Year (BTU's)	3,330	3,530	2,730	3,380	2,830	3,540
Total Transit Passenger Miles per Gallon of Diesel Fuel to Design Year (BTU's)	40.9	38.5	49.8	40.1	48.1	39.4
Dependence on Petroleum-Based Fuel	All trips dependent	All trips dependent	All trips dependent	All trips dependent	8 percent of transit trips not dependent	8 percent of transit trips not dependent
Petroleum-Based Fuel Use by Transit to Design Year (gallons of diesel fuel)	134,355,000	100,744,850	144,697,000	114,936,000	124,502,200	112,450,000
Automobile Propulsion Energy Use in Design Year (gallons of gasoline)	404,800,000	338,400,000	395,200,000	332,800,000	395,200,000	332,800,000
Objective Nos. 3 and 5—Provide Appropriate Service and Quick Travel						
Average Weekday Transit Trips in Design Year						
Total Transit System	326,800	169,400	371,300	176,000	372,900	176,300
Primary Element	15,000	9,500	75,100	22,500	96,300	34,200
Percent of Transit Trips Using Primary Element	4	6	20	12	26	19
Service Coverage						
Population Served Within a One-Half-Mile Walking Distance of Primary Transit Service	257,100	181,500	373,500	250,100	392,200	260,100
Population Served Within a Three-Mile Driving Distance of Primary Transit Service	1,012,400	698,800	1,620,700	933,167	1,300,000	930,600
Jobs Served Within One-Half-Mile Walking Distance of Primary Transit Service	237,000	194,600	293,600	253,100	309,300	260,200
Average Speed of Transit Vehicle (mph)						
Primary Element	19	24	29	27	29	27
Total System	14	15	18	17	18	17
Average Speed of Passenger Travel on Vehicle (mph)						
Primary Element	25	25	34	32	32	30
Total System	15	15	20	18	21	19

Table 379 (continued)

Evaluative Measure	Alternative: Base Plan — Optimistic Scenario: Moderate Growth-Centralized Land Use Plan	Base Plan — Pessimistic Scenario: Stable or Declining Growth-Decentralized Land Use Plan	Bus-on-Metered Freeway Plan — Optimistic Scenario: Moderate Growth-Centralized Land Use Plan	Bus-on-Metered Freeway Plan — Pessimistic Scenario: Stable or Declining Growth-Decentralized Land Use Plan	Lower Tier of the Two-Tier System Plan — Optimistic Scenario: Moderate Growth-Centralized Land Use Plan	Lower Tier of the Two-Tier System Plan — Pessimistic Scenario: Stable or Declining Growth-Decentralized Land Use Plan
Objective No. 4—Minimize Environmental Impacts						
Community Disruption						
Homes, Businesses, or Industries Taken	None	None	None	None	None	None
Land Required (acres)	12	10	70	20	120	60
Air Pollutant Emissions—Total Transportation System (Highway and Transit) in Design Year (tons per year)						
Carbon Monoxide	171,200	165,800	167,400	163,100	167,300	163,100
Hydrocarbons	17,400	16,700	16,900	16,400	16,900	16,400
Nitrogen Oxides	30,700	30,100	30,000	29,200	30,000	29,200
Sulfur Oxides	2,500	2,400	2,500	2,400	2,600	2,400
Particulates	4,100	4,000	4,000	3,900	4,000	3,900
Objective No. 6—Maximize Safety						
Proportion of Total Person Trips Made on Transit	0.074	0.047	0.084	0.050	0.084	0.050

Source: SEWRPC.

base plan—which would primarily involve only the continuation of existing service and some short-range improvements—was estimated to range over the design period from about $484 million, or about $23 million annually, under the pessimistic stable or declining growth scenario-decentralized land use plan alternative future, to $580 million, or about $28 million annually, under the optimistic moderate scenario-centralized land use plan alternative future. A higher total public cost would be incurred under the most optimistic future because of the need for more transit vehicles and transit vehicle miles to serve the larger transit demand under that future. The bus-on-metered freeway plan was estimated to have a total public cost of $567 million, or about $27 million annually, under the most pessimistic future, and of $723 million, or about $34 million annually, under the most optimistic future. The two-tier plan was estimated to have a total public cost of $620 million, or about $30 million annually, under the most pessimistic future, and of $813 million, or about $39 million annually, under the most optimistic future. The total public cost of the two-tier plan would be 40 percent greater than that of the base plan, and about 12 percent greater than that of the bus-on-freeway plan.

The base plan was estimated to have the lowest capital costs, ranging from about $108 million, or about $5 million annually, to about $149 million, or about $7 million annually. The capital costs of the bus-on-metered freeway plan were found to be about 44 to 49 percent greater than the capital costs of the base plan under each of the two alternative futures, ranging from about $161 million, or about $8 million annually, to about $214 million, or about $10 million annually. The capital cost of the two-tier plan would be the highest, ranging from about $218 million, or about $10 million annually, to about $306 million, or about $15 million annually. For each plan option, the lowest capital cost was attendant to the most pessimistic future for transit needs and use—the stable or declining growth scenario-decentralized land use plan alternative future—and the highest capital cost was attendant to the most optimistic future for transit needs and use—the moderate growth scenario-centralized land use plan alternative future.

The other element of the total public cost of transit considered was the public subsidy required for the transit operating and maintenance costs over the plan design period. The base plan was determined to require a public subsidy of about $431 million, or about $21 million annually, under the most optimistic future, and of about $376 million, or about $18 million annually, under the most pessimistic future. The subsidy requirements of the recommended plan options were estimated to be somewhat greater, totaling between $507 and $509 million over the plan design period, or about $24 million annually, under the moderate growth scenario-centralized land use plan alternative future,

Table 380

FACILITY AND OPERATION CHARACTERISTICS OF THE BASE SYSTEM PLAN AND ALTERNATIVE PRIMARY TRANSIT SYSTEM IMPROVEMENT PLANS UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN AND STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

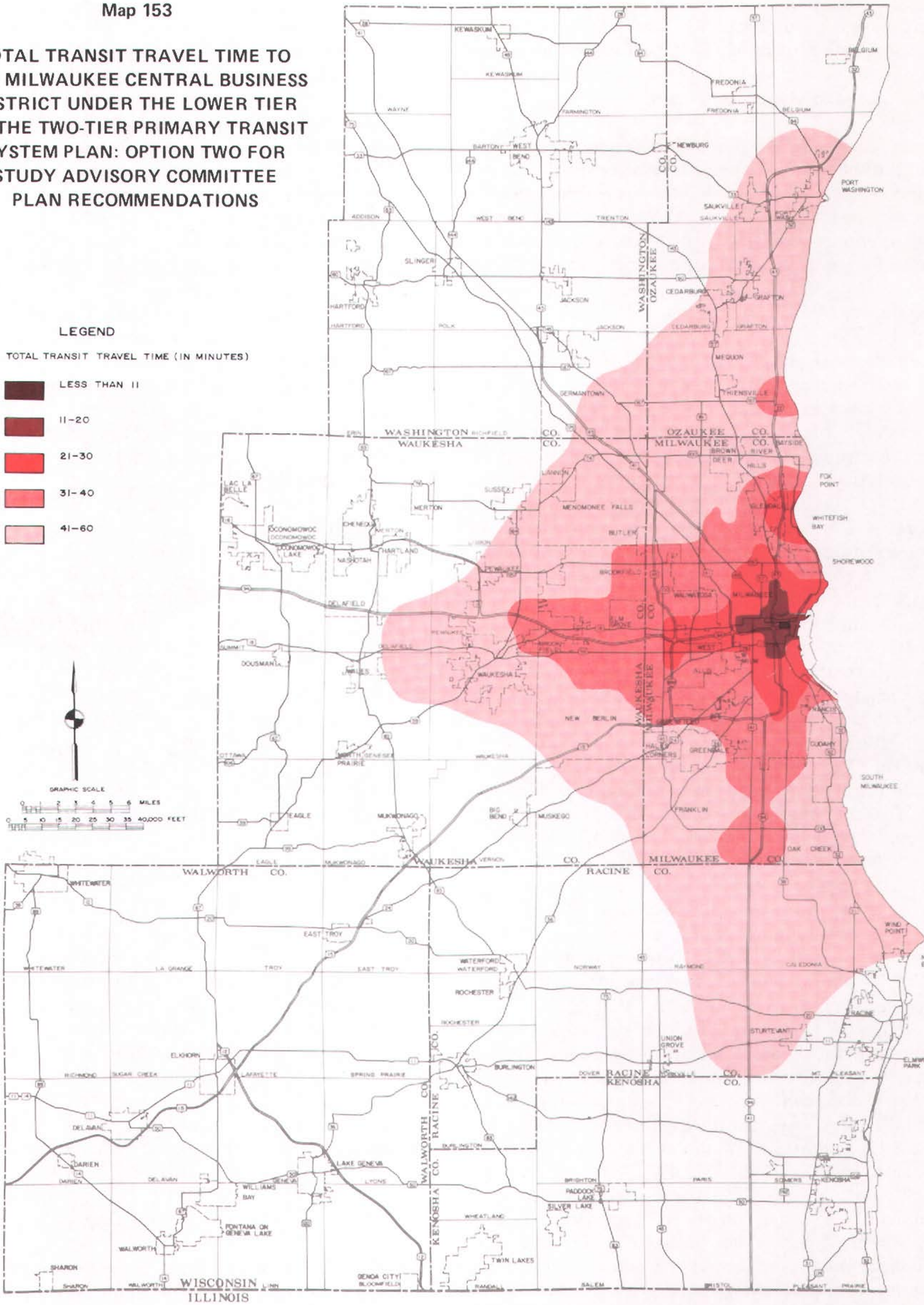
Characteristic	Optimistic Scenario			Pessimistic Scenario		
	Moderate Growth-Centralized Land Use Plan			Stable or Declining Growth-Decentralized Land Use Plan		
	Base Plan	Bus-on-Metered Freeway Plan	Two-Tier System Plan	Base Plan	Bus-on-Metered Freeway Plan	Two-Tier System Plan
Primary Element						
Exclusive Guideway Miles						
Subway	--	--	--	--	--	--
Elevated	--	--	2.5	--	--	2.5
At-Grade	--	--	11.8	--	--	11.8
Total	--	--	14.3	--	--	14.3
Shared Guideway Miles						
Freeways	51.5	141.0	138.6	51.5	141.0	138.6
Surface Arterial Streets	49.5	84.2	74.6	49.5	84.2	74.6
Total	101.0	225.2	213.2	101.0	225.2	213.2
Stations	20	52	73	20	52	73
Route Miles	449	955	975	449	755	775
Vehicle Miles[a]	8,900	40,140	42,500	6,620	14,250	14,310
Vehicle Hours	460	1,410	1,490	280	530	525
Vehicles Required						
Motor Buses	78	199	240	55	126	102
Light Rail Vehicles	--	--	32	--	--	9
Trains Required	--	--	16	--	--	9
Express and Local						
Route Miles	1,302	1,545	1,518	1,302	1,350	1,331
Vehicle Miles	85,900	90,460	88,220	52,680	52,410	51,390
Vehicle Hours	6,520	5,900	5,750	3,610	3,410	3,370
Motor Buses Required	823	797	776	521	522	487
Total System						
Route Miles	1,755	2,500	2,493	1,751	2,133	1,573
Vehicle Miles	94,800	130,600	130,720	59,300	66,660	65,700
Vehicle Hours	6,980	7,310	7,240	3,890	3,940	3,895
Vehicles Required						
Motor Buses	901	996	1,016	576	614	589
Light Rail Vehicles	--	--	16	--	--	9
Trains Required	--	--	16	--	--	9

[a] *Vehicle miles of travel per average weekday on the light rail transit route under the lower tier of the two-tier plan is estimated at 3,570 vehicle miles under the moderate growth scenario-centralized land use plan alternative future, and at 1,880 vehicle miles under the stable or declining growth scenario-decentralized land use plan alternative future.*

Source: SEWRPC.

