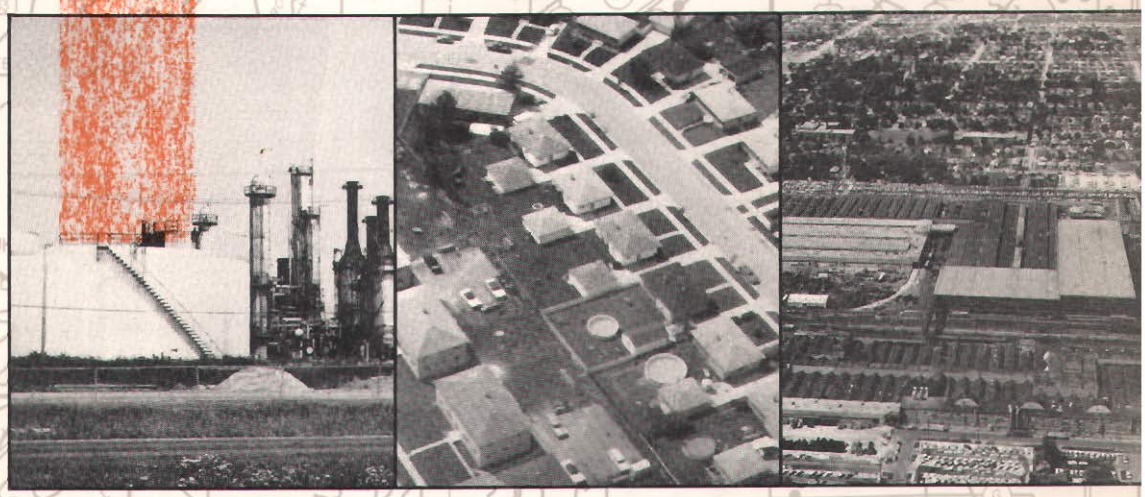
TECHNICAL REPORT NUMBER 25

ALTERNATIVE FUTURES FOR SOUTHEASTERN WISCONSIN



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The three key external factors which can be expected to affect the future of transit utilization in southeastern Wisconsin during the next 20 years—the cost and availability of energy, population lifestyles, and economic conditions—are depicted on the cover photographs of a petroleum refinery in northern Wisconsin, a residental subdivision in the City of Milwaukee, and the American Motors Corporation main plant in the City of Kenosha.

Photos courtesy of Otto P. Dobnick and SEWRPC.

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ALTERNATIVE FUTURES FOR SOUTHEASTERN WISCONSIN

Prepared by the
Southeastern Wisconsin Regional Planning Commission
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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.

December 1980

Inside Region $ 5.00
Outside Region $10.00

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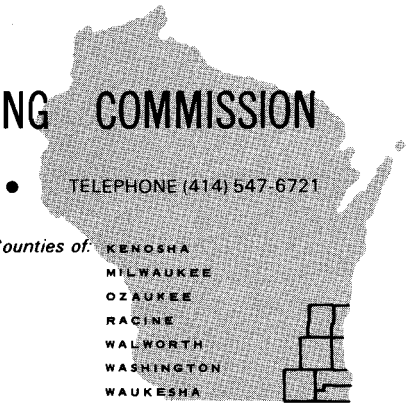

November 11, 1980

STATEMENT OF THE EXECUTIVE DIRECTOR

At the request of Milwaukee County, the Southeastern Wisconsin Regional Planning Commission in March of 1979 undertook a study to determine the best means of providing rapid transit service within the greater Milwaukee area. The 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 such service within those corridors. These objectives required the Commission to reevaluate the feasibility within the greater Milwaukee area of providing rapid transit service by bus on freeway, bus on metered freeway, bus on reserved freeway lanes, bus on busway, light rail rapid transit, heavy rail rapid transit, and commuter rail transit.

The traditional practice in long-range transportation system planning has been to prepare a single forecast of future levels of population and economic activity, and of such factors as the cost of automobile operation, and to use these forecasts in the testing and evaluation of alternative transportation system plans. This approach has worked well in periods of relative stability, when historic trends could be expected to extend over a plan design period. During periods of major social and economic changes, however, the assumption that historic trends will continue becomes uncertain and a different approach to planning becomes necessary.

Accordingly, a new approach, termed "alternative futures," was used in the transit planning effort. This approach attempts to deal with the uncertainty that currently exists about future conditions influencing public transit development. These conditions include energy cost and availability, population lifestyles, and land use centralization/decentralization. Under the new approach, the design, testing, and evaluation of alternative rapid transit system plans is based upon a number of alternative futures which together define a range of possible future conditions affecting rapid transit system development, and which permit the identification of those rapid transit facilities that may be expected to perform well under a wide range of futures. Thereby, "robust" facilities that can be expected to be viable under greatly varying future conditions can be identified and recommended for implementation.

This report presents the results of the application of the alternative futures approach to rapid transit system planning in the Milwaukee area. The report accordingly identifies key factors external to the Region influencing future public transit needs within the Region, and sets forth alternative scenarios of possible change in these factors over time. These key external factors include motor fuel cost and availability, automobile motor fuel use efficiencies, population lifestyles, and economic conditions. The possible changes in these external factors over time were used to develop consistent, reasonably extreme alternative future conditions within the Region affecting rapid transit system development. The most optimistic scenario developed postulates moderate population and economic growth, significantly higher motor fuel costs and lower motor fuel use efficiencies, and a potential for motor fuel supply restrictions, all acting as incentives for increased transit use. The least optimistic scenario developed postulates a stable economy, a declining population, and moderately higher motor fuel costs and higher motor fuel use efficiencies, all acting as disincentives to transit use. Both centralized and decentralized land use plans are presented for each of the two alternative scenarios, thus providing in effect four "alternative futures" as a framework for rapid transit system planning within the greater Milwaukee area.

Although the information provided in this report on these alternative futures is intended to be used primarily for rapid transit system planning, it is the Commission staff's opinion that this information will also be useful in planning for other public works systems, such as sewerage, water supply, drainage and flood control, and park and open space systems.

Respectfully submitted,

Kurt W. Bauer
Executive Director

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TABLE OF CONTENTS

LIST OF TABLES

Table — Chapter II — Page

LIST OF FIGURES

LIST OF MAPS

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Chapter I

INTRODUCTION

In any systems planning effort, forecasts are required of all future events and conditions that lie outside the scope of the plan but that affect plan design or plan implementation. For example, the future demand for land and for transportation in the Region will depend primarily upon the size and spatial distribution of future population and upon the nature and distribution of future economic activity within the Region. Changes in population and economic activity can be influenced, although not fully controlled, by governmental activity at the regional and local levels, as well as at the state and national levels. The type and quality of transportation services provided are particularly important influences on the growth and development of an area, both in terms of the total level and character of economic activity and in terms of the spatial distribution of that activity and the related resident population. Because governmental activity, particularly at the regional and local level, is only one factor influencing changes in population and economic activity, such changes are difficult to predict over the 20-or-more-year planning period required for the design and development of major systems of public works, such as primary transit systems. Changes in population and economic activity levels over the plan design period must, therefore, be in some manner projected or forecast without conclusive knowledge of what the governmental policies influencing such changes may, in fact, be, or of the precise effects of such policies on growth and development.

The historic practice in long-range systems planning has been to prepare a number of projections of possible future population and economic activity levels, selecting from this range a single forecast population and economic activity level believed to be most probably representative of future conditions to be utilized as a basis for the development, testing, and evaluation of alternative land use and supporting transportation system plans.[1] The selection and use of such single forecast values was usually dictated by budgetary and staff time limitations that precluded the preparation of

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[1] *In 1963, at the time that the Commission was preparing its first generation land use and transportation system plans, the universal practice in other metropolitan areas was to consider the spatial distribution of future land use as lying outside of the scope of the planning process and, therefore, as an element to be forecast. The Commission, however, chose to define the spatial distribution of future land use within the scope of the plans to be prepared and, therefore, as a design rather than a forecast problem. In preparing its initial land use plan for the Region, the Commission prepared and evaluated four alternative plans—a controlled existing trend, or centralized, plan; a corridor plan; a satellite city plan; and an uncontrolled existing trend, or decentralized, plan. (See SEWRPC Planning Report No. 7, Land Use-Transportation Study, Volume Two, Forecasts and Alternative Plans: 1990, for a description of these alternative plans.) These alternative land use plans, while based upon a single common forecast of future population and economic levels within the Region, in effect constituted a set of alternative futures for the Region with respect to land use development. In 1972, when the Commission undertook the preparation of a second generation regional land use plan, it prepared two alternative plans—a centralized and a decentralized plan. Since the first generation alternative land use plans were prepared for a design year population of 2.7 million persons and an employment level of one million, and since the second generation plans were prepared for a population in the design year of 2.2 million persons and an employment level of one million, a limited set of alternative future scenarios for the Region already exist.*

alternative system plans for a number of alternative population and economic activity levels spanning the range of possible future conditions.

This traditional approach to system planning works well in periods of socioeconomic stability, when historic trends can be anticipated to continue relatively unchanged over the plan design period. However, during periods of major change in social and economic conditions, when there is uncertainty as to whether historic trends will continue, an alternative to the traditional approach to systems planning may be required. One such alternative approach proposed in recent years, and utilized to a limited extent at the national level for public and quasi-public planning purposes but not as yet at the regional level, is termed "alternative futures." Under this approach, the development, testing, and evaluation of alternative system plans is based not upon a single most probable forecast of future conditions, but rather upon a number of futures chosen to represent a range of future conditions which may be expected to occur over the plan design period. The purpose of this approach is to permit the evaluation of the performance of alternative system plans over a variety of possible future conditions in order to identify those alternatives that perform well under a wide range of such conditions. The alternative futures used under this approach are selected to represent the reasonable extremes of a range of future conditions on the assumption that alternative system plans which 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 can be expected to remain viable under greatly varying future conditions can be identified.

ALTERNATIVE FUTURES PLANNING IN THE MILWAUKEE AREA PRIMARY TRANSIT SYSTEM ALTERNATIVES ANALYSIS

The use of this new alternative futures planning approach was recommended for the Milwaukee area primary transit system alternatives analysis in the prospectus[2] prepared for that study. This new approach was selected because it was recognized that future conditions will strongly influence the kind and extent of primary transit service in the Milwaukee area. Such conditions include the future price and availability of energy, and particularly of petroleum-based motor fuel; future automobile technology and cost of automobile travel; future economic growth and change in the nation, the north-central states, the State, and the Region; future lifestyles, particularly with regard to residential preferences; and the future size and distribution of population and economic activity in the Milwaukee area.

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

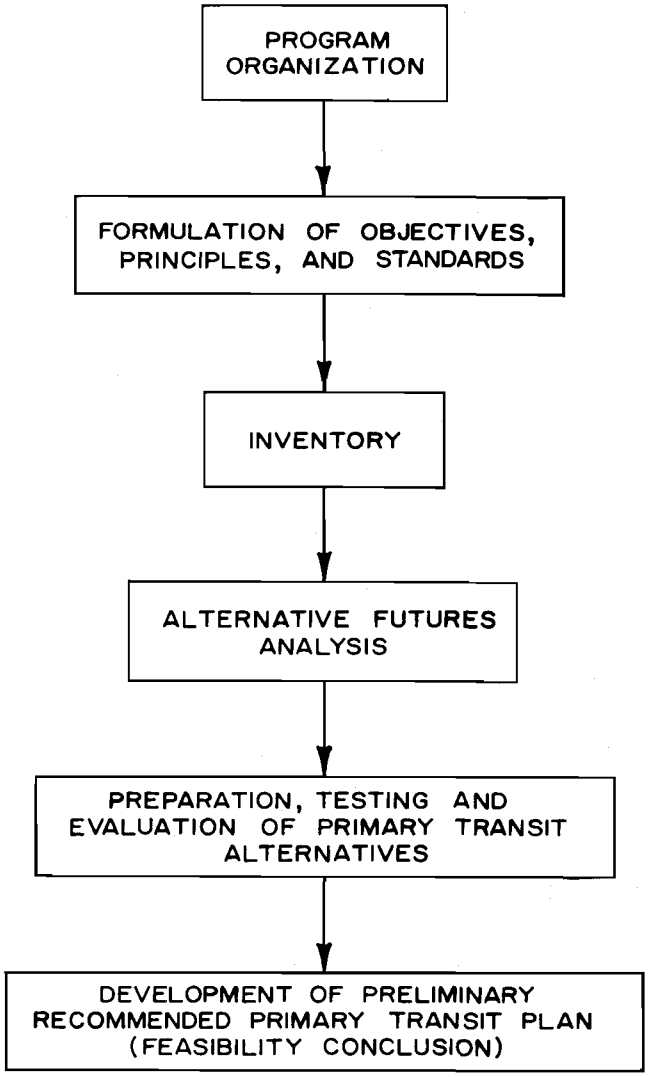
The alternative futures analysis has three phases, as shown in Figure 2. The first phase consists of the development of alternative scenarios of future change in factors that operate external to the Region, but that may directly or indirectly affect regional growth or decline and, therefore, primary transit needs within the Region. The second phase consists of the determination of the amount of regional growth or decline likely to result under the alternative scenarios developed under the first phase. The third phase consists of the development of alternative land use plans for each scenario of future changes in external factors.

The fifth step in the overall alternatives analysis is the preparation, testing, and evaluation of alternative primary transit plans for each alternative land use plan identified in the alternative futures analysis. The sixth step is the development of a preliminary recommended primary transit system plan. That plan is to consist of a "lower tier" and an "upper tier" of recommendations, a concept used in the Commission's newly adopted long-range regional transportation system plan. The recommendations placed in the lower tier are proposed for immediate implementation, while the

[2] *See Milwaukee Area Primary Transit System Alternatives Analysis Prospectus, SEWRPC, October 1978.*

Figure 1

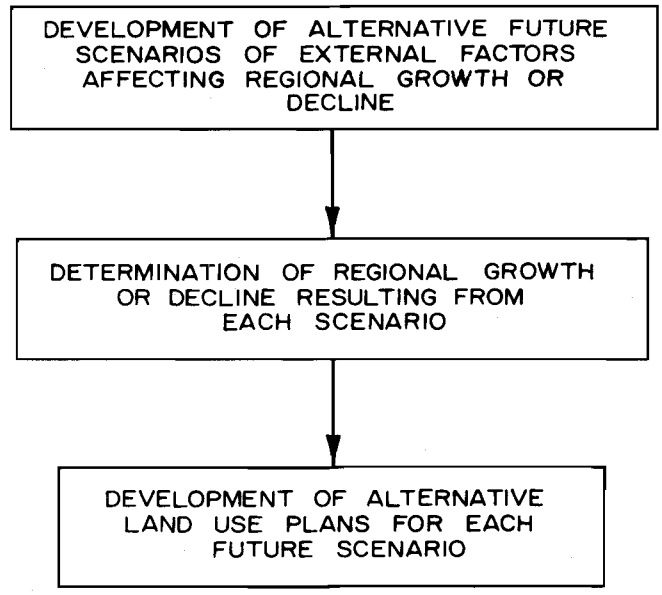
THE MILWAUKEE AREA PRIMARY TRANSIT SYSTEM ALTERNATIVES ANALYSIS PLANNING PROCESS



Source: SEWRPC.

Figure 2

THE ALTERNATIVE FUTURES ANALYSIS OF THE MILWAUKEE AREA PRIMARY TRANSIT SYSTEM ALTERNATIVES ANALYSIS



Source: SEWRPC.

recommendations placed in the upper tier are not to be implemented for at least a decade. The inclusion of upper-tier recommendations in the plan ensures that no action is taken that would preclude their possible future implementation, while at the same time 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 that can be integrated into the existing transportation system. The upper tier consists of those elements that perform well only under some futures or a single future. This method of developing the preliminary primary transit plan recommendation—namely, that of basing such a recommendation on the evaluation of how well alternative primary transit system plans perform under a variety of futures—constitutes the principal difference between the alternatives analysis planning process and the traditional Commission land use-transportation planning process.

This technical report sets forth the findings of the fourth step in the overall alternatives analysis process—the alternative futures analysis—and thereby defines the alternative futures under which alternative primary transit system plan performance will be determined and compared in the development of a recommended system plan and the identification of lower and upper tiers of that plan.

The first step in the alternative futures analysis is the development of alternative future scenarios of factors which, while external to the Region, affect

the growth or decline of the Region and, therefore, the primary transit needs of the Milwaukee area. The factors are considered external to the Region because public and private decision-makers within the Region have little or no influence over them, yet in the future must respond to them. That is, these external factors can be expected to strongly influence, if not control, the future characteristics of the Milwaukee area and the Region, and therefore shape the primary transit needs of the area. Some key external factors, such as future energy price and availability, will directly affect primary transit needs in the Milwaukee area. Other key external factors, such as the national and north-central states' economies, will indirectly affect primary transit needs in the Milwaukee area through their impacts on the future population and economic characteristics of the Region.

In the exploration of alternative futures for the Region, an attempt was made first to identify all those external factors that may be expected to directly or indirectly affect primary transit needs in the Milwaukee area, together with the likely future range of prospects for these factors. Two alternative scenarios for regional growth and change were then defined. These scenarios represent opposite extremes of the future prospects identified for the external factors and, consequently, may be expected to indicate vast differences in the future population growth and economic development of the Milwaukee area, and hence in the primary transit needs of the area. The future characteristics of the Region established for each scenario included changes in population size and composition, changes in size and characteristics of employment, changes in automobile and truck availability, and changes in land use demand.

Alternative regional land use plans were then developed for each of the two alternative future scenarios of external factors. The two land use plans under each future differed primarily in their degree of centralization, one land use plan under each future being a centralized plan and the other being a decentralized plan. The centralized and decentralized plans, in turn, differed in their estimates of future densities of now existing and new land use development, and of the extent to which new urban development may be expected to be served by a full complement of urban facilities and services, including centralized sanitary sewer, centralized water supply, and mass transit facilities and services.

SCHEME OF PRESENTATION

The findings of the alternative futures analysis for southeastern Wisconsin conducted under the Milwaukee area primary transit system alternatives analysis are presented in this technical report. Chapter II of the report presents alternative future scenarios of external factors affecting southeastern Wisconsin. Chapter III establishes probable levels of regional growth and change attendant to each alternative scenario presented in Chapter II. The centralized and decentralized alternative land use plans developed for each scenario and the likely level of regional growth and change under these plans are presented in Chapter IV. Chapter V presents a summary of the alternative futures studies and discusses their implications for the Milwaukee area primary transit system alternatives analysis.

It should be noted that this technical report, together with its companion documents, SEWRPC Technical Report No. 23, Transit-Related Socio-economic, 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. 26, Milwaukee Area Alternative Primary Transit System Plan Preparation, Test, and Evaluation, is intended to document the procedures and data used, the alternatives developed and evaluated, 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 resulting recommendations of the process 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 V of that report contains, in summary form, the findings of the alternative futures analysis presented in greater detail in this technical report.

Chapter II

ALTERNATIVE FUTURE SCENARIOS OF EXTERNAL FACTORS

INTRODUCTION

The primary transit system alternatives analysis for the Milwaukee area envisions the design, testing, and evaluation of alternative primary transit system plans under four "alternative futures" intended to represent the range of probable future conditions affecting transit system development and use within the Southeastern Wisconsin Region over the next two decades. The first step in the development of these alternative futures entails consideration of possible future change in factors which, while operating largely external to the Region, may affect transit system development and use in the Milwaukee area either directly—for example, by affecting the cost of urban travel—or indirectly—for example, by influencing regional population growth or decline or the spatial distribution of land use in the Region. Such factors are termed "external" because they are variables over which public and private decision-makers within the Region may be expected to have relatively little or no influence, and are variables to which the Region in the future must respond.

Four external variables have been considered in the development of alternative futures under the Milwaukee area primary transit system planning program: 1) energy cost and availability; 2) energy-related technology; 3) population lifestyles; and 4) national economic activity. The energy cost and availability variable attempts to consider possible future energy costs and availability, focusing primarily on motor fuel production, price, and availability. Energy cost and availability can be expected to directly affect transit needs by determining the future cost and convenience of urban travel. Energy cost and availability can also be expected to indirectly affect transit needs by influencing the future distribution of urban land development and redevelopment, as well as the levels and types of economic activity.

The energy-related technology variable attempts to assess possible technological advancements which may significantly alter both the availability and use of energy. The prospects for technological advancements leading to increased supplies of conventional energy resources are examined, as are the prospects for the development of unconventional energy resources, along with the potential to make more efficient use of energy resources. The energy-related technology variable is intended to provide an additional basis for establishing future ranges in the production, cost, and availability of energy.

The economy variable attempts to assess trends in national economic activity and to provide a range of future prospects for change in such activity at the national and regional level. The lifestyle variable attempts to assess historic and possible future changes in family pattern and residential lifestyles. Family pattern characteristics considered include labor force participation, household size, and fertility and mortality rates. Residential lifestyles considered include housing unit location and structure-type patterns.

Two alternative future scenarios for these four external factors were developed. The two scenarios were developed to provide a reasonably extreme range of possible future conditions within the Region. Each of the two scenarios, by including a range of possible residential lifestyles, addresses the prospects for the centralization and decentralization of urban land uses within the Region. The scenarios also provide a range in anticipated growth and change for the Region, with one future scenario pointing toward moderate growth in the Region and the other toward stability or moderate decline. In Chapter III of this report, the amount of regional growth and decline which may be expected to be associated with each scenario is discussed, and in Chapter IV alternative centralized and decentralized land use plans are presented for each scenario.

In the following sections of this chapter, each of the four external variables is discussed, including historic and recent trends, and prospects for the continuation of, or change in, these trends in the future. The two future scenarios for the Region developed from the range of future prospects in these external factors are then presented.

ENERGY COST AND AVAILABILITY

Since the embargo on the export of oil to the United States, enforced by the Organization of Petroleum Exporting Countries (OPEC) at the end of 1973, and particularly since the halt in Iranian oil exports to the United States late in 1978, there have been substantial changes in the cost and availability of energy, notably petroleum-based fuels, in the United States. Concern over future energy cost and availability in the United States has been expressed, and the desirability of the nation relying on foreign energy sources has been questioned. There has been increasing public awareness of the fact that some energy resources are finite, both in the United States and the world, and that energy production has been on the decline within the United States in recent years. It has also been recognized that some energy alternatives to the now more heavily used and more finite sources have associated safety and environmental problems which make their prospects for future use as uncertain as that of the more finite sources. The lack of a consensus on national policy to deal with the energy problem, as well as on the extent of the energy problem, makes any consideration of future energy cost and availability difficult.

The future cost and availability of energy in the nation may be expected to directly affect transit needs in the Milwaukee area, as the price and availability of energy may be expected to influence travel patterns and possibly land use patterns, which in turn shape transit needs. This is because the cost and convenience of operating an automobile is, in part, a function of the cost and availability of energy and, specifically, of petroleum-based motor fuels on which the automobile is exclusively dependent.

In the following sections, the future prospects for the production, cost, and availability of energy, in particular petroleum-based motor fuels, are considered, as are trends in energy use by sector of demand and by energy source. Trends in and future prospects for petroleum use and availability are also discussed, and factors which could significantly affect future prospects are identified.

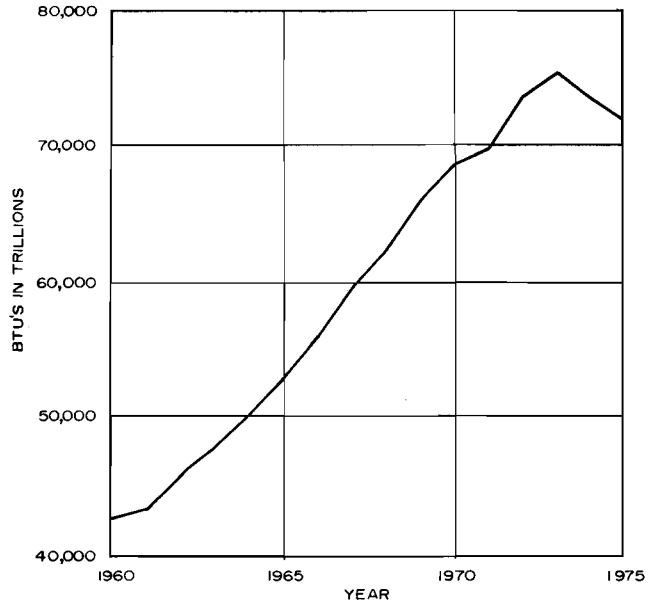
Energy Use

Energy use in the State and in the United States has historically, uniformly, and rapidly increased. Energy use in the nation in 1900 totaled 8 quadrillion (10^{15}) British Thermal Units (BTU's) and in 1975 totaled 72 quadrillion BTU's—an eightfold increase in 75 years. The population of the United States over the same 75-year period increased from about 76 million people to about 213 million people, less than threefold. From 1960 to 1975, energy use increased from 43 quadrillion BTU's to 72 quadrillion BTU's—an increase of 67 percent—compared with an increase of 19 percent in the nation's population over the same time period. The annual compound rate of increase in energy use over this 15-year period, 3.5 percent, was greater than that over the entire 75-year period of 1900 to 1975, about 3 percent. It should be noted, however, that from 1973 to 1975, energy consumption in the nation declined somewhat, as shown in Figure 3. Since 1975 energy consumption in the nation has again increased, to 75 quadrillion BTU's in 1976 and to 78 quadrillion BTU's in 1978.

Industrial Energy Consumption: The energy consumption of the industrial sector, the largest consumer of energy in the United States, is summarized in Table 1 for the years 1960 through 1975. The industrial sector is dominated by manufacturing activities, but also includes mining, construction, and agricultural activities. As shown in Table 2, the principal use of energy by industry is process steam, followed by direct heat, electric drive, and feedstocks. Energy consumption by the industrial sector represented about 40 percent of

Figure 3

TOTAL ENERGY CONSUMPTION IN THE UNITED STATES: 1960 TO 1975



Source: U. S. Department of Energy and SEWRPC.

Table 1

ENERGY CONSUMPTION IN THE UNITED STATES BY SECTOR OF DEMAND: 1960-1975

Energy Consumption (quadrillion BTU's)					
Year	Industrial	Transportation	Residential	Commercial	Total
1960	18.6	9.7	8.8	5.7	42.8
Percent	43.4	22.7	20.0	13.3	100.0
1965	22.3	12.2	10.6	7.4	52.5
Percent	42.5	23.2	20.2	14.1	100.0
1970	28.1	16.0	13.8	10.5	68.4
Percent	41.1	23.4	20.2	15.3	100.0
1975	27.3	18.0	14.9	11.6	71.8
Percent	38.0	25.1	20.7	16.2	100.0
Percent Change 1960-1975	46.8	85.6	69.3	103.5	69.4

Source: U. S. Department of Energy and SEWRPC.

all energy consumption in the nation between 1960 and 1975. Energy consumption by the industrial sector of the nation increased from 18.6 quadrillion BTU's in 1960 to 27.3 quadrillion BTU's in 1975—an increase of 8.7 quadrillion BTU's, or about 47 percent. In comparison, total energy consumption in the nation increased from 42.8 quadrillion BTU's in 1960 to about 71.8 quadrillion BTU's in 1975, an increase of 69 percent.

Industry is also the largest energy user in the State of Wisconsin, accounting for about one-third of the total energy consumption between 1960 and 1975. As shown in Tables 1 and 3, however, the consumption of energy by industry in the State and nation has declined since 1970. In 1975 the principal source of energy for industry in the State and nation was natural gas, as shown in Tables 4 and 5. Natural gas was also the principal source of energy for industry in the nation in 1960, but in the State coal was the principal source of energy for industry at that time.

Transportation Energy Consumption: The transportation sector is the second largest user of energy in the nation, consuming in 1975 about 18 quadrillion BTU's of energy—about 25 percent of total national energy consumption. Energy consumption by transportation in the nation increased from

Table 2

ENERGY CONSUMPTION IN THE UNITED STATES BY USE IN THE INDUSTRIAL SECTOR: 1973

Energy Use	Energy Consumption (quadrillion BTU's)	Percent
Process Steam. . .	10.5	35.5
Direct Heat	7.1	24.0
Electric Drive . . .	6.5	22.0
Feedstocks.	4.0	13.5
Electrolysis	0.9	3.0
Other	0.6	2.0
Total	29.6	100.0

Source: Resources for the Future, Inc., and SEWRPC.

9.7 quadrillion BTU's in 1960 to over 18.0 quadrillion BTU's in 1975—an increase of about 8.2 quadrillion BTU's, or 86 percent (see Table 1). Historically, the largest consumer of energy for transportation purposes has been passenger transportation, accounting for nearly 54 percent of all transportation energy consumption in the nation in 1971, as shown in Table 6. Furthermore nearly 90 percent of this energy is consumed by automobiles. Use of energy by trucking represents the greatest proportion of freight transportation energy con-

Table 3

ENERGY CONSUMPTION IN THE STATE OF WISCONSIN BY SECTOR OF DEMAND: 1960-1975

Year	Energy Consumption (quadrillion BTU's)				
	Industrial	Transportation	Residential	Commercial	Total
1960	0.27	0.17	0.27	0.13	0.84
Percent	32.1	20.3	32.1	15.5	100.0
1965	0.36	0.20	0.31	0.15	1.02
Percent	35.3	19.6	30.4	14.7	100.0
1970	0.46	0.27	0.38	0.21	1.32
Percent	34.8	20.5	28.8	15.9	100.0
1975	0.39	0.31	0.39	0.23	1.32
Percent	29.5	23.5	29.5	17.5	100.0
Percent Change 1960-1975	44.4	82.0	44.4	76.9	57.1

Source: U. S. Department of Energy and SEWRPC.

Table 4

ENERGY SOURCES FOR SECTORS OF ENERGY DEMAND IN THE UNITED STATES: 1960 AND 1975

Sector	Year	Energy Consumption[a] (quadrillion BTU's)				
		Petroleum	Natural Gas	Coal	Electricity	Other
Industrial	1960	2.3	4.8	4.7	1.2	2.7
	1975	2.4	8.9	4.2	2.3	3.8
Transportation . . .	1960	9.7	--	--	--	--
	1975	17.4	0.6	--	--	--
Residential	1960	2.6	3.2	0.7	0.7	--
	1975	2.8	5.0	0.1	2.0	--
Commercial	1960	1.7	1.1	0.4	0.5	0.8
	1975	2.1	2.6	0.1	1.6	1.0

[a] *Does not include energy consumed in the production of electrical power.*

Source: U. S. Department of Energy and SEWRPC.

sumption in the nation. In 1971, trucking represented 53 percent of total freight transportation energy consumption and freight transportation accounted for nearly 38 percent of total transportation energy consumption. Thus, highway transportation represented nearly two-thirds of all energy use by transportation in the nation, and about one-sixth of all energy use in the nation.

The amount of energy consumed by highway transportation is particularly significant because petroleum is the sole source of energy for highway transportation. Petroleum is by far the dominant energy source for transportation in the nation and the State, accounting for over 95 percent of all transportation energy consumed in the nation and State over the past 15 years (see Tables 4 and 5).

Table 5

ENERGY SOURCES FOR SECTORS OF ENERGY DEMAND IN THE STATE OF WISCONSIN: 1960 AND 1975

Sector	Year	Energy Consumption[a] (quadrillion BTU's) Petroleum	Natural Gas	Coal	Electricity	Other
Industrial	1960	0.05	0.04	0.12	0.02	0.01
	1975	0.03	0.16	0.05	0.04	0.01
Transportation	1960	0.17	--	--	--	--
	1975	0.31	--	--	--	--
Residential	1960	0.10	0.05	0.05	0.02	--
	1975	0.11	0.12	0.01	0.04	--
Commercial	1960	0.04	0.01	0.03	0.01	0.02
	1975	0.03	0.07	--	0.03	0.02

[a] *Does not include energy consumed in the production of electrical power.*

Source: U. S. Department of Energy and SEWRPC.

The petroleum consumed by transportation in the United States in 1975 accounted for over 55 percent of all petroleum consumed in the nation.

Trends in transportation energy consumption in the State have been similar to national trends. As shown in Table 3, from 1960 through 1975 transportation energy use in the State increased 82 percent—about the same increase experienced by the nation. In 1975 transportation accounted for about 23 percent of the total energy use in the State and over 60 percent of the total petroleum use in the State, both about the same as national percentages. Also like the nation, transportation in the State is heavily oriented toward highway transportation—in particular the automobile in passenger transportation and the truck in freight transportation—as shown in Table 7.

Residential Energy Consumption: Residential energy consumption ranks third in importance among the four sectors of energy demand in the nation, accounting for a nearly constant 20 percent of total national energy use over the past 15 years (see Table 1). Residential energy use in the nation increased from 8.8 quadrillion BTU's in 1960 to 14.9 quadrillion BTU's in 1975, for a 69 percent increase—about the same percentage increase experienced in total national energy consumption over the same period. Natural gas, electricity, and oil were the principal sources of energy for the residential sector of the nation in 1975, as shown in Table 4.

Table 6

ENERGY CONSUMPTION IN THE UNITED STATES BY USE IN THE TRANSPORTATION SECTOR: 1971

Energy Use	Energy Consumption (trillion BTU's)	Percent
Domestic		
Passenger		
Automobile	8,652	48.2
Air	852	4.8
Railroad	24	0.1
Marine	81	0.4
Other	160	0.9
Total	9,769	54.4
Freight		
Trucking	3,445	19.2
Air	233	1.3
Pipeline	1,590	8.9
Railroad	520	2.9
Marine Shipping	340	1.9
Total	6,128	34.1
Military	784	4.4
Subtotal	16,681	92.9
International		
Passenger-Air Freight	204	1.1
Air	129	0.7
Shipping	277	1.5
Total	406	2.2
Military	659	3.4
Subtotal	1,269	7.1
Total	17,951	100.0

Source: The Rand Corporation and SEWRPC.

Table 7

ENERGY CONSUMPTION IN THE STATE OF WISCONSIN BY USE IN THE TRANSPORTATION SECTOR: 1974

Energy Use	Energy Consumption (trillion BTU's)	Percent
Automobile . .	171.0	60
Truck.	93.1	33
Rail	10.7	4
Urban Bus . . .	0.9	- -
Airplane	10.0	3
Total	285.7	100

Source: Wisconsin Department of Transportation and SEWRPC.

Table 8

ENERGY CONSUMPTION IN THE UNITED STATES BY USE IN THE RESIDENTIAL SECTOR: 1973

Energy Use	Energy Consumption (quadrillion BTU's)	Percent
Space Heating	7.8	51.0
Water Heating	2.3	15.0
Refrigeration	1.3	8.5
Air Conditioning . . .	1.1	7.2
Lighting	0.9	5.9
Cooking	0.7	4.6
Clothes Drying	0.4	2.6
Other.	0.8	5.2
Total	15.3	100.0

Source: Resources for the Future, Inc., and SEWRPC.

About one-half of the energy consumed by the residential sector was for space heating, historically the major use of energy in the home, as shown in Table 8. Other residential uses of energy, in order of amount of use, include water heating, air conditioning, refrigeration, cooking, lighting, and clothes drying. Electricity accounted for about 75 percent of these other residential energy uses.

The residential sector is the second largest consumer of energy in the State, accounting for about 30 percent of total state energy use between 1960 and 1975 (see Table 3). Energy consumed by the residential sector in the State increased from 0.27 quadrillion BTU in 1960 to 0.39 quadrillion BTU in 1975, a 44 percent increase—somewhat less than the 57 percent increase in total state energy use over the same period. As in the nation, the principal sources of energy in the residential sector in 1975 were natural gas, electricity, and oil, as shown in Table 5.

Table 9

ENERGY CONSUMPTION IN THE UNITED STATES BY USE IN THE COMMERCIAL SECTOR: 1973

Energy Use	Energy Consumption (quadrillion BTU's)	Percent
Space Heating	3.8	35.4
Lighting	2.9	27.0
Air Conditioning . . .	1.5	13.9
Road Surfacing	1.1	10.2
Refrigeration	0.8	7.6
Water Heating	0.5	4.9
Cooling.	0.1	1.0
Total	10.7	100.0

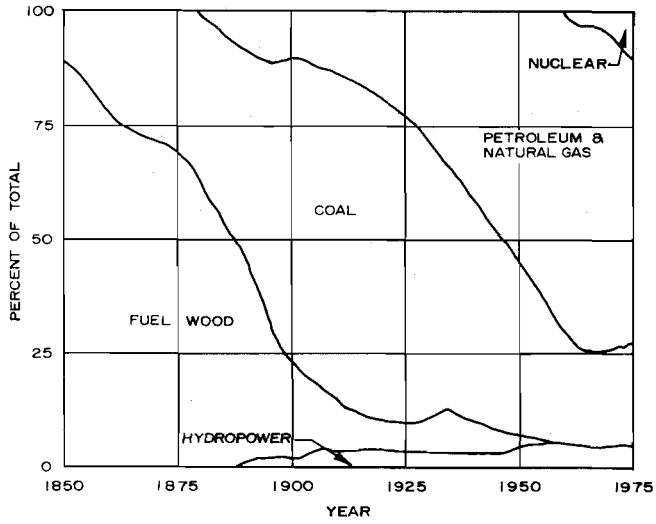
Source: Resources for the Future, Inc., and SEWRPC.

Commercial Energy Consumption: The commercial sector of the nation, which includes retail and service activities as well as governmental and institutional uses, is the smallest consumer of energy in the nation. Between 1960 and 1975, the commercial sector accounted for about 15 percent of the total energy use in the nation. Energy consumption by the commercial sector of the nation increased from 5.7 quadrillion BTU's in 1960 to nearly 11.6 quadrillion BTU's in 1975, a 104 percent increase (see Table 1). In comparison, total energy consumption in the United States over the same time period increased by 67 percent. As shown in Table 9, the principal use by the commercial sector, like the residential sector, is space heating. Lighting is the next largest use of energy in the commercial sector. As shown in Table 4, in 1975 the principal sources of energy for the commercial sector of the nation were natural gas, petroleum, and electricity.

The commercial sector of the State is, like that of the nation, the smallest sector of energy use, accounting for about 18 percent of total state energy use. Also, like energy use by the commercial sector of the nation, energy use by the commercial sector of the State has increased faster since 1960 than total state energy use, as shown in Table 3. Total energy use by the commercial sector of the State increased from 0.13 quadrillion BTU in 1960 to 0.23 quadrillion BTU in 1975, a 77 percent increase. The principal sources of energy for the commercial sector of Wisconsin are natural gas, electricity, and petroleum, as shown in Table 5.

Figure 4

ENERGY SOURCES CONSUMED
IN THE UNITED STATES: 1850-1975



Source: Ford Foundation and SEWRPC.

Table 10

FUEL WOOD CONSUMPTION
IN THE UNITED STATES: 1850-1975

Year	Energy Consumption (quadrillion BTU's)
1850	2.1
1860	2.6
1870	2.9
1880	2.9
1890	2.5
1900	2.0
1910	1.8
1920	1.6
1930	1.5
1940	1.4
1950	1.2
1960	0.8
1970	0.4

Source: U. S. Bureau of the Census, and SEWRPC.

Energy Sources

The sources of energy consumed in the United States have constantly changed, as shown in Figure 4. Throughout the 1800's, wood was the predominant energy source, accounting in 1850 for nearly 90 percent of the total energy consumed in the United States, with coal accounting for the other 10 percent. By 1890, coal had become the major energy source in the nation. In 1910 coal reached its maximum proportion of national energy use, 79 percent, and until the 1950's was the dominant source of energy in the nation. Petroleum and natural gas have accounted for the major proportion of energy use since the 1950's, having first been introduced in the late 1800's. Until the introduction of large-scale nuclear power generation in the early 1970's, petroleum and natural gas had provided an increasing percentage of the energy consumed in the nation, reaching a maximum of 78 percent in 1972. In 1975 about 67 percent of the total energy used in the nation was provided by petroleum and natural gas, 19 percent by coal, and 12 percent by hydropower and nuclear power.

Fuel Wood: Until the end of the 19th century, fuel wood was the leading source of energy in the nation, reaching a peak in total use between the 1870's and 1880's, as shown in Table 10. Use of fuel wood has steadily declined in the United States since then, and in 1970 fuel wood was estimated to constitute less than 1 percent of national energy use. Few data are available on trends in wood fuel consumption since 1970, but sales of wood-burning stoves and fireplaces have increased dramatically since 1972. However, because of the limited supply of timber and competing uses, fuel wood is unlikely to ever serve as more than a supplemental energy source, and then as that only in areas where local wood supply is plentiful. Any more widespread use will require technological advancements to improve fuel wood efficiency.

Coal and Lignite: Coal energy consumption in the nation reached a peak in 1918 of 16.9 quadrillion BTU's and then declined during the 1920's and 1930's, but again peaked at 16.9 quadrillion BTU's in 1943 and 1944. Since the end of World War II, coal consumption has again declined to a level of about 13.7 quadrillion BTU's in 1975, as shown in Table 11. Declines in the use of coal occurred in the industrial, commercial, and residential sectors of the nation (see Table 12). In the State of Wisconsin, the use of coal has declined from 1970 levels, as shown in Table 13. This decline is largely a result of decreases in coal use in the industrial sector, as well as in the commercial and residential sectors.

The historic decline in coal use in the nation and State appears to be related to neither the availability nor the price of coal. It has been estimated by a variety of sources that recoverable resources of coal in the United States approach 35,000 to 40,000 quadrillion BTU's, or a level of energy sufficient to last five centuries at current national total energy consumption levels, or to last one century at an assumed 2 percent annual growth rate in national total energy use. Price would also not appear to be a factor in the historical decline in coal consumption within the nation, as historically the price of delivered coal per BTU has generally been less than that of other, substitutable sources.

Table 11

ENERGY CONSUMPTION IN THE UNITED STATES BY ENERGY SOURCE: 1850-1975

Year	Energy Consumption (quadrillion BTU's)				
	Petroleum	Natural Gas	Coal	Other	Total
1850	--	--	0.2	2.1	2.3
1860	--	--	0.5	2.7	3.2
1870	--	--	1.0	3.0	4.0
1880	0.1	--	2.0	2.9	5.0
1890	0.2	0.3	4.1	2.3	6.9
1900	0.2	0.3	6.8	2.0	9.3
1910	1.0	0.5	12.7	1.8	16.0
1920	3.0	0.8	15.5	1.3	20.6
1930	6.1	2.2	13.6	1.1	23.0
1940	7.7	3.0	12.5	1.2	24.4
1950	12.3	6.8	12.9	1.8	33.8
1960	16.9	10.8	10.0	5.1	42.8
1970	25.1	22.1	13.4	7.8	68.4
1975	27.8	20.3	13.7	9.7	71.8

Source: U. S. Bureau of the Census, U. S. Department of Energy, and SEWRPC.

Coal production has been limited largely because of the environmental impacts of its combustion and because it is expensive and inconvenient to transport, store, and use. Coal combustion can cause health and environmental hazards through the release of nitrogen oxides, sulfur oxides, trace elements, and carbon dioxide. Some of these environmental problems can be controlled through the use of low sulfur coal and air pollutant emission controls. Because of the large reserves of coal in the United States and the potential for the environmental impacts of its use to be lessened, the recent trend of a decline in the use of coal in the United States is likely to be reversed in the future.

Natural Gas: Only in the last 20 years has the production, distribution, and widespread consumption of natural gas occurred in the United States. Consumption of natural gas in the nation increased from 6.8 quadrillion BTU's in 1950 to 10.8 quadrillion BTU's in 1960, and to 20.3 quadrillion BTU's in 1975, as shown in Table 11. The peak year of natural gas use in the nation was 1972, in which 23.1 quadrillion BTU's were consumed. Natural gas use in the State of Wisconsin increased from 0.1 quadrillion BTU in 1960 to 0.4 quadrillion BTU in 1975, as shown in Table 13. In both the State and the nation, natural gas accounted for about 30 percent of total energy use in 1975. The major users of natural gas in both the nation and State were the commercial and residential sectors, as shown in Table 14.

Until the late 1940's, natural gas was largely consumed only in the southern and western regions of the nation, where natural gas was primarily found. In the late 1940's pipeline technology was developed to allow the economical transmission of natural gas over long distances, and over a 15-year period pipelines were constructed to all of the

Table 12

COAL CONSUMPTION BY SECTOR OF DEMAND IN THE UNITED STATES AND THE STATE OF WISCONSIN: 1960-1975

Sector	Coal Consumption (quadrillion BTU's)							
	1960		1965		1970		1975	
	United States	Wisconsin	United States	Wisconsin	United States	Wisconsin	United States	Wisconsin
Industrial	4.7	0.12	5.6	0.15	5.4	0.14	4.2	0.05
Transportation . .	--	--	--	--	--	--	--	--
Residential	0.7	0.05	0.5	0.04	0.3	0.03	0.1	0.01
Commercial	0.4	0.03	0.3	0.02	0.2	0.02	0.1	--

Source: U. S. Department of Energy and SEWRPC.

nation's metropolitan areas. This pipeline system for natural gas, however, made existing regulation by individual states impossible, and caused the formation of the Federal Power Commission to assure "just and reasonable" natural gas pricing. It was not until the late 1960's that the differences in interstate and intrastate regulation affected the production and consumption of natural gas. During the late 1960's natural gas reserves began to decline, and interstate and intrastate natural gas prices began to diverge. Interstate prices were regulated to "fair and reasonable" levels, while intrastate prices were allowed to rise, reflecting levels of supply and demand. The result of the two-level pricing structure has been a curtailment in the growth of natural gas consumption and shortages in interstate market natural gas. Proven natural gas reserves in the nation have declined by about 25 percent from their peak level in 1967 to their lowest level since 1954. It has been estimated that to sustain current levels of natural gas consumption, prices of natural gas will have to dramatically increase.

Table 13

ENERGY CONSUMPTION IN THE STATE OF WISCONSIN BY ENERGY SOURCE: 1960-1975

Year	Energy Consumption (quadrillion BTU's)				
	Petroleum	Natural Gas	Coal	Other	Total
1960	0.4	0.1	0.3	--	0.8
1970	0.5	0.4	0.4	--	1.3
1975	0.5	0.4	0.3	0.1	1.3

Source: U. S. Department of Energy and SEWRPC.

Petroleum: The demand for energy from petroleum in the nation began rapidly increasing in the 1940's. In 1920 petroleum provided less than 15 percent of the total energy consumed in the nation, as shown in Table 11. In 1975 petroleum accounted for nearly 40 percent of the nation's energy needs, and it is estimated that petroleum now meets over 50 percent of current energy needs. The principal user of petroleum in the nation is transportation, accounting for nearly 55 percent of the petroleum consumed in the nation in 1975. The industrial, commercial, and residential sectors of the nation and electric utilities accounted for about an equal share of the remainder of petroleum consumption in the nation, as shown in Table 15.

Until the 1950's the United States produced most of the petroleum that the nation consumed, with production centered in the States of Texas, California, Oklahoma, and Louisiana. In fact, the United States was a net exporter of petroleum through the year 1948. Since 1950, the United States has been a net importer of petroleum. Between 1950 and 1960 the United States annually imported about 15 percent of its petroleum energy needs, and between 1960 and 1970 the United States annually imported approximately 20 percent of its total petroleum consumption. Petroleum production in the United States peaked in the early 1970's, as shown in Figure 5, and the decline in domestic production of petroleum since those years, combined with the continuing increases in demand for petroleum in the nation since 1971, has served to significantly increase the amount of petroleum imported to the United States. It is estimated that in 1978 almost 50 percent of the oil consumed in the nation was imported, as indicated in Table 16. The sources of the imports of petroleum to the United States for the years 1950 through 1976 are shown in Table 17.

Table 14

NATURAL GAS CONSUMPTION BY SECTOR OF DEMAND IN THE UNITED STATES AND THE STATE OF WISCONSIN: 1960-1975

Sector	Natural Gas Consumption (quadrillion BTU's)							
	1960		1965		1970		1975	
	United States	Wisconsin	United States	Wisconsin	United States	Wisconsin	United States	Wisconsin
Industrial.	4.8	0.04	6.5	0.09	9.8	0.16	8.9	0.16
Transportation . .	--	--	0.5	--	0.8	--	0.6	--
Residential.	3.2	0.05	4.0	0.08	5.0	0.11	5.0	0.12
Commercial	1.1	0.01	1.5	0.02	2.5	0.06	2.6	0.07

Source: U. S. Department of Energy and SEWRPC.

Table 15

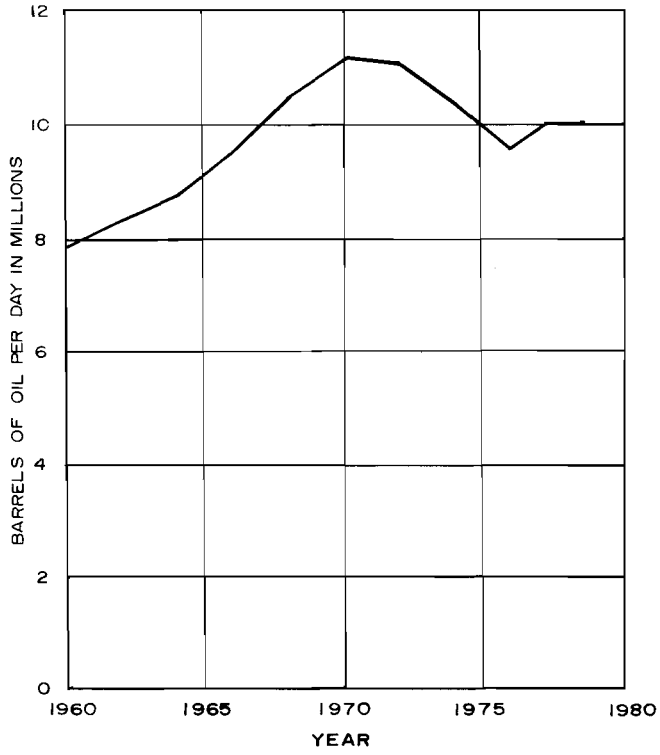
PETROLEUM CONSUMPTION BY SECTOR OF DEMAND IN THE UNITED STATES AND THE STATE OF WISCONSIN: 1960-1975

Sector	Petroleum Consumption (quadrillion BTU's)							
	1960		1965		1970		1975	
	United States	Wisconsin	United States	Wisconsin	United States	Wisconsin	United States	Wisconsin
Industrial.	2.3	0.05	2.3	0.03	2.3	0.03	2.4	0.03
Transportation . .	9.7	0.17	11.7	0.19	15.2	0.25	17.4	0.31
Residential.	2.6	0.10	2.0	0.11	3.2	0.13	2.8	0.11
Commercial	1.7	0.04	2.0	0.04	2.3	0.04	2.1	0.03

Source: U. S. Department of Energy and SEWRPC.

Figure 5

CRUDE OIL PRODUCTION IN THE UNITED STATES: 1950-1980



Source: British Petroleum Company, American Society of Civil Engineers, and SEWRPC.

Petroleum production has declined in the United States partly because the use of petroleum represents essentially a withdrawal from a fixed and limited supply of a naturally occurring resource.

Table 16

FOREIGN OIL CONSUMPTION IN THE UNITED STATES: 1960-1978

Year	Oil Consumption (percent)
1960	19
1962	21
1964	21
1966	22
1968	22
1970	24
1972	29
1974	38
1976	43
1978[a]	47

[a] *Estimate.*

Source: British Petroleum Company and SEWRPC.

Consideration of the recoverable petroleum resources of the United States and of present reserves does not indicate substantial increases in domestic production beyond current levels of production, even if regulation and price controls on petroleum production were eliminated.[1] In the

[1] *Estimates of recoverable petroleum resources consider the total amount of oil known and believed to be present in the United States and its continental shelves, and known and believed to be recoverable under present technology and its expected advances, and under current prices and their anticipated changes. Estimates of petroleum reserves consider only identified oil deposits known to be recoverable with existing technology under present prices.*

Table 17

FOREIGN OIL IMPORTS TO THE UNITED STATES BY SELECTED SOURCE COUNTRIES: 1950-1976

Year	Abu Dhabi[a]		Algeria		Canada		Indonesia		Iran	
	Thousands of Barrels	Percent of Total	Thousands of Barrels	Percent of Total	Thousands of Barrels	Percent of Total	Thousands of Barrels	Percent of Total	Thousands of Barrels	Percent of Total
1950	--	--	--	--	--	--	--	--	111	0.1
1955	--	--	--	--	16,810	5.9	11,941	4.2	3,202	1.1
1960	--	--	284	0.1	41,349	11.1	26,720	7.2	13,056	3.5
1965	5,035	1.1	3,256	0.7	107,762	23.8	22,170	4.9	28,633	6.3
1970	23,047	4.8	2,093	0.4	245,258	50.7	25,670	5.3	12,184	2.5
1971	29,026	4.7	4,685	0.8	263,294	42.9	40,232	6.6	38,576	6.3
1972	26,873	3.3	31,753	3.9	312,440	38.5	59,633	7.4	49,700	6.2
1973	25,764	2.2	43,619	3.7	365,370	30.8	73,055	6.2	78,900	6.7
1974	25,158	2.0	65,764	5.2	288,763	22.7	103,482	8.2	168,956	13.3
1975	42,585	2.9	96,459	6.4	219,175	14.6	138,270	9.2	101,575	6.8
1976	93,421	4.8	149,190	7.7	135,690	7.0	196,283	10.1	109,073	5.6

Year	Libya		Nigeria		Saudi Arabia		Venezuela		Others		Total
	Thousands of Barrels	Percent of Total	Thousands of Barrels	Percent of Total	Thousands of Barrels	Percent of Total	Thousands of Barrels	Percent of Total	Thousands of Barrels	Percent of Total	
1950	--	--	--	--	14,650	8.2	107,019	60.2	55,934	31.5	177,714
1955	--	--	--	--	29,050	10.2	140,754	49.3	83,664	29.3	285,421
1960	--	--	--	--	28,232	7.6	172,887	46.5	89,047	24.0	371,575
1965	15,152	3.4	5,296	1.2	48,235	10.7	157,852	34.9	58,649	13.0	452,040
1970	17,156	3.5	17,490	3.7	6,140	1.3	97,996	20.3	36,259	7.5	483,293
1971	19,426	3.2	34,826	5.7	41,971	6.8	110,574	18.0	30,807	5.0	613,417
1972	40,069	4.9	88,887	11.0	63,626	7.8	93,300	11.5	44,854	5.5	811,135
1973	48,585	4.1	163,687	13.8	168,525	14.2	125,742	10.6	90,749	7.7	1,183,996
1974	1,495	0.1	254,358	20.0	159,827	12.6	116,437	9.2	84,915	6.7	1,269,155
1975	81,403	5.4	272,265	18.2	256,036	17.1	144,221	9.6	146,192	9.8	1,498,181
1976	162,457	8.5	371,092	19.2	447,071	23.1	88,139	4.6	182,726[b]	9.4	1,935,142

[a] *Includes other members of the United Arab Emirates.*

[b] *Represents imports of 12,881 barrels from Norway; 451 from Kuwait; 5,914 from Malaysia; 2,426 from Angola; 18,671 from Ecuador; 38,412 from Trinidad; 1,849 from Bolivia; 9,685 from Gabon; 31,670 from Mexico; 6,311 from Egypt; 5,400 from Tunisia; 9,542 from Iraq; 8,631 from Qatar; 10,943 from Oman; 2,041 from Columbia; 3,142 from Congo (Brazzaville); 2,368 from Israel; 648 from U.S.S.R.; 7,088 from Zaire; and 4,923 from England.*

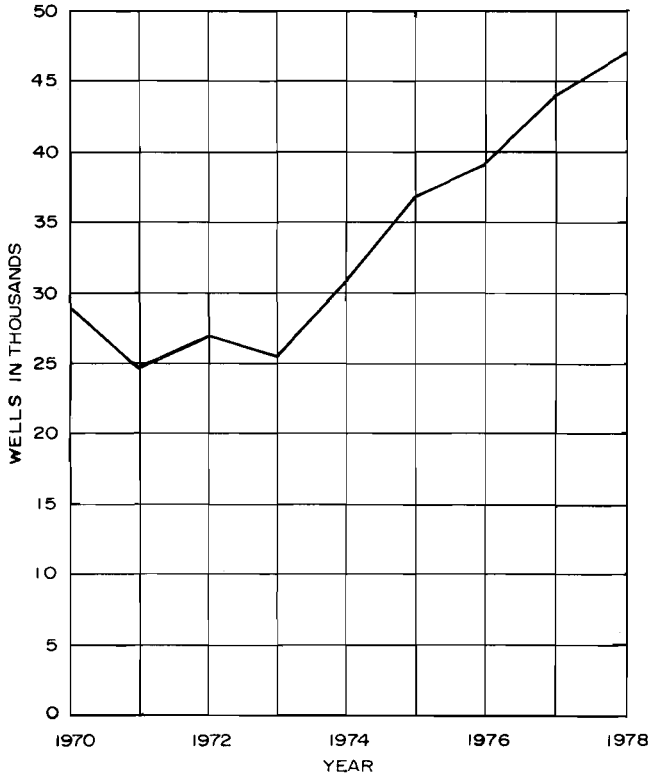
Source: Twentieth Century Petroleum Statistics 1976; U. S. Department of the Interior, Bureau of Mines; and SEWRPC.

United States over 2.5 million petroleum wells have been drilled, nearly four times as many as in all non-Communist countries of the world. Since 1973, the number of wells drilled each year has nearly doubled from about 25,000 to 50,000, yet national petroleum reserves have declined by 20 percent over this period, as shown in Figures 6 and 7. This fact is seen as one indication of the probable continuing decline in national petroleum reserves, and a continuing slow decrease in future petroleum production in the United States.

Information on the discovery of petroleum in the coterminous United States indicates a dramatic decline in the rate of domestic petroleum discovery since the 1940's. As shown in Figure 8, the number of barrels of crude oil discovered per foot of exploratory drilling was high and stable until the middle 1940's, and since then has become low and stable. The drastic decline and subsequent stability of this oil discovery rate has been tied to the observed concentration of oil in a few large fields which, because of their size, are generally found in early exploratory drilling. Of the 20,000 oil fields that have been discovered in the nation since the 1800's, 275 fields have accounted for nearly 60 percent of all crude petroleum produced in the nation to the year 1975, or about 66.5 billion barrels of crude oil. Over 80 percent of these fields were discovered prior to 1950. Each of these 275 fields

Figure 6

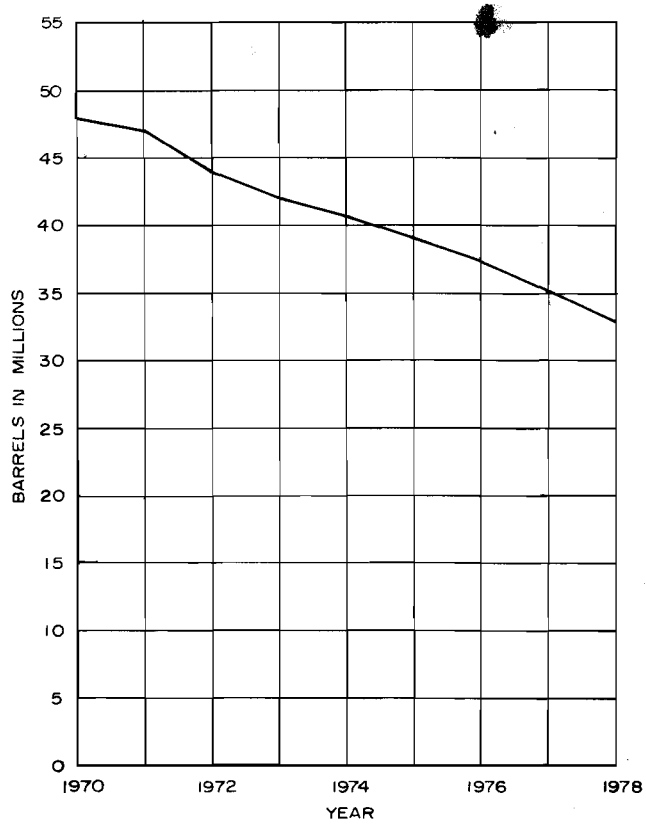
ANNUAL NUMBER OF NEW OIL WELLS DRILLED IN THE UNITED STATES: 1970-1978



Source: American Society of Civil Engineers and SEWRPC.

Figure 7

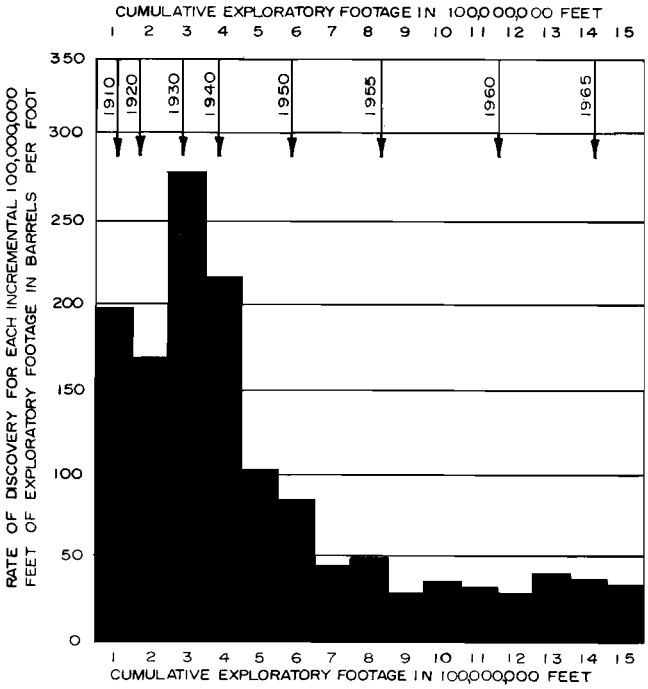
OIL RESERVES OF THE UNITED STATES: 1970-1978



Source: American Society of Civil Engineers and SEWRPC.

Figure 8

RATE OF OIL DISCOVERY IN THE COTERMINOUS UNITED STATES



Source: U. S. Geological Survey and SEWRPC.

is anticipated to produce at least 100 million gallons of crude oil, and taken together, the fields contain 90 percent of the proven reserves of the nation. This observed concentration of oil in large fields combined with the observed low petroleum discovery rate since the middle 1950's, despite the drilling of 291,000 new oil wells between 1951 and 1977, points toward a continuing decline in national oil reserves and production. Only new and yet unexplored territories, such as parts of Alaska and the outer continental shelf of the United States, may provide for the discovery of fields other than the small oil fields now being found.

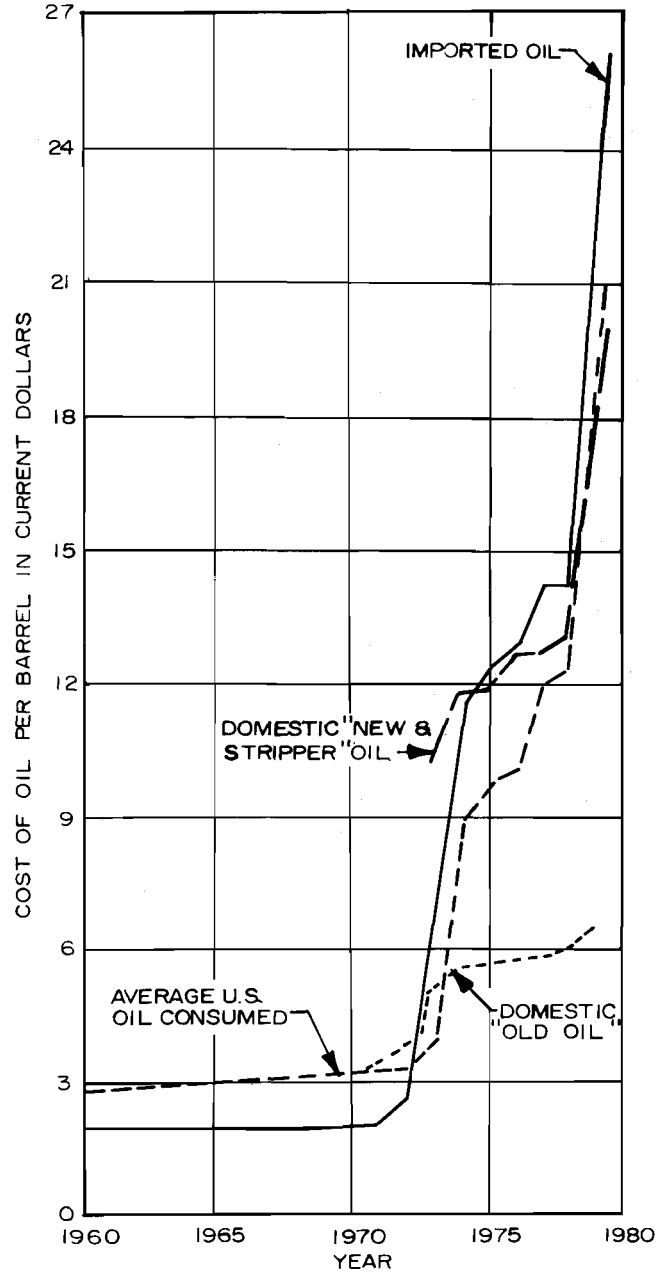
As noted earlier, in response to the rapid increases in domestic petroleum demand, particularly since 1950, the more moderate production of oil in the 1950's and 1960's, and the actual decline in domestic oil production in the 1970's, imports of petroleum began to meet the increasing petroleum demand in the United States. Imported petroleum accounted for an estimated 50 percent of petroleum demand in the United States in 1977. A substantial proportion of this imported oil came from the Middle East, where foreign and American oil producers began to uncover large oil fields and

reserves in the 1940's and 1950's. During the 1960's and early 1970's, petroleum use in the United States and world began to rapidly increase, and the exports of oil from the Middle East and other oil-exporting countries also grew. With oil production in the United States, and in a number of oil-exporting countries, reaching its peak in 1971, and with world oil demand rapidly increasing and beginning to approach world production capacity, the Organization of Petroleum Exporting Countries (OPEC),[2] which was formed in 1960, set a precedent in 1971 by not accepting the price for crude oil offered by major oil producers, and by instead setting its own price. The price increase obtained by OPEC in 1971 was $0.50 per barrel, about a 40 percent increase. In late 1973 an embargo on oil imports to the United States was enforced by the OPEC country of Saudi Arabia because of the United States' announced decision to provide arms to Israel. With most other Arab nations of OPEC following the lead of Saudi Arabia, major United States oil companies and refiners were forced to bid at auctions for oil at prices approaching $20 per barrel, even though the holdback of world oil production was less than 10 percent. The embargo ended in early 1974, but at the beginning of 1974 the price of OPEC oil was increased to $7 a barrel, and toward the end of 1974 the OPEC price was increased to $10 a barrel.

