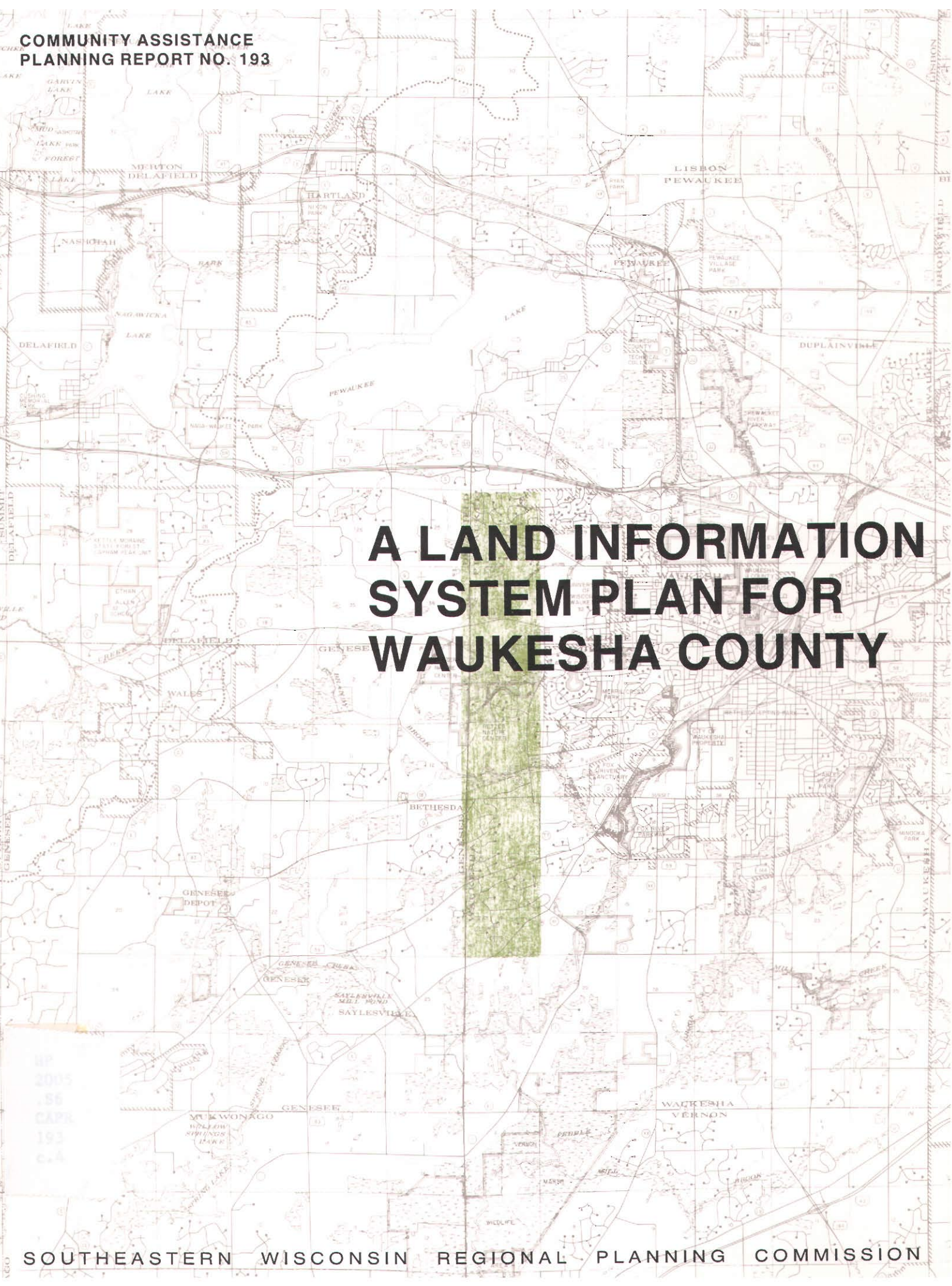
COMMUNITY ASSISTANCE
PLANNING REPORT NO. 193



A LAND INFORMATION SYSTEM PLAN FOR WAUKESHA COUNTY

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SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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COMMUNITY ASSISTANCE PLANNING REPORT
NUMBER 193

A LAND INFORMATION SYSTEM PLAN FOR WAUKESHA COUNTY

Prepared by the

Southeastern Wisconsin Regional Planning Commission
P. O. Box 1607
Old Courthouse
916 N. East Avenue
Waukesha, Wisconsin 53187-1607

April 1991

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SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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April 22, 1991

Mr. Curtis E. Manke, Chairman,
and Members of the Waukesha County
Board of Supervisors
Waukesha County Courthouse
515 W. Moreland Boulevard
Waukesha, Wisconsin 53188

Mr. Daniel M. Finley
Waukesha County Executive
Waukesha County Courthouse
515 W. Moreland Boulevard
Waukesha, Wisconsin 53188

Dear Chairman and Members of the Board and County Executive:

On February 16, 1988, the Waukesha County Board of Supervisors created a Geoprocessing Committee, charging that Committee with the task of preparing a plan for the development of an automated mapping and land information system for the County. Acting on behalf of that Committee, the Waukesha County Register of Deeds, on March 28, 1990, requested the Southeastern Wisconsin Regional Planning Commission to provide staff support to the Committee in the preparation of the requested plan. The Geoprocessing Committee consists of knowledgeable representatives of Waukesha County, of local units and agencies of government in the County, and of private utilities serving the County. This report sets forth the plan developed by that Committee with the assistance of the Regional Planning Commission.

The Geoprocessing Committee concluded, after a careful review of pertinent information, that a modernized land records system in Waukesha County could best be created by providing a single automated mapping base for the entire County. This single mapping base would be prepared to a set of specifications sufficient to meet the most stringent of accuracy and map feature content requirements of all users concerned. Each organization—including Waukesha County—intending to use the automated base would provide its own operating environment in terms of computer hardware, software, and supporting staff. Only the computerized maps and common parcel identification system would be shared. With the use of a shared automated mapping base in such a decentralized land information system, it would be possible for individual local units of government and utilities to proceed at their own pace in establishing an automated land information system, preserving, however, the capability for the ready exchange of data among the decentralized data banks that ultimately would be established.

The Geoprocessing Committee found that the capital expended over the years by Waukesha County and by certain of the local units of government in the County in the remonumentation of the U. S. Public Land Survey Section system and in the preparation of topographic and cadastral maps represents a wise investment and collectively has contributed most significantly toward building the automated mapping base. All such work has been completed to standard specifications promulgated many years ago by the Regional Planning Commission. What remains to be accomplished now is the extension of the Commission-recommended mapping system to the entirety of Waukesha County and to the conversion of the data developed to computer-readable form.

Given presently available revenues—including the current Waukesha County property tax revenue of $150,000 annually being directed toward monumentation and mapping work and the newly available recording and filing fees from the Register of Deeds Office of about $217,500 annually—Waukesha County, under the plan recommended by the Geoprocessing Committee, should be able to complete by the end of 1996 a functional automated base map for the eastern one-half of the County. Without additional revenues, a fully operational mapping base for the entire County cannot be expected before the year 2005. Nearly $400,000 annually in additional funds would be required to complete the program for the entire County by the end of 1996.

On April 22, 1991, the Geoprocessing Committee acted unanimously to adopt the six-year plan set forth herein and to recommend adoption of the plan and its implementation to the County Board and County Executive. The Committee further unanimously recommended that the plan be submitted by the County to the Wisconsin Land Information Board for endorsement in order to qualify the County for grants from the State in support of the recommended plan implementation work.

Sincerely,

Kurt W. Bauer
Executive Director

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Chapter I

INTRODUCTION

BACKGROUND

On February 16, 1988, the Waukesha County Board of Supervisors adopted a resolution establishing a Geoprocessing Committee. This Committee was charged with preparing a plan for the development of a geoprocessing system—that is, for the development of an automated mapping and parcel-based land information system—within Waukesha County. A copy of the adopted resolution is provided in Appendix A. By letter dated March 28, 1990, the Waukesha County Register of Deeds, acting on behalf of the Waukesha County Geoprocessing Committee, requested the Southeastern Wisconsin Regional Planning Commission to assist the Committee in preparing the desired plan and in formulating a report to the County Board. This report sets forth the findings and recommendations of the Geoprocessing Committee in this matter. This report is also intended to constitute the Waukesha County land information system plan required under the Wisconsin Land Information Program established by 1989 Wisconsin Act 31 as amended by 1989 Wisconsin Act 339.

LAND INFORMATION OFFICE

Under the Wisconsin Land Information Program, counties are encouraged to establish a Land Information Office. A Waukesha County Land Information Office was designated by the County Board on June 19, 1990 (see Ordinance reproduced in Appendix B). As set forth in the Ordinance, the Office of the Register of Deeds is to perform the functions and duties of the Waukesha County Land Information Office. The County Register of Deeds is the official contact person for the County Land Information Office. The present Register of Deeds is:

Mr. Michael J. Hasslinger
Register of Deeds
Waukesha County Courthouse
515 W. Moreland Boulevard
Waukesha, Wisconsin 53188
Telephone: (414) 548-7583

PURPOSE OF THE REPORT

The basic purpose of this report is to explore and document the need for the development of an automated mapping and parcel-based land information system in Waukesha County. The report is intended to provide sufficient information to permit the Waukesha County Board of Supervisors, the affected Waukesha County departments, the concerned local units of government, and the public and private utilities operating within the County to consider the need for such a system and to determine the desirability of proceeding with the creation of such a system. To this end, the report is intended to accomplish the following purposes:

1. To provide county and local officials, utility managers, and concerned citizens with a basic understanding of the components of an automated mapping and land information system and of the manner in which these components must be assembled to provide a conceptually and technically sound operational system.

2. To identify and briefly describe existing automated mapping and land information systems whose operation pertains to all or portions of Waukesha County.

3. To examine the advantages and disadvantages of different organizational arrangements for the development of an automated mapping and land information system for Waukesha County, including potential cooperative intergovernmental organizational arrangements between and among the affected units of government.

4. To identify those technical issues which, in the case of a shared, multi-user, automated mapping and land records system, would need to be resolved before a shared system could be developed.

5. To provide a plan for the creation of an automated mapping and parcel-based land information system in Waukesha County, including estimates of the time and resour-

ces required for the creation of such a system and the possible means of financing the creation of such a system, and to recommend a course of action with respect to implementing the plan.

ADVISORY COMMITTEE STRUCTURE

The Waukesha County Geoprocessing Committee provided the necessary guidance in the conduct of the required analysis and in the preparation of this report. The Committee included knowledgeable representatives of the County, of concerned local units and agencies of government, and of the private utilities serving Waukesha County. A roster of the Geoprocessing Committee is reproduced on the inside front cover of this report. The findings, plan, and recommendations herein provided represent the work of that Committee.

Chapter II

AUTOMATED MAPPING AND LAND INFORMATION SYSTEMS: AN OVERVIEW

INTRODUCTION

For over a decade there has been growing interest in the United States in land information systems. This interest ranges from a relatively narrow concern about the need to modernize land title recordation systems to a relatively broad concern about the need to create entirely new land-related data banks for multipurpose applications. This growing interest has involved the practitioners of many professional disciplines, ranging from surveyors, abstractors, assessors, and attorneys concerned with the fiscal and legal administration of real property to planners, engineers, public utility managers, public administrators, and elected officials concerned with resource management and community development. Much of the interest was initially centered on the use of electronic computers for the storage, manipulation, and retrieval of land-related information and, more recently, for the use of computer-assisted graphics collection and display hardware for the reproduction of the data in mapped as well as tabular form.

As interest in the area of land data systems has grown, the topic has become increasingly prominent as a subject of professional papers, reports, conferences, and the meeting programs of various professional organizations. Accordingly, a body of professional literature on the subject of automated mapping and land information systems has begun to coalesce and accumulate. During the same period, an increasing number of local units of government and private utilities have undertaken the creation of automated mapping and land information systems, including several systems that currently cover all or parts of Waukesha County. This chapter presents a summary of the basic concepts involved in automated mapping and land information systems, describes the various means by which graphic data may be converted into a computer-compatible format, and identifies and briefly describes currently operating automated mapping and land information systems whose operations pertain to all or portions of Waukesha County.

NATIONAL RESEARCH COUNCIL STUDIES

In 1979, the National Research Council convened a Panel on a Multipurpose Cadastre to review the status of cadastral activities at the federal, state, and local governmental levels and in the private sector and to review a number of demonstration projects that had been undertaken at various locations. This action was taken by the Council in response to the growing interest in land data systems and to the perceived increasing need for land-related information by all levels of government and also the private sector. In 1980, a report was issued, the principal finding of which was that:

> There is a critical need for a better land-information system in the United States to improve land-conveyance procedures, furnish a basis for equitable taxation, and provide much needed information for resource management and environmental planning.[1]

The report set forth the concept of the multipurpose cadastre as a basis for a dynamic public process that could effectively collect, maintain, and disseminate land-related information. It identified the land resource-related problems faced by public and private organizations and outlined the basic structure of a multipurpose cadastre that could help to remedy those problems. However, the report did not address how governments, especially local governments, could carry out the recommendations made in the report.

To address certain questions left unanswered by its 1980 report, the National Research Council prepared a second report, which set forth a set of recommended procedures and standards for

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[1] *National Research Council, Assembly of Mathematical and Physical Sciences, Committee on Geodesy, Panel on a Multipurpose Cadastre, Need for a Multipurpose Cadastre, National Academy Press, Washington, D. C., 1980.*

the design and implementation of a multipurpose cadastre.[2] It was the intent of this report to assist not only the local units of government wishing to pursue the development of cadastral records systems for their own jurisdictions but also the many other regional, state, and federal agencies, as well as private businesses, whose participation will be needed for the development over time of true multipurpose land information systems.

The procedural model put forth by the Panel identified the basic components of a modern land information system as: 1) a spatial reference framework consisting of monumented geometric control points; 2) a series of accurate, large-scale topographic base maps; 3) a cadastral overlay to the base maps that delineates all cadastral, that is, real property ownership, parcels; 4) a cadastral parcel numbering scheme that provides for unique identification of each cadastral parcel; and 5) a series of compatible registers of interests in, and data about, the land parcels keyed to the parcel identifiers. It is important to note, in this regard, that the creation of such land information systems requires as a foundation a means of spatial reference for the data. An adequate geometric framework for such spatial reference must, if it is to serve even the narrowest purposes of a land information system, permit identification of land areas by coordinates down to the individual ownership parcel level. A geometric framework of adequate accuracy and precision to permit system operation at the highly disaggregated parcel level is the most demanding specification possible, but, once achieved, permits ready aggregation of information from the more intensive and detailed level to the more extensive and general level when necessary.

The local mapping and survey control network recommended by the Southeastern Wisconsin Regional Planning Commission since 1964, which is described in greater detail in Chapter III of this report, provides two of the five basic components of a modern land information system as set forth by the Panel, namely: 1) the required spatial reference framework; and 2) the required accurate large-scale topographic base maps; and facilitates the creation of the third component, a cadastral map overlay. The spatial reference framework is provided by the relocation, monumentation, and placement on the State Plane Coordinate System of the U. S. Public Land Survey corners. The Commission-recommended topographic maps provide the base maps specified by the Panel. In addition, by placing the U. S. Public Land Survey corners on the State Plane Coordinate System, the Commission-recommended system provides the basis for the ready and economical preparation of accurate cadastral, that is, real property boundary line, overlays to the topographic base maps, since all real property boundary descriptions in Wisconsin are, by law, tied to these corners. Less obvious, but of equal importance, is the fact that the Commission-recommended survey control network ties these real property boundary descriptions to the State Plane Coordinate System and, in turn, to latitude and longitude, thereby facilitating the precise correlation of real property boundary lines and earth science data, a necessary condition to the creation of a modern, automated, land information system.

It is important to note in this regard that the Commission-recommended local mapping and survey control network program was one of a select few local land information system modernization efforts described by the Panel in its reports, and therefore put forth as a system for emulation across the nation.

It is also important to note, particularly within the context of the development of this report, that both National Research Council reports determined that, for much of the United States, the county presented the most logical locus for the development of multipurpose land information systems.

WISCONSIN LAND RECORDS COMMITTEE

Within Wisconsin there has also been growing interest in land information systems and land records modernization. In 1985, then Governor Anthony Earl appointed the Wisconsin Land Records Committee, a group representing state, regional, and local governmental interests,

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[2]*National Research Council, Assembly of Mathematical and Physical Sciences, Committee on Geodesy, Panel on a Multipurpose Cadastre, Procedures and Standards for a Multipurpose Cadastre, National Academy Press, Washington, D. C., 1983.*

private utilities, and other private businesses that utilize local maps and land records. Over a period of two years, this group issued 13 reports on various aspects of automated mapping and land records modernization and a final report summarizing the more important findings of the Committee's deliberations.[3]

Like the National Research Council Panel, the Wisconsin Land Records Committee determined a need for continued efforts directed at land records modernization and recognized the contribution that could be made by computer technology in certain aspects of this modernization process. The Committee also determined that the costs of developing modernized land records systems would not be trivial, but that these costs would be reasonable, nonetheless, in view of the sums already being expended for current outdated and inefficient land information management practices. The Committee recognized, correctly, that the ultimate costs of land records modernization would be borne by citizens, in the form of tax bills and utility bills, and accordingly recommended that various levels of government, private utilities, and other private businesses involved in the use of land information make every effort to develop and use jointly such automated systems to minimize their total societal costs.

The Committee recognized that its recommendation for the development of shared approaches to land information systems modernization would create new organizational and institutional strains that would be as demanding in their solutions as the technical issues involved in the creation of new, automated land information systems. The Committee accordingly recommended that the educational and coordinative aspects of land records modernization receive as much attention as the technical issues.

The deliberations of the Committee and its published reports reaffirmed the validity of the procedural model advanced by the National Research Council Panel for the development of modern, automated, land information systems and, as did the National Research Council reports, highlighted the Commission-recommended local mapping and survey control network program as a basis for the development of modern, automated, land information systems.

Also, like the National Research Council Panel, the Wisconsin Land Records Committee recognized that there is a central role to be played by counties in the land records modernization process. Although the Committee chose not to define precisely that role, preferring instead to have individual counties make that determination, at the minimum, a coordinative role was seen as necessary in view of the records maintenance functions given to the counties by the state constitution and state statutes.

WISCONSIN LAND INFORMATION PROGRAM

Among the final recommendations of the Wisconsin Land Records Committee was a proposal for the creation of a Wisconsin Land Information Program overseen by a state-level board that would provide a focal point for land records modernization issues and efforts within Wisconsin. During 1989, the Wisconsin Legislature enacted legislation creating the Wisconsin Land Information Program. The legislation was signed into law by the Governor and, late in 1989, following the appointment of its members by the Governor, the Wisconsin Land Information Board began to meet. Voting members of the Board are specified by Statute as follows:

1. The Secretary of the Department of Administration; the Secretary of the Department of Agriculture, Trade and Consumer Protection; the Secretary of the Department of Natural Resources; and the Secretary of the Department of Transportation, or their designees.

2. Four representatives from county and municipal government appointed by the Governor to six-year terms, including at least one member of a county board of supervisors, at least one member of a city council or village board, and at least one person who is a county officer active in land information management.

[3] *Wisconsin Land Records Committee, Final Report of the Wisconsin Land Records Committee, Modernizing Wisconsin's Land Records, University of Wisconsin-Madison, Center for Land Information Studies, Madison, Wisconsin, 1987.*

3. Four representatives, appointed by the Governor to six-year terms, chosen from public utilities and private businesses, including at least one public utility representative and at least one representative of a professional land information organization.

4. The State Cartographer.

In addition, the State Historic Preservation Officer, the Secretary of the Department of Revenue, the State Geologist, or their designees; a representative of a regional planning commission selected by the Board; a county employee active in land information management who is selected by the Board; and representatives of state and federal agencies active in land information management selected by the Board to serve as nonvoting, advisory members of the Board, were selected.

As set forth in the legislation, the duties of the Board include:

1. The provision of technical assistance and advice to state agencies and local units of government with land information responsibilities.

2. The preparation of guidelines and standards to coordinate the modernization of land records and land information systems.

3. The creation and administration of a grant program for local units of government to assist in the development of modernized land records systems.

In its initial meetings, the Board identified the creation of a grants program to provide a source of partial funding for land records modernization as one of its high-priority issues and took steps to encourage the passage of a bill in the State Legislature that would provide such a funding mechanism. This bill was passed by both houses of the Legislature in March and April 1990. The Governor signed the legislation into law in April 1990.

Under the Wisconsin Land Information Program, it is envisioned that counties throughout the State will prepare and implement plans to modernize land records systems. Toward this end, the legislation provides for Wisconsin Land Information Board review and approval of countywide land information system plans. On January 7, 1991, the Land Information Board adopted final guidelines pertaining to the preparation of such county plans.

To help fund the Wisconsin Land Information Program, including the preparation and implementation of county land information system plans, the new legislation requires counties to increase Register of Deeds filing and recording fees from $4.00 to $8.00 in state fiscal year 1991—July 1, 1990 through June 30, 1991—and to $10.00 in the five subsequent state fiscal years, resulting in a six-year program that under present Statutes would end June 30, 1996. At that time, the present Statute requires that the Register of Deeds filing and recording fee return to the original $4.00 level.

For the first year of the six-year program, counties are permitted to retain $2.00 of the $4.00 increase in filing and recording fees. For the remaining five years of the program, counties are permitted to retain $4.00 of the increased fee. Such monies can be retained, however, only if: a) the county has established a Land Information Office; b) the county has received approval from the Land Information Board of a county plan for land records modernization; and c) the county uses the monies to develop, implement, and maintain the countywide plan.

The law provides that counties must remit to the State the incremental Register of Deeds filing and recording fees not retained at the county level. Over the six-year period, this means that the State will receive $2.00 for each filing in the State. Such monies, under the new law, are to be used by the State to fund the activities of the Wisconsin Land Information Board and to provide grants of up to $100,000 to county and local governments for activities designed to implement approved county plans. Under the law, only counties are eligible to apply for such grants. Counties may act, however, on behalf of local units of government in the county to apply for grants. A minimum local match of 25 percent is required. The legislation is silent as to whether that 25 percent match can come from the retained county Register of Deeds recording fees.

ALTERNATIVE TYPES OF OPERATIONAL COMPUTER SYSTEMS AVAILABLE FOR THE DEVELOPMENT OF AN AUTOMATED MAPPING AND LAND INFORMATION SYSTEM

The professional literature currently categorizes operational automated mapping and land information systems into three general types: strictly automated mapping or computer-assisted drafting (CAD) systems; automated mapping-facilities management (AM-FM) systems; and geographic and land information systems (GIS/LIS). The distinction between these types of systems is somewhat artificial and stems from marketplace segmentation strategies adopted by vendors of computer hardware and software. Nevertheless, as long as it is recognized that operational systems comprise a continuum and that many systems will resist being neatly categorized as one or another of the three general types of systems, the tripartite division is a useful one for discussion purposes.

The computer hardware components comprising these three types of systems usually provide no basis for categorization, and the different systems are virtually identical in a physical sense. Computer software available for operating the different system types generally provides a basis for distinguishing between CAD systems on the one hand and the AM-FM and GIS systems on the other; but the differences between the software utilized to operate AM-FM systems and GIS systems is often less clear. Indeed, a number of proprietary software products currently purport to support either type of operation equally well.

Functionally, the CAD systems are perhaps the easiest of the three to categorize since they tend to be almost exclusively automated mapping systems with little or no capability for the management of associated land records. Both AM-FM and GIS systems possess automated mapping and records management capabilities, although the distinction between the two, as often as not, is a function of the type of associated land information managed by the system rather than of any pronounced functional difference between system components. Typically, systems categorized as AM-FM systems are found where the predominant function is to manage information associated with networks: for example, water distribution systems, sanitary sewerage systems, telephone systems, and electric power or natural gas distribution systems. GIS systems are usually systems that manage information associated with areas: real property parcels, administrative districts, land use polygons, and soil mapping units. While these distinctions between predominant functions of AM-FM and GIS systems are helpful in a taxonomic sense, in practice these distinctions are often more apparent than real since virtually all currently available AM-FM software systems, while they may, in fact, be designed for optimal operation in network data analysis environments, are capable of analyzing polygon data. Likewise, virtually all currently popular GIS software is capable of performing network data analysis functions.

CONVERSION OF GRAPHIC DATA INTO A COMPUTER-COMPATIBLE FORMAT

Much of the current interest in the modernization of land data systems has been centered on the use of electronic computers for the storage, manipulation, and retrieval of the data and, more recently, the use of computer-assisted graphic collection and display hardware for the reproduction of the data in mapped as well as tabular form. Nongraphic land information—parcel identification numbers, legal descriptions, and assessment information, for example, can be entered into a computer through standard procedures for data entry. Land information that has traditionally been maintained in the form of maps—such as real property boundary lines—however, must be converted into a numeric, or digital, format before it can be entered into a computer. This is most often accomplished by a device, sometimes itself computer-controlled, called a "digitizer," and the process by which the conversion is completed is often identified as "board digitizing."

A digitizer, therefore, is a machine system which transforms mapped information into a computer-readable form to facilitate information manipulation and display. A digitizer is usually comprised of the following hardware components:

1. A controller, which is often a small- to medium-size computer.
2. An on-line data storage device.
3. An operator's work station, consisting of a keyboard for entering commands and nongraphic data into the system and a

graphic display screen or screens for viewing collected information.

4. A digitizing board or tablet allowing for determination of the accurate relative location of a point identified on the surface of the board using a device, a cursor, which is able to move freely over the surface of the board.

Additional equipment may include a printer, a computer tape unit, and graphic production devices called "plotters." Each component can vary greatly in size and capability depending on the operating requirements of the particular system.