Map 153

TOTAL TRANSIT TRAVEL TIME TO THE MILWAUKEE CENTRAL BUSINESS DISTRICT UNDER THE LOWER TIER OF THE TWO-TIER PRIMARY TRANSIT SYSTEM PLAN: OPTION TWO FOR STUDY ADVISORY COMMITTEE PLAN RECOMMENDATIONS



One of the standards by which the primary transit system plans were evaluated calls for the maximization of transit accessibility to the Milwaukee central business district. This standard was measured by determining the overall travel time to the Milwaukee central business district from all parts of the Milwaukee area. These overall travel times are indicated on the map by travel time isopleths. Under the lower tier of the two-tier primary transit system plan, the various travel time isopleths form a lobate pattern extending outward from downtown Milwaukee generally along the alignments of IH 43 to the north and IH 94 to the west and south. Areas up to two miles away are within 20 minutes travel time and areas up to 13 miles in a northerly and southerly direction, and up to 15 miles in a westerly direction, are within 40 minutes travel time of downtown Milwaukee. Areas within 60 minutes travel time extend as far as 27 miles to the north, as far as 22 miles to the west, and as far as 25 miles to the south of downtown Milwaukee.

Source: SEWRPC.

and between $402 and $407 million over the plan design period, or about $19 million annually, under the stable or declining growth scenario-decentralized land use plan alternative future.

Thus, in terms of cost-effectiveness, the average total public cost per passenger trip over the 21-year plan design period for the base plan may be expected to range from $0.39 to $0.43. For the bus-on-metered freeway plan option, the average total public cost per passenger trip over the 21-year plan design period may be expected to range from $0.46 to $0.50, an increase of $0.07, or about 17 to 18 percent, over the base plan cost. The average total public cost per passenger trip for the two-tier plan would range between $0.52 and $0.54, an increase of between $0.11 and $0.13, or about 30 percent, over the base plan cost. It is important to recognize, however, that transit passenger trips under the recommended plan options will, on the average, be of longer distance; therefore, if the total costs were measured against passenger miles carried, both the recommended plan options would be at least as cost-effective as the base plan under future conditions which would be optimistic for public transit. For the bus-on-metered freeway plan option, the average total public cost per passenger mile may be expected to range between $0.09 and $0.12, or about 10 percent less than that of the base plan, under future conditions which would be optimistic for public transit. The average total public cost per passenger mile for the two-tier plan would be about the same as for the base plan under similar future conditions, ranging between $0.10 and $0.13.

The base system plan was estimated to result in the least energy consumption over the 21-year design period, including system construction as well as system operation and maintenance—an estimated 20,278 billion BTU's under the moderate growth scenario-centralized land use plan alternative future, and 15,037 billion BTU's under the stable or declining growth scenario-decentralized land use plan alternative future. The bus-on-metered freeway plan was estimated to have about 9 percent higher total energy consumption, estimated to range from 16,121 billion BTU's under the most pessimistic future to 22,305 billion BTU's under the most optimistic future. The total energy consumption under the two-tier plan was determined to be about 3 percent greater than under the bus-on-metered freeway plan, and about 12 percent greater than under the base plan, ranging from about 16,551 billion BTU's to about 23,214 billion BTU's.

The two-tier plan, on the other hand, would require the least petroleum-based motor fuel, up to 14 percent less than the bus-on-metered freeway plan and up to 7 percent less than the base plan, since under the two-tier plan about 8 percent of the transit trips would be made on electrically propelled vehicles. However, this savings of petroleum-based motor fuel—ranging from between 10 million and 20 million gallons over the 21-year plan implementation period—was estimated to represent less than a one-tenth of 1 percent savings in petroleum-based motor fuel used on the total transportation system in the Milwaukee area. This is because levels of automobile tripmaking and travel are expected to be about the same under all three alternative transit plans, and to be at least three times greater than levels of transit tripmaking and travel in the Milwaukee area. Consequently, any savings in petroleum-based motor fuels through use of electrically propelled transit vehicles will be dominated by the petroleum-based fuel used for automobile travel.

It is important to recognize with respect to the energy efficiency of the plans that the bus-on-metered freeway and two-tier plans would be more efficient than the base plan. These plans would be about 17 percent more efficient under the most optimistic future compared to the base plan, expending between 2,730 and 2,830 BTU's per passenger mile compared to 3,330 BTU's per passenger mile under the base plan. Under the most pessimistic future, the energy expended per passenger mile would be about the same, ranging from 3,480 to 3,540 BTU's under the improvement plans, compared to 3,530 BTU's under the base plan.

Objectives 3 and 5—Provision of Adequate Level of Service and Provision for Quick and Convenient Travel

The third primary transit system development objective calls for a transit system which provides an adequate level of service, and the fifth calls for a primary transit system which provides for quick and convenient travel. These two objectives can be considered together for this evaluation. These objectives are supported by three key standards: level of transit ridership, number of residents and jobs served, and transit trip speed. The remaining standards under these two objectives either have all been met in the design of the alternative plans, or could be met by all the plans if properly implemented.

Of all the standards under these two objectives, the level of transit ridership perhaps best represents the level of transit service provided by alternative transit plans, as it indicates the extent to which trips have been attracted to use the transit system. The base system plan would attract the least total transit system ridership in the Milwaukee area, ranging from about 169,400 to about 326,800 trips per average weekday in the plan design year. Under the bus-on-metered freeway plan, between 176,000 and 371,300 trips may be expected to be made by public transit in the Milwaukee area on an average weekday in the plan design year, or between 4 and 14 percent more than under the base plan. The two-tier plan would attract slightly more total transit ridership in the plan design year than the bus-on-metered freeway option, but still only 4 and 14 percent more than the base plan, as under the two-tier plan between 176,300 and 372,900 trips would be expected to be made by transit in the Milwaukee area in the plan design year.

It should be noted further that the 6,600 to 46,100 transit trips not made under the base system plan under the range of futures considered would nevertheless be made, but by automobile rather than transit and, importantly, about 30 percent of these trips would be made to the Milwaukee central business district during the peak travel periods. This difference in automobile travel to the Milwaukee central business district is equivalent to the design capacity of one lane of central business district freeway in the morning peak travel hour and two lanes of central business district freeway in the evening peak travel hour.

It is also important to note that, because both of the recommended plan options would attract a larger proportion of longer transit trips than the base plan, passenger miles traveled would increase significantly over the base plan. The bus-on-metered freeway plan option would be expected to carry between 0.8 million and 2.4 million passenger miles on an average weekday, compared to between 0.6 million and 1.4 million passenger miles under the base plan—between a 25 and 70 percent increase. The two-tier plan option would carry between 0.9 million and 2.5 million passenger miles on an average weekday in the plan design year—a 50 to 80 percent increase over the base plan.

With respect to the standard calling for maximizing the number of jobs and resident population served, the primary transit elements of the two-tier and bus-on-metered freeway plans under the moderate growth scenario-centralized land use plan alternative future would serve about 1.3 million and 1.6 million, or 30 and 60 percent, more residents, respectively, within a three-mile driving distance of rapid transit service than the base system plan, which would serve about 1.0 million residents. The two-tier plan would provide the greatest accessibility to residents and jobs within walking distance of primary transit stations and stops, estimated at 392,000 residents and 309,000 jobs, compared with 274,000 residents and 294,000 jobs under the bus-on-metered freeway plan and 257,000 residents and 237,000 jobs under the base plan. Under the stable or declining growth scenario-decentralized land use plan alternative future, the bus-on-metered freeway and two-tier plans would serve about 933,000 and 931,000 residents within a three-mile driving distance of rapid transit service, or 33 percent more residents than the base system plan, which would serve 699,000 residents. The two-tier plan would provide the greatest accessibility to residents and jobs within walking distance of primary transit stations and stops—260,000 residents and 260,000 jobs, compared with 250,000 residents and 253,000 jobs under the bus-on-metered freeway plan and 182,000 residents and 195,000 jobs under the base plan.

With respect to the standard relating to the average speed provided by primary transit, the bus-on-metered freeway and two-tier plans would both provide somewhat faster service than the base system plan. Average vehicle speeds are expected to be about 12 to 50 percent faster—estimated at between 27 and 29 mph—under the primary transit element of both the two-tier plan and the bus-on-metered freeway plan than under the base plan, under which average vehicle speeds would range from 19 to 24 mph. With respect to average vehicle speed on all elements of the plans—primary, express, and local—average vehicle speeds on the bus-on-metered freeway and two-tier plans would be expected to range between 17 and 18 mph, compared with between 14 and 15 mph under the base plan. The average speeds of passenger travel on the primary transit vehicles would be the highest under the bus-on-freeway and two-tier plans—estimated at 30 to 34 mph, compared with 25 mph under the base plan. Average speeds of passenger travel on vehicles of all service elements of the three plan options would also be highest under the bus-on-freeway and two-tier plans—estimated at 18 to 21 mph, compared with 15 mph under the base plan. Average speeds for passenger travel on vehicles are generally higher than vehicle speeds because passengers are typically concentrated on the transit facilities and services which operate at the highest speeds.

Objective 4—Environmental and Resource Disruption

The fourth objective is to minimize the disruption of existing neighborhood and community development and to minimize deterioration of the natural resource base. This objective is supported by key standards relating to community disruption and air quality.

In terms of community disruption, neither of the two primary transit system plan options nor the base plan would require the taking of any homes, businesses, or industries. They would, however, require the acquisition of right-of-way for guideway, stations, and maintenance and storage facilities. Under the most optimistic future for transit needs and use in the Milwaukee area, the two-tier plan would require the acquisition of about 120 acres of land, compared with 70 acres under the bus-on-metered freeway system plan and 12 acres under the base plan. Under the most pessimistic future, land requirements would be somewhat less, with the two-tier plan requiring 60 acres, the bus-on-metered freeway plan requiring 20 acres, and the base plan requiring 10 acres.

