A topographic map of Washington County, Wisconsin, showing various towns and geographical features. A vertical green shaded strip highlights a specific area in the center of the county, extending from the northern to the southern edge. The map includes labels for numerous towns such as Kewaskum, Barton, West Bend, Cedar, and Jackson. It also shows major roads, water bodies like Cedar Lake and Cedar Creek, and various land parcels.

A LAND INFORMATION SYSTEM PLAN FOR WASHINGTON COUNTY

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**COMMUNITY ASSISTANCE PLANNING REPORT
NUMBER 184**

A LAND INFORMATION SYSTEM PLAN FOR WASHINGTON COUNTY

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

March 1992

Inside Region \$ 5.00
Outside Region \$10.00

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SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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March 21, 1992

Mr. Reuben J. Schmahl, Chairman, and
Members of the Washington County
Board of Supervisors
Washington County Courthouse
432 E. Washington Street
West Bend, Wisconsin 53095

Dear Chairman and Members of the County Board:

On June 12, 1990, the Washington County Board of Supervisors created a Land Information Office pursuant to Section 59.88 of the Wisconsin Statutes. The Board also created a Land Information Board to provide policy oversight for that Office, and designated the Register of Deeds as the official contact person for that Office. On March 21, 1991, the County Board requested that the Regional Planning Commission provide staff support to the Land Information Office in the preparation of a countywide plan for land records modernization. This report sets forth that plan as developed by the Land Information Board, the Board being representative of the local units of government, the private utilities, and other private sector interests in Washington County.

After a careful review of pertinent information, the Land Information Board concluded that a modernized land records system in Washington 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 Washington 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 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 Land Information Board recognized that it will take many years to complete the development of the recommended common automated mapping base, although the Board noted that significant progress has been made to date in preparing base maps to Regional Planning Commission specifications, work that now needs only to be converted to computer-readable form. Over the next five years, the Committee recommended that Washington County focus available resources toward completing the required geodetic reference framework as a basic first step in the development of an automated mapping base for the County. More specifically, the Board recommended that the County Surveyor complete the remonumentation of U. S. Public Land Survey Section corners at designated locations throughout Washington County using a county tax levy budget of \$25,000 annually. In addition, the Board recommended that the retained Register of Deeds recording and filing fees, which would approximate \$75,000 annually, be used for a control survey program to establish the State Plane Coordinates and vertical elevations of the remonumented corners. The Board also recommended that any available state land information system grant monies be used for additional work efforts that would complete the land and control survey work programs in other areas of the County. Finally, the Board recognized that local units of government in the County may desire to proceed independently with completion of an automated mapping base for a portion of the County. In those cases, the Board recommended that the Washington County Board provide matching county financial support from tax levy sources, working with the local unit of government in seeking a state grant in support of the work program.

In addition to the foregoing activities, the Board also recommended that three related work activities be undertaken over the next several years. These include a special technical study to agree upon specifications and standards for the digital base mapping work; the conduct of a study of how best to convert the four existing Washington County parcel numbering systems to the standard parcel numbering system proposed by the Wisconsin Land Information Board; and the conduct of a work effort to revise the name and address fields of the present Washington County property ownership files.

On March 20, 1992, the Land Information Board acted unanimously to adopt the five-year plan set forth herein and to recommend adoption of the plan and its implementation to the County Board. The Board 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 and the local units of government in 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 March 21, 1991, the Washington County Board of Supervisors adopted a resolution asking the Southeastern Wisconsin Regional Planning Commission to help Washington County prepare a plan for land records modernization, focusing on the development of an automated mapping and parcel-based land information system. This initiative by the County Board was a direct result of the establishment of the Wisconsin Land Information Program under 1989 Wisconsin Act 31 as amended by 1989 Wisconsin Act 339. The resultant plan is documented in this report.