The transformation of mapped information into computer-readable information requires maps which are related to some system of geometric control and which have at least two or three points for which an x-y coordinate pair can be determined. The coordinate system utilized can vary from an arbitrary scale unique to the base map to some more universal system such as the State Plane Coordinate System. Once the base map has been placed on the digitizer board, the known coordinates of the map are entered into the digitizer and located on the base map with the cursor. When this operation is complete the map is said to be "scaled," and positions of other points on the map can be established based upon their positions relative to the known points.

Each line on the map is defined as a series of connected points. The cursor is used to identify each point, which is then assigned an x-y coordinate pair based on the position of the point relative to the known base points used to scale the maps. Each map line is then stored in the system as a series of x-y coordinates. Each line or segment can be stored separately or combined with other segments to form closed polygons with defined attributes and measurable areas.

Base map accuracy is an important consideration when digitizing. A digitizing system does not improve the accuracy of a base map but only replicates the map features, including errors and discrepancies. While the board-digitizing procedure just described is the most common technique for conversion of map data into digital form, several other techniques have been developed which work well in certain specialized situations or with certain specific types of map information. These are optical scanning, direct digitizing from stereoscopic models, and coordinate geometry entry.

An optical scanning system is a machine system that is much like aboard digitizing system in its physical arrangement. It merely substitutes an optical scanning device for the digitizing board or tablet. In operation, the document to be converted to digital form is mounted on a large drum that rotates at high speed under an optical device that scans the drum and "reads" the document. While these devices are capable of converting documents to digital form more rapidly than can board digitizing, they have typically required quite complex software to perform editing and categorizing of the converted data. For anything other than very simple maps, these devices have yet to supplant board digitizing.

Direct digitizing from stereoscopic models is relatively more recent in origin than either board digitizing or optical scanning, but is, however, based upon long-established photogrammetric engineering procedures. In a direct, stereoscopic digitizing system, the digitizing board or tablet that would be present in a board-digitizing system is replaced by a stereoscopic map compilation machine. Stereoscopic aerial photography acquired for map compilation purposes can be used to establish a stereoscopic model in the traditional manner, but rather than utilizing the model to prepare an analog map manuscript for subsequent board digitization, the operator optically "digitizes" map features directly from the model, thereby producing the digital map files directly.

An additional means of converting map information into maps is coordinate geometry entry, sometimes referred to as "precision digitizing." In coordinate geometry entry, there is no analog device present in the machine system for the conversion of map documents to digital maps. All of the information needed to construct a map is key entered and the map is constructed utilizing plane geometry relationships and formulae contained in highly specialized computer software. Conversion of map data by coordinate geometry is exceedingly tedious and is generally used only for relatively small project areas, or for areas where the quality and precision of the data available warrant the additional effort of this procedure. Of all the currently available methods of data entry, however, coordinate geometry procedures are the only

procedures that do not result in a loss of precision and are the only conversion procedures that produce digital map data that are truly scale-independent.

Once the initial map data are transformed into digital form with the digitizer, a variety of manipulations become possible. Data mapped at one scale can be reproduced at different scales, provided that the accuracy limitations of the original maps are recognized in any enlargement, as opposed to reduction, in scale. Graphic base files collected from different sources can be merged and reproduced at a uniform scale. Data for special study areas can be identified, reproduced, and measured. Information on the base maps can be identified in such a manner that only selected portions of that information are reproduced at a time.

CURRENTLY OPERATING AUTOMATED MAPPING AND LAND RECORDS SYSTEMS PERTAINING TO ALL OR PARTS OF WAUKESHA COUNTY

It was previously noted in this chapter that there are several automated mapping and land information systems already in existence whose areas of operation cover all or portions of Waukesha County. Since one of the primary purposes of this report is to determine the feasibility of some type of shared, or joint, operation of a countywide automated mapping and land information system, these existing systems are identified and their operations briefly described below.

The map coordinate systems utilized by the different automated mapping operations in Waukesha County represent an issue of central importance in any consideration of cooperative mapping efforts and of the transfer of existing digital map information between the existing automated mapping sites. Therefore, the map coordinate system or systems utilized and the horizontal map datum upon which the coordinate system is based are identified for each operation.

Currently, two coordinate systems are in regular use in the Waukesha area: the State Plane Coordinate System and the Universal Transverse Mercator (UTM) coordinate system. Both of these systems are based upon the North American Datum of 1927 (NAD-27) which, in turn, is derived from the Clarke 1866 mapping spheroid. Since both the State Plane Coordinate System and the UTM coordinate system are based upon NAD-27, it is possible, albeit computationally tedious, to translate with mathematical precision from one of these coordinate systems to the other. It is, in an analogous fashion, further possible to move with mathematical precision between either of these two systems and any other map coordinate system derived from NAD-27, although again, the procedures are tedious.

Recently, the National Geodetic Survey of the National Oceanic and Atmospheric Administration, U. S. Department of Commerce, the federal government agency responsible for the maintenance of the nation's geodetic control system, has begun to move all federal mapping activity from the Clarke 1866 mapping spheroid onto the Global Reference System of 1980 (GRS 80), a newly defined mapping spheroid. As part of this transfer, an entirely new horizontal datum, NAD-83, has been developed for use with GRS 80. Any precise conversion between NAD-27 and NAD-83 requires recomputation utilizing the original control survey field measurements. The implications for the conversion from NAD-27 to NAD-83 of the type of control network and related large-scale planimetric mapping typically prepared by local units of government and utilities are therefore both technically severe and operationally costly. A similar situation exists for large-scale topographic mapping with the proposed replacement of the National Geodetic Vertical Datum of 1929 (NGVD 29) by NGVD 87, which has been developed for use with GRS 80 and NAD-83. Importantly, the replacement of NAD-27 and NGVD 29 with NAD-83 and NGVD 87 will be costly, while offering no improvement in map accuracy or precision for locally oriented large-scale mapping operations.[4]

Southeastern Wisconsin Regional Planning Commission

The Southeastern Wisconsin Regional Planning Commission installed CALMA hardware and software in 1976 to begin conversion to digital format of its land use and natural resource

[4]*This matter is discussed in detail in Appendix G of SEWRPC Technical Report No. 7, (2nd Edition), Horizontal and Vertical Survey Control in Southeastern Wisconsin.*

inventory data. Since then, the Commission has converted its analog land use inventories for 1963, 1970, and 1975 for its 2,689-square-mile planning area, and has completed a digital land use inventory for 1980 and 1985. During 1990 the Commission completed digitization of the detailed operational soil surveys, which includes maps completed by the U. S. Soil Conservation Service under contract to the Commission in 1966 for the entire planning area. That area includes Waukesha County. The primary Commission system products are land use maps, interpreted soil maps, wetland maps, wildlife habitat maps, floodplain maps, civil division boundary maps, and watershed and related analytical hydrologic unit maps, summary areal extent statistics prepared in support of long-range planning activities, and "camera ready" artwork prepared for the printing of thematic maps appearing in published reports. The Commission utilizes the State Plane Coordinate System, NAD-27, for its digital mapping activities.

The experience gained by the Commission in more than a decade of automated land use and natural resource mapping provided a valuable base upon which to evaluate the available hardware and software products when, in 1986, the Commission reached a decision to acquire new computer hardware and software for its automated mapping operation. In 1987, a completely new automated mapping system was installed comprised of DELTAMAP software running on Hewlett-Packard and Calcomp hardware. The enhanced operational capability provided by this new system allowed the Commission staff to begin taking steps in 1988 to convert its large-scale and intermediate-scale base mapping operations from analog to digital format.

State of Wisconsin

Two agencies of state government currently possess and use automated mapping systems: the Department of Transportation and the Department of Natural Resources.

The Department of Transportation installed INTERGRAPH hardware and software in 1982. This system is used primarily for maintaining and updating the Department's official State Highway Map and the Department's statewide series of county highway maps. Some of the map data for these two programs were created by optical scanning of color separation plates that had been used for color map printing. The system is also used for project mapping in support of highway construction and improvement projects. The map data for this activity are usually acquired through direct digitization from stereoscopic models. All of the Wisconsin Department of Transportation's digital mapping currently utilizes the State Plane Coordinate System, NAD-27, although the Department is in the process of shifting its mapping datum to a modified NAD-83, the modification being based on data derived from global positioning surveys.

The Department of Natural Resources began building a digital map data collection system in 1980. This system has been, in effect, custom built by Department staff who have configured purchased hardware components and written their own computer software. The system is used primarily in support of Department land acquisition, improvement, and management projects, but was used to create, and currently maintains, a statewide inventory of wetlands. The Department of Natural Resources has not chosen a standard coordinate system for its digital mapping, and, although it utilizes the UTM coordinate system, NAD-27, for some projects, it also utilizes the State Plane Coordinate System, NAD-27, for some projects and local coordinate systems on occasion. The Department possesses computer software translation capability between UTM and State Plane coordinates. The Department of Natural Resources is in the process of evaluating whether or not to shift its mapping datum to NAD-83.

Recently, both the Department of Transportation and the Department of Natural Resources began to use the proprietary software ARC/INFO to develop network and polygon map data analysis capability, while continuing to maintain their automated mapping functions on the originally acquired systems. The Department of Transportation has acquired the software and is running it on Digital Equipment Corporation (DEC) hardware recently installed for that purpose. The Department of Natural Resources is running the software in a "time-share" mode on the University of Wisconsin's DEC system, and has recently utilized this system to develop a statewide analysis—including a state map, prepared by computer-assisted methods, of groundwater contamination susceptibility.

Wisconsin Electric Power Company and Wisconsin Natural Gas Company

The Wisconsin Electric Power Company (WEPCo) and the Wisconsin Natural Gas Company (WNG), both subsidiaries of Wisconsin Energy Corporation, have jointly developed a digital mapping base upon which to map their respective electric and gas service networks. This effort was initiated in 1979 with the installation of INTERGRAPH hardware and software at WEPCo. Waukesha County lies entirely within the service territory of WEPCo. About four-fifths of Waukesha County lies within the service area of WNG. WEPCo and WNG completed the development of digital map coverage for that portion of Waukesha County lying within their service territories prior to 1985.

Throughout much of the Southeastern Wisconsin Region, WEPCo and WNG utilized data from large-scale topographic mapping and control survey projects prepared to Commission-recommended specifications to establish their spatial reference framework. These data were acquired in State Plane Coordinate System, NAD-27, format and converted by WEPCo and WNG to the UTM coordinate system, NAD-27, which the two companies continue to utilize for their digital mapping activity.

Both WEPCo and WNG have recently begun to transfer a portion of their automated mapping capability to IBM hardware and software in order to utilize the digital maps created on the INTERGRAPH system for the mapping of nongraphic attribute data stored on the Corporations' corporate data base, which is maintained on IBM equipment.

Wisconsin Gas Company

The Wisconsin Gas Company installed IBM hardware and software in 1984 to begin its automated mapping activities. It is currently creating its digital mapping base through a combination of board digitizing and direct digitizing from stereoscopic models. Within Waukesha County, the conversion of the company's facility network information is currently underway. The Company serves an area in the northeastern corner of Waukesha County, encompassing the communities of Lisbon, Sussex, Lannon, Menomonee Falls, and a portion of the Brookfield area. Wisconsin Gas is utilizing the State Plane Coordinate System, North American Datum of 1927, having obtained the spatial reference framework for its automated mapping in Ozaukee, Washington, and Waukesha Counties with the assistance of the Regional Planning Commission. At the Company's request the Commission arranged for the relocation, monumentation, and placement on the State Plane Coordinate System of certain carefully selected additional U. S. Public Land Survey corners in Ozaukee and Washington Counties to provide the necessary ground control for the large-scale aerial photography obtained by the Company for the direct digitization from stereoscopic models of its automated mapping base in these counties.

In the Lisbon, Sussex, and Brookfield areas of Waukesha County the Company board digitized its automated mapping base from large-scale topographic maps prepared to Commission-prepared specifications under Waukesha County's large-scale topographic mapping and survey control program. In recent years the Company has been one of the advocates of cooperative digital mapping efforts and in 1987 approached both Waukesha County and the Commission as the County's agent for mapping concerning the preparation of topographic mapping in digital rather than analog format in the Menomonee Falls area. Much of this area had been mapped in the 1960s and a revision of this mapping—including the preparation of new mapping in some small, previously unmapped pockets—using standard photogrammetric procedures, was scheduled for 1987 and 1988. The Company agreed to pay the incremental cost between the preparation of entirely new mapping in digital format and the preparation of mostly revised and some new mapping in analog format as originally planned. Accordingly, the specifications for the project were modified by the Commission to provide for the delivery of the mapping in digital format. Digital map files began to be delivered in this format in the summer of 1988, with copies provided to the Company for its use. Subsequently, Waukesha County decided to have all new mapping completed under the countywide large-scale topographic mapping and control survey programs delivered in digital format, beginning with the 1988 project areas.

Wisconsin Bell

In 1990, after several years of study and after a hiatus attributable in part to the issues surrounding the federal court ordered reorganization of American Telephone and Telegraph and

its subsidiaries, Wisconsin Bell reached a decision to acquire an INTERGRAPH system for conversion of its facilities information. Wisconsin Bell plans to begin conversion of its facilities information, possibly including areas in Waukesha County in 1991. Wisconsin Bell anticipates using the Universal Transverse Mercator coordinate system, North American Datum of 1927, for its digital mapping inasmuch as this system is already being used for its present analog mapping operations.

Village of Menomonee Falls

As reported earlier, the Village of Menomonee Falls, in cooperation with Waukesha County and Wisconsin Gas Company, acquired digital topographic map files for its corporate area in 1987 and 1988. At the present time, the Village has made no decision with respect to a computer hardware and software system for the use of these files, but is currently investigating different vendor systems. The Village will be using the State Plane Coordinate System, North American Datum of 1927, for its digital mapping operations.

City of New Berlin

Following the experience in the Menomonee Falls area, the City of New Berlin, in cooperation with Waukesha County, contracted in 1988 for the preparation of digital topographic map files. In 1990 the City acquired the GENAMAP software product which runs on Hewlett-Packard computer hardware. This system will be utilized to manipulate the topographic map files. In addition, the City has made arrangements for the conversion of its analog cadastral mapping to digital format. The City will be utilizing the State Plane Coordinate System, North American Datum of 1927, for its digital mapping operations.

Digital Map Exchange Issues

The ability to exchange digital map data between different automated mapping sites and systems is an important consideration in the development of a county land records modernization plan. In this regard, it should be noted that the use of different hardware and software systems and the use of different map coordinate systems by the various governmental units and private utilities that currently maintain digital mapping capability in Waukesha County will affect the ability to exchange digital map data between different automated mapping sites and systems.

Commercial software products are increasingly available to provide for the "translation" of digital map data between specific sets of proprietary automated mapping systems; however, basic incompatibilities between the instruction sets, data structures, and the basic architecture of different systems may render some digital map data "untranslatable," even between systems that supposedly have translators available. Accordingly, digital map translation cannot be taken for granted. General speaking, translations will be most successful between systems that have a high degree of compatibility between software instruction sets, data structures, and hardware architecture; or in instances where the need to translate digital map data is anticipated in advance and influences the basic decisions on the manner in which digital map data will be captured and stored.

The use of different map coordinate systems does not affect the ability to exchange digital map data provided that the different map coordinate systems have been developed on the same horizontal datum. The use of mathematically unrelated horizontal datums, however, does pose potential problems for the exchange of digital map data. Simply stated, the relative mapped position of geographic features can be expected to differ between maps prepared on mathematically unrelated datums. This situation can be expected to affect adversely—at least at higher required levels of precision—the correct integration of digital map data between sites using NAD-27 and NAD-83.

SUMMARY

Over the past ten years there has been a significant and growing interest in the United States in developing land information systems. The interest is indeed broad, involving many disciplines, and centers on the use of electronic computers to store, manipulate, retrieve, and—most recently—graphically display land and land-related information. This chapter presents an overview of the growing body of professional literature in this area and summarizes the automated mapping and land information systems which to date have been developed in, and pertain to, Waukesha County. The following summarizes the material included in this chapter:

1. National interest on land information systems was focused in 1979 by a Panel on

a Multipurpose Cadastre convened by the National Research Council. The report of this Panel found that there is a critical need to modernize land information systems in the United States and thereby to improve land-conveyance procedures, to furnish a basis for equitable taxation, and to provide information for resource management and environmental planning. The Panel's report emphasized the concept of a multipurpose cadastre as a basis for a dynamic public process that could effectively collect, maintain, and disseminate land-related information. In a subsequent report issued by the Panel, the basic components of a modern land information system were identified as: 1) a spatial reference framework consisting of monumented geometric control points; 2) a series of accurate, large-scale topographic base maps; 3) a cadastral overlay to the base maps that delineates all cadastral—that is—real property ownership, parcels; 4) a cadastral parcel numbering scheme that provides for unique identification of each cadastral parcel; and 5) a series of compatible registers of interests in, and data about, the land parcels keyed to the parcel identifier.

2. The local mapping and survey control network recommended by the Southeastern Wisconsin Regional Planning Commission since 1964 possesses two of the five basic components of a modern land information system: the spatial reference framework and the accurate large-scale planimetric and topographic base maps. In addition, the Commission-recommended program facilitates the creation of the cadastral map overlay as a third component. Finally, the Commission-recommended survey control network provides a mechanism for relating real property boundary descriptions to the State Plane Coordinate System and, in turn, to latitude and longitude, thereby facilitating the precise correlation of real property boundary lines and earth science data—a condition necessary for the creation of a modern, automated land information system.

3. Following issuance of a report by the Wisconsin Land Records Committee recommending that counties perform a central role in the land records modernization process, new state legislation was enacted to create a Wisconsin Land Information Program. That Program is overseen by the Wisconsin Land Information Board. The duties of the Board include providing technical assistance to state agencies and local governments establishing land information systems; promulgating standards to coordinate the modernization of land records and the establishment of land information systems; and the administration of a grant program to assist local governments in developing modernized land records systems. The Wisconsin Land Information Program, which is scheduled to be carried out over the six-year period beginning on July 1, 1990, and extending through June 30, 1996, is being funded by increased register of deeds filing and recording fees. A portion of the increased fees is retained by counties and a portion is remitted by the counties to the State. In order to retain monies at the county level, however, counties must establish a land information office, prepare and receive Land Information Board approval of a county plan for land records modernization, and use the retained monies to implement the county plan. Counties are also permitted to apply for up to 75 percent matching grants and up to a maximum of $100,000 per year from the Wisconsin Land Information Board to help carry out the plans. In so doing, counties may act on their own behalf or on behalf of local units of government in the county.

4. Three general types of automated mapping and land information system operational structures are currently recognized: strictly automated mapping or computer-assisted drafting (CAD) systems; automated mapping/facilities management (AM-FM) systems; and geographic information systems (GIS). Although the distinctions between the types are not always clear, the CAD systems are perhaps the easiest of the three to categorize since they tend to be almost exclusively automated mapping systems with little or no capability for the management of associated land records. Both AM-FM and GIS systems possess automated mapping and records management capabilities, although the distinction

between the two systems is quite often a function of the type of associated land information managed by the system rather than of any pronounced functional difference between the two system types. Typically, systems categorized as AM-FM systems are found in situations where the predominant function is to manage information associated with networks: for example, water distribution systems, sanitary sewerage systems, telephone systems, and electric power and natural gas distribution systems. GIS systems are usually systems that manage information associated with areas: real property parcels, administrative districts, land use polygons, and soil mapping units.

5. Much of the information that would be incorporated within a multipurpose cadastre or an automated mapping and land information system has traditionally been stored in the form of maps. Conversion of map information into a digital format where it can be manipulated and operated upon by a computer requires the use of a device called a digitizer. Alternatively, certain forms of specialized data conversion procedures, such as optical scanning, direct digitizing from stereoscopic models, or coordinate geometry entry, can be utilized. Once the initial map data are transformed into numeric form, a variety of manipulations become possible. Data mapped at one scale can be reproduced at different scales, provided that the accuracy limitations of the original maps are recognized in any enlargement, as opposed to reduction, in scale. Graphic base files collected from different sources can be merged and reproduced at a uniform scale. Data for special study areas can be identified, reproduced, and measured; and information on base maps can be identified in such a manner that only selected portions of that information are reproduced at a time.

6. There are a number of automated mapping and land information systems already in existence whose areas of operation include all or portions of Waukesha County. Several of these systems—those of the Southeastern Wisconsin Regional Planning Commission, the Wisconsin Electric Power Company, the Wisconsin Natural Gas Company, and the Wisconsin Gas Company—have been functional for a decade or more and have developed extensive digital map holdings. These existing systems currently utilize a variety of proprietary computer hardware and software products in their operation, and are using several different map coordinate systems, not all of which can mathematically relate to each other. The use of different proprietary products may affect the ability to exchange digital map data between different automated mapping sites and systems, as commercial software products are available that can "translate" digital map data between different proprietary automated mapping systems, although under certain circumstances translations may be partial rather than complete. The use of mathematically unrelated map coordinate systems, however, can be expected to adversely affect, at least at higher required levels of precision, the correct integration of digital map data between sites using mathematically unrelated map coordinate systems.

7. There is a growing interest at the local governmental level in Waukesha County in developing automated mapping and geographic information systems. In particular, the City of New Berlin and the Village of Menomonee Falls, in cooperation with Waukesha County, have acquired a digital topographic mapping base suitable for the development of municipal automated and parcel based land information systems.

Chapter III

COMPONENTS OF AN AUTOMATED MAPPING AND LAND INFORMATION SYSTEM

INTRODUCTION

This chapter provides a description of the major elements of a multipurpose cadastre, or parcel-based land information system, and discusses such a cadastre within the more general context of geographic information systems. The remonumentation and base mapping efforts previously carried out in the Region and in Waukesha County, which provide the essential base for the establishment of an automated mapping and land information system, are also reported. The chapter concludes with an assessment of mapping and land information system needs within the County.

THE CADASTRE AS PART OF A LARGER SYSTEM OF LAND INFORMATION

A cadastre may be defined as a record of interests in land, encompassing both the nature and extent of these interests. Historically, cadastres have been created and maintained for the purpose of taxing these interests, and evidence of the existence of cadastres goes back through hundreds of years of human civilization. It is possible to develop an automated version of a cadastre defined in this more narrow, historical sense; and, in fact, the development of such single-purpose cadastres has been advanced on the premise that the development of more complex multipurpose cadastres and land information systems ought to begin with the development of single-purpose cadastres relating only to the value of real property as a basis for taxation, and, perhaps the registration of land ownership; their use was extended later in an evolutionary manner to other applications.

Thus, the development of a more narrowly defined cadastre can be considered a preliminary step in the development of a broader land-related information system. Additional information subsequently incorporated into such a system may include data on land use; certain natural characteristics of the land such as soil and geologic conditions; natural hazards such as flooding and shoreline erosion; environmentally sensitive areas such as woodlands and wetlands; permits; public and private infrastructure systems; and selected social and economic data, to name just a few. These broader land information systems are considered to contain, in addition to the information considered to be part of a single-purpose cadastre, all types of land-related information both cultural and natural.

ELEMENTS OF A MULTIPURPOSE CADASTRE

A multipurpose cadastre—a parcel-based land information system—can be conceptualized as a public, operationally and administratively integrated, land-related information system which provides continuous, readily available, and comprehensive information at the ownership-parcel level. The Panel on a Multipurpose Cadastre of the National Research Council has proposed the procedural model shown in Figure 1 for the development of multipurpose cadastres. This model consists of the following five basic elements: 1) a geographic reference frame consisting of a geodetic survey network; 2) a series of current, accurate, large-scale base maps properly related to the geographic reference frame; 3) a cadastral map overlay delineating all cadastral parcels which is also properly related to the geographic reference frame; 4) a unique identifying number assigned to each parcel; and 5) a series of registers, or land data files, each including a parcel index for purposes of information retrieval and cross referencing with information in other land data files.

Additional elements in the form of maps and records of land-related information can be added readily to the base over time.

Geodetic Reference Framework

A reference frame, or survey control network, consisting of a system of survey monuments having geodetically based coordinates, is necessary for defining the relative spatial location of all land-related data, and as such comprises the first component for a multipurpose cadastre. In the United States, two different, and heretofore largely uncoordinated, systems of survey control

have evolved. One of these two systems, the State Plane Coordinate System, is founded on the science of measurement and is intended to be utilized as a basis for the collection of earth science data and for the preparation of earth science maps, such as topographic, geologic, soils, and hydrographic maps. The other of these two systems, the U. S. Public Land Survey System, is founded on the principles of property law, as well as in the science of measurement, and is utilized for the collection of cadastral data and for the preparation of cadastral maps, such as maps of boundary lines of real property.

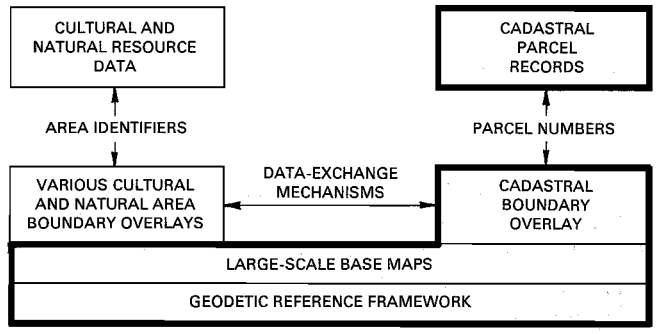
U. S. Public Land Survey System: For most of the United States, the federal government has provided the basic survey control system for cadastral mapping in the form of the U. S. Public Land Survey System. Under regulations imposed by the Congress, the U. S. Public Land Survey System has been extended into 30 of the 50 states, including Wisconsin.