Between 1974 and 1978, increases in OPEC crude oil prices were limited, as shown in Figure 9, as a result of some moderation of world oil demand. Believed to have contributed to this moderation of demand was an economic slowdown of the world during this period, oil discoveries in the North Sea and in Alaska, and the implementation of conservation practices, all of which have been partially attributed to the OPEC oil price increases of the early 1970's. This surplus of world oil over demand ended in late 1978 with the ceasing of production in Iran as a result of political revolution. Iran's normal five million barrels of production per day represented about 16 percent of OPEC oil daily production, yet brought world supply, particularly for exports, above demand. At the end of 1978, OPEC increased its crude oil price 5 percent and announced scheduled increases for the remainder of 1979 totaling 14.5 percent. In addition, OPEC member nations began to add surcharges to the OPEC price, and by late 1979 the price of crude oil to the United States from the OPEC nations had reached $26 a barrel.

Figure 9

COSTS OF OIL PER BARREL TO THE UNITED STATES: 1960-1980



Source: U. S. Department of Transportation, Chase Manhattan Bank, and SEWRPC.

The prospects with regard to oil, either from imports or domestic production, as a major energy source in the United States are not good. Increased domestic production is not likely unless reserves are tapped in largely unexplored areas of Alaska or the outer continental shelves. Even the American Petroleum Institute, which traditionally has been one of the most optimistic forecasters of future national oil prospects, estimates an increase in domestic oil production by 1985 of only 5 to 15 percent, and then only if price decontrol occurs and oil exploration and drilling increase. Increased reliance on imports would surely be accompanied

[2] *OPEC originally included the countries of Iran, Iraq, Saudi Arabia, Venezuela, and Kuwait, and now also includes Algeria, Libya, Nigeria, Bahrain, Indonesia, Qatar, United Emirates, and Mexico.*

by increased prices. OPEC crude oil prices doubled during 1978 and 1979. Major OPEC oil price increases have occurred principally following disruptions in its oil production, and because it is generally accepted that its member countries do not constitute an area of stability, future disruptions can be expected to occur. But even more importantly, the announced policy of at least some OPEC countries is to hold production down to create such disruption, and to continually increase crude oil prices. Such a policy would result in a continuing tight supply situation with resulting upward pressure on prices.

An alternative to the importation of oil, or to the increased conventional domestic production of oil, is technological advancement allowing use of oil from shale, tar sands, or coal. Improved recovery of conventional oil could also affect the future supply of oil in the United States. The potential of such technology will be discussed in the next section of this chapter.

Electrical Power: Electrical power must be considered differently from other sources of energy because it involves the conversion of other forms of energy to electricity, which in turn is used. In 1975 electric power represented about 12 percent of the energy used by the nation's industrial, transportation, residential, and commercial sectors. As shown in Table 18, the principal user of electricity in the nation in 1975 was the industrial sector, followed by the commercial and residential sectors. About equal absolute increases since 1960 in the use of electricity have occurred for all three of these sectors of the nation. The energy used in the conversion to electricity represented about 29 percent of all energy used in the nation in 1975. In the United States in 1975, coal was by far the leading form of energy converted into electricity, accounting for nearly 45 percent of all energy converted to electricity. Nuclear power accounted for about 8 percent of all energy converted to electricity, while oil, natural gas, and hydroelectric sources accounted for about equal shares of the remaining energy converted to electric power in the nation, as shown in Table 19. The amount of electrical power generated, and thus consumed, in the nation has more than doubled since 1960, as shown in Table 18. The energy sources used to produce electrical power have also changed, with the major difference being the introduction of nuclear power.

As can be seen by comparing Tables 18 and 19, there is energy loss in the production of electricity. In 1975, about 5.9 quadrillion BTU's of electricity were produced in the nation from an estimated 20.8 quadrillion BTU's of other energy sources, reflecting a conversion efficiency rate of 28 percent. Because electrical power requires, on the average, about three units of input energy to produce and distribute one unit of output energy, the cost of electrical power increases rapidly with price increases in its energy supply. Another problem somewhat unique to electrical energy is that it cannot be stored in large quantities for later use and, as a consequence, its generating facilities must be built to accommodate peak, and not average, loads.

Table 18

ELECTRIC POWER CONSUMPTION BY SECTOR OF DEMAND IN THE UNITED STATES: 1960-1975

Sector	Electric Power Consumption (quadrillion BTU's)			
	1960	1965	1970	1975
Industrial	1.2	1.5	2.0	2.3
Transportation	--	--	--	--
Residential	0.7	1.0	1.5	2.0
Commercial	0.5	0.8	1.3	1.6
Total	2.4	3.3	4.8	5.9

Source: U. S. Department of Energy and SEWRPC.

Table 19

ENERGY SOURCES FOR ELECTRICAL POWER IN THE UNITED STATES: 1960-1975

Year	Energy Converted to Electrical Power (quadrillion BTU's)											
	Petroleum		Natural Gas		Coal		Nuclear		Hydro		Total	
	Total	Percent	Total	Percent	Total	Percent	Total	Percent	Total	Percent	Total	Percent
1960	0.6	7	1.8	22	4.2	52	--	--	1.5	19	8.1	100
1965	0.7	6	2.4	22	5.9	54	--	--	2.0	18	11.0	100
1970	2.1	13	4.0	24	7.5	46	0.2	1	2.6	16	16.4	100
1975	3.3	16	3.3	16	9.3	45	1.8	8	3.1	15	20.8	100

Source: U. S. Department of Energy and SEWRPC.

Electrical power represented about 11 percent of the total energy consumed by the industrial, transportation, residential, and commercial sectors of the State. The residential sector was the principal consumer of electrical power in the State in 1975, followed by the industrial and commercial sectors (see Table 20). Substantial increases in the use of electrical power since 1960 were observed in both the residential and industrial sectors. In 1975 the principal form of energy used in the State in the conversion to electrical power was coal, accounting for about 62 percent of all energy converted to electricity (see Table 21). Nuclear sources provided another 27 percent of all energy converted to electricity in the State. In 1960 coal accounted for nearly 84 percent of all energy converted to electricity in the State, and none was provided by nuclear power.

Summary and Future Prospects

Extrapolation of trends in energy consumption in the United States over the last two decades would indicate substantial increases in energy use. During the 1960's and 1970's, energy use in the nation increased by about 3.5 percent annually, and trends indicate a growth in energy use to a level of about 170 quadrillion BTU's by the year 2000—an increase of about 128 percent over the 1975 level. If the current relative shares of total national energy needs provided by the various energy sources in the United States remained about the same in the future, the United States would require in the year 2000 about 85 quadrillion BTU's of petroleum. If the current proportion of petroleum use in the nation met by imports also remained about the same, petroleum production in the United States would need to more than double, and imports of petroleum to the United States would also need to more than double. Even greater use and importation of petroleum is indicated by the trends in national energy use over the last two decades, which were marked by an increasing reliance on petroleum to meet national energy needs and on the import of petroleum.

It would appear, however, that a continuation in the future of recent trends in energy consumption is unlikely for a variety of reasons. Importantly, the population growth and economic growth of the nation are not anticipated to be at the same levels in the next 20 years as in the previous 20 years. Another factor which points to the departure from

Table 20

ELECTRIC POWER CONSUMPTION BY SECTOR OF DEMAND IN THE STATE OF WISCONSIN: 1960-1975

Sector	Electric Power Consumption (quadrillion BTU's)							
	1960		1965		1970		1975	
	Total	Percent	Total	Percent	Total	Percent	Total	Percent
Industrial.	0.016	37	0.023	39	0.032	37	0.036	34
Transportation . .	--	--	--	--	--	--	--	--
Residential.	0.017	40	0.023	39	0.033	39	0.041	39
Commercial	0.010	23	0.013	22	0.020	24	0.029	27
Total	0.043	100	0.059	100	0.106	100	0.106	100

Source: U. S. Department of Energy and SEWRPC.

Table 21

ENERGY SOURCES FOR ELECTRIC POWER IN THE STATE OF WISCONSIN: 1960-1975

Year	Petroleum		Natural Gas		Coal		Nuclear		Hydro		Total	
	Total	Percent	Total	Percent	Total	Percent	Total	Percent	Total	Percent	Total	Percent
1960	0.001	1	0.002	1	0.125	84	--	--	0.021	14	0.140	100
1965	0.001	1	0.015	7	0.167	83	--	--	0.019	9	0.202	100
1970	0.008	3	0.031	10	0.250	81	0.002	1	0.017	6	0.308	100
1975	0.005	1	0.021	5	0.252	62	0.108	27	0.018	4	0.404	100

Source: U. S. Department of Energy and SEWRPC.

current trends in energy use is the effort by the federal government to reverse recent trends in energy use, particularly petroleum use, in order to reduce dependence on foreign petroleum resources. And perhaps even more significantly, the real price of generally all energy sources, and in particular of petroleum, is expected to increase markedly in the future, in contrast to the trends of the 1950's, 1960's, and early 1970's (see Table 22). Nearly all studies of future energy supply and demand in the United States have anticipated real energy cost increases in the future, including, importantly, studies conducted by the U. S. Department of Energy, the Institute for Energy Analysis of the Oak Ridge Associated Universities, the National Academy of Sciences-National Research Council, the Electric Power Research Institute, and Resources for the Future, Inc. These real energy cost increases are anticipated largely because of the problems surrounding the continued or increased production of certain energy sources, particularly natural gas and petroleum. In general, the cost of natural gas is expected to increase most rapidly, followed by the cost of petroleum, while coal and electricity costs are anticipated to rise more slowly. Overall, an annual real price increase in energy of about 2 percent is projected over the next 20 years, with a range of about 5 percent to less than 2 percent being postulated.

Historic change in the price of crude petroleum in the United States is outlined in Figure 9. The rate of price inflation over the same period is given in Figure 10. As shown in Figure 11, changes in the price of crude petroleum have only in recent years begun to exceed the general rate of price inflation in the nation. A projection of real oil price increases would indicate a year 2000 price of $32 per barrel in 1979 dollars at a 2 percent price increase, and of $59 per barrel at a 5 percent price increase, as shown in Figure 12. Assuming that the price of crude oil in the United States will increase faster than 2 or 5 percent over the next few years in order to rapidly converge with the world oil price, and thereafter increase at the projected 2 to 5 percent rate of annual increase, the price per barrel in the year 2000 will be $39 at a 2 percent rate of increase and $72 per barrel at a 5 percent rate of increase in 1979 dollars (see Figure 12).

The price of gasoline is not expected to increase as fast as the price of crude oil. This is because crude oil price only represents about 40 to 50 percent of total gasoline price, the remaining proportion of the price largely reflecting the costs of refining,

Table 22

TRENDS IN REAL ENERGY PRICES IN THE UNITED STATES: 1925-1977

Year	Price to Personal Consumers[a]			
	Electricity	Gas	Fuel Oil	Gasoline
1925	262.1	--	--	--
1930	248.8	--	--	--
1940	227.9	168.8	96.4	114.5
1950	125.9	101.4	100.7	99.6
1955	118.7	101.0	107.2	104.2
1960	112.5	110.1	100.3	104.3
1965	104.9	105.4	99.9	100.4
1970	91.3	93.3	94.0	90.8
1971	80.2	95.8	95.7	87.6
1972	94.9	97.6	93.1	85.9
1973	93.8	96.1	101.1	88.7
1974	99.9	97.4	144.2	108.3
1975	103.6	108.7	143.1	106.0
1976	104.2	118.0	145.0	104.3
1977	104.3	131.8	154.4	103.7

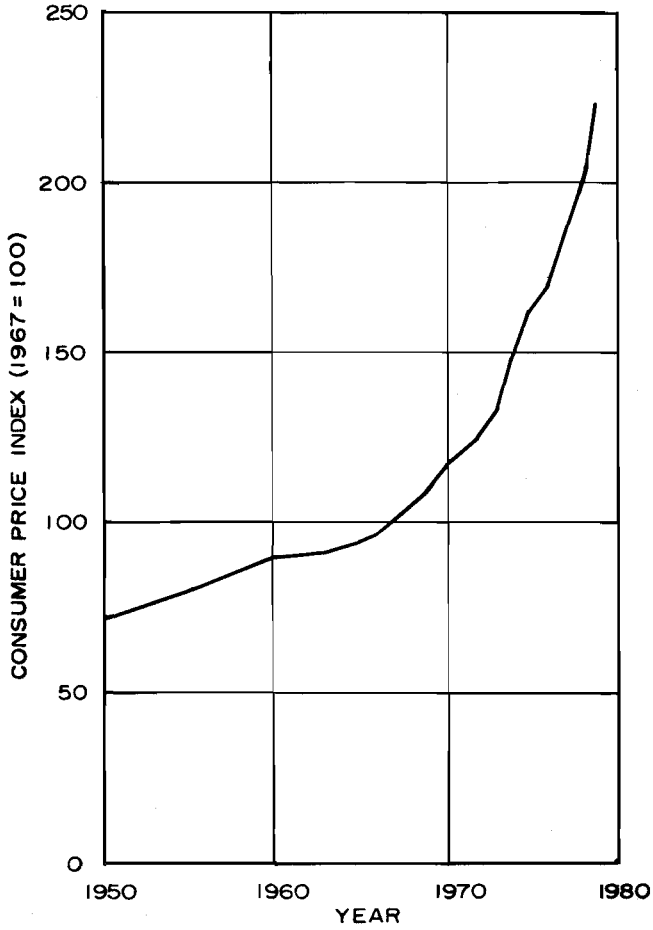
[a] *These "prices" provide a measure of real price change per unit of energy for a particular energy source, based on an assumption of a real price in 1967 of $100 per unit of energy. A comparison of changes in the real cost of a unit of energy over time can only be made for an individual energy source. For example, it can be seen by reviewing the fuel oil column that prices were quite stable from 1925 to the mid-1970's, when prices dramatically increased. A comparison of the relative costs of different sources of energy cannot be made using these indexes.*

Source: Sam H. Schurr, et. al., Energy in America's Future—the Choices Before Us, The Johns Hopkins University Press Baltimore, Maryland.

final product transportation, and state and federal taxes. As shown in Figure 13, increases in the price of gasoline have only in recent years approached the rate of general price inflation in the nation. Based upon the projected crude oil price increases and assuming no real price changes in gasoline taxes, refining, or transportation, the price of gasoline in 1979 dollars can be expected to increase by the year 2000 to between $1.30 and $1.50 per gallon under an annual 2 percent crude oil price increase, and to between $1.90 and $2.30 per gallon under an annual 5 percent crude oil price increase. The latter prices reflect the rapid convergence of United States and world crude oil prices. It should be noted that these projected gasoline prices represent real price increases and do not reflect increases due to general price inflation. An annual 10 percent rate of inflation to the year 2000 in addition to the projected real price increase would result in gasoline prices of $9.60 to $17 per gallon in year 2000 dollars.

Figure 10

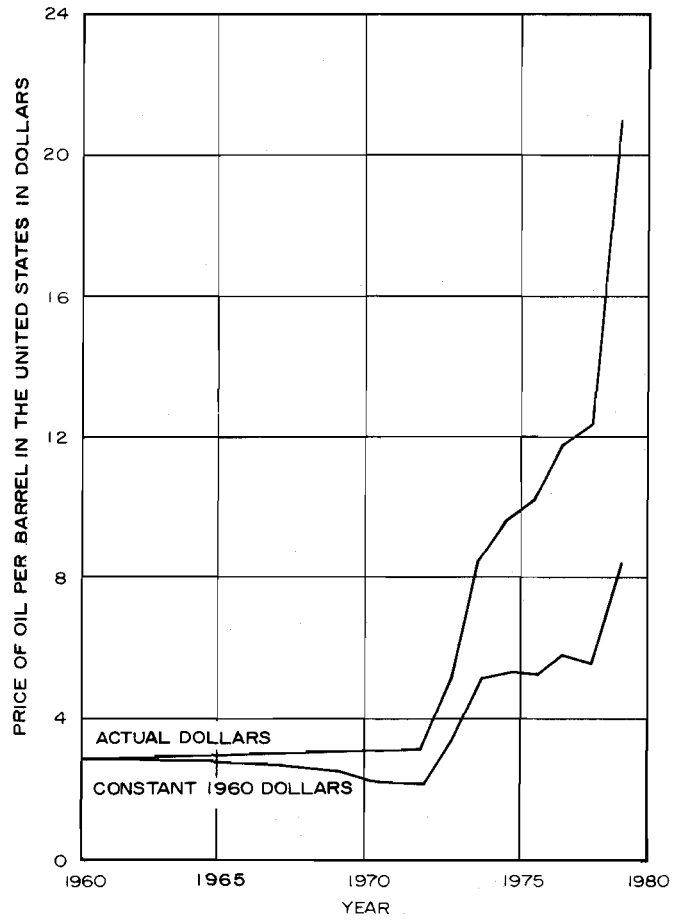
PRICE INFLATION IN THE UNITED STATES: 1950-1980



Source: U. S. Bureau of Labor Statistics; and SEWRPC.

Figure 11

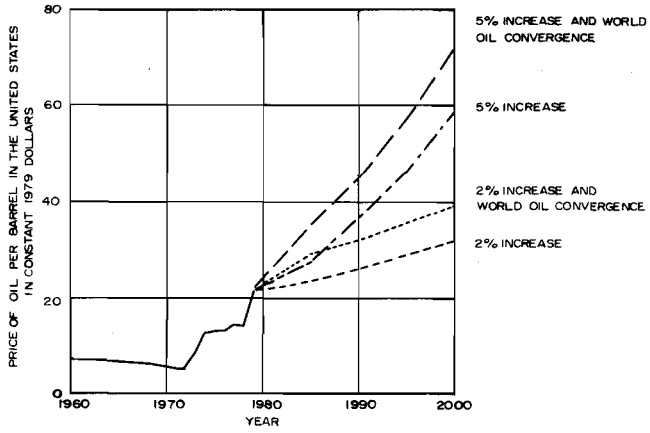
PRICE OF CRUDE OIL IN THE UNITED STATES IN ACTUAL AND CONSTANT DOLLARS: 1960-1980



Source: U. S. Bureau of Labor Statistics; and SEWRPC.

Figure 12

PROJECTION OF CONSTANT CRUDE OIL PRICE IN THE UNITED STATES TO THE YEAR 2000



Source: U. S. Department of Transportation; U. S. Bureau of Labor Statistics; Chase Manhattan Bank; and SEWRPC.

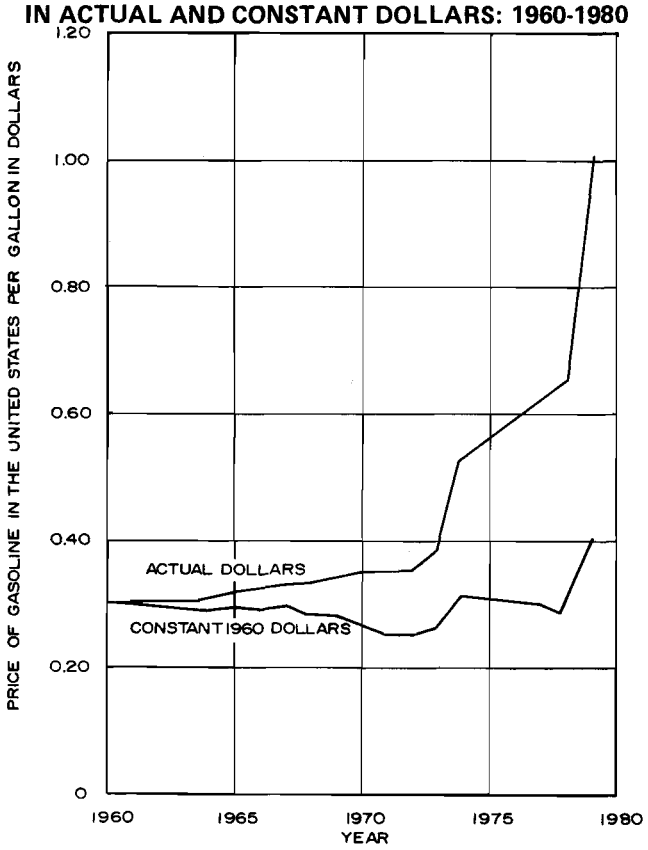
As a result of these anticipated real energy price increases, major departures from current trends in energy use and production can be expected in the United States. There is potential for the increased production of certain conventional energy sources, as well as for the initiation of production of some unconventional energy sources. Such production could act to remove the pressure for price increases, or could substitute at the higher prices for any continued dependence on foreign energy sources. There may also be potential for increased efficiency of energy use, which could similarly lessen the pressure for energy price increases or reduce the dependence on foreign energy sources.

TECHNOLOGY AND CONSERVATION OF ENERGY

The previous sections of this chapter have outlined recent trends in energy use and production in the

Figure 13

PRICE OF GASOLINE IN THE UNITED STATES IN ACTUAL AND CONSTANT DOLLARS: 1960-1980



Source: U. S. Bureau of Labor Statistics; and SEWRPC.

United States, and have indicated the energy cost and availability problems that could arise if these trends continue. It has been noted that energy demand in the nation is substantial and has been increasing faster than population growth and at about the same rate as gross national product. It has further been noted that, for a variety of reasons, petroleum-based fuels have become increasingly more important as an energy source in the United States, resulting in a high level of dependence on foreign sources of petroleum. Finally, it has been noted that these sources will likely be unstable with respect to both availability and price. These potential problems have particularly important implications for urban transportation in the Milwaukee area because the transportation system of that area is now totally dependent upon petroleum-based fuels. Consequently, any large price increases in, or shortages of, petroleum may be expected to have an immediate and significant effect on transportation, and to be an important factor in the ability of transportation facilities and services to adequately meet the socioeconomic needs of the area.

The possible increased efforts of the federal government to slow or reduce national energy demand, and in particular to reduce the dependence on foreign petroleum sources, and the expected future increases in energy cost could both result in a departure from recent trends in energy use in the nation. This departure could be effected over the next 20 years through the development of new, unconventional energy sources within the United States; the increased production of existing sources within the United States; and the more efficient use of energy within the United States. The development of more petroleum fuel from less conventional sources of petroleum could mean less reliance on foreign petroleum resources, perhaps allowing for continued growth in national energy and, more particularly, in petroleum consumption. The development or increased production of other conventional or unconventional nonpetroleum energy sources could also allow for continued national energy growth and the reduction of reliance on foreign petroleum resources. Any increase in the availability of nonpetroleum energy resources would make limited petroleum resources more available to essentially captive uses, like transportation, by permitting a shift of other uses to the nonpetroleum energy sources. The more efficient use and conservation of energy could potentially reduce the nation's energy problems by reducing the demand for energy, again particularly for petroleum-based fuels.

Governmental intervention may be expected in the future both because of the uncertainty regarding the supply and cost of foreign energy and because of the amount of money which must flow out of the nation in exchange for the foreign energy. In addition, in the future market forces may be expected to induce individuals and business and industry to seek out actions to avoid the costs and uncertainties likely to be associated with high levels of petroleum use.

In the following paragraphs, the potential for technological innovations to influence the future cost and availability of energy in the United States is assessed. It must be noted in this respect that an important consideration is the lead time necessary for practical implementation and market penetration. In order for a new technology to have any substantial effect, it must not only be technologically practicable and commercially avail-

able, but must also be sufficiently successful in application to replace other technologies to a significant extent. Thus, only those technological advancements that are presently in a reasonably advanced state of development, and that may therefore be expected to have an effect upon energy use in the United States over the planning period for the alternatives analysis—that is, over the next 20 years—will be considered. Technological solutions that are now only in the early phases of development are not likely to have a major effect until the twenty-first century, and therefore should not be considered within the time frame of this study.

New Sources of Petroleum

It may be possible in the future to alleviate some of the nation's energy problems through further development of domestic petroleum sources. For example, it may be possible to use enhanced petroleum recovery technology in oil fields that have been abandoned because conventional primary recovery has become uneconomical. Another possibility is the production of petroleum from nonconventional sources such as shale, tar sands, and coal. As noted in the previous section of this chapter, it is unlikely that major new oil fields will be discovered within the coterminous United States. Large new fields are likely to be discovered only at the outer continental shelf of the United States and in the more remote parts of Alaska. Most projections of oil production in Alaska and at the outer continental shelf see a level of oil production, when combined with declining conventional production in the rest of the United States, that is equal to or somewhat less than existing national oil production, although more optimistic projections see a level of oil production, when combined with declining conventional United States production elsewhere, that is as much as 251 percent greater than existing production.

Oil from Enhanced Recovery Technology: Under current petroleum primary recovery technology, only from 10 to 60 percent of the petroleum in an oil field is recovered, with an average rate of recovery of 30 percent. Technologies have been developed for the improved recovery of petroleum, and are referred to as secondary and tertiary recovery technologies. These enhanced recovery technologies include hydraulic fracturing, acidization, injection, and thermal techniques. Hydraulic fracturing involves forcing water under high pressure into the minute cracks or pores of oil-bearing rock in an attempt to break the rock and free more oil. Acidization involves the forcing of acid into oil-bearing rock to dissolve the rock and free more oil. Injection involves flushing water or gas into oil-bearing rock to free oil clinging to oil-bearing rock. Thermal techniques involve heating of the oil-bearing rock through steam or gas injection, or in situ combustion, to free the remaining oil.

Currently, about 25 percent of the total oil production in the nation can be attributed to use of enhanced recovery. Significant expansion of the use of enhanced recovery technologies is limited by their cost. The cost of the application of both existing and potential enhanced recovery techniques has been estimated to increase exponentially with each additional percentage of oil recovered in an oil field. Consequently, significantly increased use of enhanced recovery in oil fields cannot be anticipated, even with substantial real increases in the price of crude oil in the future.

Oil from Oil Shale: Another potential source of new petroleum for the United States is oil shale. There are two basic types of technology available to extract oil from oil shale. One involves mining oil shale like coal, crushing the shale, and then retorting the crushed rock to extract the oil. The recovered oil must then be refined in the same manner as conventional crude petroleum. This type of oil shale technology has not yet proven economical for large-scale commercial operation. In addition, plans for the abatement of the attendant adverse environmental impacts have not as yet been developed. The environmental impacts of oil production from oil shale by mining are similar to those attendant to coal strip mining, but with the added solid waste disposal problems since the volume of rock to be disposed of following processing exceeds the volume of extracted rock. In addition, the water requirements of oil shale production technology are large, and the water resources in the areas of oil shale resources could be overtaxed if this mining technology were employed, leading to increases in already high levels of salinity.

The other major shale oil production technology, which has been found to be about one-half as effective as mining technology in terms of amount of oil extracted per unit of ore and cost per unit of oil produced, is termed the in situ method. Under this technology, oil is extracted from shale deposits in place through electrical ignition and the pumping of crude oil from holes drilled into the shale deposits. Means for increasing the economic feasibility of this technology are being explored, including hydraulic or explosive breaking of the

shale rock prior to ignition and pumping. This technology is more environmentally attractive than mining technology.

The recoverable resources of oil from oil shale are estimated to be at least as large as those of conventional oil, and have been estimated to be up to five times as large. The total resources of oil in oil shale in the United States are estimated to be 25 to 200 times as large as conventional oil resources, including conventional oil resources considered not to be economically recoverable at this time. The most serious problem attendant to the production of oil from oil shale is cost. For years the initiation of large-scale production of oil from oil shale in the nation has been viewed as being dependent upon a real increase in the price of conventional crude petroleum. Estimates of the cost of oil shale production in 1977 dollars range from $25 to $40 per barrel for the mining technology, and up to $50 per barrel for the in situ technology. In addition, it has been recognized in recent years that the environmental impacts of oil shale mining technology may be too great to allow commercial application. This is supported by the direction of current research and development in oil shale production exclusively toward in situ technology, and particularly toward modified in situ technologies which would reduce the cost of oil shale production. It would appear that production of oil from oil shale could become economically feasible if crude oil prices increase significantly in real terms. Further technological developments, along with significant real price increases for crude oil, could speed the production of oil from oil shale. The federal government will be spending approximately $60 million per year over the next five years for oil shale technology research and development.

Oil from Tar Sands: Another potential source of unconventional oil is tar sands. Tar sands are sandstone oil reservoirs in which the pores or minute cracks are wholly or partially filled with congealed petroleum. When tar sands are heated to a low temperature, the tar liquefies to crude oil and can then be separated from the sands for distillation. Tar sands, like oil shale, must be mined, either through strip or underground mining, or extracted through in situ methods.

The tar sand deposit in the northern part of the Canadian Province of Alberta is one of the largest single deposits of petroleum in the world, and is estimated to contain 300 billion barrels of oil. The amount of this oil which can be recovered economically, however, is not known. Production of oil on a pilot scale from tar sands is now underway in Alberta using conventional strip-mining technology. It is estimated that, because of the depth of the tar sands, underground mining or in situ extraction technologies will also need to be developed and used.

Tar sands do not have as much potential as oil shade to serve as an unconventional oil source for the United States over the next 20 years because its production technology is not as well developed and appears to be more costly. In addition, the United States does not itself have any known significant tar sand deposits, and would have to import oil from tar sands in Canada. Canada has scheduled the cut-off of all its conventional oil imports to the United States during the early 1980's.

Increased Use of Nonpetroleum-Based Energy Sources

The energy problem in the United States could potentially be relieved through the development of energy sources that are not petroleum-based. A shift in national energy consumption away from its current dependence on petroleum for 50 percent its energy needs and toward other conventional sources such as coal or nuclear power, or unconventional sources such as solar or biomass energy, could alleviate the nation's energy problem. Such a shift in energy demand in the transportation sector would require new propulsion technology, since transportation energy demand, of which highway transportation constitutes over two-thirds, is largely dependent upon existing petroleum-based technology. However, greater use of nonpetroleum energy sources in the commercial, industrial, and residential sectors of the nation is possible without new technology, as the technology required to use alternative energy sources in these sectors has been long available. Increased use of nonpetroleum energy sources in these sectors of the nation could make more petroleum available for transportation purposes.

Increased Use of Coal: From 1960 to 1975 the use of coal in the nation increased by 37 percent, from 10.0 to 13.7 quadrillion BTU's. The total energy used by the nation increased over the same period by over 67 percent, from 42.8 quadrillion BTU's to 71.8 quadrillion BTU's. Use of coal by the industrial sector of the nation declined from about 4.7 quadrillion BTU's in 1960 to 4.2 quadril-

lion BTU's in 1975, and in the commercial and residential sectors from 1.1 quadrillion BTU's to 0.2 quadrillion BTU. Coal has been and continues to be primarily used for electric power generation. In 1960 electric utilities converted 4.2 quadrillion BTU's of coal to electricity. The use of coal by electric utilities increased to 9.3 quadrillion BTU's in 1975. Over the same period electric power use increased from 2.3 to 5.9 quadrillion BTU's, with the industrial, commercial, and residential sectors of the nation each accounting for about equal shares of this increase. However, although coal has been estimated to constitute a large portion of the United State's current recoverable energy reserves, it has for the last few years accounted for less than 18 percent of total national energy use.

Three potential ways to increase coal use in the United States have been advanced, including increased direct combustion of coal, the gasification of coal for use as an unconventional natural gas, and the liquefaction of coal for use as an unconventional oil.

Increased Direct Coal Combustion: The increased conventional use of coal resources has promise for meeting national energy needs and reducing national dependence on petroleum-based fuels. This could be accomplished largely through an increase in direct combustion by electric utilities and then the increased use of electricity by the industrial, commercial, and residential sectors of the nation, but also through the return to direct coal use by the industrial, commercial, and perhaps residential sectors of the nation. Environmental problems are the major obstacles to wider direct coal combustion. These environmental problems include the emission of sulfur and nitrogen oxides and trace elements, including mercury and lead, through coal combustion; the emission of carbon dioxide through coal combustion and its increasing and potentially catastrophic buildup in the atmosphere; and the disposal of coal ash and sludge from scrubbers that have been used to clean up the emission from coal combustion. It must also be recognized that, in addition to the environmental problems associated with the combustion of coal, the mining of coal itself presents substantial environmental problems. It is estimated that from 300 to 600 acres of land are disturbed each year by the mining required to provide a major electric power generating plant with coal. Reclamation of this land has proven to be expensive, and the results still remain generally unacceptable. Coal mining can also affect local groundwater conditions and plant and animal life.

It would appear that the increased use of coal through direct combustion would entail acceptance of these environmental problems, except possibly the increased emission of oxides of sulfur and nitrogen as air pollutants. The increased use of coal from the western United States, which represents by heat content about one-third of all coal reserves in the nation, could lessen sulfur dioxide emissions, as it has a lower sulfur content than coal from the eastern United States. In addition, there are a number of technological advancements which address the problem of sulfur and nitrogen dioxide emissions from coal combustion. One advanced sulfur dioxide removal process now in commercial use collects sulfur dioxide emissions and reduces such emissions to marketable sulfur. Other widespread commercial removal processes, commonly termed scrubbing, reduce sulfur dioxide emissions to a waste sludge, which must then be disposed of as a solid waste. Other coal combustion clean-up processes only now being developed and tested would remove both sulfur and nitrogen oxides through the combustion of coal in a fluidized limestone bed.

Gasification of Coal: Another way to use the nation's coal would be to produce an unconventional or synthetic natural gas through the gasification of coal. The production of unconventional natural gas would abate the nation's energy problem by encouraging shifts in the energy demands of the industrial, commercial, and residential sectors away from petroleum and toward synthetic gas. From 1960 to 1975 the use of natural gas in the nation increased from 10.8 quadrillion BTU's to 20.3 quadrillion BTU's, with the largest increase, 4.1 quadrillion BTU's, occurring in the nation's industrial sector.

Technology for the production of low energy-content gas from coal has been available for years. Gases of low energy content can be made from coal through distillation, through the admitting of oxygen or steam over burning coal or coke, or through underground coal gasification. This latter process, which has been developed and tested for over 40 years, involves the partial combustion of undisturbed coal deposits through electrical ignition and the drawing of the resulting coal gas from holes drilled into the burning, undisturbed coal deposit. The low-energy value of this and of all unconventional gases makes their future prospects for use limited without further processing.

The production of high-quality gas from coal is based on the purification and conversion of these low-energy gases to methane. The production of

methane from coal has been demonstrated in several pilot plants in the United States and other countries; however, commercial applications have not yet been implemented, the principal reason being cost. The cost in 1978 of producing synthetic gas from coal was estimated at between $3 and $6 per thousand cubic feet, as compared with the then interstate market natural gas price of about $1 per thousand cubic feet and the intrastate market price of about $2 per thousand cubic feet.

Liquefaction of Coal: The production of a liquid fuel, or unconventional oil, from coal would also encourage the industrial, commercial, and residential sectors to shift away from the use of conventional oil to the use of coal, but would additionally provide a new source of liquid fuel to directly meet the nation's transportation-related energy problems. The production of unconventional oil from coal is a more complex and costly process than coal gasification. This is because coal liquefaction generally requires first the gasification of coal, and then the conversion of medium-to-high energy content coal gases to liquid synthetic fuel. One such conversion process was used during World War II in Germany and is used today in South Africa. This process produces a low-octane synthetic gasoline and a medium energy-content synthetic gas from a low energy-content synthetic coal gas. Various mixes of gasoline or fuel oil types, however, can be obtained through this conversion process. Methanol, which can be used as a fuel oil or mixed with gasoline, can also be made from coal by converting methane gas synthesized from coal to a liquid.

The cost of a barrel of unconventional oil obtained through coal liquefaction has been estimated to range from $16 to $25 in 1977 dollars. However, the uncertainties inherent in this cost estimate must be recognized. Because the liquefaction of coal necessarily involves first the gasification of coal, this cost estimate includes the costs of converting coal to low-energy gas, purifying the low-energy gas to medium- and high-energy gases, and then liquefying the medium- and high-energy gases. Yet, although the estimated cost of producing synthetic oil from coal is relatively high, it is lower than the cost of extracting oil from oil shale. Thus, it may be expected that with higher conventional petroleum prices approaching the costs of synthetic liquid fuels, unconventional oil from coal would probably be first developed.

Increased Use of Nuclear Power

In 1978 nuclear power supplied approximately 4 percent of total national energy needs by generating about 13 percent of all electricity consumed in the nation. Current nuclear power in the nation is largely supplied by what are termed light water nuclear fission reactors. This type of nuclear reactor is considered to be highly efficient in terms of the amount of energy produced per ton of uranium used, and in terms of refueling needs in that refueling is required at only one- or two-year intervals. It has been estimated that the uranium fuel-recoverable resources of the United States are sufficient to satisfy, through this conventional nuclear power, about one-half of all national energy needs through this century. However, public concern over the safety of the operation of conventional nuclear reactors and over the disposal of radioactive waste has escalated in recent years. This concern can be expected to seriously impede further conventional and perhaps all nuclear power development in the nation, and possibly even lead to some curtailment of the use of nuclear power in the nation.

New forms of nuclear technology with potential include improved conventional converter nuclear fission reactors, "breeder" nuclear fission reactors, and nuclear fusion. The principal improvement to conventional converter reactors being examined is technology to operate conventional converter reactors more efficiently and to higher safety standards. Technology for the development of what have been termed "breeder" nuclear fission reactors is also under investigation, and is in limited commercial application. The breeder reactor would create, or breed, high-grade fuel as it produces power which can be used again by the breeder reactor to again produce power. In addition, it would produce power with more available uranium sources and would not have the same level of radioactive waste disposal problems as conventional nuclear reactors. There are a number of types of breeder reactors under development, one of which has been technologically proven. Two breeder reactors using the proven technology have been built in France and are in use, and two such reactors are now being built in the United States. The other nuclear technology being considered is nuclear fusion. Nuclear fusion technology has the potential to produce electrical power by using water from the ocean for fuel. This technology would not have the radioactive operation or waste

disposal problems of conventional or breeder forms of nuclear fission technology. Nuclear fusion technology, however, can probably not be expected to be implemented until some time in the twenty-first century. Its technology is not yet feasible scientifically and, beyond this feasibility breakthrough, is expected to contain some engineering problems.

Use of Biomass Fuels

Another possible future energy source is biomass fuels, or fuels derived from organic or animal and vegetable compounds. These include especially agricultural and animal waste materials, as well as woods. The potential over the next 20 years of biomass fuels—either solids, liquids, or gases—to substitute for, or encourage shifts away from, petroleum-based fuels could be substantial if the prices of conventional fuels continue to show real price increases. Significant research is underway concerning the development of new sources of biomass fuels, and ways to increase the energy intensity of existing sources of these fuels. The burning of solid organic materials, including municipal and agricultural solid wastes, and the conversion of such materials into usable gaseous or liquid fuels could possibly have an impact on the nation's future energy sources.

Gases from biomass can be generated through a variety of technologies. Some technologies are similar to those used in coal gasification—namely, they introduce heat and pressure to cause the release of methane gas. A different and promising technology to produce gas fuels strictly from biomass uses anaerobic digestion, a process which produces gas in an oxygen-poor environment and which has been tested on animal and agricultural solid wastes. This process has been found to produce a high-quality methane from biomass through the introduction of bacteria to significantly increase the rate of biomass decomposition, which is necessary to the formation of synthetic gas. Another technology for generating gas from biomass fuels would introduce temperature control and would split the formation of methane gas from the biomass into two steps, the first using one type of bacteria to break down the biomass into alcohols and the second using another type of bacteria to convert the alcohols to methane. In addition, it should be noted that the gasification of biomass yields as a by-product nitrogen-rich residues that are valuable as fertilizers.

Liquid fuels can also be derived from biomass and could substitute for conventional petroleum. The production of methanol from gases derived from biomass is as efficient as the derivation of liquid fuels from gases produced from coal. The pyrolytic techniques which can be used to distill liquids from coal can also be used with biomass, and there are other well-developed technologies for the conversion of organic matter to unconventional oil and methanols. Also, the fermentation of sugars and other biomass materials has long been known as a way to produce ethanol. Ethanol can be used directly as a liquid fuel, or as an additive to petroleum-based fuels.

The cost of obtaining medium energy-content synthetic gas from biomass is estimated to range from $0.60 to $4 per 1,000 cubic feet. Thus, obtaining synthetic gas from biomass, in particular from wood and agricultural wastes, may have more potential than the gasification of coal. Liquid fuels obtained from coal or oil shale, however, would appear to have more potential than liquid fuels obtained from biomass, as the cost per barrel of biomass liquid fuels ranges from about $30 to $50 per barrel for fuel, $60 per barrel for methanol, and $60 to $120 per barrel for ethanol.

Use of Solar Energy

Solar energy could also affect energy use in the future by encouraging shifts away from petroleum-based fuels. The technology of solar energy is usually separated into two categories—"big solar" and "little solar"—in order to reflect differences in the power generation capacity at a single solar technology site. Little solar technologies principally include decentralized, onsite residential, commercial, and industrial heating applications. Big solar technology focuses on large-scale centralized power generation technologies.

Little solar heating applications are commercially available today, and, when used in combination with practical conservation measures such as insulation and weather-stripping, could have significant impacts on residential, commercial, and industrial energy consumption over the next 10 years. Little solar heating systems generally use solar heat collectors and some type of heat transfer mechanism or medium to transfer collected solar heat to either a storage tank or direct use. Existing solar heating systems typically provide one-half to two-thirds of the heating needs of their residential or small commercial applications. The potential for widespread implementation of solar space and water heating systems is great only under substantially increased fuel prices and governmental tax incentives which would allow a reasonable payback period, about 10 years for proven technology. Solar space and

water heating systems cost nearly three to six times as much as conventional systems. One of the problems with solar heating systems is that they would provide only one-half to two-thirds of total heating needs, and therefore would need to be supplemented with auxiliary or backup conventional heating systems.

Big solar developments principally include solar furnaces, or power towers, designed for the large-scale production of electrical power. The solar furnace operates by concentrating sunlight on a steam boiler. The furnace is composed of a multi-storied structure which includes the boiler and, at the top of the furnace, a collector for sunlight reflected from several acres of remote-controlled mirrors. The steam generated in the boiler is used to turn a conventional stream turbine for electric power generation. Solar furnace technology has been proven on a small scale in areas enjoying high annual sunlight; however, for large-scale development even in such areas, several additional technical and material breakthroughs will be necessary, particularly with regard to automatic mirror positioning and sunlight collector composition.

Commercial application of big solar technology is not likely to be widespread for another 20 years. Other big solar or related solar reactor technologies, such as ocean thermal conversion or waves, tidal power, large wind machines, geothermal energy, and microwave-generating solar satellites, also appear to be twenty-first century solutions to the energy problems, and should be viewed, along with solar furnace technology, as technologies that will not be available during the next 20 years.

There is a solar technology with both big and little solar applications that could be applied over the next 20 years. This technology is called photovoltaic conversion, and involves the direct conversion of light to electricity. Photovoltaic conversion technology has been employed during the 1960's and early 1970's to power space satellites, and is now being used in other special applications. Photovoltaic technology is seen as having possibly significant potential because the basic process used in making photovoltaic cells is generally the same as that used by the semi-conductor industry in the manufacture of transistors and integrated circuits which, importantly, have been rapidly decreasing in cost. Early photovoltaic systems cost 1,000 to 2,000 times as much as current conventional electric power. The commercial cost of photovoltaic systems, however, dropped by a factor of 60 by 1977, and is estimated to have since declined by an additional factor of five. Current use of photovoltaic systems is still limited to special applications. Widespread use either in big or little solar application hinges on further radical technological development, as the major cost item of photovoltaic systems is the silicon for the photovoltaic cell. It has been estimated that the thickness of the silicon in photovoltaic cells will require nearly a 100-fold reduction in order for this technology to be competive with conventional electric power technology.

Increase in Energy Efficiency and Energy Conservation

Increased efficiency in energy use can be expected to have major impacts on the consumption of energy in the United States over the next 20 years. Recent increases in the real price of some energy sources, notably petroleum, and the continued real price increases expected for nearly all energy sources of the nation can both be expected to be major forces encouraging greater efficiency in energy use. Government policy to encourage a reduction in national energy consumption and lessen the nation's dependence on foreign energy sources can also be expected to be a force encouraging greater efficiency in energy use. In fact, recent government policies have encouraged automobile fuel consumption efficiency and the regulation of nonresidential building temperature controls, and the energy-efficiency labeling of household applicances.

Increases in the efficient use of energy can to some extent be expected in the industrial, commercial, residential, and transportation sectors. In the following paragraphs, possible increases in the energy efficiency of the transportation sector will be discussed, primarily with regard to the automobile. The energy efficiency of the automobile can be expected to be a major factor in establishing the future cost of automobile travel in urban areas like the Milwaukee area, and therefore may be expected to influence the future primary transit needs of the Milwaukee area. The potential for new automobile technology, e.g., the electric automobile, to reduce the dependence of the automobile on liquid fuels will also be discussed.

Energy Efficiency in the Transportation Sector: The transportation sector, as has been noted earlier, uses about 25 percent of the total energy consumed in the United States and about 55 percent of the oil consumed. Use of the automobile alone accounts for more than one-half of the transportation sector's total energy use in the

United States. Among all transportation modes the automobile is, in particular, expected to increase in energy efficiency over the next 20 years, in part due to government regulation. However, increases in the efficiency of other modes may also be expected.

Aircraft are expected to increase in energy efficiency over the next 20 years. Innovations in engine components, wing design, and wing and tail active controls could each contribute up to a 5 percent increase in efficiency. Major new generation engines and composite material body construction have the potential to effect 10 to 15 percent increases in energy efficiency, although widespread use cannot be expected until the 1990's. Total increases in airplane energy efficiency by the year 2000 are anticipated to range from 20 to 30 percent.

Increases in the efficiency in freight transportation modes are not expected to be as substantial. Some increases are expected from increased dieselization of trucks and of marine transportation. Improvements in engines, drive-trains, aerodynamic design, and structural weight reduction, along with possible increases in regulated size and weight, may also result in increased energy efficiency for trucks, but are not expected to have substantial impact.

Part of the reason for anticipating major increases in automobile fuel efficiency is the enactment by the federal government of the Energy Policy and Conservation Act of 1975, which set fuel efficiency standards to be met by nearly all automobiles sold in the nation. These standards, as amended, called for a new car fleet average energy efficiency of at least 18 miles per gallon in 1978 for city driving conditions, increasing to 27.5 miles per gallon in 1985 (see Table 23). As shown in Figure 14, average new automobile energy efficiency in the United States had declined prior to 1975.

The increases in fuel consumption efficiency observed in new cars between the years 1975 and 1979 have been largely due to improvements in tires and transmissions, reductions in weight, and reductions in engine size. Continued overall size and weight reductions appear to be necessary to meet the year 1985 standards for fuel consumption with today's standard internal combustion engine, unless new, more efficient engine technologies are introduced. Likely alternatives to the standard internal combusion engine through the 1980's include only the diesel engine and the stratified-charge, spark ignition engine. Alternatives which may be possible in the 1990's include the gas turbine engine, Stirling engine, and electric and hybrid electric propulsion systems.

Table 23

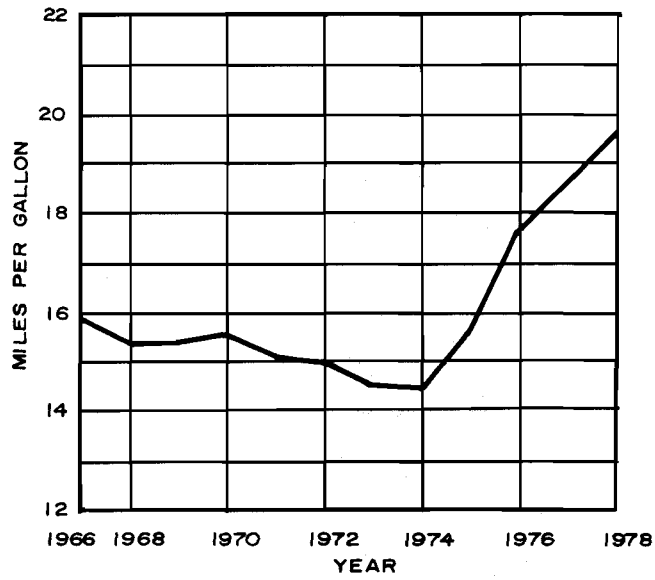
AVERAGE AUTOMOBILE FUEL ECONOMY STANDARDS: ENERGY POLICY AND CONSERVATION ACT OF 1975 AS AMENDED

Year	Standard (miles per gallon)
1976	18.0
1979	19.0
1980	20.0
1981	22.0
1982	24.0
1983	26.0
1984	27.0
1985	27.5

Source: U. S. Department of Transportation and SEWRPC.

Figure 14

AVERAGE FUEL ECONOMY FOR THE NEW AUTOMOBILE FLEET: 1967-1976



Source: Resources for the Future, Inc., and SEWRPC.

The diesel engine has in recent years been increasingly viewed as a practical alternative to comparably sized gasoline engines. Diesel engines can meet current federal emission regulations, and offer over comparably sized gasoline engines a 25 to 30 percent improvement in fuel consumption efficiency. The future application of diesel engines in automobiles in the 1980's is in doubt, despite its better fuel economy and proven durability and low maintenance needs, because of the general agreement that it will not in the near future be economically feasible for the diesel engine to meet federally mandated nitrogen oxide emission standards. A similar problem will arise if particulate emission standards are ever mandated.

The stratified-charge, spark-ignition engine is similar to the standard internal combustion engine of today, which is technically termed the uniform-charge, spark-ignition engine. The stratified-charge, spark-ignition engine uses a much richer fuel-to-air mixture in the combustion chamber which permits lower peak temperatures, higher compression ratios, and more complete combustion than does the conventional engine. The result is higher fuel economy, reduced emission levels, and good performance—a combination of benefits which have made this engine technology very attractive. One version of this type of engine was first introduced by Honda in the United States in 1973. This engine, termed the CVCC or compound vortex-controlled combustion engine, however, is available only in a four-cylinder version. It remains uncertain whether the fuel efficiency and emission characteristics of this engine will apply to larger engines. The Ford Motor Company, however, is currently developing another version of the stratified charge, spark-ignition engine, which is termed a programmed combustion, or PROCO, engine and is designed to achieve improved fuel economy and pollutant emission levels in larger engines.

The gas turbine engine and the Stirling engine have long been considered to be possible alternatives to the conventional standard internal combustion engine. Both engines are characterized by a process in which a fuel is continuously burned. The gas turbine engine uses compressed and heated air to rotate a turbine, which then provides propulsion. In the Stirling engine, hydrogen, helium, or similar gases are permanently sealed in pistons, which move and provide propulsion through the alternate heating and cooling of the gas. These engines are considered to be attractive alternative technologies because both are potentially more efficient than spark-ignited engines, and should be able to meet all pollutant emission standards. In addition, neither engine would be confined to the narrow range of fuel types and qualities necessary for spark-ignited and diesel engines. Gas turbine vehicles, including both automobiles and trucks, have been experimentally developed and tested. More limited testing of Stirling engines for automobiles has taken place. However, commercialization of continuous-combustion engines cannot be expected to occur without several new engineering developments, including a continuously variable transmission, new high temperature engine alloys, more economical engine casting processes, and a method for sealing the cooling and heating regeneration systems of the engine. The introduction of either engine is not anticipated until the 1990's.

For years there has been interest in electric propulsion systems for vehicles because such vehicles would be dependent upon a central station power source, which would not necessarily be dependent upon petroleum or other liquid fuels, and their environmental impacts could be closely controlled. In addition, electric vehicles could be charged largely at night during periods of low electric power demand. The recent Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976 authorized federal funds to promote electric and hybrid vehicle technologies and has encouraged increasing commercial interest in electric vehicle propulsion systems. Hybrid vehicles combining both electric and internal combustion engines have not, as yet, been commercially developed. However, even prior to the federal interest and funding, several versions of all-electric vehicles had been developed, and some are in fact commercially available, although on a limited scale. The battery is the biggest constraint on future electric car development. Present battery and even promising advanced battery technology still are not able to effectively match the power, efficiency, or endurance of conventional automobile engines. Because of their limited range and modest acceleration, electric vehicles are likely to penetrate only a small specialized portion of the automobile market, serving possibly as second vehicles for short urban trips and as certain types of delivery vehicles. Further use will depend on the rate of battery technology development in the 1980's.

Thus, although it appears that there are a number of potentially attractive alternatives to the conventional internal combustion automobile engine, it appears that conventional internal combustion

and diesel engines will continue to be the most widely used automobile engines, and may be expected to be the subject of extensive development to improve their fuel economy.

By the year 2000, average energy efficiency for the total automobile fleet may be expected to attain at least the federally mandated 1985 new car fleet efficiency standard for fuel of 27.5 miles per gallon. It has been estimated that this average automobile efficiency could be obtained even if the auto size mix that exists today—50 percent six-passenger cars and 25 percent each five- and four-passenger cars—is maintained, and engines achieving the same efficiency as the best automobile engines of the year 1975 are used, if the drive-trains of newer automobiles are upgraded over the years and nonfunctional body weight is reduced. Under these conditions, the future energy efficiency of automobiles would be approximately double that of the nation's automobile fleet in 1975. Further reductions in average automobile efficiency could be achieved with declines in the proportion of six-passenger automobiles. It has been estimated that each 10 percent reduction in the market share of such automobiles will lead to about a 3 percent increase in average overall automobile fleet efficiency.

Under conventional internal combustion or diesel engine technology, the limit for average automobile fuel economy for the year 2000 has been estimated to be 32 to 37 miles per gallon. The lower limit of 32 miles per gallon would be achieved if the increases in new car efficiency obtained to date largely by weight and size reduction continue, and if more diesel engines are used by the year 2000 and plastic or aluminum are increasingly substituted for steel in automobiles. The upper limit of 37 miles per gallon would require more radical changes in the future auto size mix of the nation in addition to the above-mentioned changes. Increases beyond 37 miles per gallon are seen as being dependent upon the use of alternative advanced engine technologies like the Stirling engine, and even then an average fuel efficiency of only about 40 miles per gallon would be achieved.

In addition to the potential for more efficient travel in the future, there is a potential for travel itself to be reduced through increased reliance on communication. Two new uses of telecommunications could affect urban travel needs: the use of electronic mails and the electronic transfer of funds. It is estimated that 10 to 30 percent of all mail could be delivered electronically, and that another 25 percent could be electronically transmitted between central/regional distribution centers for physical delivery locally. It is conceivable that postal service activities could be reduced to that of parcel delivery. Electronic transfers of funds are increasingly being relied upon in interbank and payroll applications and could be relied upon in nearly all such banking transactions in the next two decades.

The use of telecommunications in teleconferencing to reduce personal travel also exists, but it is doubtful that such technology will reduce the amount of travel over the next 20 years. Telecommunications usage has permitted some decentralization of business sites, and it may further encourage some work at home activities; however, drastic reductions in work travel through use of telecommunications are considered unlikely.

Telecommunications could also be used to reduce the need for personal business travel. Electronic fund transfers, payment of bills, and some direct shopping from home through telecommunications are possible, but would require widespread implementation of telecommunications. Large institutions, however, are virtually the only users today of advanced telecommunication technologies such as teleconferencing and facsimile and electronic message systems. The use of sophisticated telecommunication systems in the home may be expected to be limited in the future by the high costs of such systems and by the fact that they would need to be widely used for maximum value. The costs of telecommunication systems must include both the costs of the necessary onsite equipment and the costs of a new transmission network.

Conservation in Nontransportation Sector Energy Uses: A wide variety of technological and energy use management techniques can be implemented to reduce the total consumption of energy by the residential, commercial, and industrial sectors. Surprisingly, large energy savings can often be realized with little capital investment by, for example, improving air-conditioning, space-heating, and water-heating efficiencies and reducing lighting requirements. In addition, low capital improvements in weather-stripping and insulation and building maintenance can significantly reduce heating requirements. In industrial settings, processes and products can be technologically redesigned to restructure energy demands. And finally, the use of energy audits, professional onsite evaluations

of home, commercial, and industrial energy use efficiencies, can be effective in determining what types of measures can best be employed to enhance energy conservation.

Residential Sector: Residential space heating accounts for over 50 percent of the total energy consumed by households, and about 10 percent of the total energy consumed nationwide. In 1975, the approximately 70 million housing units in the nation—consisting of roughly 47 million single-family units, 21 million apartments, and two million mobile homes—consumed energy for space heating at an average rate of 122 million BTU's per unit per year, or about 110 thousand BTU's per square foot per year. Variations in the space-heating requirements of different types of homes in different geographic sections of the nation can range from 50,000 to 200,000 BTU's per square foot per year. While the use of insulation is a major factor in the thermal efficiency of residences, other factors, such as variations in the use of space, the control of heating systems, and the construction type of individual units, also directly influence space-heating efficiencies and can be affected by energy conservation measures. Concern over the use of adequate insulation materials has risen as the price of residential heating fuels has increased. The 1975 housing survey conducted by the U. S. Bureau of the Census revealed that 16 percent of the housing units in the nation were without attic insulation. Prior to 1939, the use of attic insulation was rare, and external wall insulation did not come into general use in residential construction until the late 1950's.

In order to assess the potential for residential energy conservation, it is useful to distinguish between the performance, or relative efficiency, of heating systems and the thermal efficiencies of the building shell itself. Today's conventional electric, oil, or gas heating systems are about 55 percent efficient and can be improved significantly with already proven heating system management techniques. Such techniques include: the use of an electric pilot that saves about 5 percent of annual home heating costs by reducing the amount of fuel wasted during furnace start-up cycles; the reduction of the flow of fuels into the system, which can save about 12 percent of heating costs by lengthing heating system cycles; and the use of flue dampers, which can save about 3 percent of heating system losses by closing exhaust conduits during the heating system's "off" cycle. Through the use of these relatively low-cost techniques, energy savings of at least 20 percent are achievable.

Even greater reductions in energy consumption can be effected by reducing the amount of heat lost through building shells. The amount of heat loss a building may experience is dependent upon air infiltration and conductance through furnace exhausts, walls, floors, ceilings, windows, and doors. The use of flue dampers, insulation, storm windows and doors, and weather-stripping and caulking together can eliminate significant heat losses. For newly constructed buildings, such techniques can be made more effective through the use of infiltration seals around ventilation breaks in building exteriors, south-facing windows, and heavy wall insulation. Percentage reductions in energy consumption resulting from such measures are difficult to estimate, however, because of the wide variations in the types of residential construction and heating system equipment available. However, savings of up to 25 percent are possible.

It must be noted that the energy savings to be achieved through heating system and building shell improvements that are individually cost-effective are not necessarily cumulative. Therefore, the estimates referenced above will not constitute an overall 45 percent energy savings. As a rule, heating system or building shell improvements become less attractive economically once extensive improvements have been made to one or the other. On the basis of this rule, it is estimated that energy savings of from 20 to 25 percent can be achieved through residential energy conservation efforts.

Four major barriers to the implementation of residential heating conservation practices and techniques can be identified. First, energy-efficient innovations in the residential building industry are difficult to achieve because of the wide variance in building code specifications, industry fragmentation and work force stratification by craft or trade, and low capitalization per unit constructed. Second, builders are sensitive to direct construction costs, and therefore have lacked incentive to construct energy-efficient units. Third, because of the wide range of existing building types, retrofit techniques cannot be standardized. These three barriers to improving residential energy performance are related to economic factors. However, a fourth factor, the lack of information about the technically complex nature of residential energy efficiency available to builders and homeowners, is also a major barrier to home energy conservation.

Energy consumption for heating in the residential sector is related to the number and types of units constructed and to the space-heating requirements

of the total housing stock. Estimations of the amount of energy to be consumed in the future for heating by residential units depend on judgments regarding the degree to which improved heating systems and building shells can be introduced, and therefore must be quite general. It is estimated that national residential heating requirements can be reduced by up to 20 to 30 percent through the use of the conservation techniques identified herein. Additional energy savings, up to 3 percent, may be attained through conservation in nonheating residential energy consumption, which can be achieved through energy-saving improvements in such appliances as water heaters, refrigerators, freezers, air conditioners, and lighting fixtures. It should be noted, however, that the higher estimates of residential sector conservation may be expected to be reached only if further energy supply problems in the next decade lead to very high energy price levels, the development and adoption of conservation technology, and strengthened conservation incentives and regulations.

Commercial Sector: The commercial sector has experienced rapid growth since 1950 as increasingly larger portions of the gross national product and personal income are related to the production and purchase of services. Space heating accounts for roughly 45 percent of the energy consumed in this sector and is therefore subject to the same types of conservation measures identified in the above section on the residential sector. A variety of techniques are available for reducing commercial nonheating energy uses.

Electricity, the primary nonheating energy form employed in the commercial sector, accounts for at least 75 percent of all nonheating commercial energy demand for the provision of lighting and the operation of equipment. Through lighting intensity adjustments and efficiency improvements in service equipment, it may be possible to reduce the commercial sector's consumption of energy by as much as 25 percent over the next two decades. However, barriers to the implementation of energy conservation practices in this sector may reduce the energy savings potential to 10 or 15 percent because, as is the case in the residential sector, the energy savings to be achieved through heating improvements in building shells and in heating systems and through nonheating conservation strategies and technologies are not necessarily cumulative, and become less economically attractive as changes in one area are implemented. Because of this rule, it is estimated that the potential for conservation in the commercial sector ranges from only 15 to 20 percent of current demand.

Industrial Sector: The industrial sector accounts for about 40 percent of total national energy use and is dominated in terms of energy consumption by manufacturing activity, which accounts for about 90 percent of total industrial sector energy demand, the remainder being used in mining, agricultural, and construction activities. The potential to conserve energy in the industrial sector is very large and can be divided into three principal areas: the cogeneration of steam for heating and electric power; the sharing of energy resources among similar industries; and the retrofit of industrial processes and equipment with more energy-efficient techniques and devices.

The greatest potential for conservation in the industrial sector lies with the cogeneration of electrical power for transmission and process steam for heating. Conventional electric-generating equipment ejects heat at relatively low temperatures so as to maximize the amount of electricity produced in turbines. Cogeneration equipment is designed to maximize the combined value of the two products—electricity and "waste" heat. Overall, energy conservation through cogeneration may reduce industrial energy requirements by as much as 30 percent, as well as reduce total capital and equipment needs for power generation, reduce distribution costs for power transmissions, reduce cooling requirements, and add flexibility to power-generating capacities. The two major applications of cogeneration are district heating for residential and commercial building and heating for industrial processes.

Barriers to the wide implementation of cogneration facilities are largely economical and institutional and have fostered past trends toward large central station power generation. Electric power utilities, until recently, actively resisted the concept of industrial cogeneration by charging very high rates for delivering backup power to industries and offering very low rates for industrial power generated in excess of onsite industrial needs. The future prospects for cogeneration are more optimistic, however, because electric generation costs are rising because of shortages in primary fuels and because of recent trends in national policy of encouraging efficiency.

Central power-generating facilities and industries may also conserve energy by sharing power-generating facilities and thus reducing the need for peak-load capacities by balancing the demand for power across an expanded generating network. Certain institutional and legal barriers, however, will have to be overcome before the concept of shared energy supply will be widely accepted. These barriers include the previously mentioned fact that most utilities have resisted wide implementation of cogeneration, and that many industries hesitate to enter the electric power generation business. In addition, present utility regulatory practices discriminate against the shared generation of electricity because of the potential for diffused transmission and distribution accountability.

Although energy supplies have, in the past, been inexpensive, industrial energy use in the nation has been on the decline. Nevertheless, manufacturing processes have only recently intensively sought to develop retrofit technologies for enhanced energy efficiencies. Such retrofits, however, are generally capital intensive, and it is likely that substantial retrofits will occur only as capital equipment and plants are replaced or the cost of energy becomes so high that profits are seriously affected by the continued use of less efficient technologies. The potential for continued and accelerated conservation in the industrial sector is large, but it is dependent upon institutional and economic barriers rather than technological limitations, barriers that will be difficult to overcome without strong regulatory and economic incentives.

Summary and Prospects

Energy conservation—that is, the more efficient use of energy—offers the greatest potential for a departure over the next two decades from current trends in energy use and production in the United States. However, a major departure from current trends through increased domestic production of, in particular, petroleum or substitutable liquid fuels does not appear likely. This is largely because increases in the production of energy sources, specifically petroleum or substitutes thereof, are likely to occur only under significantly increased real energy prices, which should, in turn, bring about energy conservation and dampen the need for such substantial additional production. It is questionable whether domestic production of petroleum can be increased significantly over current levels, either by conventional or unconventional means, without significant energy price increases. Meanwhile, environmental, public health, and safety concerns are expected to limit significant increases in the use of other energy sources, such as coal and nuclear power, over the next two decades. Necessary safeguards in the form of government regulations and attendant delays can be expected to increase the costs of and restrain the production of these energy sources. Finally, questions of technological and economic feasibility remain regarding solar energy and some synthetic liquid and gas fuels even under probable future increased conventional energy costs.