Table 379 summarizes the levels of highway and transit air pollutant emissions anticipated under each of the alternative primary transit system plans. Both the bus-on-metered freeway and two-tier plans are expected to have similar levels of total transportation system carbon monoxide, hydrocarbon, particulate matter, sulfur oxide, and nitrogen oxide air pollutant emissions. The total levels of pollutants would be about 2 percent less under the bus-on-freeway and two-tier plans, principally because of the decline in automobile travel anticipated under these plans.

Objective 6—Safety

The sixth transportation objective relates to the reduction of accident exposure and the provision of increased travel safety. This objective is supported by two key standards, one measuring the degree to which travel by transit is maximized and the other measuring the degree to which travel on exclusive guideway transit is maximized. Travel by transit is safer than travel by automobile, and travel on exclusive guideway transit is the safest travel by transit because of the elimination of many conflicts with pedestrian or vehicle traffic.

As demonstrated in Table 379, there is little difference between the three plans with respect to travel safety. The proportion of total person trips using transit is slightly higher under the bus-on-freeway and two-tier plans than under the base plan, and none of the alternatives utilize fully exclusive guideways with grade separation of all crossing vehicle and pedestrian traffic.

Summary

The comparative quantitative evaluation of the three primary transit options for the Milwaukee area—the base or "no build" plan, the bus-on-metered freeway plan, and the lower tier of the two-tier plan—indicated that under the range of alternative future conditions, the bus-on-metered freeway and two-tier recommended plan options would provide about equal levels of transit service in the Milwaukee area, and that both would represent substantial improvements over the base system plan. Under the range of future conditions considered, these two options were determined to perform better than the base system plan by providing service to more Milwaukee area residents and jobs, providing a higher level of service through quicker transit speeds, attracting higher levels of total and primary transit ridership, and having higher energy efficiencies and generating somewhat less air pollutant emissions.

However, because it would only maintain existing service, the base plan would entail the least public cost—an estimated \$23 to \$28 million per year. The bus-on-metered freeway plan would require an additional \$4 million to \$6 million annually over the plan design period, or an additional 17 to 25 percent. The two-tier plan would require an additional 12 to 13 percent, or \$2 million to \$4 million annually, over the bus-on-metered freeway plan, and 28 to 40 percent, or \$6 to \$11 million annually, over the base plan. Because the recommended plan options would carry between 4 and 14 percent more transit passenger trips and 25 and 80 percent more transit passenger miles than the base plan, their cost per trip, including both direct and indirect costs, would generally be less than that of the base plan, and their cost per passenger mile—even if only direct costs are considered—would generally be less than that of the base plan.

Further analysis of the key benefits and costs of the two-tier plan and bus-on-metered freeway plan relative to each other and the base plan is provided below. This analysis is presented by first comparing the base system plan against the bus-on-metered freeway and two-tier plans, and then comparing the two recommended plan options—the bus-on-metered freeway plan against the two-tier plan. This successive comparison of alternative plans is not unlike incremental economic plan evaluation techniques which have long been used to establish whether the marginal benefits of alternative plans exceed their additional costs over other alternative plans.

Comparison of the Bus-on-Metered Freeway and Two-Tier Plan Options to the Base Plan: The comparative evaluation of the base plan against the bus-on-metered freeway and two-tier plan options indicated that under the range of alternative futures—although both of the recommended plan options could be expected to entail greater total cost, ranging from 17 to 40 percent, or $83 to $233 million, over the 21-year plan design period—each would have a number of benefits over the base plan which would make either option a more preferable course of action. Under the range of futures, the improvement plans would provide between about 24 and 60 percent greater accessibility to jobs and residents of the Milwaukee area than the base plan, and would carry between 4 and 14 percent more total transit trips. Because both of the recommended plan options would attract a larger proportion of longer transit trips than the base plan, the difference in passenger miles traveled between the recommended options and the base plan would be greater than the difference in total cost. The recommended options would carry from 32 to 75 percent more passenger miles than the base plan, while their total cost would be 17 to 40 percent greater than the base plan cost.

As set forth in Tables 381 and 382, the principal disadvantage of the bus-on-metered freeway plan and two-tier plan is that the total public costs of the two plans may be expected to be substantially higher than that of the base plan, in terms of both capital and operating cost requirements under the range of future conditions. Under the moderate growth scenario-centralized land use alternative future, the recommended improvement plans would entail between 44 and 109 percent, or between $65 million and $157 million, more capital cost over the plan design period, with the two-tier plan incurring the largest capital cost. With respect to public costs for operation and maintenance, both of the improvement plans would be somewhat less efficient than the base plan under the optimistic future, with the bus-on-freeway plan entailing about an 18 percent, or $78 million, greater deficit and the two-tier plan entailing about an 18 percent, or $76 million, greater deficit over the design period. Thus, under this scenario, the total public cost of the improvement options would be 25 to 40 percent greater than the base plan cost, with an additional $143 million, or $7 million annually, being required under the bus-on-metered freeway plan, and an additional $233 million, or $11 million annually, being required under the two-tier plan. Under the stable or declining growth scenario-decentralized land use plan alternative future, the difference in total public costs between the base plan and the improvement plans may be expected to differ by between 17 and 28 percent, with an additional $83 million, or $4 million annually, being required under the bus-on-metered freeway plan, and an additional $136 million, or $6 million annually, being required under the two-tier plan. The improvement plans would incur between 49 and 102 percent, or between $53 million and $110 million, more capital cost, and between 7 and 8 percent, or between $26 and $31 million, greater public subsidy of transit operating and maintenance costs over the 21-year plan design period.

One important advantage of the bus-on-metered freeway and two-tier plans which would partially offset the additional total public costs is the substantial increase in accessibility to residents and jobs over the accessibility provided under the base plan. Under the moderate growth scenario-centralized land use plan alternative future, the improvement plans would serve between 45 and 53 percent, or between 116,400 and 135,100, more people and between 24 and 30 percent, or 60,600 and 72,300, more jobs within walking distance of primary transit facilities. Under the pessimistic future, between 38 and 43 percent, or 68,600 and 78,600, more residents and between 30 and 33 percent, or 58,500 and 65,600, more jobs would be served. It should be noted that the greatest increase in accessibility would be expected under the two-tier plan under the range of alternative future conditions. With respect to transit utilization, on an average weekday in the plan design year about 14 percent, or between about 44,500 and 46,100, more total transit trips may be expected to be made under the optimistic future for transit needs and use in the Milwaukee area, and about 4 percent, or between 6,600 and 6,900, more total transit trips may be expected to be made under the pessimistic future. Moreover, trips made on the primary element would be expected to increase nearly five-fold, or by about 60,100 trips on an average weekday, under the bus-on-metered freeway plan, and nearly six-fold, or by about 81,300 trips, under the two-tier plan for the most optimistic future. Primary transit trips under the most pessimistic future would increase by 13,000 trips under the bus-on-metered freeway plan and by about 25,700 trips under the two-tier plan.

It should be noted that because total transit ridership under the recommended improvement plans would not be expected to increase in proportion to the total costs required to implement either

Table 381

KEY ADVANTAGES AND DISADVANTAGES OF THE BUS-ON-METERED FREEWAY SYSTEM PLAN IN COMPARISON TO THE BASE SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED USE PLAN AND STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Factor	Advantages		Disadvantages	
	Moderate Growth-Centralized Land Use Plan	Stable or Declining Growth-Decentralized Land Use Plan	Moderate Growth-Centralized Land Use Plan	Stable or Declining Growth-Decentralized Land Use Plan
Cost	$0.01, or 10 percent, less total cost per passenger mile over design period $4.0 million transportation system user cost savings over design period, resulting from the diversion of 44,500 auto trips to transit and transit travel time savings averaging about 2 minutes per transit trip	$0.2 million transportation system user cost savings over design period, resulting from the diversion of 6,600 auto trips to transit and transit travel time savings averaging about 2 minutes per transit trip	$143 million, or 25 percent, more total cost over design period $65 million, or 44 percent, more capital cost over design period $97 million, or 42 percent, more capital investment over design period $78 million, or 18 percent, more operating and maintenance cost subsidy over design period $0.07, or 18 percent, more total cost per passenger over design period	$83 million, or 17 percent, more total cost over design period $53 million, or 49 percent, more capital cost over design period $68 million, or 42 percent, more capital investment over design period $31 million, or 8 percent, more operating and maintenance cost subsidy over design period $0.07, or 16 percent, more total cost per passenger over design period
Level of Service	Service on all primary transit routes under the plan would be provided on an all-day basis	Service would be provided on an all-day basis for the seven bus-on-freeway routes recommended under the first stage of the plan	--	--
Accessibility	116,400, or 45 percent, more resident population within walking distance of primary transit stations or stops 608,000, or 60 percent, more residents within driving distance of primary transit stations or stops 60,600, or 24 percent, more jobs within walking distance of primary transit stations or stops	68,600, or 38 percent, more resident population within walking distance of primary transit stations or stops 234,300, or 34 percent, more residents within driving distance of primary transit stations or stops 58,500, or 30 percent, more jobs within walking distance of primary transit stations or stops	--	--
Transit Ridership	44,500, or 14 percent, more total transit trips on an average weekday in design year 60,100, or five times, more primary transit trips on an average weekday in design year 2.4 million, or 72 percent, more passenger miles on an average weekday in design year	6,600, or 4 percent, more total transit trips on an average weekday in design year 13,000, or 137 percent, more primary transit trips on an average weekday in design year 0.2 million, or 32 percent, more passenger miles on an average weekday in design year	--	--
Energy	600 BTU's, or 18 percent, less total energy consumed per passenger mile traveled 8.9, or 22 percent, more passenger miles carried on the transit system per gallon of diesel fuel consumed for propulsion	12 BTU's, or 72 percent, less total energy consumed per passenger mile traveled 2, or 4 percent, more passenger miles carried on the transit system per gallon of diesel fuel consumed for propulsion	--	--
Disruption	58 acres, or 483 percent, more land required for system development	10 acres, or 100 percent, more land required for system development	--	--

Source: SEWRPC.