This system is founded on the best features of the English common law of boundaries, superimposing on that body of law systematic land survey procedures under which the original public domain is surveyed, monumented, and platted before patents are issued. Legal descriptions are by reference to a plat; lines actually run and marked on the ground control boundaries; adjoiners are respected; and the body of law in effect at the time of the issuing of the deed is controlling, and forever a part of, the deed. Unlike scientific surveys, which are made for the collection of information and can be amended to meet improved standards or changing conditions, the original government land survey in an area cannot be legally ignored, repudiated, altered, or corrected as long as it controls rights vested in lands affected.

The U. S. Public Land Survey System is one of the finest systems ever devised for describing and marking land. It provides a basis for a clear, unambiguous title to land, together with the physical means by which that title can be related to the land it describes. The system is ingenious, being simple and easy to comprehend and administer; and without it, the nation would unquestionably have been poorer. This "rectangular" land survey system, however, has one serious flaw. Its use requires the perpetuation of monuments set by the original government surveyors, the positions of which are not precisely related to the surface of the earth through a scientifically established map projection.

Figure 1

COMPONENTS OF A MULTIPURPOSE CADASTRE



The basic elements of a multipurpose cadastre (in heavy outline) provide a ready framework for the incorporation of additional land related information in the form of maps and records.

Source: National Research Council and SEWRPC.

State Plane Coordinate System: A strictly scientific control survey system designed to provide the basic control for all federal—and most private—topographic and other earth science mapping operations exists separate from the U. S. Public Land Survey System in the triangulation and traverse stations established by the National Geodetic Survey (formerly U. S. Coast and Geodetic Survey). The triangulation and traverse stations established by this agency comprise a nationwide network connecting thousands of monumented points whose geodetic positions, expressed in terms of latitude and longitude, are known. In order to make the National Geodetic Survey control network more readily available for local use, the U. S. Coast and Geodetic Survey devised the State Plane Coordinate System in 1933. This system transforms the spherical coordinates—latitudes and longitudes—of the stations established in the national geodetic survey into rectangular coordinates—eastings and northings—on a plane surface. This plane surface is mathematically related to the spheroid on which the spherical coordinates of latitude and longitude have been determined. The mutual relationship, which makes it practicable to pass with mathematical precision from a spherical to a plane coordinate system, makes it also practicable to utilize the precise scientific data of the National Geodetic Survey control network for the reference and control of local surveying and mapping operations. Limitations on such uses, however, are

imposed by the relatively widespread location of the basic triangulation and traverse stations and by the difficulties often encountered in the recovery and use of these stations.

Large-Scale Base Maps

To satisfy the growing need for an integrated, land-related information base, a system capable of handling a variety of information ranging from such earth science-related data as delineation of flood hazard boundaries to such cadastral-related data as real property boundary line locations, is required. It is also mandatory that fieldwork, data resolution, and information presentation be consistent with the most detailed level of land-related decision-making; the individual proprietary parcel. These requirements call for base maps at scales significantly larger than those generally available in the United States are required as the second component of a multipurpose cadastre. These maps should be topographic maps, showing in their correct location and orientation the principal natural and cultural features of the area concerned and the elevation and configuration of the surface of the earth.

Cadastral Overlay

The third component of a multipurpose cadastre is the cadastral overlay. Preparation of the cadastral overlay requires identifying and delineating the most fundamental unit of land, a cadastral parcel. This unit of land becomes the basic building block for maintaining real property boundary line-related information, including information on rights and interests. A cadastral parcel is, therefore, an unambiguously and uniquely defined unit of land within which rights and interests are legally recognized and for which there is a unique and complete group of rights. The primary type of interest, for this definition, is land ownership associated with that set of rights and interests that may be acquired and transferred.

Parcel Number

The fourth component of a multipurpose cadastre is the parcel identifier, defined as a code for recognizing, selecting, identifying, and arranging information to facilitate storage and retrieval of parcel records. It may also be used for spatial referencing of information and as a means of referring to a particular parcel in lieu of a full legal description. There is general agreement that the identifier system should provide for the assignment of a unique code to each parcel, should be easily understandable and usable to the general public, or at least to that segment of the public that may have cause to use the system, should be capable of serving a variety of different uses, and should be reasonably permanent.

Land Information Files

The fifth and last component of a multipurpose cadastre is the land information files, or land data files, which contain facts about the land parcel in question and are related to the cadastral map through the parcel identifier. The various types of information that may be compiled about the land are potentially voluminous, and may include information about both natural and cultural—that is, man-made—features of the parcel. Perhaps the most familiar land information files are those of local land-title records systems and records systems for tax assessment and collection.

EXISTING FRAMEWORK FOR THE DEVELOPMENT OF MULTIPURPOSE CADASTRES WITHIN SOUTHEASTERN WISCONSIN

It should be noted that the first three elements of the procedural model for the creation of a multipurpose cadastre as proposed by the National Research Council have long been embodied in the Regional Planning Commission's recommended large-scale base mapping program. Recognizing the importance of good large-scale maps and attendant survey control to sound community development and redevelopment, the Commission has, for almost three decades, encouraged the preparation of large-scale topographic and cadastral maps within its 2,689-square-mile Planning Region. These maps are based on a unique system of survey control that combines the best features of the U. S. Public Land Survey System and State Plane Coordinate System. The large-scale maps and attendant control survey system, where they already exist, provide, in a highly cost-effective manner, the technical foundation for the creation of multipurpose cadastres within the Region. Because of their critical and central importance to the implementation of a multipurpose cadastre, these three elements—the geodetic reference frame, large-scale base maps, and the cadastral overlays—are discussed in greater detail in the following sections.

A Composite System for the Geodetic Reference Framework

From the preceding brief discussion of the U. S. Public Land Survey and State Plane Coordinate Systems, it is apparent that two essentially unrelated control survey systems have been established in the United States by the federal government. One of these—the U. S. Public Land Survey System—is founded on the legal principles of real property description and location and was designed primarily to provide a basis for the accurate location and conveyance of ownership rights in land. The other—the State Plane Coordinate System—is founded on the science of geodesy and was designed primarily to provide a basis for earth science mapping operations and for the conduct of high-precision scientific and engineering surveys over large areas of the earth's surface. Both systems have severe inherent limitations for use as a geographic framework for a local land data system. By combining these two separate survey systems into one integrated system, however, an ideal system for the geometric control required for land data systems is created.[1] This ideal system includes the relocation and monumentation of all U. S. Public Land Survey section and quarter-section corners, including the centers of sections, within the geographic area for which the land data system is to be created, and the utilization of these corners as stations in second order traverse and level nets, with both nets tied to the National Geodetic Datum. The traverse net establishes the precise geographic positions of the U. S. Public Land Survey corners in the form of state plane coordinates, while the level net establishes the precise elevation above mean sea level of the monuments marking the corners.

Such a system of survey control has at least the following three advantages as a geographic framework for a multipurpose cadastre:

1. It provides an accurate system of control for the collection and coordination of cadastral data, since the boundaries of the original government land subdivision form the basis for all subsequent property divisions and boundaries. As all subsequent legal descriptions and plats must be tied to the U. S. Public Land Survey System, accurate reestablishment and monumentation of the quarter-section lines and corners permits the ready compilation of accurate property boundary line data and the ready maintenance of these data in current form over time. These data can be readily and accurately updated and extended since, in Wisconsin, all new land subdivisions must by law be tied to corners established in the U. S. Public Land Survey, and since the accuracy of the surveys for these subdivisions can be readily controlled by state and local land subdivision regulations. The recommended survey control system thus fully meets the needs of a narrowly defined cadastre for the fiscal and legal administration of real property, yet this cadastre can be developed readily and soundly into a multipurpose land data system.

2. It provides a common system of control for the collection and mapping of both cadastral and earth science data. By relocating the U. S. Public Land Survey corners and accurately placing them on the State Plane Coordinate System, it becomes possible to correlate real property boundary line information with earth science data accurately. This placement of property boundary and earth science data on a common datum is absolutely essential to the sound development of any multipurpose land data system. Yet such a common control datum is rarely used. The establishment of state plane coordinates for the U. S. Public Land Survey corners permits the correlation with mathematical precision of data supplied by aerial and other forms of earth science mapping with property boundary line data compiled through the usual land surveying methods. Only through such a common geometric control system can all of the information required for a multipurpose land data system be accurately collected for, and correlated in, the system.

3. It permits lines and areas entered into the data base, whether these lines represent the limits of land to be reserved for future public uses, the limits of land to be taken for immediate public use, the limits of districts to which public regulations are to

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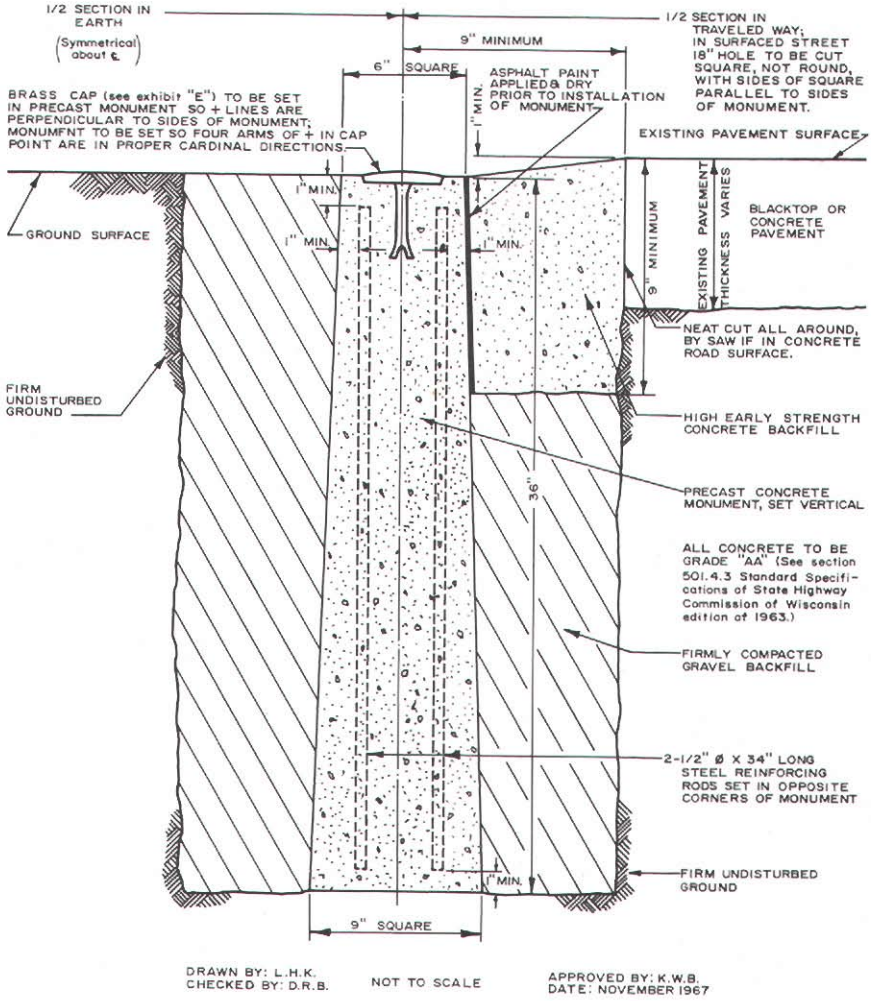
[1] *See K. W. Bauer, "Geometric Framework for Land Data Systems," Journal of the Surveying and Mapping Division, Proceedings of the American Society of Civil Engineers, Volume 107, Number SU1, November 1981.*

Figure 2

DETAIL OF MONUMENT INSTALLATION FOR SURVEY CONTROL STATIONS



Source: SEWRPC.

be applied, or the location and alignment of proposed new property boundary lines or of proposed constructed works—to be reproduced upon the ground accurately and precisely.

Commission Specifications for Geometric Framework and Base Maps

As already noted, the Regional Planning Commission, since 1961, has promoted the preparation of large-scale topographic and cadastral base maps based upon a control survey system which combines the U. S. Public Land Survey and State Plane Coordinate Systems. The maps and attendant control survey system, in addition to providing essential municipal planning and engineering tools, were intended to provide the foundation for the eventual development of automated, multipurpose cadastres within the Planning Region. Since the Commission-specified topographic base maps and survey control system are being put in place throughout Waukesha County and Commission-specified cadastral maps have been prepared for a significant portion of Waukesha County, a description of those specifications herein is warranted.

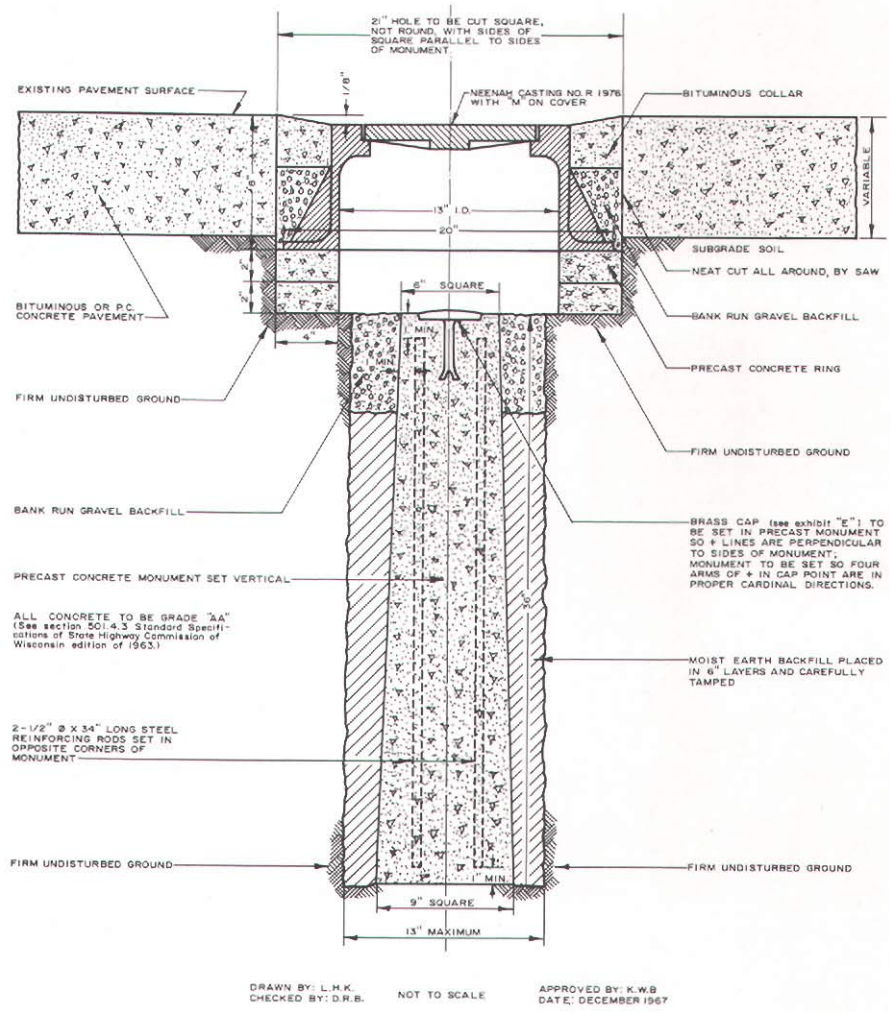
Specifications for Relocation, Monumentation, and Coordination of U. S. Public Land Survey Corners: The Commission specifications governing the creation of the necessary survey control network requires the relocation of all U. S. Public Land Survey corners in the areas to be mapped, and the marking of the relocated corners by reinforced concrete monuments, having engraved bronze caps imbedded in the tops (see Figures 2 and 3). The bronze caps are inscribed with the corner notation, one-quarter section, town, and range. The monuments placed are referenced by ties to at least four witness marks. The specifications require that the survey engineer and land surveyor provide a dossier on each control station established, in order to permit its ready recovery and use. The dossier sheets provide for each station a sketch showing the monument erected in relation to the salient features of the immediate vicinity, all witness monuments together with ties, the state plane coordinates of the corner, its U. S. Public Land Survey description, the elevation of the monument, and the location of appurtenant reference benchmarks referred to National Geodetic Vertical Datum of 1929 (see Figure 4). These dossier sheets are recorded with the County Surveyor as well as with the Commission, and are thereby readily available to all land survey-

ors and public works engineers operating in the area mapped.

The specifications require the control survey data to be summarized by means of a control survey summary diagram showing the exact grid and ground lengths and grid bearings of the exterior boundaries of each U. S. Public Land Survey quarter section; the area of each quarter section; all monuments erected; the number of degrees, minutes, and seconds in the interior angles of each one-quarter section; the state plane coordinates of all quarter-section corners together with their Public Land Survey System identification; the benchmark elevations of all monuments set; and the basic National Geodetic Survey control stations utilized to tie the Public Land Survey corners to the horizontal geodetic control datum, together with the coordinates of these stations. The angle between geodetic and grid bearing is noted, as is the combination sea-level and scale-reduction factor (see Figure 5).

Figure 3

DETAIL OF ALTERNATIVE CONTROL SURVEY MONUMENT INSTALLATION IN SURFACE TRAVELED WAY OF STREETS AND HIGHWAYS



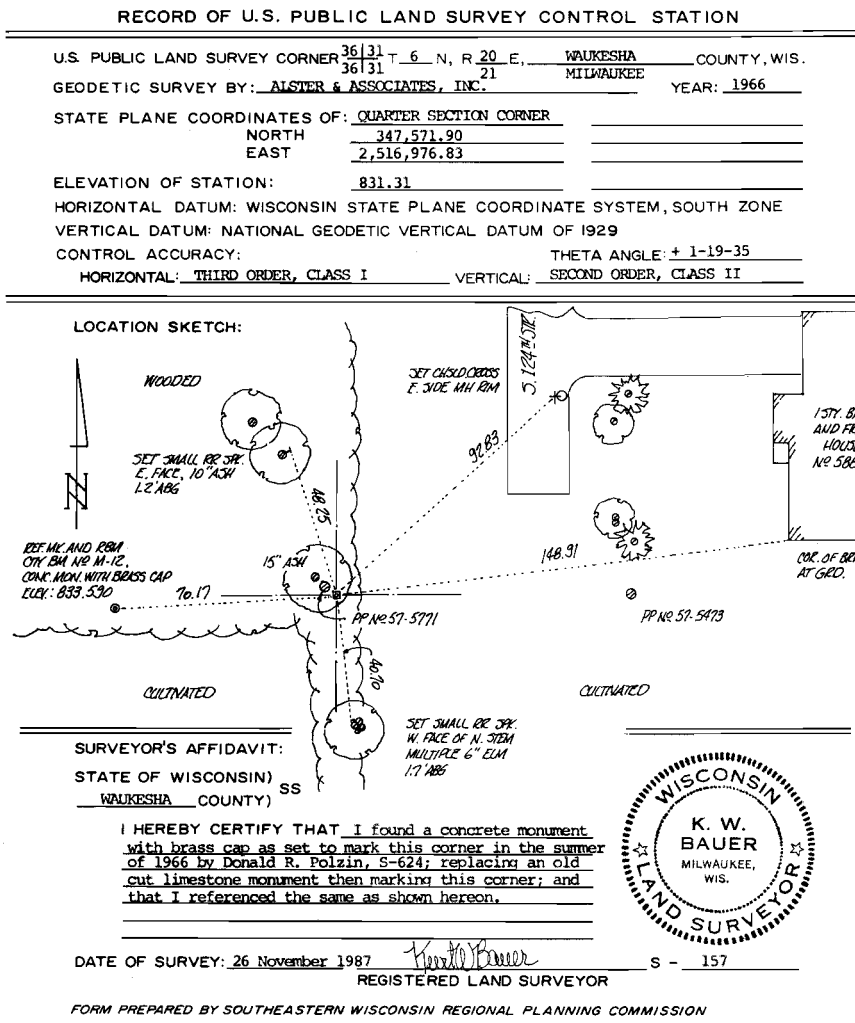
Source: SEWRPC.

All the work necessary to execute the control surveys and provide the finished topographic maps described below has been done in southeastern Wisconsin on a negotiated contract basis with an experienced photogrammetric and control survey engineer. In this regard, it was considered essential to retain a photogrammetric and control survey engineer familiar with higher order field methods and procedures and with the attendant geodetic survey computations and adjustments, and whose crews were properly equipped with state-of-the-art survey instruments. Electronic distance-measuring equipment was employed in the work, as well as optically reading theodolites and appurtenant traverse equipment, automatic levels, and precision level rods. Indeed, the control survey system used is made economically feasible only through the application of these relatively recently developed instruments, particularly the electronic distance-measuring devices.

Although the specifications governing the work make the photogrammetric engineer responsible for overall supervision and control of the mapping work as well as for the quality of the finished maps, they require that the actual relocation of the Public Land Survey corners be done by a local land surveyor employed as a subcontractor by the photogrammetric engineer or as a contractor by the Commission directly. The specifications thereby recognize that this portion of the work requires expert knowledge of local survey custom and boundary and title law, as well as the assembly and careful analysis of all authoritative survey information, such as title documents and attendant legal descriptions, land subdivision plats and certified survey

Figure 4

RECORD OF U. S. PUBLIC LAND SURVEY CONTROL STATION



RECORD OF U.S. PUBLIC LAND SURVEY CONTROL STATION

U.S. PUBLIC LAND SURVEY CORNER 36|31 / 31|21 T 6 N, R 20 E, WAUKESHA / MILWAUKEE COUNTY, WIS.

GEODETIC SURVEY BY: ALSTER & ASSOCIATES, INC. YEAR: 1966

STATE PLANE COORDINATES OF: QUARTER SECTION CORNER

NORTH 347,571.90

EAST 2,516,976.83

ELEVATION OF STATION: 831.31

HORIZONTAL DATUM: WISCONSIN STATE PLANE COORDINATE SYSTEM, SOUTH ZONE

VERTICAL DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929

CONTROL ACCURACY: THETA ANGLE: + 1-19-35

HORIZONTAL: THIRD ORDER, CLASS I VERTICAL: SECOND ORDER, CLASS II

LOCATION SKETCH:

SURVEYOR'S AFFIDAVIT:

STATE OF WISCONSIN) SS
WAUKESHA COUNTY)

I HEREBY CERTIFY THAT I found a concrete monument with brass cap as set to mark this corner in the summer of 1966 by Donald R. Polzin, S-624; replacing an old cut limestone monument then marking this corner; and that I referenced the same as shown hereon.

WISCONSIN K. W. BAUER MILWAUKEE, WIS. LAND SURVEYOR

DATE OF SURVEY: 26 November 1987 S - 157

REGISTERED LAND SURVEYOR

FORM PREPARED BY SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

Source: SEWRPC.

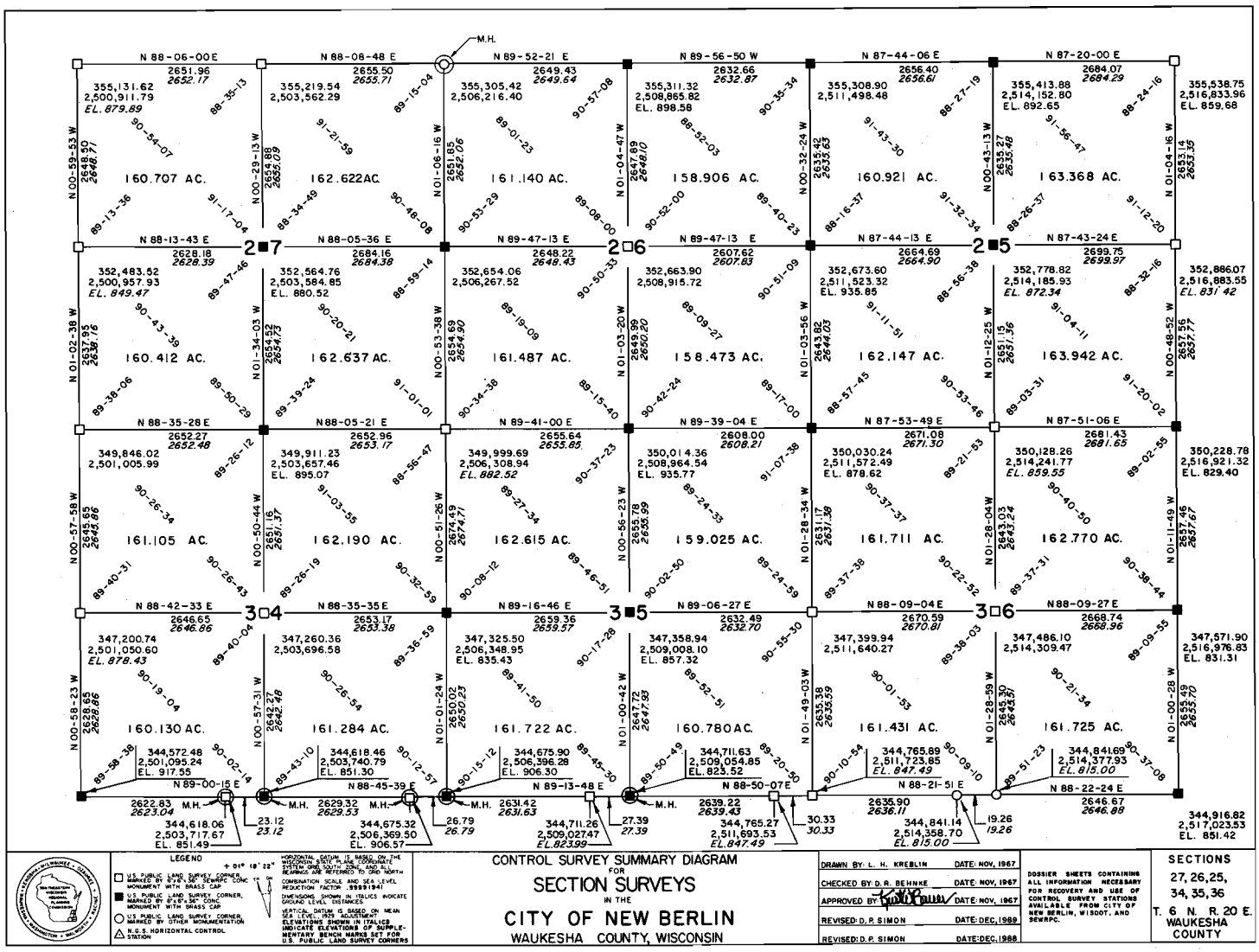
maps, survey records, and, of cardinal importance, records on existing land survey monumentation and land occupation, in order to arrive at the best possible determination of the location of the land survey corners. In the areas mapped, the land survey portion of the control survey work requires a very high degree of professional competence, as almost all of the Public Land Survey corners fall under the federal definition of either obliterated or lost corners. The importance of this phase of the work and its impact on real property boundaries throughout the community can hardly be overemphasized.