Because of the anticipated pressure for future energy price increases, conservation is the measure most likely to effect a departure from recent trends in energy use and production in the United States. The continuing and increasing involvement of the federal government in the reduction of energy use, particularly to reduce foreign oil dependence, also points toward more efficient use of energy in the future. More efficient use of energy is readily attainable in the use of the automobile, residential space heating, and certain industrial processes. These three energy uses represent about one-third of total current national energy use. As a result of present and anticipated governmental regulations and incentives, as well as of the expected effects of future market forces, these three energy uses are expected to remain at about the same level of consumption with increased energy use, even though their total application is anticipated to substantially increase over the next two decades. Automobile energy efficiency in particular may be expected to increase by as much as 100 percent by the year 2000. Declines in the historic rate of increases in residential energy use, expressed as the amount of energy consumed per capita, and in commercial and industrial energy use, expressed as the amount of energy consumed per unit product, may also be expected.

Most studies of future energy consumption in the United States, including studies by the U. S. Department of Energy, the Institute for Energy Analysis of the Oak Ridge Associated Universities, the National Academy of Sciences-National Research Council, and Resources for the Future, Inc., project an annual rate of increase of about 2 percent to the year 2000, well under the 3.5 percent annual increase experienced from 1960 to 1975. The lower limit projection of energy consumption levels in the United States is generally a 1 percent annual rate of increase. A 3 percent annual increase in national energy use is generally projected as an upper level. Thus, nearly

all projections—likely, lower, and even upper—see a decline in the rate of increase of national energy use in the future. Generally, the largest rates of annual increase in energy use are projected for the commercial and industrial sectors of the nation, with smaller or even negligible increases projected for the transportation and residential sectors.

This decreasing rate of increase is, in part, a function of anticipated energy conservation over the next 20 years, but is also a function of the reduced levels of population and economic growth expected over the next 20 years; of an increasing shift of the nation to a service economy rather than an industrial economy; and of the fact that some energy-related indicators, such as the number of automobiles per person in the nation, are reaching saturation levels. Departures from recent trends in energy use which can be attributed to conservation—that is, changing the efficiency of energy use per unit of activity or substituting capital or labor for energy—are anticipated to be modest, except under the lowest projections of national energy consumption.

Under likely future levels of national energy use, electrical power use in the nation is expected to at least double over the next 20 years, and this increase will be provided through greater use of coal and nuclear energy sources. The use of coal through direct combustion is also anticipated to double by the year 2000, while the level of natural gas use is anticipated to remain stable or to slightly decline. Oil consumption is projected to remain at about the same level. Regarding transportation, the amount of petroleum-based fuel used by automobiles in the United States is anticipated to decline over the next 20 years as a result of expected increases in automobile fuel consumption efficiency. An increase in automobile fuel consumption efficiency to 27.5 miles per gallon in the year 2000 would effect a substantial decline in total national automobile gasoline consumption, even with increases in the driving age population, increases in the number of automobiles per person of driving age, and an unchanging number of annual miles driven per vehicle.

National energy use projections that anticipate upper levels of energy consumption in the United States are generally based on even greater increases in the use of electricity and coal, as well as of liquid fuels, including fairly significant use of synthetic oils, and about the same level of imports of foreign oil. Higher energy prices are generally projected to occur under these upper levels of future energy consumption. The energy use projections which anticipate the more likely and lower levels of national energy consumption anticipate somewhat less necessary reliance on synthetic fuels and oil imports, and somewhat lower real increases in overall energy prices.

POPULATION LIFESTYLES

In recent years, significant changes have occurred in many of the socioeconomic characteristics of the residents of the Region, which when taken together can be defined as the family pattern lifestyles of the Region's residents. These family pattern lifestyle changes include shifts in many factors which affect land use and travel patterns, which in turn have a significant effect upon the future primary transit service needs of the Milwaukee area. These changes include, importantly, lower fertility rates, higher female labor force participation rates, and a reduction in average household size.

Significant changes in what can be termed the residential lifestyles of the Region's residents have also become well established in recent years. These residential lifestyle pattern changes include changes in inter- and intraregional population migration and changes in housing unit-type occupancy. Regional residential lifestyle patterns also influence land use and travel patterns, and are shaped by family pattern lifestyles.

In the following sections, the major trends that can be observed in family pattern and residential lifestyle changes will be described. The prospects for family lifestyle patterns in the Region will be described and their implications for regional land use and travel patterns considered. The prospects for residential lifestyles in the Region will also be described, considering the potential trends in family lifestyle patterns and the implications of the trends for primary transit needs.

Lifestyle Changes in Family Patterns

In recent years the long-established, traditional, family-centered lifestyle orientation in the Region has, as in the nation, been changing toward a more individualistic orientation. The traditional family may be characterized by its size and division of function. The common traditional family consisted of a husband, wife, and children—usually two to three. The husband was the sole economic provider of the family, and the wife cared for the home and children. Thus, in the past when the traditional family-centered orientation of the Region was

strong, the labor force participation in the Region among women was low. Women quit the labor force upon marriage or at their first pregnancy, and would, if at all, re-enter the labor force only on a part-time or part-year basis after their youngest child entered school. Most women did not pursue higher education, but married within a few years after high school and bore their first children within one to two years after marriage. The so-called "baby boom" children born after World War II were largely a product of this traditional family orientation.

In recent years, there has been a dramatic shift away from the traditional family orientation, which can be largely attributed to a changing role of women in society; but this shift is also a response to a more individualistic orientation of society as a whole, and to changing economic conditions which require families to have two wage earners to maintain the desired standard of living in a time of rapid price inflation. These changes have led to increases in the labor force participation of women, declines in fertility rates, and reductions in average household size. Substantially higher percentages of women are postponing marriage, completing college, and pursuing careers, many in traditional male fields of study. Women are also entering the labor force in larger numbers, filling a rapidly growing need for service and clerical workers. This increasing need can, in part, be attributed to the fact that the private as well as public sectors of the economy have undertaken some of the past functions of women in the traditional family.

Fertility rates and female labor force participation are inversely related variables. Substantial numbers of women delay childbearing while working, and continue to work throughout their childbearing period. Lower fertility rates, postponement of marriage, higher rates of divorce, differentials in male and female mortality rates, and the increased tendency of younger and older adults to live independently of family have resulted in a substantial reduction in average household size. Although most households are still families of husband and wife, the less traditional types of households have increased rapidly in proportion, including one-parent, one-person, and nonfamily households. The following sections will examine these trends in regional and national family patterns and discuss the prospects for labor force participation, fertility rates, mortality rates, and household size.

It is important to recognize that because of the current age structure of the Region's population, an age structure which results from the fact that a large group of people were born during the "baby boom" period of the late 1940's and early 1950's and are now in their twenties and thirties, the implications of changes in family pattern lifestyles will be magnified and have a substantial impact on society. The extent of participation in the labor force by women, postponement of marriage, postponement of childbearing, and independent living from family will be determined by individuals in this large age group over the next 10 to 15 years and will have a substantial effect on the socioeconomic characteristics of the future regional population. It is also important to consider the current age structure of the Region's population because it may be postulated that the sheer size of this "baby boom" age group has led to the postponement of marriage and to decreases in childbearing similar to those observed during the depression of the 1930's and during World War II, and that another "baby boom" reversal of current family pattern trends could occur in the future. Because of the size of the current "baby boom" population in the Region, even a modest reversal of current trends would be significant. Reasons which have been advanced for the current trends of marriage postponement and childbearing decreases include current unfavorable economic conditions, the larger than normal competition for job promotions and advancement as a result of the size of the age group, and the need for increased labor force participation in households to maintain a desired quality of life because of the greater demand for, and resulting higher prices of, goods and services, again as a result of the size of the age group.

The age distribution of the population of the Region for the year 1970 is given in Table 24, along with a projected age distribution for the year 2000 assuming no migration into or out of the Region and a continuation of the low fertility rates of the 1970's—about 1,800 births per 1,000 women during their lifetime. The potential for a large increase in the Region's working age population (ages 20 to 64), and the elderly population (ages 65 and older) are shown. The effect of these age structure changes can be summarized through a dependency ratio, a measure of the relationship between the largely economically dependent portion of the population (those people under 20 and those 65 years of age and older) and the primarily economically productive segment of the population (those people between 20 and 64 years of

Table 24

AGE COMPOSITION OF THE POPULATION IN THE REGION IN 1970 AND 2000 ASSUMING ZERO MIGRATION

Age Group	1970		2000		Change: 1970 to 2000	
	Number	Percent	Number	Percent	Number	Percent
Under 5	153,243	8.7	156,262	7.3	3,019	2.0
5-9	183,283	10.4	166,677	7.8	- 16,606	- 9.1
10-14	186,865	10.6	156,388	7.3	- 30,477	- 16.3
15-19	163,033	9.3	142,598	6.7	- 20,435	- 12.5
20-24	132,672	7.5	132,831	6.2	159	0.1
25-29	114,042	6.5	126,557	5.9	12,515	11.0
30-34	98,001	5.6	146,348	6.8	48,347	49.3
35-39	95,857	5.5	177,618	8.3	81,761	85.3
40-44	104,631	6.0	179,513	8.4	74,882	71.6
45-49	103,140	5.9	154,490	7.2	51,350	49.8
50-54	93,714	5.3	123,508	5.8	29,794	31.8
55-59	85,424	4.9	102,730	4.8	17,306	20.3
60-64	72,567	4.1	83,476	3.9	10,909	15.0
65-69	57,494	3.3	74,970	3.5	17,476	30.4
70-74	46,711	2.7	71,553	3.3	24,842	53.2
75 and Older	65,210	3.7	146,451	6.8	81,241	124.6
Total	1,755,887	100.0	2,141,970	100.0	386,083	22.0

Source: U. S. Bureau of the Census and SEWRPC.

Table 25

DEPENDENCY RATIOS OF THE POPULATION IN THE REGION IN 1950, 1960, 1970, AND 2000 ASSUMING ZERO MIGRATION

Year	Dependency Ratio per 1000 Persons		
	Total	Youth	Old Age
1950	63.6	50.5	13.1
1960	88.6	71.7	16.9
1970	95.1	76.3	18.8
2000 (zero migration)	74.6	50.7	23.9

Source: U. S. Bureau of the Census and SEWRPC.

age). As shown in Table 25, between 1950 and 1970 dependency ratios in the Region increased, reflecting the large numbers of children born in the 1950's and 1960's. The dependency ratio would decline significantly by the year 2000 under this projection, assuming no migration and continued low fertility rates. In Table 25, these dependency ratios are broken down into youth dependency ratios and old age dependency ratios. The old age dependency ratio shows a continual increase from 1950 to the year 2000, but the youth dependency ratio is projected to decline substantially between 1970 and 2000.

Thus, given the Region's current age structure, unless migration is significant in certain age groups, the future trends in family pattern lifestyles—namely, traditional family versus nontraditional individualistic orientations—will have a significant impact on the level and characteristics of the Region's future population.

Labor Force Participation

Since 1920 and particularly since 1950, labor force participation in the Region and the United States has steadily increased, as shown in Tables 26 and 27. During this time, male labor force participation has generally declined slightly, while female labor force participation has increased substantially. The male labor force participation rate in the United States declined from 85 percent in 1920 to 78 percent in 1978. This decline can be explained largely by trends toward earlier retirement, and in small part by recent trends toward delayed entry by males into the labor force primarily in order to seek higher education. The national labor force participation rate of men 65 years of age and older

Table 26

LABOR FORCE PARTICIPATION RATES IN THE UNITED STATES BY AGE AND SEX: 1920-1978

Age and Sex	Labor Force Participation Rate (percent)							Change 1920-1978
	1920	1930	1940	1950	1960	1970	1978	
Male								
16 to 19	51.5	40.1	34.7	51.7	56.1	56.1	62.1	10.6
20 to 24	89.9	8.88	88.1	81.9	88.1	83.3	86.0	- 3.9
25 to 44	95.6	95.8	94.9	93.3	97.6	96.6	95.5	- 0.1
45 to 64	90.7	91.0	88.7	88.2	91.9	89.3	83.0	- 7.7
65 and Older . . .	55.6	54.0	41.8	41.4	33.1	26.8	20.5	- 35.1
Subtotal	84.6	82.1	79.1	81.6	83.3	79.7	77.9	- 6.7
Female								
16 to 19	28.4	22.8	18.9	31.1	39.3	44.0	53.9	25.5
20 to 24	37.5	41.8	45.6	42.9	46.1	57.7	68.3	30.8
25 to 44	21.7	24.6	30.5	33.3	39.8	47.9	61.9	40.2
45 to 64	16.5	18.0	20.2	28.8	44.3	49.3	49.6	33.1
65 and Older . . .	7.3	7.3	6.1	7.8	10.8	9.7	8.4	1.1
Subtotal	22.7	23.6	25.8	29.9	37.7	43.3	50.0	27.3
Total	54.3	53.2	52.4	55.1	59.4	60.4	63.2	8.9

Source: U. S. Bureau of the Census, U. S. Bureau of Labor Statistics, and SEWRPC.

Table 27

PARTICIPATION OF THE POPULATION IN THE LABOR FORCE IN THE REGION: SELECTED YEARS 1950-1970

Population 14 Years and Over	1950	1960	1970
Male	466,938	534,824	604,341
Female	485,157	565,703	664,204
Total	952,095	1,100,527	1,268,545
Labor Force			
Male	384,946	432,433	456,918
Female	155,111	206,300	287,596
Total	540,057	638,733	744,514
Participation Rate (percent)			
Male	82.4	80.0	75.6
Female	32.0	36.5	43.3
Total	56.7	58.0	59.2

Source: U. S. Bureau of the Census and SEWRPC.

is now less than half of what it was in 1920, and the participation rate of men between 45 and 64 years of age has also dropped slightly.

The observed decline in male labor force participation in the Region and the nation is more than offset by increases in female labor force participation. The national labor force participation rate for women has more than doubled—from 23 percent in 1920 to 50 percent in 1978. Increases in female labor force participation are evident for all age groups of women in the nation except those over 65 years of age. Particularly substantial increases in female labor force participation rates occurred in the 1960's and 1970's, coincident with observed decreases in fertility rates.

Increasing particularly rapidly since 1960 has been the labor force participation rate for both married women and never married women. Table 28 shows female labor force participation rates by marital status and family characteristics for the years 1960, 1970, and 1978. As would be expected, never-married women in 1978 had a higher labor force participation rate—60 percent—than married women—48 percent—or widowed, divorced, or separated women—43 percent. The labor force participation rate of married women, however, has risen at a faster rate—56 percent—since 1960 than that of the other two marital status groups, both of which also experienced increases. In 1960 the rate of participation of married women was about 30 percent, or about 69 percent of that of never married women, and in 1978 was about 48 percent, or about 79 percent of that of never married women.

Table 28

FEMALE LABOR FORCE PARTICIPATION RATES IN THE UNITED STATES BY MARITAL STATUS AND PRESENCE AND AGE OF CHILDREN: 1960, 1970, AND 1978

Marital Status/Presence and Age of Children	Labor Force Participation Rate (percent)			Change 1960-1978
	1960	1970	1978	
Never Married	44.1	53.0	60.5	16.4
No Children Under 18 Years	N/A	N/A	61.1	--
Children 6 to 17 Years Only	N/A	N/A	69.9	--
Children Under 6 Years	N/A	N/A	41.5	--
Married	30.5	40.8	47.6	17.1
No Children Under 18 Years	34.7	42.2	44.7	10.0
Children 6 to 17 Years Only	39.0	49.2	57.2	18.2
Children Under 6 Years	18.6	30.3	41.6	23.0
Widowed, Divorced, Separated	40.0	39.1	42.8	2.8
No Children Under 18 Years	35.7	33.4	34.4	- 1.3
Children 6 to 17 Years Only	66.2	67.3	71.2	5.0
Children Under 6 Years	39.8	50.7	59.9	20.1
Total Women	37.7	43.3	50.0	12.3

NOTE: N/A indicates data not available.

Source: U. S. Bureau of the Census, U. S. Bureau of Labor Statistics, and SEWRPC.

The labor force participation rate of women with children has also generally increased since 1960, as shown in Table 28. The fastest rates of growth in labor force participation among women with children are evident for married women with children under six years of age—from 19 to 42 percent—and for widowed, divorced, or separated women with children under six years of age—from 40 to 60 percent. In 1978 women with children 6 to 17 years of age had the highest labor force participation rate in each category of marital status: 70 percent for never-married women, 57 percent for married women, and 71 percent for widowed, divorced, or separated women. The fact that married women and widowed, divorced, and separated women with no children under 18 years of age generally have lower rates of participation than other women of their same marital status is a function of the generally older ages of these women.

The distribution of labor force participation in the United States for husband and wife families with and without children is shown in Table 29 for the years 1960, 1970, and 1976. Husband and wife families with only the husband in the labor force declined from 61 percent of all such families in the nation in 1960 to 41 percent in 1976, while husband and wife families with both spouses in the labor force increased from 28 percent to

Table 29

PARTICIPATION OF HUSBAND-WIFE FAMILIES IN THE LABOR FORCE IN THE UNITED STATES: 1960-1976

Participation	Percent of Husband-Wife Families		
	1960	1970	1976
Both in Labor Force	28	38	41
Husband Only	61	49	41
Wife Only	2	3	4
Neither in Labor Force	9	10	14
Total	100	100	100

Source: U. S. Bureau of the Census, U. S. Bureau of Labor Statistics, and SEWRPC.

41 percent, now equal to the percentage of husband and wife families with only the husband in the labor force.

As shown in Table 27, the regional labor force participation rates for males and females 14 years of age and older in 1970 were 76 percent and 43 percent, respectively. Male labor force participation rates may be expected to continue to decline a few percentage points in the future as a result of continued early retirements. Future change in the female labor force participation rate will depend on whether the current trend in the Region toward the nontraditional individualistic lifestyle continues. Under a modest return to the traditional family pattern lifestyle, in which the labor force participation rate of women with children would stop increasing, overall female labor force participation rates would probably still continue to increase, and by the year 2000 60 percent of all women would be in the labor force. The increase would result from changes over time in the age structure of women in the Region, and from continued increases in the labor force participation rate of women without children. A continuation of the trend away from traditional family pattern lifestyles would result in increasing rates of female labor force participation, perhaps reaching 70 percent by the year 2000 and approaching the labor force participation rate of males. Indicative of the future labor force participation rates of women are the current educational pursuits of women. In the 1950's only 32 women in the United States earned college degrees for every 100 men earning degrees. This ratio had risen by 1972 to 69 college degrees for women per 100 degrees for men. It is more significant that over time a greater percentage of women are

entering traditional male fields of study, although still constituting only a small proportion of practioners in these fields. Historically and presently, most female workers have been and are employed in farm work, domestic service, and other service or clerical work.

Fertility Rates

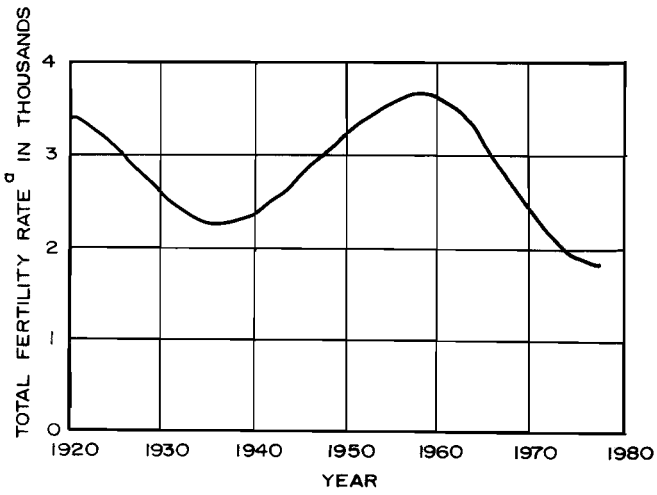
Fertility rates in the Region and the United States have been declining since the 1800's, when the movement from rural to urban areas began. The decline in total fertility rates in the United States since 1920 is shown in Figure 15. Part of the reason for this general decline was that, as a result of urbanization, families were no longer viewed as a unit of economic production, but rather as a unit of consumption. This decline in fertility rates was interrupted by a period of increase in fertility rates in the late 1940's and 1950's, often referred to as the "baby boom." However, it is important to note that the fertility rate increase of this period can be viewed not as an absolute increase in births per family, but as an adjustment in the timing of childbearing. Many people postponed childbearing during the depression of the 1930's and World War II, and began families in the late 1940's and 1950's, along with younger people who, prompted by the favorable economic conditions of the period, entered marriage and childbearing earlier in their lives. The long-term downward trend in fertility rates resumed in the 1960's, as shown in Figure 15.

The fertility rate for the year 1978 for women in the United States, expressed as the number of children 1,000 women would bear during their lifetime, is 1,795. This is significantly less than the lowest fertility rate experienced in the nation—2,235 during the depths of the depression of the 1930's. In contrast, the fertility rate during the "baby boom" in the nation reached as high as 3,690 in the late 1950's. A replacement-level fertility rate, or the level of fertility at which married couples produce enough children to merely replace themselves given existing death-rates, is 2,100. Fertility rates in the State of Wisconsin and the United States have been estimated to be below replacement level since 1972.

It is possible, as noted earlier, that current fertility rate declines represent a postponement of marriage and childbearing and that an upswing in fertility rates will occur in the next decade. It has been argued that the sheer size of the "baby boom" children now aged in their twenties and thirties has produced an unfavorable economic outlook for

Figure 15

TOTAL FERTILITY RATES IN THE UNITED STATES: 1920-1978



[a] THE TOTAL FERTILITY RATE REPRESENTS THE NUMBER OF CHILDREN 1,000 WOMEN WOULD BEAR DURING THIER LIFETIME GIVEN THE CURRENT AGE-SPECIFIC FERTILITY RATES.

Source: National Center for Health Statistics, U. S. Bureau of the Census, and SEWRPC.

this population cohort, an outlook made even more unfavorable by uncertainties about future income because of the severe price inflation of recent years, and that this factor has caused fertility rates to continue to decline. It is possible that fertility rates will return to, or exceed, replacement level if the current or future economic status of this potential childbearing population of the Region and nation is perceived to be improving.

Although the postponement of childbearing and current economic conditions may account in part for the recent radical declines in fertility rates, the increased participation of women in higher education and in the labor force of the Region and nation is probably the most important factor influencing the current low fertility rate. Moreover, it should be noted that, in the long term, as women do pursue higher education and become employed in higher paying, traditionally male jobs, the costs of having children will increase. It should be noted in this respect, however, that the increased female labor force participation rate could also be a response to unfavorable economic conditions. Surveys conducted by the U. S. Bureau of the Census in 1978 of women in the nation aged 18 to 29 indicated that their future expectations of childbearing were at rates below replacement level. It is likely, therefore, that fertility rates in

the Region and the nation will remain low for the next decade and return only as high as the replacement level by the year 2000.

A continued decline in regional and national fertility rates is seen for both white and nonwhite populations. Nonwhite population fertility rates have historically been higher than white population rates, with a rate approximately 60 percent greater than the white population fertility rate in the Region in 1970. Theoretically, the nonwhite population rate could continue to show a decline and yet remain 60 percent higher than the white population rate, reaching a fertility rate of 3,200 by the year 2000. However, because a correlation between fertility rates and level of household income has been observed, and because the average household income of the nonwhite population can be expected to improve in the future, nonwhite fertility rates may be expected to more closely approach white rates in the future. This is supported by the recent U. S. Bureau of the Census survey of birth expectations cited earlier.

In summary, it is possible that the observed long-term declines in fertility rates will be arrested and that fertility rates will increase to over replacement level by the year 2000. Such a reversal, however, would be inconsistent with the facts that women are increasingly seeking higher education and participating in the labor force. Rather, a continuation of below-replacement-level fertility rates is expected for at least the next decade, with a slight increase to replacement levels by the year 2000 reflecting some postponement and foregoing of childbearing.

Mortality

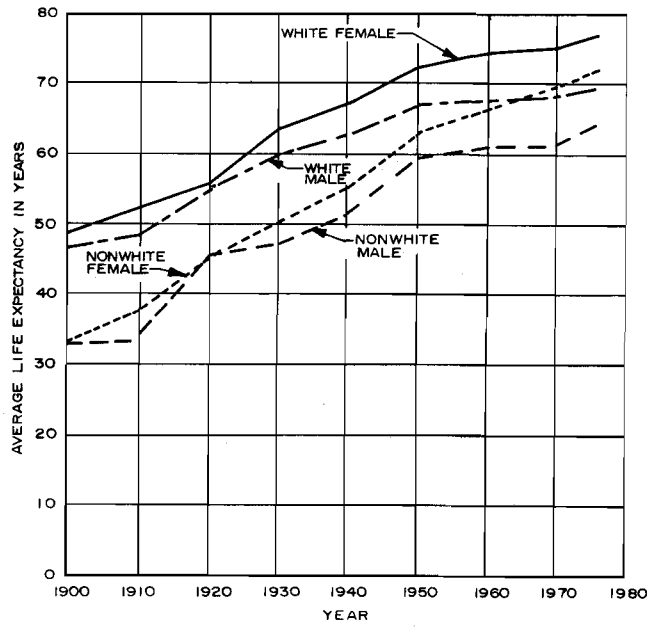
Average life expectancies in the Region and the United States have increased significantly since the year 1900, as shown in Figure 16. Largely responsible for the substantial decline in deathrates, especially between the years 1900 and 1950 among younger age groups, was the control of contagious disease. Another substantial decline in deathrates occurred early in the 1970's with improvements in the treatment of major cardiovascular diseases. As a result, average life expectancies over the last decade have increased by about the same number of years as they had during the 20 years preceding the last decade.

Average life expectancies in the nation as estimated in 1976 are 69.7 years for white males, 77.3 for white females, 64.1 for nonwhite males, and 72.6 for nonwhite females. The sex differential in life expectancy has been increasing over time. In 1900, female life expectancy was only two years greater than male life expectancy, compared with about eight years difference at this time. Racial differentials in life expectancy have been narrowing over time. Currently, life expectancy for the white population is about five years greater than for the nonwhite population, which is only about one-third the difference that existed in the year 1900.

Future increases in average life expectancy are expected to be small because deathrates in all but the older age groups are now very low. A small increase in life expectancy may be expected to occur as the deathrates of the nonwhite population continue to approach that of the white population. The differential in average life expectancies for the male and female segments of the population, however, is expected to remain the same. Life expectancies in the year 2000 are expected to reach 69.9 for white males and 78.0 years for white females, with nonwhite population life expectancies remaining somewhat below these levels and not equaling the white population life expectancies for yet another 20 years following the year 2000.

Figure 16

AVERAGE LIFE EXPECTANCY IN THE UNITED STATES BY SEX AND RACE: 1900-1976



Source: U. S. Public Health Service and SEWRPC.

Household Size

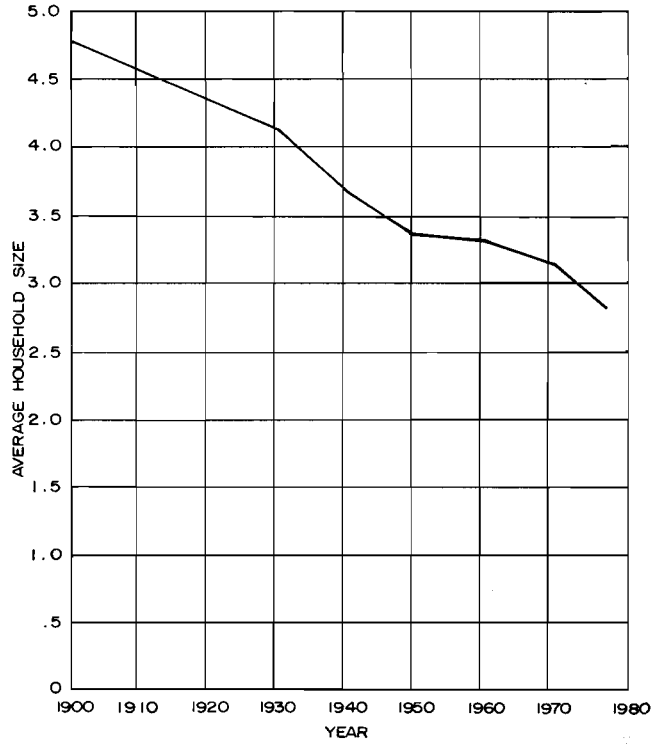
The average size of households in the Region and the nation has declined substantially since the beginning of this century, as shown in Figure 17. The observed reduction of almost two persons from the average household size since 1900 reflects the changes which have taken place in the family unit in the Region and nation since that time.

The distribution of households in the Region by the number of persons per household in the years 1950, 1960, and 1970 is shown in Table 30. The observed decline in average household size in the Region, as shown in Table 30, resulted from decreases in the proportion of three- and four-person households, and a more than doubling of the proportion of one-person households. The proportion of larger households of five or more persons remained fairly constant over that 20-year period.

From 1970 to 1978 a significant decline—from 40 percent to 32 percent of all households—occurred in what has been historically considered the traditional household, the family consisting of a husband and wife with children, in the nation (see Table 31). In 1960 traditional households constituted over 44 percent of all households in the nation. Nontraditional households thus now constitute over two-thirds of all households in the United States. Among the most rapidly increasing nontraditional households in number and proportion are one-person households, which increased from 13 percent of all households in the nation in 1960 to 17 percent in 1970 and 22 percent in 1978. Other nontraditional households that gen-

Figure 17

AVERAGE HOUSEHOLD SIZE IN THE UNITED STATES: 1900-1978



Source: U. S. Bureau of the Census and SEWRPC.

Table 30

NUMBER OF HOUSEHOLDS IN THE REGION BY HOUSEHOLD SIZE: 1950, 1960, AND 1970

Number of Persons per Household	Households					
	1950		1960		1970	
	Number	Percent	Number	Percent	Number	Percent
1	25,394	7.2	57,787	12.4	93,102	17.4
2	100,681	28.4	131,044	28.1	153,669	28.6
3	86,341	24.4	87,253	18.7	88,033	16.4
4	70,844	20.0	82,283	17.7	82,026	15.3
5	38,075	10.7	54,988	11.8	55,699	10.4
6	18,250	5.1	28,750	6.2	32,103	6.0
7	8,054	2.3	12,700	2.7	16,840	3.1
8 or More	6,683	1.9	11,108	2.4	15,014	2.8
Total	354,322	100.0	465,913	100.0	536,486	100.0
Average Household Size	3.36	--	3.30	--	3.20	--

Source: U. S. Bureau of the Census and SEWRPC.

Table 31

HOUSEHOLD COMPOSITION OF THE UNITED STATES: 1960-1978

Household Type	Households							
	1960		1970		1978		Change 1960-1978	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Family	44,904	85.0	51,456	81.2	56,958	74.9	12,054	26.8
Husband-Wife	39,254	74.3	44,728	70.6	47,357	62.3	8,103	20.6
With Children	23,284	44.1	25,532	40.3	24,621	32.4	1,337	5.7
Without Children	15,970	30.2	19,196	30.3	22,736	29.9	6,766	42.4
Male Head, No Wife Present	1,228	2.3	1,228	1.9	1,564	2.0	336	27.4
Female Head, No Husband Present	4,422	8.4	5,500	8.7	8,037	10.6	3,615	81.8
Nonfamily	7,895	15.0	11,945	18.8	19,071	25.1	11,176	141.6
One-Person	6,896	13.1	10,851	17.1	16,715	22.0	9,819	142.4
Two-Person Shared with Unrelated Person of Opposite Sex	242	0.5	327	0.5	865	1.1	623	257.4
Other Nonfamily	757	1.4	767	1.2	1,491	2.0	734	97.0
Total	52,799	100.0	63,401	100.0	76,029	100.0	23,230	44.0

Source: U. S. Bureau of the Census and SEWRPC.

erally increased in number and proportion from 1960 to 1978 are husband and wife only families, which accounted for 15.9 million households, or 30 percent of all households, in 1960, and 22.7 million households, or 30 percent of all households, in 1978; families with only one adult, which accounted for 5.7 million households, or 11 percent of all households, in 1960, and 9.6 million households, or 13 percent of all households, in 1978; and nonfamily households, which accounted for 8 million households, or 15 percent of all households, in 1960, and 19 million households, or 25 percent of all households, in 1978.

The observed reduction in household size is strongly related to the changing female labor force participation rate in the Region and nation, as well as to the recent movement toward nontraditional lifestyles as reflected by current trends in marital status, fertility rates, and divorce rates. One factor in the decline of the average household size is a trend toward the postponement of marriage. The median age at first marriage for never previously married women increased by nearly two years between 1960 and 1978, from 20 to 22 years of age. Particularly large increases in the percentage of women in the nation never married have been observed over the years 1960 to 1978 for women 20 to 24 and 25 to 29 years of age, as shown in Table 32. The percentages of never previously married women in each of these two age groups nearly doubled during this time period, approaching 48 percent for women 20 to 24 years of age and 18 percent for women 25 to 29 years of age in 1978.

Moreover, it is apparent that while women, and men, are delaying marriage as they pursue higher education and enter the labor force, they are also living independently of their parents. The

Table 32

PERCENT NEVER MARRIED IN THE UNITED STATES BY AGE: 1960-1978

Age Group	Percent Never Married			1978 to 1960 Ratio
	1960	1970	1978	
14 to 17	94.6	97.3	97.4	1.03
18	75.6	82.0	86.4	1.14
19	59.7	68.8	76.2	1.28
20 to 24	28.4	35.8	47.6	1.68
25 to 29	10.5	10.5	18.0	1.71
30 to 34	6.9	6.2	8.4	1.22
35 to 39	6.1	5.4	6.1	1.00
40 to 44	6.1	4.9	4.6	0.75
45 to 54	7.0	4.9	4.4	0.63
55 to 64	8.0	6.8	4.8	0.60
65 and Over	8.5	7.7	6.2	0.73
Total	19.0	22.1	23.9	1.26

Source: U. S. Bureau of the Census and SEWRPC.

largest percentage increase between 1970 and 1978 in different types of one-person households in the nation was observed for those households maintained by persons under 35 years of age—an increase of 197 percent. Another fairly large proportion, 41 percent, of one-person households are maintained by persons 65 years of age or older, who choose to live independently. Such older one-person households consist largely of females because of the sex differential in deathrates. In 1960, 50 percent of all families with a single female head of household were headed by widowed women. However, this proportion declined to 29 percent in 1978 as a result of large increases in the number and proportion of never previously married female-headed families and divorced female-headed families, both of which are considered nontraditional families. Divorce ratios have risen rapidly in the nation, as shown in Table 33. In 1960 there were 35 divorced persons for every 1,000 married persons with spouse present, and by 1978 this rate had nearly tripled to 90 divorced persons.

Another factor influencing the observed household size decrease is the decline in fertility rates. Women are having fewer children, and increasing numbers are electing not to have any children. Table 34 indicates the percent of childless married women by age group in the nation for the years 1960, 1970, and 1978. The total percentage of childless married women has risen from 15 to 19 percent over the past 18 years. The most substantial increases occurred for childless married women in the 20 to 24 and 25 to 29 age groups, the same age groups in which significant postponement of marriage has been observed. The percentage of childless women in these age groups has nearly doubled to 41 and 25 percent, respectively, in 1978. It should be noted, however, that the percentage of childless women in the 35 to 44 age group decreased from 1970 to 1978.

Thus, the once popular concept of the traditional household in the Region and nation as one composed of a married couple with children no longer holds, although married couples—with or without children—still represent the majority of households in the nation. However, what were once considered nontraditional households, including married couples without children as well as single-parent families, one-person households, and other nonfamily households, now represent a sizable majority of all households.

The percentage of nontraditional families could decrease and household size could increase in the future for a variety of reasons. Unfavorable economic conditions in the future could encourage both younger and older adults to reside with their families, thus reducing the growth, and possibly even number, of one-person households. The proportion of one-person households and other nontraditional household types could also show decreases in growth, or even decline, if traditional lifestyle preferences—earlier and more stable marriages and increased childbearing—return. Such a shift in lifestyle preferences would probably, however, be accompanied by a shift away from the current trend of women pursuing higher education and participating in the labor force. A slowing in the decline of household size, and possibly even an increase in household size, could take place if the large population of the "baby boom" does

Table 33

DIVORCED PERSONS PER 1,000 MARRIED PERSONS WITH SPOUSE PRESENT IN THE UNITED STATES BY AGE: 1960-1978

Age Group	Divorce Ratio			Change 1960-1978
	1960	1970	1978	
Under 30.	23	38	91	68
30 to 44	33	47	108	75
45 to 64	46	53	84	38
65 and Older. . .	32	47	59	27
Total	35	47	90	55

Source: U. S. Bureau of the Census and SEWRPC.

Table 34

PERCENT CHILDLESS MARRIED WOMEN AGED 15 TO 44 IN THE UNITED STATES: 1960-1978

Age Group	Percent Childless		
	1960	1970	1978
15 to 19 . . .	43.6	50.7	54.2
20 to 24 . . .	24.2	35.9	40.9
25 to 29 . . .	12.6	15.8	25.2
30 to 34 . . .	10.4	8.3	11.6
35 to 39 . . .	11.1	7.4	7.0
40 to 44 . . .	14.1	8.6	6.1
Total	15.0	16.4	18.9

Source: U. S. Bureau of the Census and SEWRPC.

enter marriage and begin childbearing after a period of postponement, instead of continuing to form nontraditional households of husband and wife with no children, or divorced one-parent family households.

The average household size within the Region is estimated to have further declined from 3.20 persons per household in 1970 to 3.04 persons per household in 1975. Between the years 1970 and 1978, the average household size in the nation declined from 3.14 persons per household to 2.81 persons per household. Under a modest return to traditional family pattern lifestyles with reduced postponement of marriage and an increase in childbearing, the average household size in the Region would probably stabilize at about 2.9 persons per household by the year 2000. If lifestyle preferences become increasingly nontraditional, with low fertility rates, high divorce rates, increased labor force participation, and continued independent living of younger and older adults, the average household size in the Region could drop to as low as 2.2 persons per household by the year 2000.

Lifestyle Changes in Location and Housing Preferences

Significant trends have been observed in the housing locational patterns and the housing type occupancy of the population of the Region. These trends include changes in external migration—the movement of people into and out of the Region; changes in internal growth and migration—the growth of the Region and its parts and the movement of the population within the Region; and changes in housing-type occupancy—the residence of the Region's population by housing unit type and tenure category.

External Migration: External migration in the Region has been primarily outward since the 1970's and has been part of a national trend of movement from the northern portion of the country to the Sunbelt region of the country, and from metropolitan parts of the country to nonmetropolitan parts of the country. The Sunbelt is most commonly defined as including 16 states in the southern and western regions of the United States, including Alabama, Arizona, Arkansas, California, Florida, Georgia, Louisiana, Mississippi, Missouri, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia. The western states in the Sunbelt part of the country have been experiencing substantial in-migration since the 1800's. The in-migration to the southern states in the Sunbelt represents a reversal of the historic out-migration from the south, a region of the nation which, until the 1970's, lagged behind the rest of the country in urbanization and industrialization. Factors attributed as being responsible for the movement of population, and more basically business and industry, to these southern states in the 1970's include, relative to the rest of the nation, lower wage rates, lower rates of unionization, and greater availability of land. Other factors frequently identified include both business and personal tax advantages, climate advantages, and the fact that federal government spending for military, defense, and aerospace purposes has historically favored the Sunbelt region of the country.

Between 1970 and 1978, the proportion of the United States population in the southern and western regions, which include the Sunbelt states, increased from 48 to 51 percent, as shown in Table 35. Part of the population gains in these southern and western regions can be attributed to net out-migration from the north-central and northeastern regions of the nation. Between 1970 and 1978, it has been estimated that the northeastern region of the nation experienced a net out-migration of 700,000 persons and that the north-central region experienced a net out-migration of 800,000 people. The north-central region of the nation, which includes the State of Wisconsin, constituted about 28 percent of the national population in the year 1970 and slightly less than 27 percent in 1978. It has been determined that persons migrating from the north-central region of the nation are generally somewhat older than migrants to the north-central region, as shown in

Table 35

PERCENTAGE DISTRIBUTION OF THE POPULATION OF THE UNITED STATES BY REGION: 1960-1978

Region	Percent of United States Population		
	1960	1970	1978
Northeast	26.0	24.1	22.5
North-Central . . .	28.7	27.8	26.7
South.	29.7	30.9	32.4
West	15.6	17.2	18.4
Total	100.0	100.0	100.0

Source: U. S. Bureau of the Census and SEWRPC.

Table 36. In addition, persons migrating from the north-central region are somewhat more likely to be college educated and to be in professional and technical occupations than are migrants to the north-central region.

Table 36

SELECTED POPULATION CHARACTERISTICS OF THE POPULATION THREE YEARS AND OLDER MIGRATING FROM AND TO THE NORTH-CENTRAL REGION: 1975-1978

Age Group	Percent of Migrants from North-Central Region	Percent of Migrants to North-Central Region
Under 5	4.5	5.8
5 to 14	18.0	18.3
15 to 24	23.1	25.5
25 to 34	27.0	28.7
35 to 44	11.6	8.7
45 to 64	11.7	9.8
65 and Older	4.1	3.2
Total	100.0	100.0
Percent of Migrants 25 Years and Older with Four or More Years of College	33.3	29.9
Percent of Migrants Employed in Professional and Technical Occupations	25.3	23.8

Source: U. S. Bureau of the Census and SEWRPC.

Although the north-central region of the country lost nearly 800,000 people to migration between 1970 and 1978, it has been estimated that the State of Wisconsin experienced a net in-migration of about 37,000 people between 1970 and 1975, including 3,400 people aged 65 and older. The Southeastern Wisconsin Region is estimated to have experienced a net out-migration of almost 20,000 people over the same time period, 4,100 of whom were determined to be 65 years of age and older. Part of this out-migration from the Region likely has gone to the Sunbelt, but part can also be assumed to have gone to nonmetropolitan areas of the State, reflecting another recent trend evident within the Region and in the nation—namely, the movement of the population from metropolitan to nonmetropolitan areas.

The historic movement of the population of the nation from rural to urban areas, which began in the Region in the early 1800's and ended in the 1960's, appears to have begun to reverse. Since 1970 nonmetropolitan areas of the nation have been growing at a faster rate than have metropolitan areas, as shown in Table 37. This more rapid population growth of nonmetropolitan areas in recent years is estimated to have also occurred in the State and the Region, with the only nonmetropolitan county in the Region being Walworth County. Part of the growth in nonmetropolitan areas is related to the recent growth of business and industry in these areas.

The age, education, and occupational characteristics of the population of the nation that migrated from metropolitan to nonmetropolitan areas, from nonmetropolitan to metropolitan areas, and between different metropolitan areas between 1975 and 1978 are shown in Table 38. It can be noted from this table that there are more migrants in the younger populations than in the older populations. In addition, it can be seen that persons 45 years of age and older represent a greater proportion of the migrants to nonmetropolitan areas than of those migrating between Standard Metropolitan Statistical Areas (SMSA's) or to SMSA's from nonmetropolitan areas. The largest difference among the three migration groups can be seen for the 15 to 24 year age group. This age group represents 29 percent of the migrants from nonmetropolitan to metropolitan areas, but 22 percent of the migrants from metropolitan to nonmetropolitan areas.

If the out-migration experienced in recent years within the Region continues, the Region can be expected to have a net out-migration of 200,000 people over the next 20 years. The singularly most important factor determining whether this trend continues will probably be the economic conditions and outlook of the Region—specifically, the potential for employment growth beyond that necessary to satisfy any further increase in labor force participation, and the potential for earnings growth relative to that of other parts of the State and the nation. While considerations related to climate and family have been found to influence decisions concerning migration, the factor of overwhelming importance is employment.

However, the amount of out-migration from the Region may even moderate as a result of the future age structure of the Region's population. Migration rates have historically been higher for people aged

Table 37

POPULATION IN THE UNITED STATES, STATE OF WISCONSIN, AND REGION BY METROPOLITAN AREA: 1970-1978

Area	1970		1978		Percent Change 1970-1978
	Population	Percent of Total	Population	Percent of Total	
United States					
Metropolitan Areas					
In Central Cities	62,876,000	31.5	59,723,000	28.0	- 5.0
Outside Central Cities	74,182,000	37.1	83,324,000	39.0	12.3
Subtotal	137,058,000	68.6	143,046,000	67.0	4.4
Nonmetropolitan Areas	62,761,000	31.4	70,421,000	33.0	12.2
Total	199,819,000	100.0	213,467,000	100.0	6.8
Wisconsin					
Metropolitan Areas	2,543,228	57.6	2,620,289	56.3	3.0
Nonmetropolitan Areas	1,874,593	42.4	2,032,466	43.7	8.4
Total	4,417,821	100.0	4,652,755	100.0	5.3
Region					
Metropolitan Areas					
In Central Cities	891,339	50.8	793,866	44.8	- 10.9
Outside Central Cities	801,300	45.6	908,568	51.2	13.38
Subtotal	1,692,639	96.4	1,702,434	96.1	0.57
Nonmetropolitan Areas[a]	63,444	3.6	69,058	3.9	8.8
Total	1,756,083	100.0	1,771,492	100.0	0.87

[a] *Walworth County is the only nonmetropolitan county in the Region.*

Source: U. S. Bureau of the Census, Wisconsin Department of Administration, and SEWRPC.

Table 38

SELECTED POPULATION CHARACTERISTICS OF THE UNITED STATES POPULATION THREE YEARS AND OLDER MIGRATING BETWEEN, FROM, AND TO STANDARD METROPOLITAN STATISTICAL AREAS: 1975-1978

Age Group	Percent of Migrants Between SMSA's	Percent of Migrant from SMSA's to Nonmetropolitan Areas	Percent of Migrants from Nonmetropolitan Areas to SMSA's	Percent of Total Population
Under 5	4.3	4.5	4.4	2.9
5 to 14	16.9	18.6	16.5	17.4
15 to 24	24.0	22.1	29.4	19.6
25 to 34	28.8	26.6	25.4	16.2
35 to 44	10.8	10.7	10.8	11.6
45 to 64	10.7	12.9	10.2	21.3
65 and Older	4.5	4.6	3.3	11.0
Total	100.0	100.0	100.0	100.0
Percent of Migrants 25 Years and Older with Four or More Years of College	32.1	23.0	28.4	15.7
Percent of Migrants Employed in Professional and Technical Occupations	25.5	20.8	21.0	15.6

Source: U. S. Bureau of the Census and SEWRPC.

in their twenties. The continuing trend of low fertility rates in the Region, along with the aging of the "baby boom" generation, will result in an older population and labor force in the Region, perhaps indicating more population stability for the Region and less out-migration.

Regional Growth and Internal Migration

Recent trends in housing location and internal migration within the Region are indicated by changes in the distribution of households and population within the Region. The Region is estimated to have increased in population by only 1 percent between 1970 and 1978, from 1,756,083 to 1,770,484 people. However, only one county of the Region, Milwaukee County, is estimated to have lost population since 1970—about 100,000 people, or 10 percent. The City of Milwaukee has been losing population since 1960, and from 1970 to 1978 the population of the City is estimated to have declined by 14 percent—from 717,372 to 620,160 people. The population of Kenosha, Racine, and Walworth Counties each increased by less than 10 percent since 1970, a total increment of about 20,000 people. Over the same period the population of each of the three pricipal outlying counties—Ozaukee, Washington, and Waukesha Counties increased by approximately 30 percent, a total increment of about 94,000 people. The slow growth of population in the Region since 1970 and the loss of population in Milwaukee County over the same period has occurred simultaneously with a decline in average household size in Milwaukee County and the Region. Because of this, the number of households in the Region and in Milwaukee County has increased since 1970.

It is apparent though that the more rapid rates of growth in the Region since 1970 have occurred primarily within the suburban and rural-urban fringe areas of the Region. This is a continuation of an urban development trend which began in the 1950's, as shown on Map 1. Prior to 1950, urban development in the Region followed a fairly regular pattern, forming concentric rings of relatively high-density urban development contiguous to, and outward from, the existing urban areas. Soon after World War II, however, the character of urban growth in the Region began to change to a much more diffused pattern of development in suburban and rural areas, with relatively low densities and a proliferation of clusters of noncontiguous development. This overall trend has continued through the first half of the 1970's, as shown on Map 1, particularly in Waukesha County. Substantial development, however, has also taken place in locations adjacent to existing urban development, as well as in outlying rural areas.

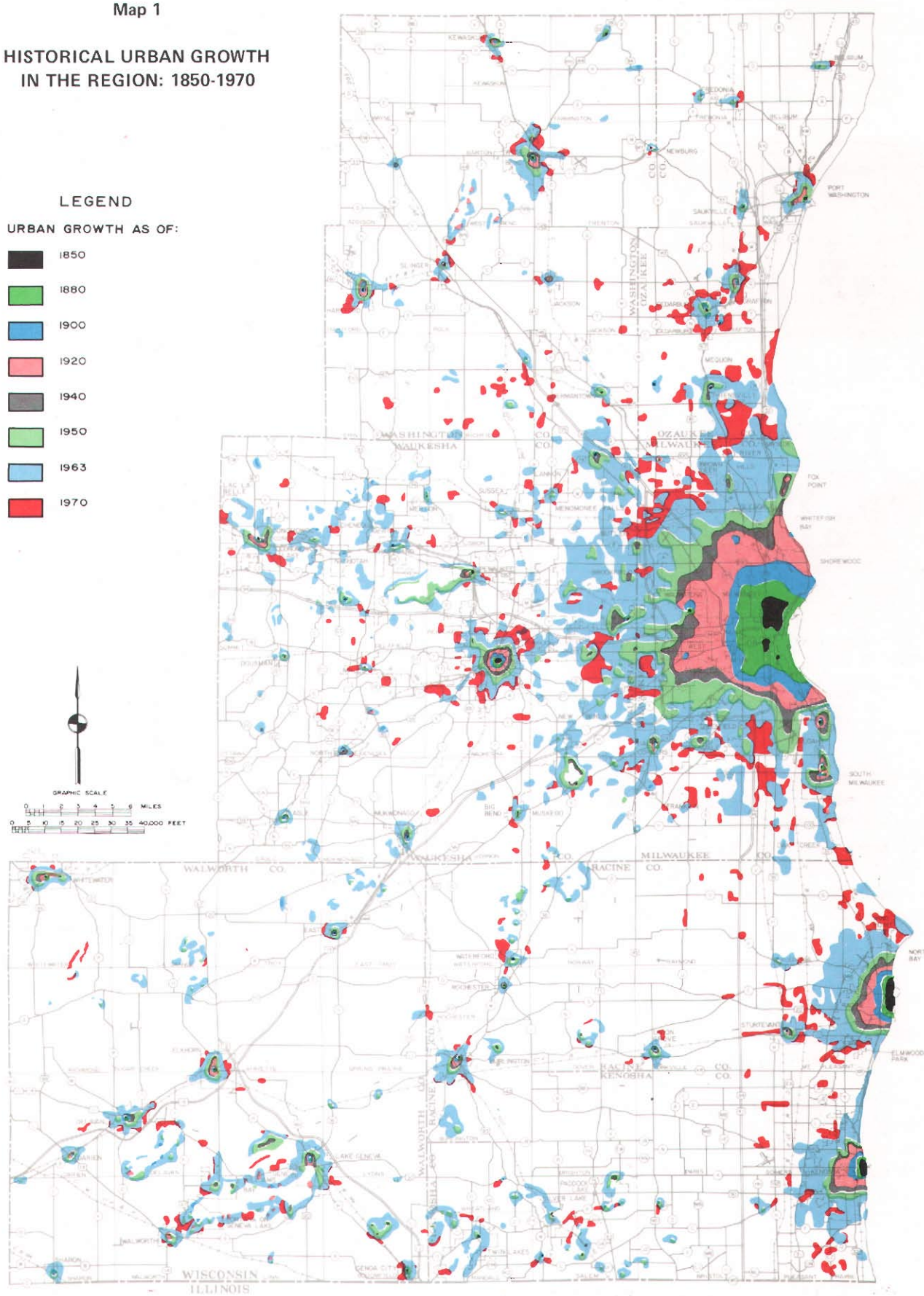
Another measure of the amount and rate of recent population growth in the Region is the number of housing units authorized through building permits obtained within the Region between 1970 and 1978, as shown in Table 39. Since 1970, Milwaukee County has been authorized to build the largest number of housing units of all counties in the Region—over 38,000 units and over 50 percent more than authorized in any other county of the Region. These 38,000 units represented an 11 percent increase in the housing stock of the County. About one-half of these housing units, nearly 19,300, were authorized within the City of Milwaukee, representing an 8 percent increase in the housing stock of the City. The other counties of the Region, however, have experienced much more rapid rates of increase in their housing stock since 1970 than Milwaukee County. Kenosha, Racine, and Walworth Counties have each experienced about a 20 percent increase in housing stock, or a total of 25,000 units. The three principal counties outlying Milwaukee County—Ozaukee, Washington, and Waukesha Counties—have each experienced about a 40 percent increase in housing stock, or a total of 40,000 units.

Findings of surveys within the Region and State of preference of housing location are consistent with these trends. A survey of Wisconsin residents in 1971 found that only 21 percent preferred residence in a city of 50,000 or more population or in a suburb adjacent to such a city. Over 79 percent of the survey respondents expressed a preference for living in rural areas or small towns, with the majority of these respondents indicating a desire, however, to reside within 30 miles of a city of 50,000 population or more. A public opinion survey of regional residents conducted by the Regional Planning Commission in 1972 found that 47 percent of the Region's residents surveyed preferred suburban residential locations over city or rural locations.

Future trends in population and housing growth in the Region will depend upon a number of factors. Energy price and availability will be an important consideration, in terms of their effects on both the cost and availability of personal transportation and the cost of maintaining a home. Residents of typical outlying suburban or rural areas generally have to travel longer distances to work

Map 1

HISTORICAL URBAN GROWTH IN THE REGION: 1850-1970



Urban development within the Region occurred in a fairly dense and compact pattern until about 1950, with new urban development occurring at relatively high densities in concentric rings contiguous to, and outward from, the existing urban areas and long-established mass transit, utility, and community facility systems. Soon after World War II, however, the character of urban growth in the Region began to change to a much more diffused pattern of development, with relatively low densities and widespread proliferation of clusters of noncontiguous development. Between 1963 and 1970, 57 square miles of land were converted from rural to urban use within the Region, a rate of approximately eight square miles per year. The continuation of this sprawl pattern of land use development threatens further destruction of prime agricultural lands and the creation of scattered enclaves of urban development in otherwise rural areas that will be difficult to serve economically, if at all, with necessary public utilities and services, including mass transit services.

Source: SEWRPC.

Table 39

HOUSING UNITS AUTHORIZED BY BUILDING PERMITS
IN THE REGION BY COUNTY AND CENTRAL CITY: 1970-1978

County	Units Authorized	Percent of Total	1970 Housing Units	Units Authorized as Percent of 1970 Housing Units
Kenosha				
City of Kenosha.	5,230	5.1	24,872	21.0
Balance of County	3,250	3.1	14,238	22.8
Subtotal	8,480	8.2	39,110	21.7
Milwaukee				
City of Milwaukee	19,250	18.7	246,065	7.8
Balance of County	19,310	18.7	103,699	18.6
Subtotal	38,560	37.4	349,764	11.0
Ozaukee				
Racine				
City of Racine.	2,590	2.5	31,042	8.3
Balance of County	7,430	7.2	21,787	34.1
Subtotal	10,020	9.7	52,829	19.0
Walworth	6,150	6.0	25,773	23.9
Washington	8,610	8.3	18,692	46.1
Waukesha	24,700	23.9	65,249	37.9
Region	103,210	100.0	566,756	18.2

Source: Allied Construction Employers Association, U. S. Bureau of the Census, and SEWRPC.

than do their city counterparts, have relatively more extensive travel requirements for nonwork travel, usually have less opportunity for carpooling, and have limited access to public transit. It should be noted, however, that the degree to which business and industry continue to decentralize, locating in or migrating to suburban and rural areas, will influence the travel energy requirements of residents of such areas.

In addition, the typical home in such low-density areas is of a large lot and floor space which has, in itself, substantial energy requirements. It should be noted in this respect, however, that it is precisely the large lot and floor space typical of homes in such areas that have made these areas desirable to the traditional family over the past 20 years, and that has contributed to the trends of growth observed in the Region. This type of residential life allows each family more of its own personal space, and allows more amenities to be present within one's private residential area. Moreover, public and private restrictions assure that those residing in such local areas are of a similar economic level and, usually, socioeconomic background.

An important factor in whether the regional population and housing growth trends continue will be the future family pattern lifestyles of the Region. The growth of the suburban and rural-urban fringe areas of the Region which began following World War II coincides with the traditional family orientation of the "baby boom" period. Residents of suburban areas tend to be younger couples with children, while central cities include more households of older couples without children, single adults, and single-parent families. As shown in Table 40, central cities in the State of Wisconsin have a lower percentage of population under 18 years of age and a higher percentage of elderly residents than do the urban fringe areas of the central cities and the State as a whole. Central cities also have a higher proportion of single adult female-headed families, nearly twice that of the urban fringe. In addition, the average household size of the urban fringe is nearly 0.5 person higher than that of central cities, and a higher percentage of families in the urban fringe are of the traditional type—that is, husband and wife families with children under 18 years of age. If family pattern lifestyle trends continue to assume a nontraditional, individualistic orientation, the trends in

Table 40

SELECTED POPULATION CHARACTERISTICS IN WISCONSIN BY AREA OF RESIDENCE: 1970

Population Characteristic	State	Urbanized Areas	Central Cities	Urban Fringe
Under 18 Years of Age (percent)	35.8	34.7	32.9	38.0
65 Years of Age and Older (percent)	10.7	9.5	10.4	7.8
Married Females 14 Years of Age and Older (percent)	60.6	57.9	54.9	64.0
Number of Persons per Household	3.22	3.14	3.00	3.43
Families with Female Head (percent)	8.2	10.2	12.3	6.3
Husband-Wife Families with Children Under 18 (percent)	51.1	50.2	46.6	56.7

Source: U. S. Bureau of the Census and SEWRPC.

Table 41

STRUCTURE TYPE OF YEAR-ROUND HOUSING UNITS IN THE REGION BY COUNTY: 1970

	Year-Round Housing Units by Structure Type											
	Single-Family		Multifamily									
			2 Units		3 to 4 Units		5 to 9 Units		10 Units or More		Total	
County	Number	Percent[a]	Number	Percent[a]	Number	Percent[a]	Number	Percent[a]	Number	Percent[a]	Number	Percent[a]
Kenosha	27,137	73.0	6,173	16.6	1,902	5.1	657	1.8	1,295	3.5	10,027	27.0
Milwaukee	165,950	47.5	94,804	27.1	27,342	7.8	18,410	5.3	43,160	12.3	183,716	52.5
Ozaukee	12,678	83.0	1,551	10.1	408	2.7	372	2.4	271	1.8	2,602	17.0
Racine	36,576	70.3	9,185	17.6	2,388	4.6	1,093	2.1	2,824	5.4	15,490	29.7
Walworth	17,604	83.1	1,866	8.8	626	2.9	334	1.6	768	3.6	3,594	16.9
Washington	14,087	78.8	2,571	14.4	563	3.1	378	2.1	279	1.6	3,791	21.2
Waukesha	53,521	84.0	4,503	7.1	2,318	3.6	1,173	1.9	2,177	3.4	10,171	16.0
Region	327,553	58.9	120,653	21.6	35,547	6.4	22,417	4.0	50,774	9.1	229,391	41.1

[a] *Percent of year-round housing units in county.*

Source: U. S. Bureau of the Census and SEWRPC.

urban growth in the Region could change away from the past movement toward a diffused pattern of suburban and rural-urban fringe area development. Declines in fertility rates, increases in divorce rates, and the postponement of marriage will produce households that will not assume suburban residence to the same extent as have traditional families. Increasing female labor force participation and the consequent rise in the number of families in which both the husband and wife are in the labor force may also affect the future extent of suburban location, as such families have substantial travel requirements.

Housing Unit Type Occupancy

The distribution of year-round housing units in the Region by structure type for the year 1970 is given in Table 41. Milwaukee County had the lowest percentage of single-family units with 48 percent, and Kenosha and Racine Counties also had lower percentages in single-family units, about 70 percent, than did other counties within the Region. Milwaukee County alone accounted for over 80 percent of all multiple-family housing units in the Region. Since 1970, a greater proportion of multiple-family housing units has been authorized through building permits in each county of the Region than existed by proportion in 1970 (see Tables 41 and 42). More multiple-family units—52 percent—were authorized within the Region than single-family units—48 percent—between the years 1970 and 1978. In 1970 only 41 percent of the regional housing stock consisted of multiple-family units. The housing units authorized within the Region between 1970 and 1978 represented over 18 percent of the 1970 regional housing stock—31 percent of the 1970 regional housing stock if Milwaukee County is excluded.

Table 42

PERCENTAGE DISTRIBUTION BY STRUCTURE TYPE OF HOUSING UNITS AUTHORIZED BY BUILDING PERMITS IN THE REGION BY COUNTY AND CENTRAL CITY: 1970-1978

County	Type of Housing Unit			
	Apartments	Duplexes	Single-Family	Total
Kenosha				
City of Kenosha	56.3	6.0	37.7	100.0
Balance of County	21.2	2.4	76.4	100.0
Subtotal	42.8	4.6	52.6	100.0
Milwaukee				
City of Milwaukee	80.0	7.8	12.2	100.0
Balance of County	57.1	6.4	36.5	100.0
Subtotal	68.6	7.1	24.3	100.0
Ozaukee				
Racine				
City of Racine	55.9	7.9	36.2	100.0
Balance of County	29.0	5.4	65.6	100.0
Subtotal	36.0	6.0	58.0	100.0
Walworth	34.9	3.2	61.9	100.0
Washington	28.1	6.2	65.7	100.0
Waukesha	28.0	6.8	65.2	100.0
Region	45.9	6.6	47.5	100.0

Source: Allied Construction Employers Association, U. S. Bureau of the Census and SEWRPC.

Table 43

AVERAGE HOUSEHOLD SIZE IN THE REGION BY TENURE STATUS AND STRUCTURE TYPE: 1970

Tenure Status and Structure Type	Average Household Size
Owner	
1 Unit	3.66
2 or More Units	2.86
Renter	
1 Unit	3.59
2 Units	2.99
3-4 Units	2.47
5-19 Units	2.03
20 or More Units	1.62
Total	3.19

Source: U. S. Bureau of the Census and SEWRPC.

In 1960, single-family housing units accounted for 62 percent of the Region's households, but by 1970 this percentage had declined to 59 percent. A similar decline has been experienced at the national level, with the percent of single-family housing units declining from 75 percent of all households in 1960 to 68 percent of all households in 1974.

Residential housing-type occupancy and tenure have been found to be correlated with household composition, as shown in Table 43. Average household size in the Region is greater for owner-occupied housing than for renter-occupied housing, and varies inversely with the number of units in the housing unit. The highest average household size, 3.7 persons per household—about the size of the traditional family—is found in single-family units. The lowest average household sizes of two persons per household or less are identified with housing of five or more units.

The percentage distribution of residences by housing structure type for one-person households, female-headed households, husband and wife households with no nonrelatives present, and other male-headed households for the Kenosha, Milwaukee, and Racine Standard Metropolitan Statistical Areas in 1970 are shown in Table 44 by age of the head of household. For all households in each area, the most prevalent residence is the single-family unit. One-person households under 65 years of age, however, are much more likely to be found in multiple-family units than in single-family structures. Nevertheless, of the one-person households found in single-family homes, more consist of persons 65 years of age and older than of younger persons. Female-headed households in which the head of household is under 65 years of age are also more likely to live in multiple-family units than in other types of housing. However, female-headed households in which the head of household is 65 years of age and older are more likely to live in single-family homes than are younger female-headed households. The households accounting for the lowest proportion of households in multiple-family units are husband and wife households in which the head of the household is 35 to 64 years of age—the age group of traditional families raising children.