Table 382

KEY ADVANTAGES AND DISADVANTAGES OF THE TWO-TIER SYSTEM PLAN IN COMPARISON TO THE BASE SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN AND STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Factor	Advantages		Disadvantages	
	Moderate Growth-Centralized Land Use Plan	Stable or Declining Growth-Decentralized Land Use Plan	Moderate Growth-Centralized Land Use Plan	Stable or Declining Growth-Decentralized Land Use Plan
Cost	Transportation system user cost savings of $4.0 million over design period, resulting from the diversion of 46,100 auto trips to transit and average transit travel time savings of 2 minutes per trip	Transportation system user cost savings of $0.2 million over design period, resulting from the diversion of 6,900 auto trips to transit and average transit travel time savings of 2 minutes per trip	$233 million, or 40 percent, more total cost over design period $157 million, or 109 percent, more capital cost over design period $237 million, or 102 percent, more capital investment over design period $76 million, or 18 percent, more operating and maintenance cost subsidy over design period $0.13, or 33 percent, more total cost per passenger over design period	$136 million, or 28 percent, more total cost over design period $110 million, or 102 percent, more capital cost over design period $203 million, or 126 percent, more capital investment over design period $26 million, or 7 percent, more operating and maintenance cost subsidy over design period $0.11, or 26 percent, more total cost per passenger over design period
Level of Service	Service on all primary transit routes under the plan would be provided on an all-day basis	Service would be provided on an all-day basis for the five bus-on-freeway routes and the light rail transit route recommended for implementation under the first stage of the plan	- -	- -
Accessibility	135,100, or 53 percent, more resident population within walking distance of primary transit stations or stops 287,600, or 28 percent, more residents within driving distance of primary transit stations or stops 72,300, or 30 percent, more jobs within walking distance of primary transit stations or stops	78,600, or 43 percent, more resident population within walking distance of primary transit stations or stops 231,800, or 33 percent, more residents within driving distance of primary transit stations or stops 65,600, or 33 percent, more jobs within walking distance of primary transit stations or stops	- -	- -
Transit Ridership	46,100, or 14 percent, more total transit trips on an average weekday in design year 81,300, or nearly six times, more primary transit trips on an average weekday in design year 1.1 million, or 75 percent, more passenger miles on an average weekday in design year	6,900, or 4 percent, more total transit trips on an average weekday in design year 25,700, or nearly three times, more primary transit trips on an average weekday in design year 0.2 million, or 36 percent, more passenger miles on an average weekday in design year	- -	- -
Energy	29,200 trips, or 8 percent of transit trips making all or a major portion of trip on transit vehicles, not dependent on petroleum-based fuels 500 BTU's, or 15 percent, less total energy consumed per passenger mile traveled 7.2, or 18 percent, more passenger miles carried on the transit system per gallon of diesel fuel consumed for propulsion	15,000 trips, or 8 percent of transit trips making all or a major portion of trip on transit vehicles, not dependent on petroleum-based fuels About the same total energy consumed per passenger mile traveled 1, or 3 percent, more passenger miles carried on the transit system per gallon of diesel fuel consumed for propulsion	- -	- -
Disruption	108 acres, or nine times, more land required for system development	50 acres, or five times, more land required for system development	- -	- -

Source: SEWRPC.

of the plans under the range of future conditions, the two plans would be somewhat less cost-effective than the base plan in terms of total public cost per passenger. For the bus-on-metered freeway plan option, the average total cost per passenger trip over the 21-year plan design period may be expected to range between $0.46 and $0.50, an increase of $0.07, or about 17 percent, over the base plan costs of $0.39 and $0.43. The average total public cost per passenger trip for the two-tier plan would range between $0.52 and $0.54, an increase of between $0.11 and $0.13, or about 30 percent, over the base plan costs. It is important to recognize, however, that transit passenger trips under the recommended plan options will, on the average, be of longer distance than transit trips under the base plan. Thus, if the total public costs are measured against passenger miles carried, both of the recommended plan options are at least as cost-effective as the base plan under optimistic future conditions for public transit. For the bus-on-metered freeway plan option, the average total public cost per passenger mile may be expected to range between $0.09 and $0.12, or to be about 10 percent less than that of the base plan under optimistic future conditions for public transit. The average total public cost per passenger mile for the two-tier plan under optimistic future conditions would be about the same as under the base plan—ranging between $0.10 and $0.13.

The improvement plans would also have some important advantages with respect to energy use over the base system plan. Under the moderate growth scenario-centralized land use plan alternative future, from 500 to 600 fewer BTU's—a difference of 15 to 18 percent—would be expended per passenger mile traveled under each of the plans—2,730 BTU's per passenger mile under the bus-on-freeway plan and 2,830 BTU's per passenger mile under the two-tier plan, compared with 3,330 BTU's per passenger mile under the base plan. In terms of propulsion energy efficiency, about 9, or 22 percent, more passenger miles per gallon of diesel fuel consumed would be carried under the bus-on-metered freeway plan; and 7, or 18 percent, more passenger miles per gallon of diesel fuel consumed would be carried under the two-tier plan. Under the stable or declining growth scenario-decentralized land use plan alternative future, about 72 percent less total energy per passenger mile would be expended and 4 percent more passenger miles would be carried per gallon of diesel fuel consumed under the bus-on-metered freeway plan. There would be only a negligible difference in energy use per passenger mile between the base plan and the two-tier system plan under this future, and about 3 percent more passenger miles would be carried per gallon of diesel fuel consumed. It should be noted that the use of electricity for propulsion of the light rail route under the two-tier plan would enable about 8 percent of all transit tripmaking, or 29,000 passenger trips under the moderate growth scenario-centralized land use plan alternative future, and 15,000 trips under the stable or declining growth scenario-decentralized land use plan alternative future, to be made on a transit route which is not dependent on petroleum-based fuels and which would not be subject to disruption if the availability of such fuel were limited.

In addition to these advantages, there would be certain other benefits attendant to the improved transit service under the two recommended plan options, as set forth in Table 383. The base plan can be expected to result in additional indirect costs to the public, both privately and publicly incurred, over and beyond those attendant to the recommended plan options. The additional benefits that would be attendant to the two plan options include out-of-pocket automobile operating cost savings, accident and insurance cost savings, and travel time savings. Under the range of futures, the improvement plans could be expected to attract an additional 6,600 to 46,100 trips on an average weekday which would otherwise be made by automobile. The resultant reduction in out-of-pocket—or automobile user—costs attendant to the improvement plans in the design year is estimated to range from $40.3 million for the two-tier system plans under the moderate growth scenario-centralized land use plan alternative future to $13.3 million for the bus-on-metered freeway plan under the stable or declining growth scenario-decentralized land use plan alternative future. These benefits take into account the user cost, in terms of transit fares, of the diverted trips using public transit. Increased transit use under the improvement plans would also provide residents of the Milwaukee area with an increase in overall transportation safety. The resultant reduction in accident and insurance costs attendant to the decrease in automobile travel would range from $8.1 million to $2.8 million in the plan design year.

Under the range of futures, travel time savings will be incurred by continuing transit users. The findings indicate that those trips made by continuing transit users under the improvement plans will average about two mph faster and will require an average of about two fewer minutes per trip.

Table 383

ESTIMATED DESIGN YEAR 2000 TRANSIT SYSTEM USER BENEFITS ATTENDANT TO THE RECOMMENDED TRANSIT IMPROVEMENT PLAN OPTIONS

Source of Benefits	Moderate Growth-Centralized Land Use Plan		Stable or Declining Growth-Decentralized Land Use Plan	
	Bus-on-Metered Freeway Plan (millions of dollars)	Two-Tier Plan (millions of dollars)	Bus-on-Metered Freeway Plan (millions of dollars)	Two-Tier Plan (millions of dollars)
Out-of-Pocket Cost	38.658	40.251	13.291	14.309
Travel Time Savings of Continuing Transit Users and Auto Passengers Diverted to Transit Use	-12.914	-13.464	-3.014	-2.948
Accident and Insurance Cost Savings	7.830	8.075	2.761	2.858
Net Quantitative Benefits	33.574	34.862	13.038	14.219

Source: SEWRPC.

However, trips being made on transit by those who have diverted from private automobiles would take an average of about 19 to 22 minutes longer per trip than an equivalent trip made by automobile. Hence, the sum of the travel time cost savings incurred by both continuing and new transit users is a net disbenefit, estimated to range from $13.5 million to $2.9 million. As shown in Table 383, the total cost savings of all three of these components—out-of-pocket cost savings, accident and insurance cost savings, and travel time savings—is estimated to range from $33.6 million to $13.0 million for the bus-on-metered freeway plan. For the two-tier system plan, the total cost benefits are estimated to range from $34.9 million to $14.2 million, depending upon the particular alternative future. This estimate assumes an average value of travel time of about $2.20 per person-hour, expressed in 1979 dollars.[10] It is important to note that the total benefits—or cost savings—attributable to the improvement plans are greater than the additional public costs of the bus-on-metered freeway plan option under the full range of future conditions, and are greater than the additional public costs of the two-tier system plan option under the optimistic end of the range of future conditions.

Benefit-Cost Analysis: The total cost and benefit estimates prepared above were supplemented by a benefit-cost analysis in order to demonstrate the economic value of the primary transit system plan proposals. Application of this approach permits a comparative analysis of "build" alternatives—those that include major transit improvements—with a "no build" alternative. The direct benefits derived from transit system improvements include a reduction in the cost of vehicle ownership and operation, of the cost of travel time, and of accidents. The direct costs of such improvements are the capital investments required to provide the improvements and the cost to public agencies to operate and maintain the physical facilities and transit services. In preparing the benefit-cost analysis, it should be noted that the benefits and costs were calculated as accruing over a period of

[10] *The value of time to the transit user has been the subject of considerable controversy. In this study, it was decided to use the average value recommended by the American Association of State Highway and Transportation Officials (AASHTO).*

time extending from 1980 to 2000. The benefit-cost ratios were calculated based on discount rates of 6 and 10 percent.[11]

Table 384 sets forth the present worth of transit system user costs and the transit system capital, operating, and maintenance costs for the base plan and each recommended plan option under the most optimistic and most pessimistic futures for transit use. Comparing the costs of each plan with the benefits derived from each plan option using the base system plan as a basis of comparison indicates that the bus-on-metered freeway plan would constitute a sound investment of public funds under the complete range of alternative future conditions which can reasonably be expected in the Milwaukee area. The results of the benefit-cost analysis indicate that the proposed bus-on-freeway system plan under the moderate growth scenario-centralized land use plan alternative future will have a benefit-cost ratio of 1.7. Under the stable or declining growth scenario-decentralized land use plan alternative future, the bus-on-freeway system plan would have a benefit-cost ratio of 1.0. Both of these ratios were calculated assuming a 6 percent rate of return. Assuming a 10 percent rate of return, the same benefit-cost ratios would be 0.8 and 0.7, respectively.

A benefit-cost analysis was also conducted for the lower tier of the two-tier system plan. The results of this analysis indicate that the two-tier plan could be expected to have a benefit-cost ratio of 1.3 under conditions attendant to the moderate growth scenario-centralized land use plan alternative future. A benefit-cost ratio of 0.6 could be expected under conditions attendant to the stable or declining growth scenario-decentralized land use plan alternative future. Both of these ratios were calculated assuming a 6 percent rate of return. Assuming a 10 percent rate of return, the benefit-cost ratios would be 0.7 and 0.4, respectively. It should be recognized that the benefit-cost ratios presented for both the bus-on-metered freeway plan and the two-tier system plan apply to the aggregations of not only primary transit services and facilities proposed within each plan, but also express and local transit services. Such ratios, therefore, cannot, and do not, imply that individual projects or services within the aggregation will necessarily have similar benefit-cost ratios. Moreover, it should be recognized that such an assessment alone is not a conclusive measure of the relative value of primary transit alternatives, but should be viewed together with the results of the cost-effectiveness analysis presented earlier. A more detailed discussion of the procedures used for the benefit-cost analysis of the two improvement plan options is presented in Appendix A of this report.