Specifications for Topographic Mapping: The specifications provide for the completion of finished topographic maps that can serve as the base maps for the preparation of a multipurpose cadastre by accurately recording the basic geography of the area mapped. In addition to showing the usual contour information, spot elevations, planimetric and hydrographic detail, and coordinate grid ticks, the maps show, in their correct position and orientation, all U. S. Public Land Survey quarter-section lines and corners established in the control surveys (see Figure 6). The specifications require that all state plane coordinate grid lines and tick marks and all horizontal survey control stations be plotted to within 1/100 inch of the true position as expressed by the coordinates for the control survey stations. The specifications further require that the planimetric features and contours shown on the maps conform to National Map Accuracy Standards. Thus, 90 percent of all well-defined planimetric features must be plotted to within 1/30 inch of their true positions, and no such features may be off by more than 1/20 inch. Ninety percent of the elevations indicated by the solid-line contours must be within one-half contour interval of the true elevation, and no such elevation may be off by more than one contour interval. A combination sea level and scale-reduction factor, and the angle between geodetic and grid bearing, are noted on each map sheet, as is the equation between any local datum and mean sea level.

Specifications for Cadastral Mapping: The Commission's specifications visualize the preparation of real property boundary line maps, complementing the topographic maps, by the local units of government concerned, utilizing resident engineering and planning staffs or consultants. The property boundary line maps are compiled at a scale matching that of the topographic maps, each map sheet covering, like the topographic maps, a U. S. Public Land Survey section or quarter section.

Figure 5

A TYPICAL CONTROL SURVEY SUMMARY DIAGRAM



Source: SEWRPC.

As the topographic maps are being compiled, the Commission specifications require that the photogrammetric engineer provide cadastral base sheets. These sheets consist of reproducible duplicates of the partially completed topographic maps showing, in addition to the state plane coordinate grid, the U. S. Public Land Survey section and quarter-section lines and corners in their correct position and orientation, together with the attendant ground lengths and grid bearings, and such salient planimetric detail and hydrographic features as may be helpful in the subsequent plotting of real property boundary lines, including railway tracks, electric power transmission lines, principal structures, wetlands, and such hydrographic features as streams and lakes.

Utilizing recorded subdivision plats, certified survey maps, and legal descriptions, all real property boundary lines, including street right-of-way lines and major utility easement lines, are then constructed on the base sheets, working within the framework of control provided by the ground lengths and grid bearings of the U. S. Public Land Survey quarter-section lines. The property boundary lines are constructed in a manner that parallels the location of these lines

on the surface of the earth following land surveying practice in the State of Wisconsin. The specifications require that all real property boundary lines be plotted within 1/30 inch of their true position based on analysis of all authoritative information available. Dimensions are shown for all platted areas as shown on the recorded subdivision plats. Wisconsin Statutes have long required that such plats be prepared to an accuracy of 1 part in 3,000, as compared to the accuracy of 1 part in 10,000 required by the specifications for the basic survey control network. Any overlaps or gaps between adjoining property boundary lines, as indicated by the construction and plotting of those lines, are noted on the cadastral maps. Finally, a cadastral parcel identification number is added.

The property boundary line maps thus show the ground length and grid bearing of all quarter-section lines; the state plane coordinates of all quarter-section corners; the monuments marking these corners; the recorded dimensions of all street lines, alley lines, and boundaries of public property; recorded street widths; platted lot dimensions; and a parcel identification number. In unplatted areas, real property boundaries are shown by scale alone. Railway tracks, electric power transmission lines, principal structures, fences, wetlands, lakes, streams, and drainage ditches are also shown (see Figure 7). As previously noted, these boundary line maps can be readily and accurately updated and extended as new land subdivision plats and certified map surveys, utilizing the survey control, are made and recorded.

Status of Survey Control, Large-Scale Topographic Base Mapping, and Cadastral Mapping in Waukesha County

As noted above, the Commission has long recognized the importance of good large-scale maps to the proper administration of local government functions, and has encouraged counties, cities, and villages within the Region to prepare such maps. Map 1 shows those areas in Waukesha County for which large-scale topographic maps have been, or are being, prepared to Commission-recommended standards, including the relocation, monumentation, and placement on the State Plane Coordinate System of the U. S. Public Land Survey corners. This area totals about 354 square miles, or about 61 percent of the total area of the County. About 124 square miles, or about 21 percent of the total area of the County, is covered by digital topographic maps. A total of 1,737 U. S. Public Land Survey corners have been or are being relocated, monumented, and coordinated, representing about 68 percent of all such corners in the County.

Cadastral maps have been prepared, or are currently being prepared, to Commission-recommended standards for about 137 square miles, or about 24 percent, of the area of Waukesha County. These cadastral maps contain about 30,000 real property parcels, or about 26 percent of all real property parcels in the County. As shown on Map 2, cadastral mapping has been completed by the Cities of Brookfield, Muskego, and New Berlin; the Village of Menomonee Falls; and by the Waukesha County Tax Lister at scattered locations throughout the County. Therefore, a significant portion of the effort necessary to develop a countywide automated mapping and land information system has already been accomplished.

Needs Assessment

Given the conceptual framework of a multipurpose cadastre as set forth by the National Research Council and as summarized earlier in this chapter, and given the progress made to date in developing the foundation elements necessary for the creation of a modern land records system, the following basic needs exist within Waukesha County:

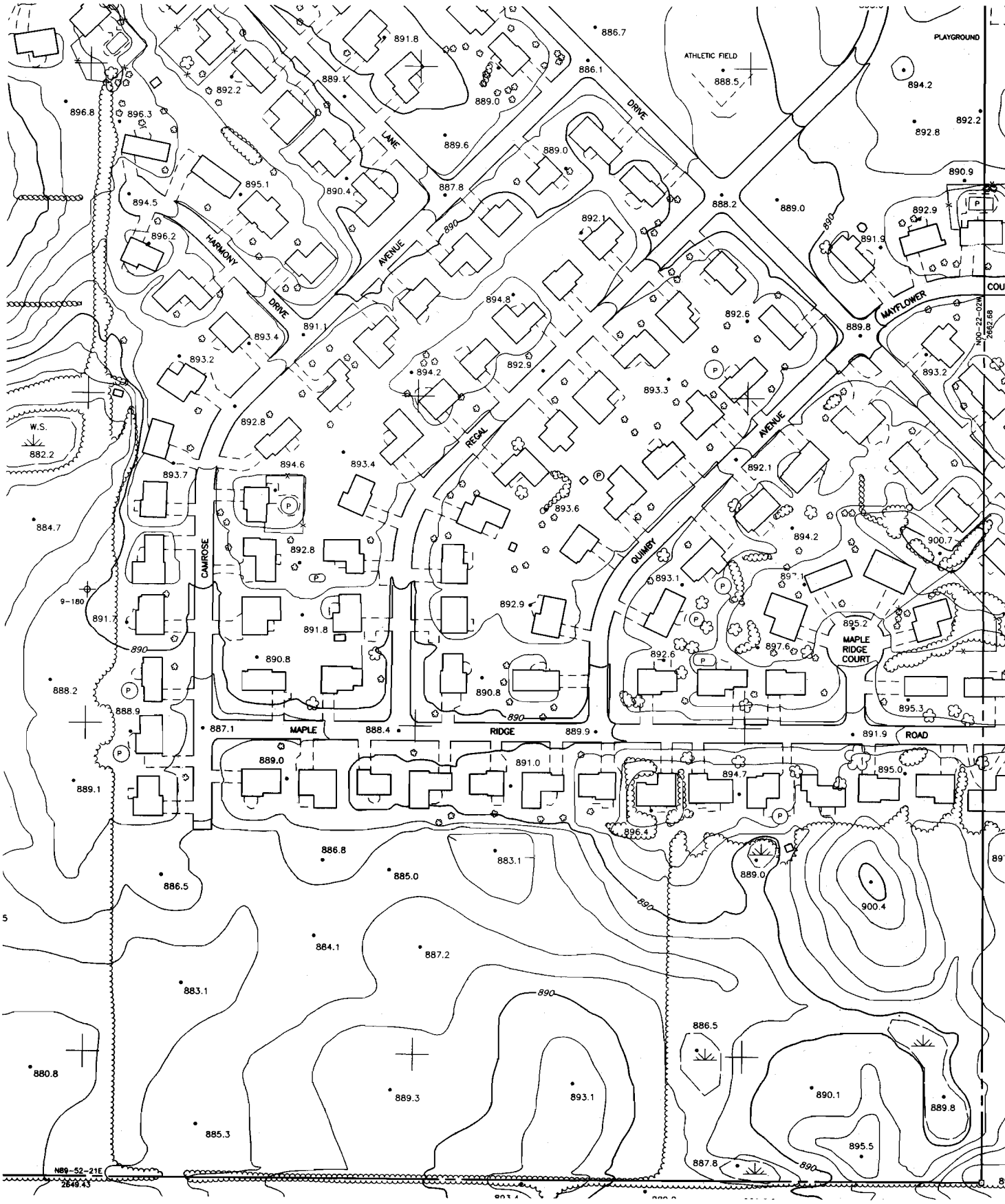
1. Completion of the Geodetic Reference Framework.

   The most basic need to be addressed in the Waukesha County land information system plan is the completion of the geodetic reference framework based upon the U. S. Public Land Survey System and the State Plane Coordinate System. More particularly, a need exists to relocate and monument the remaining 798 U. S. Public Land Survey Section and quarter-section corners, including centers of sections, that have not been completed to date; to obtain horizontal survey control data attendant to 798 U. S. Public Land Survey corners where such control has not been established to date; and to obtain vertical survey control data attendant to the 872 U. S. Public Land Survey corners where such control has not been obtained to date.

Figure 6

PORTION OF A TYPICAL LARGE-SCALE TOPOGRAPHIC MAP PREPARED IN ACCORDANCE WITH SEWRPC RECOMMENDED SPECIFICATIONS

Part of U. S. Public Land Survey Section 23, Township 6 North, Range 20 East, City of New Berlin

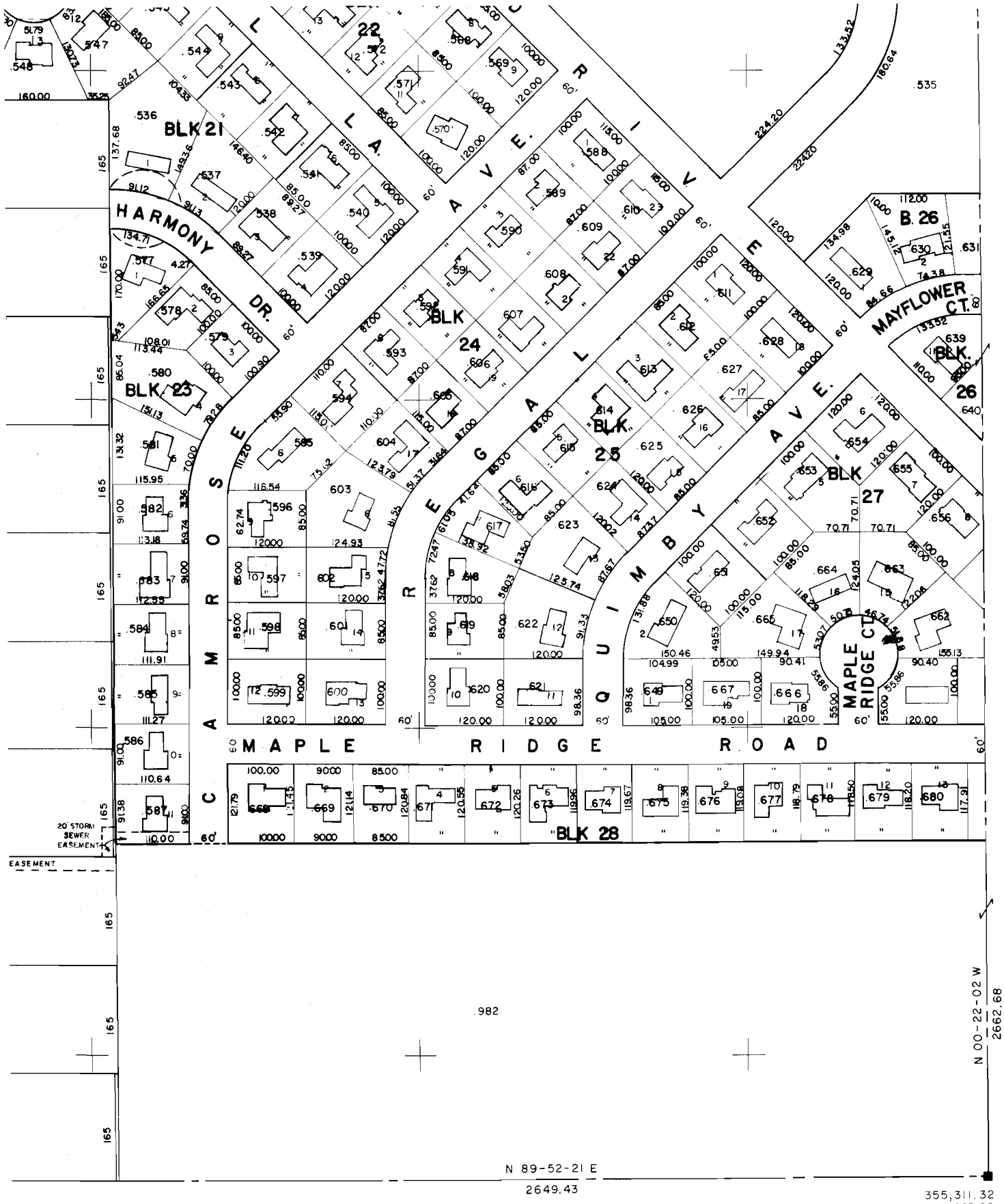


Source: SEWRPC.

Figure 7

PORTION OF A TYPICAL CADASTRAL MAP PREPARED IN ACCORDANCE WITH SEWRPC RECOMMENDED SPECIFICATIONS

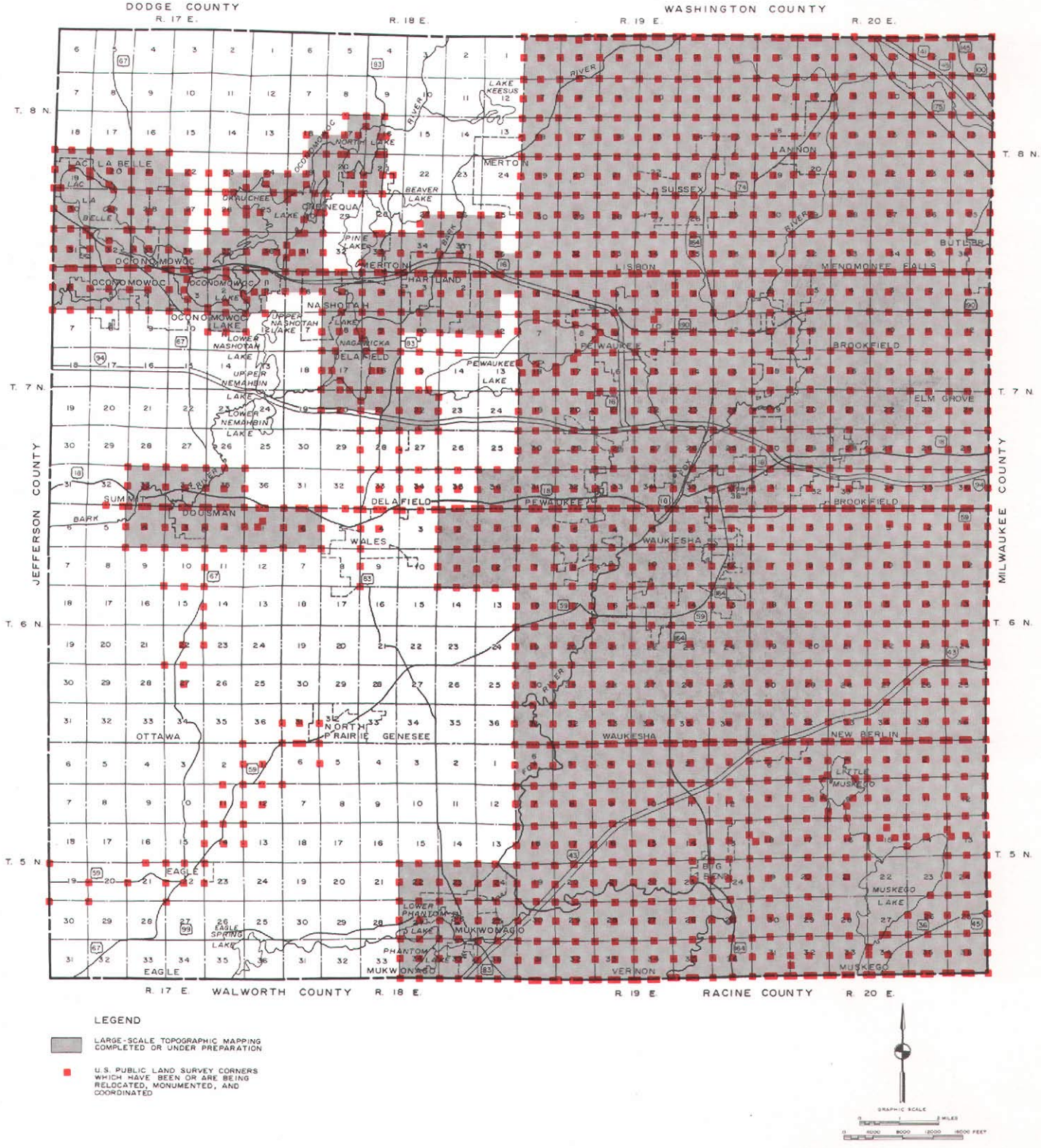
Part of U. S. Public Land Survey Section 23, Township 6 North, Range 20 East, City of New Berlin



Source: SEWRPC.

Map 1

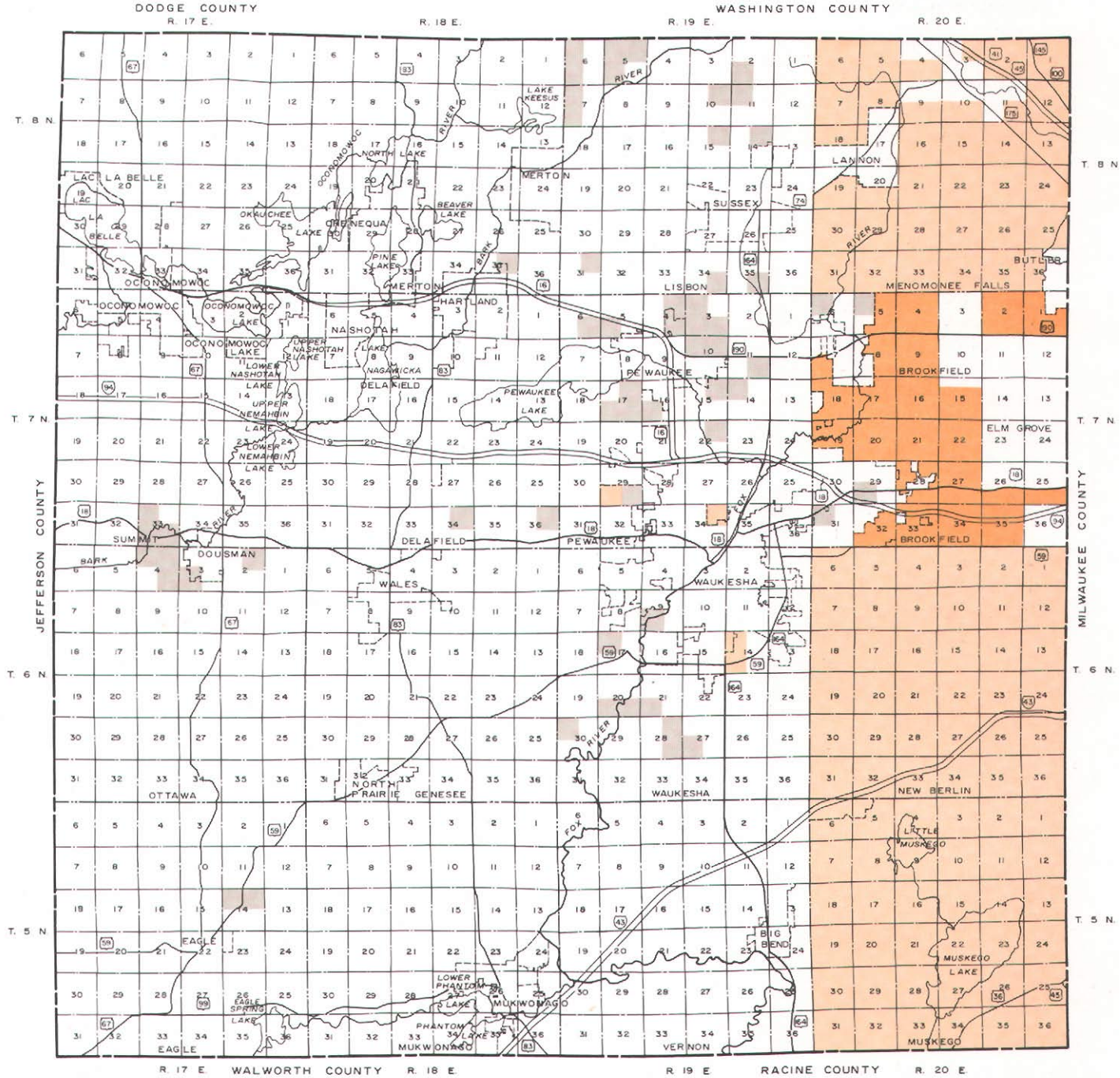
STATUS OF LARGE-SCALE TOPOGRAPHIC MAPPING AND THE RELOCATION, MONUMENTATION, AND COORDINATION OF U. S. PUBLIC LAND SURVEY CORNERS IN WAUKESHA COUNTY: DECEMBER 31, 1990



Source: SEWRPC.

Map 2

STATUS OF CADASTRAL MAPPING IN WAUKESHA COUNTY: DECEMBER 31, 1990



LEGEND

- AREA MAPPED BY WAUKESHA COUNTY AT A SCALE OF 1" = 200'; COMPILED BY U.S. PUBLIC LAND SURVEY ONE-QUARTER SECTION
- AREA MAPPED BY LOCAL GOVERNMENT AT SCALE OF 1" = 100'; COMPILED BY U.S. PUBLIC LAND SURVEY ONE-QUARTER SECTION (CITIES OF MUSKEGO, NEW BERLIN, AND WAUKESHA; AND VILLAGE OF MENOMONEE FALLS)
- AREA MAPPED BY LOCAL GOVERNMENT AT SCALE OF 1" = 200'; COMPILED BY U.S. PUBLIC LAND SURVEY SECTION (CITY OF BROOKFIELD)

NOTE: CITY OF MUSKEGO ALSO MAINTAINS A SET OF CADASTRAL MAPS AT A SCALE OF 1" = 50'

Source: SEWRPC.

2. Large-Scale Base Maps
A need exists to complete the large-scale planimetric and topographic base maps throughout Waukesha County. As noted above, about 61 percent of the area in Waukesha County has been so mapped. In addition, a need exists to convert to digital form the planimetric and topographic maps obtained in Waukesha County prior to 1987. All maps prepared since that date have been obtained in digital form.

3. Cadastral Overlay
A third need involves the completion of the preparation of cadastral maps throughout Waukesha County. As noted above, about 24 percent of the area of Waukesha County has been so mapped. In addition, all cadastral maps would need to be converted to digital form.

4. Parcel Number
A fourth need involves the assignment of a parcel identifier to facilitate the storage and retrieval of various parcel-related data. The existing parcel identification system in Waukesha County needs to be reviewed with particular reference to the data interchange standard attendant to parcel numbering systems promulgated by the Wisconsin Land Information Board.

5. Land Information Files
A fifth need relates to the creation of land information files, such files containing facts about land parcels which are related to the cadastral map through the parcel identifier.

SUMMARY

This chapter presents a description of the major elements of a multipurpose, parcel-based land information system, placing that system within the more general context of geographic information systems. In addition, this chapter summarizes the work that has been accomplished in Waukesha County to date to provide the essential base for the establishment of an automated mapping and land information system for the County. The following summarizes the material included in this chapter:

1. A multipurpose cadastre can be conceptualized as a public, operationally and administratively integrated, parcel-based land information system which provides for continuous, readily available, and comprehensive land-related information at the parcel level. The National Research Council has proposed that multipurpose cadastres consist of the following five elements: 1) a geographic reference frame consisting of a geodetic network; 2) a series of current, accurate, large-scale topographic base maps properly related to the geographic reference frame; 3) a cadastral map overlay delineating all cadastral parcels, which is also properly related to the geographic reference frame; 4) a unique identifying number assigned to each parcel; and 5) a series of registers, or land data files, each including a parcel index for purposes of information retrieval and cross-referencing with information in other land data files.