If nontraditional family lifestyles continue, the demand for multiple-family, high-density residential housing may increase. Marital postponement and instability, the increased labor force participation of women, reduced childbearing, and the increased independent living of younger and older adults would contribute to a decline in single-family housing demand and an increase in multiple-

Table 44

PERCENTAGE DISTRIBUTION OF HOUSEHOLD TYPE BY TENURE STATUS AND STRUCTURE TYPE IN THE KENOSHA, MILWAUKEE, AND RACINE STANDARD METROPOLITAN STATISTICAL AREAS: 1970

Tenure Status and Structure Type	Two or More-Person Households									One-Person Households		
	Male Head, Wife Present, No Nonrelatives					Other Male Head		Female Head				
	Under 25 Years	25 to 34 Years	35 to 44 Years	45 to 64 Years	65 Years and Older	Under 65 Years	65 Years and Older	Under 65 Years	65 Years and Older	Under 65 Years	65 Years and Older	Total
Kenosha Standard Metropolitan Statistical Area												
Owner												
1 Unit	14.4	54.7	77.1	78.9	78.3	48.8	51.1	42.6	62.0	27.8	50.3	61.5
2 or More Units	1.5	3.9	4.3	7.0	8.2	6.5	22.1	5.0	13.3	6.3	12.2	6.3
Mobile Home	5.6	3.5	1.3	1.8	1.3	--[a]	5.1	1.3	1.8	4.5	1.7	2.3
Subtotal	21.5	62.1	82.7	87.7	87.8	55.3	78.3	48.9	77.1	38.6	64.2	70.1
Renter												
1 Unit	22.0	14.7	9.5	5.6	5.1	10.9	8.5	13.4	8.1	6.7	7.4	9.4
2 to 4 Units	48.0	19.7	6.6	5.2	4.7	25.0	13.2	32.3	9.5	32.3	19.2	15.5
5 to 19 Units	4.0	1.3	0.5	0.8	1.1	5.0	0.0	3.5	4.2	11.7	5.1	2.6
20 or More Units	3.8	2.0	0.6	0.7	1.1	3.2	0.0	1.4	1.1	9.9	3.9	2.2
Mobile Home	0.7	0.2	0.1	0.0	0.2	0.6	0.0	0.5	0.0	0.8	0.2	0.2
Subtotal	78.5	37.9	17.3	12.3	12.2	44.7	21.7	51.1	22.9	61.4	35.8	29.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Milwaukee Standard Metropolitan Statistical Area												
Owner												
1 Unit	8.5	44.6	73.7	71.0	57.7	35.6	53.6	29.6	46.6	15.6	29.3	50.3
2 or More Units	3.5	6.3	7.0	9.6	15.7	8.6	15.9	7.3	17.9	7.0	15.5	9.1
Mobile Home	0.9	0.6	0.2	0.4	0.3	0.7	0.2	0.3	0.1	0.8	0.3	0.4
Subtotal	12.9	51.5	80.9	81.0	73.7	44.9	69.7	37.2	64.6	23.4	45.1	59.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Renter												
1 Unit	8.0	7.6	4.8	4.1	3.6	8.4	6.2	8.1	4.4	4.4	3.3	5.3
2 to 4 Units	50.8	30.2	11.5	11.1	15.1	25.7	17.3	37.4	18.9	26.4	21.9	20.9
5 to 19 Units	17.5	7.0	1.9	2.3	4.2	11.7	3.6	10.8	6.6	21.0	12.9	7.5
20 or More Units	10.7	3.7	0.9	1.5	3.4	9.2	3.2	6.5	5.5	24.7	16.8	6.5
Mobile Home	0.1	--[a]	--[a]	--[a]	--[a]	0.1	0.0	--[a]	0.0	0.1	0.0	--[a]
Subtotal	87.1	48.5	19.1	19.0	26.3	55.1	30.3	62.8	35.4	76.6	54.9	40.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Racine Standard Metropolitan Statistical Area												
Owner												
1 Unit	14.9	58.4	81.9	81.1	74.9	53.6	71.7	37.6	64.0	27.3	49.0	63.2
2 or More Units	3.8	3.1	3.9	5.7	10.0	6.7	6.7	6.6	10.4	6.2	11.1	5.9
Mobile Home	1.0	0.9	0.2	0.3	0.5	0.7	1.7	0.3	0.0	0.9	0.3	0.5
Subtotal	19.7	62.4	86.0	87.1	85.4	61.0	80.1	44.5	74.4	34.4	60.4	69.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Renter												
1 Unit	15.4	11.8	5.9	4.7	5.2	11.6	0.0	11.3	6.7	6.3	4.4	7.3
2 to 4 Units	46.1	20.7	7.0	6.4	5.9	18.3	12.6	32.4	14.4	28.8	23.7	15.9
5 to 19 Units	9.5	2.8	0.6	0.8	2.1	4.7	3.5	5.7	3.9	17.9	8.3	4.1
20 or More Units	9.1	2.3	0.5	1.0	1.4	4.4	3.8	5.9	0.6	12.6	3.2	3.1
Mobile Home	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	--[a]	0.0	--[a]
Subtotal	80.3	37.6	14.0	12.9	14.6	39.0	19.9	55.5	25.6	65.6	39.6	30.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] *Negligible.*

Source: U. S. Bureau of the Census and SEWRPC.

family housing demand. The older ages at which people are marrying, higher divorce rates, and lower fertility rates have reduced the average size of households and produced rapid increases in nontraditional households, including one-person, single-parent, and childless married couple households. And because of large increases in female labor force participation rates, even for mothers of

children of all ages, even traditional families have undergone significant change in recent years. The percentage of husband and wife families with both the husband and the wife in the labor force is now equal to the percentage with only the husband in the labor force. If a traditional family lifestyle pattern would, however, return even in part, single-family housing demand would increase substantially as a result of the large size of the "baby boom" population in the Region which would be in the formation years over the next 20 years.

Summary and Prospects

Certain major changes in family pattern lifestyles have occurred in the Region and the nation over the recent past. The population no longer has a predominant traditional family orientation, with households consisting of husband and wife and children and with one wage earner per household. The changing role of women in society, the more individualistic orientation of society, and more difficult economic conditions have continued to cause a higher proportion of women to seek participation in the labor force, and have resulted in reduced childbearing, later ages at first marriage, increased divorce rates, and higher proportions of one- and two-person households. Reduced birthrates and mortality rates have resulted in shifts in the population age structure toward increased proportions of elderly persons and reduced proportions of younger age groups. As a result of the "baby boom" of the late 1940's and early 1950's, a large proportion of the population is now at or near the traditional ages of making lifestyle choices regarding family formation.

This shift in family pattern lifestyles in recent years may be expected to have some impact on the future residential lifestyles of the Region's population. Housing growth patterns in the past have emphasized single-family housing in the suburban and rural-urban fringe areas of the Region, and have resulted in declines in the population of the central cities of the Region. However, nontraditional households have historically not sought suburban and rural-urban fringe area locations to the same extent as have traditional families, and nontraditional households are more likely to occupy multiple-family high-density residential housing than are traditional households.

The continuation of recent family pattern lifestyle trends could result in further increases in the female labor force participation rate, perhaps approaching that of males; the maintenance of fertility rates below replacement levels; and decreases in household size as the number of one- and two-person households account for increasingly larger proportions of total households. The continuation of current trends could also be expected to lead to a shift in the future residential lifestyles of the population of the Region, with a significant increase in the demand for multiple-family housing, accompanied by a trend toward increased centralization or recentralization of development in the Region.

A significant moderation of the recent trends toward the nontraditional family, individualistic lifestyle patterns could also occur in the Region. This is a reasonable alternative future to be examined under this study because recent trends have been the result of the large "baby boom" portion of the population entering adult years. This portion of the population has not in recent years entered family formation at traditional ages. Yet, it remains in the age of family formation, and could still decide to assume a more traditional family lifestyle orientation, but at a later than traditional age. Under this future, a slowing of recent trends in female labor force participation and childbearing would take place. The female labor force participation rate would continue to increase, but would not approach that of males. Birthrates could be expected to continue at low replacement levels for the next 10 years, but would then increase to replacement levels. Household size would remain stable.

ECONOMIC CONDITIONS

The future level of economic activity in the Region will greatly influence the primary transit needs of the Milwaukee area. The future level of employment in the Region will be an important determinant of the amount of travel for work purposes made within southeastern Wisconsin. Such travel constitutes the major component of all transit and highway travel during peak travel periods of the weekday. The future level of employment will also be an important determinant of the future size of the resident population of the Region, and, therefore, of total travel demand. In addition, the amount and character of economic activity will determine future personal income levels within the Region which will, in turn, affect future travel demand and transit use, since income is highly correlated with personal automobile ownership, level of tripmaking, and choice of mode of travel. In the following sections, major trends and prospects for economic activity within the Region are discussed.

Employment

Total employment in the Southeastern Wisconsin Region has grown considerably and steadily since 1950, as shown in Figure 18. The employment level in the Region increased from 552,700 jobs in 1950 to 835,100 jobs in 1977—an increase of 282,400 jobs and an average rate of increase of 1.5 percent per year. Over this same period, the resident population of the Region increased at a rate of only 1.3 percent per year.

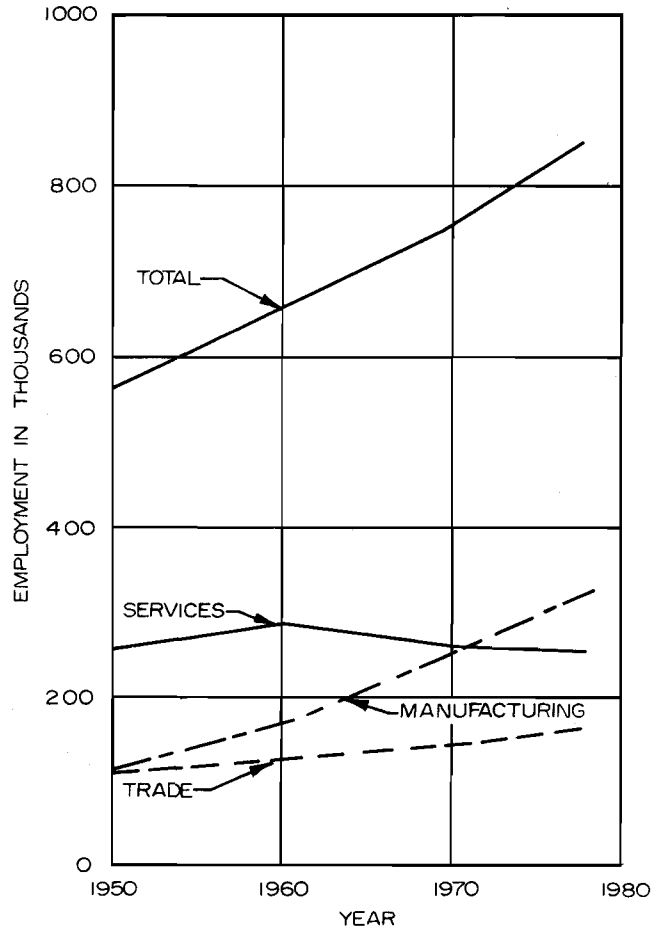
Substantial changes have occurred in the structure of employment in the Region since 1950, as shown in Figure 18. The amount of employment in manufacturing within the Region has been on the decline since 1960, and in 1977 manufacturing accounted for about 246,800 jobs, or 30 percent of the total employment in the Region. In 1950, manufacturing accounted for 245,400 jobs, or 44 percent of the total employment. Employment in private and governmental services in the Region has, in contrast, increased steadily since 1950 at an average annual rate of 4 percent. Private and governmental services is now the principal employment sector of the Region, accounting for 38 percent of total jobs in the Region in 1977, up from 20 percent in 1950. Employment in retail and wholesale trade in the Region has also increased since 1950—from 111,700 jobs in 1950, or 20 percent of total employment, to 160,100 jobs in 1977, or 19 percent of total employment.

This trend of steady employment growth over nearly the past three decades has been experienced not only in the Region but in the nation, as shown in Figure 19. However, the number of jobs available increased at a somewhat faster rate in the nation than in the Region between 1950 and 1970, a 1.9 percent increase compared with 1.5 percent. The types of changes that have occurred within the Region with respect to the structure of employment have been observed nationally since 1950. Employment in private and governmental services in the nation has steadily increased since 1950 at an average annual rate of about 3.6 percent, and since 1970 private and governmental services have accounted for the major share of total national employment. Employment in retail and wholesale trade in the nation has also increased steadily since 1950, at an average annual rate of about 2.4 percent. In contrast to the Region, the number of manufacturing jobs in the United States, however, has steadily increased since 1950 at an average annual rate of 1 percent, as compared with 0.02 percent for the Region. It should be noted, however, that data for the year 1978 and for the first six months of 1979 show a significant increase in manufacturing employment in the Region of about 11,000 jobs, or about 4.5 percent more than in 1977 and about 7,000 jobs, or 2.7 percent, more than in 1970.

Employment trends in the Region have generally been quite similar to those of the other states in the east-north central region of the country, which includes the States of Illinois, Indiana, Michigan, and Ohio, as well as Wisconsin. Total employment in the east-north central region has increased at an average annual rate of about 1.4 percent since 1950, as shown in Figure 20. Manufacturing employment declined from 1970 to 1977, but showed an increase in 1977 of 10 percent over 1950 levels. Service jobs showed the greatest

Figure 18

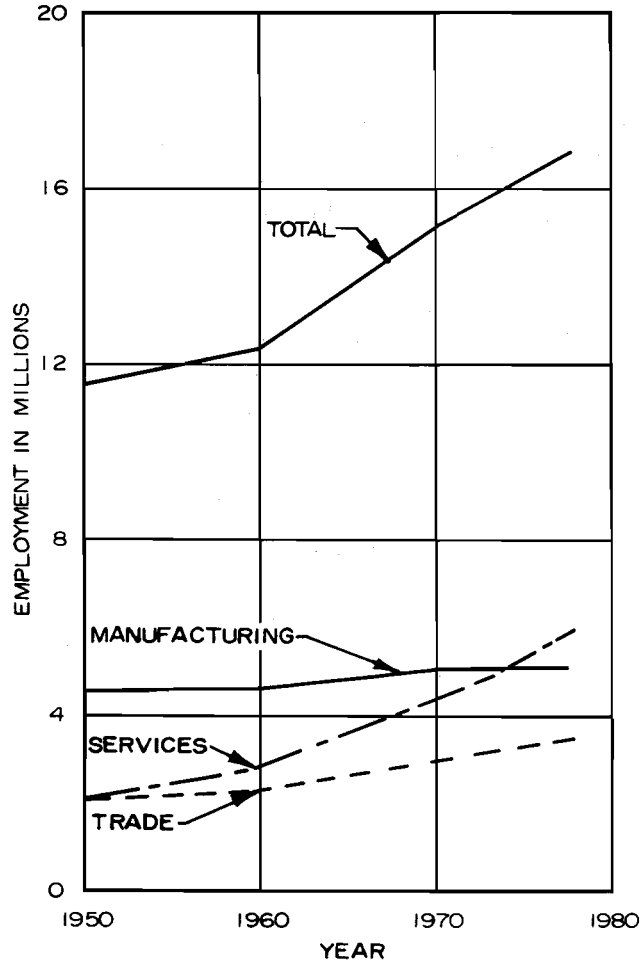
EMPLOYMENT WITHIN THE SOUTHEASTERN WISCONSIN REGION: 1950-1977



Source: Wisconsin Department of Industry, Labor and Human Relations and SEWRPC.

Figure 19

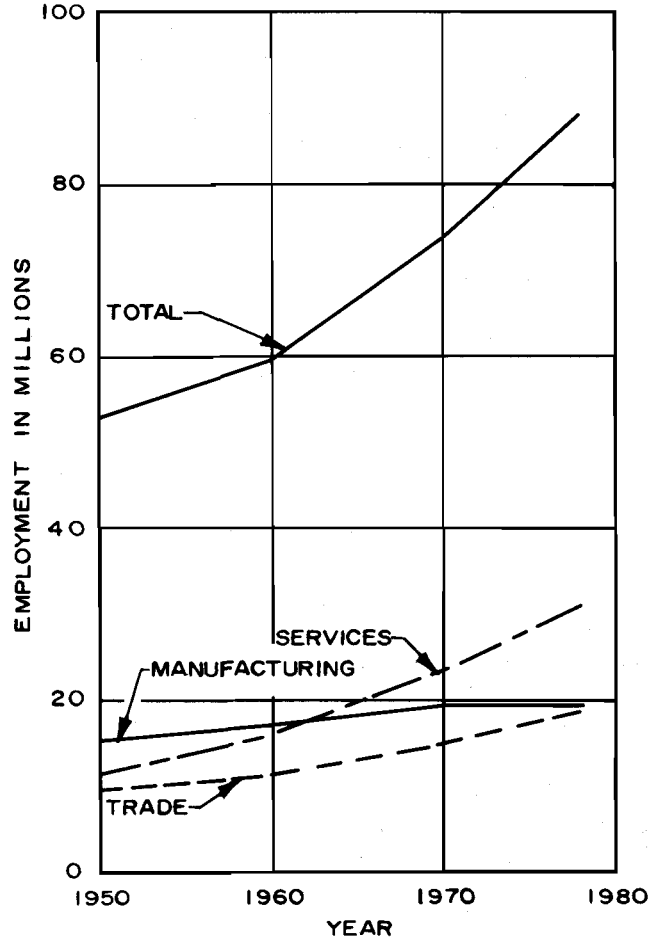
EMPLOYMENT WITHIN THE UNITED STATES: 1950-1977



Source: U. S. Department of Commerce and SEWRPC.

Figure 20

EMPLOYMENT WITHIN THE EAST-NORTH CENTRAL REGION OF THE UNITED STATES: 1950-1977



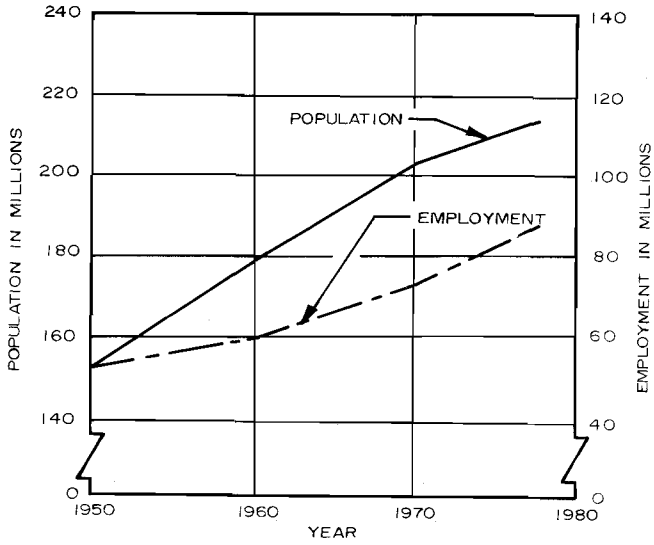
Source: U. S. Department of Commerce and SEWRPC.

increase since 1950, experiencing an average annual rate of increase of about 2.7 percent, and jobs in the retail and wholesale trades also showed a steady increase over the past three decades, increasing by 50 percent from 1950 to 1977.

Future changes in the level of employment in the nation, as well as in the Region, will be a function of many factors, including the size of the national population, the age structure of that population, and the growth in its disposable income, all of which affect the demand for the production of goods and services. A particularly important variable affecting national employment is population size. Increases in national population and employment levels are related, although not directly, as shown in Figure 21. While the population of the nation increased by about 41 percent between 1950 and 1977, employment levels increased by over 65 percent. Part of the growth in employment over the past three decades can be explained by the changing age structure of the population, which has increased the proportion of the population in the work force—increasing the potential for more income to be earned by the population. Increases in labor force participation by women has added to this increased potential for earnings, and to a need for more goods production, and more services, in the nation, which in turn results in a need for more labor. Also a factor encouraging the increased production and employment of recent years is the decline in family size, which tends to increase both the amount of income available to families and the consumption of goods and services. The continuation of these lifestyles will be an important factor in the future direction of

Figure 21

EMPLOYMENT AND POPULATION TRENDS IN THE UNITED STATES: 1950-1977



Source: U. S. Department of Commerce and SEWRPC.

employment in the United States and the Region, as such lifestyles affect the level of income in the population.

Income

Income levels in the Region and nation increased rapidly between 1950 and 1970. During this 20-year period, annual median family income in the nation increased from $9,528 to $19,403 measured in constant 1979 dollars, an increase of 104 percent. Median family income in the Milwaukee Standard Metropolitan Statistical Area (SMSA). which includes Milwaukee, Ozaukee, Washington, and Waukesha Counties, increased during this same period from $12,133 to $22,296, measured in constant 1979 dollars—an increase of 84 percent.[3] While the historic growth in income within the Milwaukee area from 1950 to 1970 was lower than the national growth, the median family income level of the Region has remained higher than the national median family income level, as shown in Table 45.

Table 45

MEDIAN FAMILY INCOME IN THE MILWAUKEE STANDARD METROPOLITAN STATISTICAL AREA AND THE UNITED STATES: 1950-1977

Year	United States		Milwaukee SMSA	
	1979 Dollars	Actual Dollars	1979 Dollars	Actual Dollars
1950	$ 9,528	$ 3,083	$12,133	$ 3,926
1960	14,351	5,660	17,736	6,995
1970	19,403	9,867	22,296	11,338
1976	20,064	14,958	23,770	17,721
1977	20,171	16,009	26,204	20,797

Source: U. S. Bureau of the Census and SEWRPC.

Since 1970, however, the rate of increase in median family income for the Milwaukee SMSA has been higher than the rate of increase in the nation, although both rates have been much lower than those between 1950 and 1970. Median family income in the Milwaukee SMSA increased from $22,296 in 1970 to $26,204 in 1977 in constant 1979 dollars, an increase of over 17 percent. Nationally, median family income increased over the same period from $19,403 to $20,171 in constant 1979 dollars, an increase of about 4 percent. The increase in median family income levels in the Milwaukee SMSA that occurred between 1970 and 1977 is consistent with increases experienced in other major metropolitan areas of the nation and may be explained, in part, by the increase in two-income households, as well as by the overall employment gains in the Milwaukee area. Per capita income in the Milwaukee SMSA is estimated to have increased from $7,098 in 1970 to $7,946 in 1977, an increase of over 12 percent measured in constant 1979 dollars.

In any consideration of the probable impact of future changes in income levels on community development, the uses as well as the level of income must be examined. Savings have historically served as the source of capital for investment. Thus, as savings decline, less money becomes available for capital investment. Such capital investment has historically resulted in increases in worker productivity and in real income levels. Nationally, current savings rates are approximately

[3] *The Milwaukee SMSA rather than the Region is being used in the comparison of income levels in Table 45 because comparable regional data for the years following 1970 will not be available until the 1980 census is completed. However, these income levels are fairly representative of the seven-county Region since the Milwaukee SMSA contains almost 80 percent of the Region's total population. Income data for the years 1976 and 1977 for the Milwaukee SMSA are based on unpublished information obtained from the U. S. Bureau of the Census.*

4 percent of income after taxes, the lowest level since the 1930's. Borrowing, however, has continued at high levels, increasing the demand for goods and services and increasing employment, but also serving to increase interest rates and inflate prices.

Since 1950, prices have increased by 210 percent, or at an average rate of over 4 percent per year. Since 1970, prices have increased by almost 42 percent, or at an average of almost 7 percent per year. Theoretically, a high rate of price inflation should reduce the consumption of goods and services, in turn slowing price increases and depleting inventories and leading to reduced employment. However, employment has continued to increase in recent years despite high inflation rates, and the consumption of goods and services has continued to remain at high levels. Among the major reasons for the continued high rates of consumption and the departure from the theoretical impact of inflation are: 1) the fact that increases in household income levels are closely matching increases in the level of price inflation—both through increases in income and labor force participation; and 2) the recently adopted tendency of consumers to purchase goods in anticipation of increased inflation. The result has been a decreasing incentive for capital investment, contributing to declines in work force productivity and real income gains.

A major cause of the current high rate of price inflation is the sharp increase in energy prices of recent years. In particular, the price of foreign crude petroleum increased nearly 1,200 percent between 1970 and 1979. The price of foreign petroleum also affects the economy of the United States in that its purchase results in an increased flow of income out of the United States, and its use at higher prices for automobiles or home heating reduces the amount of income available for savings and attendant investment in capital goods.

Future trends in the income of the population of the United States will be determined, in part, by the total value of the nation's production of goods and services, or gross national product (GNP). Historically, the United States has exhibited continued real increases in GNP; however, the rate of growth in GNP and in GNP per capita has declined since 1968, as shown in Table 46 and Figure 22. The continuation of this trend has important implications for personal income, and for the resulting future demand for goods and services and, in turn, the future level of economic activity in the nation and Region. Growth in work force productivity has been the key factor in past increases in the gross national product and in income levels. Growth in productivity for the industries of the nation is summarized for the years 1950 to 1977 in Table 47. Declines in productivity have been related to decreasing capital investment in production, increasingly expensive labor and/or capital equipment reduced demand for production, and reduced research and development. Since 1973, largely as a result of limited capital investment, growth in the capital-to-labor ratio has dropped from an annual rate of 3 percent to less than 1.75 percent. Growth in productivity may also have been reduced by the increase in relatively new, inexperienced, and younger workers in the work force. Governmental regulations have also been identified as a factor in the decline in productivity growth of selected industries.

Table 46

GROSS NATIONAL PRODUCT TRENDS IN THE UNITED STATES: 1955-1976

Time Period	Average Annual Percentage Rates of Change: Per Capita Gross National Product	Average Annual Percentage Rates of Change: Gross National Product
1955-1968	2.1	3.7
1968-1972	1.4	2.7
1972-1976	0.7	2.1
1968-1976	1.1	2.4

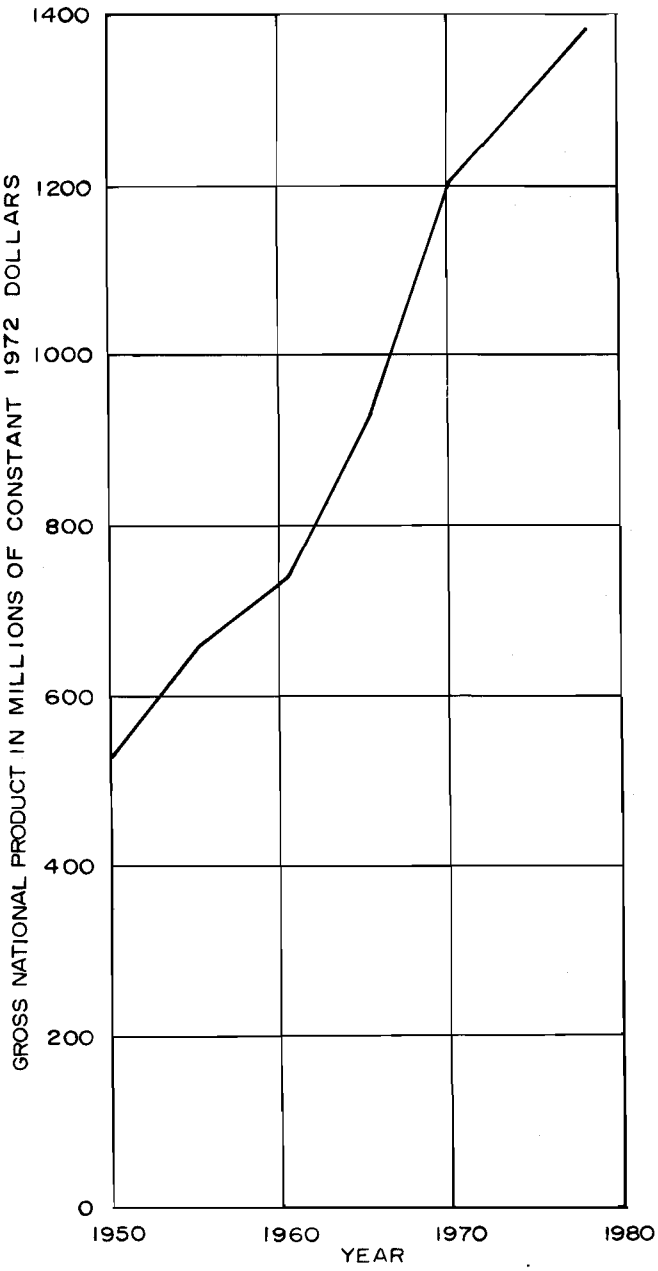
Source: U. S. Bureau of the Census and SEWRPC.

Summary and Prospects

In considering future levels of economic activity in southeastern Wisconsin, the potential influence of a number of factors must be addressed. Consideration must be given to the future size of the regional population. Such consideration is easier at a national level since future fertility and mortality rates are the major factors in population change. At a regional level, consideration must also be given to the degree of labor force participation of the population and the level of migration into and out of the Region which, in turn, will be strongly influenced by the strength of the regional economy. Other characteristics of the future population, which have been termed lifestyle characteristics in this report, will also affect the future level of economic activity in the Region. These, which will all affect the amount of income available to the population and, thus, the level and

Figure 22

GROSS NATIONAL PRODUCT TRENDS IN THE UNITED STATES: 1950-1978



Source: Economic Report of the President, 1979; and SEWRPC.

pattern of demand for goods and services, include the future age structure of the population, the size of future households, and the female labor force participation rate.

Consideration must also be given to other, more general factors which may affect future economic activity levels, including the future level of productivity of the work force and the future levels of

Table 47

PRODUCTIVITY GROWTH IN THE UNITED STATES: 1950-1977

Industry	1977 Output Share (percent)[a]	Percent Change per Year		
		1950-1965	1965-1973	1973-1977
Agriculture	2.9	4.9	3.6	3.0
Mining	1.5	4.3	1.9	-6.1
Construction	4.3	3.4	-2.1	0.3
Manufacturing				
Nondurable	9.9	3.2	3.3	2.2
Durable	14.4	2.5	2.2	1.2
Transportation	3.9	3.0	2.9	1.0
Communication	3.2	5.3	4.6	6.7
Utilities	2.3	6.1	3.5	0.2
Trade				
Wholesale	7.3	2.6	3.4	-0.8
Retail	10.0	2.3	2.1	0.8
Finance, Insurance, and Real Estate	15.4	1.6	0.2	2.3
Services	12.0	1.2	1.7	-0.3
Government	12.5	0.4	0.5	0.1
All Industries				
Current Weights	100.0	2.7	2.0	1.1
Fixed Weight (1977 output weight)	--	2.6	1.9	1.1

NOTE: Growth data relate to output per hour worked for all persons.

[a] *Detail may not add to 100 percent because of rounding.*

Source: U. S. Department of Commerce and SEWRPC.

capital investment in production facilities, as well as governmental regulation, and research and development, both of which may influence productivity. The level of income of the population which will result from future productivity gains may be expected to influence the future level of economic activity through changes in demand for goods and services. The degree to which this income will be used in the future for savings or the purchase of goods can be expected to affect future interest rates, inflation levels, and, consequently, levels of economic activity. The degree to which inflation will be abated is also important to any consideration of the future trends in economic activity.

Furthermore, consideration must be given to the future price and availability of energy. Changes in the price and availability of energy resources could contribute to changes in the rate of growth in different sectors of the economy, promoting decline in sectors heavily dependent on energy and encouraging growth in sectors that are developing ways to move toward energy efficiency or alternative fuels. Necessary increases in the prices of goods and services that are heavily energy dependent could encourage higher rates of inflation. Increased proportions of personal income being spent for energy could result in declines in the demand for goods and services and dampen future economic activity outlooks. The implications of the continued importation of foreign oil must also

be considered, both for the future level of demand for goods and services within the nation and for the national balance of trade and the strength of the dollar in the world.

Finally, consideration must be given to the extent to which the Southeastern Wisconsin Region will be able to effectively compete in the future with other areas of the country in the maintenance and expansion of its present, and in the attraction of new, business and industry.

Although it would be difficult to precisely assess the combined effects of all these factors upon the future of the economy in southeastern Wisconsin, it is possible to define a probable range in future economic activity which can be used in the development of alternative futures for the Region.

To bring about a strong and expanding economy in southeastern Wisconsin and the nation, conditions leading to increasing consumer demand for goods and services and favorable conditions for business and industry capacity utilization and expansion are necessary. Factors which would lead to an increasing demand for goods and services include an increase in population size, an age structure of population with large proportions of work force age, increased levels of discretionary income, lower rates of inflation, moderate increases in future income spent for energy, and increased levels of income spurred by increases in work force productivity. In addition, the ability of the Region to compete with other regions of the nation for business and industry expansion and development, particularly with regard to the manufacturing industry, must be maintained and enhanced.

A weaker economy in southeastern Wisconsin and the nation would be brought about by a tighter money supply, which would increase the cost of, and further decrease, capital investment. Such a tight supply could be brought about by continued high or even increased rates of interest and inflation, and would cause a slowdown in business expansion and in the demand for capital goods and services. A period of stability or decline in total population levels could add to this slowdown in demand for goods and services. Declines in the use of capital investment for production could further restrict future demand for goods and services in that increases in productivity, and consequently personal income, would not be encouraged. One result of a weaker economy would be a decline in employment. However, some areas of the United States may continue to grow in employment as employment in the nation as a whole stabilizes or declines. Nevertheless, under a weaker economy, any manufacturing employment growth could be expected to occur outside the Region and the east-north central area of the United States. Energy price and availability could also be a significant factor in this weaker future in that increased use of personal income for energy could restrict demand for production of goods and services.

ALTERNATIVE FUTURE SCENARIOS

Alternative future scenarios for the overall socio-economic development of southeastern Wisconsin have been developed under this study of primary transit system alternatives for the Milwaukee area because, as already noted, the future direction of such development is uncertain, particularly with respect to the impact of such largely external factors as cost and energy availability, population lifestyles, and economic conditions. These external factors can be expected to directly or indirectly affect future public transit system needs in the Milwaukee area by affecting the future demand for travel and the means of conducting such travel in the Milwaukee area. Energy cost and availability, together with developments in automobile fuel efficiency, will determine to a considerable extent the future cost and convenience, and thus attractiveness, of urban travel by automobile, the principal alternative to public transit in the Milwaukee area. Future directions in population lifestyles and economic conditions will influence future travel requirements, and consequently transit needs, since these variables will determine to a considerable extent future population levels and compositions as well as income levels in the Milwaukee area. It is important, therefore, that the effects of possible future variation in these external factors affecting the development of the Region be considered in order that the best course of action for primary transit system development in the Milwaukee area can be determined.

Under the alternative futures planning approach used in the study, the development, testing, and evaluation of alternative primary transit system plans is based not upon a single most probable forecast of future conditions, but rather upon a range of conditions which may be expected to occur over the plan design period—conditions represented by a set of "alternative futures." In this way, "robust" transit system elements are

proposed to be identified, elements composed of facilities and services indicated to be viable under a range of future conditions.

Each of the alternative futures developed in this technical report is intended to constitute a reasonable combination of the end points of the future range of factors largely external to the Region but influencing the development of the Region. The alternative futures considered together are intended to cover the reasonable range of conditions which can be anticipated to occur in the Southeastern Wisconsin Region and the Milwaukee area over the next 20 years. Two alternative scenarios for the external factors are defined in the following sections of this chapter. The scenarios may be expected to lead to quite different population and economic activity levels and land use development patterns, and, therefore, to quite different transit needs within the Region. The development of the alternative futures involves first the development of alternative future scenarios of the external factors influencing development in the Region, followed by a determination of the amount of growth and decline in regional population and employment that would be attendant to each of the two scenarios and the development of alternative centralized and decentralized land use plans for each scenario.

Key External Factors

The key external factors influencing the future energy requirements of the Region include: 1) the future cost and availability of energy, particularly of petroleum and petroleum-based fuels; and 2) the degree to which energy conservation measures are implemented, particularly with respect to automobile travel. Future transit needs in the Milwaukee area may be expected to be directly affected by the future cost of petroleum-based motor fuel and the fuel consumption efficiency of the automobile. These two factors will together determine to a considerable extent the future "out-of-pocket" costs of automobile travel in the Region. The cost of automobile travel is an important factor in the choice between using either automobile or public transit for urban travel, and therefore is important to the future level of transit use. The future cost of energy may also be expected to indirectly impact transit needs in the Milwaukee area by influencing the future level and distribution of employment and population in the Region, as well as the future number and lengths of trips generated by that population and employment.

The key external factors influencing the future population lifestyles of the Region include: 1) the degree to which the changing role of women in society will affect the composition of the labor force; 2) future changes in fertility rates; and 3) future changes in household size. These three key external factors may be expected to affect transit needs in the Milwaukee area principally through their influence on future levels of population, employment, and households, which together are important determinants of the level of travel demand. Future fertility rates will be a significant factor determining the future level of population. Future household size will be an important determinant of the future number of households. Future household size and labor force participation together will be an important determinant of the future level of income available to the area population and, thereby, of the level of demand for goods and services.

The key external factors influencing the future economic conditions of the Region include: 1) 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; and 2) the future change in real income as influenced by the economic conditions of the Region and productivity. Through their effect on Milwaukee area employment, these external factors will affect resident population levels and, in time, total demand for travel in the area. Future levels of income will have an additional affect on transit use in the area in that they may be expected to impact future levels of automobile ownership and tripmaking, as well as the choice of mode of travel.

Two alternative future scenarios were developed which indicate quite different future directions for transit development and use in the Milwaukee area, one optimistic and the other pessimistic. The two scenarios were developed by combining the endpoints in the range of future prospects of each of the key external factors. The combining of the endpoints of the key external factors was done with the intent of developing the most reasonably extreme optimistic and pessimistic futures for transit use in the Milwaukee area. As a result, the combination of external factor endpoints chosen for each scenario is logically consistent, but is not necessarily the most likely combination. As shown in Table 48, the two scenarios vary widely in terms of the future availability and cost of motor fuel and, therefore, the cost of automobile travel, with

Table 48

ALTERNATIVE FUTURE SCENARIOS

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

Source: SEWRPC.

one scenario pointing toward a decrease in the cost of automobile travel and the other toward a significant increase. The scenarios also differ in that one scenario points toward moderate population and economic growth in the Region and the other points toward a stable economy and declining population in the Region.

The Moderate Growth Future Scenario

The moderate growth scenario for the year 2000 assumes that energy use will continue to increase at a rate of about 3 percent per year to the year 2000, only slightly lower than the 3.5 percent rate of increase experienced from 1960 to 1975. Increased energy conservation in the future is

assumed to be minimal. It is assumed under this future that average automobile fuel consumption efficiency in the year 2000 will be 27.5 miles per gallon, the limit set forth in federal standards to be met by new car fleets in the nation by 1985.

This scenario envisions that, as a result of this continued increase in national energy use, overall average energy prices will rise at an average annual rate of 5 percent. It is assumed that oil prices in the United States will increase even faster, from their present levels of $21 per barrel, to converge with world oil prices over the next few years, and thereafter will increase with world oil prices to $72 per barrel in 1979 dollars in the year 2000. The price of petroleum-based motor fuel is thus projected to reach $2.30 per gallon by the year 2000, a 170 percent increase from 1979 levels. The motor fuel portion of the cost of automobile travel is, therefore, projected to rise in real terms by about 1.5 cents, or 20 percent, by the year 2000.

To meet the increases in national energy use assumed under this future, it is projected that use of electricity and coal in direct combustion will more than double, and that the use of liquid fuels will increase by one-third to one-half over current levels. Synthetic liquid fuels are envisoned to supply much of this increase in use. However, because of the assumed lack of any substantial increase in domestic petroleum production, the present level of reliance on foreign petroleum is anticipated to continue over the next two decades. Consequently, the potential for disruption in the supply of petroleum is anticipated to be greater under this scenario than under the stable or declining growth scenario. Thus, under one of the land use plans developed under this future, the impacts of rationing or allocation programs are tested. These programs would limit the amount of fuel available to automobile travel in the Region to about 75 percent of the amount that would otherwise be used under this scenario.

The moderate growth scenario assumes a strong and expanding regional and national economy. Lower rates of interest and inflation are envisioned, promoting capital investment and a reversal of recent trends in worker productivity. Increases in worker real income are projected, and these increases are assumed to further improve conditions for full utilization of industrial capacity. These increases in real income are anticipated to result from the greater proportions of the population being of working age and the greater rates of women participating in the labor force. And importantly, it is assumed that the Region will have the ability to compete with other areas in the nation for the maintenance and expansion of its economic base.

A moderate return to more traditional family patterns is assumed under this future. Under this future, the "baby boom" population will assume family formation and adopt more traditional family lifestyle patterns following a period of postponement of marriage and childbearing. However, some increase in the participation of women in the labor force is seen, increasing from its level in 1970 of about 43 percent to a level of about 51 percent in the year 2000.

The continued increase in the female labor force participation rate is projected to keep the level of childbearing somewhat below that which would be attained under a full return to a more traditional family lifestyle. The period of postponement of family formation by the "baby boom" cohort is envisioned as contributing to this reduction in childbearing. Thus, a continuation of below-replacement-level fertility is assumed under this future during the next decade, followed by an increase to about replacement-level fertility. The somewhat reduced fertility rates and the return to more traditional family patterns is envisioned to cause the average household size in the Region to stabilize at a level of about 2.9 persons per household in the year 2000. The larger average household size, the more traditional family pattern, and the smaller increases in the female labor force participation rate, when combined with the large proportion of the population in the family formation years, is anticipated to result in a continuation of long-term regional trends in single-family housing demand.

The Stable or Declining Growth Scenario

The stable or declining growth scenario for the year 2000 assumes that the Region and the nation will use energy significantly more efficiently in the future, as it is based on a 2 percent or less annual rate of increase in energy use in the nation over the next two decades, and little or no increase in petroleum use to the year 2000. This reduction in the rate of increase in total energy demand and the stability in petroleum use are assumed to be achieved through the wide, special application of energy conservation in all sectors: residential, commercial, industrial, and transportation. The use of energy by the automobile is seen as significantly decreasing, as average motor fuel consumption efficiency in the nation is projected to reach

32 miles per gallon by the year 2000 under this scenario, a more than 100 percent increase over the 1977 level of efficiency.

Under this future, an overall annual average increase of under 2 percent in the real price of energy is assumed, with the price of petroleum increasing by over 2 percent per year. Specifically, it is assumed that world oil prices will increase in constant dollars by 2 percent per year to the year 2000, and that the price of oil in the United States will increase even faster in the next few years to converge with world price levels and continue to increase with world levels thereafter. The price of oil in the United States is thus assumed to increase from $21 per barrel in 1979 to $39 per barrel in the year 2000, expressed in constant 1979 dollars. The price of gasoline is anticipated to increase to $1.50 per gallon in 1979 dollars, an approximately 50 percent increase over the 1979 level. The combined effect of the postulated increase in automobile efficiency and gasoline prices is a decrease in the cost of automobile travel of about $0.02 per mile, or 30 percent.

To meet national energy needs under this alternative future, it is assumed that the domestic use of coal in direct combustion and the use of electricity will slightly more than double by the year 2000, while the use of natural gas and petroleum will remain at about today's level. Some production of unconventional energy resources—specifically, synthetic liquid and gaseous fuels—is anticipated under this future. As a result, domestic production of liquid fuels is anticipated to increase somewhat over current levels, and reliance on foreign imports of oil is envisioned to be reduced. Consequently, it is assumed that major or continuing disruptions in the supply of petroleum in the United States will be minimal under this future. This assumed future of energy cost and availability is consistent with the assumption of increased federal involvement in the conservation of domestic energy and development of alternative liquid and gaseous fuel sources in the future, as well as with the assumption that the price elasticity of energy demand will, over the long run, be significant.

This scenario also envisions a lack of growth in regional employment. Under this future, it is assumed that the Region will not remain competitive with other areas of the nation for business and industry. National economic growth is also assumed to be limited under this future. Because of the small increase in population envisioned as a result of the continuing trend toward nontraditional lifestyles, only a small increase is expected in the demand for goods and services. However, somewhat higher levels of income will be available to the population under this scenario because of the greater proportions of the population in the working age groups, and greater female labor force participation rate. High rates of interest and inflation are assumed, along with limited productivity and real income gains for workers and limited national and regional employment.

As mentioned, a continuation of recent trends in nontraditional lifestyles is assumed under this future. Importantly, the role of women is anticipated to continue to change, with female labor force participation reaching 70 percent in the year 2000, nearly that anticipated for males in the future. Consequently, the total labor force participation rate in the Region will be about 72 percent in the year 2000. This continued shift toward increased participation in the labor force by women is anticipated to be accompanied by the continuation of below-replacement-level fertility rates during the next two decades. The continuation of lower fertility rates, and of recent trends toward smaller, nontraditional households of only one person, married couples with no children, and single-parent households, is assumed to result in continuing declines in average household size in the Region to a level of 2.2 persons per household in the year 2000. As a consequence, demand for high-density housing in the Region is anticipated to increase under this future.

SUMMARY

The scale and character of the future socio-economic development of the Southeastern Wisconsin Region are uncertain because of uncertainties regarding the impact on such development of factors largely external to the Region. This chapter has presented information on the possible future change in such factors which, while operating largely external to the Region, may affect transit system development and use within the Region either directly—by, for example, affecting the cost and convenience of travel—or indirectly—by, for example, influencing regional population growth or decline or the spatial distribution of land use. These factors are termed "external" because they are variables over which public and private decision-makers within the Region may be expected to have relatively little or no influence, and yet they are factors to which the Region must respond in the future. Four such external variables have been identified and considered in the development of a set

of alternative future scenarios under the Milwaukee area primary transit system planning program: energy cost and availability, energy-related technology, population lifestyles, and economic conditions. Two alternative future scenarios linking these four external variables were developed such that the future prospects of the variables are logically related, and thus the scenarios are intended to provide a reasonable range of future conditions within the Region affecting transit system development and use.

Energy Cost and Availability

The future cost and availability of energy is an important external factor, because it may be expected to influence the future cost of travel by automobile, the principal alternative to public transit in the Milwaukee area. Energy consumption in the nation increased from 43 quadrillion British Thermal Units (BTU's) to 72 quadrillion BTU's between 1960 and 1975, an increase of about 3.5 percent per year. Energy consumption then increased to 75 quadrillion BTU's in 1976 and to 78 quadrillion BTU's in 1978. Historically, the largest user of energy resources in the nation has been the industrial sector, which consumes about 40 percent of total energy consumed annually. The transportation sector is the second largest user of energy in the nation, accounting for about 25 percent of total energy consumption in the nation and about 60 percent of all petroleum consumption. The residential and commercial sectors have historically accounted for about 20 percent and 15 percent, respectively, of national energy consumption.

Until the 1950's, the United States produced most of the petroleum that the nation used. However, since then, the nation has become increasingly dependent on imported petroleum resources. Between 1950 and 1960 the United States annually imported about 15 percent of its petroleum needs. Between 1960 and 1970, imports rose to about 20 percent of total national consumption. It is estimated that in 1978, almost 50 percent of the oil consumed in the nation was imported. The price of petroleum resources has risen dramatically since the early 1970's. The price of crude oil imported to the United States has risen from less than $5 per barrel in 1970 to $26 per barrel in 1979.

The prospects for continued reliance by the United States on conventional oil as its primary energy source, either from imported or domestic production, are not promising. It has been projected by a number of studies that the price of petroleum will rise at a rate ranging from a low of 2 percent per year to a high of 5 percent per year through the year 2000, expressed in constant dollars. Assuming that the price of crude oil in the United States will, over the next few years, increase faster than 2 or 5 percent in order to rapidly converge with the world oil price, and will increase thereafter at a rate of from 2 to 5 percent, a price of $39 to $72 per barrel in 1979 dollars can be projected for oil in the year 2000. Assuming no real changes in gasoline taxes or in refining and transportation costs, the price of gasoline can be expected to increase to between $1.30 and $1.50 per gallon in 1979 dollars by the year 2000 under an annual 2 percent crude oil price increase, and to between $1.90 and $2.30 per gallon under an annual 5 percent crude oil price increase. It should be noted that these projected gasoline prices represent real price increases and do not reflect the affects of general price inflation. An annual 10 percent rate of inflation over the next 20 years would result in gasoline prices in the year 2000 of $9.60 to $17 per gallon.

Technology and Conservation of Energy

The greatest potential for a departure from past trends in energy use in the nation lies with the more efficient use of energy in the future. It is unlikely that the domestic production of petroleum can be increased significantly over current levels, either by conventional or unconventional means, without significant price increases. In addition, a variety of environmental, public health, and safety concerns may be expected to limit any radically significant increase in the use of other energy sources, such as coal and nuclear power, over the next two decades. Questions of the technological and economic feasibility of solar energy and nearly all synthetic fuels are projected to restrict any significant future use of such new energy sources, even under substantially increased conventional energy costs.

In the face of significantly higher energy costs, conservation is the most likely response over the next two decades. The continuing and generally increasing involvement of the federal government in the reduction of energy use, particularly with regard to measures aimed at reducing dependence on foreign oil, also points toward the more efficient use of energy in the future. More efficient energy uses are attainable through automobile fuel, residential space heating, and certain industrial

process efficiencies. These three energy uses represent about one-third of total national energy use and have the potential, through increased efficiency in use, to remain at about the same level of consumption, even though total application may increase substantially over the next two decades. Most studies of future energy consumption in the nation project a likely annual rate of increase of about 2 percent to the year 2000, well under the 3.5 percent annual increase experienced from 1960 to 1975. A 1 percent annual increase in energy use in the nation is generally projected as a lower limit, and a 3 percent annual increase in energy use is generally projected as an upper limit. Thus, nearly all projections anticipate a decline in the future rate of increase in energy use in the nation.

The use of coal in direct combustion is expected to at least double in the nation over the next 20 years, as will the use of electrical power generated through greater use of coal and nuclear resources. Petroleum use is projected to remain at about today's levels. The amount of petroleum-based fuels used by automobiles in the United States is anticipated to decline over the next two decades as a result of increases in automobile fuel consumption efficiencies to 27.5 miles per gallon or greater, even allowing for increases in the driving age population, increases in the number of automobiles, and an unchanging number of vehicle miles driven.

National energy use projections that anticipate upper levels of energy consumption expect even greater increases in the use of electricity and coal, significant uses of synthetic liquid fuels, and a continuation of the present level of petroleum imports. Consequently, higher prices of energy are projected along with these higher levels of energy use. The energy use projections that anticipate lower levels of national consumption envision less reliance on synthetic fuels and foreign oil, and lower real increases in overall energy prices.

Population Lifestyles

In recent years, significant changes have occurred in many of the socioeconomic characteristics of the residents of the Region, which, when taken together, can be termed lifestyles. Changes in family pattern lifestyles include lower fertility rates, higher female labor force participation rates, and reductions in average household size. Residential lifestyle changes include changes in housing unit-type occupancy and in the rate of inter- and intraregional population migration. Lifestyle patterns influence both land use development and travel patterns and, therefore, transportation needs.

The long-established traditional family-centered lifestyle orientation in the Region and the nation has been changing toward a more individualistic orientation. The traditional family may be characterized by its size and division of function. The common traditional family consisted of a husband, wife, and children—usually two or three. The husband was the sole economic provider of the family, and the wife cared for both home and children. As a result, when the traditional family-centered orientation was strong, labor force participation among women was low. Women quit the labor force upon marriage or at their first pregnancy, and would, if at all, re-enter the labor force only on a part-time or part-year basis after their youngest child entered school. Most women did not pursue higher education, but married within a few years after high school and bore their first child within one to two years after marriage. The so-called "baby boom" children born after World War II were largely a product of the traditional family.

In recent years, there has been a shift away from the traditional family orientation. This shift can be attributed in part to the changing role of women in society; in part to the more individualistic orientation of society as a whole; and in part to changing economic conditions which require families to have two wage earners to maintain a desired standard of living in the face of high rates of price inflation. These changes have led to increases in the female labor force participation rate, declines in fertility rates, and reductions in average household size. Substantially higher percentages of women are postponing marriage, completing college, and pursuing careers, many in traditional male fields of study.

Fertility rates and female labor force participation are inversely related. Substantial numbers of women delay childbearing while working, or continue to work throughout their childbearing years. Lower fertility rates, the postponement of marriage, higher rates of divorce, differentials in male and female mortality rates, and the increased tendency of younger and older adults to live independently of family have resulted in a substantial reduction in average household size. Although most households are still families of husband and wife, the less traditional types of households have increased rapidly in proportion, including one-parent, one-person, and nonfamily households.

The shifts in family pattern lifestyles may be expected to have a significant impact on the future residential lifestyles of the Region's population. Residential development patterns in the past have favored single-family housing and the development of suburban and rural-urban fringe areas of the Region, a trend which has resulted in declines in the population and population density of the central cities of the Region. However, nontraditional households have historically not sought suburban and rural-urban fringe residence location to the same extent as have traditional families, and nontraditional households are more likely to occupy multiple-family, high-density, residential housing than are traditional households.

A continuation of recent trends in lifestyle would result in a continued increase in the female labor force participation rate, perhaps approaching that of males; the maintenance of below-replacement-level fertility rates; and decreases in household size, as the number of one- and two-person households would account for increasingly larger proportions of the household population. The continuation of recent lifestyle trends can also be expected to lead to significant increases in the demand for multiple-family housing, perhaps accompanied by a trend toward increased centralization of development in the Region.

A significant moderation of recent trends toward nontraditional family lifestyle patterns is possible in the future, because a substantial portion of the "baby boom" population which has not, in recent years, assumed family formation might decide to do so, but at a later age than has been traditional. This would slow recent trends in female labor force participation and fertility rates, and household size would likely stabilize. While the rate of female labor force participation could be expected to continue to increase under this future, it would not approach that of males. Birthrates would continue at low replacement levels for the next 10 years, but would increase to replacement levels following that decade.

Economic Conditions

The future level of economic activity in the nation and, specifically, the Region will greatly influence future transportation system development needs because the level of employment in the Region is an important determinant of population size and, in turn, of the amount of travel made for work purposes. Such travel comprises the major component of all transit and highway travel during peak travel periods of the weekday. The amount and character of economic activity will also determine future personal income levels within the Region, which will, in turn, affect future travel demand and transit use, since income is highly correlated with automobile ownership, level of tripmaking, and choice of mode of travel.

In considering the future levels of economic activity in the Region, the influence of a number of factors must be addressed, including: the size of the regional population; the degree of labor force participation of the population; the age structure of the population; the future level of work force productivity; and changes in the price and availability of energy resources. Also, the implications of the continued importation of foreign oil on the future level of demand for goods and services and the national balance of trade and strength of the dollar must be considered. Finally, a particularly important consideration is the extent to which the Southeastern Wisconsin Region will be able to effectively compete with other areas of the nation in the maintenance and expansion of its present, and in the attraction of new, business and industry.

To bring about a strong and expanding economy in southeastern Wisconsin and the nation, conditions leading to increasing consumer demand for goods and services and to favorable conditions for business and industry capacity utilization and expansion are necessary. Factors which would lead to an increasing demand for goods and services include an increase in population size, population with large proportions of work force age, increased levels of discretionary income, lower rates of inflation, and increased levels of income spurred by increases in work force productivity. In addition, the ability of the Region to compete with other regions of the nation for business and industry expansion and development, particularly with regard to the manufacturing industry, must be maintained and enhanced.

A weaker economy in southeastern Wisconsin and the nation would be brought about by a tighter money supply, which would increase the cost of, and further decrease, capital investment. Such a tight supply could be brought about by continued high or even increased rates of interest and inflation, and would cause a slowdown in business expansion and in the demand for capital goods and services. A period of stability or decline in total population levels could add to this slowdown in demand for goods and services. Declines in the use of capital investment for production could further

restrict future demand for goods and services in that increases in productivity, and consequently personal income, would not be encouraged. One result of a weaker economy would be a decline in employment. However, some areas of the United States may continue to grow in employment as employment in the nation as a whole stabilizes or declines. Under a weaker economy, any manufacturing employment growth could be expected to occur outside the Region and the east-north central area of the United States.

Alternative Future Scenarios

Two alternative future scenarios indicating quite different directions in the development of the Region were developed by logically linking opposite endpoints of the range of prospects for each of the key external factors. The two scenarios vary widely in terms of future energy and petroleum price and cost of travel, with one scenario pointing toward a decrease in the cost of automobile travel and the other toward a significant increase. The scenarios also differ with respect to future regional population and economic growth, with one scenario pointing toward moderate population and economic growth in the Region and the other pointing toward a stable economy and declining population in the Region.

The Moderate Growth Future Scenario: The moderate growth scenario assumes a severe energy situation. The use of energy in the nation is assumed to continue to increase at a rate of 3 percent per year to the year 2000. Energy conservation is assumed to be minimal, and automobile fuel efficiency is assumed to reach 27.5 miles per gallon. Because of the increases in energy use, the average price of oil is assumed to rapidly increase to world prices and then to rise at a rate of about 5 percent per year. Gasoline prices are projected to increase to $2.30 per gallon in constant 1979 dollars, a 130 percent increase from 1979 levels. To meet the increases in national energy needs, the use of electricity and coal in direct combustion will more than double, and the use of liquid fuels, including some synthetic fuels, will increase by about one-third to one-half.

Economic conditions under this future are assumed to support a strong and expanding economy, with lower rates of interest and inflation and increases in income available to individuals, businesses, and industries. A moderate return to more traditional family patterns is assumed; however, continued increases in the participation of women in the work force is envisioned. A continuation of below-replacement-level fertility is assumed through 1990, followed by an increase to about replacement-level fertility. Household size in the Region is expected to stabilize under this future, and long-term regional trends in demand for single-family housing are anticipated to continue.

The Stable or Declining Growth Scenario: The stable or declining scenario for the year 2000 assumes that the Region and the nation will use energy significantly more efficiently in the future. It assumes a 2 percent or less annual increase in energy use in the nation, and little or no increase in petroleum use, over the next 20 years. This reduction in the rate of increase in energy demand is assumed to be achieved through the implementation of energy conservation in all sectors of the economy. Automobile fuel efficiences are projected to reach 32 miles per gallon in the year 2000. The price of United States oil is anticipated to rapidly converge with world oil prices and to rise at a rate of 2 percent or less thereafter. The cost of automobile travel will, as a result, decrease somewhat under this future, and major or continuing disruptions in the supply of petroleum in the United States will be minimal. The use of coal and the use of electricity generated through coal and nuclear power are assumed to slightly more than double by the year 2000. Finally, continued reliance on oil imports, but at a reduced level, is anticipated under this future.

Economic growth in the nation, and particularly in the Region, is anticipated to be limited and accompanied by high rates of interest and inflation. A continuation of the trend toward nontraditional family lifestyles is anticipated to result in only a small increase in the demand for goods and services, along with increased proportions of the population in the work force. However, somewhat higher levels of income will be available under this scenario because of the greater proportions of the population in the working age groups and greater female participation in the labor force. The female labor force participation rate is expected to approach that of men, and will be accompanied by below-replacement-level fertility rates through the year 2000, with a resulting significant decline in average household size and increased future demands for high-density housing.

Chapter III

ANTICIPATED REGIONAL CHANGE

INTRODUCTION

All systems planning activities must recognize the inevitability of change as a basic characteristic of the modern world. No nation, state, or region which participates in modern life can escape the effects of urban change, and no part of daily life can avoid being influenced in some way by forces rooted in this complex process. Since change is inevitable, the question facing public officials and citizen leaders of a region, such as southeastern Wisconsin, is not whether change will occur, but how much will occur, when will it occur, and, most importantly, how might it be shaped and guided in the public interest.

Within the six-step planning process used in the conduct of the Milwaukee area primary transit system alternatives analysis (see Figure 1 in Chapter I), the fourth step—the alternative futures analysis—is intended to address the issue of change in the Southeastern Wisconsin Region over the next 20 years. The first phase of this analysis—the development of alternative scenarios of future change in factors which are largely external to the Region, but which may directly or indirectly affect regional growth or decline and, therefore, the primary transit needs of the Region—has been presented in the preceding chapter. The scenarios were developed to provide a reasonable future range in factors which, while operating externally to the Region, will influence primary transit needs within the Region either directly, such as through energy price and availability, or indirectly, by affecting the degree of future regional change.

It is the purpose of this chapter to document the second phase of the alternative futures analysis—namely, the estimation of the amount of growth or decline in the population and economic activity of the Region which may be expected under the alternative future scenarios developed under the first phase of the analysis. The alternative future levels of population and economic activity presented in this chapter are intended to represent the reasonable range of change that may be expected. One alternative future envisions moderate growth in regional population and economic activity consistent with the moderate growth external factor scenario, and the other envisions a slight decline in regional population and stagnation in regional economic activity consistent with the stable or declining external factor scenario.

It should be noted that the alternative future population and economic activity levels presented herein are not intended to constitute precise levels to which the alternative land use plans prepared under the succeeding step of the alternative future process must adhere. Rather, these levels are intended to be used as guides in the preparation of alternative land use plans. While the "fit" between the anticipated levels and proposed distribution of population and employment presented in this chapter and the levels and distributions ultimately accommodated by the alternative land use plans may not be exact, any differences will be minor and should not affect the ability to identify realistic primary transit alternatives under the two scenarios.

Since both the preceding chapter of this Technical Report and SEWRPC Technical Report No. 23, Transit-Related Socioeconomic, Land Use, and Transportation Conditions and Trends in the Milwaukee Area, a companion document to this report discuss historical and current trends in regional population and economic activity levels and in land use changes, this chapter addresses the regional change anticipated under the two identified scenarios. Historic or current trends will be discussed only to the extent that they may be directly germane to the discussion of anticipated regional change.

ALTERNATIVE POPULATION FUTURES

The character of alternative land use plans, and of complementary primary transit system plans, will be significantly influenced by the future size, spatial distribution, age composition, and household characteristics of the Region's resident population anticipated under each of the two alternative future scenarios. The aggregate demand for the various land uses and for supporting facilities and services is partially a function of the size of the resident population. The spatial distribution of that aggregate demand within—and, in the case of certain facilities and services, between—various

subareas of the planning area is partially a function of the spatial distribution of the resident population throughout the planning area. The age composition and the household characteristics of the resident population similarly affect the demand for the various land uses and supporting facilities and services. Different age groups within the population place different demands upon society for jobs and housing—which affect land use changes—and for transportation facilities and services. Different household and living arrangements similarly produce differential demands for land uses and supporting facilities and services.

Moderate Population Growth Scenario

In general, the types of population change that would lead to moderate population growth can be characterized as a continuation—albeit at more moderate rates—of the types of changes in population attributes that occurred in the Region during the 1960's and the early 1970's. These population changes include a continuation into the 1980's, of the below-replacement-level fertility rates of the early 1970's, and a slight increase to replacement-level fertility by the year 2000, coupled with a virtual balance between in- and out-migration between 1970 and 2000. These factors combined would produce a population growth rate of about 7 to 9 percent per decade between 1970 and 2000, in contrast to a population growth rate of about 12 percent from 1960 to 1970 and of about 27 percent from 1950 to 1960. Any trend toward decentralization of the Region's population, when coupled with lower rates of population growth, would increasingly place the older urban centers of the Region at a competitive disadvantage in retaining, much less attracting, resident population. Even under a moderate growth scenario, Milwaukee County may, at best, be expected to reach a resident population level approximating its 1970 level only after a period of absolute loss, and then only if the trend toward continued urban diffusion into the outlying areas of the Region is successfully curtailed in the public interest through the exercise of land use controls and other public policy actions. In the absence of such actions, Milwaukee County may be expected to lose a significant number of residents—largely to Ozaukee, Washington, and Waukesha Counties—between 1970 and 2000. Fertility rates lower than those of the 1950's and 1960's, coupled with the aging of the "baby boom" cohort of the 1950's and first half of the 1960's, may be expected to create significant shifts in the age composition of the resident population. In addition, the lower fertility rate coupled with a continuation of the trend toward increasing numbers of one- and two-person households may be expected to result in a continued decrease in average household size in the Region, and in a rate of increase in households greater than the rate of population increase between 1970 and 2000.

Population Size: Utilizing the foregoing assumptions, a cohort-component population projection model was used to calculate the future population levels anticipated in the Region. Under the moderate growth scenario, the Region's resident population may be expected to increase from a 1970 level of 1,756,100 persons to 2,219,300 in the year 2000—an increase of about 463,200 persons, or approximately 26 percent, over the 30-year period. The anticipated population increase under this scenario will be almost exclusively a function of natural increase. The lack of any significant contribution to regional population change by net migration represents a continuation of the Region's net migration history of the 1960's, and is consistent with the assumption under the moderate population growth scenario that the Region will remain reasonably attractive and competitive with other regions of the nation and will therefore not be subject to significant population out-migration.

Population Distribution: The spatial distribution of population within a planning area such as southeastern Wisconsin can be influenced—but not completely controlled—by the planning process. The land use plans prepared as part of the alternative futures process can recommend that shifts in the spatial distribution of the base year population be made in the public interest, such recommendations taking the form of both stated land use development objectives and a recommended land use plan. In this regard, both a centralized and a decentralized land use plan have been developed for each of the two alternative future scenarios. Since the overall trend of population distribution in the Region for at least the last four decades has been toward increasing decentralization, some phenomenon or phenomena disrupting these long-standing trends will be required to effect a more centralized distribution of the Region's resident population under a moderate population growth scenario. A decentralized distribution of the Region's resident population would only require a continuation of the existing trends in population redistribution. This redistribution would be expected to be guided, however, by sound land use development objectives.

Based upon an anticipated regional population level of 2,219,300 persons in the year 2000 under a moderate population growth scenario, and upon a continuation of the types of differential changes in population levels experienced by the Region's seven counties between 1970 and 1975 (see Table 49), the alternative distribution of the Region's year 2000 resident population shown in Table 50 can be hypothesized. Under this alternative distribution, Milwaukee County would lose about 155,800 residents, or about 15 percent of its population, between 1970 and 2000. The remaining six counties would all experience population increases. Absolute increases would range from a low of about 43,100 residents in Walworth County to a high of about 231,900 residents in Waukesha County. Relative increases would range from a low of 32 percent in Racine County to a high of about 173 percent in both Ozaukee and Washington Counties.

Table 49

ESTIMATED POPULATION CHANGE IN THE REGION BY COUNTY: 1970-1975

County	Population		Estimated Change	
	1970	1975	Number	Percent
Kenosha	117,900	125,900	8,000	6.78
Milwaukee . . .	1,054,300	1,014,400	- 39,900	- 3.78
Ozaukee	54,500	64,900	10,400	19.08
Racine	170,800	178,600	7,800	4.57
Walworth. . . .	63,500	67,200	3,700	5.83
Washington . .	63,800	76,200	12,400	19.44
Waukesha . . .	231,300	261,100	29,800	12.88
Region	1,756,100	1,788,300	32,200	1.83

Source: Wisconsin Department of Administration and SEWRPC.

Based upon an anticipated regional population level of 2,219,300 persons in the year 2000, and upon the assumptions that the historic trends in population decentralization can be partially ameliorated through the voluntary, areawide implementation of land use controls and selected other public policy actions and that the population loss that has occurred in Milwaukee County since 1970 can be at least partially recovered during the 1980's and 1990's, an alternative distribution of the Region's year 2000 resident population, as shown in Table 51, can be hypothesized. Under this alternative distribution, Milwaukee County would experience a net loss of only about 4,700 residents between 1970 and 2000. The remaining six counties would all experience population increases. Absolute increases would range from a low of about 36,100 residents in Walworth County to a high of about 189,300 residents in Waukesha County. Relative increases would range from a low of about 27 percent in Racine County to a high of about 124 percent in Washington County.