Comparison of the Bus-on-Metered Freeway Plan Option to the Two-Tier Plan Option: In order to help select one of the recommended improvement plans for implementation in the Milwaukee area over the next 20 years, a comparative evaluation of the key advantages and disadvantages of the bus-on-metered freeway plan and the two-tier system plan is provided below. Under the range of future conditions, the two-tier plan, although expected to entail a slightly greater total cost over the plan design period than the bus-on-metered freeway plan, would have a number of advantages over the bus-on-metered freeway plan, as indicated in Table 385. The inclusion of a light rail transit facility in the northwest corridor would provide primary transit accessibility to about 5 percent more of the resident population and jobs in the Milwaukee area. Partially for this reason, between 11,700 and 21,200, or between 28 and 52 percent, more transit trips may be expected to be made on the primary element of the two-tier plan on an average weekday in the design year than on the primary element of the bus-on-metered freeway plan. It should be noted that all of these additional

[11] *Considerable debate continues on the discount rate that should be used when evaluating proposed investments in primary transit facilities. For transit projects, the discount rate has been tied closely to the long-term cost of borrowing money. In this study, the appropriate discount rate was based on an estimate of the average rate of return that is expected on possible investment before taxes and after inflation. Money invested privately is currently expected to return, generally, from 6 to 10 percent. Since implementation of the primary transit plan should return benefits to the public similar to those which could be attained through private investment, interest rates of 6 and 10 percent—representing the full range of discount rates currently being used—were recommended for use in the economic evaluation of the plans. It should be noted that in 1981 the Wisconsin Department of Transportation was using a rate of 8 percent for evaluating major highway improvement projects, and 4 percent in the evaluation of railway branchline projects described in the 1981 Wisconsin Transportation Planning Program State Rail Plan.*

Table 384

COMPARISON OF TRANSIT USER COSTS AND BENEFIT-COST RATIOS: RECOMMENDED TRANSIT IMPROVEMENT PLAN OPTIONS

Alternative Plan: Land Use Plan	Alternative Plan: Transit Plan	Discount Rate (percent)	Costs: 1980-2000 Transit System User	Costs: 1980-2000 Capital, Operating, and Maintenance	Benefits[a]	Costs[b]	Benefit-Cost Ratio
Moderate Growth-Centralized Land Use Plan	Base Plan	6 10	$1,317,414,000 932,992,000	$333,200,000 208,700,000	$ -- --	$ -- --	-- --
	Bus-on-Metered Freeway Plan	6 10	1,202,062,000 866,230,000	400,200,000 289,600,000	115,352,000 66,762,000	67,000,000 80,900,000	1.72 0.83
	Two-Tier Plan	6 10	1,197,637,000 863,669,000	427,600,000 308,600,000	119,777,000 69,323,000	94,400,000 99,900,000	1.27 0.69
Stable or Declining Growth-Decentralized Land Use Plan	Base Plan	6 10	1,032,113,000 767,869,000	268,500,000 199,500,000	-- --	-- --	-- --
	Bus-on-Metered Freeway Plan	6 10	987,317,000 741,942,000	313,000,000 235,200,000	44,796,000 25,927,000	44,500,000 35,700,000	1.01 0.73
	Two-Tier Plan	6 10	983,259,000 739,594,000	345,200,000 266,800,000	48,854,000 28,275,000	76,700,000 67,300,000	0.64 0.42

[a]*Benefits are defined as the difference—or "savings"—in transit system user costs resulting from the implementation of either the bus-on-metered freeway plan option or the two-tier plan option instead of the base plan under the appropriate alternative future.*

[b]*Costs are defined as the difference—or "additional capital and operating expense"—incurred because of the implementation of either the bus-on-metered freeway plan option or the two-tier plan option instead of the base plan under the appropriate alternative future.*

Source: SEWRPC.

trips on the light rail transit element of the two-tier plan may be expected to use transit, rather than private automobiles as under the bus-on-metered freeway plan, but would be made primarily on the local or express elements of that plan at a lower level of service. These trips would average about four mph slower over the on-vehicle portion of the trip, and would require an average of four additional minutes per trip.

The two-tier plan would have some important advantages with respect to energy use, as operation of some of the system would be based on an electrically propelled primary transit system. The two-tier plan may be expected to use about 14 percent less petroleum-based fuel for transit system propulsion over the plan design period than the bus-on-metered freeway plan. Importantly, this would enable between 15,000 and 29,000 transit trips on an average weekday, or 8 percent of all transit tripmaking, to be made on a transit route which is not dependent on petroleum-based fuels and would not be subject to disruption if the availability of such fuels were limited.

The two-tier plan would also be expected to be slightly more efficient at the end of the plan design period with respect to operating and maintenance costs. The two-tier plan may be expected to require between $2 and $4 million less operating subsidy over the plan design period than the bus-on-metered freeway plan. Primary transit revenues may be expected to recover 2 to 3 percent more operating and maintenance costs under the two-tier plan than under the bus-on-metered freeway plan, and farebox revenues of the total transit system would be expected to recover the same proportion of operating and maintenance costs under both improvement plans.

These small operating cost savings, however, would be offset by the greater capital cost of the two-tier plan over the bus-on-metered freeway plan, making it the more costly of the two plan options to implement. The capital cost of the two-tier plan would be between $57 million and $92 million, or about 35 to 43 percent, more than that of the bus-on-metered freeway plan. Consequently, the two-tier plan would require between $52 million and

Table 385

KEY ADVANTAGES AND DISADVANTAGES OF THE LOWER TIER OF THE TWO-TIER SYSTEM PLAN IN COMPARISON TO THE BUS-ON-METERED FREEWAY SYSTEM PLAN UNDER THE MODERATE GROWTH SCENARIO-CENTRALIZED LAND USE PLAN AND STABLE OR DECLINING GROWTH SCENARIO-DECENTRALIZED LAND USE PLAN

Factor	Advantages		Disadvantages	
	Moderate Growth-Centralized Land Use Plan	Stable or Declining Growth-Decentralized Land Use Plan	Moderate Growth-Centralized Land Use Plan	Stable or Declining Growth-Decentralized Land Use Plan
Cost	- -	- -	$90 million, or 12 percent, more total cost over design period $92 million, or 43 percent, more capital cost over design period $141 million, or 43 percent, more capital investment over design period $0.06, or 13 percent, more total cost per passenger over design period $0.01, or 11 percent, more total cost per passenger mile over design period	$52 million, or 9 percent, more total cost over design period $57 million, or 35 percent, more capital cost over design period $135 million, or 59 percent, more capital investment over design period $0.04, or 8 percent, more total cost per passenger over design period $0.01, or 8 percent, more total cost per passenger mile over design period
Accessibility	18,700, or 5 percent, more resident population within walking distance of primary transit stations and stops 15,700, or 5 percent, more jobs within walking distance of primary transit stations or stops	10,000, or 4 percent, more resident population within walking distance of primary transit stations and stops 7,100, or 3 percent, more jobs within walking distance of primary transit stations or stops	- -	- -
Transit Ridership	21,200, or 28 percent, more primary transit trips on an average weekday in design year	11,700, or 52 percent, more primary transit trips on an average weekday in design year	- -	- -
Energy	29,000 trips, or 8 percent, of transit trips making all or a portion of trips on transit vehicles not dependent on petroleum-based fuels	15,000 trips, or 8 percent, of transit trips making all or a portion of trips on transit vehicles not dependent on petroleum-based fuels	- -	- -

Source: SEWRPC.

$90 million more total public cost and about $0.04 to $0.06, or 8 to 13 percent, more total public cost per passenger than the bus-on-metered freeway during the design period. The total public cost per passenger mile would also be higher, ranging between $0.10 and $0.13, compared with between $0.09 and $0.12 under the bus-on-metered freeway plan.

Thus, it may be concluded that the direct, tangible advantages of a primary transit plan which includes light rail transit over a comparable bus-on-freeway plan in the Milwaukee area would be small compared to the additional costs entailed, resulting in less than a 1 percent increase in weekday transit passengers and less than a 2 percent increase in daily passenger miles. The operating and maintenance cost efficiencies of the light rail transit plan would be offset over the plan design period by the additional capital costs. In addition, a light rail transit system, despite its greater cost, cannot be expected to divert substantially more trips from automobiles to public transit than a bus-on-metered freeway service, and, therefore, cannot be expected to provide any substantial incremental benefits with respect to motor fuel consumption or air pollutant emissions. Therefore, because the bus-on-metered freeway plan would have the lowest total public cost and lowest total cost per passenger and per passenger mile over the plan design period, it was determined to be the best option for the provision of primary service in the Milwaukee area under the full range of alternative future conditions.

However, as much as the bus-on-metered freeway plan option was found to be superior to the two-tier plan option with respect to total public costs and cost-effectiveness over the plan design period it was determined that the two-tier plan would have certain advantages over the bus-on-metered freeway plan regarding the intangible implications of primary transit performance. As presented earlier in this chapter and as summarized in Table 386, the development of light rail transit in the Milwaukee area would have a greater, although uncertain and unmeasurable, potential to influence land development and redevelopment; to provide a more reliable and safe public transit system; and to be less subject to the adverse affects of possible future highway system deterioration from deferred maintenance. Because light rail vehicles are capable of carrying a greater number of passengers per vehicle, and because they can be coupled into trains, light rail transit was found to be able to transport a greater number of passengers per operator. The mode was determined to have greater long-range usefulness as it would require the acquisition of rights-of-way, and would require the construction of guideways which are essential to more advanced, but still unproven, futuristic transit technologies. Because of its electric propulsion, it is believed that light rail transit would have an operational advantage in Milwaukee's winter climate, as well as advantages with respect to localized noise and pollutant emission levels. Furthermore, light rail transit would have the greatest potential to continue and expand operations during a petroleum-based fuel shortage, and perhaps an advantage in long-term usefulness given the prospects for domestic and world petroleum production in the 21st century. Light rail transit was also concluded to have perhaps the greatest potential to influence land development and redevelopment because, compared to the bus-on-metered freeway plan, it would require the most permanent, least disruptive, and greatest long-term public commitment to high-quality transit in a corridor.

Conclusions Drawn from the Alternative Primary Transit Plan Testing and Evaluation

The following conclusions were drawn by the Advisory Committee in reflecting upon the extensive data generated in the evaluation of the alternative primary transit system plans for each mode designed for each alternative future.

- Heavy rail rapid transit was eliminated from further consideration in the Milwaukee area since it was currently found to be not viable under even the most optimistic future for transit need and use considered. This determination was based upon the inability of this primary transit mode to utilize its inherent efficiencies for transporting very large numbers of passengers at high speeds in the Milwaukee area without substantial unused capacity in all corridors. In addition, because this mode requires a fully grade-separated, exclusive right-of-way, the capital costs for such an alternative would be very high, ranging from two-and-one-half times those of a comparable light rail transit plan, to about three-and-one-half times those of a comparable busway plan.