2. The first three elements of the procedural model for the creation of a multipurpose cadastre as proposed by the National Research Council have long been embodied in the Regional Planning Commission-recommended large-scale base mapping and attendant survey control program. Recognizing the importance of good large-scale maps and attendant survey control to sound community development and redevelopment, the Commission has for almost three decades encouraged the preparation of large-scale topographic and cadastral maps within its 2,689-square-mile planning Region. These maps are based on a unique system of survey control that combines the best features of the U. S. Public Land Survey System and State Plane Coordinate System. The large-scale maps and attendant control survey system, where they already exist within the Region, provide in a highly cost-effective manner the technical foundation for the creation of multipurpose cadastres within the Region, providing the first two of the five elements of such a cadastre, and a part of the third element.

3. Within Waukesha County, large-scale topographic maps have been or are being prepared to Commission-recommended standards for an area of about 354 square

miles, or about 61 percent of the total area of the County. About 124 square miles, or about 21 percent of the total area of the County, is covered by digital topographic maps. A total of 1,737 U. S. Public Land Survey corners in the County have been, or are being relocated, monumented, and coordinated, representing about 68 percent of all such corners in the County. Cadastral maps have been or are being prepared to Commission-recommended standards for about 137 square miles, or about 24 percent, of the County. Therefore, a significant portion of the initial effort necessary to begin the development of a countywide automated mapping and land information system has already been accomplished.

4. The basic needs in Waukesha County consist of the completion of the geodetic reference framework; the completion of large-scale planimetric and topographic base maps in the County; the conversion to digital form of those large-scale planimetric and topographic base maps that were prepared prior to 1987; the preparation of cadastral maps for the remaining area of Waukesha County; the conversion to digital form of all cadastral maps; the assignment of parcel identifiers in a manner consistent with the parcel numbering system promulgated by the Wisconsin Land Information Board; and the creation of land information files which are related to the cadastral map through the parcel identifier.

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Chapter IV

RECOMMENDED AUTOMATED MAPPING AND LAND INFORMATION SYSTEM FOR WAUKESHA COUNTY

INTRODUCTION

The previous chapters of this report have presented an overview of the current status of automated mapping and land information system capability within Waukesha County, and have identified the National Research Council model for the creation of automated cadastres as the suggested model for the development of a multipurpose, multi-user automated mapping and land information system in Waukesha County. The elements of such a system have been identified, and the status of implementation of those elements within Waukesha County has been reported.

This chapter sets forth a recommended automated mapping and land information system plan for Waukesha County. The chapter begins with a statement of goals and objectives and follows with sections on the planning time period, system development standards, a multi-year program to build the land information system, and proposed organizational arrangements to carry out that program.

PROGRAM GOALS AND OBJECTIVES

The Waukesha County land information system planning effort seeks to meet the following two basic goals:

1. To implement over time in Waukesha County a parcel-based, multipurpose, multi-user automated mapping and land information system, such system following the National Research Council model and consisting of the following five basic elements:

    a. Geodetic reference framework.

    b. Large-scale planimetric and topographic base maps.

    c. Overlays, including cadastral boundaries and boundaries of various cultural and natural areas.

    d. Identifiers, including parcel numbers and codes associated with various cultural and natural areas.

    e. Nonspatial land information files, including cadastral parcel records and various cultural and natural resource data.

2. To reach agreement among Waukesha County, the local units of government in Waukesha County, and the various public and private utilities operating in Waukesha County on the design of a common automated mapping and land information system so as to ensure economy and efficiency in the development and use of that system and so as to ensure the ready exchange of data between the various users of the system.

To meet these two goals, the following represent the specific objectives of the current planning effort:

1. To lay out a course of action that will continue to completion the current Waukesha County base mapping effort, focusing existing Waukesha County resources and those local government resources that become periodically available on completing the geodetic reference framework and large-scale planimetric and topographic base maps for the entire County.

2. To direct any available new revenues, particularly revenues from supplemental county recording and filing fees, toward completing the cadastral boundary overlay and attendant parcel numbers, and—to the extent fiscal resources may permit—selected planning-oriented cultural and natural area boundary overlays and attendant identifiers for the entire County.

3. To encourage local units of government in Waukesha County who desire to move at a more rapid pace toward establishing an automated mapping and land information system for local government use to commit

additional fiscal resources toward that end; recommending, however, that such resources be expended for work efforts which meet the agreed-upon system development standards.

4. To facilitate applications by Waukesha County and by local units of government in Waukesha County for state grants in support of the development of the recommended automated mapping and land information system for Waukesha County.

5. To encourage partnership efforts between public sector governments and utilities and private sector utilities that will contribute toward the development of the recommended automated mapping and land information system for Waukesha County.

PLANNING PERIOD

The planning period for this initial land information system plan for Waukesha County is the six-year period beginning January 1, 1991, and extending through December 31, 1996. If sufficient resources become available during this period, it is the Advisory Committee's intent that the entire automated mapping and land information system recommended for the County be completed by the end of that period. It is recognized, however, that resource constraints may prohibit achieving full system development within that time. Should resources be so constrained, it is the Committee's intent that available resources be directed toward completing the foundation elements of the multipurpose cadastre, namely the geodetic reference framework, the large-scale planimetric and topographic base maps, and the cadastral overlays, including parcel identifiers.

RECOMMENDED STANDARDS

When discussing the design of an automated mapping and land information system, it is often assumed that the "system" is the computer hardware and software and that the "system" is physically centralized—that is, a single hardware configuration upon which reside all of the digital maps and associated land information of all system users. Users of this type of system operate in terminal fashion from the central computer. For many years, this type of operation was dictated in large part by the available computer technology. Recent advances in computer hardware and software technology—particularly as they pertain to decreasing unit costs for computational and mass data storage capability, to networking between the hardware of different vendors, and to translation capability of digital map data between some different proprietary software products—now permit a different type of "system" to be specified; that is, one in which the system users share digital maps and an agreed-upon set of map-related information, but maintain their own separate—or distributed—computing capability.

If the centralized system concept is discarded, then a number of issues that have in the past been impediments to the development of shared automated mapping and land information systems are no longer pertinent. These are the organizational structure and the cost allocation among participants of a centralized operation, and the maintenance of data security on "proprietary" files in a centralized operating environment.

More importantly, perhaps, the ability to replace the centralized operating concept with a distributed operating concept permits attention to be focused on the true system components of an automated mapping and land information system. In a distributed operating environment, the "system" is not defined in terms of hardware and software, but in terms of an agreed-upon set of procedures and specifications for the production and maintenance of a basic set of digital maps and map-related information, and an agreed-upon set of procedures and specifications for the interchange of these data between system users. It must be stressed that no amount of state-of-the-art computer technology can compensate for the absence of a robust set of specifications and standards for those elements that will be used in common.

The following recommended standards for an automated mapping and land information system for Waukesha County assume that—initially—the following set of elements—namely, a survey control network, large-scale planimetric and topographic base maps, a cadastral map overlay with parcel identifiers, and a selected set of planning-oriented data with identifiers—would be developed for joint use. Discussions held over the past several years among local operators of automated mapping systems indi-

cate that these elements in the aggregate represent a set of map feature information common to most of the users. The provision of a common automated mapping base in this manner would provide a base sufficient to support a wide variety of uses, including county and local government and utility preliminary site engineering, outside plant utility network mapping, the design and construction of public and private works, planning and zoning administration, vehicle routing, emergency services provision, and tax assessment, among others. It is envisioned, however, that these more specialized applications would be developed by the users either singly or in small groups as may be appropriate or necessary, rather than being jointly developed.

System Accuracy

The issue of map accuracy in a multi-user environment has been the subject of intense debate among mapping organizations, particularly as this issue may affect the allocation of the costs of shared development among the various participants in a multi-user system. In spite of past discussion, however, the ramifications of this issue are still not fully understood or appreciated by all participants in the dialogue. Debate, unfortunately, has focused on the relative cost of various levels of accuracy and how those costs might be allocated rather than on the more basic issue, which is the level of accuracy required to support a true multipurpose, multi-user system of digital map resources. If the accuracy standards built into the agreed-upon system are incapable of supporting the needs of the most demanding of the users, the development of multiple systems is inevitable and the creation of a multipurpose, multi-user system cannot, by definition, occur.

In this regard, the recommended standards for a joint automated mapping and land information system as set forth herein are based upon the Commission-recommended standards for the development of survey control networks and local large-scale mapping programs. These Commission programs already represent formally adopted or de facto standards for much of Southeastern Wisconsin, including Waukesha County. In addition, these programs have been subjected to critical review by knowledgeable professionals who have judged them to be both conceptually and procedurally sound.

The large-scale mapping and survey control systems recommended by the Commission have been in use for more than 25 years in manual mapping environments, and within the most recent decade have been successfully carried into digital mapping environments. They therefore represent successfully "field tested" standards and specifications. The maps and attendant survey control have been demonstrated to support a wide variety of operations to necessary levels of accuracy in both the public and private sectors, and are, therefore, ideally suited to a multipurpose, multi-user environment.

Map Projection System

It is recommended that the State Plane Coordinate System, North American Datum of 1927 (NAD-27), be used as the map projection system for a countywide automated mapping and land information system. This system is already the system of choice of much of the local mapping community, and a great deal of effort and expense has been expended in its establishment and maintenance. Those organizations operating in the local area that have chosen to use the Universal Transverse Mercator (UTM) system have, in fact, converted much of their existing basic map information to the UTM system from the State Plane Coordinate System. The methodology for the precise conversion process between the two map projection systems already exists—as long as both coordinate systems are based upon NAD-27—and the organizations concerned can continue to "load data" into their systems.

The map projection grid should be constructed inside the computer memory through key entry procedures. This requirement, if combined with the key entry of all survey control network data, will produce a map projection that is essentially independent of map scale. Constructed in this manner, the map projection will be able to accept and accurately reference not only digitized data from mapped sources at any scale, but also numeric data derived from direct field measurements. This capability is as important as it is subtle, given the increasing availability and affordability of high technology survey instruments, such as "total stations."

Survey Control Network and Large-Scale Base Mapping

It was reported in Chapter III of this report that the Commission-recommended survey control network and large-scale topographic base maps already exist throughout much of Waukesha

County, and that, where this system exists, it is already being utilized by units of government and certain utilities in both analog and digital mapping. Accordingly, the completion of this program in the remainder of Waukesha County should be pursued, and it should be considered the standard for common use.

Control Surveys: The horizontal control survey work to be completed in Waukesha County should include the recovery, or relocation, and monumentation of the approximately 798 U. S. Public Land Survey corners not previously recovered, or relocated, and monumented, including section and quarter-section and center of section corners. Having recovered, or relocated, and monumented these remaining corners, high-order control survey traverses should be run which utilize and incorporate all of the monumented corners as stations to determine the coordinates of the corners and the lengths and bearings of all quarter-section lines. Coordinates of the corners should be computed upon the Wisconsin Coordinate System, South Zone, (NAD-27) and sufficient survey connections should be made to basic National Geodetic Survey (NGS) control stations to permit the proper checks and adjustments to be made both in the traverse lengths and bearings and in the coordinate values of the monumented U. S. Public Land Survey corners. The procedures and accuracy of the horizontal control surveys should conform to the specifications for NGS Third-Order Class I traverses.

The vertical control survey work should be based upon National Geodetic Vertical Datum, 1929 Adjustment (NGVD-29), as established by the NGS. Closed level circuits should be run as necessary to establish permanent bench marks in the area remaining to be mapped. The procedures and accuracy of the vertical control surveys should conform to the specifications for NGS Second-Order, Class II level circuits. Elevations should be determined for the monuments marking the section, quarter-section, and center of section corners throughout the area remaining to be mapped, and these monuments should serve as permanent bench marks, each monument being supplemented by at least one reference bench mark.

Large-Scale Planimetric and Topographic Base Maps: For those areas of Waukesha County where large-scale base maps have yet to be prepared, these maps should be acquired in digital form. The digital map files should be prepared to National Map Accuracy Standards at a scale of 1:2,400 (one inch equals 200 feet).[1] Use of these standards will ensure that all map projection grid lines, horizontal control stations, section corners, and quarter-section corners will be plotted on finished maps to within 1/100 of an inch of their true coordinate position. Ninety percent of all well-defined planimetric features will be plotted to within 1/30 of an inch of their true coordinate position, and no point will be more than 1/20 of an inch from its true coordinate position. Ninety percent of the elevations determined from the solid-line contours of the map will have an accuracy with respect to elevation of one-half contour interval, and no elevation is to be in error by more than a full contour interval.

The digital map files should contain the following map information:

1. Hypsometry by contour lines having a vertical interval of two feet.

2. All planimetric detail, such as pavements, curbs, walks, trails, railways, power lines, buildings, fences, wooded areas, dams, piers, dock walls, culverts and bridges, retaining walls, airport runways and taxiways, and other identifiable salient features on the aerial photography from which the maps are compiled.

3. All hydrographic features, such as marshes, lakes, streams, watercourses, and drainage ditches.

4. All section and quarter-section lines and U. S. Public Land Survey corners in their correct position and orientation, together with the attendant exact grid lengths and bearings.

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[1] *Base mapping at a scale of 1:1,200 (one inch equals 100 feet) will be undertaken by Waukesha County only in those instances where local communities provide cost-share monies to obtain new or revised mapping. Those communities in Waukesha County where such larger scale mapping has been obtained include the Cities of Muskego and New Berlin and the Villages of Hartland, Lannon, and Menomonee Falls.*

5. Such lettering as may be secured from available maps of the area or as may be furnished by the participating organizations relative to the names of salient geographic features. The names of all state and county trunk highways, public streets, and major streams and lakes should be shown on the maps.

In addition to obtaining in digital form new topographic base maps for all areas of Waukesha County not yet so mapped, it is recommended that any large-scale maps prepared in past years in conventional form be converted to an automated format through board digitizing and/or scanning procedures.

Cadastral Maps

Much of what has been historically identified as cadastral mapping in southeastern Wisconsin cannot be mathematically accurately related to the surface of the earth, and therefore does not meet the definition of a map. These "cadastral maps" are more properly identified as cadastral diagrams and are manifestly unsuited to be digitized as the cadastral layer of an automated mapping and land information system where one of the stated intents is the ability to accurately correlate real property boundary line information with earth science information, such as floodplain boundaries. To meet the rigorous requirements of a modern, parcel-based, land information system, it is usually necessary that the real property boundary line maps be recompiled on the map projection established for the land information system utilizing a permanently monumented survey control network as the mechanism for this recompilation. As reported in Chapter III, cadastral maps have been recompiled in this manner for about 137 square miles, or about 24 percent of the total area of the County, and for about 30,000 parcels, or about 26 percent of all such parcels in Waukesha County.

Each cadastral map should cover one U. S. Public Land Survey section at a scale of 1:2,400.[2]

The maps should utilize the Wisconsin State Plane Coordinate System as the map projection and should show all section and quarter-section lines and corners together with their grid and ground level lengths and grid bearings, all in their correct position and orientation. The State Plane Coordinate grid should be plotted to within 1/100 of an inch of its true position, and each U. S. Public Land Survey section and quarter-section corner should likewise be plotted to within 1/100 of an inch of its true position as expressed by the State Plane Coordinate values for the corner. Ninety percent of all well-defined planimetric features plotted on the maps as an aid in the delineation of real property boundaries, such as the threads of major streams and watercourses, fence lines, pavements, and principal buildings, should be plotted to within 1/30 of an inch of their true positions. Real property boundary lines should be plotted to within 1/40 of an inch of their true positions.

Determination of the location of real property boundary lines should be based upon the examination and interpretation of all recorded subdivision plats and certified survey maps within the area to be mapped; legal descriptions, and, where available, plats of all major public utility easements in the area to be mapped; copies of legal descriptions and, where available, plats of all street right-of-way openings, reservations, or dedications in the area to be mapped; and legal descriptions contained in the most recently recorded deed transaction in the records of the County Register of Deeds for all real property boundaries in the area to be mapped not included within recorded subdivision plats or certified survey maps.

Based upon review and interpretation of these materials, the cadastral maps should show, all in their correct position and orientation, all real property boundary lines, all street right-of-way lines, and all major cross-country public and utility easement lines. These lines should be graphically constructed in a manner which parallels the location of the lines on the surface of the earth following good land surveying practice in southeastern Wisconsin.

It is recognized that the recorded dimensions and orientation of real property boundaries plotted in this manner may not always agree with the horizontal control survey data also shown on the maps. This is to be expected, since most property descriptions were written using

[2]*In those communities where base mapping has been obtained at a scale of 1:1,200 (one inch equals 100 feet) it would be desirable to also prepare the cadastral overlay at that scale, and each cadastral map should cover one U. S. Public Land Survey quarter-section.*

field survey data obtained prior to the relocation of section and quarter-section corners and completion of the horizontal control network tied to the Wisconsin State Plane Coordinate System and some property descriptions were written without benefit of any field survey data other than that provided by the original government survey. Further, the required survey accuracy for property boundary descriptions for land subdivisions, as defined in Chapter 236 of the Wisconsin Statutes and generally adhered to in other property boundary surveys, is 1 part in 3,000, as compared with the Second-Order accuracy of 1 part in 10,000 for the horizontal control surveys.

For these and other reasons, overlapping or separated property boundary descriptions may be expected to exist. The property boundary line maps should record all dimensions as contained in the official records of the County Register of Deeds, and wherever an overlap or gap of 2.5 feet or more exists, such overlap or gap shall be shown as a mapped line. Overlaps or gaps of less than 2.5 feet will be evident only from an examination of the recorded property line dimensions.

For areas covered by recorded subdivision plats and certified survey maps, the following map annotation should be provided:

1. Subdivision name or certified survey map number.
2. Block and lot numbers.
3. Street names.
4. Street, alley, and other public way right-of-way widths to the highest degree of accuracy permitted by the data source.
5. Recorded lot dimensions to the highest degree of accuracy permitted by the data source.
6. Easement right-of-way widths to the highest degree of accuracy permitted by the data source together with the purpose of the easement.
7. Waukesha County parcel identification numbers.

For all properties other than those contained in a recorded subdivision plat or certified survey map, the following map annotation should be provided:

1. Street names.
2. Street, alley, and other public way right-of-way widths to the highest degree of accuracy permitted by the data source.
3. Recorded property dimensions to the highest degree of accuracy permitted by the data source.
4. Easement right-of-way widths to the highest degree of accuracy permitted by the data source together with the purpose of the easement.
5. Waukesha County parcel identification numbers.

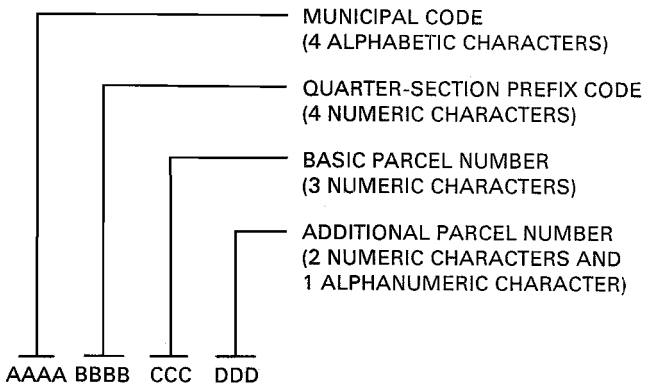
Parcel Identification Numbers

The parcel identification number provides the link between the cadastral maps, which show the location of a particular parcel, and the records, either computer-readable or traditional paper records, that contain information about the parcel. The parcel identification scheme utilized in Waukesha County—which is the standard to be applied insofar as the land information system is concerned—is administered by the Register of Deeds Office and consists of a 14-character field in the format "AAAABBBBCCCDDD." This format is illustrated in Figure 8.

"AAAA" is a four-character alphabetic code that identifies the minor civil division—the town, village, or city—in which the parcel is located. "BBBB" is a four-character numeric code that identifies the U. S. Public Land Survey one-quarter section in which the parcel is located. One-quarter sections are numbered sequentially from 1 to 2,304. It is necessary to consult an index map to convert the numeric code to a U. S. Public Land Survey location. "CCC" is a three-character numeric code, unique within the one-quarter section, that identifies an individual parcel. A number 900 or larger identifies a parcel described by "metes and bounds." If all available numbers in the 900 series are used, then numbers in the 800 series are also used for metes and bounds descriptions. With that exception, a number less than 900 identifies a parcel within

Figure 8

WAUKESHA COUNTY PARCEL NUMBERING SYSTEM



Source: Waukesha County Register of Deeds Office and SEWRPC.

a recorded land subdivision. "DDD" is an optional numeric and alphanumeric code used to identify parcels split off from previously numbered parcels. Parcels created by certified survey maps are identified through the use of the DDD code. Accordingly, the parcel identification number prefix of a parcel created by a certified survey may be greater than 900 or less than 900.

Property Ownership and Assessment Records

The property ownership and assessment records maintained by Waukesha County already exist as computer-readable files. These files contain such information as an abbreviated legal description, owner's name and mailing address, property address, acreage of the property, and assessed value of the land and any improvements to that land. These records can be integrated into the automated mapping and land information system in Waukesha County in a straightforward manner utilizing the previously described parcel identification numbering scheme which is common to both the maps and the records. The only operational step required for this integration is the establishment of proper programming access to the existing computer files of assessment records for the purpose of "reading" them.

Soil Unit Maps

Digital soil unit maps of Waukesha County already exist for all of Waukesha County through the efforts of the Southeastern Wisconsin Regional Planning Commission. A detailed operational soil survey for all of southeastern Wisconsin was conducted by the U. S. Soil Conservation Service in 1963 under contract to the Regional Planning Commission. The soil survey conducted in southeastern Wisconsin departed from the standard soil survey conducted in other areas of the State and United States in one important respect—namely, the type of aerial photography used as a base map for the field operation. The work specifications prepared by the Commission required that the boundaries of all soil mapping units be identified on prints of then current (1963) Commission aerial photographs. These photographs consisted of ratioed and rectified enlargements at a scale of one inch equals 1,320 feet of Commission one inch equals 6,000 feet scale high-altitude photographic negatives. Each field sheet base map covered six U. S. Public Land Survey sections. The specifications also required that the Commission be furnished with reproducible half-tone positives of the field sheets on dimensionally stable base material at a scale of one inch equals 2,000 feet. The reproducible positives were to be suitable for the preparation of clear blue-line or black-line prints by diazo process, and were to show clearly the soil mapping units with delineations and identifying symbols so that the prints could be used in conjunction with a published Commission report on the soils of southeastern Wisconsin. The specifications further required that finished photo maps be prepared to accompany the published soil surveys at a scale of one inch equals 1,320 feet, also using the negatives of current photography provided by the Commission. Key planimetric features, such as major highways, railroads, streams, and lakes, were to be identified on the finished photo maps, as were all U. S. Public Land Survey township, range, and section lines.

These base mapping specifications for the soils mapping program in southeastern Wisconsin were unique in that the normal U. S. Soil Conservation Service practice up to that time had been to prepare controlled photomosaics for the soil mapping. The revised base mapping procedure required by the Commission, consisting of the preparation of ratioed and rectified enlargements to eliminate all distortion except that due to relief, provided instead "photo maps" on which distances and areas could subsequently be measured. Such distances and areas cannot be reliably measured on controlled photomosaics.

Soil mapping unit boundaries were digitized from the 1 inch equals 1,320 feet scale photo maps for use in the project, this scale photo print being more convenient for the digitizer operators to scale and interpret. Because the salient features of the U. S. Public Land Survey System had been previously marked on these photos, they were readily scaled for digitization using the previously computed state plane coordinates for the section and quarter-section corners. Because the digital soil unit maps prepared by the Regional Planning Commission utilized the same geometric reference framework as that specified for Waukesha County, they are already "integrated" with the other land information being incorporated into that system.

Land Use

Digital historic and current land use information for Waukesha County already exists for all of Waukesha County, again through the efforts of the Southeastern Wisconsin Regional Planning Commission. The Commission's land use inventory—which utilizes 63 different major land use categories—also incorporates the statutorily defined wetlands originally identified by the Wisconsin Department of Natural Resources as part of a statewide inventory of these areas. The digital land use maps were originally digitized from interpreted one inch equals 400 feet scale ratioed and rectified prints of aerial photography flown for this purpose by the Commission in 1963. The ratioing and rectification of the photographs was controlled to the U. S. Public Land Survey System corners as those corners had been coordinated with the State Plane Coordinate System. The digitized land use maps were subsequently updated using aerial photography flown in 1970, 1975, 1980 and again in 1985. These maps are scheduled to be updated to 1990 conditions by the Commission utilizing new aerial photography flown for this purpose during the spring of 1990. Because the digital land use maps prepared by the Regional Planning Commission—like the digital soil unit maps—utilized the same geometric reference framework as did the Waukesha County automated mapping and land information system, they—like the digital soil unit maps—are already "integrated" with the other land information in the system.

The aerial photo enlargements upon which the land uses were originally delineated had been ratioed and rectified to provide, in effect, "photo maps" upon which distances and areas could subsequently be accurately scaled and measured. Some distortion due to relief, however, still exists in aerial photographs after ratioing and rectification. Accordingly, the cadastral maps—when completed—should be used to adjust the land use maps as may be necessary. Where discrepancies are noted between right-of-way and land/water boundary lines on the land use and cadastral maps, they should be resolved in favor of the positions recorded on the cadastral map and adjoining land use lines adjusted accordingly. Such adjustments should all be relatively minor.

Zoning Districts

Zoning district boundaries commonly follow real property boundary lines. For this reason, digital zoning district map overlays should not be prepared until digital real property boundary line maps have been completed. The digital zoning district map overlays should then be prepared by "copying" appropriate line segments from the real property boundary line maps and digitizing any additional line segments needed.