Age Composition of the Population: Expected changes in the age composition of the population of the Region under the moderate population growth scenario are presented in Table 52. As shown in Figure 23, these changes can be summarized as follows:

1. The age group from 0 through 4 years of age, representing the preschool population, may be expected to increase only slightly—

Table 50

ANTICIPATED POPULATION DISTRIBUTION CHANGES IN THE REGION UNDER A MODERATE POPULATION GROWTH SCENARIO WITH A DECENTRALIZED POPULATION: 1970-2000

County	1970		2000		Anticipated Change: 1970-2000	
	Population	Percent of Region	Population	Percent of Region	Number	Percent
Kenosha	117,900	6.7	202,800	9.1	84,900	72.0
Milwaukee	1,054,300	60.1	898,500	40.5	- 155,800	- 14.8
Ozaukee	54,500	3.1	149,000	6.7	94,500	173.4
Racine	170,800	9.7	224,700	10.1	53,900	31.6
Walworth.	63,500	3.6	106,600	4.8	43,100	67.9
Washington . . .	63,800	3.6	174,500	7.9	110,700	173.5
Waukesha	231,300	13.2	463,200	20.9	231,900	100.3
Region	1,756,100	100.0	2,219,300	100.0	463,200	26.4

Source: SEWRPC.

Table 51

ANTICIPATED POPULATION DISTRIBUTION CHANGES IN THE REGION UNDER A MODERATE POPULATION GROWTH SCENARIO WITH A CENTRALIZED POPULATION: 1970-2000

County	1970		2000		Anticipated Change: 1970-2000	
	Population	Percent of Region	Population	Percent of Region	Number	Percent
Kenosha	117,900	6.7	174,800	7.9	56,900	48.2
Milwaukee	1,054,300	60.1	1,049,600	47.3	- 4,700	- 0.4
Ozaukee	54,500	3.1	114,000	5.1	59,500	109.3
Racine	170,800	9.7	217,700	9.8	46,900	27.4
Walworth	63,500	3.6	99,600	4.5	36,100	57.0
Washington	63,800	3.6	143,000	6.4	79,200	124.0
Waukesha	231,300	13.2	420,600	19.0	189,300	81.8
Region	1,756,100	100.0	2,219,300	100.0	463,200	26.4

Source: SEWRPC.

Table 52

ANTICIPATED CHANGES IN THE AGE COMPOSITION OF THE POPULATION IN THE REGION UNDER A MODERATE POPULATION GROWTH SCENARIO: 1970-2000

Age Group	Population					
	1970		2000		Net Change: 1970-2000	
	Number	Percent of Total	Number	Percent of Total	Number	Percent
Under 5	153,243	8.7	160,934	7.2	7,691	5.0
5-9	183,283	10.4	170,180	7.7	- 13,103	- 7.1
10-14	186,865	10.6	167,140	7.5	- 19,725	- 10.5
15-19	163,033	9.3	151,685	6.8	- 11,348	- 7.0
20-24	132,672	7.5	140,979	6.4	8,307	6.3
25-29	114,042	6.5	129,997	5.9	15,955	14.0
30-34	98,001	5.6	154,704	7.0	56,703	57.8
35-39	95,857	5.5	188,760	8.5	92,903	96.9
40-44	104,631	6.0	191,741	8.6	87,110	83.2
45-49	103,140	5.9	167,888	7.6	64,748	62.8
50-54	93,714	5.3	134,187	6.0	40,473	43.2
55-59	85,424	4.9	105,876	4.8	20,452	23.9
60-64	72,567	4.1	82,322	3.7	9,755	13.4
65-69	57,494	3.3	72,328	3.3	14,834	25.8
70-74	46,711	2.7	67,719	3.0	21,008	45.0
75 and Older	65,210	3.7	132,915	6.0	67,705	103.8
Total	1,755,887	100.0	2,219,355	100.0	463,468	26.4

Source: SEWRPC.

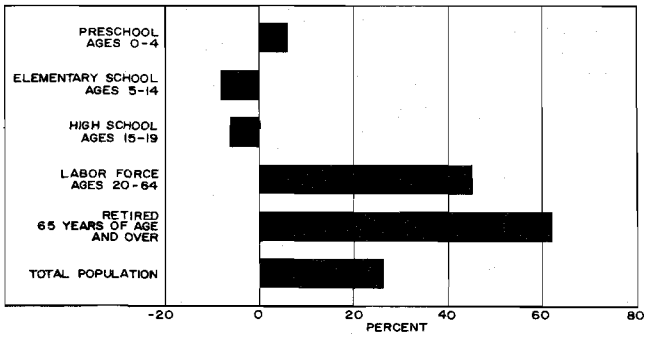
from about 153,200 persons in 1970 to nearly 161,000 persons in the year 2000, an increase of only 7,700 persons, or 5 percent, between 1970 and 2000.

2. The age group from 5 through 14 years of age, representing the elementary school-age population, may be expected to decrease from about 370,000 persons in 1970 to about 337,300 persons in the year 2000—a decrease of about 32,600 persons, or 9 percent, between 1970 and 2000.

3. The age group from 15 through 19 years of age, representing the high school-age population, may be expected to decrease from

Figure 23

PERCENT CHANGE IN POPULATION OF THE REGION BY SELECTED AGE GROUP UNDER A MODERATE POPULATION GROWTH SCENARIO: 1970-2000



Source: SEWRPC.

about 163,000 persons in 1970 to about 151,700 persons in the year 2000—a decrease of about 11,300 persons, or 7 percent, between 1970 and 2000.

4. The age group from 20 through 64 years of age, representing the working-age population of the Region, may be expected to increase from about 900,000 persons in 1970 to about 1,296,400 persons in the year 2000—an increase of about 396,400 persons, or 44 percent, between 1970 and 2000.

5. The age group 65 years of age and older, representing the elderly population of the Region, may be expected to increase from about 169,400 persons in 1970 to about 272,900 persons in the year 2000—an increase of about 103,500 persons, or 61 percent, between 1970 and 2000.

These changes in the age composition of the population anticipated under a moderate population growth scenario have important implications for land use and transportation planning. Initially, these changes indicate a reduced need for new school facilities in the Region as a whole—although not necessarily in all individual communities—at all levels of education. The reduced need reflects the expected decline in fertility rates from 1970 to 1985 and the maintenance of replacement fertility rates thereafter. Additionally, the labor force may be expected to increase substantially and to contain a larger percentage of persons between the ages of 30 and 54. Accordingly, the number of persons able to work within the Region may be expected to increase substantially. Finally, these changes indicate that the segment of the population 65 years of age and older, both between 1970 and 2000 and later as the large working population grows older, will show the largest relative increase of all age groups, indicating a general aging of the population which will bear upon the demand for housing and special transportation services over at least the next 20 years.

Household Characteristics of the Population: Accompanying the increases in the Region's resident population under the moderate population growth scenario will be increases in the number of households in the Region. Increases in the number of households have particularly important implications for long-range land use and transportation planning since it is the household which creates much of the demand for the various land uses and transportation services and facilities. The moderate population growth scenario assumes that "traditional" patterns of household composition will exist between 1970 and 2000 and that households consisting of a husband, a wife, and children will constitute the dominant type. This is particularly important in view of the fact that the large, postwar, "baby boom" population is currently between 20 and 35 years of age and is at the stage of the life cycle when decisions concerning family composition must be made. Even modest increases in birthrates could create, in effect, an "echo baby boom." Under this scenario, further decreases in the average household size of the Region would be small and would be reflective of decreased fertility rates and of some additional increases in one- and two-person households.

If it is assumed that traditional patterns of household formation will exist between 1970 and 2000 and that 2.9 persons per household represents a reasonable lower limit of average household size in the Region in 2000, then a reasonable range of 3.15—slightly smaller than the 1970 average household size in the Region of 3.20—to 2.90 can be identified as the average household size in the Region in 2000. Assuming that the same proportion of the total population—about 98 percent—will reside in households in 2000 as did in 1970, an average household size of 3.15 in the year 2000 would result in an increase in the number of households in the Region of from about 536,500 in 1970 to about 690,500—an increase of about 154,000, or approximately 29 percent,

over the 30-year period. An average household size of 2.9 in the year 2000 would result in an increase in the number of households in the Region to about 747,700—an increase of about 211,100, or approximately 39 percent, over the 30-year period. The difference in the number of households required under this range of alternative sizes is about 57,200. Since historically there has been a correlation between average household size and population density in the Region, it may be assumed that the higher end of the range of average household sizes is more typical of a decentralized population, while the lower end of the range is more typical of a centralized population.

Stable or Declining Population Growth Scenario While the moderate population growth scenario can perhaps be best described as a continuation, albeit at slightly more moderate rates, of regional population change typical of the 1960's, the stable or declining population growth scenario can be best characterized as an acceleration of the regional population change experienced in the 1970's when, for the first time in over 120 years of recorded history, the Region actually experienced a population loss, occurring during the period 1975 to 1978. This scenario can be briefly described as follows. A continuation of the below-replacement-level fertility rates of the early 1970's through the year 2000 coupled with net out-migration levels sufficiently large to offset all regional population growth attributable to natural increase would combine to produce no population increase or a slight decrease in population between 1980 and the year 2000. Under this scenario, Kenosha, Milwaukee, and Racine Counties—all of which experienced population losses between 1975 and 1978—would experience difficulty in maintaining their present population levels through the year 2000. Ozaukee, Washington, and Waukesha Counties could be expected to increase in population, perhaps even to the levels anticipated under a moderate growth scenario. Thirty years of below-replacement-level fertility rates in concert with the aging of the "baby boom" cohort of the 1950's and first half of the 1960's and the high levels of regional out-migration in the age groups below 45 years of age would create significant shifts in the age composition of the resident population, even though its size would remain virtually unchanged between 1980 and 2000. Lower fertility rates coupled with a continuation of household formation characteristics typical of the 1970's would result in a continued decrease in average household size to less than 2.5 persons per household in the Region in 2000, and in an increase in the total number of households, notwithstanding the fact that the total population would not be anticipated to increase at all between 1980 and 2000.

Population Size: Utilizing the foregoing assumptions, a cohort-component population projection model was used to calculate anticipated future population levels for the Region. Under the stable or declining population growth scenario, the Region's resident population could be expected to decline from a 1970 level of 1,756,100 persons to 1,688,400 persons in 2000—a decrease of about 67,700 persons, or about 4 percent. Under this scenario, any population growth that might have accrued to the Region through natural increase would be more than offset by net out-migration. The high level of net out-migration anticipated under this scenario—about 428,000 persons between 1970 and 2000—represents an acceleration of the net out-migration of between 100,000 and 120,000 persons experienced by the Region during the 1970's, and is consistent with the assumption under this scenario that the Region will not be able to compete with other regions of the nation and will therefore be vulnerable to population out-migration.

Population Distribution: As under the moderate population growth scenario, it is assumed under the stable or declining population growth scenario that a centralized distribution of the Region's resident population would require the implementation of certain public policy decisions to moderate the existing trends in population redistribution. A decentralized distribution assumes that the historic trends of population redistribution will not be abated and that the redistribution of the resident population will be guided in accordance with sound land use development objectives.

Based upon the regional population level of 1,688,400 persons in the year 2000 anticipated under a stable or declining population growth scenario, and upon a continuation of the types of differential changes in population levels experienced by the Region's seven counties between 1970 and 1978, and particularly between 1975 and 1978 (see Table 53), the alternative distribution of the Region's year 2000 resident population shown in Table 54 can be hypothesized. Under this alternative distribution, Milwaukee County would lose about 354,300 residents, a decrease of about 34 percent, between 1970 and 2000. Kenosha and

Table 53

ESTIMATED POPULATION CHANGE IN THE REGION BY COUNTY: 1970-1978 AND 1975-1978

County	Population			Estimated Change 1970-1978		Estimated Change 1975-1978	
	1970	1975	1978	Number	Percent	Number	Percent
Kenosha	117,900	125,900	126,200	8,300	7.04	300	0.24
Milwaukee . . .	1,054,300	1,014,400	954,100	- 100,200	- 9.50	- 60,300	- 5.94
Ozaukee	54,500	64,900	70,400	15,900	29.17	5,500	8.47
Racine	170,800	178,600	177,500	6,700	3.92	- 1,100	- 0.62
Walworth. . . .	63,500	67,200	69,200	5,700	8.98	2,000	2.98
Washington . .	63,800	76,200	84,100	20,300	31.82	7,900	10.37
Waukesha . . .	231,300	261,100	289,000	57,700	24.95	27,900	10.69
Region	1,756,100	1,788,300	1,770,500	14,400	0.82	- 17,800	- 1.00

Source: Wisconsin Department of Administration and SEWRPC.

Table 54

ANTICIPATED POPULATION DISTRIBUTION CHANGES IN THE REGION BY COUNTY UNDER A STABLE OR DECLINING POPULATION GROWTH SCENARIO WITH A DECENTRALIZED POPULATION: 1970-2000

County	1970		2000		Anticipated Change 1970-2000	
	Population	Percent of Region	Population	Percent of Region	Number	Percent
Kenosha	117,900	6.7	125,000	7.4	7,100	6.0
Milwaukee	1,054,300	60.1	700,000	41.4	- 354,300	- 33.6
Ozaukee	54,500	3.1	100,000	5.9	45,500	83.5
Racine	170,800	9.7	180,000	10.7	9,200	5.4
Walworth.	63,500	3.6	80,000	4.7	16,500	26.0
Washington . . .	63,800	3.6	115,000	6.8	51,200	80.3
Waukesha	231,300	13.2	390,000	23.1	158,700	68.6
Region	1,756,100	100.0	1,690,000	100.0	- 66,100	- 3.8

Source: SEWRPC.

Racine Counties—both of which lost population between 1975 and 1977—would experience minimal increases in their resident population between 1970 and 2000—about 7,100 residents, or about 6 percent, in Kenosha County, and about 9,200 residents, or about 5 percent, in Racine County. The remaining four counties would continue to experience population increases between 1970 and 2000. Absolute population increases in these counties would range from a low of about 16,500 residents in Walworth County to a high of about 158,700 residents in Waukesha County. Relative increases would range from a low of about 26 percent in Walworth County to a high of about 84 percent in Ozaukee County.

Based again upon the regional population level of 1,688,400 persons in the year 2000 anticipated under a stable or declining population growth scenario and upon the assumption that the 1970 to 1978 trends in population redistribution can be moderated through the voluntary, areawide implementation of land use controls and selected other public policy actions, the alternative distribution of the Region's year 2000 resident population shown in Table 55 can be hypothesized. Under this alternative distribution, Milwaukee County would lose about 224,300 residents, a decrease of about 21 percent, between 1970 and 2000. The remaining six counties would all experience population increases. Absolute increases

Table 55

ANTICIPATED POPULATION DISTRIBUTION CHANGES IN THE REGION BY COUNTY UNDER A STABLE OR DECLINING POPULATION GROWTH SCENARIO WITH A CENTRALIZED POPULATION: 1970-2000

County	1970		2000		Anticipated Change 1970-2000	
	Population	Percent of Region	Population	Percent of Region	Number	Percent
Kenosha	117,900	6.7	130,000	7.7	12,100	10.3
Milwaukee	1,054,300	60.1	830,000	49.1	- 224,300	- 21.3
Ozaukee	54,500	3.1	75,000	4.5	20,500	37.6
Racine	170,800	9.7	180,000	10.7	9,200	5.4
Walworth	63,500	3.6	70,000	4.1	6,500	10.2
Washington	63,800	3.6	95,000	5.6	31,200	48.9
Waukesha	231,300	13.2	310,000	18.3	78,700	34.0
Region	1,756,100	100.0	1,690,000	100.0	- 66,100	- 3.8

Source: SEWRPC.

Table 56

ANTICIPATED CHANGES IN THE AGE COMPOSITION OF THE POPULATION IN THE REGION UNDER A STABLE OR DECLINING GROWTH SCENARIO: 1970-2000

Age Group	Population					
	1970		2000		Net Change: 1970-2000	
	Number	Percent of Total	Number	Percent of Total	Number	Percent
Under 5	153,300	8.7	107,300	6.4	- 46,000	- 30.0
5-9	183,300	10.4	114,600	6.8	- 68,700	- 37.5
10-14	186,900	10.6	120,600	7.1	- 66,300	- 35.5
15-19	163,000	9.3	110,300	6.5	- 52,700	- 32.3
20-24	132,700	7.5	111,100	6.6	- 21,600	- 16.3
25-29	114,000	6.5	106,300	6.3	- 7,700	- 6.8
30-34	98,000	5.6	126,400	7.5	28,400	29.0
35-39	95,900	5.5	158,900	9.4	63,000	65.7
40-44	104,600	6.0	158,300	9.4	53,700	51.3
45-49	103,100	5.9	127,000	7.5	23,900	23,2
50-54	93,700	5.3	94,500	5.6	800	0.8
55-59	85,400	4.9	78,300	4.6	- 7,100	- 8.3
60-64	72,600	4.1	63,000	3.7	- 9,600	- 13.2
65-69	57,500	3.3	54,800	3.3	- 2,700	- 4.7
70-74	46,700	2.7	53,400	3.2	6,700	14.4
75 and Older	65,200	3.7	103,600	6.1	38,400	58.9
Total	1,755,900	100.0	1,688,400	100.0	- 67,500	- 3.8

Source: SEWRPC.

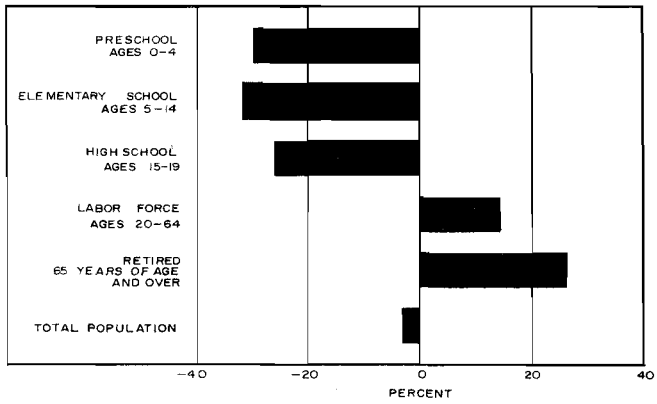
would range from a low of about 9,200 residents in Racine County to a high of about 78,700 residents in Waukesha County. Relative increases would range from a low of about 5 percent in Racine County to a high of about 49 percent in Washington County.

Age Composition of the Population: The age composition of the population of the Region that may be expected under the stable or declining population growth scenario is presented in Table 56. As shown in Figure 24, the following changes may be expected in the age distribution between 1970 and 2000:

1. The age group from 0 through 4 years of age, representing the preschool population, may be expected to decrease from about 153,300 persons in 1970 to about 107,300 persons in the year 2000—a decrease of about 46,000 persons, or about 30 percent, between 1970 and 2000.

Figure 24

PERCENT CHANGE IN POPULATION OF THE REGION BY SELECTED AGE GROUP UNDER A STABLE OR DECLINING POPULATION GROWTH SCENARIO: 1970-2000



Source: SEWRPC.

2. The age group from 5 through 14 years of age, representing the elementary school-age population, may be expected to decrease from about 370,200 persons in 1970 to about 235,200 persons in the year 2000—a decrease of about 135,000 persons, or about 36 percent, between 1970 and 2000.

3. The age group from 15 through 19 years of age, representing the high school-age population, may be expected to decrease from about 163,000 persons in 1970 to about 110,300 persons in the year 2000—a decrease of about 52,700 persons, or about 32 percent, between 1970 and 2000.

4. The age group from 20 through 64 years of age, representing the working-age population of the Region, may be expected to increase from about 900,000 persons in 1970 to about 1,023,800 persons in the year 2000—an increase of about 123,800 persons, or about 14 percent, between 1970 and 2000.

5. The age group 65 years of age and older, representing the elderly population of the Region, may be expected to increase from about 169,400 persons in 1970 to about 211,800 persons in the year 2000—an increase of about 42,400 persons, or 25 percent, between 1970 and 2000.

These expected changes in the age composition of the population indicate a substantially reduced need for new or even presently existing school facilities in the Region as a whole—although not necessarily in all individual communities—at every level of education. The expected decline in the school-age population reflects the assumptions of continued below-replacement-level fertility rates and continued or accelerated net out-migration from the Region to the year 2000 under the stable or declining population growth scenario. While the working-age population in the Region may also be expected to lose population through net out-migration under the stable or declining population growth scenario, numerical gains in the age group 20 through 64 resulting from the maturing of the "baby-boom" cohort may be expected to more than offset the net migration loss. Therefore, the number of persons able to work within the Region may be expected to moderately increase. The elderly population may be expected to experience the largest relative increase of all age groups, reflecting the general aging of the population, which, as was true under the moderate population growth scenario, will increase the demand for special housing and transportation services for the elderly.

Household Characteristics of the Population: According to a recent study by the U. S. Bureau of the Census,[1] the total number of households in the nation increased by about 20 percent between 1970 and 1978. In contrast, the total population increased by only about 8 percent over the same period. Rapidly rising divorce and separation rates and increasing numbers of persons choosing to live alone account for a significant portion of this increase. These changes in household composition and the previously noted decline in fertility rates in the 1970's were responsible for a decrease in the average household size of the nation from 3.14 in 1970 to 2.94 in 1975. In comparison, the average household size in the Region is estimated to have decreased from 3.20 in 1970 to 3.04 in 1975. The study notes that nationally, the average household size could be as low as 2.2 by 1995. The attainment of a national average household size of 2.2 by 1995 assumes a continua-

[1] *U. S. Bureau of the Census, Projections of the Number of Households and Families: 1979 to 1995, Current Population Reports, Population Estimates and Projections, Series P-25, No. 805, May 1979.*

tion of the marital status and household composition trends evident between 1964 and 1978, and continued below-replacement-level fertility rates to the year 2000. These assumptions are consistent with the assumptions underlying the stable or declining population growth scenario.

If it is assumed that current trends in household formation—including relatively larger increases in single-parent family households and nonfamily households—will continue over the next 20 years and that 2.2 persons per household represents a reasonable lower limit of household size in the Region in 2000, then a reasonable range of 2.45 to 2.20 can be identified as the average household size for the Region in 2000. Assuming that the same proportion of the total population—about 98 percent—will reside in households in 2000 as did in 1970, an average household size of 2.45 in the year 2000 would result in an increase in the number of households in the Region of from about 536,500 in 1970 to about 673,600 in 2000—an increase of about 137,100, or about 26 percent, over the 30-year period. An average household size of 2.20 in the year 2000 would result in an increase in the number of households in the Region to about 747,200 in 2000—an increase of 210,700, or about 39 percent, between 1970 and 2000. The difference in the number of households required under this range of alternative sizes is about 73,600. It is assumed that the higher end of the range of average household sizes is more typical of a decentralized population, while the lower end of the range is more typical of a centralized population.

Comparison of the Alternative Population Futures
The alternative population futures under the moderate population growth scenario and the stable or declining population growth scenario differ in their assumptions about future changes in fertility rates, in the direction and magnitude of net migration, and in household size. The moderate population growth scenario assumes a continuation of below-replacement-level fertility rates through 1990, followed by an increase to about-replacement-level fertility rates by the year 2000. Under the stable or declining population growth scenario, fertility rates are expected to remain at below replacement level to the year 2000 and, therefore, growth through natural increase is expected to be lower under the stable or declining population growth scenario. The population change expected to result from the process of migration also varies between the scenarios. The moderate population growth scenario assumes a slight net out-migration during the 1970's, followed by some net in-migration between 1980 and the year 2000. In contrast, the stable or declining population growth scenario is based on the assumption that net out-migration from the Region will accelerate in the future. Average household size in the Region is expected to stabilize under the moderate population growth scenario, but to continue to decline under the stable or declining population growth scenario. The consequences of these different assumptions for future regional population size and distribution, age composition, and household characteristics are described below.

Population Size: Under the moderate population growth scenario, the population of the Region is expected to increase by about 463,200 persons, or about 26 percent, between 1970 and 2000—from about 1,756,100 persons in 1970 to about 2,219,300 persons in the year 2000. Because of lower fertility rates and the expected population loss of about 428,000 persons through net out-migration between 1970 and 2000, population under the stable or declining population growth scenario is expected to decline to 1,688,400 persons in the year 2000—a loss of about 67,700 persons, or about 4 percent, from the 1970 level. The difference in total regional population in the year 2000 under the two alternative future scenarios is about 530,900 persons.

Population Distribution: The four alternative distributions—a centralized and a decentralized distribution under each scenario—proposed herein to be used as guides in the preparation of alternative land use plans provide wide ranges of anticipated population levels for the Region's seven counties. The ranges for each county can be summarized as follows:

1. The alternative future population levels for Kenosha County range from a high of 202,800 under the decentralized moderate population growth alternative to a low of 125,000 under the decentralized stable or declining population growth alternative—a difference of 77,800 persons, or 62 percent.

2. The alternative future population levels for Milwaukee County range from a high of 1,049,600 under the centralized moderate population growth alternative to a low of 700,000 under the decentralized stable or declining population growth alternative—a difference of 349,600 persons, or 50 percent.

3. The alternative future population levels for Ozaukee County range from a high of 149,000 under the decentralized moderate population growth alternative to a low of 75,000 under the centralized stable or declining population growth alternative—a difference of 74,000 persons, or 99 percent.

4. The alternative future population levels for Racine County range from a high of 224,700 under the decentralized moderate population growth alternative to a low of 180,000 under both the centralized and decentralized stable or declining population growth alternatives—a difference of 44,700 persons, or 25 percent.

5. The alternative future population levels for Walworth County range from a high of 106,000 under the decentralized moderate population growth alternative to a low of 70,000 under the centralized stable or declining population growth alternative—a difference of 36,000 persons, or 51 percent.

6. The alternative future population levels for Washington County range from a high of 174,000 under the decentralized moderate population growth alternative to a low of 95,000 under the centralized stable or declining population growth alternative—a difference of 79,000 persons, or 83 percent.

7. The alternative future population levels for Waukesha County range from a high of 463,200 under the decentralized moderate population growth alternative to a low of 310,000 under the centralized stable or declining population growth alternative—a difference of 153,200 persons, or 49 percent.

Age Composition of the Population: The low fertility rates expected under both scenarios will result in a decrease in the number of persons under the age of 20 between 1970 and 2000, but this decrease is expected to be about 197,500 persons greater under the stable or declining population growth scenario because of its assumptions of lower fertility rates and substantial net out-migration. The maturing of the "baby boom" cohort is expected to result in an increase in the number of persons of working age under both scenarios between 1970 and 2000, although this increase is expected to be about 272,600 persons less under the stable or declining population growth scenario because of the loss of population through net out-migration. The elderly population will also increase under both scenarios between 1970 and 2000, although the increase is expected to be about 61,100 persons less under the stable or declining population growth scenario because of the net out-migration assumption of this scenario.

Household Characteristics of the Population: Under the moderate population growth scenario, average household size in the Region would decline somewhat from a 1970 value of 3.20 persons per household to a range of between 3.15 and 2.90 persons per household by the year 2000. When combined with an expected increase in population of about 463,200 persons, this range may be expected to result in an increase of between 154,000 and 211,200 households, or between 29 and 39 percent, from the 1970 level of 536,500. Thus, the number of households in the Region in the year 2000 would range between 690,500 and 747,700, a difference of about 57,200 households. Under the stable or declining population growth scenario, a continuation of the decline in average household size would result in a range of between 2.45 and 2.20 persons per household by the year 2000. When combined with the anticipated population loss of about 67,700 persons between 1970 and 2000, this range may be expected to result in an increase in the number of households of between 137,200 and 210,700 households, or between 26 and 39 percent. Thus, the number of households in the Region in the year 2000 would range between 673,600 and 747,200, a difference of about 73,600 households. Differences in household composition are implicit in these two scenarios, with a lower proportion of traditional families expected under the stable or declining growth alternative. The anticipated compositional differences in the households under the two scenarios, as well as the differences in the spatial distribution of the households under the four alternative land use plans to be prepared, may be expected to result in different collective travel patterns—including different choices of mode—despite the similarity in the range of absolute number of households anticipated under each scenario.

ALTERNATIVE ECONOMIC FUTURES

The character of alternative land use plans and of complementary primary transit system plans will be significantly influenced by the future size, structure, and spatial distribution of economic activity

in the Region, as well as by the future personal income levels of the resident population of the Region. The aggregate demand for the various land uses, and for supporting facilities and services, is partially a function of the number and types of jobs available within the Region and of their spatial location. Personal, particularly household, income levels also affect the demand for various land uses and supporting facilities and services.

Moderate Population Growth Scenario

The economic changes that may be expected to occur under a moderate population growth scenario generally represent a continuation of the types of change that have historically occurred in the Region's economy. Briefly, long-term economic growth at rates at or slightly below national averages may be expected under this scenario. The growth in the Region's economy may be expected to result from the simultaneous interaction of several assumptions explicit in the moderate population growth scenario. The increase in the resident population of the Region anticipated under this scenario may be expected to result in a continually growing demand for goods and services. A growing regional labor force will result from the increased proportion of the resident population in the work force age groups and increased female labor force participation. Finally, under this scenario the Region will be able to preserve and expand its economic base because of its attractiveness and competitiveness in comparison with other parts of the nation.

Labor Force Size and Employment: Under the moderate population growth scenario, the labor force of the Region will increase from a 1970 level of about 744,500 persons to about 1,069,500 persons in the year 2000—an increase of about 325,000 persons, or about 44 percent, over the 30-year period. The female labor force participation rate is assumed to increase under this scenario from about 43 percent in 1970 to 50 to 55 percent in 2000. The male labor force participation rate is assumed to decrease slightly from about 76 percent in 1970 to 70 to 75 percent in 2000. The total labor force participation rate in the year 2000 is assumed to range from 60 to 65 percent, compared with 59 percent in 1970. The long-term unemployment rate under this scenario is assumed to be about 5 percent.

Under the moderate population growth scenario, the number of jobs available in the Region is anticipated to increase from a 1970 level of about 741,600 to about 1,016,000 in 2000—an increase of about 274,400 jobs, or about 37 percent, over the 30-year period. As previously noted, this increase would partially be a function of increasing resident population and labor force levels combined with an increase in the labor force participation rate, particularly for females. The relatively high attractiveness and competitiveness of the Region under this scenario, coupled with an assumed reluctance of industry to substitute mechanical or electronic technology for human labor because of potential energy shortages and disruptions and high energy prices, could also be a factor in this anticipated employment growth.

Structure of the Economy: Changes anticipated in the structure of the Region's economy—as measured by changes anticipated in employment levels—under the moderate growth scenario are shown in Table 57 and Figure 25. Employment in the trade, government and education services, and private services groups could be expected to show relative increases greater than the anticipated regional employment increase of about 37 percent between 1970 and 2000. These anticipated changes are consistent both with historic trends in these groups and with the increased demands for services that will be generated by an increasing regional population level. The employment increase anticipated in the government and education services group is especially worthy of additional comment

Table 57

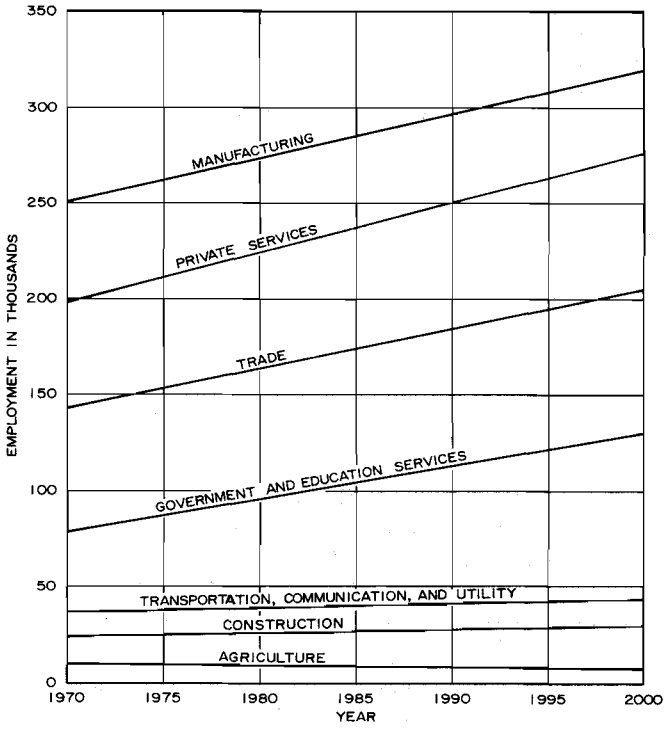
ANTICIPATED EMPLOYMENT LEVELS IN THE REGION UNDER A MODERATE POPULATION GROWTH SCENARIO: 1970-2000

Major Industry Group	Employment (in thousands)		Change 1970-2000	
	1970	2000	Number	Percent
Agriculture	10.6	7.5	- 3.1	- 29.2
Construction	24.0	30.1	6.1	25.4
Manufacturing	251.0	320.3	69.3	27.6
Trade	143.2	206.4	63.2	44.1
Transportation, Communication, and Utilities	36.0	43.7	7.7	21.4
Private Services	198.1	276.8	78.7	39.7
Government and Education Services	78.7	131.2	52.5	66.7
Total	741.6	1,016.0	274.4	37.0

Source: SEWRPC.

Figure 25

ANTICIPATED EMPLOYMENT CHANGES IN THE REGION BY MAJOR INDUSTRY GROUP UNDER A MODERATE POPULATION GROWTH SCENARIO: 1970-2000



Source: SEWRPC.

since the decrease in school-age children anticipated under the moderate growth scenario might imply an accompanying decrease in the sizes of elementary and secondary school staffs. The decrease in school-age children, however, may be partially offset by recent trends toward smaller class sizes, the development of specialized curricula and enrichment programs, additional programs for exceptional children, and increasing emphasis on adult and continuing professional education. In addition, the general population increase may be expected to result in continued growth of government employment. It should be noted that employment in this group in 1978 totaled about 94,600 jobs—about 2,000 more jobs in that year than expected under this scenario.

Manufacturing employment, while increasing at a rate approximately 10 percentage points below the anticipated regional employment growth rate, would continue to be the largest regional employment group, with about 320,300 jobs anticipated in the year 2000—an increase of about 69,300 jobs, or about 28 percent, over the 1970 level of about 251,000 jobs. The relatively high competitiveness and attractiveness of the Region under the moderate population growth scenario would enable the manufacturing group to continue to be a dominant component of the Region's economy, accounting for about 32 percent of all regional jobs in the year 2000. Private services would constitute the second largest employment group with 276,800 jobs, or about 27 percent of all regional jobs in the year 2000. One industry group, agriculture, could be expected to decline in employment by about 3,100 jobs, or about 29 percent—from about 10,600 jobs in 1970 to about 7,500 jobs in the year 2000. This decline would be a continuation of an established trend and would be due in part to the mechanization of farming processes, but more importantly to the loss of farmland in the Region through the continued conversion of land from agricultural to urban use.

Employment Distribution: As with the spatial distribution of population, the spatial distribution of employment within a planning area such as southeastern Wisconsin can be influenced, but not completely controlled, through the planning process. Since the historic trend in the spatial distribution of employment in the Region has been for a decentralization of employment, the two alternative land use plans for the moderate population growth scenario will recognize this trend while seeking to guide this decentralization with sound land use development objectives. Given the relationship between certain employment groups—such as retail trade and private services—and population distribution, the employment distribution for the centralized land use plan and the decentralized land use plan under this scenario will differ.

Based upon the regional employment level of 1,016,000 jobs anticipated in the year 2000 under the moderate population growth scenario, and upon a continuation of the types of differential changes in employment levels historically experienced by the seven-county Region, a distribution of the year 2000 regional employment—to be used as a point of comparison and departure in the preparation of the two alternative land use plans under this scenario—can be identified. As shown in Table 58, under this distribution Milwaukee and Waukesha Counties may be expected to experience the largest absolute increases in employment—82,700 and 90,200 jobs, respectively; while Kenosha and Washington Counties may be expected to have the smallest absolute increases—15,100 and 15,700

Table 58

ANTICIPATED EMPLOYMENT DISTRIBUTION CHANGES IN THE REGION BY COUNTY UNDER A MODERATE POPULATION GROWTH SCENARIO: 1970-2000

County	1970		2000		Change: 1970-2000	
	Jobs	Percent of Region	Jobs	Percent of Region	Number	Percent
Kenosha	39,200	5.3	54,300	5.3	15,100	38.5
Milwaukee	510,900	68.9	593,600	58.5	82,700	16.2
Ozaukee	17,900	2.5	38,000	3.7	20,100	112.3
Racine	61,900	8.2	95,500	9.4	33,600	54.3
Walworth	24,200	3.3	41,200	4.1	17,000	70.2
Washington	20,300	2.7	36,000	3.5	15,700	77.3
Waukesha	67,200	9.1	157,400	15.5	90,200	134.2
Region	741,600	100.0	1,016,000	100.0	274,400	37.0

Source: Wisconsin Department of Industry, Labor and Human Relations; and SEWRPC.

jobs, respectively. The largest relative rates of employment growth may be expected in Ozaukee and Waukesha Counties—112 percent and 134 percent, respectively; while the smallest relative rate of employment growth, 16 percent, may be expected in Milwaukee County. The proportion of total employment located in Milwaukee County may be expected to decline in relation to the regional total, reflecting the continued decentralization of economic activity from the highly urbanized areas of the Region under this scenario.

Personal Income: Under the moderate population growth scenario, personal income within the Region is expected to continue to increase, albeit at a more modest rate than it has over the recent past. As indicated in Table 59, total personal income in the Region may be expected to reach $22.1 billion by the year 2000 as measured in constant 1979 dollars—an increase of $10.6 billion, or about 93 percent, over the 1970 level of $11.5 billion. This increase is based on the assumption that per capita incomes will increase by less than 2 percent per year—from about $6,500 in 1970 to about $10,000 in the year 2000 measured in constant 1979 dollars. Household incomes in the Region are also anticipated to increase, but at lower rates. The increase in average household income in the Region is expected to range from about $8,200, or 38 percent, or by about 1 percent per year, to about $10,600, or 50 percent, measured in constant 1979 dollars, depending upon the number of households and the household size attendant to the alternative futures.

The increases in personal income anticipated under the moderate growth scenario have important implications for land use and transportation planning, indicating that a larger segment of the regional population will pursue their personal housing and transportation preferences unless constrained by restrictive public land use and transportation system use and development policies or by higher energy costs. It should be noted that under the moderate growth scenario, the annual rate of increase in energy costs is higher than the annual rate of increase in income.

Table 59

ANTICIPATED CONSTANT DOLLAR PERSONAL INCOME LEVELS IN THE REGION UNDER A MODERATE POPULATION GROWTH SCENARIO: 1970-2000

Year	Total Personal Income (in millions)	Per Capita Income	Average Household Income
1970	$11,470	$6,500	$21,400
2000	22,100	10,000	$29,600 to $32,000
Percent Change	92.7	53.8	38.3 to 49.5

Source: SEWRPC.

Stable or Declining Population Growth Scenario The economic changes that may be expected to occur under a stable or declining population growth scenario represent a departure from existing regional trends. This departure is based on an assumed stable or declining future population level in concert with an assumed inability of the Region

to preserve and expand its economic base and thus remain competitive with other regions of the nation. As a result, employment levels can be expected to only moderately increase over 1970 levels by the year 2000, with most of the increase occurring during the late 1970's and early 1980's. It is assumed that the rate of increase in regional employment will be significantly below national rates of increase, particularly after the mid-1980's. The employment growth that does occur is assumed to be accommodated by increases in the labor force participation rate as well as by a general aging of the population such that a larger proportion of the population is in the labor force age groups.

Labor Force Size and Employment: Under the stable or declining population growth scenario, the labor force of the Region may be anticipated to increase from a 1970 level of about 744,500 persons to about 985,400 persons in the year 2000—an increase of about 240,900 persons, or about 32 percent, over the 30-year period. The female labor force participation rate is assumed to increase under this scenario from about 43 percent in 1970 to 65 to 70 percent in 2000. The male labor force participation rate is assumed to decrease slightly from about 76 percent in 1970 to 70 to 75 percent in 2000. The total labor force participation rate is assumed to range from 70 to 75 percent in 2000, compared to a rate of about 59 percent in 1970. The long-term unemployment rate under this scenario is assumed to be about 10 percent.

Under a stable or declining population growth scenario, the number of jobs available in the Region may be anticipated to increase from a 1970 level of about 741,600 to about 851,800 in 1978, and thereafter increasing only to about 889,000 in 2000—an increase of about 145,400 jobs, or about 20 percent, over the 30-year period. The majority of these anticipated new jobs—about 110,200 jobs, or about 75 percent of the total increment—are expected to be added between 1970 and 1978. This increase in jobs is assumed to be accommodated almost exclusively by increasing labor force levels and increased female labor force participation rates. The assumed lack of attractiveness and competitiveness of the Region under this scenario may be expected to render the Region increasingly vulnerable to the loss of employment through plant closings and relocations, thereby portending minimal employment growth in the 1980's and 1990's.

Structure of the Economy: Anticipated changes in the structure of the Region's economy—as measured by anticipated changes in employment levels—under the stable or declining population growth scenario are shown in Table 60 and Figure 26. The Region's assumed loss of competitiveness under this scenario may be expected to lead to virtual stagnation in employment growth in manufacturing—historically the largest employment group in the Region—after 1978. By the year 2000, manufacturing employment may be expected to total about 266,300 jobs—only about 15,300 jobs, or about 6 percent, above the 1970 level of about 251,000 jobs. In contrast, trade and private service employment will show relatively sizable employment gains since these sectors rely upon a more local market, and since the assumed high labor force participation rates under this scenario may be expected to require many households to increasingly resort to the purchase of traditional types of household functions such as food preparation and household cleaning and maintenance.

By the year 2000, employment in private services may be expected to approximately equal manufacturing employment in importance to the regional economy. Both the manufacturing group and the private services employment group will account for about 30 percent of total regional employment in the year 2000 under this scenario. Lack of population growth or industrial expansion under this scenario may be expected to hold employment levels in the construction, government service and education, and transportation, communication, and utilities employment groups at about their 1978 levels through the year 2000. While the much smaller number of school-age children expected under this scenario could result in a decrease in employment in education, the increased emphasis on adult and continuing education noted in recent years could result in a stability in education employment rather than a decline.

Employment Distribution: Employment under this scenario of limited growth may be expected to remain to be concentrated—to the greatest extent possible—in the existing urban areas of the Region. Additional employment growth—predominantly in the service and trade employment groups—may be expected to occur in the counties surrounding Milwaukee County in conjunction with population growth in those counties. Under this scenario there will be, at best only limited potential for the development of new regional employment centers. Existing regional employment centers may be expected

Table 60

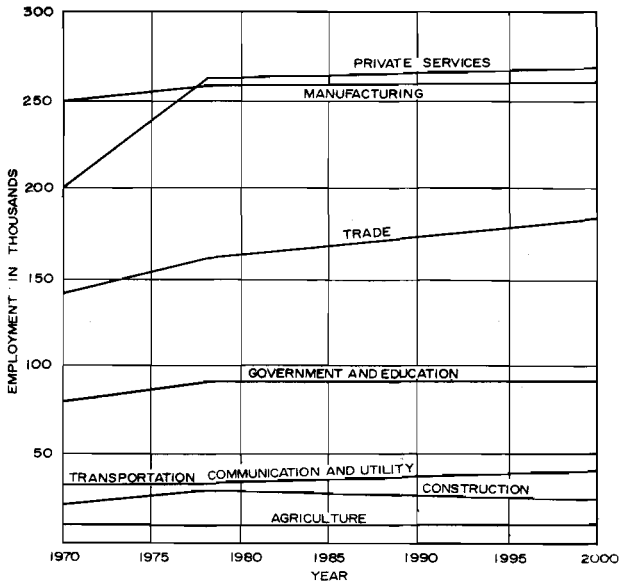
ANTICIPATED EMPLOYMENT LEVELS IN THE REGION UNDER A STABLE OR DECLINING POPULATION GROWTH SCENARIO: 1970, 1978, AND 2000

Major Industry Group	Employment (in thousands)			Change 1970-2000	
	1970	1978	2000	Number	Percent
Agriculture	10.6	9.5	7.5	- 3.1	- 29.2
Construction	24.0	28.6	26.1	2.1	8.8
Manufacturing	251.0	257.8	266.3	15.3	6.1
Trade	143.2	163.8	185.9	42.7	29.3
Transportation, Communication, and Utilities	36.0	37.3	38.9	2.9	8.1
Private Services	198.1	260.2	269.8	71.7	36.2
Government and Education Services	78.7	94.6	92.5	13.8	17.5
Total	741.6	851.8	887.0	145.4	19.6

Source: SEWRPC.

Figure 26

ANTICIPATED EMPLOYMENT LEVELS IN THE REGION BY MAJOR INDUSTRY GROUP UNDER A STABLE OR DECLINING POPULATION GROWTH SCENARIO: 1970-2000



Source: SEWRPC.

to approximately maintain their existing employment levels, with only some limited potential for employment increases.

Based upon the regional employment level of about 887,000 jobs anticipated in the year 2000 under a stable or declining population growth scenario, and upon the assumptions noted above, a distribution of the Region's year 2000 employment—to be used as a point of comparison and departure in the preparation of the two alternative land use plans under this scenario—can be identified. As shown in Table 61, under this distribution Milwaukee and Waukesha Counties may be expected to experience the largest absolute increases in employment—41,400 and 56,900 jobs, respectively—between 1970 and 2000, although Milwaukee County may be expected to lose some jobs between 1978 and 2000. Kenosha County, which may also be expected to lose some jobs between 1978 and 2000, and Walworth County may be expected to have the smallest absolute increases—4,000 and 7,000 jobs, respectively—between 1970 and 2000. The largest relative rates of employment growth over the 30-year period may be expected in Ozaukee and Waukesha Counties—64 percent and 85 percent, respectively—while the smallest relative rate of employment growth, 8 percent, may be expected in Milwaukee County. Under this scenario, the proportion of total regional employment in both Kenosha and Milwaukee Counties may be expected to decline between 1970 and 2000.

Personal Income: Despite a stable or decreasing population base and a year 2000 employment level that is only marginally higher than that recorded in

Table 61

ANTICIPATED EMPLOYMENT DISTRIBUTION CHANGES IN THE REGION BY COUNTY UNDER A STABLE OR DECLINING POPULATION GROWTH SCENARIO: 1970, 1978, AND 2000

County	1970		1978		2000		Change 1970-2000		Change 1978-2000	
	Jobs	Percent of Region	Jobs	Percent of Region	Jobs	Percent of Region	Number	Percent	Number	Percent
Kenosha	39,200	5.3	44,500	5.2	43,200	4.9	4,000	10.2	- 1,300	- 2.9
Milwaukee . . .	510,900	68.9	562,200	66.0	552,300	62.3	41,400	8.1	- 9,900	- 1.8
Ozaukee	17,900	2.5	23,800	2.8	29,300	3.3	11,400	63.7	5,500	23.1
Racine	61,900	8.2	74,800	8.8	78,400	8.8	16,500	26.7	3,600	4.8
Walworth. . . .	24,200	3.3	28,900	3.4	31,200	3.5	7,000	28.9	2,300	8.0
Washington . .	20,300	2.7	24,700	2.9	28,500	3.2	8,200	40.4	3,800	15.4
Waukesha . . .	67,200	9.1	92,900	10.9	124,100	14.0	56,900	84.7	31,200	33.6
Region	741,600	100.0	851,800	100.0	887,000	100.0	145,400	19.6	35,200	4.1

Source: Wisconsin Department of Industry, Labor and Human Relations; and SEWRPC.

1978 under this scenario, total personal income and per capita income, when expressed in constant 1979 dollars, may be expected to increase over the 1970 levels. However, the gains may be expected to be less than under the moderate population growth scenario. Under this scenario, household income is assumed to experience very little or no real dollar increase to the year 2000. This is consistent with the more restrictive economic assumptions of this scenario and with the stable or decreasing population base expected in the Region under this scenario. As shown in Table 62, the level of total personal income in the Region under this scenario will be limited to about $16 billion in the 2000 as measured in constant 1979 dollars—an increase of $4.5 billion, or about 40 percent, over the 1970 level. The increase in total personal income reflects the fact that per capita incomes are expected to increase by slightly more than 1 percent per year under this scenario—from $6,500 in 1970 to $9,500 in the year 2000, measured in constant 1979 dollars. Part of the increase in per capita income may be attributed to the fact that the number of jobs per capita in the Region is expected to increase significantly under this future—specifically, from 0.42 job per capita in 1970 to 0.53 job per capita in 2000. The increase in average household income in the Region is expected to range from zero to 11 percent, measured in constant dollars, over the planning period, depending upon the number of households and the household size attendant to the alternative patterns.

Comparison of the Alternative Economic Futures

The alternative economic futures under the moderate population growth scenario and the stable or declining population growth scenario differ in their assumptions about future changes in labor force participation, personal income, and the ability of the Region to preserve and expand its economic base. Both scenarios anticipate increased female and increased total labor force participation, although these increases are significantly greater under the stable or declining population growth scenario. Both scenarios anticipate increased personal income levels, with higher per capita income levels anticipated under the stable or declining population growth scenario and higher average household income levels anticipated under the moderate population growth scenario. The moderate population growth scenario assumes that the Region will have relatively high attractiveness and competitiveness; the stable or declining population growth scenario assumes that the Region will have relatively low attractiveness and competitiveness. The consequences of these different assump-

Table 62

ANTICIPATED CONSTANT DOLLAR INCOME LEVELS IN THE REGION UNDER A STABLE OR DECLINING POPULATION GROWTH SCENARIO: 1970-2000

Year	Total Personal Income (in millions)	Per Capita Income	Average Household Income
1970	$11,470	$6,500	$21,400
2000	16,000	9,500	$21,400 to $23,700
Percent Change	39.5	46.2	0.0 to 10.7

Source: SEWRPC.

tions for the future labor force and employment levels, economic structure, employment distribution, and personal income levels of the Region are discussed below.

Labor Force Size and Employment: Under the moderate population growth scenario, the labor force of the Region is expected to increase by about 325,000 persons, or about 44 percent, between 1970 and 2000. The female labor force participation rate is assumed to increase about 10 percentage points, the male labor force participation rate to decrease by about 2 or 3 percentage points, and the total labor force participation rate to increase by about 5 percentage points between 1970 and 2000. Under the stable or declining population growth scenario, the labor force is anticipated to increase by about 240,900 persons, or about 32 percent, between 1970 and 2000, to a year 2000 level of about 985,400 persons. The female labor force participation rate is assumed to increase about 25 percentage points, the male labor force participation rate to decrease by about 2 or 3 percentage points, and the total labor force participation rate to increase by about 15 percentage points between 1970 and 2000.

Under the moderate population growth scenario, the number of jobs available in the Region is anticipated to increase by about 274,400, or about 37 percent, between 1970 and 2000—from a 1970 level of 741,600 jobs to about 1,016,000 jobs in 2000. Principally due to the assumed lack of competitiveness of the Region under the stable or declining population growth scenario, the number of jobs under this scenario may be expected to increase only by about 145,400, or about 20 percent, to about 851,800 jobs in 2000. The difference in total regional employment in the year 2000 under the two alternative future scenarios is about 164,200 jobs.

Structure of the Economy: Different regional economic structures may be expected under the two alternative future scenarios. Under the moderate population growth scenario, manufacturing may be expected to provide about 320,300 jobs—about 32 percent of total regional jobs—in the year 2000, while private services may be expected to provide about 276,800 jobs—about 27 percent of total regional jobs—in the same year. Under the stable or declining population growth scenario, however, manufacturing and private services may be expected to provide about an equal proportion—about 30 percent—of total regional jobs in the year 2000—about 266,300 and 269,800 jobs, respectively.

Employment Distribution: The two alternative employment distributions—one for each alternative scenario—proposed herein to be used as points of departure in the preparation of alternative land use plans provide significant ranges of future employment levels for the Region's seven counties. The ranges for each county can be summarized as follows:

1. The alternative future employment levels for Kenosha County range from 54,300 jobs under the moderate population growth scenario to 43,200 jobs under the stable or declining population growth scenario—a difference of 11,000 jobs, or 26 percent.

2. The alternative future employment levels for Milwaukee County range from 593,600 jobs under the moderate population growth scenario to 552,300 jobs under the stable or declining population growth scenario—a difference of 41,300 jobs, or 7 percent.

3. The alternative future employment levels for Ozaukee County range from 38,000 jobs under the moderate population growth scenario, to 29,300 jobs under the stable or declining population growth scenario—a difference of 8,700 jobs, or 30 percent.

4. The alternative future employment levels for Racine County range from 95,500 jobs under the moderate population growth scenario to 78,400 jobs under the stable or declining population growth scenario—a difference of 17,100 jobs, or 22 percent.

5. The alternative future employment levels for Walworth County range from 41,200 jobs under the moderate population growth scenario to 31,200 jobs under the stable or declining population growth scenario—a difference of 10,000 jobs, or 32 percent.

6. The alternative future employment levels for Washington County range from 36,000 jobs under the moderate population growth scenario to 28,500 jobs under the stable or declining population growth scenario—a difference of 7,500 jobs, or 26 percent.

7. The alternative future employment levels for Waukesha County range from 157,400 jobs under the moderate population growth scenario to 124,100 jobs under the stable or declining population growth scenario—a difference of 33,300 jobs, or 27 percent.

Personal Income: Under the moderate population growth scenario, average household income may be anticipated to increase by $8,200, or about 38 percent—from $21,400 in 1970 to $29,600 in 2000 as measured in constant 1979 dollars. Under the stable or declining population growth scenario, average household income as measured in constant dollars is assumed to experience no change between 1920 and 2000. Because of the differences in household size expected under the two scenarios, per capita income under the moderate growth scenario may be expected to increase to $9,950 in the year 2000, about 5 percent more than the per capita income level of $9,475 expected under the stable or declining growth scenario. With respect to future disposable income, since the constant dollar cost of energy is expected to increase at a greater rate than is personal income under both scenarios, it may be anticipated that a smaller proportion of total disposable income will be available for nonenergy-related purchases under both scenarios.

PROJECTIONS OF LAND USE DEMAND AND AUTOMOBILE AND TRUCK AVAILABILITY

Future changes in the Region with respect to land use demand and automobile and truck availability will influence future area primary transit needs. The land use plans developed under this study for each future scenario and its attendant levels of anticipated regional change will determine the future levels of regional land use demand and of automobile and truck availability to be used in the testing and evaluation of alternative transit plans under this study. A projection of current trends in land use demand and in automobile and truck availability, while not determining such levels in the plans, provides a useful basis of comparison for each plan.

Such projections of land use demand and of automobile and motor truck availability are set forth in the remaining sections of this chapter. It should be stressed, however, that these projections are not levels of future regional change to which the land use and primary transit sytem plans prepared under the study must or will adhere. Rather, it is to be expected in the preparation of the land use plans under each alternative future scenario, and in the preparation of primary transit plans under each land use plan, that recommendations will be made to change the projected course of events.

Future Land Use Demand

The changes in land use that occurred within the Region from 1963 to 1970 are summarized in Table 63, which indicates that a total of 74 square miles of land were converted from rural to urban use during this seven-year period, or an average of about 10.6 square miles per year. About half of the land converted during this period was converted to accommodate residential use. However, the two major land uses experiencing the highest percentage increase during this period were retail sales and service and recreational use. The land use showing the lowest percentage increase during this period was transportation, communication, and utilities. Agricultural and other open lands were reduced by the increases in urban land, the bulk of the loss occurring in agricultural lands.

As further shown in Table 63, a projection of land use demand based upon the assumption that the land use development trends evident in the Region from 1963 to 1970 will continue indicates that nearly 319 square miles of land will be converted from rural to urban use during the 30-year period from 1970 to the year 2000. This is an increase of about 62 percent over the 1970 urban land total. The projection further indicates that the bulk of this conversion to urban use will occur within the agricultural areas, with approximately 293 square miles of agricultural land being converted during the 30-year period. This projected conversion of land from rural to urban use would result in major changes in the regional land use pattern. For example, urban land uses accounted for approximately 19 percent of the total area of the Region in 1970. Based upon the projections, nearly 31 percent of the Region will be devoted to urban use by the year 2000, a substantial increase. Similarly, rural land uses, which accounted for nearly 81 percent of the land area of the Region in 1970, would account for approximately 69 percent of the land area in the year 2000.

Urban population density within the Region is one of the important factors which must be considered in the preparation of regional land use and transportation plans, and the trends in density must be evaluated along with the projected demand for land. The alternative future regional population levels for the year 2000 of 2,219,300 and 1,688,400 persons and the projected demand for land may be expected to be accompanied by major changes in urban densities in the Region. In 1970 the gross population density of the developed

Table 63

PROJECTED LAND USE DEMAND IN THE REGION: 1970-2000

Land Use Category	Existing Land Use[a] 1963 Acres	1963 Square Miles	1970 Acres	1970 Square Miles	1970 Percent of Region	1963-1970 Change Acres	1963-1970 Change Square Miles	1963-1970 Change Percent	Average Annual Change 1963-1970 Acres	Average Annual Change 1963-1970 Square Miles	Average Annual Change 1963-1970 Percent	1970-2000 Projected Change[b] Acres	1970-2000 Projected Change[b] Square Miles	1970-2000 Projected Change[b] Percent	Total Projected Land Use 2000 Acres	Total Projected Land Use 2000 Square Miles	Total Projected Land Use 2000 Percent of Region
Residential	129,219	201.91	156,266	244.17	9.1	27,047	42.26	20.9	3,863	6.04	3.00	115,890	181.09	74.2	272,156	425.24	15.8
High Density	*21,471*	*33.55*	*25,401*	*39.69*	*1.5*	*3,930*	*6.14*	*18.3*	*561*	*0.88*	*2.61*	*16,830*	*26.30*	*66.3*	*42,231*	*65.99*	*2.5*
Medium Density	*31,596*	*49.37*	*43,230*	*67.55*	*2.5*	*11,634*	*18.18*	*36.8*	*1,662*	*2.60*	*5.26*	*49,860*	*77.91*	*115.3*	*93,090*	*145.45*	*5.4*
Suburban and Low Density	*76,152*	*118.99*	*87,635*	*136.93*	*5.1*	*11,483*	*17.94*	*15.1*	*1,640*	*2.56*	*2.16*	*49,200*	*76.88*	*56.1*	*136,835*	*213.80*	*7.9*
Retail Sales and Service[c]	6,759	10.56	9,464	14.79	0.6	2,705	4.23	40.0	387	0.61	5.71	11,610	18.14	128.0	21,074	32.93	1.2
Industrial[c]	9,668	15.11	11,383	17.79	0.7	1,715	2.68	17.7	245	0.38	2.53	7,350	11.48	64.5	18,733	29.27	1.1
Transportation, Communication, and Utilities[c]	96,121	150.19	103,350	161.48	6.0	7,229	11.29	7.5	1,033	1.61	1.07	30,990	48.42	30.0	134,340	209.91	7.8
Governmental and Institutional[c]	14,910	23.30	17,878	27.93	1.0	2,968	4.63	19.9	424	0.66	2.84	12,720	19.87	71.1	30,598	47.81	1.8
Recreational[d]	23,548	36.79	29,502	46.10	1.7	5,954	9.31	25.3	851	1.33	3.61	25,530	39.89	86.5	55,032	85.99	3.2
Total Urban	280,225	437.86	327,843	512.26	19.1	47,618	74.40	17.0	6,803	10.63	2.43	204,090	318.89	62.3	531,933	831.15	30.9
Agricultural	1,083,800	1,693.44	1,040,121	1,625.19	60.4	-43,679	-68.25	-4.0	-6,240	-9.75	-0.57	-187,200	-292.50	-18.0	852,921	1,332.69	49.6
Other Open Lands[f]	357,075[e]	557.93[e]	353,136	551.78	20.5	-3,939	-6.15	-1.1	-563	-3.00	-0.16	-16,890	-26.39	-4.8	336,246	525.39	19.5
Total Rural	1,440,875[e]	2,251.37[e]	1,393,257	2,176.97	80.9	-47,618	-74.40	-3.3	-6,803	-10.63	-0.47	-204,090	-318.89	-14.6	1,189,167	1,858.08	69.1
Region Total	1,721,030[e]	2,689.23[e]	1,721,100	2,689.23	100.0	--	--	--	--	--	--	--	--	--	1,721,100	2,689.23	100.0

[a] *Based on SEWRPC regional land use inventories conducted in April 1963 and April 1970.*

[b] *Based on a 30-year projection of the 1963-1970 average annual change.*

[c] *Includes related off-street parking.*

[d] *Includes only "active" recreation areas within parks or parkways and related off-street parking. All other uses within parks or parkways are tabulated in the appropriate land use category.*

[e] *Includes 85 acres added to make the 1963 and 1970 data directly comparable.*

[f] *Includes water, wetlands, woodlands, unused lands, and quarries.*

Source: SEWRPC.

urban land within the Region approximated 4,350 persons per square mile. If the projected land use demand is met entirely through the conversion of rural land to urban use, the overall density of the developed area of the Region can be expected to fall to about 3,000 persons per square mile under the moderate population growth scenario, a decrease in gross density of approximately 30 percent. The overall density of the developed area of the Region can be expected to fall to about 2,300 persons per square mile under the stable or declining population growth scenario.

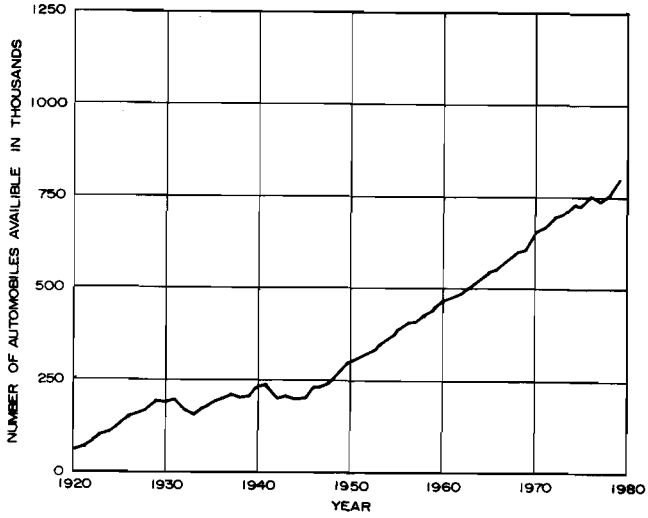
It should be noted that these land use projections are not plans, nor should the numbers provided by such projections be construed as the numbers to which each plan prepared must adhere. In the preparation of alternative land use plans for each alternative future scenario, recommendations may be made to change this projected course of events to bring about a more efficient, beautiful, and attractive regional settlement pattern.

Future Automobile Availability

As shown in Figure 27, between 1920 and 1979 the number of automobiles available to residents of the Region increased from 58,500 to 802,100. The period from 1920 to 1950 was characterized by short-term, erratic trends in automobile availability as a result of the Great Depression and World War II. From 1950 to 1970, however, the number of automobiles available to residents of the Region increased every year—from 294,000 in 1950 to 462,000 in 1960, to 497,000 in 1963, and to 634,000 in 1970. By 1979, the number of automobiles available to residents of the Region had increased to 802,100. Most of this increase, 67 percent, occurred from 1970 to 1974, and the other 26 percent occurred from 1978 to 1979. The 1950 to 1979 increase is equivalent to an annual uniform growth rate of approximately 3.5 percent over this 29-year period. If the increase in the number of automobiles within the Region were to continue at this rate, 1,659,100 automobiles would be available to residents of the Region in 2000. Such a projection would, however, lead to unrealistically low ratios of 1.3 persons per automobile in the year 2000 under the alternative future population level of 2,219,300 persons, and 1.0 person per automobile under the alternative future population level of 1,688,400 persons.

Figure 27

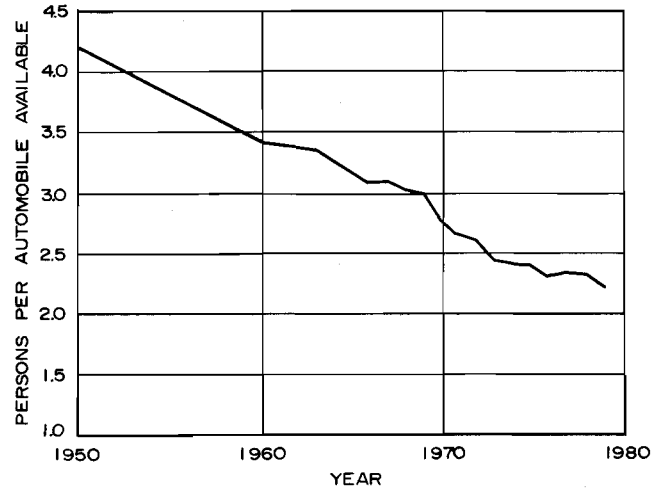
AUTOMOBILE AVAILABILITY IN THE SOUTHEASTERN WISCONSIN REGION: 1920-1979



Source: SEWRPC.

Figure 28

PERSONS PER AVAILABLE AUTOMOBILE IN THE SOUTHEASTERN WISCONSIN REGION: 1950-1979



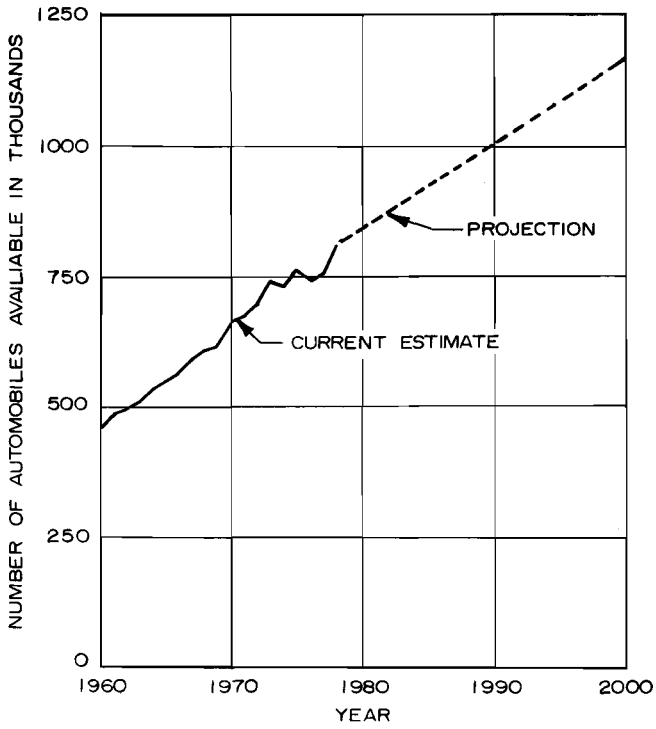
Source: SEWRPC.