- As an areawide primary transit system, commuter rail could be expected to be viable under only the most optimistic of the alternative futures for transit need and use—the moderate growth scenario-centralized land use plan future. Under that future, three commuter rail routes radiating from the Milwaukee central business district—north to Grafton, west to Oconomowoc, and south to Racine and Kenosha—would have the potential to meet at least one-half of their annual operating and maintenance costs from farebox revenues. The route to Racine and Kenosha could also be expected to perform well under the two intermediate futures for transit need and use. Under the least optimistic future for transit use, however, not even the Racine/Kenosha route was found to be viable. These conclusions relate only to the provision of a system of true primary transit service—that is, service throughout the entire weekday period, as well as some service on weekends. They would not rule out the possible introduction of specialized peak-period, weekday-only service along one or more of the routes considered and the inclusion of such service in any final plan that may be selected.

- The bus-on-freeway, busway, and light rail transit alternatives—the latter two modified as necessary to include supplemental bus-on-freeway service to make the plans comparable to the bus-on-freeway plan—may be expected to perform well in the Milwaukee area under a wide range of future conditions. These three alternatives were determined to have the potential to provide essentially identical levels of service, and to attract very

Table 386

SUMMARY OF THE INTANGIBLE BENEFITS ATTENDANT TO THE IMPLEMENTATION OF THE RECOMMENDED TWO-TIER PRIMARY TRANSIT PLAN OPTION IN THE MILWAUKEE AREA

Benefit	Description	Potential Impact in the Milwaukee Area
Land Use	Potential to influence land development and redevelopment would permit public transit to be used to meet land use development objectives, as well as transportation development objectives, through the promotion of sound land use development and the inducement of urban development in desired locations	Would contribute to the evolution of a more desirable land use pattern along the northwest corridor under the lower tier of the plan, and potentially throughout other corridors of high travel demand within the Milwaukee area if the upper tier of the plan is implemented. The benefits which could be obtained include regional environmental and resource protection; preservation and revitilization of the City of Milwaukee; and reductions in the public and private costs of land development and supporting facilities and services, including public transit. Areas within the northwest corridor which would particularly lend themselves to new development or redevelopment include the Milwaukee central business district, the northwest industrial land bank area, and older central city areas of Milwaukee located along the final selected alignment.
Energy	Potential for operation in the event of a serious petroleum shortage	About 8 percent of all transit trips would be made on vehicles not dependent on petroleum-based fuels
Environment	Light rail transit vehicles emit no air pollutants along routes of operation and would generate about 20 percent less noise than diesel motor buses	Although the potential reduction in air pollution and noise pollution would be experienced to some degree along the light rail transit facility, the largest positive impacts would be concentrated along the proposed transit mall in the Milwaukee central business district, the W. Wisconsin Avenue area, and the N. Sherman Boulevard area, because of the reduction in the number of diesel motor buses
Traffic	Light rail transit would offer more attractive service which, accordingly, would have the potential to increase transit ridership and reduce automobile travel, and thus reduce the associated negative impacts on street and highway capacity	Because of its perceived attractiveness, light rail transit would be expected to be more effective in reducing traffic growth within the northwest corridor, particularly in the N. Sherman Boulevard area and the N. 76th Street area
Safety	Greater safety is provided on public transit modes that extensively use reserved and exclusive rights-of-way and have preferential treatment at intersections	The light rail transit facility proposed for Milwaukee's northwest corridor requires a fixed guideway and would be located almost entirely on either a reserved or exclusive alignment, resulting in a smaller probability of vehicle-to-vehicle and vehicle-to-fixed object collisions compared with transit vehicles which must operate in mixed traffic. In addition, the larger size and stronger construction of rail transit vehicles over that of motor buses offers more protection against personal injuries. Also, boarding and deboarding accidents and injuries can be significantly reduced if the light rail transit facility incorporates high-level loading at stations
Reliability	Public transit provided over fixed guideways is typically considered to be more reliable than public transit provided over arterial streets in mixed traffic	Light rail vehicles would experience fewer operational problems caused by traffic congestion and traffic accidents, street and utility repairs, and inclement weather than buses operated on public streets. In particular, light rail transit service in Milwaukee's northwest corridor could be expected to be very reliable since the entire alignment would be located on a reserved or exclusive right-of-way. Importantly, this advantage would be particularly critical to the Milwaukee area during the winter months because of the severe winter weather conditions frequently experienced

Table 386 (continued)

Benefit	Description	Potential Impact in the Milwaukee Area
Attractiveness	Studies have indicated that light rail transit has a greater potential to attract ridership than motor bus alternatives. Rider comfort will be enhanced by the smooth acceleration and ride afforded by light rail vehicles. Interior noise levels in light rail vehicles are also less than in motor buses	The most heavily used Milwaukee County Transit System route currently operates along N. Sherman Boulevard. A light rail transit facility in the same area serving much of the same ridership that currently uses the local bus routes could be expected to provide comfortable and attractive service to a large number of transit users
Flexibility	Light rail transit has the greatest potential to respond to sudden ridership increases. This potential becomes even more significant if future local or national policies encourage a large shift from the use of private automobiles to transit	Light rail vehicles typically allow greater "crush capacity" loads to be accommodated than do motor buses because of vehicle design and performance characteristics. During a given period of the day, additional passenger-carrying capacity can be added to the system without changing operating headways or speeds, by increasing train size

Source: SEWRPC.

similar levels of transit ridership. Under the range of alternative futures considered, a bus-on-freeway system could be expected to attract between 5.0 and 8.6 percent of the total person trips, a busway system could be expected to attract between 4.9 and 8.4 percent of the total person trips, and a light rail transit system could be expected to attract between 4.9 and 8.5 of the total person trips during an average weekday in the Milwaukee area. In addition, these three alternatives were found to have similar annual operating and maintenance cost subsidy requirements, and to have similar systemwide energy consumption and environmental impacts. The light rail transit plan would require the least amount of petroleum-based motor fuel, ranging from 5 percent to 8 percent less than the busway plan and 8 percent to 11 percent less than the bus-on-freeway plan, depending upon the alternative future considered. From 21 percent to 27 percent of all transit trips could be expected to be made on electrically propelled vehicles under the light rail transit plan. Any savings in the consumption of petroleum-based motor fuel attendant to implementation of a light rail transit plan would, however, represent less than a 1 percent savings in petroleum-based motor fuel used on the total transportation system in the Milwaukee area.

- The only significant measurable difference between the bus-on-freeway, busway, and light rail transit alternative plans lies in the capital costs attendant to plan implementation—or in their total public costs. The bus-on-freeway plan would entail substantially less capital costs over the 21-year plan design period than either the busway or light rail transit plans. Capital costs attendant to the bus-on-freeway plan could be expected to range from \$7 million to \$11 million annually, depending upon the alternative future. The busway and light rail transit plans would entail 50 percent and 150 percent more capital costs because they require extensive new fixed guideway facility construction. The busway plan would require capital costs ranging from \$13 million to \$17 million per year, with the light rail transit plan requiring capital costs ranging from \$16 million to \$21 million per year. Consequently, while the light rail transit and busway plans would have greater potential annual net operating and maintenance cost savings, such savings would be offset by the capital cost requirements. Viewing tangible cost considerations alone, then, the bus-on-freeway plan would be the best plan for the Milwaukee area under a wide range of future conditions.

- The light rail transit plan, however, would be superior to the bus-on-freeway plan if consideration is given to some of the intangible benefits of primary transit system performance. Light rail transit would probably have a greater, although uncertain and unmeasurable, potential to influence land development and redevelopment, would probably provide a more reliable and safer public transit system, and would be less subject to the adverse effects of highway system deterioration from deferred maintenance. Light rail transit has a potentially higher passenger-carrying capability per operator because of its ability to couple more than one vehicle into a train. Because of its electrical propulsion, light rail transit would also have environmental advantages in terms of localized noise and pollutant emission levels, as well as an operational advantage in the severe winter climate of the Milwaukee area, would have the best potential to continue and expand operations during a petroleum-based fuel shortage, and perhaps would have an advantage in long-term usefulness given the prospects for domestic and foreign petroleum production in the 21st century.

Thus, based on the quantitative test and evaluation of both the direct and indirect benefits of the recommended improvement plan options over the base plan, it was concluded that either plan option would be a more preferable course of action than merely maintaining the existing system. Compared to the base plan, both plan options would provide a higher level of transit service, would provide significantly greater accessibility to residents and jobs, and would attract a higher level of both total and primary transit ridership. Furthermore, because the recommended plan options would carry between 4 and 14 percent more transit passenger trips and between 25 and 80 percent more passenger miles than the base plan, their cost per trip, including both direct and indirect costs, would generally be less than that of the base plan, and their cost per passenger mile—even if only direct costs are considered—would generally be less than that of the base plan.

Given these conclusions, the Advisory Committee determined that two final plans should be prepared and presented together with the base plan at a series of public informational meetings and at a public hearing. One of the two improvement plans would be the bus-on-metered freeway plan, and would represent a continued public commitment to the provision of primary transit service in the Milwaukee area exclusively through the bus-on-freeway mode. The other improvement plan, however, would recognize the importance of the intangible advantages inherent in light rail transit technology, and would recommend implementation of that technology in the Milwaukee area in at least one important travel corridor. This would be done by dividing the second plan into lower and upper tiers. The lower tier would seek to implement a basic bus-on-freeway system plan, together with a light rail transit facility in the northwest travel corridor of the Milwaukee area—one of the corridors not served by existing or proposed freeway facilities. Under the upper tier of the plan certain of the bus-on-freeway routes would eventually be converted to light rail transit or commuter rail operation, as may be appropriate, depending upon future conditions.

Should the Advisory Committee support the bus-on-metered freeway option, this would mean that the Committee—after careful review of the comments and suggestions presented by the general public and elected officials at the public informational meetings and public hearing—had concluded that the intangible benefits attendant to development of the two-tier system plan did not outweigh the capital cost differences between the two recommended final plan options. Furthermore, it would mean that the intangible advantages of light rail transit do not appear certain enough to outweigh a selection of a final alternative plan based solely on measures of cost-effectiveness. Should the Advisory Committee support the two-tier system plan, this would mean that the intangible benefits attendant to the light rail transit mode sufficiently outweigh the total public cost advantage of the bus-on-metered freeway option. This conclusion would warrant a recommendation for light rail transit facility development in the northwest corridor of the study area in and around the Milwaukee metropolitan area. Furthermore, this conclusion would indicate that the potential of light rail transit to operate during a motor fuel shortage, and to operate in the very long-term future when petroleum-based motor fuels may be expected to become scarce and very costly, is very important. Furthermore, it would indicate that the potential of a primary transit service operating on a fixed guideway to shape urban land use development and redevelopment is of great importance.