Flood Hazard and Shoreland Areas

The digitization of surface waters and stream channels occurs as part of the digital preparation of new topographic maps or the conversion to digital format of existing topographic maps. Two additional water-related areas which have particular implications for planning and engineering, and for zoning administration, and which are related one to another—floodlands and shorelands—should also be digitized as part of the creation of a countywide automated mapping and land information system. As topographic maps are prepared in Waukesha County, the limits of the 100-year recurrence interval floodplain are delineated by the Regional Planning Commission on the large-scale topographic base maps based upon flood profiles and are then digitally captured. Through the application of the statutory definition, the limits of shorelands in Waukesha County on the large-scale topographic base maps should also be digitally encoded.

Digital Graphic Data Exchange

In order to exchange digital map data between two or more physically separated automated mapping and land information systems, one of two conditions must exist. Either the systems must have compatible data structures for the storage of digital map data or an interchange mechanism between the two systems must be provided. It has been noted in this report that

the existing automated mapping and land information systems in the Waukesha area are of several different proprietary types; therefore, before digital map data can be shared, agreement must be reached between the various organizations concerning the manner in which digital map data may be exchanged.

Currently there is no uniform, widely accepted and used, mechanism for the exchange of digital map data. Such a mechanism, if it did exist, would constitute an industry wide, or formal, standard. For the present time, it will be necessary to exchange digital map data through the use of informal digital map data exchange mechanisms. Informal exchange standards are simply those methods and formats for exchanges that can be agreed upon between two or more data compilers and/or users that want to exchange digital map data. Examples of some currently available mechanisms of the informal type are: Drawing Exchange Format (DXF); Initial Graphic Exchange Standard (IGES); Intergraph Standard Interchange Format (ISIF); and Digital Line Graph 3 (DLG3). The specific informal exchange mechanism utilized between any two specific sites will be largely a function of the specific vendor software and hardware existing at the sites.

It should be noted that the majority of currently available digital map data exchange mechanisms are "batch-oriented," meaning that they are used to load entire files of digital map information. Therefore, to update digital map files involving a transfer of files between two different vendor sets of hardware and software, it is usually necessary to reload the entire affected file rather than to load only the revisions. "Transaction-oriented" file update capability, or the ability to load only the revisions to a file, is a less well-developed capability and may be relatively easy or relatively difficult between different vendor sets of hardware and software, depending upon the similarity or dissimilarity of the internal architecture of the involved systems. As a practical matter, transaction-oriented capability may be available only through custom computer programming, or through the acquisition of the same hardware and software by the different operators involved.

In this regard, it should also be noted that the use of many of the currently available mechanisms for digital map data exchange may be expected to pose some problems for operations using IBM mainframe computers to operate automated mapping systems. IBM mainframe systems utilize digital map data storage models that differ from the models used by most other vendors, and translation between IBM models and non-IBM models is not a trivial programming task. This issue has not been addressed in the commercial market to the extent that digital graphic data exchange between other systems has been. The efficient and effective exchange of digital map data between IBM and non-IBM sites, therefore, may well require custom programming.

Finally, it should be noted that the foregoing text applies to map feature elements rather than to data that may relate to map features. The National Research Council model, proposed in preceding chapters of this report as the model to guide the creation of the recommended automated mapping system for Waukesha County, utilizes the parcel identifier as a "key" to link location, or geometry, of features on maps to nongeometric information about the feature. The transfer of files of nongeometric, or attribute, data can be accomplished using existing procedures for the transfer of character data between different computer systems.

PROPOSED WORK PROGRAM

Within the framework of the goals and objectives set forth herein, it is recommended that the Waukesha County land information program over the period 1991 through 1996 consist of the following major projects:

1. Large-Scale Base Mapping
   It is recommended that the Waukesha County large-scale base mapping program continue over the next six years without any change in present operational practices. Through this program, the necessary geodetic reference framework is put in place and large-scale planimetric and topographic base maps are obtained. Since 1987, these base maps have been obtained in a digital form and it is recommended that this practice be continued.[3] As shown

[3] *As of December 31, 1990, 217 square miles of Waukesha County were covered by planimetric and topographic mapping prepared in conventional form. These conventional maps will need to be digitized. As of this same date, about 125 square miles of Waukesha County had been mapped in digital form.*

in Table 1, the geodetic reference framework and large-scale base maps have been completed for the entire eastern one-half of Waukesha County and for portions of the western one-half of the County. As of January 1, 1991, the work remaining to be completed includes the relocation and monumentation of 798 U. S. Public Land Survey corners, the establishment of State Plane Coordinates for those 798 corners, the establishment of elevations for 872 corners, and the preparation of topographic base maps in digital form for an area of 234 square miles.

The average unit cost of conducting this element of the work program expressed in 1991 dollars is $9,375 per square mile. On this basis, the total cost entailed to complete this work element for the 234 square miles remaining to be mapped Waukesha County is estimated at $2.19 million. Presently, this work program is supported by an annual appropriation of $150,000 from the county property tax levy. If this level of tax levy support is continued—and if it is further assumed that this amount is appropriately adjusted to reflect any affects of general price inflation over the six-year period—then it will be possible to complete about 96 additional square miles of mapping and control survey work over that six-year period. This represents about 41 percent of the remaining work effort. The proposed schedule for the mapping and control survey work over the six-year period, assuming current revenues, is shown on Map 3.

At the present level of expenditure, a 15-year period will be required to complete the entire County, resulting in a completion date of 2005. In order to complete this portion of the work program by December 31, 1996, an annual appropriation of nearly $366,000 would be required, or about $216,000 more than at present. Map 3 shows a proposed schedule for completing the topographic mapping for the western portion of the County by the end of 1996, assuming that such additional monies were to be provided by the County Board beginning in 1992.

2. Cadastral Mapping and Digital Conversion of Data—Eastern One-Half of County

It is recommended that the new revenue from the increased document filing fees be directed toward the completion of the preparation of cadastral maps and the digital conversion of data in the eastern one-half of Waukesha County. The foundational elements of the geodetic reference framework and large-scale base maps have already been completed for that portion of the County and, thus, the proper base is in place to develop an operational system. Moreover, urban development pressures are greatest in the eastern one-half of Waukesha County, and the greatest need for municipal automated mapping and land information systems exists in that portion of the County. Indeed, one municipality—the City of New Berlin—has already committed funds to complete the envisioned digital base mapping for its entire geographic area, and has installed hardware and software to operate the system.

Over the six-year period 1991 through 1996, it is expected that the revenue from the document filing fees in Waukesha County should total about $1.3 million. This estimate assumes that the average number of applicable recordings and filings that obtained over the period 1985 through 1990 will continue over the period 1991 through 1996. The total number of such recordings is estimated at 59,300 annually.

It should be noted that the number of annual recordings subject to document filing fees will vary with changes in the national and local economies, interest rates, in tax legislation, and in the urban land market. Experience in Waukesha County indicates that fluctuations of about 10 percent more or less than the average may be expected. Accordingly, the annual revenue available from this source may be expected to vary, and the amount of program work that can be supported by such revenue may also be expected to vary from year to year.

Table 1

ESTIMATED COSTS TO COMPLETE THE RECOMMENDED AUTOMATED MAPPING AND LAND INFORMATION SYSTEM BASE FOR WAUKESHA COUNTY[a]

Program Element	Description of Work Remaining to be Completed	Average Unit Cost of Work	Total Cost to Complete Work Element	Estimated Annual Revenue Available	Projected Progress Over Six-Year Period 1991-1996	Projected Year of Completion at Current Annual Revenue Level	Annual Amount Required to Complete Element by December 31, 1996
Geodetic Reference Framework and Large-Scale Base Maps—Entire County	• Relocate and monument 798 U. S. Public Land Survey corners • Establish State Plane Coordinates for 798 corners • Establish vertical elevations for 872 corners • Obtain digital planimetric and topographic base maps for 234 square miles	$9,375 per square mile	$2,193,750	$150,000 (county tax levy)	Complete 96 square miles, or about 41 percent of remaining work	2005 (15 years)	$365,625
	Subtotal	--	$2,193,750	$150,000	--	--	$365,625
Cadastral Maps and Digital Conversion of Data—Eastern One-Half of County	• Conventional cadastral map compilation—155 square miles containing 45,400 parcels	$7.50 per parcel	$ 340,500	$56,750 (Register of Deeds filing fees)	Complete 155 square miles containing 45,400 parcels, or 100 percent of remaining work	1996	$ 56,750
	• Digital conversion of planimetric map features—170 square miles containing 52,900 parcels	$1,556 per square mile	$ 264,500	$44,085 (Register of Deeds filing fees)	Complete 170 square miles containing 52,900 parcels, or 100 percent of remaining work	1996	$ 44,085
	• Digital conversion of cadastral maps—252 square miles containing 70,000 parcels[b]	$10 per parcel	$ 700,000	$116,670 (Register of Deeds filing fees)	Complete 252 square miles containing 70,000 parcels, or 100 percent of remaining work	1996	$116,670
	• Digital conversion of topographic map features—170 square miles	$2,000 per square mile	$ 350,000	None	None	--	$ 56,670
	Subtotal	--	$1,655,000	$217,505	--	--	$274,175
Cadastral Maps and Digital Conversion of Data—Western One-Half of County	• Conventional cadastral map compilation—285 square miles containing 32,700 parcels	$7.50 per parcel	$ 244,650	None	None	--	$ 40,775
	• Digital conversion of planimetric map features—44 square miles containing 10,400 parcels	$1,182 per square mile	$ 52,000	None	None	--	$ 8,670
	• Digital conversion of cadastral maps—288 square miles containing 33,000 parcels	$10 per parcel	$ 330,000	None	None	--	$ 55,000
	• Digital conversion of topographic map features—44 square miles	$2,000 per square mile	$ 88,000	None	None	--	$ 14,670
	Subtotal	--	$ 714,650	None	--	--	$119,115
Total Cost		--	$4,563,400	$367,505	--	--	$758,915

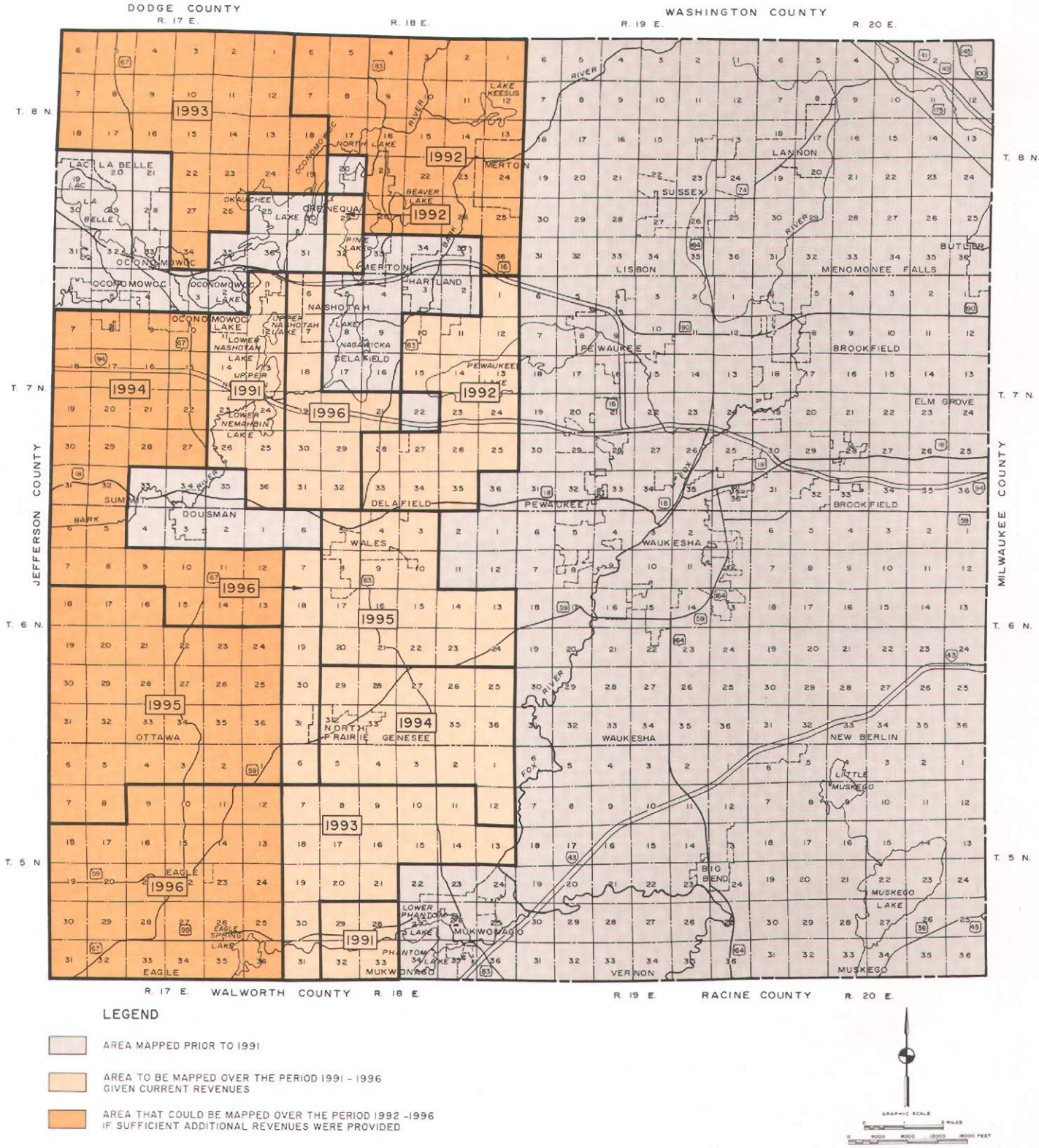
[a] *All dollar figures are expressed in 1991 costs. To the extent that general price inflation occurs over the period 1991 through 1996, and to the extent that such inflation affects these costs, additional monies will be required to achieve the system development progress reflected in this table.*

[b] *Assumes that the digital conversion of cadastral maps in the City of New Berlin will be carried out with city funds already committed for this purpose.*

Source: SEWRPC.

Map 3

PROPOSED SCHEDULE OF LARGE-SCALE BASE MAPPING AND SURVEY CONTROL PROGRAM IN WAUKESHA COUNTY: 1991-1996



Source: SEWRPC.

Given the anticipated new revenue, it is recommended that the following work be undertaken:

a. The completion of conventional cadastral maps, including parcel identifiers, for an area of 155 square miles of eastern Waukesha County, this area containing about 45,400 parcels. The current status of cadastral mapping in Waukesha County, including map scales and the agencies which have undertaken the mapping, was reported in Chapter III. A schedule of proposed cadastral map compilation work over the six-year planning period is shown on Map 4. At an estimated average cost of $7.50 per parcel, this subelement of the work program may be expected to cost about $340,500.

   It should be noted that the foregoing cost estimates to complete conventional cadastral maps are based upon an assumption that all data necessary to compile such maps will be available from primary source documents. It should be recognized, however, that in some instances it may become necessary to obtain supplemental data through field surveys. It should also be recognized that it may in some areas become necessary to request local assessors and the local governments concerned to prepare assessors plats as a basis for clarifying property descriptions, and related property boundary line maps. Any costs associated with assessors plats would be borne by the requesting county or local governmental unit as provided by state law. The requesting county, city, village, or town has the option under the law to recover such costs from the property owners directly affected by the assessor's plat, distributing such costs on the basis of the assessed valuation of the parcels included in the plat, not including, however, improvement valuations.

b. The digital conversion of planimetric features of the topographic maps over an area of about 170 square miles. The proposed six-year schedule of digital map conversion work is shown on Map 5. At an estimated average cost of $1,556 per square mile, this subelement of the work program may be expected to cost $264,500.

c. The digital conversion of cadastral mapping over an area of about 252 square miles, this area containing about 70,000 parcels. The proposed six-year schedule of digital map conversion work is shown on Map 6. This schedule already takes into account the committed digital conversion of cadastral maps in the City of New Berlin. At an estimated average cost of $10 per parcel, this subelement of the work program can be expected to cost $700,000.

The foregoing work would provide an operational automated base map for the eastern one-half of Waukesha County. At that point, the automated base map would be ready for linkage to both graphic and nongraphic element data files.

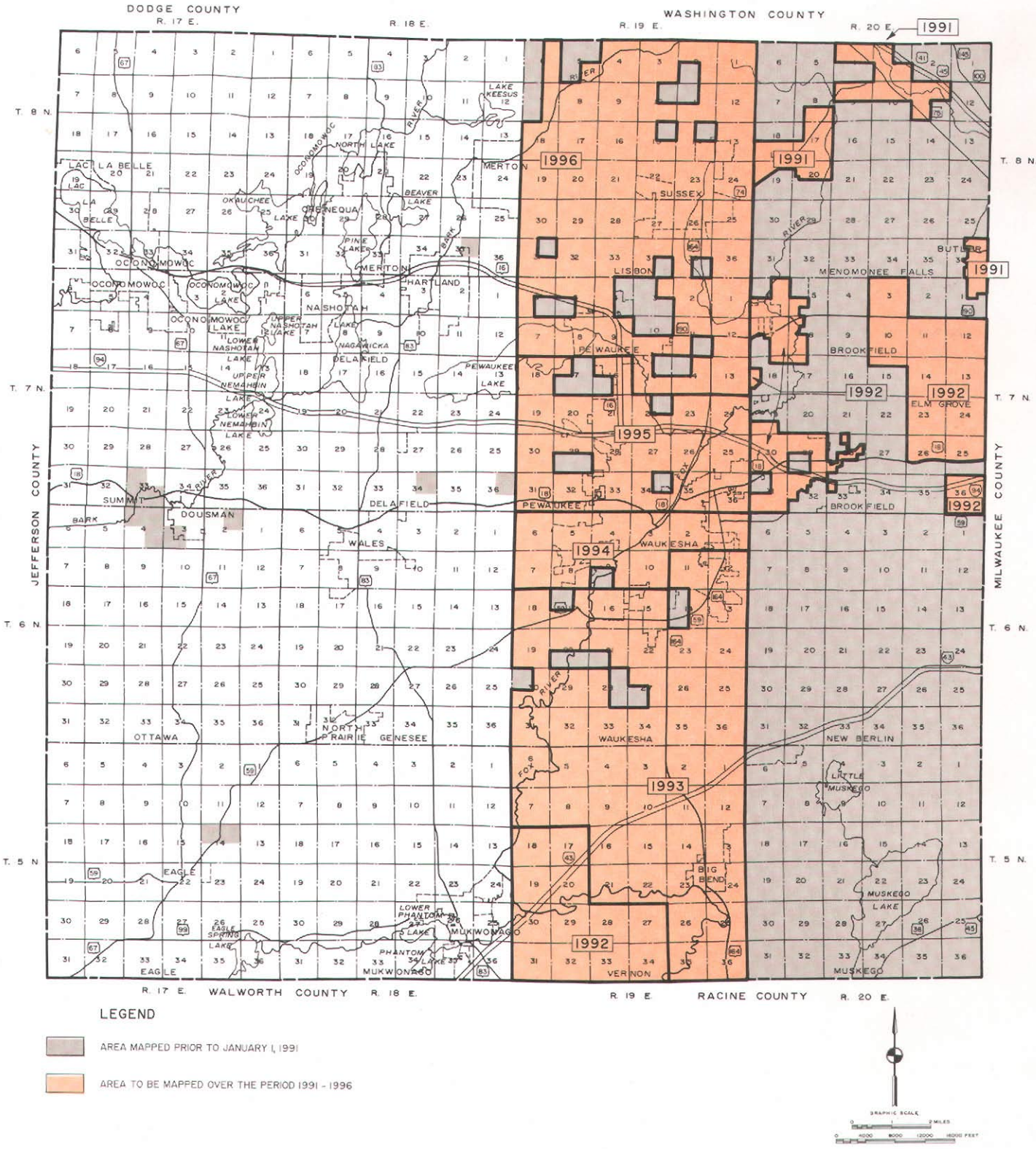
While it is not essential to have a completed digital file of the hypsometric features of the topographic maps, Table 1 does identify the additional resource that would be required to complete the digital conversion of such features. Such work is required for an area of about 170 square miles for which topographic maps were originally obtained in a conventional—as opposed to digital—form. At a cost of about $2,000 per square mile, an additional $350,000 would be required to complete the digital conversion work. Over the six-year period, this would amount to a revenue requirement of about $57,000 annually. The anticipated revenue from the document filing fees over that period would be insufficient to fund this additional digital conversion work. Map 7 identifies the projected status of the digital availability of topographic map features in Waukesha County at the end of 1996 presuming that the required additional revenue is not obtained.

3. Cadastral Mapping and Digital Conversion of Data—Western One-Half of County

Table 1 also identifies the amount of money that would be required to complete the entire automated mapping system for

Map 4

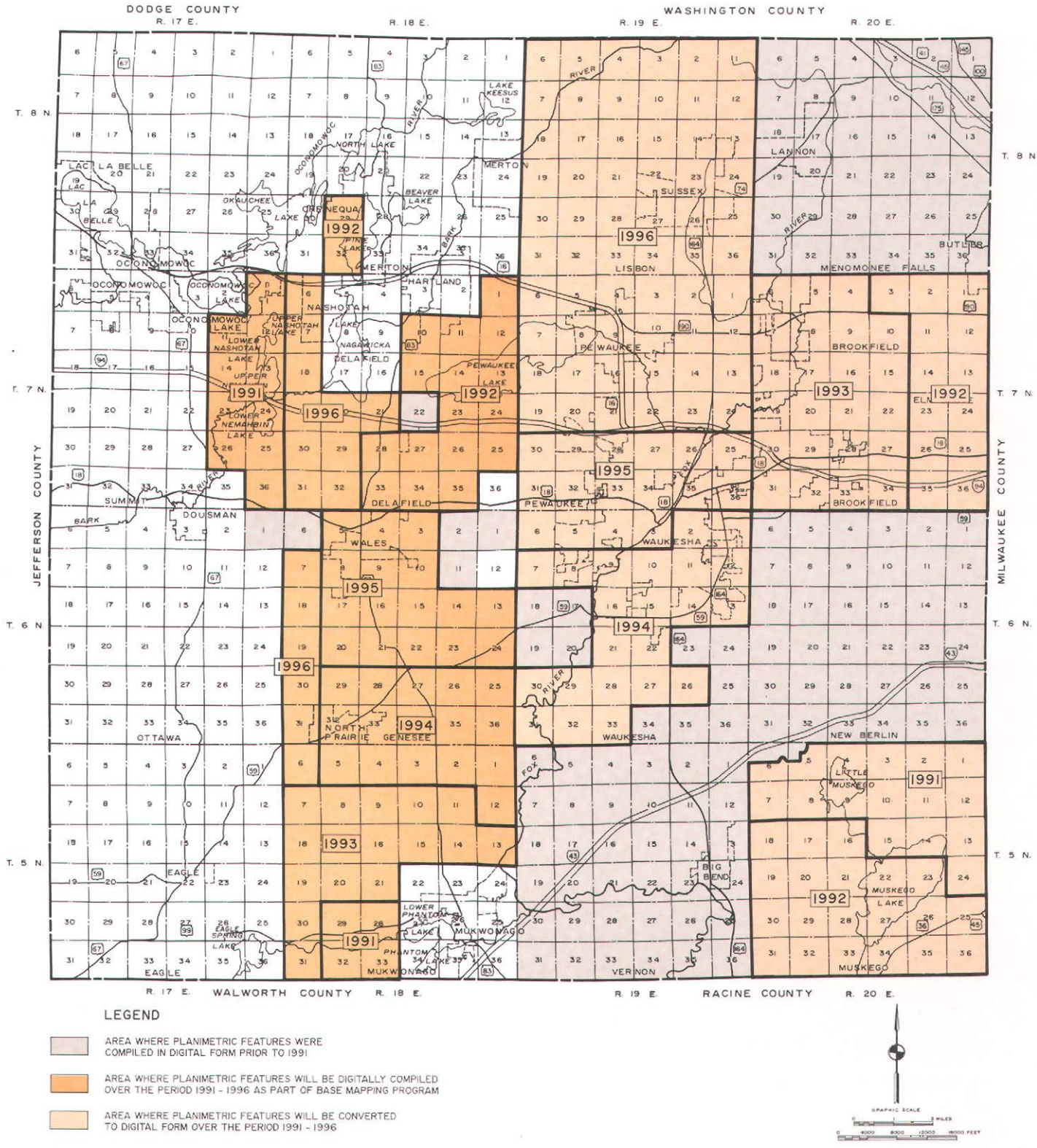
PROPOSED SCHEDULE OF CADASTRAL MAP COMPILATION IN WAUKESHA COUNTY: 1991-1996



Source: SEWRPC.