As shown in Figure 28, the ratio of persons per automobile within the Region decreased from 4.23 in 1950 to 3.41 in 1960, to 3.36 in 1963, to 2.77 in 1977, and to 2.22 in 1979. While it is likely that this ratio will continue to decline somewhat as more single-person households and more multicar households are formed, as a practical matter the absolute lower limit is the ratio of persons per automobile available for every licensed driver residing within the Region. Based upon the age distribution of the regional population under the moderate population growth future of 2,219,300 persons in the year 2000 and an estimate that nearly 88 percent of the population within the Region between the ages of 16 and 75 will be licensed to drive, this absolute lower limit of automobile availability is 1.62 persons per available automobile, representing a total of 1.40 million automobiles in the Region in the year 2000. Under the stable or declining population growth future, which anticipates a population of 1,688,400 persons in the year 2000, this absolute lower limit of automobile availability is 1.57 persons per available automobile, representing about 1.07 million automobiles in the Region in the year 2000. While such ratios may be possible, it is highly unlikely that they will ever be attained, since not every licensed driver will be able to afford, or be inclined to own, an automobile.

As shown in Figure 29, the number of automobiles available within the Region is projected to reach 1,168,000 by the year 2000 under the moderate population growth scenario. This projection is based on the assumption of continued growth in automobile availability within the Region, but at a decreasing rate. This continued growth will, in turn, largely be a result of the anticipated increases in household income, decreases in household size, increases in labor force participation, and increases in the size of the driving age population, as well as of increases in motor fuel price and the existence of a saturation level of automobile ownership. This projection represents an increase of approximately 365,900 automobiles, or 46 percent, over the 1979 level. The corresponding ratio of persons per available automobile is projected to decline from 2.22 to 1.90 persons, as shown in Figure 30. Under the stable or declining population growth scenario, a smaller ratio of 1.80 persons per available automobile in the Region is projected for the year 2000, representing a level of automobile availability of 938,000 in that year (see Figures 31 and 32). Under this alternative future, greater decreases in household size and a greater increase in labor force participation and in the size of the driving age population are anticipated than under the moderate growth scenario, along with lesser increases in the costs of operating an automobile.

Figure 29

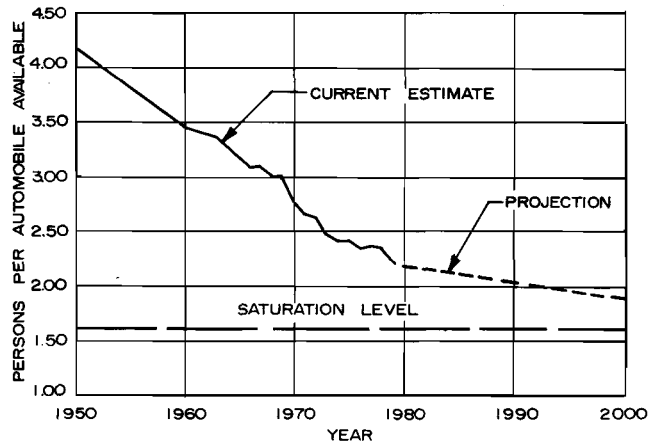
FUTURE AUTOMOBILE AVAILABILITY UNDER A MODERATE POPULATION GROWTH SCENARIO



Source: SEWRPC.

Figure 30

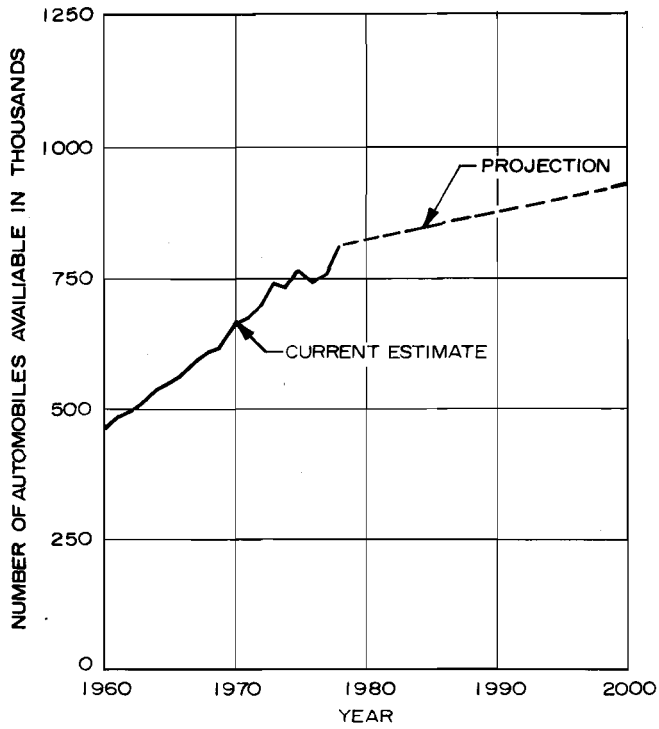
FUTURE PERSONS PER AVAILABLE AUTOMOBILE UNDER A MODERATE POPULATION GROWTH SCENARIO



Source: SEWRPC.

Figure 31

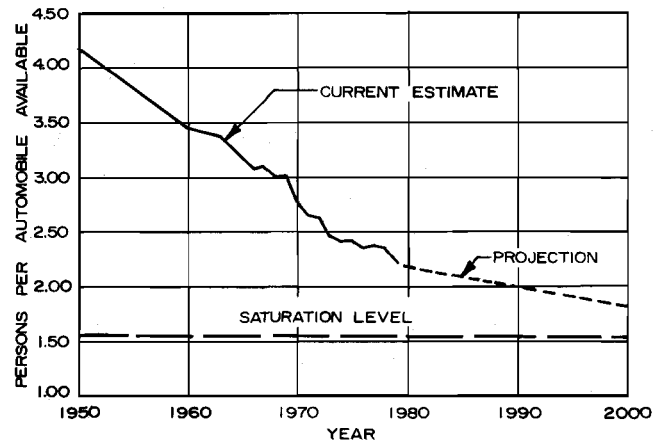
FUTURE AUTOMOBILE AVAILABILITY UNDER A STABLE OR DECLINING POPULATION GROWTH SCENARIO



Source: SEWRPC.

Figure 32

FUTURE PERSONS PER AVAILABLE AUTOMOBILE UNDER A STABLE OR DECLINING POPULATION GROWTH SCENARIO



Source: SEWRPC.

It should be noted that these automobile availability projections, like those of land use demand, should not be construed as the numbers to which plans prepared under the study must adhere. Rather, in the preparation of alternative land use and transportation plans under each alternative scenario, recommendations to change this projected course of events can be expected to be made.

Future Motor Truck Availability

The number of motor trucks available to truck operators within the Region during the period 1950 to 1979 has generally increased rapidly, particularly between 1962 and 1979. From 1950 to 1979, the number of trucks available increased from 49,400 to 125,600, with most of the increase—69,700 trucks, or 90 percent—occurring in the last 12 years. This represents an increase in regional truck availability between 1950 and 1979 of about 154 percent, as compared with an increase of 262 percent in automobile availability over the same period. The rapid increase in the number of motor trucks in the Region between 1950 to 1979 can be attributed primarily to large increases in motor truck availability in Waukesha and Milwaukee Counties, which exhibited increases of 21,100 and 21,400 trucks, respectively. The greatest rates of increase in motor truck availability over the same 29-year period occurred in Waukesha, Kenosha, and Washington Counties, which experienced net increases of over 350, 212, and 206 percent, respectively. Much of the increase in truck availability in recent years can be attributed to a growing preference for light trucks and vans as passenger vehicles.

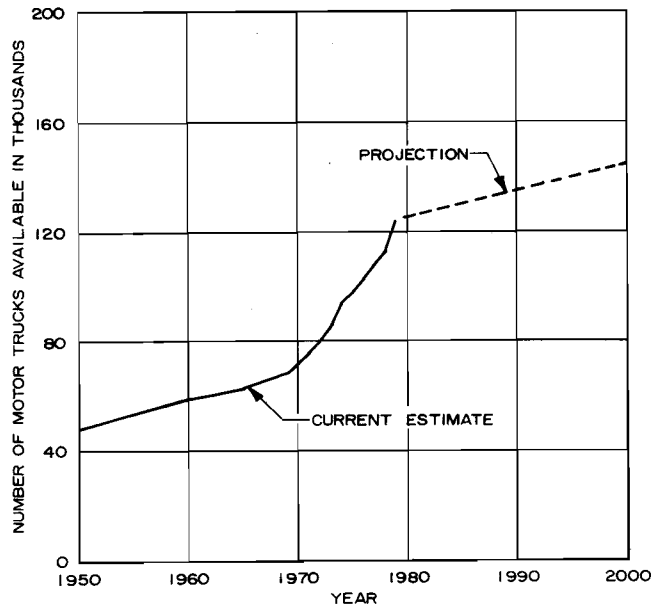
The number of trucks available in the Region is projected to increase under both alternative future scenarios from 125,600 in 1979 to 144,000 in the year 2000, an increase of 18,400 trucks, or approximately 15 percent (see Figure 33). The anticipated decline in the rate of growth of truck availability envisioned under both scenarios will result largely from the increasing price of motor fuel.

SUMMARY

The fourth step of the six-step planning process being used in the conduct of the Milwaukee area primary transit system alternatives analysis—the alternative futures analysis—is intended to address the issue of change and, more importantly, the uncertainty inherent in such change in the Southeastern Wisconsin Region over the next 20 years. The first phase of the alternative futures analysis

Figure 33

FUTURE MOTOR TRUCK AVAILABILITY



Source: SEWRPC.

was the development of alternative scenarios of future changes in factors which are largely external to the Region, but which may directly or indirectly affect regional growth or decline and, therefore, the primary transit needs of the Region.

This chapter documents the second phase of the alternative futures analysis—namely, the estimation of the amount of growth or decline in the population and economic activity of the Region to be expected under each of the two alternative future scenarios developed under the first phase of the analysis. The alternative future levels of population and economic activity presented in this chapter are intended to represent a reasonable range of change that may be expected over the next 20 years. One alternative future envisions moderate growth in regional population and economic activity consistent with the moderate growth external factor scenario, and the other envisions a slight decline in regional population and stagnation in regional economic activity consistent with the stable or declining external factor scenario. The alternative future population and economic activity levels presented herein are not intended to constitute precise levels to which the alternative land use plans prepared under the succeeding step of the alternative futures process must adhere. Rather, the levels are intended as guides to be used in the preparation of alternative land use plans.

Alternative Population Futures

In general, the types of population change that would lead to moderate population growth can be characterized as continuation—albeit at more moderate rates—of the types of changes in population attributes that occurred in the Region during the 1960's and the early part of the 1970's. These population changes include a continuation into the 1980's of the below-replacement-level fertility rates of the early 1970's, and a slight increase to replacement-level fertility by the year 2000, coupled with a virtual balance between in- and out-migration between 1970 and 2000. Under this scenario, any trend toward decentralization of the Region's population, when coupled with lower rates of population growth, would increasingly place the older urban centers of the Region at a competitive disadvantage in retaining, much less attracting, resident population. Fertility rates lower than those of the 1950's and 1960's, coupled with the aging of the "baby boom" cohort of the 1950's and first half of the 1960's, may be expected to create significant shifts in the age composition of the resident population. In addition, the lower fertility rate coupled with a continuation in the trend toward increasing numbers of one- and two-person households may be expected to result in a continued decrease in average household size in the Region to less than 3.2 persons per household in 2000, and in a rate of increase in households greater than the rate of population increase between 1970 and 2000.

The stable or declining growth scenario can be best characterized as an acceleration of the regional population change experienced in the 1970's when, for the first time in over 120 years of recorded history, the Region actually experienced a population loss, occurring during the period 1975 to 1978. A continuation of the below-replacement-level fertility rates of the early 1970's through the year 2000, when combined with net out-migration levels sufficiently large to offset all regional population growth attributable to natural increase, would result in no population increase or a slight population decrease in the Region between 1980 and the year 2000. Under this scenario, Kenosha, Milwaukee, and Racine Counties—all of which experienced population losses between 1975 and 1978—would experience difficulty in maintaining their present population levels through the year 2000. Thirty years of below-replacement-level fertility rates in concert with the aging of the "baby boom" cohort of the 1950's and first half of the 1960's and the high levels of regional out-migration in the age groups below 45 years of age would create significant shifts in the age composition of the resident population, even though its size would remain virtually unchanged between 1980 and 2000. Lower fertility rates coupled with a continuation of household formation characteristics typical of the 1970's would result in a continued decrease in average household size to less than 2.5 persons per household in the Region in 2000, and to an increase in the total number of households, notwithstanding the fact that the total population would not be anticipated to increase at all between 1980 and 2000.

The resident population of the Region under the moderate population growth scenario may be expected to increase by about 463,200 persons, or about 26 percent, between 1970 and 2000—from about 1,756,100 persons in 1970 to about 2,219,300 persons in the year 2000. Population under the stable or declining population growth scenario may be expected to decline to 1,688,400 persons in the year 2000—a loss of about 67,700 persons, or about 4 percent, from the 1970 level. The difference in total regional population in the year 2000 under the two alternative future scenarios is about 530,900 persons.

The four alternative distributions—a centralized and decentralized distribution under each scenario—proposed herein to be used as guides in the preparation of alternative land use plans provide wide ranges of anticipated population levels for the Region's seven counties.

1. The alternative future population levels for Kenosha County range from a high of 202,800 to a low of 125,000, a difference of 77,800 persons, or 62 percent.

2. The alternative future population levels for Milwaukee County range from a high of 1,049,600 to a low of 700,000, a difference of 349,600 persons, or 50 percent.

3. The alternative future population levels for Ozaukee County range from a high of 149,000 to a low of 75,000, a difference of 74,000 persons, or 99 percent.

4. The alternative future population levels for Racine County range from a high of 224,700 to a low of 180,000, a difference of 44,700 persons, or 25 percent.

5. The alternative future population levels for Walworth County range from a high of 106,000 to a low of 70,000, a difference of 36,000 persons, or 51 percent.

6. The alternative future population levels for Washington County range from a high of 174,000 to a low of 95,000, a difference of 79,000 persons, or 83 percent.

7. The alternative future population levels for Waukesha County range from a high of 463,200 to a low of 310,000, a difference of 153,200 persons, or 49 percent.

The low fertility rate expected under each scenario will result in a decrease in the number of persons under the age of 20 between 1970 and 2000, but this decrease is expected to be about 197,500 persons greater under the stable or declining population growth scenario. The maturing of the "baby boom" cohort is expected to result in an increase in the number of persons of working age under both scenarios between 1970 and 2000, although this increase is expected to be about 272,600 persons less under the stable or declining growth scenario. The elderly population will also increase under both scenarios between 1970 and 2000. This increase is expected to be about 61,100 persons less under the stable or declining population growth scenario.

Under the moderate population growth scenario, average household size in the Region can be anticipated to decline somewhat from a 1970 value of 3.20 persons per household to between 3.15 and 2.90 persons per household by the year 2000. When combined with an expected increase in population of about 463,200 persons, this range may be expected to result in an increase of between 154,000 and 211,200 households, or between 29 and 39 percent, from the 1970 level of 536,500 households. Thus, the number of households in the Region in the year 2000 would range between 690,500 and 747,700, a difference of about 57,200 households. Under the stable or declining population growth scenario, a continuation of the decline in average household size would result in a range of between 2.45 and 2.20 persons per household by the year 2000. When combined with the anticipated population loss of about 67,700 persons between 1970 and 2000, this range may be expected to result in an increase in the number of households of between 137,200 and 210,700 households, or between 26 and 39 percent. Thus, the number of households in the Region in the year 2000 would range between 673,600 and 747,200, a difference of about 73,600 households. Differences in household composition are implicit in these two scenarios, with a lower proportion of traditional families expected under the stable or declining growth alternative. The anticipated compositional differences in the households under the two scenarios, as well as the differences in the spatial distribution of the households under the four alternative land use plans to be prepared, may be expected to result in different collective travel patterns—including different choices of mode—despite the similarity in the range of absolute number of households anticipated under each scenario.

Alternative Economic Futures

The economic changes that may be expected to occur under a moderate population growth scenario generally represent a continuation of the types of change that have historically occurred in the regional economy. Long-term economic growth at a rate at or slightly below national averages may be expected under this scenario. The growth in the regional economy may be expected to result from the interaction of several factors explicitly assumed as a part of the moderate population growth scenario. The increase in the resident population of the Region anticipated under this scenario may be expected to result in a continually growing demand for goods and services. A growing regional labor force will result from the increased proportion of the resident population in the work force age groups and increased female labor force participation. Finally, under this scenario the Region will be able to preserve and expand its economic base and thus compete with other regions of the nation for business and industry.

The economic changes that may be expected to occur under a stable or declining population growth scenario represent a departure from existing regional trends. This departure is based on an assumed stable or declining future population level in concert with an assumed inability of the Region to preserve and expand its economic base and thus remain competitive with other regions of the nation. As a result, employment levels can be expected to only moderately increase over 1970 levels by the year 2000, with most of the increase occurring during the 1970's and early 1980's. It is assumed that the rate of increase in regional employment will be significantly below the national rates of increase, particularly after 1980. The employment growth that does occur is assumed to be accommodated by increases in the labor force participation rate as well as by a general aging of the population such that a larger proportion of the population is in the labor force age groups.

Under the moderate population growth scenario the number of jobs available in the Region is anticipated to increase by about 274,400, or about 37 percent, between 1970 and 2000—from a 1970 level of 741,600 jobs to about 1,016,000 jobs in 2000. Principally due to the assumed inability of the Region to compete with other regions of the nation under the stable or declining population growth scenario, the number of jobs under this scenario may be expected to increase only by about 145,400, or about 20 percent, to about 851,800 jobs in 2000. The difference in total regional employment in the year 2000 under the two alternative future scenarios is about 164,200 jobs.

Different regional economic structures may be expected under the two alternative future scenarios. Under the moderate population growth scenario, manufacturing may be expected to provide about 320,300 jobs—about 32 percent of total regional jobs—in the year 2000, while private services may be expected to provide about 276,800 jobs—about 27 percent of total regional jobs—in the same year. Under the stable or declining population growth scenario, however, manufacturing and private services may be expected to provide about an equal proportion—about 30 percent—of total regional jobs in the year 2000—about 266,300 and 269,800 jobs, respectively.

The two alternative employment distributions—one for each alternative scenario—proposed herein to be used as points of departure in the preparation of alternative land use plans provide significant ranges of future employment levels for the Region's seven counties. The ranges for each county can be summarized as follows:

1. The alternative future employment levels for Kenosha County range from a high of 54,300 jobs to a low of 43,200 jobs, a difference of 11,100 jobs, or 26 percent.

2. The alternative future employment levels for Milwaukee County range from a high of 593,600 jobs to a low of 552,300 jobs, a difference of 41,300 jobs, or 7 percent.

3. The alternative future employment levels for Ozaukee County range from a high of 38,000 jobs to a low of 29,300 jobs, a difference of 8,700 jobs, or 30 percent.

4. The alternative future employment levels for Racine County range from a high of 95,500 jobs to a low of 78,400 jobs, a difference of 17,100 jobs, or 22 percent.

5. The alternative future employment levels for Walworth County range from a high of 41,200 jobs to a low of 31,200 jobs, a difference of 10,000 jobs, or 32 percent.

6. The alternative future employment levels for Washington County range from a high of 36,000 jobs to a low of 28,500 jobs, a difference of 7,500 jobs, or 26 percent.

7. The alternative future employment levels for Waukesha County range from a high of 157,400 jobs to a low of 124,100 jobs, a difference of 33,300 jobs, or 27 percent.

Under the moderate population growth scenario, average household income—a factor which influences the demand for primary transit services—is assumed to increase from about $8,200 to about $10,600, or by about 38 to 50 percent—from $21,400 in 1970 to between $29,600 and $32,000 in 2000 as measured in constant 1979 dollars. Under the stable or declining population growth scenario, average household income as measured in constant dollars is assumed to increase from zero to about 11 percent over the planning period. The increase assumed in each case is dependent upon the number and size of households attendant to the alternative future concerned.

Future Land Use Demand

A projection of land use demand based upon the assumption that the land use development trends evident in the Region from 1963 to 1970 will continue indicates that nearly 319 square miles of land will be converted from rural to urban use over the 30-year period from 1970 to the year 2000. This is an increase of about 62 percent over the 1970 urban land total. The projection further indicates that the bulk of this conversion to urban use will occur within the agricultural areas, with approximately 293 square miles of agricultural land being converted over the 30-year period. In 1970, urban land uses accounted for approximately 19 percent of the total area of the Region. Based upon the projections, nearly 31 percent of the Region will be devoted to urban use by the year 2000, a substantial increase.

The alternative future regional population levels for the year 2000 of 2,219,300 and 1,688,400 persons and the projected demand for land may be expected to be accompanied by major changes in urban densities in the Region. In 1970 the gross population density of the developed urban land within the Region approximated 4,350 persons per square mile. If the projected land use demand is met entirely through the conversion of rural land to urban use, the overall density of the developed area of the Region can be expected to fall to about 3,000 persons per square mile under the moderate population growth scenario, a decrease in gross density of approximately 30 percent, and to about 2,300 persons per square mile under the stable or declining population growth scenario, a decrease in gross density of approximately 47 percent.

Future Motor Vehicle Availability

The number of automobiles available within the Region is projected to reach 1,168,000 by the year 2000 under the moderate population growth scenario. This projection is based on the assumption of continued growth in automobile availability within the Region, but at a decreasing rate. This continued growth will, in turn, result from the anticipated increases in household income, decreases in household size, increases in labor force participation, and increases in the size of the driving age population, as well as from increases in motor fuel price and the existence of a saturation level of automobile ownership. This projection represents an increase of approximately 365,900 automobiles, or 46 percent, over the 1979 level. The corresponding ratio of persons per available automobile is projected to decline from 2.22 to 1.90 persons. Under the stable or declining population growth scenario, a smaller ratio of 1.80 persons per available automobile in the Region is projected for the year 2000, representing a level of automobile availability of 938,000 in that year.

The number of trucks available within the Region is projected to increase under both alternative future scenarios from 125,600 in 1979 to 144,000 in the year 2000, an increase of 18,400, or approximately 15 percent.

It must be noted that the projections of land use demand, automobile availability, and motor truck availability set forth in this chapter are not levels of future regional change to which the land use and primary transit system plans prepared under the study must adhere. Rather, in the preparation of the land use plans under each alternative future scenario, and in the preparation of primary transit plans under each land use plan, recommendations may be expected to be made to change the projected course of events. However, the levels of future change in population characteristics and economic activity set forth in this chapter under the two alternative future scenarios are intended to serve as the basis for the preparation of alternative land use plans for each scenario.

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Chapter IV

REGIONAL DEVELOPMENT ALTERNATIVES

INTRODUCTION

The third and last step in the development of the four alternative futures under which alternative primary transit system plans are to be designed, tested, and evaluated is the preparation of alternative land use plans. Two alternative land use plans are to be prepared for each of the two alternative future scenarios for the external factors influencing development in the Southeastern Wisconsin Region, and the attendant future levels of population and economic activity in the Region.

Urbanizing regions like southeastern Wisconsin can develop and redevelop in a number of ways, and each of the various possible regional development patterns can be expected to be accompanied by differing needs for transit service. It is accordingly important that the alternative land use plans developed under the primary transit system planning effort for each future scenario encompass the range of reasonably possible future land use patterns in the Region, particularly as such patterns might influence future transit needs. This is important because the alternative futures approach is intended to permit the differentiation of those primary transit system alternatives that perform well under a full range of future conditions from those that perform well under only a few, or under a single set of, future conditions. The four land use plans prepared under the study are intended to postulate one future which provides an upper limit, or optimistic set, of reasonable and consistent conditions with respect to land use, energy price and availability, and regional population and economic activity levels and characteristics affecting transit use within the Region, and another future which provides a lower limit, or pessimistic set, with respect to such conditions.

The range of reasonable future land use conditions within the Region as these conditions affect transit use under each of the two alternative scenarios will be developed by assuming, at one extreme, the future centralization of land use in the Region and, at the other extreme, the decentralization of land use in the Region. Both the future centralized and decentralized concepts of land use must, however, reflect reasonable judgments regarding existing land use development within the Region, existing trends in such development, and the degree to which future development may be expected to depart from these existing conditions and trends.

Concepts of future centralized, as well as of decentralized, land use development in the Region could vary widely. Under the Commission's initial land use planning effort undertaken in 1963, four alternative land use plans for the design year 1990 were prepared and evaluated.[1] These plans included three centralized land use plans and one decentralized land use plan. One of the centralized land use plans provided for a continuation of existing historic trends within the Region, but with such trends guided and shaped with respect to location and density in the public interest through public land use controls. New urban development under this plan continued to occur in concentric rings around the full periphery of, and outward from, the existing major urban centers within the Region at densities which could economically support urban services, including transit. Within each major urban area of the Region the resulting development pattern was continuous, both radially and circumferentially, and was linked to the commercial and industrial centers of the larger central cities of the Region.

A second centralized plan, a corridor plan, represented a planned concentration of new urban development along radial corridors centered on major transportation routes emanating from the existing major urban centers within the Region. Within each major urban area of the Region, the resulting development pattern was continuous radially but discontinuous circumferentially, with wedges of open space alternating with radial corridors of urban development. The resulting development pattern was also linked to the commercial and industrial centers of the larger central cities of the Region.

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[1] *See SEWRPC Planning Report No. 7, The Regional Land Use-Transportation Study, Volume Two, Forecasts and Alternative Plans—1990.*

The third centralized plan, a satellite city plan, represented a conscious concentration of new development in outlying communities of the Region, relatively independent of the commercial and industrial activities of the larger central cities and separated from the larger existing urban centers by large areas of open space. The resulting urban development pattern was discontinuous radially but continuous circumferentially.

The fourth alternative, a decentralized land use plan, represented an uncontrolled continuation of existing trends and a highly diffused pattern of low-density development.

Under the Commission's land use and transportation system plan reevaluation completed in 1978, only one centralized land use plan, a controlled existing trend plan, and one decentralized land use plan were considered. This was in part because of the expressed widespread opposition of local, county, and state officials to the corridor and satellite city plans and to the consequent impracticality of implementing such plans; in part because work conducted under the initial regional land use-transportation study had demonstrated that travel demand and transit use under each of the three alternative centralized land use plans were very similar; and in part because substantial progress toward implementation of the adopted regional land use plan was being achieved, and sewer and municipal services were being provided in accordance with that plan. In addition, these two types of land use plans alone were considered in 1978 because the plan reevaluation indicated that population and employment growth within the Region would be only relatively modest over the next two to three decades, unlike the growth expected under the original study which was conducted in the early 1960's. Therefore, consideration of any land use plan which required for implementation a drastic departure from existing trends, like the corridor or satellite city plans, was apt to be impractical. For similar reasons, two land use plans, a centralized plan and a decentralized plan, were developed under the primary transit system alternatives analysis study for each of the two future scenarios.

The centralized plans envision that virtually all new urban development will occur in concentric rings along the full periphery of, and outward from, existing urban centers as it did within the Region prior to 1950, and that existing developed areas in Milwaukee County will retain at least the same density of occupied housing units as in 1970. Moreover, the new urban development would occur at densities consistent with the economical provision of important urban facilities and services such as centralized public sanitary sewer, water supply, and transit. Under this development concept, new urban development would occur in planned neighborhood development units, primarily at medium-density population levels—that is, with new single-family residential development ranging from a low of 2.3 to a high of 6.9 dwelling units per net residential acre, and averaging four to five dwelling units per net residential acre; and with new multiple-family residential development ranging from a low of 7.0 to a high of 17.9 dwelling units per net residential acre, and averaging 10 to 12 dwelling units per net residential acre. The plans would also importantly provide for the protection of all the remaining primary environmental corridors within the Region from further urban development, and would seek to minimize the conversion of agricultural lands, particularly prime agricultural lands, to urban uses.

In contrast, the decentralized plans place less emphasis and importance on the centralization of urban development, on the concentration of residential development in planned neighborhood units, on the provision of public sanitary sewer, water supply, and transit services, and on the attainment of medium-density population levels. These plans place more emphasis on the use of onsite soil absorption sewage disposal systems (septic tanks) and private water supply wells, on the continued use of the automobile as the dominant form of urban transportation, and on low-density residential development, including suburban and exurban development. Employment as well as residences would be decentralized, and the population of the larger central cities and older first ring suburbs would continue to decline. Even in view of future increases in energy costs and potential shortages of energy, regional land use development trends evident since 1963, along with Commission behavioral and attitudinal studies and some national assessments of urban growth, indicate continued potential for low-density, unsewered urban development. The decentralized land use plan alternative represents a continuation of historic development trends observed within the Region since 1950, with urban development occurring in a highly diffused pattern, at low densities, and in noncontiguous enclaves well beyond the periphery of existing urban centers, particularly Milwaukee County. New urban development would take place both in those areas

where sanitary sewer service can be readily provided and in those areas beyond the existing and planned future sewer service areas where soils are suitable for the utilization of onsite sewage disposal systems. New urban development would not, however, be placed in primary environmental corridors, and the conversion of prime agricultural lands to urban uses would be minimized.

Thus, both the centralized and decentralized land use plans represent a conscious continuation of historic development trends in the Region, the centralized plan representing principally pre-1950 trends and the decentralized plan representing post-1950 trends. Under the centralized plans, urban development occurs generally outward from the existing urban centers and is continuous and of relatively high density. Under the decentralized plans, urban development occurs in a highly diffused pattern, is discontinuous both radially and circumferentially, and is of relatively low density. Development under the centralized plans is more strongly and closely linked to the commercial and industrial activity centers of the larger central cities than under the decentralized plans. Because the plans differ significantly with respect to densities of development, they represent wide variations in the extent to which new urban development can be served by a full set of urban services and facilities, primarily centralized sanitary sewer, water supply, neighborhood elementary schools, and, importantly for this study, public transit service.

LAND USE PLAN DESIGN METHODOLOGY

A design-oriented mapping methodology concerned primarily with the spatial distribution of the various land uses within the Region, carefully relating these to existing development and to the natural resource base through application of well-established physical planning and engineering principles, was applied in this study in the preparation of the regional land use plans.[2] While the planning techniques applied in this methodology are traditional and well established, a great deal more information about the physical features of the Region, important to plan design, was available than normally is in such land use planning.

This information, summarized in Commission planning and technical reports, includes definitive data on the following natural features of the Region: topography and drainage patterns; soils; surface waters; floodlands; wetlands; woodlands; wildlife habitat; sites having historic, scientific, and other cultural value; existing and potential park and related open space sites; and groundwater recharge areas. Particularly important with respect to the relationship of these natural features to regional development is the concept of the environmental corridor as an elongated area in the landscape which encompasses the most significant and highest quality elements of the regional resource base, including the best remaining surface waters and associated floodlands and shorelands; the best remaining woodlands, wetlands, and wildlife habitat areas; and valuable historic, scenic, scientific, and cultural sites. One of the basic concepts embodied in the design of the Commission's past land use plans was the preservation of these environmental corridors in essentially natural, open uses. This concept recognized that failure to protect these corridors from improper development would ultimately result in the loss of the best remaining park and related open space sites; deterioration or destruction of the best remaining wildlife habitats; further encroachment of urban development upon the natural floodlands of perennial streams and watercourses; loss of water impoundment areas and reduction of groundwater recharge; loss of the largest and best remaining woodlands and wetlands; and continued deterioration of surface water quality within the Region. Because the environmental corridors are poorly suited to urban development of any kind, the intrusion of such development into the corridors may be expected to create not only severe environmental problems but costly developmental problems. This important concept of preserving the primary environmental corridors of the Region will be carried over into the design of both the centralized and decentralized land use plans under this study.

In addition to the physiographic data, the information base for the physical planning techniques included definitive data on the extent and location of existing development within the Region, including data on the existing distribution of population and economic activity, the existing land use, the

[2] *The Commission did develop both land use simulation and design models, but experience indicated that regional land use plans could be produced as quickly and more economically using the conventional rather than with the mathematical model techniques. See SEWRPC Technical Report No. 3, A Mathematical Approach to Urban Design, and SEWRPC Technical Report No. 8, A Land Use Plan Design Model, Volume One, Model Development; Volume Two, Model Test; and Volume Three, Final Report.*

existing highway and transit facilities, and the existing public utility facilities. Importantly, the information base also included data on local proposals for future development within the Region, including data provided in local community plans and zoning ordinances and locally proposed utility service areas. Finally, the data base included information on the prime agricultural areas delineated on the basis of soil capabilities, size of the farm units, capital investment in such agricultural improvements as irrigation and drainage systems, demonstrated ability to provide higher than average crop yields, and the ability of the area to maintain supporting agri-businesses.

The data base also importantly included definitive data on natural floodlands developed as part of the Commission's watershed planning programs for the Root, Fox, Milwaukee, Menomonee, and Kinnickinnic River watersheds; data on the delineation of logical future sanitary sewer service areas as developed in the regional sanitary sewerage system and water quality management planning programs; community level land use data developed as part of comprehensive planning programs for the Kenosha and Racine Urban Planning Districts; and data on airport system development and land use planning in and around airports developed under the regional airport system planning program. In addition, a substantial amount of detailed data was made available through the Commission's continuing community assistance program, including logical growth area delineations, refined community level land use and circulation plans, and neighborhood development plans.

Design Methodology—Centralized Land Use Plans

The following four guidelines were used in designing the centralized plan alternatives under each alternative scenario:

1. New urban development would emphasize medium and high development densities and would be located in areas along the periphery of, and outward from, existing urban centers which can be readily provided with essential urban services, particularly centralized sanitary sewer, water supply, and transit services; and new residential development would occur largely in planned neighborhood units.

2. The number of occupied housing units in all parts of Milwaukee County would not decline from 1970 levels.

3. No new urban development would be allocated to the delineated primary environmental corridors in order to preserve the best remaining elements of the natural resource base of the Region.

4. To the maximum extent possible, no new urban development would be allocated to delineated prime agricultural lands, thereby preserving these highly productive lands for the continued production of food and fiber.

The following procedures were utilized in preparing the centralized plans under each scenario:

1. A determination was made of the amount of "developable" land located within each U. S. Public Land Survey quarter section. Developable land was defined as land which, while not presently developed for urban use, is suitable and can be assumed available for such use. The developable land area for each quarter section was determined by subtracting from the total area within each quarter section the area in primary environmental corridors, the area covered by soils having "severe" and "very severe" limitations for urban development even with public centralized sanitary sewers, and the area covered by urban development.

2. An identification was made of those quarter sections currently served by public sanitary sewerage facilities and those planned to be served by such facilities by the year 2000.

3. A proposed potential urban or rural density was assigned to each quarter section based upon consideration of the four guidelines to be used in developing the centralized land use plans, the existing development densities in the quarter section concerned and in adjacent quarter sections, trends in densities in adjacent quarter sections, community plans and zoning provisions, and professional judgment. The density categories utilized in the plan preparation are identified in Table 64. These categories include urban high density, meaning net lot area per dwelling unit ranges from 0.06 to 0.14 acre; urban medium density, meaning net lot area per dwelling unit ranges from 0.15 to 0.44 acre; urban low density, meaning net lot area per dwelling unit ranges from 0.45 acre to 1.44 acres;

Table 64

RESIDENTIAL DENSITY CLASSIFICATIONS USED IN REGIONAL LAND USE PLAN PREPARATION

Residential Density Classification	Net Lot Area per Dwelling Unit		Number of Dwelling Units per Net Residential Acre[a]	Number of Persons per Net Residential Acre				
	Square Feet	Acres		Kenosha and Walworth Counties[b]	Milwaukee County[c]	Ozaukee and Waukesha Counties[d]	Racine County[e]	Washington County[f]
Urban High Density	2,439- 6,230	0.06-0.14	7.0-17.9	21.0-54.0	18.2-46.8	24.5-63.0	21.7-55.8	23.1-59.4
Urban Medium Density	6,231- 18,980	0.15-0.44	2.3- 6.9	6.9-20.9	6.0-18.1	8.1-24.4	7.1-21.6	7.6-23.0
Urban Low Density	18,981- 62,680	0.45-1.44	0.7- 2.2	2.1- 6.8	1.8- 5.9	2.5- 8.0	2.2- 7.0	2.3- 7.5
Suburban	62,681-217,800	1.45-5.00	0.2- 0.6	0.6- 2.0	0.5- 1.7	0.7- 2.4	0.6- 2.1	0.7- 2.2
Rural	217,800	5.00	0.2	0.6	0.5	0.7	0.6	0.7

Residential Density Classification	Number of Dwelling Units per Gross Acre	Number of Persons per Gross Square Mile[g]				
		Kenosha and Walworth Counties[b]	Milwaukee County[c]	Ozaukee and Waukesha Counties[d]	Racine County[e]	Washington County[f]
Urban High Density	4.8-11.9	9,199-22,797	7,973-19,757	10,735-25,000[h]	9,508-23,557	10,121-25,000[h]
Urban Medium Density	1.7- 4.7	3,327- 9,198	2,883- 7,972	3,882-10,734	3,438- 9,507	3,660-10,120
Urban Low Density	0.6- 1.6	1,045- 3,326	906- 2,882	1,200- 3,881	1,080- 3,437	1,084- 3,659
Suburban	0.2- 0.5	315- 1,044	273- 905	368- 1,219	326- 1,079	347- 1,083
Rural	0.2	315	273	368	326	347

[a] *A net residential acre includes only land actually devoted to residential use; that is, land within the "site" boundaries including the building ground area coverage together with the necessary onsite yards and open spaces.*

[b] *Assumes that each dwelling unit is occupied by 3.0 persons.*

[c] *Assumes that each dwelling unit is occupied by 2.6 persons.*

[d] *Assumes that each dwelling unit is occupied by 3.5 persons.*

[e] *Assumes that each dwelling unit is occupied by 3.1 persons.*

[f] *Assumes that each dwelling unit is occupied by 3.3 persons.*

[g] *A gross residential square mile includes the net area devoted to residential use plus the supporting land uses, such as streets, parks, schools, churches, and neighborhood shopping centers.*

[h] *A population density of 25,000 persons per gross square mile was considered to the maximum desirable population density level within the Region.*

Source: SEWRPC.

suburban residential density, meaning net lot area per dwelling unit ranges from 1.45 to 5.00 acres; and rural residential density, meaning net lot area per dwelling unit exceeds 5.00 acres. The urban high-, medium-, and low-density categories of residential development are to be provided with a full array of urban services, including centralized sanitary sewer and water supply and walk-in elementary schools. The suburban density category is to be provided with partial urban services, including solid waste collection and police, fire, and rescue services, but not including walk-in elementary schools or centralized sanitary sewer and water supply. Thus, within the context of this report, the term "suburban" is utilized in its literal sense—that is, "suburban,"—indicating that a particular area of urban development is being provided with less than the full array of available urban services. This definition of the term suburban should not be confused with the more popular meaning used to identify civil divisions adjacent to a large central city. Taken together, the urban high-, medium-, and low-density and suburban residential density categories constitute the full range of urban development contemplated in the proposed land use plans, with any development

exceeding a net lot area of five acres per dwelling unit deemed by definition to constitute either rural estate or farm-related residential development.

4. A determination was made of those planning analysis areas in Milwaukee County to be reduced in population size. Milwaukee County is the only county of the Region that loses population under the regional population distribution assumed in preparing the centralized plan for the declining growth scenario.

5. A determination was made of the location of all proposed major regional land uses by quarter section, including major multipurpose commercial centers; major industrial centers; major state, regional, and county parks; and major airports as determined in the adopted regional airport system plan.

6. A determination was made of those quarter sections to which new urban development should be assigned, following the four guidelines set forth above.

7. New residential land was allocated as follows:

   a. New residential development was allocated first to land identified in the 1975 land use inventory as being "under development"; that is, land platted and committed to residential use but not yet used for such development. In this step, lands were designated for development at high, medium, low, or suburban-residential densities, depending on the development pattern to which the land was committed.

   b. When the existing supply of residential land under development was exhausted, new residential development was allocated, generally at medium densities, to available developable land in quarter sections covered by soils suitable for such use and within delineated sanitary sewer service areas. It should be noted that no new suburban density residential development was allocated in this step.

   c. Under the moderate growth scenario, about 10 percent of the increase in the population of the Region through the plan design year 2000 was accommodated in rural density residential development in response to the apparent demand for very low-density, country estate-type development.

8. All new high-, medium-, and low-density residential development was assumed to occur in planned neighborhood units. Accordingly, the developable land areas in those quarter sections to which new high-, medium-, or low-density residential development was assigned were broken down into urban land uses that support residential development at the neighborhood level. These urban land uses consist of: neighborhood commercial, neighborhood institutional, neighborhood park, and neighborhood transportation. The distribution of these urban land uses was based upon the land development percentages embodied in the neighborhood development standards for each residential density.

9. The incremental and total housing units and population of each quarter section and planning analysis area were determined.

10. An adjustment was made to the population and housing unit totals compiled under the preceding steps utilizing the year 2000 regional and county population levels developed for each alternative future scenario set forth in Chapter III of this report.

11. Permanent centralized plan computer tape files were prepared for use in the development of alternative primary transit system plans.

Design Methodology—
Decentralized Land Use Plans

As already noted, the decentralized plans differ conceptually from the centralized plans in that they place more emphasis on low development densities and thus on the use of onsite soil absorption sewage disposal systems and private water supply wells. The following guidelines were used in designing the decentralized plan alternatives under each alternative scenario.

1. New urban development would emphasize the same proportion of medium- and low-urban-density and suburban density development existing within the Region since 1950.

That portion of the new development that is proposed to occur at medium or low urban densities would be allocated to those areas of the Region where centralized sanitary sewer and water supply services could be readily extended or otherwise provided, and such development would be assumed to occur in planned neighborhood units. That portion of the new urban development that is proposed to occur at the suburban residential density would be allocated to those areas of the Region covered by soils having only "very slight," "slight," or "moderate" limitations for development without centralized sanitary sewer service, and would not occur in planned neighborhood units.

2. No new urban development would be allocated to the delineated primary environmental corridors in order to preserve the best remaining elements of the natural resource base of southeastern Wisconsin.

3. To preserve to the maximum extent possible highly productive land for the continuing production of food and fiber, new urban development would be allocated to the delineated prime agricultural lands only in those cases where there did not exist sufficient areas of nonprime agricultural lands and other open lands to accommodate the assumed land use demand.

The following procedures were utilized in preparing the decentralized plans under each scenario:

1. A determination was made of the amount of "developable" land located within each U. S. Public Land Survey quarter section in the same manner as for the centralized plans.

2. An identification was made of those quarter sections with soils having "very slight," "slight," or "moderate" limitations for large lot—one acre or more of net lot area per dwelling unit—residential development without public sanitary sewer service, and the amount of such land in each identified quarter section was determined.

3. An identification was made of those quarter sections currently served by public sanitary sewerage facilities and those planned to be served by such facilities by the year 2000.

4. A determination was made of that proportion of residential land development that occurred within each planning analysis area between 1963 and 1970 that was either served or committed to be served by public sanitary sewerage facilities. This proportion was used to determine the amount of each planning analysis area that should be designated for low- and medium-density urban development and the amount that should be designated for unsewered, suburban residential development.

5. A proposed potential urban or rural density was assigned to each quarter section in the same manner as for the centralized plans.

6. A determination was made of those planning analysis areas in Milwaukee County to be reduced in population size. Milwaukee County is the only county in the Region that loses population under the regional population distribution assumed in preparing the decentralized plans. This determination was based upon trends observed since 1963. In addition, a determination was made of those planning analysis areas in the six outlying counties of the Region that will experience increases in population size. This determination was also based upon trends observed since 1963.

7. A determination was made of the location of all proposed major regional land uses by quarter section, in the same manner as for the centralized plans.

8. A determination was made of those quarter sections to which new urban and suburban development should be assigned, following the three guidelines set forth above.

9. New residential land was allocated as follows:

   a. New residential development was allocated first to land identified in the 1975 land use inventory as being "under development"; that is, land platted and committed to residential use but not yet used for such development. In this step, lands were designated for development at high, medium, low, or suburban residential densities, depending on the development pattern to which the land was committed.

b. When the existing supply of residential land under development was exhausted, new residential development was allocated at medium densities to available developable land in quarter sections covered by soils suitable for such use and within delineated sanitary sewer service areas, and at suburban densities to available developable land in quarter sections with soils having "very slight," "slight," or "moderate" limitations for large lot—one acre or more of net lot area per dwelling unit—residential development without public sanitary sewer service.

10. All new high-, medium-, and low-density residential development was assumed to occur in planned neighborhood units. Accordingly, the developable land areas in those quarter sections to which new high-, medium-, or low-density residential development was assigned were broken down into urban land uses that support residential development at the neighborhood level. These urban land uses consist of: neighborhood commercial, neighborhood institutional, neighborhood park, and neighborhood transportation. The distribution of these urban land uses was based upon the land development percentages embodied in the neighborhood development standards for each residential density. Suburban development was not envisioned to occur in neighborhood units, and thus the only additional urban land use that was allocated to support suburban development was transportation land use.

11. The incremental and total housing units and population of each quarter section and planning analysis area were determined.

12. An adjustment was made to the population and housing units compiled under the preceding steps, utilizing the year 2000 regional and county population levels developed for each alternative future scenario set forth in Chapter III of this report.

13. Permanent decentralized plan computer tape files were prepared for use in the development of alternative primary transit system plans.

LAND USE PLANS FOR THE MODERATE GROWTH ALTERNATIVE SCENARIO

Based on the guidelines, and utilizing the procedures described, two land use plans—a centralized plan and a decentralized plan—were developed under the moderate growth alternative scenario. Table 65 shows how the regional population of 2,219,300 people and the regional employment of 1,016,000 jobs anticipated under this scenario for the year 2000 would be distributed within the Region under the centralized plan, and Table 66, shows how they would be distributed under the decentralized plan.

Centralized Land Use Plan for the Moderate Growth Scenario

The centralized plan for the year 2000 represents a planned continuation of historic development trends apparent within the Region prior to 1950. Under this plan, new urban development is proposed to occur at largely medium densities, and in concentric rings along the full periphery of, and outward from, existing urban centers. In addition, urban development would be encouraged to occur only in those areas of the Region having soils suitable for such development and not subject to special hazards such as flooding, and having readily available sanitary sewer, public water supply, and other essential urban services. The most basic regional development objectives would be achieved by protecting from further urban development the floodlands of the perennial streams and the best

Table 65

DISTRIBUTION OF YEAR 2000 MODERATE GROWTH SCENARIO REGIONAL POPULATION AND EMPLOYMENT BY COUNTY UNDER THE CENTRALIZED LAND USE PLAN

County	Population	Employment
Kenosha	174,800	54,300
Milwaukee	1,049,600	593,600
Ozaukee	114,000	38,000
Racine	217,700	95,500
Walworth	99,600	41,200
Washington	143,000	36,000
Waukesha	420,600	157,400
Region	2,219,300	1,016,000

Source: SEWRPC.

remaining woodlands and wetlands, and by developing an integrated system of park and open space areas centered on the primary environmental corridors. The regional land use growth and density pattern proposed under this alternative future is shown on Maps 2 and 3, and is summarized in Table 67.

The plan would accommodate an increase from the year 1970 of about 463,000 people, or 26 percent; of 203,000 households, or 38 percent; and of 274,000 jobs, or 37 percent through the conversion of 113 square miles of land from rural to urban use, a 20 percent increase in urban land. Furthermore, implementation of the centralized plan would result in employment increases over the 1978 levels in each county in the Region, ranging

Table 66

DISTRIBUTION OF YEAR 2000 MODERATE GROWTH SCENARIO REGIONAL POPULATION AND EMPLOYMENT BY COUNTY UNDER THE DECENTRALIZED LAND USE PLAN

County	Population	Employment
Kenosha	202,800	76,600
Milwaukee	898,500	523,400
Ozaukee	149,000	53,300
Racine	224,700	94,500
Walworth	106,600	46,700
Washington	174,500	59,100
Waukesha	463,200	162,400
Region	2,219,300	1,016,000

Source: SEWRPC.

Table 67

EXISTING AND PROPOSED LAND USE IN THE REGION: 1970 AND 2000 CENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

Land Use Category	Existing 1970		Planned Increment		Total 2000	
	Acres	Percent of Major Category	Acres	Percent Change	Acres	Percent of Major Category
Urban Land Use						
Residential						
Urban High Density	24,389	7.4	371	1.5	24,760	6.2
Urban Medium Density	37,092	11.3	41,046	110.7	78,138	19.5
Urban Low Density	72,701	22.2	- 7,689	- 10.6	65,012	16.2
Suburban Density	22,079	6.7	4,862	22.0	26,941	6.7
Subtotal	156,261	47.6	38,590	24.7	194,851	48.6
Commercial	6,517	2.0	698	10.7	7,215	1.8
Industrial	10,038	3.1	6,672	66.5	16,710	4.2
Governmental and Institutional	16,628	5.1	951	5.7	17,579	4.4
Transportation, Communication, and Utilities[a]	109,430	33.4	21,441	19.6	130,871	32.7
Recreation	28,982[b]	8.8	4,166[c]	14.4	33,148	8.3
Urban Land Use Subtotal	327,856	100.0	72,518	22.1	400,374	100.0
Rural Land Use						
Residential	--[d]	--	22,306	--	22,306	1.7
Agriculture	1,040,119	74.7	- 79,779	- 7.7	960,340	72.7
Other Open Lands[e]	353,125	25.3	- 15,045	- 4.3	338,080	25.6
Rural Land Use Subtotal	1,393,244	100.0	- 72,518	- 5.2	1,320,726	100.0
Total	1,721,100	--	--	--	1,721,100	--

[a] *Includes off-street parking uses.*

[b] *Includes net site area of public and nonpublic recreation sites.*

[c] *Includes only that net site area recommended for public recreation use.*

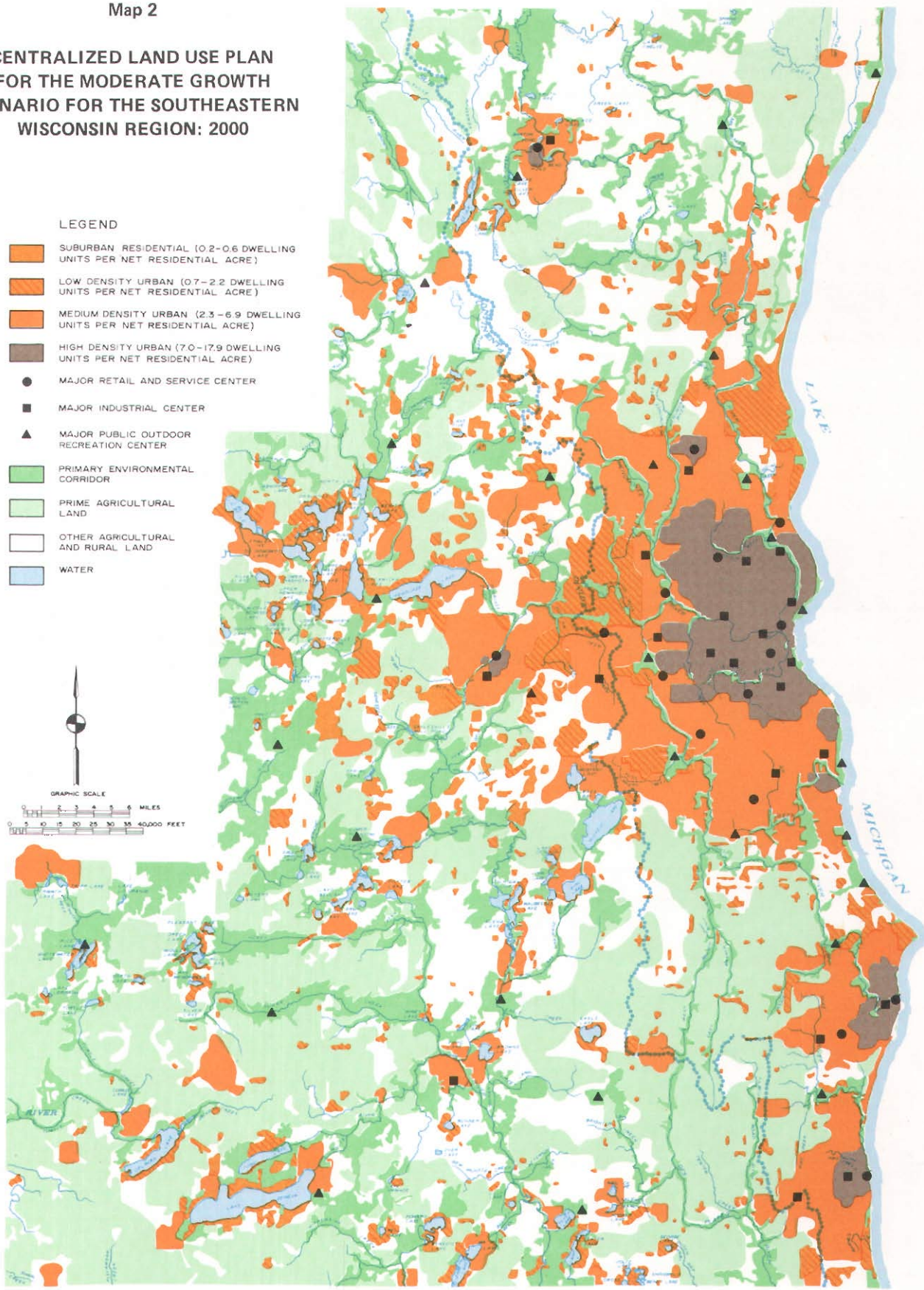
[d] *Included in land use inventory as part of urban residential land use.*

[e] *Includes woodlands, water, wetlands, unused lands, and quarries.*

Source: SEWRPC.

Map 2

CENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO FOR THE SOUTHEASTERN WISCONSIN REGION: 2000

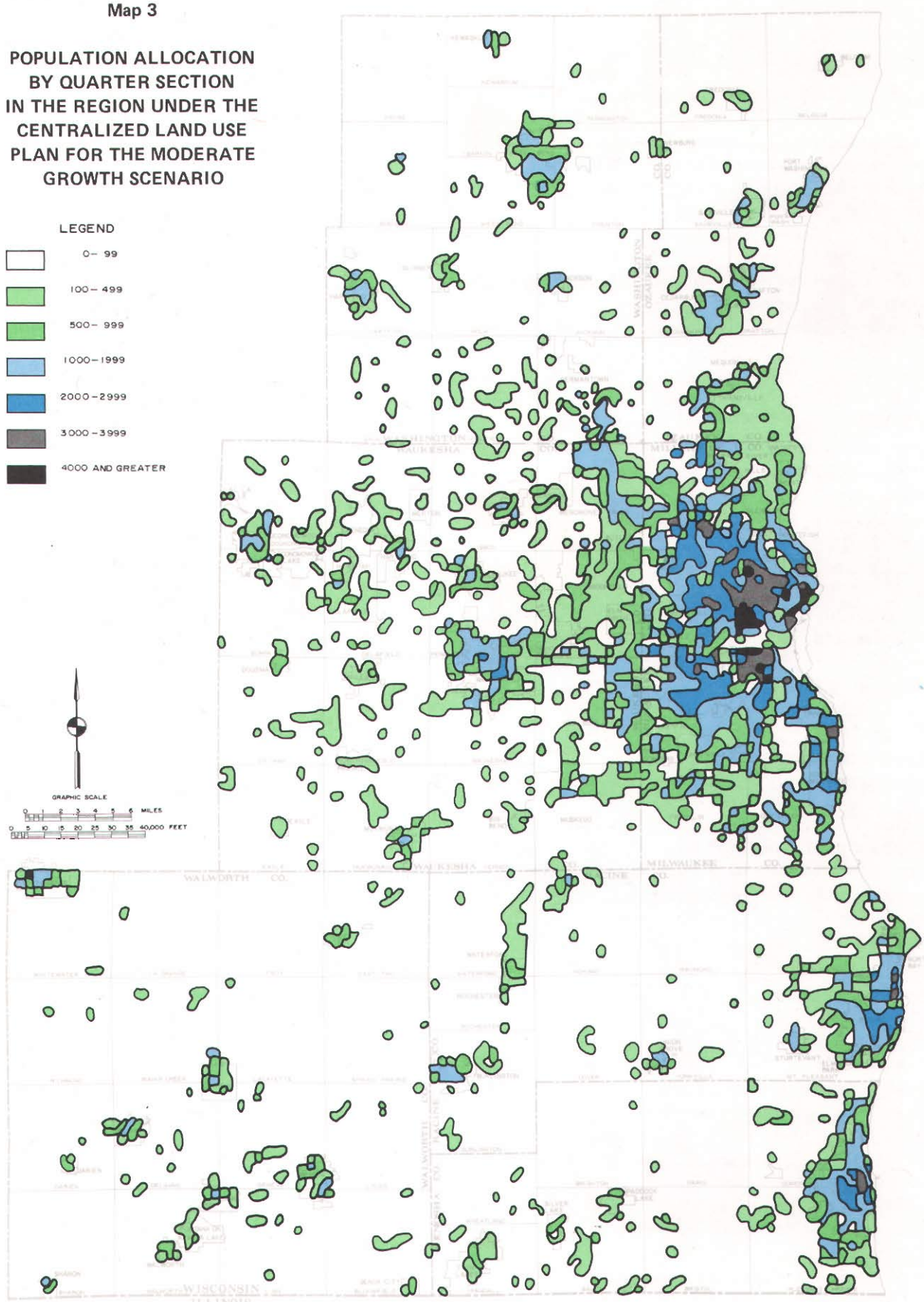


The centralized land use plan for the moderate growth scenario represents a continuation of historic development trends apparent within the Region prior to 1950, with urban development proposed to continue to occur largely in concentric rings along the full periphery of, and outward from, existing urban centers, and at densities consistent with the provision of centralized public sanitary sewer, public water supply, and public transit facilities. Under the centralized land use plan, 62 percent of the new urban residential development would be located within a distance of 20 miles from the central business district of Milwaukee by the year 2000. Primary environmental corridors would be protected from further urban development and the conversion of prime agricultural lands to urban uses would be minimized.

Source: SEWRPC.

Map 3

POPULATION ALLOCATION BY QUARTER SECTION IN THE REGION UNDER THE CENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO



Because the centralized land use plan for the moderate growth scenario envisions the maintenance of the existing population levels of the older central cities, there is a heavy concentration of U. S. Public Land Survey quarter sections with more than 2,000 residents under this plan. These quarter sections are located primarily in the central areas of Milwaukee, Racine, and Kenosha. New urban development is evidenced by an increase in the number of quarter sections with a resident population of 500 to 2,000 persons, especially in the fringe areas of expanding outlying urban communities and areas contiguous to the Milwaukee, Racine, and Kenosha urbanized areas. Scattered concentrations of quarter sections with 100 to 499 residents evident in southern Washington County and throughout Waukesha County represent the diffused, low-density development that occurred in those counties from 1950 through 1975.

Source: SEWRPC.

from an additional 9,800 jobs in Kenosha County to an additional 64,500 jobs in Waukesha County (see Table 68). The proportion of total regional employment in Milwaukee County would continue to decline—from 66 percent in 1978 to 59 percent in the year 2000—although Milwaukee County would gain 31,400 jobs over this time period, an increase of 6 percent.

Table 69 shows the county distribution of the regional population as estimated for 1978 and as anticipated under the centralized land use plan for the year 2000. Under this plan, the absolute changes in county population levels from the year 1978 would range from an increase of nearly 132,000 persons in Waukesha County to an increase of only 30,000 persons in Walworth County. The relative changes from 1978 would range from a gain of 70 percent in Washington County to a gain of 10 percent in Milwaukee County. The year 2000 population of Milwaukee County under this plan—1,049,600 people—would approach its recorded peak in 1970 of 1,054,300 people. The county distribution of the number of households in the Region is shown in Table 70 for the year 1975 and as anticipated under this land use plan. The greatest absolute changes in the number of households would occur in Milwaukee and Waukesha Counties, which would experience increases of 41,500 and 46,000 households, respectively.

Table 71 indicates the additional amount of land proposed to be devoted to urban use within each county from 1970 to 2000 under the centralized land use plan, along with the proposed population change within each county over the same time period. Under the centralized plan of the moderate growth scenario, the population density of the developed urban area of the Region would continue to decline over the planning period—from the 1970 level of about 4,300 persons per square mile to a year 2000 level of about 3,500 persons per square mile—thus maintaining the trend of declining densities evident in the Region since 1920 (see Table 72). The rate of decline would be significantly reduced, however, by implementation of the proposals in the centralized plan to both maintain densities of existing urban areas and to develop the majority of new residential land uses within the Region at medium instead of low densities and to provide such development with public sanitary sewer and water supply services.

Residential Development: The centralized plan of the moderate growth scenario would accommodate the regional population increase of 448,800 persons from 1978 to the year 2000 primarily through an outward expansion of the existing urban areas of the Region. The future intensity and distribution of residential development would be determined largely by the urban land market, guided in the public interest, however, by the required adaptation to certain physiographic and cultural features of the Region, particularly the primary environmental corridors and the sanitary sewer service areas identified in the adopted regional sanitary sewerage system and areawide water quality management plans. The centralized plan would ensure that leapfrog urban development would not occur in outlying areas of the Region by maintaining rural development densities in these areas—that is, minimum lot sizes of five acres per dwelling unit—and by encouraging higher density development in those areas of the Region that can be readily served by essential urban services.

Under this plan, about 62 percent of all new urban residential development in the Region would be located within 20 miles of the central business district of Milwaukee. Future residential development within the Region would occur primarily at medium densities through an outward expansion of existing urban areas, and new urban residential development would consist of a mix of single- and multiple-family housing located primarily in planned residential development units.

As indicated in Table 67, nearly 38,600 acres of new urban residential development would be added to the existing stock of residential land within the Region under this plan. More than one-half of this increment would be developed in Milwaukee and Waukesha Counties. Nearly all of this additional acreage would be developed at medium densities, with a typical single-family lot size being one-quarter acre and typical multiple-family development averaging 10 dwelling units per net acre. Minor amounts of new urban high-density development would occur in Kenosha, Milwaukee, and Racine Counties, with additional minor amounts of urban low-density development occurring in Ozaukee County.

Commercial and Industrial Land Uses: Employment within the Region is anticipated to increase by about 164,000 jobs between 1978 and 2000 under this plan, and about 75 percent of this increase is anticipated to occur in the commercial and industrial employment groups. Many of these new employment opportunities will be located in existing employment centers within the Region, while others will be located in new employment centers proposed under the plan.

Table 68

EMPLOYMENT BY COUNTY IN THE REGION: 1978 AND 2000 CENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

County	Employment		Anticipated Change 1978-2000	
	1978	2000	Number	Percent
Kenosha	44,500	54,300	9,800	22.0
Milwaukee . . .	562,200	593,600	31,400	5.6
Ozaukee	23,800	38,000	14,200	59.7
Racine	74,800	95,500	20,700	27.7
Walworth. . . .	28,900	41,200	12,300	42.6
Washington . .	24,700	36,000	11,300	45.7
Waukesha . . .	92,900	157,400	64,500	69.4
Region	851,800	1,016,000	164,200	18.5

Source: Wisconsin Department of Industry, Labor and Human Relations; and SEWRPC.

Table 69

POPULATION BY COUNTY IN THE REGION: 1978 AND 2000 CENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

County	Population		Anticipated Change 1978-2000	
	1978	2000	Number	Percent
Kenosha	126,200	174,800	48,600	38.5
Milwaukee . . .	954,100	1,049,600	95,500	10.0
Ozaukee	70,400	114,000	43,600	61.9
Racine	177,500	217,700	40,200	22.6
Walworth. . . .	69,200	99,600	30,400	43.9
Washington . .	84,100	143,000	58,900	70.0
Waukesha . . .	289,000	420,600	131,600	45.5
Region	1,770,500	2,219,300	448,800	25.3

Source: Wisconsin Department of Administration and SEWRPC.

Table 70

HOUSEHOLDS IN THE REGION BY COUNTY: 1975 AND 2000 CENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

County	Households		Anticipated Change 1975-2000	
	1975	2000	Number	Percent
Kenosha	39,000	56,400	17,400	44.6
Milwaukee . . .	351,200	392,700	41,500	11.8
Ozaukee	18,000	32,500	14,500	80.6
Racine	53,400	67,800	14,400	27.0
Walworth. . . .	20,700	29,900	9,200	44.4
Washington . .	21,300	42,200	8,600	40.4
Waukesha . . .	71,900	117,900	46,000	64.0
Region	575,500	739,400	163,900	28.5

Source: SEWRPC.

Table 71

URBAN LAND AREA AND POPULATION INCREMENT IN THE REGION BY COUNTY: 1970 AND 2000 CENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

County	Increment: 1970-2000			
	Urban Land Area		Population	
	Acres	Percent	Number	Percent
Kenosha	6,643	9.2	56,900	48.3
Milwaukee . . .	14,453	19.9	- 4,700	- 0.4
Ozaukee	7,652	10.5	59,500	109.2
Racine	5,679	7.8	46,900	27.5
Walworth. . . .	5,186	7.2	36,100	56.9
Washington . .	8,974	12.4	79,200	124.1
Waukesha . . .	23,931	33.0	189,300	81.8
Total	72,518	100.0	463,200	100.0

Source: SEWRPC.