The findings and conclusions reached during the preparation, test, and evaluation of alternative primary transit system plans for the Milwaukee area could have far-reaching implications. Such implications will affect not only the development and operation of transportation facilities and services in the Region, but also the pattern of urban development and redevelopment for generations to come. As noted above, the Advisory Committee—prior to making a final recommendation to the Regional Planning Commission—directed that the two final recommended plan options be presented together with the base plan at a series of public informational meetings, and that a formal public hearing be held to obtain the reaction of citizens and public officials to the study findings and conclusions to date.[12] Upon completion of these public meetings, the Advisory Committee will meet to consider the record of the meetings and to prepare a final recommended plan. The final recommended plan, following consideration and adoption by the Regional Planning Commission, will then be documented in the concluding chapters of SEWRPC Planning Report No. 33, A Primary Transit System Plan for the Milwaukee Area.

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[12] *Comments, observations, and suggestions presented at these meetings pertaining to the findings of this study are summarized in SEWRPC Planning Report No. 33, A Primary Transit System Plan for the Milwaukee Area.*

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APPENDICES

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Appendix A

BENEFIT-COST ANALYSIS PROCEDURES USED IN THE MILWAUKEE AREA PRIMARY TRANSIT ALTERNATIVES ANALYSIS STUDY

INTRODUCTION

The benefit-cost analysis method of evaluating government investments in public works came into general use after adoption of the Federal Flood Control Act of 1936. That Act stated that waterways should be improved "if the benefits to whomsoever they may accrue are in excess of the estimated costs." The monetary value of benefits has since been defined as the amount of money an individual would pay for that benefit if he were given the market choice of purchase. Monetary costs are taken as the total value of the resources used in the construction of the project.

While benefits must exceed costs in order for a project to be justified, this criterion alone is not sufficient to justify the investment. Although a project may have a benefit-cost ratio greater than 1.0, it may be less than the benefit-cost ratio of an alternative project which would accomplish the same objectives. Accordingly, in order to assure that public funds are invested most profitably, alternative plans or projects should be investigated and analyzed.

Benefit-cost analysis requires that an assumption be made concerning the life of the project. Desirably, that economic life is equal to the physical life of the project. In transportation planning, it is generally advisable to amortize the capital costs over the same number of years for which the travel forecasts have been made, since the risk involved in the use of capital increases as the amortization exceeds the travel forecast period. For the Milwaukee area primary transit alternatives analysis study, the 21-year period from 1980 through the year 2000 was selected as the period of economic analysis. Although this period is shorter than that often used to evaluate certain other types of public works improvements—such as flood control works—it results in a lower risk with respect to the travel forecasts involved. In addition, this shorter period recognizes the inability to anticipate other social, economic, and technological changes which may occur in the more distant future, and which may influence project benefits and costs.

In considering a single urban mass transit facility project, the selection of a period of economic analysis can be relatively simple and direct. In considering an entire system, however, which entails the staged construction of varying components of the system through a series of public works projects over a long period of time, there is no single period of physical and economic life which can be readily assigned to all of the facilities comprising the system. Consequently, the period of economic analysis selected must be long enough to permit a reasonable amortization of the costs incurred in, and a reasonable accrual of the benefits derived from, construction and operation of the total system. This period is estimated to be from 40 to 50 years, considerably longer than the 20- to 25-year period used for the analysis of any single facility. During such a longer period, all of the staged facilities comprising the recommended system will have reached the end of their physical life and, presumably, will require replacement. Moreover, the total system will not accommodate the forecast travel demands as intended until shortly after the completion of the last facility staged for construction under the recommended plan implementation program, and, therefore, will not return maximum benefits until beyond the end of the planning period. Since the travel demand is unknown beyond that period, and since the useful life of several components of a primary transit system extends beyond the plan design period—in particular, guideway facilities, maintenance and storage facilities, stations, and rail rolling stock—it is necessary to limit the time frame of the analysis to the plan design period and to calculate a salvage value at the end of that period for all transit facilities constructed over the period.

OVERVIEW OF BENEFITS AND COSTS

The benefits and costs attributable to a project can be classified either as tangible, or direct, or as intangible, or indirect. Direct benefits and costs are readily measurable in monetary terms. Indirect benefits and costs either are of such a nature that no monetary value can be assigned to them, or are so obscure that calculation of the monetary value is impractical.

For the Milwaukee area primary transit alternatives analysis, direct costs were assumed to include the following:

1. Right-of-way acquisition and related relocation assistance. All right-of-way was assumed to be purchased in the year 1985 for the purposes of the benefit-cost analysis. Right-of-way was further assumed to have an economic life of 100 years.

2. Construction costs attendant to transit guideways, passenger stations, and vehicle storage and maintenance facilities. For benefit-cost analysis purposes, these items were assumed to be constructed in uniform annual increments over the period 1985 through 2000. For analysis purposes, guideways and stations were assumed to have an economic life of 30 years, while vehicle storage and maintenance facilities were assumed to have an economic life of 35 years.

3. Transit vehicle costs. With respect to buses, which were assumed to have an economic life of 12 years, it was assumed that those buses needed for fleet replacement would be purchased on a regularly scheduled basis, with the schedule determined based on the age of the buses in the current fleet. With respect to bus fleet expansion, it was assumed that such buses would be acquired in uniform annual increments over the period 1985 through 2000. For light rail vehicles, which were assumed to have an economic life of 30 years, it was assumed that half of the required vehicles would be purchased in 1987 and that the other half would be purchased in 1988.

4. Transit system operation and maintenance deficit; that is, those costs of operating and maintaining the transit system not recovered through farebox revenues.

As noted above, indirect costs, being intangible and not readily measurable, were not included in the benefit-cost analysis. Indirect costs include such costs as those attendant to the disruption of community patterns; the division of neighborhood and community service areas; and the deterioration or destruction of the natural resource base or of scenic, historic, or cultural features.

For the Milwaukee area primary transit alternatives analysis, direct benefits were assumed to include the following:

1. Reductions in out-of-pocket costs incurred by transit users. Such reductions were calculated as follows:

   a. The total farebox revenues were calculated for the base plan and each final alternative plan considered, using the assumed fare structure for the plans. For example, in the year 2000, total transit fares were calculated at $37.115 million for the base plan and $51.289 million for the two-tier plan under the moderate growth scenario-centralized plan alternative future. This difference in transit fares represents an increase in out-of-pocket costs of $14.174 million paid by transit riders under the two-tier plan over the amount paid by riders under the base plan.

   b. An estimate was made of the savings accruing to those transit riders diverted from automobiles to transit attendant to the implementation of each alternative plan. Travel by automobile was estimated to cost 24.0¢ per mile and 20.3¢ per mile for the moderate growth and stable or declining growth futures, respectively. Continuing the example given above, it was estimated that the transit riders diverted from the automobile through the implementation of the two-tier alternative plan would save $54.425 million in automobile-related out-of-pocket costs.

   c. Using the foregoing information, it was possible to calculate a single benefit in terms of out-of-pocket cost savings. This was accomplished by subtracting the increase in transit fares incurred under the plan alternative under consideration from the savings in automobile operating costs resulting from implementation of the alternative plan. Again continuing the above example—$54.425 million minus $14.174 million results in a reduction in out-of-pocket costs, or a benefit, of $40.251 million.

2. Reductions in accident costs incurred by transit users. Such reductions were calculated as follows:

   a. Using the estimates of total passenger miles of travel and total transit vehicle miles of travel, estimated accident costs attendant to transit travel were calculated for the base plan and for each alternative

Table A-1

ACCIDENT RATES AND COSTS BY TYPE OF TRANSPORTATION FACILITY: 1979

Transportation Facility	Rate of Accident Occurrence (per 100 million vehicle miles traveled)			Cost of Accident		
	Fatality	Injury	Property Damage	Fatality	Injury	Property Damage
Freeway	0.73	89.15	569.24	$150,000	$5,800	$850
Surface Arterial	4.17	516.00	2,379.03	150,000	5,800	850
Mass Transit	0.51[a]	171.88[a]	5,077.35	150,000	380	860

[a]Accident rate expressed as the number of fatalities or injuries per 100 million passenger miles of travel.

Source: National Safety Council and SEWRPC.

plan considered. For example, in the year 2000, total transit accident costs were calculated at $1.816 million for the base plan and $2.526 million for the two-tier plan under the moderate growth scenario-centralized land use plan alternative future. This difference in transit accident costs represents an increase in accident costs of $0.710 million incurred by transit riders under the two-tier plan over the amount incurred by riders under the base plan.

b. An estimate was made of the savings accruing to those transit riders diverted from automobiles attendant to the implementation of each alternative plan. The rates of accident occurrence and the cost per accident assumed for these calculations are set forth in Table A-1. Continuing the example given above, it was estimated that the transit riders diverted from the automobile to transit through the implementation of the two-tier alternative plan would save $8.785 million in automobile-related accident costs.

c. Using the foregoing information, it was possible to calculate a single benefit in terms of accident cost savings. This was accomplished by subtracting the increase in transit accident costs incurred under the plan alternative under consideration from the savings in automobile accident costs resulting from implementation of the alternative plan. Again continuing the above example—$8.785 million minus $0.710 million results in a reduction in accident costs, or a benefit, of $8.075 million.

3. Reductions, or increases, in travel time costs incurred by transit users. The diversion of automobile drivers and passengers to transit results in changes in the travel time required to make individual trips. These changes must be taken into account in calculating the benefits associated with the implementation of a transit plan. If the data indicate that such diverted trips are made in less time, then such reductions in travel time can be calculated and added to the above-described benefits in out-of-pocket costs and accident costs. On the other hand, if the data indicate that such diverted trips take longer by transit than they did by automobile, then the incremental time associated with such change and the value attendant thereto would constitute a disbenefit attendant to implementation of the plan under consideration, and, accordingly, would have to be subtracted from the above-described benefits accruing through reductions in out-of-pocket costs and accident costs. Accordingly, the benefits, or disbenefits, associated with changes in travel time were calculated as follows:

a. A dollar value attendant to travel time was determined. A review was made of the approaches historically used to estimate the value of travel time in previous Commission studies and in national studies. This review is summarized in

Table A-2

REVIEW OF APPROACHES HISTORICALLY USED TO ESTIMATE THE VALUE OF TRAVEL TIME IN TRANSPORTATION ECONOMIC ANALYSES

Study or Project	Value of Travel Time Used	Basis for Use	Comments
SEWRPC 1990 Land Use and Transportation Study	$1.10 per passenger-hour in 1963 dollars ($2.10 per passenger-hour in 1979 dollars)	Recommended for use by the American Association of State Highway Officials' 1960 report, Road User Benefit Analysis for Highway Improvements	Does not distinguish between small and large time savings Is not adjusted to reflect characteristics of Milwaukee area
SEWRPC 2000 Land Use and Transportation Plan Reevaluation	$4.00 per passenger-hour in 1975 dollars ($7.00 per passenger-hour in 1979 dollars)	Based solely on the average manufacturing hourly wage rate in the Region	Does not distinguish between small and large time savings Implies that all travelers value time the same Does not reflect the true wage rate of the Milwaukee area since it includes the wage rate of production line workers only
Transportation Research Board, National Cooperative Research Report 133	$2.50 per passenger-hour in 1972 dollars ($3.25 per passenger-hour in 1979 dollars)	Based on a weighted value of wage rate in the nation's urbanized areas	Does not distinguish between small and large time savings Does not recommend adjusting to reflect characteristics of specific urban areas
American Association of State Highway and Transportation Officials, A Manual on User Benefit Analysis of Highway and Bus Transit Improvements, 1977	$0.26 per person-hour for low-time savings (0-4 minutes, in 1979 dollars) $2.20 per person-hour for medium-time savings (5-14 minutes, in 1979 dollars) $4.80 per person-hour for high-time savings (over 14 minutes, in 1979 dollars)	Unit value of time estimates were derived by observing how travelers were willing to trade off money expenditures for time savings at statistically identifiable rates. Unit values were based on identifiable proportions of household income	This approach was updated to extend and replace the 1960 AASHTO and 1972 National Cooperative Highway Research Program Report procedures Recognizes that travel time is sensitive to the amount of savings per trip The value of time is explicitly based on average household income Procedures recommended by the U. S. Department of Transportation (Evaluating Urban Transportation System Alternatives, 1978)

Source: SEWRPC.