Map 5

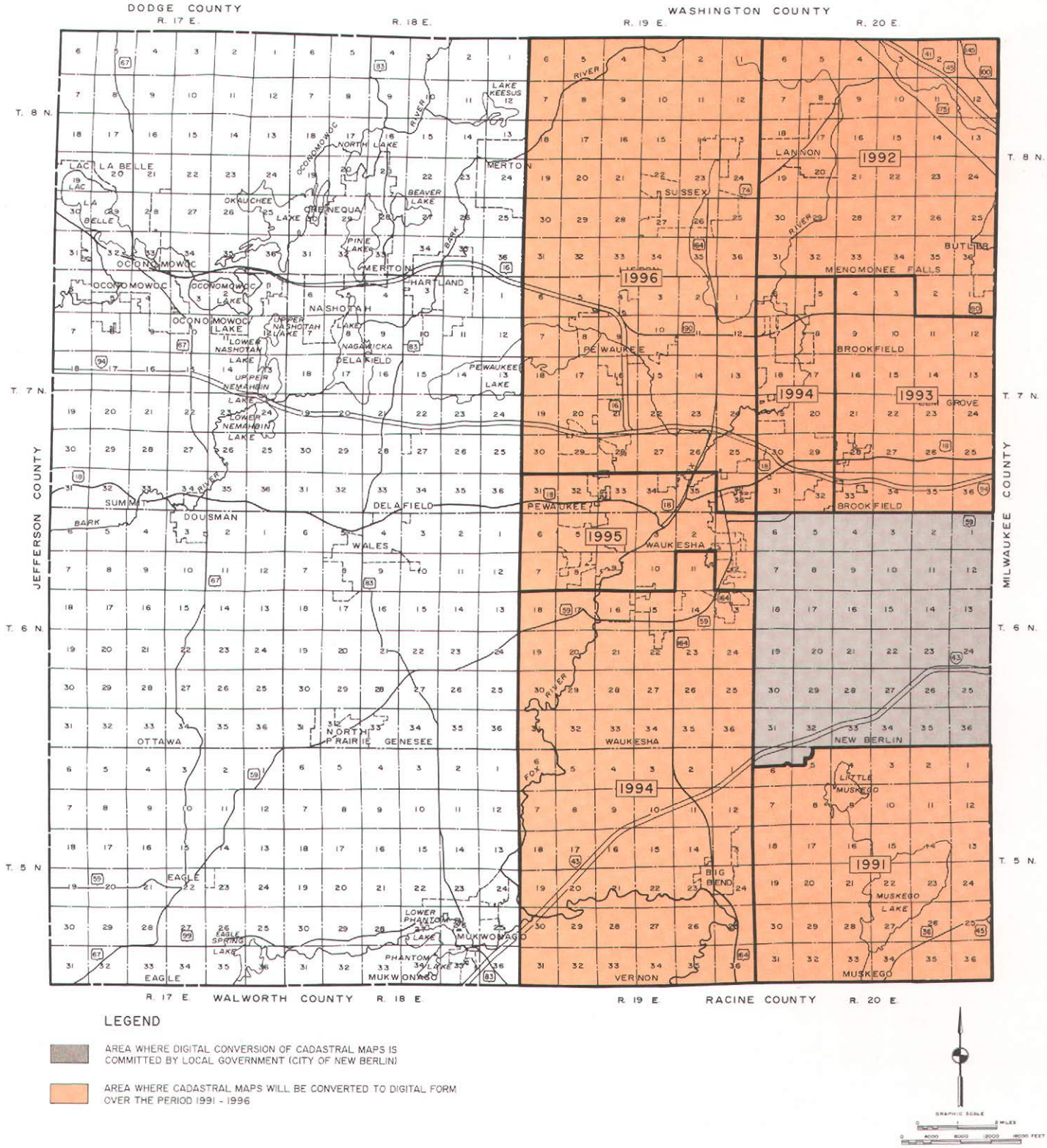
PROPOSED SCHEDULE OF DIGITAL CONVERSION OF PLANIMETRIC MAP FEATURES IN WAUKESHA COUNTY: 1991-1996



Source: SEWRPC.

Map 6

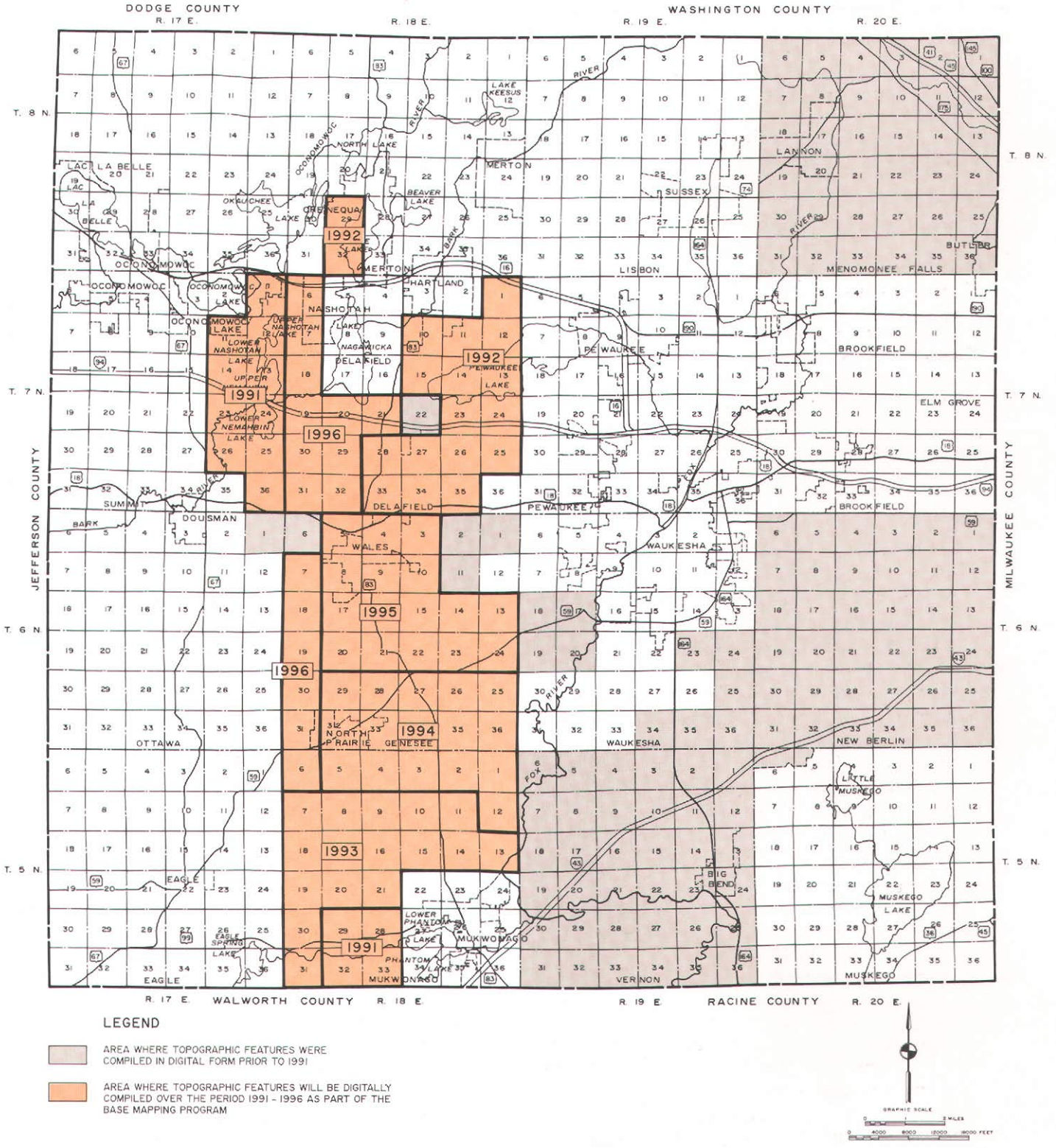
PROPOSED SCHEDULE OF DIGITAL CONVERSION OF CADASTRAL MAPS IN WAUKESHA COUNTY: 1991-1996



Source: SEWRPC.

Map 7

PROJECTED STATUS OF DIGITAL CONVERSION OF TOPOGRAPHIC MAP FEATURES IN WAUKESHA COUNTY: 1991-1996



Source: SEWRPC.

Table 2

SUMMARY OF COSTS TO COMPLETE RECOMMENDED AUTOMATED MAPPING AND LAND INFORMATION SYSTEM BASE FOR WAUKESHA COUNTY

Program Element	Eastern One-Half of Waukesha County	Western One-Half of Waukesha County	Total
Survey Control and Large-Scale Mapping	$ --	$2,193,750	$2,193,750
Cadastral Map Compilation	340,500	244,650	585,150
Digital Conversion of Planimetric Map Features	264,500	52,000	316,500
Digital Conversion of Cadastral Maps	700,000	330,000	1,030,000
Digital Conversion of Topographic Map Features	350,000	88,000	438,000
Total	$1,655,000	$2,908,400	$4,563,400

Source: SEWRPC.

the western one-half of Waukesha County. This total cost is estimated at $710,000, which represents about $119,000 annually over the six-year period. It is important to note that much of this additional work could not be accomplished without a prior commitment to finish the geodetic reference framework and large-scale topographic base maps in the manner identified above. Unless additional monies are received, either through county appropriations from the property tax levy, through local government contributions to the development of the system, and/or through state grants, it should not be expected that an automated base map will have been completed for the western one-half of the County by the end of the six-year planning period.

4. Summary of Program Costs

A summary of the estimated costs of completing the recommended automated mapping and land information system base for all of Waukesha County is set forth in Table 2. The total costs are estimated at $4.56 million, representing an average annual cost of about $760,570. The average annual revenue to support the program—consisting of an assumed $150,000 in County tax levy money and $217,500 in document recording fees—totals $367,500. This leaves an estimated shortfall, if the entire program were desired to be completed over the next six years, of $393,070 annually.

It is recommended that Waukesha County seek on an annual basis over the period 1991 through 1996 state grants in the amount of $100,000 in support of the work program outlined above. Necessary matching monies would be available through the existing county appropriation for monumenting and base mapping. It is recommended that any state grant monies made available to Waukesha county be used first to accelerate the completion of the automated mapping base for the eastern portion of the county, and then—if sufficient monies are available—for any necessary mapping activities in the western portion of the County.

As work proceeds over the next six years to develop the survey control and automated mapping base required for the recommended Waukesha County land information system,

additional activities need to be undertaken to help direct the development and management of the overall system. Toward this end, the following specific work activities are recommended to be undertaken by Waukesha County during the planning period:

1. Specifications and Standards for Digital Conversion
   A special technical study needs to be undertaken to develop and document specifications and standards for the conversion to digital format of the survey control network, the large-scale planimetric and topographic maps, and the real property boundary line maps. This study should be undertaken in the early part of the planning period, since specifications need to be in place before resources are committed to digital conversion efforts. In part, this work effort involves defining the digital "sets" of information to be developed. As a point of departure for this work effort, Table 3 presents an initial proposal for such digital "sets". This initial proposal should be reviewed and revised as may be necessary. It is recommended that this work effort be the responsibility of the Waukesha County Land Information Office under the direction of the Waukesha County Register of Deeds. It is believed that this particular study can be accomplished with the aid of a subcommittee of the Geoprocessing Committee. It is also believed that this particular study can be undertaken without a special budget involving additional costs to the County.

2. Parcel Identification Numbers
   Early in the planning period, Waukesha County should conduct a special study of the present system of identifying parcels. This study should identify in detail how the current Waukesha County parcel numbering system should be adapted to meet the unique parcel identification numbering system promulgated by the Wisconsin Land Information Board. In addition, this work effort should address issues attendant to the assignment of parcel identification numbers. Presently, such numbers are assigned by the Waukesha County Real Property Lister for all that area of Waukesha County except the Cities of Brookfield, Muskego, New Berlin, and Waukesha. In the case of the Cities of Brookfield, New Berlin, and Waukesha, the parcel number assignment is made by the local assessor. In the case of the City of Muskego, the parcel numbering effort is done jointly by the City Assessor and the County Tax Lister. Consideration in the study should be given to centralizing all parcel numbering activities in the office of the County Tax Lister, or to continuing a decentralized assignment to county standards. It is recommended that this work effort be the responsibility of the Waukesha County Register of Deeds, and that existing personnel in that office perform the work at no additional cost to the program.

3. Data Custody, Control, and Maintenance
   During the planning period, it is recommended that Waukesha County also conduct a cooperative study with the local units of government in the County attendant to issues involving the custody, control, and maintenance of land records information, including issues attendant to the security of the system and to public access. Agreement needs to be reached in such a study on the best way in which to maintain the cadastral maps throughout the County. At the present time, such cadastral maps are being maintained both by Waukesha County and by individual local units of government, particularly including the Cities of Brookfield, New Berlin, Muskego, and Waukesha and the Village of Menomonee Falls. In the case of Muskego, three separate sets of cadastral maps are maintained—one by Waukesha County and two by the City of Muskego. The study should consider whether Waukesha County should offer to assume maintenance responsibility for all cadastral maps, or whether the individual municipalities should maintain the maps to county standards. Consideration should be given in the study also to the costs associated with maintaining the digital land information base once that base is completed for a given geographic area of the County. This would include the maintenance efforts associated with the Public Land Survey system, topographic mapping, and cadastral mapping. The study should ascertain any needs attendant to the security of the land information sys-

Table 3

PROPOSED INITIAL DIGITAL SETS OF INFORMATION UNDER THE WAUKESHA COUNTY LAND INFORMATION SYSTEM PLAN

Multipurpose Cadastre Element	Information Category	Digital Information "Set"
Geodetic Reference Framework	Map projection system	• Wisconsin State Plane Coordinate System, South Zone, North American Datum of 1927, 1,000 feet interval grid intersections and corresponding state plane coordinate values[a]
	U. S. Public Land Survey System	• U. S. Public Land Survey corners and monument symbols and state plane coordinates • U. S. Public Land Survey section and and quarter-section lines and grid lengths and grid bearings
Large-Scale Base Maps	Natural features	• Lakes, ponds, streams, watercourses, and drainage ditches symbolized as open water and associated lettering • Streams, watercourses, and drainage ditches not symbolized as open water and associated lettering • Marshes and associated lettering • Accentuated contour lines and elevations • Other contour lines • Accentuated depression contour lines and elevations • Other depression contour lines • Spot elevations and associated lettering • Water surface elevations and associated lettering • U. S. Public Land Survey corner elevations
	Cultural features	• Pavements and curbs and their associated lettering • Unimproved roads and their associated lettering • Driveways and their associated lettering • Trails and their associated lettering • Power line towers and fences and their associated lettering • Railways and their associated lettering • Buildings, building foundations, and ruins and their associated lettering • Wooded areas and their associated lettering • Dams, piers, dock walls, and similar water-related structures and their associated lettering • Culverts and culvert headwalls and their associated lettering • Bridge decks and their associated lettering • Bridge wing walls, retaining walls, and similar transportation-related structures and their associated lettering • Runways, taxiways, and similar aviation-related features and their associated lettering • All other identifiable planimetric features not separately enumerated above and their associated lettering
Overlays	Cadastral boundaries	• Right-of-way lines and their associated lettering • Public easement lines and their associated lettering • Land subdivision boundaries and their associated lettering • Certified survey map boundaries and their associated lettering • Real property parcel lines • Real property parcel dimensions • Real property parcel polygons

Table 3 (continued)

Multipurpose Cadastre Element	Information Category	Digital Information "Set"
Overlays (continued)	Cultural area boundaries	• Civil division boundary lines and their associated text • Land use polygons • Zoning district polygons • Shoreland district polygons
	Natural area boundaries	• Floodplain polygons • Soil mapping unit polygons
Identifiers	Parcel numbers	• Waukesha County real property parcel identification numbers
	Area identifiers	• SEWRPC land use codes • Local jurisdiction zoning district identifiers • SCS soil mapping unit identifiers
Land Information Files	Cadastral parcel records	• Real property ownership records • Real property assessment records • Real property tax records • Permits
	Cultural Data	• Civil division areas • Land use areas • Zoning district areas
	Natural resource data	• SCS soil suitability and characteristic records

[a]*Assumes standard one inch equals 200 feet scale mapping; for one inch equals 100 feet scale mapping, the grid interval would be 500 feet.*

Source: SEWRPC.

tem. The study should propose recommendations attendant to all of these interrelated matters and, as may be necessary, include a recommended system maintenance budget for consideration by the Waukesha County Board of Supervisors. In addition, the study should investigate the feasibility under current state law of establishing public access fees in such a manner as to enable Waukesha County to recover some of its capital investment in the development of the land information system base. It is recommended that this work effort be the responsibility of the Waukesha County Land Information Office under the direction of the Waukesha County Register of Deeds. It is believed that this particular study can be undertaken without a special budget involving additional costs to the County.

4. Hardware and Software Analyses for Waukesha County

During the six-year planning period it is also recommended that Waukesha County undertake an analysis of its own geoprocessing needs. This analysis should examine such needs throughout the entire structure of county government and should be predicated upon the ultimate completion of the automated mapping base described earlier in this chapter. The study should culminate in the making of recommendations to the Waukesha County Board of Supervisors attendant to the acquisition of hardware and software needed to meet Waukesha County internal geoprocessing needs, together with recommendations for building the information "sets" uniquely suited to meet Waukesha County's needs as a unit of government. The study should

also explicitly identify and address any security issues attendant to the development and maintenance of the unique information base to be constructed for Waukesha County. Public access needs attendant to that information base should also be addressed, as well as any needs attendant to the preservation of an individual's right to privacy as might be associated with, for example, certain types of law enforcement records. Finally, the study should identify a strategy for education and training of county personnel in particular attendant to the use of the County's land information system.

It is recommended that this work effort be the responsibility of the Waukesha County Land Information Office and that the Waukesha County Register of Deeds be the individual responsible for the study. Overall guidance in the conduct of this study should be given by a subcommittee of the Geoprocessing Committee. It should be expected that the Waukesha County Information Systems Director will also contribute to the study. The Geoprocessing Committee recommends that Waukesha County create a new position of Land Information System Coordinator to lead this study. The individual chosen to fill this position should report to the Waukesha County Register of Deeds and should have the technical capability to carry out the study outlined above, and then work with Waukesha County Departments in implementing the study recommendations over time. For budgeting purposes, the Geoprocessing Committee suggests that Waukesha County assume a base salary range for the Coordinator position of $35,000 to $50,000, with attendant normal county fringe benefit costs.

One of the purposes of the aforedescribed study is to determine the additional costs that would be incurred by Waukesha County in implementing a land information system once the recommended automated mapping base that is the subject of this report is completed and ready to use. Pending the conduct of that study, the Geoprocessing Committee directed that a range of potential future costs be outlined in this report in order that the County Board is made aware of the additional costs that will be incurred in future years to complete a functional land information system for the County as a unit of government, recognizing that the individual municipalities will also incur additional costs should they choose to put in place an operational land information system. Such additional costs at the county level may be divided into three basic categories: 1) additional development of data base "sets"; 2) software costs; and 3) hardware costs.

With respect to the additional costs that might be incurred in building additional data "sets", it is the purpose of the outlined study to ascertain, by reviewing individual Department operations, how many additional such "sets" are necessary and desirable. Thus, a total cost estimate attendant to this item is not possible at this time. By way of example, the Park and Planning Department will probably want an automated zoning data "set" for the unincorporated area of the County. At present costs, the development of such a data "set" can be accomplished for about $2.00 per parcel. With an estimated total of 34,200 parcels in the unincorporated portion of Waukesha County, the total cost of establishing such an additional data "set" is estimated at $68,400.

With respect to hardware and software costs, only very gross estimates can be made at this time, pending an evaluation of the particular proprietary software and hardware that would be selected for use in Waukesha County. It is believed, however, that a major land information system work station would be required in the County Land Information Office, with auxiliary work stations in at least three county departments: Park and Planning, Transportation, and Land Conservation. Such hardware, together with the software necessary for storing, retrieving, and manipulating the parcel-based land information base, is estimated to cost $900,000.

Additionally, it should be recognized that the land information system data base, like any data base, will require maintenance and updating on a continuous basis in order to maintain its utility for the end

user. The updating work would contain three distinct elements: maintenance of the system of U. S. Public Land Survey corners; updating of topographic mapping owing to urbanization; and updating of cadastral mapping also owing primarily to urbanization.

It is estimated that on an average annual basis, about 1 percent of the 2,535 U. S. Public Land Survey corners would require maintenance work. Thus, about 25 corners annually would require maintenance activity at a current annual cost of $280 per corner. The total land survey maintenance cost is estimated at $7,000 annually.

An average of about 7.5 square miles of land is converted from rural to urban use annually in Waukesha County based upon Commission land use inventories conducted since 1963. Assuming that this rate of urbanization would continue in the future, it would be necessary over time to remap, on an average annual basis, 7.5 square miles of land. At a current cost of $4,000 per square mile for updated topographic mapping, the average annual maintenance cost for such mapping is estimated at $30,000.

Finally, nearly 1,200 new parcels are created in Waukesha County annually. At an average cost of $17.50 per parcel, the total estimated maintenance cost for cadastral maps is $21,000 annually. Thus, the total estimated cost of maintaining the automated mapping base in Waukesha County once it is completed would approximate $58,000 annually based on current costs. These maintenance costs pertain only to the items included in the defined automated mapping base and, thus, do not include any costs associated with updating the data "sets" that ultimately may be added to the mapping base such as zoning.

5. State Grant Applications

It may be expected that both Waukesha County as a unit of government and various local units of government within Waukesha County will over the six-year period seek state grants in support of the development of the recommended automated mapping and land information system. It is recommended that any such grant applications, before being submitted to the Wisconsin Land Information Board, first be found to be consistent with the program objectives and standards set forth in this document. It is recommended that upon such a finding, Waukesha County—acting through the Land Information Officer—submit to the Wisconsin Land Information Board any application by a local unit government in the County with a recommendation for approval.

Potential State Mapping Aids through County Assessment

Although not an essential part of the land information system plan set forth herein, it is suggested that Waukesha County and the local units of government within the County give consideration to the potential benefits to be derived from establishing a county assessor system, as permitted under Section 70.99 of the Wisconsin Statutes. At the present time, the assessment function is performed by each individual municipality in the County. As previously noted, in some instances the local assessment function also includes the tax listing and mapping functions. Collectively, local governments in Waukesha County expend about $1.4 million annually for routine performance of the assessment function—not including periodic major reassessment efforts. The cost of assessment ranges from a low of about $3.70 per parcel in the Town of Waukesha to a high of about $27.40 per parcel in the Town of Brookfield. The average cost is $11.60 per parcel.

One of the important benefits attendant to a county assessment system would be state funding. Under the law, the State would pay the lesser of 75 percent of the actual cost of the operation of the county assessor system or 75 percent of the sum of two-tenths of one mill multiplied by the full value of the County plus $3.95 multiplied by the total number of land parcels in the County. Based on the current property value of, and parcel count in, Waukesha County, the latter would amount to nearly $2.4 million annually. In addition to representing state aids that do not currently flow into Waukesha County, a portion of those aids could be used to prepare assessment maps of the County. The cadastral maps specified under the County's land information program should meet and,

indeed, exceed the minimum specifications for assessment maps promulgated by the Wisconsin Department of Revenue. The establishment of a county assessor system in Waukesha County would also automatically resolve some issues noted above attendant to the maintenance and custody of cadastral maps, since all map responsibility would rest at the county level.

Assuming that a county assessor system was put into place and that the Wisconsin Department of Revenue agreed to allow the costs of preparing cadastral/assessment maps within the county assessor function and budget, then it would be possible both to accelerate the completion of the Waukesha County automated base mapping program to the end of 1996 and to reduce the amount of property tax monies that are expended within Waukesha County to perform the assessing function. As already noted, the existing average assessment cost in the County approximates $12 per parcel, and local taxpayers within Waukesha County spend about $1.4 million annually in carrying out the routine assessment function. Assuming that the assessment function is transferred to the county level, assuming that the average cost would remain at $12 per parcel, and further given that there are approximately 113,000 parcels in Waukesha County, the total county budget for performing annually the traditional assessment function would approximate $1,356,000. Under the county assessing law, the State would fund 75 percent of this amount, or $1,017,000, leaving property taxpayers in Waukesha County to fund the remaining 25 percent, or $339,000. If over the next six-year period, the costs associated with preparing and digitizing the cadastral maps throughout the remainder of Waukesha County were included in the county assessor budget, such costs would total about $381,000 annually. This would include costs identified in Table 1 for the remonumentation, horizontal survey control, cadastral map compilation, and cadastral map digitization elements of the recommended county land information system plan. Under the state law, 75 percent of this amount, or $286,000, would be funded by the State, with the remaining 25 percent, or $95,000, to be funded by county taxpayers.

Thus, the total budget for a Waukesha County assessment office over the next six years would approximate $1,737,000, of which the State would fund $1,303,000 and property taxpayers in the County $434,000. Under this scenario, then, the state share would be well within the State's funding cap of $2.4 million; property taxpayers in Waukesha County would have the collective assessment cost burden reduced by about $1.0 million, from $1.4 million to $434,000 annually; and a new revenue stream of $381,000 annually would be in place to help build the automated mapping base for the entire County by the end of 1996. This amount approximates the average annual shortfall noted earlier in this chapter of about $393,000.

PROPOSED ORGANIZATIONAL ARRANGEMENTS

Institutional Structure to Conduct Program

The following institutional structure is recommended to carry out the aforedescribed work program in the period 1991 through 1996:

1. It is recommended that the entire land information system program be placed under the direction of the Waukesha County Geoprocessing Committee and that the County Board dissolve the Waukesha County Monumenting Committee. As the Land Information Officer, the County Register of Deeds would provide the principal staff support to the County Geoprocessing Committee. The Geoprocessing Committee would oversee the monumentation and topographic mapping efforts, as well as all of the cadastral map and digital conversion efforts recommended in this report. Finally, the Geoprocessing Committee should oversee the preparation of the digital specifications and standards; parcel identification; data custody, control, and maintenance; and county hardware and software studies described earlier in this chapter. Any fiscal and policy findings and recommendations developed from those special studies should be reported to the Waukesha County Board of Supervisors for funding and policy determination.