Table 72

POPULATION DENSITY IN THE REGION: SELECTED YEARS 1850-1970 AND 2000 CENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

Year	Population					Area (square miles)		Persons per Square Mile	
	Urban		Rural		Total	Urban	Total	Urban	Total
	Number	Percent of Total	Number	Percent of Total					
1850	28,623	25.2	84,766	74.8	113,389	4	2,689	7,156	42.2
1880	139,509	50.3	137,610	49.7	277,119	18	2,689	7,751	103.1
1900	354,082	70.6	147,726	29.4	501,808	37	2,689	9,570	186.6
1920	635,376	81.1	148,305	18.9	783,681	56	2,689	11,346	291.4
1940	991,535	92.9	76,164	7.1	1,067,699	90	2,689	11,017	397.1
1950	1,179,084	95.0	61,534	5.0	1,240,618	138	2,689	8,544	461.4
1963	1,634,200	97.6	40,100	2.4	1,674,300	340	2,689	4,807	622.6
1970	1,728,949	98.5	27,137	1.5	1,756,086	397	2,689	4,355	653.1
2000	2,201,100	99.2	18,200	0.8	2,219,300	635	2,689	3,466	825.3

Source: SEWRPC.

The centralized plan proposes a total of 22 major industrial centers and 16 major multipurpose commercial centers, of which 14 industrial centers and 10 commercial centers would be located in Milwaukee County. In total, these two types of centers would employ about 239,300 and 127,500 people, respectively, for a total of about 44 percent of the year 2000 regional employment in the commercial and industrial employment groups. The other 56 percent, or approximately 466,800 jobs, would be located in smaller community and local employment centers. Of the 22 planned major industrial centers, 17 existed in 1970 and 5 are proposed new centers. These 5 new centers, as shown on Map 2, are: Kenosha-West, Milwaukee-Granville, Oak Creek, Burlington, and Waukesha. Of the 16 planned major retail and service centers, 11 existed in 1970 and 5 are proposed new centers, as shown on Map 2. These 5 new centers are proposed to be located in or near the Cities of Milwaukee, Oak Creek, Racine, West Bend, and Waukesha. Of these new major centers, one—Northridge in the City of Milwaukee—has already been developed.

The total commercial and industrial land use changes proposed under the centralized plan are presented in Table 67. Nearly 700 acres of commercial land use development and 6,700 acres of industrial land use development would be added to the existing stock of these land uses. This land use development is exclusive of any development area required for off-street parking, access roads, and yards and open spaces.

Governmental and Institutional Land Use: As indicated in Table 67, the centralized plan would add about 950 acres of governmental and institutional land uses to the existing governmental and institutional land use stock within the Region. This represents about a 6 percent increase over the 1970 level. Most of the additional governmental and institutional lands proposed under the plan would be of neighborhood and community, rather than of regional, significance. Specifically, the planned increment of 950 acres would largely be developed for such neighborhood and community uses as new schools, hospitals, and churches; for public facilities such as police and fire stations; and for city, village, and town halls.

Transportation Land Use: As indicated in Table 67, the centralized plan would add about 21,400 acres of transportation land uses to the existing transportation land use stock within the Region. It should be noted that this category includes all communication and utility uses; harbor, railroad, and airport uses; truck terminals; and off-street parking associated with other land use development; as well as streets and highways. This 21,400 acres represents a 20 percent increase over the 1970 acreage in this category. The proposed increase would be required to accommodate the expansion of existing airport facilities; the construction of new and the expansion of existing sewage treatment plants; and the improvement of existing and the provision of new arterial streets, as well as the provision of new collector and local land access streets needed to serve new land use development or to provide adequate transportation service to existing urban development.

Open Space—Recreational Land Use: Under the centralized plan, a total of 29 major parks would be provided and about 4,200 acres of land would be added to the existing stock of recreational land (see Map 2 and Table 67). This represents an increase of 14 percent over the 1970 acreage. It should be noted that this recommended additional recreational land only represents land to be devoted to public recreational use. Included in these 4,200 acres are two new major public park and outdoor recreation centers, as well as additional land to be acquired at existing undeveloped major public park sites and community and neighborhood park and open space to be provided auxiliary to new residential uses under the plan. The rather small increment in recreational land of regional significance—two new parks—is due to the progress made since the adoption of the initial regional land use plan in 1966 toward the acquisition of the 12 new regional park sites proposed in that plan.

Open Space—Primary Environmental Corridors: Primary environmental corridors consist of elongated areas in the landscape which encompass the most important and highest quality elements of the regional natural resource base, including the best remaining surface waters and associated undeveloped floodlands and shorelands, woodlands, wetlands, wildlife habitat, groundwater recharge areas, and scenic, historic, scientific, and cultural sites. The linear pattern which these corridors form in the Region is shown on Map 2. About 347,000 acres, or approximately 20 percent of the total land and water acreage in the Region, are occupied by primary environmental corridors.

The acreage of each land use within the net and gross corridor is set forth in Table 73. Net corridor, which includes water, wetlands, woodlands, agricultural lands, recreational lands, and other open lands but not corridor that is in urban use, constitutes nearly 93 percent of the gross corridor area. Urban development within the corridor constitutes nearly 25,000 acres, or the remaining 7 percent. About 41 percent of the net corridor area, or nearly 133,000 acres, is in water and wetland uses; about 32 percent, or about 204,000 acres, is in agricultural and other open land uses; and about 20 percent, or over 64,000 acres, is in woodland use. The remaining 6 percent, representing about 19,000 acres, is devoted to active recreational land uses.

Under the centralized plan the net corridor area would be developed only to accommodate compatible public or private park and outdoor recreational land uses, since maintenance of essential land uses in the net corridor is vital to the protection of the natural resource base and to the maintenance of the overall quality of the regional environment. Of the total net corridor area of over 322,000 acres, more than 42,000 acres, or about 13 percent, are covered by surface water, leaving the remaining 280,000 acres, or nearly 16 percent of the total land area of the Region, as corridor area requiring protection through appropriate public actions—that is, public acquisition or protection through appropriate land use controls, including accommodation as appropriate of rural estate residential development.

Open Space—Agriculture and Other Open Space Land Use: Under the centralized plan, the expansion of urban activities into presently rural areas of the Region would result in the conversion of about 72,500 acres, or about 113 square miles, of rural land uses to urban land uses between 1970 and the year 2000. Another 22,300 acres of rural land use, or 35 square miles, would be devoted to rural or "country estate" residential use. Because of the very low density recommended for such use, at least five acres per dwelling unit, rural estate development would maintain the basic natural state of the open land.

As indicated in Table 67, much of the urban expansion and country estate residential development proposed under this land use plan—79,800 acres—would inevitably take place on lands now in agricultural use. The result would be a decrease

Table 73

PRIMARY ENVIRONMENTAL CORRIDOR AREA IN THE REGION: 2000 CENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

Environmental Corridor	Acres	Percent of Gross Corridor	Percent of Net Corridor
Gross Corridor	347,108	100.0	--
Urban Development Within Corridor	24,882	7.2	--
Net Corridor	322,226	92.8	100.0
Water	42,529	--	13.2
Wetlands	90,684	--	28.2
Woodlands	64,920	--	20.1
Agriculture	92,761	--	28.8
Other Open Lands[a]	11,748	--	3.6
Recreational Lands	19,584	--	6.1

[a] *Includes quarries, landfill sites, and unused lands.*

Source: SEWRPC.

of about 8 percent in the existing stock of agricultural land within the Region. The plan proposes to preserve in agricultural use to the greatest extent practicable those areas identified as prime agricultural lands. In 1970 these lands totaled about 746 square miles, or 28 percent of the total area of the Region, and 39 percent of the total land in agricultural use in the Region. This year 2000 plan proposes to convert to urban use only those prime agricultural lands that have already been committed to urban development because of proximity to existing and expanding concentrations of urban uses and the prior commitment of heavy capital investments in utility extensions. Only about 8,000 acres, or about 2 percent, of the prime agricultural lands in the Region would be converted to urban use under the plan.

There were 353,100 acres of open lands in addition to agricultural lands in the Region in 1970, including woodlands, water, wetlands, quarries, and unused land. As indicated in Table 67, under the land use plan a total of 15,000 acres, or about 4 percent of the remaining acreage of these other open lands, would be converted to urban use or to rural estate residential use by the year 2000. Most of this acreage would consist of individual woodlots that are located directly in the path of urban growth, and that are of insufficient size or quality

to warrant permanent preservation. Careful subdivision design, however, can preserve the full aesthetic and some of the ecological value of these woodlands and can, at the same time, provide more desirable and valuable building sites.

Decentralized Land Use Plan for the Moderate Growth Scenario

The decentralized land use plan for the year 2000 under the moderate growth scenario represents a planned continuation of historic development trends apparent in the Region since 1950, and particularly since 1963. Much of the new urban development under the plan would occur at low densities, and in noncontiguous enclaves well beyond the periphery of existing urban centers, particularly Milwaukee County. In addition, much of this new urban development would take place in areas beyond existing and planned future sanitary sewer service areas, but in areas covered by soils suitable for the utilization of onsite sewage disposal systems. New urban development would not, under the plan, be located in primary environmental corridors, and the conversion of prime agricultural lands to urban uses would be minimized. The regional land use pattern proposed under this alternative future is shown on Maps 4 and 5 and summarized in Table 74.

Table 74

EXISTING AND PROPOSED LAND USE IN THE REGION: 1970 AND 2000
DECENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

Land Use Category	Existing 1970		Planned Increment		Total 2000	
	Acres	Percent of Major Category	Acres	Percent Change	Acres	Percent of Major Category
Urban Land Use						
Residential						
Urban High Density	24,389	7.4	- 2,548	- 10.4	21,841	4.6
Urban Medium Density	37,092	11.3	43,888	118.3	80,980	16.9
Urban Low Density	72,701	22.2	- 2,423	- 3.3	70,278	14.7
Suburban Density	22,084	6.7	64,889	293.8	86,973	18.2
Subtotal	156,266	47.6	103,806	66.4	260,072	54.4
Commercial	6,517	2.0	385	5.9	6,902	1.4
Industrial	10,039	3.1	3,847	38.3	13,886	2.9
Governmental and Institutional	16,617	5.1	2,735	16.5	19,352	4.0
Transportation, Communication, and Utilities[a]	109,407	33.4	33,788	30.9	143,195	30.0
Recreation	28,996[b]	8.8	5,738[c]	19.8	34,734	7.3
Urban Land Use Subtotal	327,842	100.0	150,299	45.8	478,141	100.0
Rural Land Use						
Residential	--[d]	--	4,782	--	4,782	0.4
Agriculture	1,040,122	74.7	- 141,070	- 13.6	899,052	72.3
Other Open Lands[e]	353,136	25.3	- 14,011	- 4.0	339,125	27.3
Rural Land Use Subtotal	1,393,258	100.0	- 150,299	- 10.8	1,242,959	100.0
Total	1,721,100	--	--	--	1,721,100	--

[a] *Includes off-street parking uses.*

[b] *Includes net site area of public and nonpublic recreation sites.*

[c] *Includes only that net site area recommended for public recreation use.*

[d] *Included in land use inventory as part of urban residential land use.*

[e] *Includes woodlands, water, wetlands, unused lands, and quarries.*

Source: SEWRPC.

The plan would accommodate an increase from the year 1970 of about 463,000 people, or 26 percent; of about 145,000 households, or 27 percent; and of about 274,000 jobs, or 37 percent through the conversion of about 234 square miles of land from rural to urban use, a 46 percent increase in urban land. Furthermore, implementation of this plan would result in employment increases over the 1978 levels in each county in the Region except Milwaukee County, which would lose about 38,800 jobs (see Table 75). The largest increase in employment over the 1978 level, 69,500 jobs, would occur in Waukesha County. Kenosha, Ozaukee, and Washington Counties would each experience increases in employment of about 30,000 jobs. The proportion of total regional employment in Milwaukee County would continue to decline—from 66 percent in 1978 to 52 percent in the year 2000.

Table 76 shows the county distribution of the regional population as estimated for 1978 and as anticipated under the decentralized land use plan for the year 2000. Under this plan, all counties would experience increases in resident population except Milwaukee County, which would lose nearly 56,000 people between 1978 and the year 2000. The largest absolute change in county population levels from the year 1978 would occur in Waukesha County, which would experience an increase of over 174,000 persons. The largest relative change from 1978 levels would occur in Ozaukee and Washington Counties, both of which would more than double in resident population. The county distribution of the number of households in the Region is shown in Table 77 for the year 1975 and as anticipated under the land use plan. The greatest absolute change in households would occur in Waukesha County, which would experience an increase of 56,200 households.

Table 78 indicates the additional amount of land proposed to be devoted to urban use within each county from 1970 to 2000 under the decentralized land use plan, along with the proposed population change within each county over the same time period. Under this plan, the population density of the developed urban area of the Region would decline significantly over the planning period—from the 1970 level of about 4,300 persons per square mile to a year 2000 level of only 2,300

Table 75

EMPLOYMENT BY COUNTY IN THE REGION: 1978 AND 2000 DECENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

County	Employment		Anticipated Change 1978-2000	
	1978	2000	Number	Percent
Kenosha	44,500	76,600	32,100	72.1
Milwaukee . . .	562,200	523,400	- 38,800	- 6.9
Ozaukee	23,800	53,300	29,500	123.9
Racine	74,800	94,500	19,700	26.3
Walworth. . . .	28,900	46,700	17,800	61.6
Washington . .	24,700	59,100	34,400	139.3
Waukesha . . .	92,900	162,400	69,500	74.8
Region	851,800	1,016,000	164,200	19.3

Source: Wisconsin Department of Industry, Labor and Human Relations; and SEWRPC.

Table 76

POPULATION BY COUNTY IN THE REGION: 1978 AND 2000 DECENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

County	Population		Anticipated Change 1978-2000	
	1978	2000	Number	Percent
Kenosha	126,200	202,800	76,600	60.7
Milwaukee . . .	954,100	898,500	- 55,600	- 5.8
Ozaukee	70,400	148,900	78,500	111.5
Racine	177,500	224,700	47,200	26.6
Walworth. . . .	69,200	106,600	37,400	54.0
Washington . .	84,100	174,500	90,400	107.5
Waukesha . . .	289,000	463,300	174,300	60.3
Region	1,770,500	2,219,300	448,800	25.3

Source: Wisconsin Department of Administration and SEWRPC.

Table 77

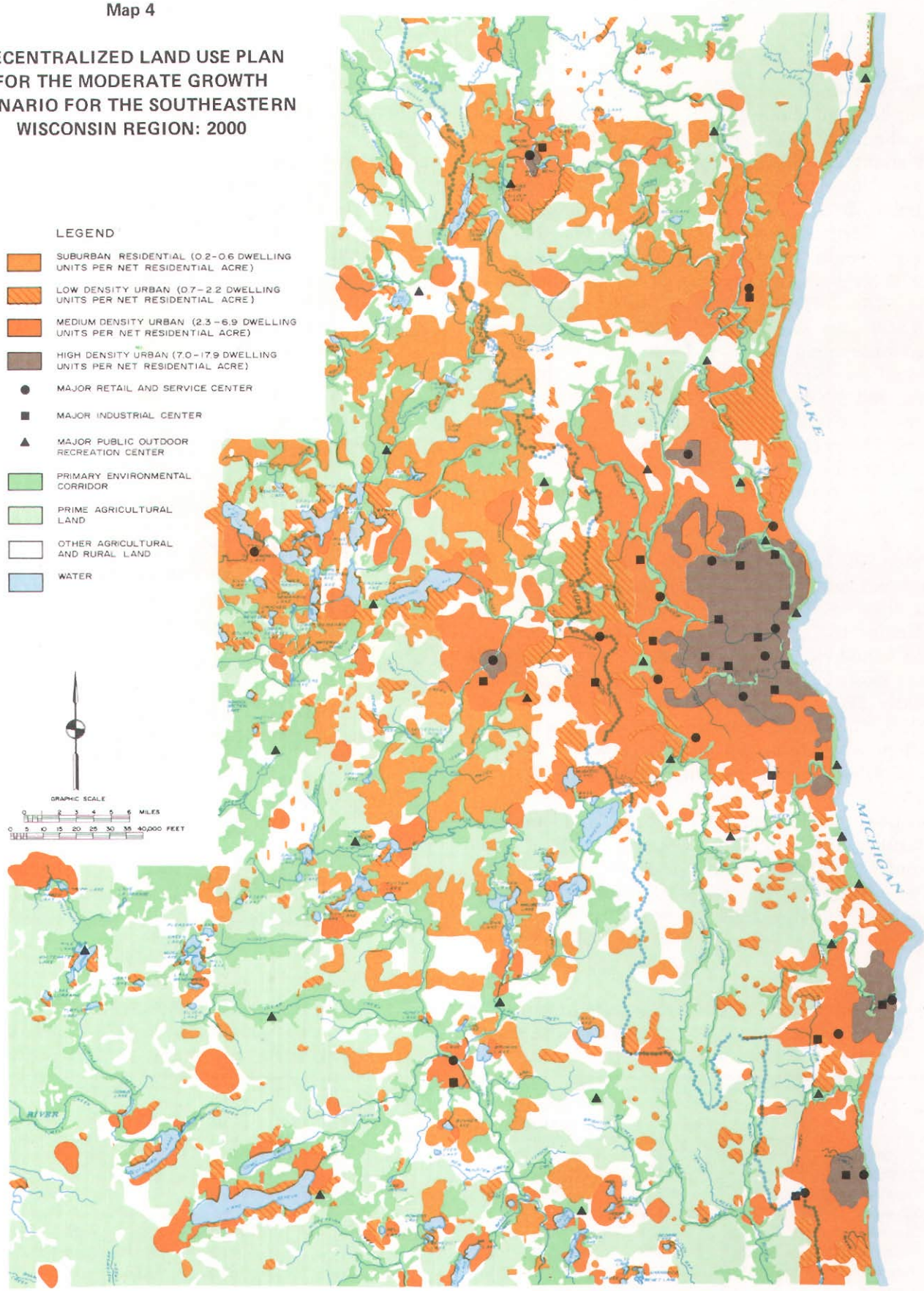
HOUSEHOLDS IN THE REGION BY COUNTY: 1975 AND 2000 DECENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

County	Households		Anticipated Change 1975-2000	
	1975	2000	Number	Percent
Kenosha	39,000	63,800	24,800	63.6
Milwaukee . . .	351,200	295,600	- 55,600	- 15.8
Ozaukee	18,000	41,700	23,700	131.7
Racine	53,400	68,100	14,700	27.5
Walworth. . . .	20,700	32,900	12,200	58.9
Washington . .	21,300	50,900	29,600	138.9
Waukesha . . .	71,900	128,100	56,200	78.2
Region	575,500	681,100	105,600	18.3

Source: SEWRPC.

Map 4

DECENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO FOR THE SOUTHEASTERN WISCONSIN REGION: 2000

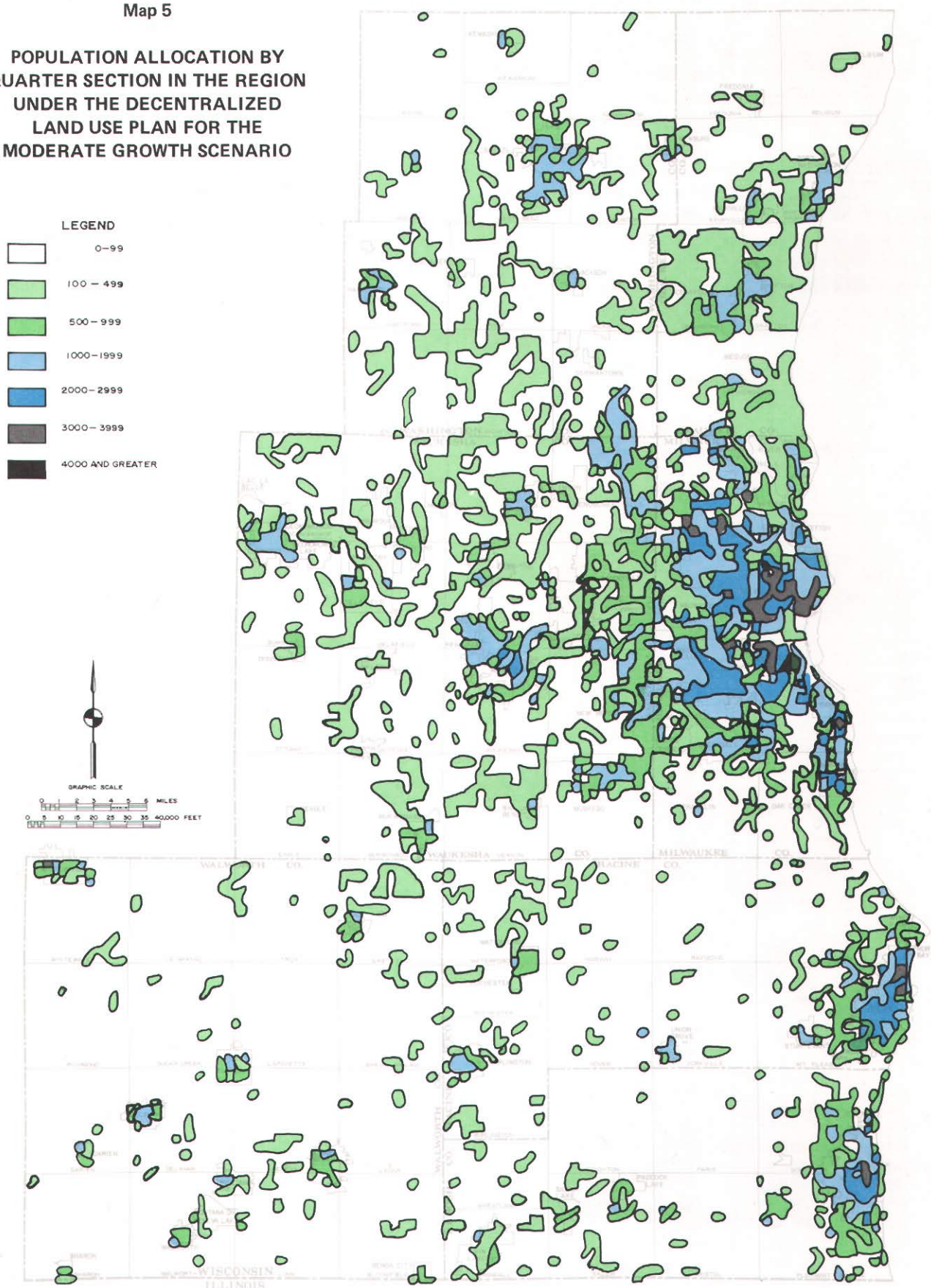


The decentralized land use plan for the moderate growth scenario represents a continuation of the highly diffused, low-density development trends observed within the Region since 1963. Most new urban development under this plan would take place in outlying areas of the Region beyond the periphery of existing urban centers, at low densities, and in noncontiguous enclaves. Under this plan only 27 percent of the new urban residential development would be within 20 miles of the central business district of Milwaukee. New urban development would not, however, be placed in the primary environmental corridors, and the conversion of prime agricultural lands to urban uses would be minimized. However, nearly three times as much prime agricultural land, and twice as much other agricultural lands, would be converted from rural to urban uses under the decentralized plan as would under the centralized plan for this scenario.

Source: SEWRPC.

Map 5

POPULATION ALLOCATION BY QUARTER SECTION IN THE REGION UNDER THE DECENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO



Because of the emphasis on suburban residential development under the decentralized land use plan for the moderate growth scenario, there is a heavy concentration of U. S. Public Land Survey quarter sections with 100 to 499 residents under this plan in central Ozaukee County, western and southern Washington County, and throughout Waukesha County. Under this plan, there are fewer quarter sections in the central Milwaukee, Racine, and Kenosha urban areas with population concentrations of more than 2,000 persons than there are under the centralized plan. The limited extent of new urban medium- and high-density development in the urbanizing portions of the Region surrounding these areas is evidenced by the small number of quarter sections with 500 to 1,999 persons in these portions of the Region, especially in areas around Milwaukee.

Source: SEWRPC.

persons per square mile—thus maintaining the trend of declining densities evident in the Region since 1920 (see Table 79).

Residential Development: The decentralized plan of the moderate growth scenario would accommodate the forecast regional population increase of 440,800 persons from 1978 to the year 2000, as well as the redistribution of about 55,600 persons from Milwaukee County over this same period, through an outward expansion of existing urban areas and through the development at low urban and suburban densities of areas lying well beyond existing urban centers and existing and planned sanitary sewer service areas, particularly in Ozaukee, Washington, and Waukesha Counties. The future intensity and distribution of residential development would be constrained in the public interest only to the extent necessary to ensure that urban development does not intrude upon the primary environmental corridors of the Region; that such development occurs first on agricultural and open space lands not identified as prime lands in the regional land use inventory; and that such development occurs only on soils suitable for the use of onsite sewage disposal systems. Thus, unlike the centralized plan, the decentralized plan would accommodate a continued diffusion of low-density urban and suburban development into outlying areas of the Region.

Under this plan, about 27 percent of all new urban residential development in the Region would be located within 20 miles of the central business district of Milwaukee. That proportion of the new residential development to be provided with centralized sanitary sewer and water supply services, estimated at 80 percent of the new households, would be accommodated in planned residential development units at medium or low densities. That portion of the new residential development planned not to be served with centralized sanitary sewer and water supply services and not to be accommodated in neighborhood units—about

Table 78

URBAN LAND AREA AND POPULATION INCREMENT IN THE REGION BY COUNTY: 1970 AND 2000 DECENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

County	Increment 1970-2000			
	Urban Land Area		Population	
	Acres	Percent	Number	Percent
Kenosha	12,004.68	43.3	84,884	72.0
Milwaukee . . .	4,100.92	3.9	- 155,728	- 14.8
Ozaukee	27,627.75	116.3	94,475	173.5
Racine	12,705.13	36.2	53,858	31.5
Walworth. . . .	12,064.92	37.3	43,161	68.0
Washington . .	35,766.82	136.9	110,663	173.3
Waukesha . . .	46,028.67	60.1	231,901	100.2
Total	150,298.89	45.8	463,214	26.4

Source: SEWRPC.

Table 79

POPULATION DENSITY IN THE REGION: SELECTED YEARS 1850-1970 AND 2000 DECENTRALIZED LAND USE PLAN FOR THE MODERATE GROWTH SCENARIO

Year	Population					Area (square miles)		Persons per Square Mile	
	Urban		Rural		Total	Urban	Total	Urban	Total
	Number	Percent of Total	Number	Percent of Total					
1850	28,623	25.2	84,766	74.8	113,389	4	2,689	7,155.8	42.2
1880	139,509	50.3	137,610	49.7	277,119	18	2,689	7,750.5	103.1
1900	354,082	70.6	147,726	29.4	501,808	37	2,689	9,569.8	186.6
1920	635,376	81.1	148,305	18.9	783,681	56	2,689	11,346.0	291.4
1940	991,535	92.9	76,164	7.1	1,067,699	90	2,689	11,017.1	397.1
1950	1,179,084	95.0	61,534	5.0	1,240,618	138	2,689	8,544.1	461.4
1963	1,634,200	97.6	40,100	2.4	1,674,300	340	2,689	4,806.5	622.6
1970	1,728,949	98.5	27,137	1.5	1,756,086	397	2,689	4,355.0	653.1
2000	2,201,700	99.2	17,600	0.8	2,219,300	969	2,689	2,272.1	601.6

Source: SEWRPC.

20 percent of the new households—would be accommodated at suburban residential densities, with a net lot area per dwelling unit averaging nearly two acres.

As indicated in Table 74, nearly 104,000 acres, or about 163 square miles, of new residential development would be added to the existing stock of residential land within the Region under this plan. Most of this new development would occur in Ozaukee, Washington, and Waukesha Counties, and primarily at suburban residential densities.

Commercial and Industrial Land Uses: The decentralized plan proposes a total of 22 major industrial centers and 19 major multipurpose commercial centers, of which 13 industrial centers and 9 commercial centers would be located in Milwaukee County. Together, these centers would employ about 234,500 and 120,500 people, respectively, for a total of 43 percent of the year 2000 regional employment in the commercial and industrial groups. The other 57 percent, or approximately 478,000 jobs, would be located in smaller community and local employment centers. Of the 22 planned major industrial centers, 17 existed in 1970 and 5 are proposed new centers. These 5 new centers, as shown on Map 4, are Kenosha-West, Cedarburg-Grafton, Oak Creek, Burlington, and Waukesha. The decentralized plan does not propose the expansion of the developing industrial center identified as Milwaukee-Granville, and that center would not be developed into a major regional employment center under this plan.

Of the 19 planned major retail and service centers, 11 existed in 1970 and 8 are proposed new centers, as shown on Map 4. Of the 8 proposed new centers, 4 are to be located in or near the Cities of Kenosha, Milwaukee, Cedarburg-Grafton, and Racine, and the other 4 are the West Bend central business district (CBD), Waukesha CBD, Burlington CBD, and Oconomowoc CBD. Of these new major centers, one—Northridge in the City of Milwaukee—has already been developed.

The commercial and industrial land use changes proposed under the decentralized plan are presented in Table 74. Nearly 400 acres of commercial land use development and about 3,800 acres of industrial land use development would be added to the existing stock of these land uses. This land use development is exclusive of any development area required for off-street parking, access roads, and yards and open spaces.

Governmental and Institutional Land Use: As indicated in Table 74, the decentralized plan would add about 2,700 acres of governmental and institutional land uses to the existing governmental and institutional land use stock within the Region. This represents about a 16 percent increase over 1970 levels. Most of the additional governmental and institutional lands proposed under the plan would be of neighborhood and community, rather than of regional, significance. Specifically, the planned increment of 2,700 acres would largely be developed for such neighborhood and community uses as new schools, hospitals, and churches; for public facilities such as police and fire stations; and for city, village, and town halls.

Transportation Land Use: As indicated in Table 74, the decentralized plan would add about 34,000 acres of transportation land uses to the existing transportation land use stock within the Region. It should be noted that this category includes all communication and utility uses; harbor, railroad, and airport uses; truck terminals; and off-street parking associated with other land use development; as well as streets and highways. This 34,000 acres represents a 31 percent increase over the 1970 acreage in this category. The proposed increase would be required to accommodate the expansion of existing airport facilities; the construction of new and the expansion of existing sewage treatment plants; and the improvement of existing and the provision of new arterial streets, as well as the provision of new collector and local land access streets needed to serve new land use development or to provide adequate transportation service to existing urban development.

Open Space—Recreational Land Use: Under the decentralized plan, a total of 29 major parks would be provided and about 5,700 acres of land would be added to the existing stock of gross recreational land (see Map 4 and Table 74). This represents an increase of about 20 percent over the 1970 acreage. It should be noted that this recommended additional recreational land only represents land to be devoted to public recreational use. Included in these 5,700 acres are two new major public park and outdoor recreation centers, as well as additional land to be acquired at existing undeveloped major public park sites and community and neighborhood park and open space to be provided auxiliary to new residential uses under the plan.

Open Space—Primary Environmental Corridors: Under the decentralized plan, the primary environmental corridors, which contain the highest quality

elements of the natural resource base, would be preserved and protected from development as under the centralized plan for this scenario.

Open Space—Agriculture and Other Open Space Land Use: Under the decentralized plan, the expansion of urban activities into presently rural areas of the Region would result in the conversion of about 150,000 acres, or about 234 square miles, of rural land uses to urban land uses between 1970 and the year 2000. Another 5,000 acres of rural land would be developed for rural or "country estate" residential use. Because of the very low density recommended for such use, at least five acres per lot, rural estate development would maintain the basic rural state of the open land.

As indicated in Table 74, much of the urban expansion and country estate residential development proposed under this land use plan—141,000 acres—would take place on lands now in agricultural use. The result would be a decrease of about 14 percent in the existing stock of agricultural land within the Region. The plan proposes to preserve in agricultural use to the greatest extent practicable those areas identified as prime agricultural lands. In 1970 these lands totaled about 746 square miles, or 28 percent of the total area of the Region, and 39 percent of the total land in agricultural use in the Region. About 22,000 acres, or about 6 percent, of the prime agricultural lands in the Region would be converted to urban use under the plan.

In addition to agricultural lands, there were 353,100 acres of other open land uses in the Region in 1970, including woodlands, water, wetlands, quarries, and unused land. As indicated in Table 74, under the land use plan a total of 14,000 acres, or about 4 percent of the remaining acreage of these other open lands, would be converted to urban use or to rural estate residential use by the year 2000.

Comparison of the Centralized and Decentralized Land Use Plans for the Moderate Growth Scenario: The two land use plans developed under the moderate growth scenario for the Southeastern Wisconsin Region are intended to encompass the range of reasonably possible future land use patterns, particularly as such patterns might influence future transit needs under that growth scenario. The land use plans have therefore been developed to consider, at one end of the range, the planned centralization of land use in the Region and, at the other end of the range, the planned decentralization of land use in the Region. Under the centralized plan, virtually all new urban development would occur in concentric rings along the full periphery of, and outward from, existing urban centers as it did within the Region prior to 1950. Also, existing developed areas in Milwaukee County would, under this plan, maintain at least the same density of occupied housing units as in 1970. New urban development under this plan would occur primarily at medium and high densities, consistent with the economical provision of important urban facilities and services including, importantly, public transit. In contrast, under the decentralized land use plan much of the new urban development would occur in a highly diffused pattern that is discontinuous both radially and circumferentially. Such development would be of low urban and suburban density, thus following the land use development trends evident in the Region since 1950, and particularly since 1963.

Under the centralized plan, the population of Milwaukee County would increase by more than 95,000 people over the 1978 level, an increase of 10 percent. The number of households in Milwaukee County would increase by over 41,000, or nearly 12 percent over the 1975 level, and the number of jobs would increase by over 31,000, or nearly 6 percent over the 1978 level. Under the decentralized plan, the levels of population, households, and employment in Milwaukee County would all decline from the base year levels. Employment would decline by over 38,000 jobs, or nearly 7 percent; population would decline by over 56,000 people, or over 5 percent; and the number of households would decline by over 55,000, or over 15 percent.

In the three outlying counties contiguous to Milwaukee County—Ozaukee, Washington, and Waukesha Counties—population under the centralized plan would increase by nearly 234,000 people, or about 41 percent, over the 1978 level. Employment in these three counties would increase by over 90,000 jobs, or over 63 percent, over the 1978 level. Under the decentralized land use plan, population in these three counties would increase by over 343,000 people, or 77 percent, over 1978 levels, and employment would increase by over 133,000 jobs, or 94 percent. Because the decentralized land use plan would accommodate new and redistributed urban development in the Region to the year 2000 primarily at suburban population densities, the population density of the developed area of the Region under this plan would decline

from a 1970 level of 4,350 persons per square mile to less than 2,300 persons per square mile. Under the centralized land use plan, population density would decline to about 3,500 persons per square mile.

The centralized land use plan would accommodate the forecast population and employment increases in the Region through the conversion of about 113 square miles of land from rural to urban use from 1970 to the year 2000. Thus, the plan proposes a 20 percent increase in urban land to accommodate a 26 percent increase in population, a 38 percent increase in the number of households, and a 37 percent increase in jobs. In contrast, the decentralized land use plan would require the conversion of 234 square miles of land from rural to urban use, or over a 45 percent increase in urban land. Under the decentralized land use plan nearly 104,000 acres of new urban residential development would be added to the Region, compared with 38,600 acres under the centralized plan.

LAND USE PLANS FOR THE STABLE OR DECLINING GROWTH ALTERNATIVE SCENARIO

Based on the guidelines, and utilizing the procedures described, two land use plans—a centralized plan and a decentralized plan—were developed under the stable or declining growth alternative scenario. Table 80 shows how the regional population of 1,690,000 people and the regional employment of 887,000 jobs anticipated under this scenario for the year 2000 would be distributed within the Region under the centralized plan, and Table 81 shows how they would be distributed under the decentralized plan.

Centralized Land Use Plan for the Stable or Declining Growth Scenario

The centralized plan for the year 2000 represents a planned continuation of historic development trends apparent within the Region prior to 1950. Under this plan, new urban development is proposed to occur at largely medium densities in concentric rings along the full periphery of, and outward from, existing urban centers. Existing developed areas in Milwaukee County, particularly high-density areas, would maintain at least the same density of housing units as these areas had in 1970, when the population of Milwaukee County reached its historic peak. In addition, new urban development would occur only in those areas of the Region having soils suitable for such development and not subject to special hazards such as flooding, and having readily available sanitary sewer, public water supply, and other essential urban services. The most basic regional development objectives would be achieved by protecting from further urban development the floodlands of the perennial streams and the best remaining woodlands and wetlands, and by developing an integrated system of park and open space areas centered on the primary environmental corridors. The regional land use growth and density pattern proposed under this alternative future is shown on Maps 6 and 7 and summarized in Table 82.

The plan would accommodate an increase from the year 1970 of about 214,000 households, or 40 percent, through the conversion of 112 square miles of land from rural to urban use, a 22 percent increase in urban land. Furthermore, implementation of the centralized plan would result in employment increases over the 1978 levels in

Table 80

DISTRIBUTION OF YEAR 2000 STABLE OR DECLINING GROWTH SCENARIO REGIONAL POPULATION AND EMPLOYMENT BY COUNTY UNDER THE CENTRALIZED LAND USE PLAN

County	Population	Employment
Kenosha	130,000	43,200
Milwaukee	830,000	552,300
Ozaukee	75,000	29,300
Racine	180,000	78,400
Walworth	70,000	31,200
Washington	95,000	28,500
Waukesha	310,000	124,100
Region	1,690,000	887,000

Source: SEWRPC.

Table 81

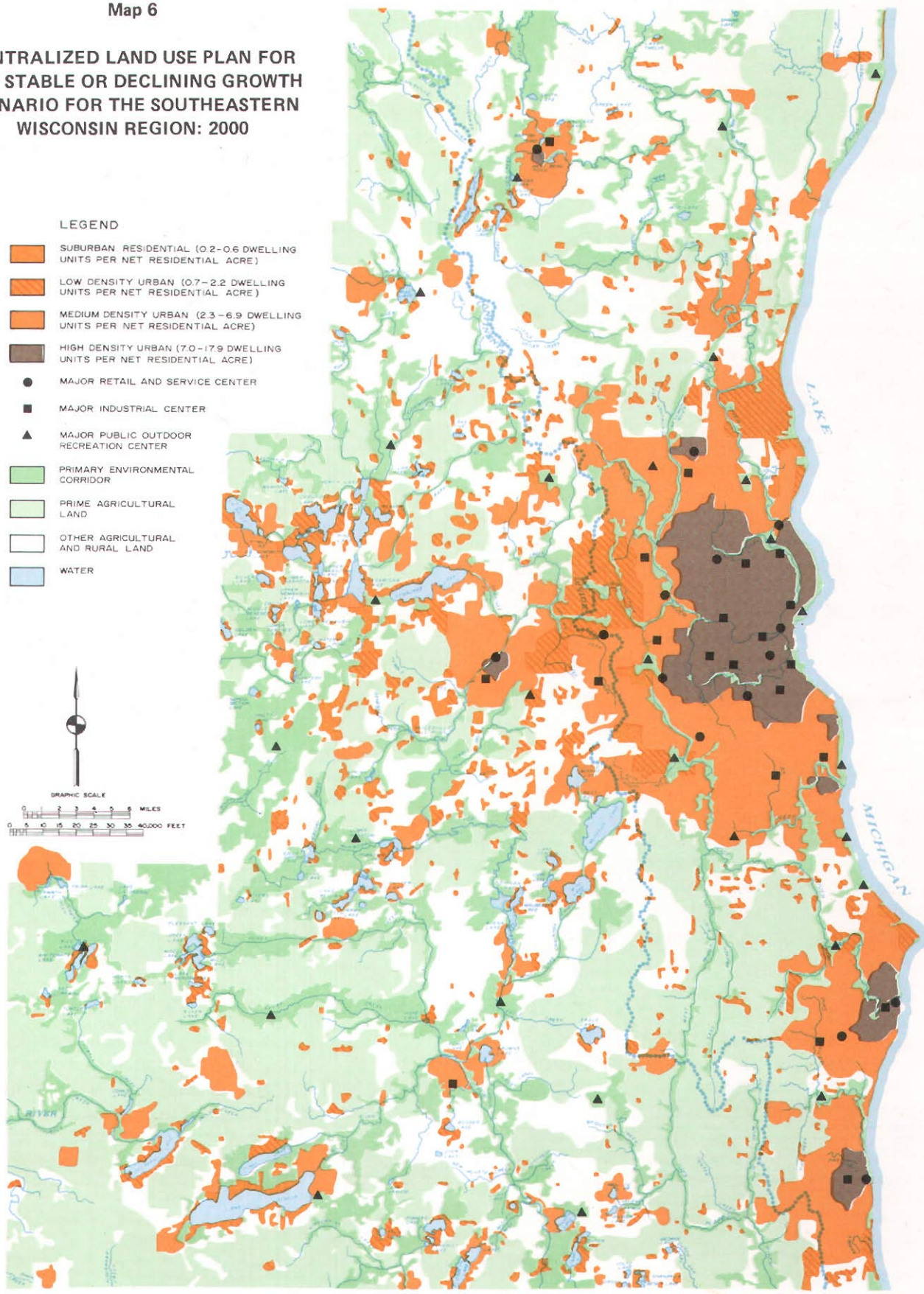
DISTRIBUTION OF YEAR 2000 STABLE OR DECLINING GROWTH SCENARIO REGIONAL POPULATION AND EMPLOYMENT BY COUNTY UNDER THE DECENTRALIZED LAND USE PLAN

County	Population	Employment
Kenosha	125,000	43,200
Milwaukee	700,000	525,300
Ozaukee	100,000	37,300
Racine	180,000	78,400
Walworth	80,000	33,200
Washington	115,000	33,500
Waukesha	390,000	136,100
Region	1,690,000	887,000

Source: SEWRPC.

Map 6

CENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO FOR THE SOUTHEASTERN WISCONSIN REGION: 2000

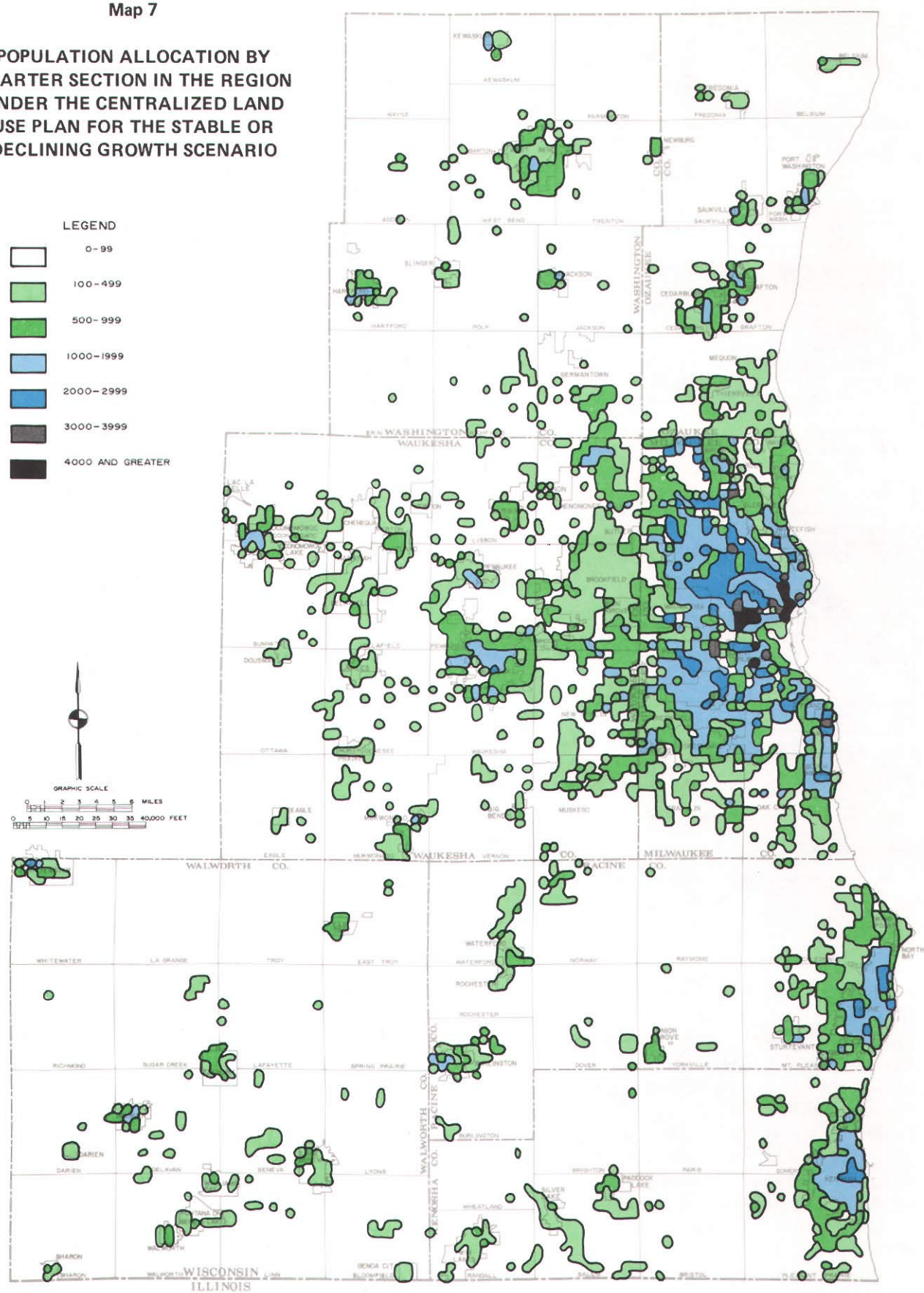


The centralized land use plan for the stable or declining growth scenario, like the centralized land use plan for the moderate growth scenario, represents a continuation of the historic development trends of compact medium- and high-density development which occurred within the Region prior to 1950. Under this plan, urban development is proposed to occur largely in concentric rings along the full periphery of, and outward from, existing urban centers, and at medium and high densities consistent with the provision of centralized public sanitary sewer, public water supply, and public transit services. Under the centralized land use plan, 42 percent of the new urban residential development would be located within 20 miles of the central business district of Milwaukee. Primary environmental corridors would be protected from further urban development, and the conversion of prime agricultural lands to urban uses would be minimized.

Source: SEWRPC.

Map 7

POPULATION ALLOCATION BY QUARTER SECTION IN THE REGION UNDER THE CENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO



Under the centralized land use plan for the stable or declining growth scenario, there is a heavy concentration of U. S. Public Land Survey quarter sections with more than 2,000 residents in the Milwaukee, Racine, and Kenosha urban areas. The number of quarter sections with more than 1,000 residents is significantly less than under the centralized plan for the moderate growth scenario because of the lower population levels and household sizes anticipated under the stable or declining growth scenario. The scattered concentrations of quarter sections with 100 to 499 residents evident primarily in southern Washington County and throughout Waukesha County represent the diffused, low-density development that occurred in those counties from 1950 to 1975.

Source: SEWRPC.

Table 82

EXISTING AND PROPOSED LAND USE IN THE REGION: 1970 AND 2000
CENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO

Land Use Category	Existing 1970		Planned Increment		Total 2000	
	Acres	Percent of Major Category	Acres	Percent Change	Acres	Percent of Major Category
Urban Land Use						
Residential						
Urban High Density	24,389	7.4	1,974	8.1	26,363	6.6
Urban Medium Density	37,092	11.3	42,303	114.0	79,395	19.9
Urban Low Density	72,701	22.2	- 13,297	- 18.3	59,404	14.8
Suburban Density	22,079	6.7	15,840	71.7	37,919	9.5
Subtotal	156,261	47.6	46,820	30.0	203,081	50.8
Commercial	6,517	2.0	587	9.0	7,104	1.8
Industrial	10,038	3.1	2,304	23.0	12,342	3.1
Governmental and Institutional	16,628	5.1	801	4.8	17,429	4.4
Transportation, Communication, and Utilities[a]	109,430	33.4	17,712	16.2	127,142	31.8
Recreation	28,982[b]	8.8	3,655[c]	12.6	32,637	8.1
Urban Land Use Subtotal	327,856	100.0	71,879	21.9	399,735	100.0
Rural Land Use						
Residential	--[d]	--	--	--	--	--
Agriculture	1,040,119	74.7	- 58,439	- 5.6	981,680	74.3
Other Open Lands[e]	353,125	25.3	- 13,440	- 3.8	339,685	25.7
Rural Land Use Subtotal	1,393,244	100.0	- 71,879	- 5.2	1,321,365	100.0
Total	1,721,100	--	--	--	1,721,100	--

[a] *Includes off-street parking uses.*

[b] *Includes net site area of public and nonpublic recreation sites.*

[c] *Includes only that net site area recommended for public recreation use.*

[d] *Included in land use inventory as part of urban residential land use.*

[e] *Includes woodlands, water, wetlands, unused lands, and quarries.*

Source: SEWRPC.

each county in the Region except Kenosha and Milwaukee Counties, as shown in Table 83. The proportion of total regional employment in Milwaukee County would continue to decline—from 66 percent in 1978 to 62 percent in the year 2000.

Table 84 shows the county distribution of the regional population as estimated for 1978 and as anticipated under the centralized land use plan for the year 2000. Under this plan, the absolute changes in county population levels from the year 1978 would range from an increase of about 21,000 persons in Waukesha County to a decrease of 124,100 persons in Milwaukee County. The county distribution of the number of households in the Region is shown in Table 85 for the year 1975 and as anticipated under the land use plan. Because of the decline in household size envisioned under this scenario, all seven counties would experience an increase in the number of households. The highest absolute changes in households would occur in Milwaukee and Waukesha Counties, with increases of 37,100 and 53,100 households, respectively.

Table 86 indicates the additional amount of land proposed to be devoted to urban use within each county from 1970 to 2000 under the centralized land use plan, along with the proposed population change within each county over the same time

Table 83

EMPLOYMENT BY COUNTY IN THE REGION: 1978 AND 2000 CENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO

County	Employment		Anticipated Change 1978-2000	
	1978	2000	Number	Percent
Kenosha	44,500	43,200	- 1,300	- 2.9
Milwaukee . . .	562,200	552,300	- 9,900	- 1.8
Ozaukee	23,800	29,300	5,500	23.1
Racine	74,800	78,400	3,600	4.8
Walworth. . . .	28,900	31,200	2,300	8.0
Washington . .	24,700	28,500	3,800	15.4
Waukesha . . .	92,900	124,100	31,200	33.6
Region	851,800	887,000	35,200	4.1

Source: Wisconsin Department of Industry, Labor and Human Relations; and SEWRPC.

Table 84

POPULATION BY COUNTY IN THE REGION: 1978 AND 2000 CENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO

County	Population		Anticipated Change 1978-2000	
	1978	2000	Number	Percent
Kenosha	126,200	130,000	3,800	3.0
Milwaukee . . .	954,100	830,000	- 124,100	- 13.0
Ozaukee	70,400	75,000	4,600	6.5
Racine	177,500	180,000	2,500	1.4
Walworth. . . .	69,200	70,000	800	1.2
Washington . .	84,100	95,000	10,900	13.0
Waukesha . . .	289,000	310,000	21,000	7.3
Region	1,770,500	1,690,000	- 80,500	- 4.5

Source: Wisconsin Department of Administration and SEWRPC.

Table 85

HOUSEHOLDS IN THE REGION BY COUNTY: 1975 AND 2000 CENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO

County	Households		Anticipated Change 1975-2000	
	1975	2000	Number	Percent
Kenosha	39,000	58,800	19,800	50.8
Milwaukee . . .	351,200	388,300	37,100	10.6
Ozaukee	18,000	30,700	12,700	70.6
Racine	53,400	79,300	25,900	48.5
Walworth. . . .	20,700	29,500	8,800	42.5
Washington . .	21,300	39,000	17,700	83.1
Waukesha . . .	71,900	125,000	53,100	73.9
Region	575,500	750,600	175,100	30.4

Source: SEWRPC.

Table 86

URBAN LAND AREA AND POPULATION INCREMENT IN THE REGION BY COUNTY: 1970 AND 2000 CENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO

County	Increment: 1970-2000			
	Urban Land Area		Population	
	Acres	Percent	Number	Percent
Kenosha	6,555	23.6	12,100	10.3
Milwaukee . . .	9,749	9.2	- 224,300	- 21.3
Ozaukee	4,704	19.8	20,500	37.6
Racine	8,066	23.0	9,200	5.4
Walworth. . . .	6,399	19.8	6,500	10.2
Washington . .	11,782	45.1	31,200	48.9
Waukesha . . .	24,624	32.1	78,700	34.0
Total	71,879	21.9	- 66,100	- 3.8

Source: SEWRPC.

period. Under the centralized plan of the stable or declining growth scenario, the population density of the developed urban area of the Region would continue to decline over the planning period—from the 1970 level of about 4,300 persons per square mile to a year 2000 level of about 2,650 persons per square mile—thus maintaining the trend of declining densities evident in the Region since 1920 (see Table 87). Much of this decline, however, would be the result of the decrease in household size in the Region under this scenario. The population density of the developed urban area of the Region, expressed in terms of number of households per square mile, would decline under this centralized plan—from 1,430 households per square mile in 1970 to 1,180 households per square mile in the year 2000.

Residential Development: The centralized plan of the stable or declining growth scenario would accommodate the regional household increase of 214,000 households from 1970 to the year 2000 primarily through an outward expansion of the existing urban areas of the Region. The future intensity and distribution of residential development would be determined largely by the urban land market, guided in the public interest, however, by the required adaptation to certain phy-

Table 87

POPULATION DENSITY IN THE REGION: SELECTED YEARS 1850-1970 AND 2000
CENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO

Year	Population					Area (square miles)		Persons per Square Mile	
	Urban		Rural						
	Number	Percent of Total	Number	Percent of Total	Total	Urban	Total	Urban	Total
1850	28,623	25.2	84,766	74.8	113,389	4	2,689	7,156	42.2
1880	139,509	50.3	137,610	49.7	277,119	18	2,689	7,751	103.1
1900	354,082	70.6	147,726	29.4	501,808	37	2,689	9,570	186.6
1920	635,376	81.1	148,305	18.9	783,681	56	2,689	11,346	291.4
1940	991,535	92.9	76,164	7.1	1,067,699	90	2,689	11,017	397.1
1950	1,179,084	95.0	61,534	5.0	1,240,618	138	2,689	8,544	461.4
1963	1,634,200	97.6	40,100	2.4	1,674,300	340	2,689	4,807	622.6
1970	1,728,949	98.5	27,137	1.5	1,756,086	397	2,689	4,355	653.1
2000	1,671,000	98.9	19,000	1.1	1,690,000	631	2,689	2,648	628.5

Source: SEWRPC.

siographic and cultural features of the Region, particularly the primary environmental corridors and the sanitary sewer service areas identified in the adopted areawide water quality management plan.

Under this plan, about 42 percent of all new urban residential development in the Region would be located within 20 miles of the central business district of Milwaukee. Future residential development within the Region would occur primarily at medium densities, such development accommodating over 81 percent of the new households in the Region after 1970. New urban residential development would expand outwardly from existing urban areas, and would consist of a mix of single- and multiple-family housing located primarily in planned residential development units.

As indicated in Table 82, over 46,800 acres of new urban residential development would be added to the existing stock of residential land within the Region under this plan. Nearly one-half of this increment would be developed in Milwaukee and Waukesha Counties. Nearly all of this additional acreage would be developed at medium densities, with a typical single-family lot size being one-quarter acre and typical multiple-family development averaging 10 dwelling units per net acre. Some new high-density urban development would occur in Kenosha, Milwaukee, and Racine Counties. Under this plan, suburban density development would be located primarily in Washington and Waukesha Counties, where low-density development has been occurring.

Commercial and Industrial Land Uses: Employment within the Region is anticipated to increase by only 35,200 jobs between 1978 and 2000 under this plan, and nearly all of this increase is anticipated to occur in the commercial and industrial employment groups. Under the plan, many of these new employment opportunities would be located in existing employment centers within the Region, although some would be located in new employment centers.

The centralized plan proposes a total of 21 major industrial centers and 15 major multipurpose commercial centers, of which 14 industrial centers and 9 commercial centers would be located in Milwaukee County. In total, these two types of centers would employ about 199,100 and 125,700 people, respectively, for a total of about 44 percent of the year 2000 regional employment in the commercial and industrial employment groups. The other 56 percent, or approximately 420,700 jobs, would be located in smaller community and local employment centers. Of the 21 planned major industrial centers, 17 existed in 1970 and 4 are proposed new centers. These 4 new centers, as shown in Map 6, are: Milwaukee-Granville, Oak Creek, Burlington, and Waukesha. Of the 15 planned major retail and service centers, 11 existed in 1970 and 4 are proposed new centers, as shown on Map 6. These four new centers are proposed to be located in or near the Cities of Milwaukee, Racine, West Bend, and Waukesha. Of these new major centers, one—Northridge in the City of Milwaukee—has already been developed.

The total commercial and industrial land use changes proposed under the centralized plan are presented in Table 82. Nearly 600 acres of commercial land use development and 2,300 acres of industrial land use development would be added to the existing stock of these land uses. This land use development is exclusive of any development area required for off-street parking, access roads, and yards and open spaces.

Governmental and Institutional Land Use: As indicated in Table 82, the centralized plan would add about 800 acres of governmental and institutional land uses to the existing governmental and institutional land use stock within the Region. This represents about a 5 percent increase over the 1970 level. Most of the additional governmental and institutional lands proposed under the plan would be of neighborhood and community, rather than of regional, significance. Specifically, the planned increment of 800 acres would largely be developed for such neighborhood and community uses as new schools, hospitals, and churches; for public facilities such as police and fire stations; and for city, village, and town halls.

Transportation Land Use: As indicated in Table 82, the centralized plan would add about 17,700 acres of transportation land uses to the existing transportation land use stock within the Region. It should be noted that this category includes all communication and utility uses; harbor, railroad, and airport uses, truck terminals; and off-street parking associated with other land use development, as well as streets and highways. This 17,700 acres represents a 16 percent increase over the 1970 acreage in this category. The proposed increase would be required to accommodate the expansion of existing airport facilities; the construction of new and the expansion of existing sewage treatment plants; and the improvement of existing and the provision of new arterial streets, as well as the provision of new collector and local land access streets needed to serve new land use development or to provide adequate transportation service to existing urban development.

Open Space—Recreational Land Use: Under the centralized plan, a total of 29 major parks would be provided and about 3,700 acres of land would be added to the existing stock of recreational land (see Map 6 and Table 82). This represents an increase of 13 percent over the 1970 acreage. It should be noted that this recommended additional recreational land only represents land to be devoted to public recreational use. Included in these 3,700 acres are two new major public park and outdoor recreation centers, as well as additional land to be acquired at existing undeveloped major public park sites and community and neighborhood park and open space to be provided auxiliary to new residential uses under the plan. The rather small increment in recreational land of regional significance—two new parks—is due to the progress made since the adoption of the initial regional land use plan in 1966 toward the acquisition of 12 new regional park sites proposed in that plan.

Open Space—Primary Environmental Corridors: Under the centralized plan for the stable or declining growth scenario, the primary environmental corridors, which contain the highest quality elements of the natural resource base, would be preserved and protected from development as under the centralized plan for the moderate growth scenario.

Open Space—Agriculture and Other Open Space Land Use: Under the centralized plan, the expansion of urban activities into presently rural areas of the Region would result in the conversion of about 71,900 acres, or about 112 square miles, of rural land uses to urban land uses between 1970 and the year 2000.

As indicated in Table 82, much of the urban expansion proposed under this land use plan—71,900 acres—would take place on lands now in agricultural use. The result would be a decrease of about 6 percent in the existing stock of agricultural land within the Region. The plan proposes to preserve in agricultural use to the greatest extent practicable those areas of the Region identified as prime agricultural lands. In 1970 these lands totaled about 746 square miles, or 28 percent of the total area of the Region, and 39 percent of the total land in agricultural use in the Region. The plan proposes to convert to urban use only those prime agricultural lands which have already been committed to urban development because of proximity to existing and expanding concentrations of urban uses and the prior commitment of heavy capital investments in utility extensions. Only about 11,500 acres, or about 3 percent, of the prime agricultural lands in the Region would be converted to urban use under the plan.

There were 353,100 acres of open lands in addition to agricultural lands in the Region in 1970, including woodlands, water, wetlands, quarries, and unused land. As indicated in Table 82, under the land use plan a total of 13,400 acres, or about

4 percent of the remaining acreage of these other open lands, would be converted to urban use by the year 2000. Most of this acreage would consist of individual woodlots that are located directly in the path of urban growth, and that are of insufficient size or quality to warrant permanent preservation. Careful subdivision design, however, can preserve the full aesthetic and some of the ecological value of these woodlands and can, at the same time, provide more desirable and valuable building sites.

Decentralized Land Use Plan for the Stable or Declining Growth Scenario

The decentralized land use plan for the year 2000 under the moderate growth scenario represents a planned continuation of historic development trends apparent in the Region since 1950, and particularly since 1963. Much of the new urban development under the plan would occur at low densities, and in highly diffused, noncontiguous enclaves well beyond the periphery of existing urban centers, particularly Milwaukee County. In addition, much of this new urban development would take place in areas beyond existing and planned future sanitary sewer service areas, but in areas covered by soils suitable for the utilization of onsite sewage disposal systems. New urban development would not, under the plan, be located in primary environmental corridors, and the conversion of prime agricultural lands to urban uses would be minimized. The regional land use pattern proposed under this alternative future is shown on Maps 8 and 9 and summarized in Table 88.

Table 88

EXISTING AND PROPOSED LAND USE IN THE REGION: 1970 AND 2000 DECENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO

Land Use Category	Existing 1970		Planned Increment		Total 2000	
	Acres	Percent of Major Category	Acres	Percent Change	Acres	Percent of Major Category
Urban Land Use						
Residential						
Urban High Density	24,389	7.4	- 2,848	- 11.7	21,541	4.4
Urban Medium Density	37,092	11.3	35,479	95.7	72,571	14.7
Urban Low Density	72,701	22.2	- 13,371	- 18.4	59,330	12.0
Suburban Density	22,079	6.7	109,300	495.0	131,379	26.5
Subtotal	156,261	47.6	128,560	82.3	284,821	57.6
Commercial	6,517	2.0	361	5.5	6,878	1.4
Industrial	10,038	3.1	2,084	20.8	12,122	2.4
Governmental and Institutional	16,628	5.1	526	3.2	17,154	3.5
Transportation, Communication, and Utilities[a]	109,430	33.4	33,986	31.1	143,416	29.0
Recreation	28,982[b]	8.8	1,481[c]	5.1	30,463	6.1
Urban Land Use Subtotal	327,856	100.0	166,998	50.9	494,854	100.0
Rural Land Use						
Residential	--[d]	--	--	--	--	--
Agriculture	1,040,119	74.7	- 154,028	- 14.8	886,091	72.2
Other Open Lands[e]	353,125	25.3	- 12,970	- 3.7	340,155	27.8
Rural Land Use Subtotal	1,393,244	100.0	- 166,998	- 12.0	1,226,246	100.0
Total	1,721,100	--	--	--	1,721,100	--

[a] *Includes off-street parking uses.*

[b] *Includes net site area of public and nonpublic recreation sites.*

[c] *Includes only that net site area recommended for public recreation use.*

[d] *Included in land use inventory as part of urban residential land use.*

[e] *Includes woodlands, water, wetlands, unused lands, and quarries.*

Source: SEWRPC.

The plan would accommodate an increase from the year 1970 of about 137,100 households, or 26 percent over the 1970 level, through the conversion of about 261 square miles of land from rural to urban use, a 51 percent increase in urban land. Furthermore, implementation of this plan would result in employment increases over the 1978 levels for each county in the Region except Kenosha and Milwaukee Counties, which would lose about 1,300 and 36,900 jobs, respectively (see Table 89). The proportion of total regional employment in Milwaukee County would continue to decline—from 66 percent in 1978 to 59 percent in the year 2000.

Table 90 shows the county distribution of the regional population as estimated for 1978 and as anticipated under the decentralized land use plan for the year 2000. Under this plan, all counties would experience increases in resident population except Milwaukee and Kenosha Counties. Milwaukee County would lose over 254,000 people from 1978 to the year 2000. The largest absolute increase in county population levels from the year 1978 would occur in Waukesha County, which would experience an increase of 101,000 persons, or about 35 percent. The county distribution of the number of households in the Region is shown in Table 91 for the year 1975 and as anticipated under the land use plan. Milwaukee County would experience a decrease of over 50,000 households under the plan. The number of households in Ozaukee, Washington, and Waukesha Counties would nearly double, with Waukesha County experiencing the largest absolute increase of about 70,000 households.

Table 90

POPULATION BY COUNTY IN THE REGION: 1978 AND 2000 DECENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO

County	Population		Anticipated Change 1978-2000	
	1978	2000	Number	Percent
Kenosha	126,200	125,000	- 1,200	- 1.0
Milwaukee . . .	954,100	700,000	- 254,100	- 26.6
Ozaukee	70,400	100.000	29,600	42.0
Racine	177,500	180,000	2,500	1.4
Walworth. . . .	69,200	80,000	10,800	15.6
Washington . .	84,100	115,000	30,900	36.7
Waukesha . . .	289,000	390,000	101,000	34.9
Region	1,770,500	1,690,000	- 80,500	- 4.5

Source: Wisconsin Department of Administration and SEWRPC.

Table 89

EMPLOYMENT BY COUNTY IN THE REGION: 1978 AND 2000 DECENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO

County	Employment		Anticipated Change 1978-2000	
	1978	2000	Number	Percent
Kenosha	44,500	43,200	- 1,300	- 2.9
Milwaukee . . .	562,200	525,300	- 36,900	- 6.6
Ozaukee	23,800	37,300	13,500	56.7
Racine	74,800	78,400	3,600	4.8
Walworth. . . .	28,900	33,200	4,300	14.9
Washington . .	24,700	33,500	8,800	35.6
Waukesha . . .	92,900	136,100	43,200	46.5
Region	851,800	887,000	35,400	4.1

Source: Wisconsin Department of Industry, Labor and Human Relations; and SEWRPC.