Table A-2. In the interests of simplicity in comparatively estimating the time value of the benefits, or disbenefits, the factor of $2.20 per person-hour for medium-time savings promulgated by the American Association of State Highway and Transportation Officials (AASHTO) and referenced in Table A-2 was selected for use in the analysis.

b. Using the estimates of total passenger hours of travel, the estimated value of time attendant to travel was calculated for the base plan and for each alternative plan considered. For example, in the year 2000, the value of total transit travel time was calculated at $119.878 million for the base plan and $148.280 million for the two-tier plan under the moderate growth scenario-centralized plan alternative future. This difference in transit travel time value represents an increase in travel time costs of $28.402 million incurred by transit riders under the two-tier plan over the amount incurred by riders under the base plan.

c. An estimate was made of the travel time cost savings accruing to those transit riders diverted from automobiles to transit attendant to the implementation of each alternative plan. Continuing the example given above, it was estimated that the transit riders diverted from the automobile to transit through implementation of the two-tier alternative plan would save $14.938 million in automobile-related travel time costs.

d. Using the foregoing information, it was possible to calculate a single benefit, or disbenefit, for the anticipated reductions or increases in travel time attendant to any given plan under consideration. This was accomplished either by subtracting the increase in transit travel time costs from the savings in automobile travel time costs resulting from the implementation of the alternative plan under consideration, resulting in a benefit in the case where the savings in automobile travel time cost is larger than the increase in transit travel time cost, or by subtracting the savings in automobile travel time costs from the increase in transit travel time costs, resulting in a disbenefit in the case where the transit travel time cost is larger than the savings in automobile travel time cost. Again continuing the above example—$28.402 million minus $14.938 million results in a $13.464 million disbenefit, or increase, in travel time cost, since the transit travel time cost increase is larger than the automobile travel cost savings.

4. Calculation of net total benefit. Using the above example results in a net benefit, as indicated below:

Benefits in out-of-pocket cost savings:	$40,251,000
Benefits in accident cost savings:	8,075,000
Subtotal	$48,326,000
Disbenefits in travel time costs:	$13,464,000
Net Total Benefit	$34,862,000

As noted earlier, indirect benefits, being intangible and not readily measurable, were not included in the benefit-cost analysis. Indirect benefits include reductions in adverse environmental impacts such as air pollution emissions and noise, the ability to promote sound land use development and redevelopment, reductions in energy utilization and reliance on petroleum-based fuels, increased reliability for trips occurring during weekday peak travel periods, and the attractiveness of peak-period travel by certain technologies.

DETAILED PROCEDURE FOR CALCULATING BENEFITS AND COSTS

The foregoing discussion was intended to provide an overview of the method by which the benefits and costs were calculated for the Milwaukee area primary transit alternatives analysis study. The following discussion is intended to describe the step-by-step methodology by which such benefits and costs were computed.

Step-by-Step Calculation of Benefits

1. Estimates were made of the transit passenger fares, transit vehicle miles, transit vehicle hours, passenger miles, and passenger hours of travel which might be expected to occur on each system to be considered, including the base plan, on an average weekday.

2. The annual transit system user out-of-pocket costs—transit fares—were derived by multiplying the average weekday transit passenger revenue by 290 and 255 for nonprimary system and primary system fares, respectively.

   The conversion of nonprimary average weekday transit revenues to annual revenues, accomplished with an empirically derived factor of 290, accounts for weekend and holiday travel, which occurs at a rate lower than average weekday travel. The conversion of primary average weekday revenue to annual revenue, accomplished with a factor of 255 (the number of weekdays in a year minus the number of holidays which occur on weekdays), accounts for travel on nonholiday weekdays during the year.

3. The annual transit system accident costs were derived by multiplying the annual number of accidents by the cost of each accident (see Table A-1 for accident rates and costs).

4. The annual transit travel time costs were derived by multiplying the transit passenger hours of travel by $2.20 (see Table A-2).

5. Estimates were made of the annual automobile vehicle miles and person hours of travel saved—when compared to the base plan—by transit riders diverted from the automobile to transit attendant to the implementation of each alternative transit plan.

6. The annual savings in highway-related, out-of-pocket costs were derived by multiplying the annual savings in automobile vehicle miles of travel by $0.240 and $0.203 for the moderate growth and stable or declining growth futures, respectively.[1]

7. The annual savings in highway-related accident costs were derived by multiplying the annual number of accidents by the cost of each accident (see Table A-1 for accident rates and costs).

8. The annual savings in highway-related travel time costs were derived by multiplying the savings in automobile person hours of travel by $2.20.

9. Steps 1 through 8 were carried out for users of the the existing (1980) transit system and for users of each of the alternative (2000) transit systems under consideration for each of the two alternative futures.

10. The total annual transit system user costs for each alternative plan were derived by:

    a. Reducing the annual transit system user out-of-pocket costs by the amount of the savings in highway-related, out-of-pocket costs attendant to the diversion of trips from the automobile to transit.

    b. Reducing the annual transit system user accident costs by the amount of the savings in highway-related accident costs attendant to the diversion of trips from the automobile to transit.

    c. Reducing the annual transit system travel time costs by the amount of the savings in highway-related travel time costs attendant to the diversion of trips from the automobile to transit.

    d. Adding the annual transit system user out-of-pocket costs, accident costs, and travel time costs to obtain the total transit system user costs for each transit system alternative plan and the base plan under each future.

11. The present worth on January 1, 1980, of the transit system user costs[2] was then calculated for each future transit system plan over the 21-year time period, using a 6 percent and a 10 percent rate of return for two time periods:

    a. 1980 through 1985, wherein user costs were assumed to accrue annually at the 1980 level, thereby providing sufficient time to realize implementation of planned improvements.

    b. 1986 through 2000, wherein equal staging of system improvements and travel demand was assumed to yield an equal annual increase in user costs.

12. The transit system user benefits, defined as the reduction in out-of-pocket, accident, and travel time costs accrued through the provision of the proposed transit system improvements, were obtained by subtracting the

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[1] *These costs for the operation of motor vehicles reflect the cost of vehicle maintenance, vehicle acquisition (depreciation), and motor fuel, the cost of which varies on a per-mile basis under each of the two alternative growth futures. It should be noted that the cost of operation does not include the cost of insurance, which is accounted for in the analyses by the inclusion of accident costs.*

[2] *For detailed tabulations of transit system user costs, see Chapter VII of this report.*

present worth of the user costs under the transit system alternative being analyzed from the present worth of the user costs anticipated to occur under the base plan transit system alternative.

Step-by-Step Calculations of Costs

A monetary value for the costs incurred under the proposed alternative primary transit systems was calculated as follows:

1. Construction costs, which included right-of-way acquisition and related engineering costs, were obtained by summing such costs as estimated for all facilities proposed under the transit system plan under evaluation.[3]

2. Capital costs involved in the provision of the mass transit system, which included vehicles needed for replacement of obsolete vehicles, as well as for improvement and expansion of the system, were obtained in a manner similar to that in which the construction costs were obtained.[4]

3. The salvage value of all facilities constructed or equipment acquired for the operation of the transit system was calculated based on the remaining useful life of the facilities and equipment on December 31, 2000.

4. The total operation and maintenance costs incurred under the proposed alternative transit systems were calculated. The public cost of operation and maintenance of the transit system was then derived by reducing the total operation and maintenance cost by the transit user fares.

5. The present worth on January 1, 1980, of the transit system capital costs was obtained using a 6 percent and a 10 percent rate of return assuming that:

   a. Construction and capital costs, except the cost of buses acquired to replace obsolete vehicles, were incurred in equal annual increments over the period 1985 through 2000.

   b. Capital costs for buses used to replace obsolete vehicles were incurred on a bus-replacement schedule based on a 12-year vehicle life and fleet age.

6. The present worth on January 1, 1980, of the salvage value of the mass transit system was obtained using a 6 percent and a 10 percent rate of return.

7. The present worth on January 1, 1980, of the public transit system operating and maintenance cost was obtained using a 6 percent and a 10 percent rate of return for two time periods:

   a. 1980 through 1985, wherein such costs were assumed to accrue at the 1980 level.

   b. 1986 through 2000, wherein equal staging of transit system improvements was assumed to yield equal annual increases in public operating and maintenance costs from the 1985 annual level to the 2000 annual level.

8. The total present worth of the plan alternative costs was obtained by summing the present worth of the construction, capital, and public operating and maintenance costs, and subtracting the present worth of the transit system salvage value.[5]

9. The costs associated with a specific alternative transit plan under analysis were obtained by subtracting the cost of the base plan transit system from the cost of the alternative in question, as derived in Step 8.

10. The benefit-cost ratio was then calculated by dividing the benefits or difference in transit user costs between the alternative and the base plan by the increment of cost involved in implementing the alternative plan, as opposed to the base plan.

CONCLUDING REMARKS—RATE OF RETURN

Considerable debate continues on the rate of return that should be used when evaluating proposed investments in primary transit facilities. For transit projects, the rate of return has been tied

[3]*For detailed tabulations of alternative transit system construction costs, see Chapter VII of this report.*

[4]*Ibid.*

[5]*For detailed tabulations of transit system user costs, see Chapter VII of this report.*

closely to the long-term cost of borrowing money. In this study, the appropriate rate of return was based on an estimate of the average rate of return that is expected on possible investment before taxes and after inflation. Money invested privately is currently expected to return, generally, from 6 to 10 percent. Since implementation of the primary transit plan should return benefits to the public similar to those which could be attained through private investment, interest rates of 6 and 10 percent—representing the full range of rates of return currently being used—were recommended for use in the economic evaluation of the plans. It should be noted that in 1981 the Wisconsin Department of Transportation was using a rate of 8 percent for evaluating major highway improvement projects, and 4 percent in the evaluation of railway branchline projects described in the 1981 Wisconsin Transportation Planning Program State Rail Plan.