2. It is recommended that the Waukesha County Register of Deeds serve as the agent for Waukesha County in the development and submittal of any grant applications for Waukesha County that seek

state grants from the Wisconsin Land Information Board. It is further recommended that the County Geoprocessing Committee serve as the body for reviewing any applications submitted by a local unit of government in Waukesha County for state funds in support of land information system development work. If the Geoprocessing Committee finds that an application by a local unit of government is consistent with the plan objectives and standards set forth in this document, it should forward the application to the Wisconsin Land Information Board with a favorable recommendation for approval. If the Committee cannot make such a finding, then it should return the application to the local unit of government, together with a statement of the reasons why the application is inconsistent with the objectives and standards set forth in this plan and any suggestions that the Committee might have to modify the application to make it consistent with the plan.

Public Access to Records

All of the information that comprises the Waukesha County Land Information System base—including monumentation and survey control data, planimetric and topographic base mapping data, cadastral mapping data, and parcel identification data—may constitute public information under the Wisconsin Open Records Law. Consequently, Waukesha County may have to make such data available to both public and private sector interests upon request. In adopting this plan document, Waukesha County recognizes the Register of Deeds as the official custodian of all data attendant to the County Land Information System base. In accordance with the established policy of Waukesha County, all requests for data from that base should be submitted to the Register of Deeds on such forms and in such manner as the Register of Deeds may prescribe. All reasonable costs associated with fulfilling such requests shall be paid for by the requesting party.

As Waukesha County in future years builds upon the automated mapping base described in this plan, it may be expected that additional "sets" of information will be added to that base. Some of those "sets" of information may consist of data that under Wisconsin law is to be kept confidential in order to protect individual rights of privacy. The detailed study of Waukesha County geoprocessing needs recommended earlier in this chapter should explicitly address public access considerations attendant to these additional "sets" of information.

Administrative Considerations

The guidelines promulgated by the Wisconsin Land Information Board call for the explicit response of Waukesha County to certain administrative standards and requirements. The following explicitly addresses those guidelines:

1. Relationship to Wisconsin Land Information Program
   By adopting the Waukesha County Land Information System Plan set forth in this document, Waukesha County agrees to observe and follow Wisconsin Statutes attendant to the Wisconsin Land Information Program.

2. Access to Books, Records, and Projects
   By adopting the Waukesha County Land Information System Plan set forth in this document, Waukesha County agrees to permit the Wisconsin Land Information Board, upon reasonable notice, access to books, records, and project materials for inspection and audit purposes.

3. Annual Report
   By adopting the Waukesha County Land Information System Plan set forth in this document, Waukesha County agrees to prepare an annual report on the status of plan implementation and submit that report to the Wisconsin Land Information Board.

4. Plan Update and Revision
   By adopting the Waukesha County Land Information System Plan set forth in this document, Waukesha County agrees to revise, update, and extend the Waukesha County plan, such updating work to be undertaken during calendar year 1995.

SUMMARY

This chapter sets forth a recommended automated mapping and land information system plan for Waukesha County. The following summarizes the salient elements of that plan:

1. It is the goal of Waukesha County to implement over time a multipurpose, multiuser automated mapping and land information system, such system to follow the National Research Council model. The system would have five basic elements including a geodetic reference framework; large-scale planimetric and topographic base maps; overlays, including cadastral boundaries and boundaries of various cultural and natural areas; identifiers, including parcel numbers and codes associated with various cultural and natural areas; and nonspatial land information files, including cadastral parcel records and various cultural and natural resource data.

2. The planning period for the initial land information system plan for Waukesha County is the six-year period beginning January 1, 1991, and extending through December 31, 1996. Should sufficient fiscal resources become available, it is intended that the entire automated mapping and land information system recommended for Waukesha County be completed by the end of that period. Given probable fiscal resource constraints, however, available resources should be directed first toward completing the foundation elements of the multipurpose cadastre, namely the geodetic reference framework; the large-scale planimetric and topographic base maps; and the cadastral overlays, including parcel identifiers.

3. The recommended standards for the automated mapping and land information system for Waukesha County are based upon the standards for the development of survey control networks and local large-scale mapping programs promulgated by the Southeastern Wisconsin Regional Planning Commission. The standards have been used for many years throughout Southeastern Wisconsin, including Waukesha County and have proven to be both conceptually and procedurally sound. The standards include the use of the State Plane Coordinate System, North American Datum of 1927 (NAD-27) as the map projection system for the Waukesha County automated mapping and land information system; the recovery, or relocation, and monumentation of U. S. Public Land Survey corners, including section and quarter-section and center of section corners; the establishment through high order control surveys of coordinates for such corners based upon the Wisconsin Coordinate System, South Zone, (NAD-27); the establishment through high order control surveys of elevations of all such corners based upon National Geodetic Vertical Datum, 1929 adjustment (NGVD-29); the preparation in digital form to National Map Accuracy Standards of large-scale planimetric and topographic base maps; the preparation of companion large-scale cadastral maps identifying real property boundary lines and related information, and parcel identification numbers.

4. The continuation under the guidance of the Waukesha County Geoprocessing Committee over the next six years of the large-scale base mapping program. The Waukesha County Monumenting Committee would be dissolved. Assuming that the current annual appropriation of $150,000 from the county property tax levy is maintained over that period, an additional 96 square miles of mapping and control survey work would be completed. This represents about 41 percent of the work effort remaining to complete the County. Given the present level of expenditure, a 15-year period would be required to complete the entire County, resulting in a completion date of 2005. If it were desired to accelerate this portion of the work program and complete all large-scale base mapping work by December 31, 1996, an annual appropriation of about $366,000 would be required, or about $216,000 more than at present.

5. The use of new revenues through the increased Register of Deeds recording and filing fees to provide a fully operational automated base map for the eastern one-half of Waukesha County by the end of 1996. This work also would be done under the guidance of the Waukesha County Geoprocessing Committee. Over the six-year period 1991 through 1996, such filing fees are expected to total about $1.3 million. It is recommended that these monies be used to complete conventional cadastral maps in the eastern one-half of Waukesha County, to convert to digital form the planimetric features of topographic maps within the eastern one-half of Waukesha County, and to convert to digital form cadastral map data within the eastern one-half of Waukesha County. With the com-

pletion of this work, an automated base map would be in place and be ready for linkage to both graphic and nongraphic element data files. This work effort would not include the conversion to digital form of the hypsometric features for those areas where topographic maps were originally obtained in a conventional form.

6. If it were desired to complete by the end of 1996 a fully operational automated base map for the entirety of Waukesha County, considerable additional fiscal resources would be required. The total cost of such work is estimated at $4.56 million, representing an average annual cost of about $760,500. The average annual revenue to support the program—consisting of an assumed $150,000 in county tax levy money and $217,500 in document recording fees—totals $367,500. This would leave an estimated shortfall, if the entire program were desired to be completed over the next six years, of $393,000 annually.

7. It is also recommended in the plan that Waukesha County seek on an annual basis over the next six years state grants in the amount of $100,000. Any such state grant monies made available to Waukesha County should be used first to accelerate the completion of the automated base map for the eastern portion of the County.

8. As the automated base mapping work continues over the next six years, several technical studies need to be undertaken. These include studies relating to specifications and standards for digital conversion; data custody, control, and maintenance; and hardware and software for Waukesha County. In addition, a study is required with respect to parcel identification numbers, identifying in detail how the existing Waukesha County parcel numbering system should be adapted to meet the unique parcel identification numbering system promulgated by the Wisconsin Land Information Board. All four studies should be conducted under the sponsorship of the Waukesha County Geoprocessing Committee, with principal staff responsibility lying with the County Register of Deeds as the Land Information Officer. It is also recommended that Waukesha County create and fill the position of Land Information System Coordinator, placing that position under the direction of the Register of Deeds.

9. It is recommended that Waukesha County give consideration to establishing a county assessor system. Under the county assessor law, the State funds 75 percent of the costs of performing the assessing function. The preparation of cadastral maps is an essential part of the assessing function. By establishing a county assessing office, the property tax burden in the County could be reduced by about $1.0 million. In addition, a new revenue stream could be put in place to provide the cadastral mapping element of the automated mapping base and likely result in the completion of the entire automated mapping base throughout Waukesha County by the end of 1996.

10. Upon approval of the Waukesha County land information system plan by the Waukesha County Board of Supervisors and by the Wisconsin Land Information Board, local units of government in Waukesha County would be eligible to seek state grants from that Board. It is recommended that any locally sponsored land information project seeking such state funds meet the system standards identified in this chapter. In that way all projects will contribute toward achieving the overall objectives underlying the county plan. All local applications for state grants should be reviewed by the County Geoprocessing Committee. Upon a finding by the Committee that an application is consistent with the Waukesha County plan, the application should be forwarded to the Wisconsin Land Information Board with a favorable recommendation for approval.

11. In order to meet the administrative standards and requirements promulgated by the Wisconsin Land Information Board, Waukesha County by adopting this document agrees to observe and follow Wisconsin Statutes attendant to the Wisconsin land information program; to permit the Wisconsin Land Information Board access to books, records, and project materials for inspection and audit purposes; to prepare and submit to the Wisconsin Land Information Board an annual report on the status of plan implementation; and to revise, update, and extend the Waukesha County plan by the end of calendar year 1995.

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Chapter V

SUMMARY AND CONCLUSIONS

INTRODUCTION

On March 28, 1990, the Waukesha County Register of Deeds, acting on behalf of the Waukesha County Geoprocessing Committee, requested the Southeastern Wisconsin Regional Planning Commission to assist that Committee in the preparation of a plan for the development of an automated mapping and land information system for the County. The Geoprocessing Committee was charged with the task of preparing such a plan by a resolution of the Waukesha County Board of Supervisors dated February 16, 1988. The Committee consists of knowledgeable representatives of Waukesha County, of local units and agencies of government in the County, and of private utilities serving the County. This report sets forth the findings and recommendations of that Committee.

The Committee reviewed the pertinent conclusions of previous research efforts in the area of land records modernization; including, importantly, the reports of the National Research Council of the National Academy of Sciences, the reports of the Wisconsin Land Records Committee, the guidelines promulgated by the Wisconsin Land Information Board, and the long-standing recommendations of the Southeastern Wisconsin Regional Planning Commission. The Committee also reviewed the accomplishments to date of public and private efforts to create automated mapping and land records systems covering all or portions of Waukesha County.

The Geoprocessing Committee concluded that a modernized land records system in Waukesha County could best be created by provision of a single automated mapping base for the entire County. This single mapping base would be prepared to a set of specifications sufficient to meet the most stringent of accuracy and map feature content requirements of all of the users concerned. Such specifications are set forth in Chapter IV of this report. Each organization using the automated base would provide its own operating environment—that is, computer hardware and software. Only the digital maps and parcel identification system would be shared. This basic system would provide an automated mapping capability suitable for the development by individual operators of a wide variety of applications such as land ownership and title recordation systems, real property assessment and taxation systems, public and private utility inventory and management systems, environmental inventory and management systems, zoning and other code monitoring and enforcement systems, and emergency and service vehicle response and routing systems.

The plan set forth in this document is recommended to the Waukesha County Board of Supervisors for adoption. Upon adoption of the plan by the County Board, the Committee recommends that the plan be formally submitted to the Wisconsin Land Information Board with a request that the plan be approved by that Board. Upon approval by that Board, Waukesha County would be in a position to begin expending the supplemental Register of Deeds filing and recording fees authorized under the Wisconsin Land Information Program in a manner consistent with the plan recommendations. In addition, Waukesha County would be in a position to submit applications for state grants in support of the activities specified in the plan. Finally, local units of government in Waukesha County would also be in a position to submit applications for state grants. Such applications under state law would have to come through Waukesha County and be endorsed by the County so that any state funds expended are directed at activities consistent with the adopted plan.

RECOMMENDED CONCEPTUAL FRAMEWORK

The conceptual framework for a multipurpose cadastre as set forth by the National Research Council and as adapted for use by Waukesha County consists of the following elements:

1. A geodetic reference framework to identify the spatial location of all land-related data. This reference framework—or survey control network—consists of a system of survey monuments for which geodetically based coordinates have been determined through high order control surveys. In

accordance with the long-standing recommendations of the Southeastern Wisconsin Regional Planning Commission, the geodetic reference framework to be used in Waukesha County is to consist of the corners of the U. S. Public Land Survey System tied to the State Plane Coordinate System.

2. Large-scale topographic base maps showing in their correct location and orientation the principal natural and cultural features of the area concerned and the elevation and configuration of the surface of the earth. Within the context of the Waukesha County program, large-scale means one inch equals 200 feet scale—or in those cases where local governments desire and are willing to share in the cost entailed, one inch equals 100 feet scale—two-foot contour interval topographic maps. These maps are to be prepared to National Map Accuracy Standards in accordance with specifications promulgated by the Southeastern Wisconsin Regional Planning Commission.

3. A cadastral overlay to the topographic base map which identifies and delineates the most fundamental units of land ownership—the cadastral parcels. Such cadastral overlay maps are also to be prepared in accordance with specifications promulgated by the Southeastern Wisconsin Regional Planning Commission.

4. A parcel identifier constituting the means for linking all spatially related data to the mapping base and of storing, retrieving, and exchanging such data. Every parcel must have a unique identifier code.

5. Land information files which contain data about the land parcels and which are related to the mapping base through the parcel identifier. Such files can be either graphic or nongraphic in nature.

It is intended that the first four of the five elements of the multipurpose cadastre in Waukesha County be provided by the County and that such elements be made available in digital—i.e., computer-readable—form. These four elements constitute the automated mapping base. Building upon that base, Waukesha County, the local units of government in the County, and public and private utilities operating in the County can create the fifth element of the cadastre, namely, the land information files required to support the particular functions of the public and private agencies concerned.

STATUS OF DEVELOPMENT OF AUTOMATED MAPPING BASE

The following summarizes the status of the development of the recommended automated mapping base in Waukesha County as of December 31, 1990:

1. The Regional Planning Commission, Waukesha County, and the local units of government in the County have all collectively contributed in a significant manner to the development of the required geodetic reference framework. Of the estimated 2,535 U. S. Public Land Survey corners in Waukesha County, 1,737 corners, or about 69 percent, have been recovered and remonumented. In addition, State Plane Coordinates have been obtained for that same set of corners through high order control surveys. Elevations have been similarly obtained for 1,663 of the 1,737 monumented corners, or about 96 percent of the monumented corners, and 66 percent of all corners.

2. Large-scale topographic base maps have been obtained for 354 square miles, or about 61 percent of the 581 square miles of land within the County. Prior to 1987, such maps were obtained in "hard copy" analog form. Since then, the maps have been prepared in digital form. A total of 230 square miles of the topographic mapping completed in analog form need to be converted to digital form.

3. Cadastral maps have been prepared for about 137 square miles, or about 24 percent, of the total area of Waukesha County. None of the cadastral maps are available in digital form; therefore, all of the completed maps will have to be converted to that form. The cadastral mapping process includes the assignment of the required parcel identifier.

RECOMMENDED PLAN

The recommended Waukesha County land information system plan was prepared for the six-year period 1991 through 1996. This planning period corresponds with the state legislation which established the supplemental Register of Deeds recording and filing fees. Based on current state law, the additional filing fees expire at the end of state fiscal year 1996. Should sufficient fiscal resources become available, it is intended that the entire automated mapping base recommended for Waukesha County be completed by the end of 1996. Given probable fiscal constraints, however, the Committee made the following recommendations:

1. That current county property tax revenue totaling $150,000 annually continue to be directed toward the completion of the geodetic reference framework and large-scale topographic mapping in the western one-half of Waukesha County. All geodetic reference framework and large-scale mapping work in the eastern one-half of the County has been completed.

2. That the supplemental Register of Deeds recording and filing fees retained annually by Waukesha County be directed to complete a fully functional automated base map for the eastern one-half of the County. An average of $217,500 annually in such fees is expected over the next six years.

3. That any state grants received by Waukesha County be used first to accelerate the completion of the automated mapping base for the eastern portion of the County, and then for any necessary activities in the western portion of the County.

Given this policy framework, the following summarizes the anticipated projects proposed by the Committee to be completed over the period 1991 through 1996:

1. The completion of an additional 96 square miles of survey control and topographic mapping work in the western portion of Waukesha County given the current annual appropriation of $150,000 from the county property tax levy. This would complete such control and topographic mapping work for about 41 percent of the 234 square miles still to be done.[1] With the completion of this work, the total area covered within the County by survey control and topographic mapping would reach 443 square miles, or 76 percent of the total. At the present level of expenditure, a 15-year period would be required to complete the entire County, resulting in a completion date of 2005. If it were desired to accelerate the survey control and base mapping program and complete all such work by December 31, 1996, an annual appropriation of about $366,000 would be required, or about $216,000 more than at present.

2. Over the six-year period 1991 through 1996, the supplemental recording and filing fees in Waukesha County are expected to total about $1.3 million. All of this money would be required to complete conventional cadastral maps in the eastern one-half of the County, to convert to digital form the planimetric features of those topographic maps within the eastern one-half of the County that were not digitally compiled, and to convert to digital form cadastral map data within the eastern one-half of the County. With the completion of this work, an automated base map would be in place for the 290-square-mile eastern one-half of the County; ready for linkage to both graphic and nongraphic element data files by Waukesha County or any other user. This work effort would not include, however, the conversion to digital form of the hypsometric features for those portions of eastern Waukesha County where topographic maps were originally obtained in a conventional form. The latter would entail an additional cost of $350,000.

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[1] *There are 581 square miles of land in Waukesha County. A total of 354 square miles have been mapped to date, leaving a residual of 227 miles yet to be done. This figure differs from the 234 square miles noted above because of the need to remap seven square miles in scattered locations where earlier mapping was not completed to full U. S. Public Land Survey Sections.*

If Waukesha County desires to complete by the end of 1996 a fully operational automated base map for the entire County, including hypsometry, considerable additional fiscal resources would be required. The total cost of such work is estimated at $4.56 million, representing an average annual cost of about $760,500. The average annual revenue to support the program totals $367,500 and consists of an assumed $150,000 in county tax levy money and $217,500 in document recording fees. Consequently, there is an estimated shortfall of $393,000 annually if the entire program were desired to be completed over the next six years.

It is recommended that the Waukesha County Monumenting Committee be dissolved and that the development of the geodetic reference framework, the preparation of the large-scale topographic maps, and all other work necessary to complete an automated mapping base for Waukesha County be directed by the Waukesha County Geoprocessing Committee. That Committee should also sponsor four technical studies needed to provided additional guidance in the development of the land information system for the County. These studies are:

1. A study to develop detailed specifications and standards for the digital conversion of data.

2. A study to identify and address issues attendant to data custody, control, and maintenance.

3. A study to identify the geoprocessing hardware and software requirements for Waukesha County as a unit of government.

4. A study to determine how the existing Waukesha County parcel numbering system can best be adapted to meet the unique parcel identification numbering system promulgated by the Wisconsin Land Information Board.

All four studies should be the responsibility of the Waukesha County Register of Deeds and should be done cooperatively with the municipalities. The Geoprocessing Committee recommends that Waukesha County create and fill the position of Land Information System Coordinator, placing that position under the direction of the Register of Deeds.

The Geoprocessing Committee gave consideration to the potential additional costs that may be incurred by Waukesha County both with respect to the acquisition of computer hardware and software needed to operate the automated land information base upon its completion, and to the costs associated with maintaining that base annually. Pending the conduct of the aforerecommended study dealing with geoprocessing hardware and software requirements for Waukesha County, it is believed that the County will require a major land information work station in the County Land Information Office operated under the supervision of the Register of Deeds, with auxiliary work stations in at least three county departments: Park and Planning, Transportation, and Land Conservation. Hardware and software costs associated with these work stations may be expected to approximate $900,000. In addition, individual county departments may desire the creation of supplemental automated data sets. The aforerecommended study should determine how many such sets are required. There would be additional data base development costs associated with such sets. Finally, the annual cost of keeping the automated mapping data base current and useful may be expected to approximate $58,000. This includes costs associated with maintaining the system of U. S. Public Land Survey corners, obtaining updated topographic mapping as urbanization proceeds, and keeping the cadastral mapping current.

The Geoprocessing Committee also recommends that the Waukesha County Board of Supervisors give consideration to establishing a county assessor system. Under state law, state aids are available to support 75 percent of the cost of such a system, not to exceed an amount specified by a formula which currently results in a cap of $2.4 million annually in Waukesha County. Under such an approach, state funds could be used to help prepare the cadastral maps specified under the county land information plan, since such maps are essential to performing the assessment function. A preliminary analysis of such a Waukesha county assessment office indicates a need for a total annual budget over the next six years of about $1.7 million, including about $381,000 annually to prepare digital cadastral maps. Of this total, the State could be expected to provide about $1.3 million and property taxpayers in the County about $0.4 million. Under such a scenario, the state share

would be well within the state funding cap; the property tax burden in Waukesha County would be reduced by about $1.0 million; and a new revenue stream of about $381,000 annually would be in place to help build—and likely complete—the automated mapping base for the entire County by the end of 1996.

Finally, the Geoprocessing Committee recommends that Waukesha County commit to meeting all of the administrative requirements for county land information programs established by the Wisconsin Land Information Board. In particular, Waukesha County should prepare and submit to that Board an annual report on the status of plan implementation. Furthermore, Waukesha County should commit to revise, update, and extend this plan by the end of calendar year 1995.

CONCLUDING STATEMENT

The Waukesha County Geoprocessing Committee has herein set forth a plan and program for the development over time of an automated base map suitable for the development within the County of a parcel-based land information system usable by all Waukesha County departments, by local governments in Waukesha County, and by public and private utilities. The plan includes technical specifications for the mapping work involved, and recommends an organizational structure for the conduct of that work. The Committee recommends that the plan and program set forth herein be approved by the Waukesha County Board of Supervisors and that work efforts proceed over the next six years in accordance with the outline and organizational structure recommended in this report.

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APPENDICES

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Appendix A

RESOLUTION OF THE WAUKESHA COUNTY BOARD OF SUPERVISORS ESTABLISHING A GEOPROCESSING COMMITTEE

ENROLLED ORDINANCE 142-140

ESTABLISH A GEO-PROCESSING STUDY COMMITTEE

WHEREAS the recent years have brought about a change in the level of sophistication available to process information concerning land usage and structure, and

WHEREAS the level of interest in forming a cooperative approach to establishing and maintaining Geo-processing information on a County-wide basis has increased to the point of receiving requests from other public and private agencies to develop cooperative plans, and

WHEREAS a sharing of Geo-processing information among agencies would be of benefit to those agencies and the public.

THE COUNTY BOARD OF SUPERVISORS OF THE COUNTY OF WAUKESHA DOES ORDAIN that the County Board authorizes a fifteen (15) member Geo-processing Study Committee consisting of:

a. Two (2) County Board Supervisors, one of whom shall be appointed committee chairman,
b. One representative of each of the following jurisdictions, City of Waukesha, Village of Menomonee Falls, City of Brookfield, City of New Berlin, and the Town of Pewaukee,
c. One representative of each of the following public utilities, Wisconsin Electric Power Company, Wisconsin Natural Gas Company, Wisconsin Gas Company, and Wisconsin Bell,
d. One representative of each of the following County Departments, Register of Deeds Office, Highway Department, Park and Planning Department, UW-Extension Office, and Department of Information Systems.

Appointments to this committee will be made by the County Board Chairman.

BE IT FURTHER ORDAINED that the committee will report back to the County Board with a tentative plan and recommendations on actions necessary for the County Board to adopt a plan for implementing a Geo-processing system in Waukesha County.

BE IT FURTHER ORDAINED that expenses be allowed for committee members and be charged to the County Board agency budget.

Reference: Proposed Ordinance 142-152

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Appendix B

RESOLUTION OF THE WAUKESHA COUNTY BOARD OF SUPERVISORS ESTABLISHING A LAND INFORMATION OFFICE

ENROLLED ORDINANCE 145-23

AMEND COUNTY CODE TO PROVIDE FOR PERFORMANCE
OF COUNTY LAND INFORMATION FUNCTION
BY REGISTER OF DEEDS OFFICE

WHEREAS, the Legislature has amended Wisconsin Statute Sec. 59.88 to provide for the creation of a county land information office, and

WHEREAS, the Legislature has provided for an increase in certain user fees to be collected by the Register of Deeds and retained for use to develop, implement and maintain a county-wide plan for land records modernization, and

WHEREAS, the Board has previously established a geo-processing committee to supervise the coordination and modernization of land information in Waukesha County, and

WHEREAS, modernization expenses can be funded through both the statutorily established retained fee and grants from the State Board to modernize land records.

THE COUNTY BOARD OF SUPERVISORS OF THE COUNTY OF WAUKESHA DOES ORDAIN as follows:

That the Code of Ordinances of the County of Waukesha be amended by adding a section to Chapter 2 following Section 506 to read as follows:

SECTION 1 - The Office of the Register of Deeds shall perform the functions and duties of the Waukesha County Land Information Office, as set forth in Wisconsin Statute 59.88.

SECTION 2 - Those duties shall consist of coordinating land information projects within the County, between the County and local governmental units, between the State and local governmental units and among local governmental units, the Federal government and the private sector.

SECTION 3 - The Register of Deeds Office shall within two years from the date of this action develop a county-wide plan for land modernization.

SECTION 4 - The Register of Deeds Office shall review and recommend projects for local governmental units for grants from the Land Information Board under Wisconsin Statute 16.967 (7).

SECTION 5 - The Register of Deeds is directed to collect and retain the fees as set forth in Wisconsin Chapter 59.57 and the retainage of said fees shall be utilized to develop, implement and maintain the county-wide plan for land records modernization.

The County portion of the additional revenues provided by the statute shall be reserved to be used for allowable purposes only. The Register of Deeds shall design and submit a plan for county-wide land records modernization which shall include specific appropriation of these retained fees for County Board approval, prior to any release or use thereof.

SECTION 6 - The provisions of this ordinance shall be included and incorporated in the Code of Ordinances of the County of Waukesha, Wisconsin as an addition thereto and shall be appropriately renumbered to conform to the numbering system contained therein.