Table 91

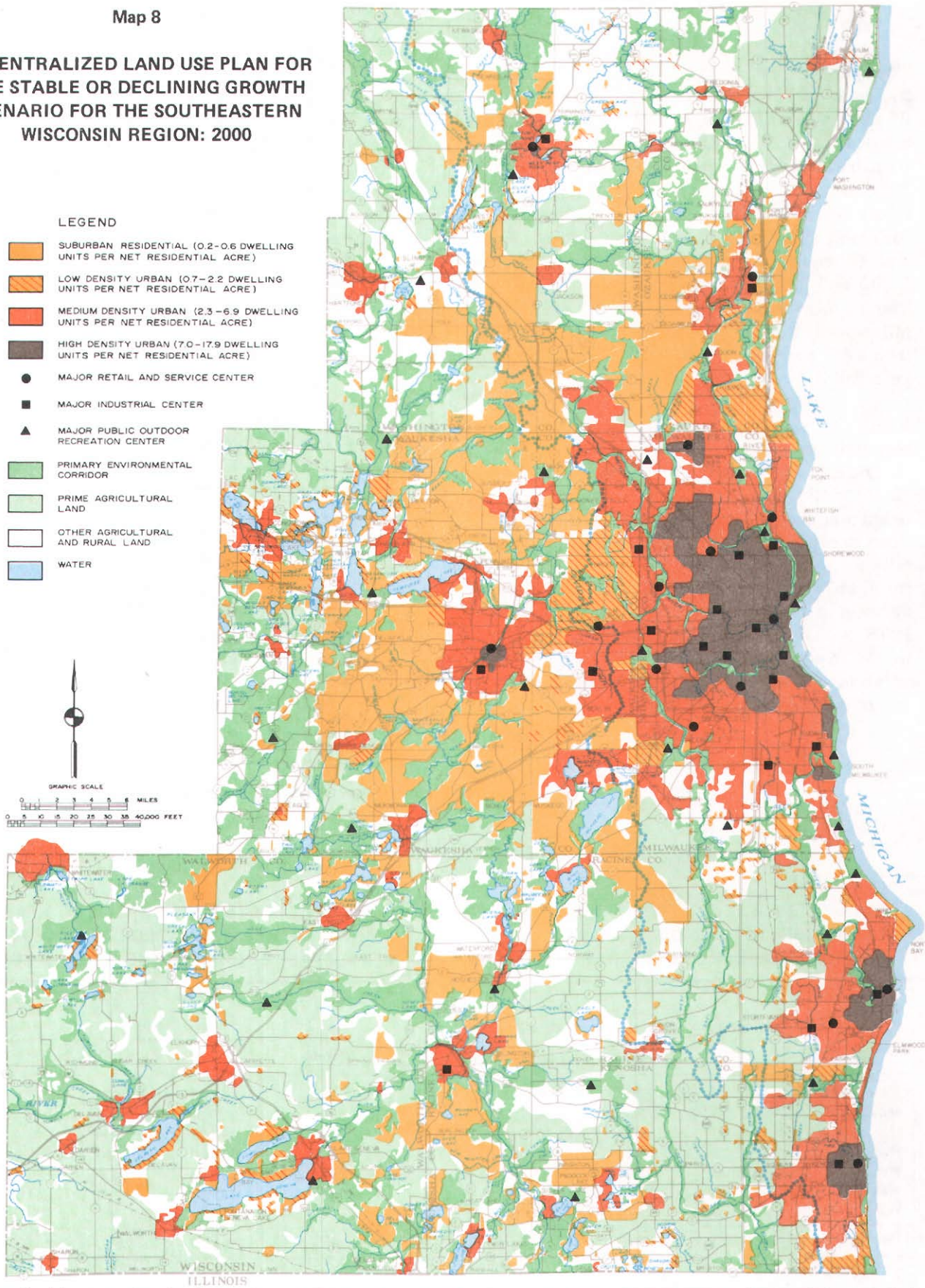
HOUSEHOLDS IN THE REGION BY COUNTY: 1975 AND 2000 DECENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO

County	Households		Anticipated Change 1975-2000	
	1975	2000	Number	Percent
Kenosha	39,000	50,500	11,500	29.5
Milwaukee . . .	351,200	300,500	- 50,700	- 14.4
Ozaukee	18,000	36,500	18,500	102.8
Racine	53,400	70,700	17,300	32.4
Walworth. . . .	20,700	32,000	11,300	54.6
Washington . .	21,300	42,200	20,900	98.1
Waukesha . . .	71,900	141,200	69,300	96.4
Region	575,500	673,600	98,100	17.0

Source: SEWRPC.

Map 8

DECENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO FOR THE SOUTHEASTERN WISCONSIN REGION: 2000

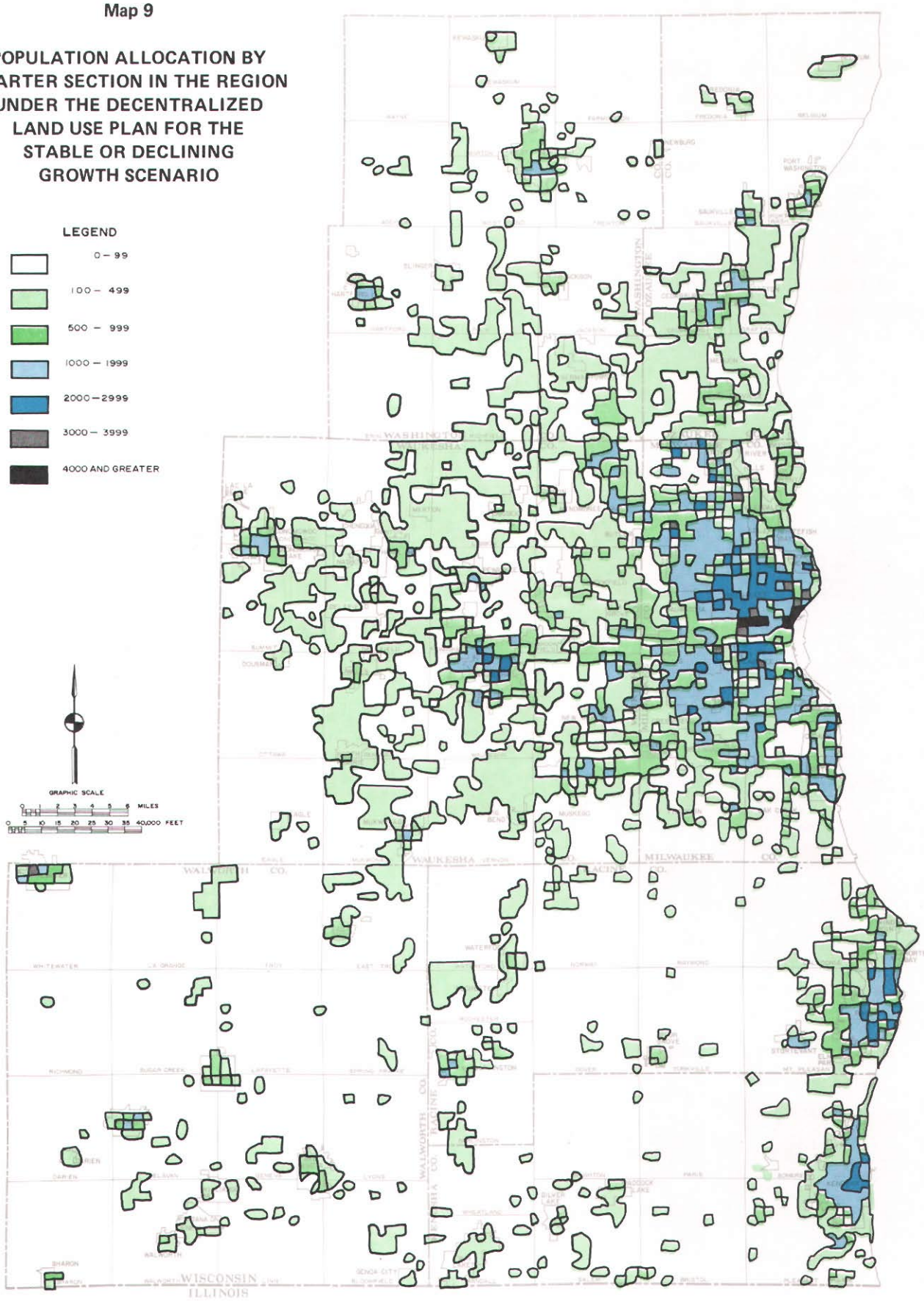


The decentralized land use plan for the stable or declining growth scenario, like the decentralized land use plan for the moderate growth scenario, represents a continuation of the highly diffused, low-density development trends observed within the Region since 1963. Most new urban development under this plan would take place at low densities in noncontiguous enclaves beyond existing urban centers. Under this plan, 37 percent of the new urban residential development would be within 20 miles of the central business district of Milwaukee. New urban development would not, however, be placed in the primary environmental corridors, and the conversion of prime agricultural lands to urban uses would be minimized. However, under this plan over three times as much prime agricultural land, and twice as much other agricultural land, would be converted to urban uses in the Region as would under the centralized plan for this scenario.

Source: SEWRPC.

Map 9

POPULATION ALLOCATION BY QUARTER SECTION IN THE REGION UNDER THE DECENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO



Under the decentralized land use plan for the stable or declining growth scenario, there is an extremely heavy concentration of U. S. Public Land Survey quarter sections with 100 to 499 persons in southern Ozaukee and Washington Counties and throughout Waukesha County. This occurs as a result of significant population increases in Ozaukee, Washington, and Waukesha Counties and a corresponding decrease of 354,000 persons in Milwaukee County, and because of the emphasis on suburban residential development under this plan.

Source: SEWRPC.

Table 92 indicates the additional amount of land proposed to be devoted to urban use within each county from 1970 to 2000 under the decentralized land use plan, along with the proposed population change within each county over the same time period. Under this plan, the population density of the developed urban area of the Region would decline significantly over the planning period—from the 1970 level of about 4,350 persons per square mile to a year 2000 level of only 1,720 persons per square mile—thus maintaining the trend of declining densities evident in the Region since 1920 (see Table 93). Much of this decline would be the result of the decrease in household size under this scenario. However, residential density within the developed urban area of the Region, expressed in terms of the number of households per square mile, would decline from 1,430 households per square mile in 1970 to 690 households per square mile in the year 2000 under this plan.

Residential Development: The decentralized plan of the stable or declining growth scenario would accommodate the forecast regional household increase of 137,000 households from 1970 to the year 2000, as well as the redistribution of population principally from Milwaukee County over this same period, through an outward expansion of existing urban areas and through the development at low urban and suburban densities of areas lying well beyond existing urban centers and existing and planned sanitary sewer service areas, particularly in Ozaukee, Washington, and Waukesha Counties. The future intensity and distribution of residential development would be constrained in the public interest only to the extent necessary to ensure that urban development does not intrude upon the primary environmental corridors of the Region; that such development occurs first on agricultural and open space lands not identified as prime lands in the regional land use inventory; and that such development occurs only on soils suitable for the use of onsite sewage disposal systems. Thus, unlike the centralized plan, the decentralized plan would accommodate a continued diffusion of low-density urban and suburban development into outlying areas of the Region.

Table 92

URBAN LAND AREA AND POPULATION INCREMENT IN THE REGION BY COUNTY: 1970 AND 2000 DECENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO

County	Increment: 1970-2000			
	Urban Land Area		Population	
	Acres	Percent	Number	Percent
Kenosha	10,300	37.1	7,100	6.0
Milwaukee . . .	4,800	4.5	- 354,300	- 33.6
Ozaukee	20,500	86.3	45,500	83.5
Racine	13,100	37.4	9,200	5.4
Walworth. . . .	15,800	48.9	16,500	26.0
Washington . .	30,700	117.5	51,200	80.3
Waukesha . . .	71,800	93.6	158,700	68.6
Total	167,000	50.9	66,100	- 3.8

Source: SEWRPC.

Table 93

POPULATION DENSITY IN THE REGION: SELECTED YEARS 1850-1970 AND 2000 DECENTRALIZED LAND USE PLAN FOR THE STABLE OR DECLINING GROWTH SCENARIO

Year	Population					Area (square miles)		Persons per Square Mile	
	Urban		Rural						
	Number	Percent of Total	Number	Percent of Total	Total	Urban	Total	Urban	Total
1850	28,623	25.2	84,766	74.8	113,389	4	2,689	7,155.8	42.2
1880	139,509	50.3	137,610	49.7	277,119	18	2,689	7,750.5	103.1
1900	354,082	70.6	147,726	29.4	501,808	37	2,689	9,569.8	186.6
1920	635,376	81.1	148,305	18.9	783,681	56	2,689	11,346.0	291.4
1940	991,535	92.9	76,164	7.1	1,067,699	90	2,689	11,017.1	397.1
1950	1,179,084	95.0	61,534	5.0	1,240,618	138	2,689	8,544.1	461.4
1963	1,634,200	97.6	40,100	2.4	1,674,300	340	2,689	4,806.5	622.6
1970	1,728,949	98.5	27,137	1.5	1,756,086	397	2,689	4,355.0	653.1
2000	1,673,000	99.0	17,000	1.0	1,690,000	973	2,689	1,719	628.5

Source: SEWRPC.

Under this plan, only about 37 percent of all new urban residential development in the Region between 1970 and the year 2000 would be located within 20 miles of the central business district of Milwaukee. That proportion of the new residential development to be provided with centralized sanitary sewer and water supply services, estimated at 73 percent of the new households, would be accommodated in planned residential development units at medium densities. That portion of the new residential development planned not to be served with centralized sanitary sewer and water supply services and not to be accommodated in neighborhood units—about 27 percent of the new households—would be accommodated at low urban and suburban residential densities, with a net lot area per dwelling unit averaging nearly two acres.

As indicated in Table 88, nearly 128,600 acres, or about 201 square miles, of new residential development would be added to the existing stock of residential land within the Region under this plan. Most of this new development would occur in Ozaukee, Washington, and Waukesha Counties, and primarily at suburban residential densities.

Commercial and Industrial Land Uses: The decentralized plan proposes a total of 21 major industrial centers and 15 major multipurpose commercial centers, of which 13 industrial centers and 8 commercial centers would be located in Milwaukee County. Together, these centers would employ about 196,500 and 124,900 people, respectively, for a total of 43 percent of the year 2000 regional employment in the commercial and industrial groups. The other 57 percent, or approximately 424,100 jobs, would be located in smaller community and local employment centers. Of the 21 planned major industrial centers, 17 existed in 1970 and 4 are proposed new centers (see Map 8). These 4 new centers are Cedarburg-Grafton, Burlington, Oak Creek, and Waukesha. Unlike the centralized plan for this future scenario, the decentralized plan does not propose to expand the developing industrial center identified as Milwaukee-Granville, and that center would not become a major regional employment center under this plan.

Of the 15 planned major retail and service centers, 10 existed in 1970 and 5 are proposed new centers. The 5 proposed centers are to be located in or near the Cities of Milwaukee, Racine, Cedarburg, West Bend, and Waukesha. Of these new major centers, one—Northridge in the City of Milwaukee—has already been developed.

The commercial and industrial land use changes proposed under the decentralized plan are presented in Table 88. Nearly 360 acres of commercial land use development and about 2,080 acres of industrial land use development would be added to the existing stock of these land uses. This land use development is exclusive of any development area required for off-street parking, access roads, and yards and open spaces.

Governmental and Institutional Land Use: As indicated in Table 88, the decentralized plan would add about 526 acres of governmental and institutional land uses to the existing governmental and institutional land use stock within the Region. This represents about a 3 percent increase over the 1970 level. Most of the additional governmental and institutional lands proposed under the plan would be of neighborhood and community, rather than of regional, significance. Specifically, the planned increment of 526 acres would largely be developed for such neighborhood and community uses as new schools, hospitals, and churches; for public facilities such as police and fire stations; and for city, village, and town halls.

Transportation Land Use: As indicated in Table 88, the decentralized plan would add about 33,990 acres of transportation land uses to the existing transportation land use stock within the Region. It should be noted that this category includes all communication and utility uses; harbor, railroad, and airport uses; truck terminals; and off-street parking associated with other land use development; as well as streets and highways. This 33,990 acres represents a 31 percent increase over the 1970 acreage in this category. The proposed increase would be required to accommodate the expansion of existing airport facilities; the construction of new and the expansion of existing sewage treatment plants; and the improvement of existing and the provision of new arterial streets, as well as the provision of new collector and local land access streets needed to serve new land use development or to provide adequate transportation service to existing urban development.

Open Space—Recreational Land Use: Under the decentralized plan, a total of 29 major parks would be provided and about 1,500 acres of land would be added to the existing stock of gross recreational land (see Map 8 and Table 88). This represents an increase of 5 percent over the 1970 acreage. It should be noted that this recommended additional recreational land only represents land to be devoted to public recreational use. Included in

these 1,500 acres are two new major public park and outdoor recreation centers, as well as additional land to be acquired at existing undeveloped major public park sites and community and neighborhood park and open space to be provided auxiliary to new residential uses under the plan.

Open Space—Primary Environmental Corridors: Under the decentralized plan, the primary environmental corridors, which contain the highest quality elements of the natural resource base, would be preserved and protected from development as under the decentralized plan for the moderate growth scenario.

Open Space—Agriculture and Other Open Space Land Use: Under the decentralized plan, the expansion of urban activities into presently rural areas of the Region would result in the conversion of about 167,000 acres, or about 261 square miles, of rural land uses to urban land uses between 1970 and the year 2000.

As indicated in Table 88, much of the urban expansion proposed under this land use plan—154,000 acres—would take place on lands now in agricultural use. The result would be a decrease of about 15 percent in the existing stock of agricultural land within the Region. The plan proposes to preserve in agricultural use to the greatest extent practicable those areas identified as prime agricultural lands. In 1970 these lands totaled about 746 square miles, or 28 percent of the total area of the Region, and 39 percent of the total land in agricultural use in the Region. About 37,300 acres, or about 9 percent, of the prime agricultural lands in the Region would be converted to urban use under the plan.

In addition to agricultural lands, there were 353,100 acres of other open land uses in the Region in 1970, including woodlands, water, wetlands, quarries, and unused land. As indicated in Table 88, under the land use plan a total of 13,000 acres, or about 4 percent of the remaining acreage of these other open lands, would be converted to urban use.

Comparison of the Centralized and Decentralized Land Use Plans for the Stable or Declining Growth Scenario: The two land use plans developed under the stable or declining growth scenario for the Southeastern Wisconsin Region are intended to encompass the range of reasonably possible future land use patterns, particularly as such patterns might influence future transit needs under that growth scenario. The land use plans have therefore been developed to consider, at one end of the range, the planned centralization of land use in the Region and, at the other end of the range, the planned decentralization of land use in the Region. Under the centralized plan, virtually all new urban development would occur in concentric rings along the full periphery of, and outward from, existing urban centers as it did within the Region prior to 1950. Also, existing developed areas in Milwaukee County would, under this plan, maintain at least the same density of occupied housing units as in 1970. New urban development under this plan would occur primarily at medium and high densities, consistent with the economical provision of important urban facilities and services including, importantly, public transit. In contrast, under the decentralized land use plan much of the new urban development would occur in a highly diffused pattern that is discontinuous both radially and circumferentially. Such development would be of low urban and suburban density, thus following the land use development trends evident in the Region since 1950, and particularly since 1963.

Under the centralized plan, the population of Milwaukee County would decrease by 124,000 people from the 1978 level, primarily as a result of decreasing average household size. The number of households in Milwaukee County, however, would increase by over 37,000, or nearly 11 percent, over the 1975 level, and the number of jobs would decline by nearly 10,000, or about 2 percent, from the 1978 level. Under the decentralized plan, the levels of households, as well as population and employment, in Milwaukee County would significantly decline from the base year levels. Employment would decline by almost 37,000 jobs, or nearly 7 percent; population would decline by 254,000 people, or about 27 percent; and the number of households would decline by over 50,000, or over 14 percent.

In the three outlying counties contiguous to Milwaukee County—Ozaukee, Washington, and Waukesha Counties—population under the centralized plan would increase by nearly 37,000 people, or about 8 percent, over the year 1978 level. Employment in these three counties would increase by 40,500 jobs, or about 29 percent, over the 1978 level. Under the decentralized land use plan, population in these three counties would increase by more than 161,000 people over the 1978 level, or by 36 percent, and employment would increase by 65,500 jobs, or 46 percent. Because the decentralized land use plan would

accommodate new and redistributed urban development in the Region to the year 2000 primarily at suburban densities, the overall population density of the developed area of the Region under this plan would decline from a 1970 level of 4,350 persons per square mile to about 1,720 persons per square mile. Under the centralized land use plan, population density would decline to only about 2,650 persons per square mile. Much of the decline in density under each plan would result from the decline in household size attendant to the stable or declining growth scenario. Expressed in terms of the number of households per square mile, residential density in the developed urban areas of the Region would decline from 1,430 households per square mile in 1970 to 1,180 households per square mile under the centralized plan, and to 690 households per square mile under the decentralized plan.

The centralized land use plan would accommodate the forecast population and employment increases in the Region through the conversion of about 112 square miles of land from rural to urban use from 1970 to the year 2000. Thus, the plan proposes a 20 percent increase in urban land to accommodate a 40 percent increase in the number of households. In contrast, the decentralized land use plan would require the conversion of 261 square miles of land from rural to urban use, for about a 51 percent increase in urban land. Under the centralized land use plan nearly 46,800 acres of new residential development would be added to the Region, compared with 128,600 acres under the decentralized plan.

SUMMARY AND CONCLUSION

The third and last step in the development of the four alternative futures under which alternative primary transit system plans are to be designed, tested, and evaluated is the preparation of alternative land use plans. Two alternative land use plans have been prepared for each of the two alternative future scenarios of external factors influencing development in the Southeastern Wisconsin Region. The alternative land use plans have been developed to encompass for each scenario the range of reasonably possible future land use patterns in the Region, particularly as such patterns might influence future transit needs. The plans developed for each of the two alternative scenarios consider, at the one extreme, the future centralization of land use in the Region and, at the other extreme, the decentralization of land use in the Region. The future centralized and decentralized concepts of land use envisioned in the plans reflect reasonable judgments regarding existing land use development within the Region, existing trends in such development, and the degree to which future development may be expected to depart from these conditions and trends.

In the centralized plans, virtually all new urban development occurs in concentric rings along the full periphery of, and outward from, existing urban centers as it did within the Region prior to 1950. Moreover, the new urban development occurs principally at medium densities in neighborhood units consistent with the economical provision of important urban facilities and services such as centralized public sanitary sewer, water supply, and transit. Importantly, the plans provide for the protection of all of the remaining primary environmental corridors within the Region from further urban development, and seek to minimize the conversion of agricultural lands, particularly prime agricultural lands, to urban uses. With respect to existing development, existing developed areas in Milwaukee County retain at least the same density of occupied housing units as in 1970.

In contrast, the decentralized plans place less emphasis and importance on the centralization of urban development, on the concentration of residential development in planned neighborhood units, on the provision of public sanitary sewer, water supply, and transit services, and on the attainment of medium-density population levels. These plans place more emphasis on the use of onsite soil absorption sewage disposal systems (septic tanks) and private water supply wells, on the continued use of the automobile as the dominant form of urban transportation, and on low-density residential development, including suburban and exurban development. Employment as well as residences are decentralized, and the population of the larger central cities and older first ring suburbs continues to decline. The decentralized land use plan alternative represents a continuation of historic development trends observed within the Region since 1950, with urban development occurring in a highly diffused pattern, at low densities, and in noncontiguous enclaves well beyond the periphery of existing urban centers, particularly Milwaukee County. New urban development is not, however, permitted in primary environmental corridors, and the conversion of prime agricultural lands to urban uses is minimized.

Both the centralized and decentralized land use plans for the moderate growth scenario accommodate an increase from the year 1978 of 448,800

persons, or 25 percent, and of 164,200 jobs, or 18 percent. Furthermore, the centralized plan accommodates an increase in the number of households from 1970 of 203,000, and the decentralized plan, of 145,000. Under the centralized plan, the population of Milwaukee County increases by over 95,000 people from the 1978 level to 1,049,600 by the year 2000, an increase of 10 percent. Furthermore, the number of households in Milwaukee County increases by over 41,000 to a total of 392,700 by the year 2000, or nearly 12 percent over the 1975 level; and the number of jobs in Milwaukee County increases by over 31,000 to a total of 593,600 by the year 2000, or nearly 6 percent over the 1978 level. Under the decentralized plan the levels of population, households, and employment in Milwaukee County all decline from the base year levels. Employment declines by over 38,800, or nearly 7 percent, to a total of 523,400 jobs; population declines by 56,000 people, or over 5 percent, to a total of 898,500 people; and the number of households declines by over 55,000, or over 15 percent, to a total of 295,600 households.

In the three outlying counties contiguous to Milwaukee County—Ozaukee, Washington, and Waukesha Counties—population under the centralized plan for the moderate growth scenario increases by 234,000 people, or about 41 percent, from the year 1978 to a total of 687,600 persons. Employment in these three counties increases by more than 90,000 jobs, or over 63 percent, over the 1978 level to a total of 231,400 jobs in the year 2000. Under the decentralized land use plan, population in these three counties increases by over 343,000 people, or 78 percent, over 1978 levels to a total of 786,700 persons, and employment increases by over 133,000 jobs, or 94 percent, to a total of 274,800 jobs.

Because the decentralized land use plan for the moderate growth scenario accommodates the new and redistributed urban development in the Region to the year 2000 primarily at suburban population densities, the population density of the developed area of the Region under the decentralized land use plan declines from a 1970 level of 4,350 persons per square mile to under 2,300 persons per square mile. Under the centralized land use plan, population density declines to about 3,500 persons per square mile. The centralized land use plan accommodates the population and employment increases in the Region through the conversion of 72,518 acres of land, or about 113 square miles, from rural to urban use from 1970 to the year 2000. In contrast, the decentralized land use plan requires the conversion of 150,299 acres of land, or about 234 square miles, from rural to urban use, or over a 45 percent increase in urban land.

The centralized land use plan developed under the stable or declining growth scenario for the Southeastern Wisconsin Region accommodates an increase from the year 1975 of 214,100 households, and the decentralized land use plan, of 137,000 households. Each plan accommodates an increase of about 35,000 jobs between 1978 and the year 2000. The population of the Region under this scenario, however, declines by about 81,000 people, or approximately 5 percent. Under the centralized plan, the population of Milwaukee County declines by only 124,000 people from the 1978 level to 830,000 in the year 2000, largely as a result of a significant decline in average household size. The number of households in Milwaukee County increases by over 37,000, or nearly 11 percent, over the 1975 level to a total of 388,300 in the year 2000, and the number of jobs declines by only 10,000 from the year 1978 to a total of 552,300 in the year 2000. Under the decentralized plan the level of households, as well as of population and employment, declines in Milwaukee County from the base year level. Employment declines by almost 37,000 jobs, or nearly 7 percent, to a total of 525,300 jobs; population declines by 254,000 people, or over 27 percent, to a total of 700,000 persons; and the number of households declines by more than 50,000, or over 14 percent, to a total of 300,500 households.

In the three outlying counties contiguous to Milwaukee County—Ozaukee, Washington, and Waukesha Counties—population under the centralized plan increases by nearly 37,000 people, or about 8 percent, over the year 1978 to a total of 480,000 persons. Employment in these three counties increases by over 40,500 jobs, or more than 29 percent, over the 1978 levels to a total of 181,000 jobs in the year 2000. Under the decentralized land use plan, population in these three counties increases by more than 161,000 people, or 36 percent, over the 1978 level to a total of 605,000 persons, and employment increases by 65,500 jobs, or 46 percent, to a total of 206,900 jobs.

Because the decentralized land use plan would accommodate the new and redistributed urban development in the Region to the year 2000 primarily at suburban population densities, the population density of the developed areas of

the Region under this plan declines from a 1970 level of 4,350 persons per square mile to under 1,720 persons per square mile. Under the centralized land use plan, population density declines to about 2,650 persons per square mile. Much of the decline in density under each plan is a result of the decline in household size under the stable or declining growth scenario. Expressed in terms of number of households per square mile, density in the developed urban areas of the Region declines from 1,430 households per square mile in 1970 to 1,180 households per square mile under the centralized plan, and to 690 households per square mile under the decentralized plan. The centralized land use plan accommodates this change in the Region through the conversion of 71,900 acres of land, or about 112 square miles, from rural to urban use from 1970 to the year 2000. In contrast, the decentralized land use plan requires the conversion of 167,000 acres of land, or about 261 square miles of land, from rural to urban use, for about a 51 percent increase in urban land.

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Chapter V

SUMMARY AND CONCLUSIONS

INTRODUCTION

Traditionally, long-range transportation system planning has involved the preparation of a single forecast of future levels of population and economic activity and of such factors as the cost of automobile operation, and the use of these forecasts in the testing and evaluation of alternative land use and transportation system plans. This approach has worked well in periods of relative stability, when historic trends in the factors underlying and influencing population and economic change and motor fuel cost could be reasonably expected to extend over the plan design period. However, during periods of major changes in social and economic conditions, and particularly during times when external factors such as the cost and availability of motor fuel are subject to rapid change, the assumption that historic trends will continue becomes uncertain and different procedures become necessary.

For the study of primary transit alternatives in the Milwaukee area, a new approach, termed alternative futures, was accordingly used in an attempt to deal with the high level of uncertainty that exists today about key future conditions that influence public transit needs. These conditions include energy cost and availability as well as population lifestyles and land use centralization. Under the alternative futures approach, the design, testing, and evaluation of alternative primary transit system plans is based upon a number of alternative futures which are intended to define the range of future conditions that may be expected to occur over the plan design period. The purpose of the alternative futures approach is to identify those alternative system plans that perform well under a wide range of future conditions. In this way, "robust" system plans that can be expected to remain viable under greatly varying future conditions can be identified and recommended for implementation. In addition, the alternative futures approach is intended to permit the identification of those system options which work best under particular futures, so that actions can be taken to avoid foreclosing those options.

The identification of the alternative futures under which the primary transit system plans were to be tested was accomplished in three phases. First, key factors external to the Region influencing future public transit needs were identified, and alternative scenarios of future change in these factors were developed. The external factors included were motor fuel cost and availability, technology and the conservation of energy, population lifestyles, and economic conditions. These factors may affect transit needs directly—for example, by affecting the cost of urban travel—or indirectly, by affecting regional growth or decline. Two scenarios were developed to represent consistent and reasonable extremes of future conditions as they relate to potential transit utilization. The more optimistic scenario, termed the moderate growth scenario, envisions particularly favorable conditions for public transit, with the external factors leading to moderate population and economic growth in the Region, and to significantly higher energy prices and the potential for motor fuel supply restrictions to act as incentives for increased transit use. The less optimistic scenario, termed the stable or declining growth scenario, envisions conditions less favorable to transit utilization, with the external factors leading to a stable economy, a slight population decline, and moderately higher energy prices which, when combined with the increased fuel efficiency, would result in a slight decrease in the real cost of automobile travel. The second phase of the alternative futures process was the development of future regional population and employment levels for each of the two scenarios based upon assumptions consistent with the scenarios. In the third phase of the process, centralized and decentralized land use plans representing the reasonable extremes of land use distribution and intensity that could be expected under each scenario were developed.

ALTERNATIVE FUTURE SCENARIOS

External Factors Affecting Regional Growth

Because of factors operating largely external to the Region, the magnitude and character of the future overall development of the Southeastern Wis-

consin Region are uncertain. Four external factors have been identified as a basis for the development of two alternative future scenarios defining the widest reasonable range of conditions influencing primary transit system needs in the Milwaukee area. These factors are: energy cost and availability, technology and conservation, population lifestyles, and economic conditions.

Energy Cost and Availability: The future cost and availability of energy is an important external factor affecting transit needs in southeastern Wisconsin because of its influence on the future cost and convenience of travel and its effects on regional growth patterns. Total energy use in the United States has risen from 43 quadrillion British Thermal Units (BTU's) in 1960 to 78 quadrillion BTU's in 1978, an increase of 82 percent over 19 years. Petroleum use in the nation increased from 17 to 39 quadrillion BTU's, or by 130 percent, over the same period. The amount of petroleum imported to the United States has increased by over 400 percent over this same time period. By 1978, the United States was importing almost 50 percent of its petroleum. This increased dependence on foreign petroleum has resulted in major increases in the cost of motor fuel and periodic disruptions in motor fuel supply. Imported petroleum prices have risen rapidly, principally since the early 1970's, from less than $5.00 per barrel in 1960 to $26 per barrel by late 1979, causing the average price of petroleum per barrel in the United States to increase from under $4.00 to over $20 over the same period. This situation is especially critical to the transportation sector, which accounts for about 25 percent of the total national energy use and about 60 percent of the total national petroleum consumption. Prospects for the economy and for transportation in the United States are highly uncertain, largely because of this dependency upon imported petroleum, but also because high rates of usage and future increases in energy, and particularly motor fuel, costs are likely. Furthermore, there is the potential for future disruptions in supply, with attendant short- and long-term impacts on transportation. Thus, major readjustments will be necessary to deal with the nation's energy problem.

Technology and Conservation: The greatest potential for a departure from past trends in energy use lies with the more efficient use of energy and increased conservation. It is unlikely that the domestic production of petroleum can be increased significantly over current levels, either by conventional or unconventional means, without significant price increases. In addition, a variety of environmental, public health, and safety concerns may be expected to constrain significant increases in the use of other conventional energy sources, such as coal and nuclear power, in the next two decades. Questions of the technological and economic feasibility of unconventional energy sources such as solar power and synthetic fuels—liquified coal or biomass—coupled with the long lead time necessary to develop and implement these new energy sources can be expected to limit their impact on overall energy consumption patterns over the next two decades. For similar reasons, it appears unlikely that radical changes in automobile technology, such as the introduction of new propulsion systems (e.g., electric automobiles), will have any significant influence on the overall demand for petroleum. Thus, the prospects for a simple technological solution to the current energy situation are poor, and fuel costs may be expected to continue to become an increasingly large component of the unit costs of urban travel over the next two decades. While this does not preclude important shifts in the efficiency of transportation technology, it does imply that major technological changes will not solve the transportation energy crisis in the near-term future.

In the face of significantly higher energy costs and the potential for disruptions in supply, conservation is the most likely response to the energy problem over the next two decades. The increasing involvement of the federal government in programs to reduce dependence on foreign oil, as well as the economic pressures on consumers and producers, points toward the more efficient use of energy in the future. Conservation of energy is attainable through increased automobile fuel efficiency, better residential space heating systems, and improvements in industrial process steam generation. Automobile use, residential space heating, and industrial process steam generating currently represent about one-third of total national energy use. Through future conservation in these three energy uses the rate of growth in national energy demand could be reduced from the 3.5 percent annual rate of increase experienced from 1960 through 1975, to a 2.5 percent annual rate of increase. It is expected that, even to meet this reduced energy demand, the use of coal in direct combustion will at least double in the nation over the next 20 years, as will the use of electrical power generated through greater use of coal and nuclear resources.

Accordingly, it appears that two key factors will influence the future development of the Region: 1) the future cost and availability of energy, particularly of petroleum-based fuels but of other fuels as well; and 2) the degree to which energy conservation measures are implemented, particularly with respect to automobile travel. Future transit needs in the Milwaukee area may be expected to be affected directly by the future cost of petroleum-based motor fuel and the fuel consumption efficiency of the automobile, and indirectly by the subsequent changes in future levels of tripmaking and travel patterns in the area brought about by changes in the distribution of employment and population in the Region.

Population and Lifestyles: In recent years, significant changes have occurred in the lifestyles and attendant socioeconomic characteristics of the residents of the Region and the nation. Family pattern changes have included lower fertility rates, higher female labor force participation rates, increased rates of divorce, and reductions in average household size. Residential lifestyle changes have included changes in the rate of inter- and intraregional population migration.

The long-established, traditional, family-centered lifestyle marked by a husband as the sole provider, a wife who cares for home and family, and two or three children has been changing toward a more individualistic orientation, with increased numbers of nonfamily households. This shift has resulted from a number of factors, including the changing role of women in society, a more individualistic orientation of people, and changing economic conditions which require families to have more than one wage earner to maintain a desired standard of living. These changes have led to increases in the labor force participation of women, a decline in birthrates, and a consequent general aging of the population. These changes, coupled with higher rates of divorce, differentials in male and female mortality rates, and the increased tendency of younger and older adults to live independently, have resulted in a substantial reduction in average household size and rapid increases in the number of one- and two-person households. Residential development patterns in the past have favored single-family housing in the suburban and rural areas of the Region and have resulted in declines in the population of the central cities of the Region. However, if the number of nontraditional households continues to grow, a shift to a demand for multiple-unit housing may be expected, along with a decrease in the demand for single-unit housing, perhaps accompanied by a trend toward centralization of development in the Region.

The key external factors influencing the future population lifestyles of the Region include: 1) the degree to which the changing role of women in society affects the composition of the labor force; 2) future changes in fertility rates; and 3) future changes in household size. These three key external factors may be expected to affect transit needs in the Milwaukee area principally by influencing future levels of population, employment, and households. A continuation of recent lifestyle trends would result in a continued increase in female labor force participation; the maintenance of below-replacement-level fertility rates; and decreases in household size as the number of one- and two-person households accounts for increasingly larger proportions of the population. On the other hand, if a substantial portion of the population currently in its twenties and early thirties ultimately decides to enter family formation, albeit at later ages than has been traditional, some moderation of recent trends toward nontraditional family lifestyle patterns may be expected. A slowing of the rate of increase in female labor force participation would occur, along with decreased fertility rates and a stabilization in household size. To an extent, these factors will also be influenced by the state of the economy of the Region and the nation.

Economic Conditions: The future level of economic activity in the nation and Region will greatly influence future transportation system development needs because employment levels and income are important determinants of population size and lifestyles, and of the overall amount of travel. In considering the future levels of economic activity in the Region, the influence of a number of factors must be addressed, including: the size of the regional population; labor force participation rates; the age structure of the population; levels of work force productivity; and changes in the price and availability of energy resources, especially imported petroleum. A particularly important consideration is the extent to which southeastern Wisconsin will be able to compete effectively with other areas of the nation in the maintenance and expansion of its present, and the attraction of new, business and industry.

The key external factors influencing the future economic conditions of the Region include: 1) the degree to which the Region will be able to compete

with other parts of the nation for business and industry; and 2) the future change in real income effected by the price of resources, especially energy. Future transit needs in the Milwaukee area will be affected by changes in economic conditions in that changes in area employment and population levels will directly affect total demand for travel in the area. Future income levels will have the additional effect of influencing future levels of automobile ownership, levels of trip-making, and choice of mode of travel.

To bring about a strong and expanding future economy in southeastern Wisconsin, conditions leading to increasing consumer demand for goods and services and favorable conditions for business and industry expansion in the Region are necessary. Factors that would lead to an increasing demand for goods and services include an increase in population size, an age structure of population with large proportions of work force age, lower rates of inflation, and increased levels of income. In addition, the ability of the Region to compete with other regions of the nation for business and industry expansion and development, particularly with regard to the manufacturing industry, must be maintained and enhanced.

A weak economy in southeastern Wisconsin would result from a failure of the Region to compete effectively with other areas of the country and from continued high rates of interest and inflation, which would cause a slowdown in business expansion and in the demand for goods and services. A period of stability or decline in total population levels would further add to a decrease in demand for goods and services. Finally, declines in capital investment for production could further reduce demand for goods and services in that increases in productivity, and consequently personal income, would not be encouraged.

Alternative Scenarios

Two alternative scenarios with quite different implications for the development of the Region were developed by logically linking opposite endpoints of the range of future prospects for each of these key external factors. These alternative futures are intended to constitute a reasonable combination of the endpoints of the future range of factors external to the Region. One scenario represents optimistic conditions for transit system utilization, and the other represents conditions that are pessimistic for transit system use. As shown in Table 94, the key external factors that may be expected to influence development in the Region differ considerably under the two scenarios. The optimistic, or moderate growth, scenario points toward a significant increase in the cost of automobile travel brought about by relatively high fuel costs and a relatively low degree of conservation; a stabilization of lifestyle trends accompanied by a small increase in female labor force participation and a stabilization in household size; and a strong and expanding regional economy. Such conditions may be expected to result in economic conditions conducive to transit use as well as in a sizable market of potential transit users. The pessimistic, or stable or declining growth, scenario, on the other hand, postulates conditions less conducive to transit use, including a decrease in the real cost of automobile travel as a result of successful efforts at conservation, increased automobile fuel efficiency, a low rate of increase in fuel prices, a more individualistic lifestyle with a high level of female labor force participation; low fertility rates and small household sizes; and a declining economy with substantial out-migration from the Region.

The Moderate Growth Scenario: The moderate growth scenario was developed to represent the most optimistic conditions for future primary transit system development. Thus, transit alternatives that were determined to be infeasible under this future were dropped from further consideration under less transit-oriented futures. The moderate growth scenario assumes a severe energy situation, and, as its name implies, moderate growth in regional employment and population. Under this scenario, energy conservation is marked by only limited success, and alternative fuel sources are only moderately successful in reducing the demand for petroleum-based fuels. Consequently, there is a continued high degree of dependency upon petroleum as a source of energy accompanied by continued high levels of petroleum imports. The use of energy in the nation is assumed to continue to increase at a rate of 3 percent per year to the year 2000, and average automobile fuel efficiency is assumed to reach 27.5 miles per gallon. To meet the increases in national energy needs, the use of electricity and coal in direct combustion more than double, and the use of liquid fuels, including some synthetic fuels, increases by about one-third to one-half. Even with such increases and with some success at conserving petroleum, the use of petroleum still increases. As a result, the average price of oil produced in the United States is assumed to increase rapidly to world prices, and

then to rise at a rate of about 5 percent per year in constant 1979 dollars. Under these conditions, gasoline prices are projected to increase to $2.30 per gallon by the year 2000, expressed in constant 1979 dollars—a 130 percent real increase over 1979 levels.

The moderate growth population scenario envisions a continuation of the types of population change experienced in the Region during the 1960's and early part of the 1970's. A partial return to a family-oriented lifestyle is assumed, as is a desire by many persons now in their twenties or early thirties to form traditional families. Under this scenario, fertility rates continue at below replacement levels into the 1980's, followed by a slight increase to replacement level by the year 2000. In addition, there is a balance between in- and out-migration of population between 1970 and the year 2000. These fertility rates, coupled with a general aging of the population, are expected to create significant shifts in the age composition of the resident population, with a small decrease in number of school-age children and major increases in the numbers of people in the work force and retirement age groups. Low fertility, coupled with some continuation in the trend of increasing numbers of one- and two-person households, is expected to lead to an average household size in the Region of between 2.9 and 3.1 persons in the year 2000, and to a rate of increase in households that is greater than the rate of increase in population between 1970 and 2000. The total number of households in the Region in the year 2000 is expected to range between 680,000 and 740,000, as compared with the 1970 level of 536,500. Under the moderate population growth scenario, the resident population of the Region is expected to increase by about 463,000 persons, or about 26 percent, between 1970 and 2000—from about 1,756,100 persons in 1970 to about 2,219,300 persons in the year 2000.

The economic changes that may be expected to occur under the moderate growth scenario represent a continuation of the types of changes that have occurred historically in the regional economy. This scenario can be characterized as long-term economic growth at a rate at or slightly below national averages. Growth in the regional economy will result from the interaction of several factors explicitly assumed as a part of the moderate growth scenario, and this growth will be met by a growing demand for goods and services because of the increase in the Region's population. An increased proportion of the population will be in the work force age groups, and there will be increased female labor force participation as a result of the growing regional labor force and the continued ability of the Region to compete economically with other regions of the nation. Under the moderate growth scenario, the number of jobs available in the Region will increase by about 274,000, or about 37 percent, between 1970 and the year 2000—from a 1970 level of 741,600 jobs to about 1,016,000 jobs in the year 2000. Average household income will increase to between $29,600 and $32,000 in the year 2000, or by about 38 to 49 percent over the 1970 level of $21,400 as measured in constant 1979 dollars.

The Stable or Declining Growth Scenario: The stable or declining growth scenario represents the combination of levels of motor fuel availability and price and population and economic activity that would be least oriented to transit use in the future. The stable or declining growth scenario envisions a moderate increase in petroleum prices, no major disruptions in the supply of petroleum, and a high degree of conservation in all sectors of the economy. Under this scenario, efforts to conserve energy are successful, and there is a substantial substitution of coal, synthetic fuels, and other fuel sources for petroleum fuels. The use of coal and electricity generated through coal and nuclear power plants is assumed to double by the year 2000. Continued reliance on oil imports, but at a reduced level, is anticipated under this future, and average automobile fuel efficiency is projected to reach 32 miles per gallon in the year 2000. As a result of these efforts, little or no increase in petroleum use over the next 20 years is postulated. The price of oil in the United States is anticipated to converge rapidly with world oil prices and to rise in real terms at a rate of 2 percent or less per year thereafter. Because of greater efficiency and moderate fuel price increases, the cost of automobile travel per mile is somewhat less than the current level in constant dollars.

Population changes under this scenario can be best characterized as an acceleration of the regional population change experienced in the late 1970's, when the Region experienced a decline in its rate of growth. Fertility rates at below replacement levels are assumed to continue to the year 2000. This assumption, combined with a rate of net out-migration sufficiently large to offset all natural increases in regional population, will produce a slight population decrease in the Region by the

year 2000. Thus, it is also assumed under this scenario that the Region will be unable to compete effectively with other regions of the country for economic development, and that persons presently in their twenties and thirties will continue to have a low rate of family formation. Under this scenario, Kenosha, Milwaukee, and Racine Counties—all of which experienced population losses between 1975 and 1978—will continue to lose population through the year 2000. Continued low fertility rates in concert with the general aging of the population, and with high levels of regional out-migration in the age groups below 45 years of age, will create significant shifts in the age composition of the resident population, with major decreases in the school-age population and slight increases in the work force age and retirement age population.

Table 94

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

Table 94 (continued)

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)

Land Use Plan Characteristics	Moderate Growth Scenario		Stable or Declining Growth Scenario	
	Centralized Plan	Decentralized Plan	Centralized Plan	Decentralized Plan
Urban Growth and Density				
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.

Lower fertility rates, coupled with a continuation of nonfamily-oriented household formation patterns, will lead to a major decrease in average regional household size to between 2.2 and 2.5 persons in the year 2000, as compared with the 1978 national rate of 2.81, and to an increase in the total number of households to between 674,000 and 750,000, as compared with the 1970 level of 536,500. This increase in households will occur in spite of the fact that the total population will decrease slightly between 1980 and the year 2000 under this scenario. Population under this scenario will decline to 1,690,000 persons in the year 2000, a loss of about 66,000 persons, or about 4 percent, from the 1970 level. The difference in total regional population in the year 2000 under the two alternative futures scenarios is about 529,000 persons.

The economic changes that may be expected to occur under this scenario represent a departure from existing regional trends. This departure is based on a decline in the population level, along with an assumed inability of the Region to compete with other sectors of the nation economically. As a result, employment levels may be expected to show only moderate increases over 1970 levels in the year 2000, with most of the increase occurring during the 1970's. It is assumed that the rate of increase in regional employment will be significantly below the national rates of increase, particularly after 1980. Employment growth that does occur is assumed to be accommodated by increases in the labor force participation rate and by the slight increase in the size of the population in labor force age groups.

Under this scenario, the number of jobs in the Region may be expected to increase by about 145,400, or about 20 percent, over 1970 levels to about 887,000 jobs in the year 2000. The difference in total regional employment in the year 2000 under the two alternative future scenarios is about 129,000 jobs. Average household income is envisioned as ranging from its 1970 level of $21,400, measured in constant 1979 dollars, to $23,700, an 11 percent real increase.

REGIONAL DEVELOPMENT ALTERNATIVES

The third step in the development of the alternative futures under which alternative primary transit plans are to be designed, tested, and evaluated was the preparation of alternative land use plans. Two alternative land use plans were prepared fo each of the two scenarios to represent the range of possible development patterns in the Region. These plans consist of a centralized land use plan and a decentralized land use plan. The centralized plans developed for each scenario represent a planned continuation of historic development trends evident within the Region prior to 1950, with new urban development proposed to occur at largely medium densities in concentric rings along the periphery of, and outward from, existing urban centers. Urban development would be encouraged to occur only in those areas of the Region having soils suitable for development, not subject to special hazards such as flooding, and having sanitary sewer, public water supply, and other essential urban services readily available. The decentralized land use plans developed for each scenario represent a continuation of historic development trends evident within the Region since 1950, and particularly since 1963. Much of the new urban development under the plan would occur at low densities, and in noncontiguous enclaves well beyond the periphery of existing urban centers, particularly Milwaukee County. Much of this new urban development would take place in areas beyond existing and planned future sanitary sewer service areas, but where soils are suitable for onsite sewage disposal systems. New urban development would not, under any of the land use plans, be located in primary environmental corridors or in areas of poor soil conditions. Furthermore, under all of the land use plans the conversion of prime agricultural land to urban use would be minimized.

Land Use Plans for the Moderate Growth Scenario

Under the centralized plan for the moderate growth scenario, virtually all new urban development would occur in concentric rings along the periphery of, and outward from, existing urban centers. Existing developed areas in Milwaukee County would maintain at least the same density of occupied housing units as in 1970. New urban development under this plan would occur primarily at medium and high densities consistent with the economical provision of important urban facilities and services, including public transit. In contrast, under the decentralized land use plan much of the new urban development would occur in a highly diffused pattern that is discontinuous both radially and circumferentially. Such development would be of low urban and suburban density, thus following the land use development trends evident in the Region prior to 1950.

Under the centralized plan, the population of Milwaukee County would increase by more than 95,000 people over the 1978 level to a level of

1,049,600 in the year 2000, an increase of 10 percent. The number of households in Milwaukee County would increase by over 41,000 to a total of 392,700 in the year 2000, or nearly 12 percent over the 1975 level, and the number of jobs would increase by over 31,000 to a total 593,600 in the year 2000, or nearly 6 percent over the 1978 level. Under the decentralized plan, the levels of population, households, and employment in Milwaukee County would all decline from the base year levels. Employment would decline by over 38,000, or nearly 7 percent, to a total of 523,400 jobs; population would decline by over 56,000 people, or over 5 percent, to a total of 898,500 persons; and the number of households would decline by over 55,000, or over 15 percent, to a total of 295,600 households.

In the three outlying counties contiguous to Milwaukee County—Ozaukee, Washington, and Waukesha Counties—population under the centralized plan would increase by nearly 234,000 people, or about 41 percent, over the 1978 level to a total of 677,600 persons. Employment in these three counties would increase by over 90,000 jobs, or over 63 percent, over the 1978 level to a total of 231,400 jobs by the year 2000. Under the decentralized land use plan, population in these three counties would increase by over 343,000 people, or 77 percent, over the 1978 level to a total of 786,700 persons, and employment would increase by 133,000 jobs, or 94 percent, to a total of 274,800 jobs. Because the decentralized land use plan would accommodate new and redistributed urban development in the Region to the year 2000 primarily at suburban population densities, the population density of the developed area of the Region under this land use plan would decline from a 1970 level of 4,350 persons per square mile to less than 2,300 persons per square mile. Under the centralized land use plan, population density would decline to about 3,500 persons per square mile.

The centralized land use plan would accommodate the forecast population and employment increases in the Region through the conversion of 72,518 acres of land, or about 113 square miles, from rural to urban use from 1970 to the year 2000, as shown in Table 94. The greatest amounts of increase are expected in urban medium-density residential land use, which will increase by 41,046 acres, or 111 percent, over the 1970 level; industrial land use, which will increase by 6,672 acres, or 66 percent; and transportation, communication, and utilities, which will increase by 21,441 acres, or 20 percent. Overall, the plan proposes a 20 percent increase in urban land between 1970 and the year 2000 to accommodate a 26 percent increase in population, a 38 percent increase in the number of households, and a 37 percent increase in jobs. In contrast, the decentralized land use plan would require the conversion of 150,299 acres of land, or about 234 square miles of land, from rural to urban use, or over a 45 percent increase in urban land, as shown in Table 94. Major increases will occur in urban medium-density residential land use, which will increase by 43,888 acres, or 118 percent, over the 1970 level; suburban residential land use, which will increase by 64,889 acres, or 294 percent; industrial land use, which will increase by 3,847 acres, or 38 percent; and transportation, communication, and utilities, which will increase by 33,788 acres, or 31 percent. Under the decentralized land use plan, nearly 109,000 acres of new residential development would be added to the Region, compared with 38,600 acres under the centralized plan.

Land Use Plans for the Stable or Declining Growth Scenario

Under the centralized plan for the stable or declining growth scenario, virtually all new urban development would occur in concentric rings along the periphery of, and outward from, existing urban centers. Existing developed areas in Milwaukee County would maintain at least the same density of occupied housing units as in 1970. New urban development under this plan would occur primarily at medium and high densities consistent with the economical provision of important urban facilities and services, including public transit. In contrast, under the decentralized land use plan, much of the new urban development would occur in a highly diffused pattern that is discontinuous both radially and circumferentially. Such development would be of low urban and suburban density, thus following the land use development trends evident in the Region since 1950, particularly since 1963.

Under the centralized plan, the population of Milwaukee County would decrease by 124,000 people from the 1978 level to a level of 830,000 in the year 2000, largely as a result of a significant decline in average household size. The number of households in Milwaukee County would increase by over 37,000, or nearly 11 percent over the 1975 level, to a total of 388,300 in the year 2000, and the number of jobs would decline by 10,000 from the 1978 level to a total of 552,300 in the year 2000. Under the decentralized plan, the level of households, population, and employment all would

decline in Milwaukee County from the base year levels. Employment would decline by over 37,000 jobs, or nearly 7 percent, to a total of 525,300 jobs; population would decline by 254,000 people, or over 27 percent, to a total of 700,000 persons; and the number of households would decline by over 50,000, or over 14 percent, to a total of 300,500 households.

In the three outlying counties contiguous to Milwaukee County—Ozaukee, Washington, and Waukesha Counties—population under the centralized plan would increase by nearly 37,000 people, or about 8 percent, over the year 1978 to a total of 480,000 persons. Employment in these three counties would increase by 40,500 jobs, or about 29 percent, over the 1978 level to a total of 181,900 jobs in the year 2000. Under the decentralized land use plan, population in these three counties would increase by more than 161,000 people over the 1978 level, or by 36 percent, to a total of 605,000 persons, and employment would increase by 65,500 jobs, or 46 percent, to a total of 206,900 jobs. Because the decentralized land use plan would accommodate the new and redistributed urban development in the Region to the year 2000 primarily at suburban population densities, the population density of the developed area of the Region under this plan would decline from a 1970 level of 4,350 persons per square mile to about 1,720 persons per square mile. Under the centralized land use plan, population density would decline to about 2,650 persons per square mile. Much of the decline in density under each plan would result from the decline in household size under the scenario. Expressed in terms of number of households per square mile, residential density in the developed urban areas of the Region will decline from 1,430 households per square mile in 1970 to 1,180 households per square mile under the centralized plan, and to 690 households per square mile under the decentralized plan.

The centralized land use plan would accommodate the forecast population and employment increases in the Region through the conversion of 71,900 acres of land, or about 112 square miles, from rural to urban use from 1970 to the year 2000. The greatest amounts of increase are expected in urban medium-density residential land use, which will increase by 42,300 acres, or 114 percent, over the 1970 level; and transportation, communication, and utilities, which will increase by 17,700 acres, or 16 percent. Overall, the plan proposes a 20 percent increase in urban land to accommodate a 40 percent increase in households. In contrast, the decentralized land use plan would require the conversion of 167,000 acres of land, or about 261 square miles, from rural to urban use, for about a 51 percent increase in urban land use. Major increases will occur in urban medium-density residential land use, which will increase by 35,500 acres, or 95 percent, over the 1970 level; suburban residential land use, which will increase by 109,300 acres, or 49.5 percent; and transportation, communication, and utility land use, which will increase by 33,990 acres, or 31 percent. Under the decentralized land use plan, nearly 129,000 acres of new residential development would be added to the Region, compared with 47,000 acres under the centralized plan.

CONCLUSION

Because of the uncertainty associated with future changes in social and economic conditions which may affect transit needs, an alternative futures approach has been used in the primary transit system alternatives analysis for the Milwaukee area. The approach involved first the identification and analysis of key external factors affecting the future of the Region and, in particular, its transit needs. The range of prospects for these factors of energy, population lifestyles, and economic conditions was determined, and two alternative scenarios of the endpoints of this range were developed. One scenario was developed to represent a reasonably extreme optimistic future for transit in the Region, and the other was developed to represent a reasonably extreme pessimistic future. Future regional population and employment levels consistent with these two scenarios were determined, and centralized and decentralized land use plans for the two scenarios were then developed.

As shown in Table 94, these four alternative futures were intentionally chosen to span the range of logical possibilities of future change which may affect transit needs in the Region. They are not singly, or collectively, forecasts of future change in the Region. These futures will be used to identify those alternative primary transit systems and system elements that may be expected to be viable under a wide range of future conditions in the Region, as well as to identify those alternative systems that work particularly well under certain futures. The former systems and system elements are to be considered for implementation, and the latter are to be considered in terms of actions required to avoid their implementation being

foreclosed in the future. From this effort, the following conclusions can be drawn with regard to future change in key external factors, regional population and economic activity, and regional land use distribution:

Key External Factors

As shown in Table 94, three external factors to the Region were considered as being critical to the establishment of the future range of transit needs in the Region. These three factors were energy, population lifestyles, and economic conditions.

- The cost and availability of energy may be expected to continue to be a major concern to the nation and the Region for the foreseeable future. Because of the high degree of dependency upon imported petroleum, and because of the time required to adjust demand patterns, it is likely that increases in petroleum prices will continue to occur in the future. However, whether such increases will be rapid and will occur in conjunction with disruptions in supply is not clear. This energy situation may be expected to have a significant impact upon the need for and use of public transit through its effects upon the cost and amount of automobile travel and upon urban development patterns.

  The greatest potential for a departure from past trends in energy use and a reduction in the level of dependency upon imported petroleum lies in greater efficiency in energy use and in increased conservation of energy. Major increases in the domestic production of petroleum are unlikely, as is radical technological change in energy production and usage that will lead to significant changes in overall energy consumption patterns. The price of petroleum-based motor fuels is therefore projected to increase to a level of between $1.50 and $2.30 per gallon by the year 2000, as measured in constant 1979 dollars. Automobile fuel efficiency is anticipated to increase to between 27.5 and 32 miles per gallon.

- In recent years, the lifestyles of the residents of the nation and of the Region have changed significantly. These changes have resulted in a shift from a more traditional family-oriented lifestyle to a more individualistic lifestyle, and have resulted in lower fertility rates, higher female labor force participation rates, and a reduction in average household size. The future direction of such changes is not clear at this time, since this shift may only reflect a postponement of family formation by the large portion of the regional population that is now in the traditional family formation ages.

- The major determinant of the health of the regional economy appears to be the extent to which the Region can remain competitive with other regions of the nation in preserving and expanding its economic base. Employment within the Region has historically increased steadily and considerably—from 552,700 jobs in 1950, to 647,900 jobs in 1960, to 741,600 jobs in 1970, and to 835,100 jobs in 1977. Manufacturing employment in the Region, however, has declined since its peak of 276,600 jobs in 1960 to 246,800 jobs in 1977. Manufacturing employment within the United States has continued to increase since 1960, and the increase in the total employment rate of the nation has been greater than that of the Region since 1960—a 2.3 percent annual rate in the nation compared with a 1.5 percent annual rate in the Region.

Two scenarios linking opposite endpoints of these external factors were developed. The scenarios were developed to provide extreme, yet reasonable, futures with regard to transit need and use in the Region.

- As shown in Table 94, the moderate growth scenario represents the future change in the key external factors that would create the most optimistic future for transit need and use within the Region. This scenario postulates a severe energy situation and an attendant significant increase in the cost of automobile travel; a stabilization of lifestyle trends accompanied by relatively small increases in female labor force participation; a return of replacement-level fertility rates and a stabilization of household size; and a competitive and attractive economic base in the Region which, when combined with the population lifestyles envisioned under this scenario, will result in little net population in- or out-migration.

- As shown in Table 94, the stable or declining growth scenario represents the future change in the key external factors that would create the most pessimistic future for transit need

and use within the Region. This scenario postulates a moderately severe energy situation accompanied by successful conservation efforts and a slight decrease in the cost of automobile travel; a continuation of the trend toward individualistic population lifestyles and an attendant decline in household size; a significantly higher female labor force participation rate, and continued below-replacement-level fertility rates; and a declining economy in the Region leading to only stable employment levels and, when combined with the population lifestyles envisioned under this scenario, substantial population out-migration.

Attendant Regional Change

The level of regional change in population and economic activity consistent with each scenario was determined.

- Under the moderate growth scenario, the level of employment in the Region will increase to 1,016,000 jobs, or by 19 percent over the 1978 level. Manufacturing employment will increase by 62,500 jobs, or 24 percent; services employment will increase by 53,200 jobs, or 15 percent; and all other employment will increase by 48,500 jobs, or 20 percent. The population of the Region will increase by 448,800 people, or 35 percent, over the 1978 level of 1,770,500 people. The average household size in the Region is anticipated to be between 2.9 and 3.1 persons; as a result, the number of households in the Region is envisioned to increase from the 1975 level of 575,500 households to between 681,000 and 739,000 households. Increases in household income will be modest, ranging from a real 1.1 to 1.4 percent annual rate of increase.

- Under the stable or declining growth scenario, the level of employment in the Region will not change significantly from the existing level of 851,800 jobs, increasing only to 887,000 jobs. Manufacturing employment will increase by 8,500 jobs, or 3 percent; services employment will increase by 7,500 jobs, or 2 percent; and all other employment will increase by 19,200 jobs, or 8 percent. The population of the Region will decline by 4 percent under this scenario—from 1,770,500 people in 1978 to 1,690,000 people in the year 2000. Because average household size in the Region will decline to between 2.2 and 2.5 persons under this scenario, the number of households in the Region will increase to between 674,000 and 751,000. Increases in household income will range from no real increase to just over a 0.3 percent annual rate of increase.

Land Use Plans

Two land use plans were developed for each scenario. The plans, one representing a centralized land use distribution and the other a decentralized land use distribution, were developed to encompass the reasonable range of future land use patterns which could influence transit needs under each scenario.

- The centralized land use plan developed for the moderate growth scenario is the most optimistic of the four futures for transit use. Under this plan, occupied housing unit densities within Milwaukee County attain at least the same densities as in 1970, when Milwaukee County population reached its recorded peak. New urban residential growth occurs at medium densities along the full periphery of, and outward from, existing urban centers, consistent with the provision of economical transit service. The Milwaukee County population increases by 10 percent over the 1978 level to a total of 1,049,600 persons, and its employment increases by 6 percent to 593,600 jobs. Population in the outlying counties of Ozaukee, Washington, and Waukesha continues to grow rapidly, and increases 41 percent over 1978 levels to 677,600 persons, and employment in these areas increases by 63 percent to 231,400 jobs. These increases in population and employment activity are accommodated by the conversion of about 113 square miles of land from rural to urban use between 1970 and the year 2000, or an increase of 20 percent in urban land.

- Under the decentralized land use plan for the moderate growth scenario, housing unit density levels in Milwaukee County decline from 1970 levels, as do urban population density levels in the Region. A significant portion of new urban residential growth occurs in a diffused pattern at suburban densities in noncontiguous enclaves removed from existing urban centers. Under such

a future, the population of Milwaukee County declines by 5 percent to 898,500 persons, and employment declines by 6 percent to 523,400 jobs from 1970 levels. Population in the three counties outlying Milwaukee County increases by 78 percent between 1978 and the year 2000 to 786,700 persons, and employment increases by 94 percent to 274,800 jobs. Because of the low densities at which new development occurs, future population and employment growth require the conversion of 234 square miles of land from rural to urban use between 1970 and the year 2000, or over a 45 percent increase in urban land.

- Under the centralized land use plan for the stable or declining growth scenario, the Region's population will be redistributed such that housing unit densities in Milwaukee County are maintained at 1970 levels. In addition, new urban growth will occur at medium densities along the full periphery of, and outward from, existing urban areas. Nevertheless, the population of Milwaukee County will decline by 13 percent from the 1978 level under this plan to a total of 830,000 persons. Employment in Milwaukee County will increase by 2 percent to 552,000 jobs. The number of households in Milwaukee County will increase by 37,000, or 11 percent, over 1975 levels. The population of the outlying counties of Ozaukee, Washington, and Waukesha will continue to grow, increasing by 8 percent over 1978 levels to 480,000 persons, and employment in these counties will increase by 29 percent to 181,900 jobs. The increases in population and employment activity will be accommodated by the conversion of about 112 square miles of land from rural to urban use between 1970 and the year 2000, or an increase of 20 percent in urban land.

- The decentralized land use plan for the stable or declining growth scenario is the most pessimistic future for transit use. Under this plan, the population of the Region will be redistributed such that housing unit densities in Milwaukee County decline significantly from 1970 levels. New urban growth will occur in a highly diffused pattern at suburban densities in noncontiguous enclaves removed from existing urban centers. Under such a future, the population of Milwaukee County declines by 27 percent to 700,000 persons, and employment declines by 7 percent to 36,900 jobs from 1978 levels, while population in the three counties outlying Milwaukee County increases by 36 percent to 605,000 persons, and employment increases by 46 percent to 206,900 jobs. Because of the low densities at which new development will occur under this plan, future population and employment growth will require the conversion of 261 square miles of land from rural to urban use between 1970 and the year 2000, or about a 51 percent increase in urban land.