LAND INFORMATION OFFICE

Under the Wisconsin Land Information Program, counties are encouraged to establish a Land Information Office. A Washington County Land Information Office designation was made by the Washington County Board of Supervisors on June 12, 1990. To oversee the activities of the Land Information Office, the County Board established a Land Information Board. The Board consists of the Chairman of the County Board, the Chairman of the County Park and Planning Commission, the Chairman of the County Finance Committee, the County Corporation Counsel, the County Real Property Lister, the County Surveyor, the County Auditor, the County Land Use and Park Administrator, the County Register of Deeds, the County Conservationist, and a representative of the abstractor and title insurance interests in the County. On December 10, 1991, the County Board formally designated the County Register of Deeds as the official contact person for the County Land Information Office. The Register of Deeds, then, functions as the County Land Information Officer. The present Register of Deeds is:

Ms. Dorothy C. Gonnering
Register of Deeds
Washington County Courthouse
432 E. Washington Street
West Bend, Wisconsin 53095
(414) 335-4318

PURPOSE OF THE REPORT

The basic purpose of this report is to document a Washington County land information system plan with emphasis on the need for the development of an automated mapping and parcel-based land information system for the County. The report is intended to provide sufficient information to permit the Washington County Board of Supervisors, the affected Washington 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 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 Washington County.
3. To propose an organizational arrangement for the development of an automated mapping and land information system for Washington County.
4. To identify those technical issues which, in the case of a shared, multi-user, automated mapping and parcel-based land information system, would need to be resolved before a shared system could be developed.
5. To estimate the time and resource requirements for implementing an automated mapping and parcel-based land information system for Washington County.
6. To recommend a course of action.
7. To qualify Washington County and, through the County, the local units of

government within Washington County for state grants from the Wisconsin Land Information Board in support of carrying out automated mapping and land information system projects in a manner consistent with the Washington County plan.

In addition to meeting the needs of Washington County, of the local municipalities in Washington County, and of the public and private utilities operating in Washington County, it is intended that the land information system plan set forth herein meet the requirements of the Wisconsin Land Information Program. Toward this end, it is recommended that, upon approval of the plan by the Washington County Board of Supervisors, Washington County seek approval of the plan by the Wisconsin Land Information Board. The plan is summarized in a format specified by the Board in Appendix A.

LOCAL GOVERNMENT AND PRIVATE SECTOR INVOLVEMENT

The Washington County Land Information Board provided the policy guidance in the preparation of the County's land information system plan. In order to ensure that local government and private sector interests were fully represented in the deliberations concerning the content of the plan, the County Board, on December 10, 1991, expanded the membership of the Land Information Board by adding a representative of a private utility operating within Washington County and three representatives from local governments in the County, one each representing cities, villages, and towns. The membership of the Land Information Board is reproduced on the inside front cover of this report. The Board carefully reviewed and approved the findings and recommendations of this report.

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 practitioners of many 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. At the same time, an increasing number of local units of government and private utilities have undertaken the creation of automated mapping and land information systems, including systems that currently cover all or parts of Washington County.

This chapter presents a summary of pertinent literature on automated mapping and land information systems and identifies and briefly describes currently operating automated mapping and land information systems which pertain to all or portions of Washington 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 already undertaken at various locations. The Council was responding to the growing interest in land data systems and to the perceived increasing need for land-related information by all levels of government and by 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 to 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 the questions left unanswered by its 1980 report, the National Research Council prepared a second report, which set forth a set

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.*

of recommended procedures and standards for the design and implementation of a multipurpose cadastre.² It was the intent of this report to assist the local units of government wishing to pursue the development of cadastral records systems for their own jurisdictions and also the many other regional, state, and federal agencies and 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 identifier. 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, as may be necessary, of information from the more intensive and detailed level to the more extensive and general level.

The local mapping and survey control network recommended by the Southeastern Wisconsin Regional Planning Commission since 1964, 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 precondition to the creation of a modern, automated, land information system.

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 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, 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

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.*

land records modernization and a final report that summarized 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 toward land records modernization and recognized the contribution that could be made by computer technology in certain aspects of this modernization process. The Committee determined that the costs to develop 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, 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 that role precisely, preferring instead to have individual counties make the determination that, at the minimum, a coordinative role was seen as necessary in view of the records maintenance functions given to the counties by the Wisconsin Constitution and 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 Governor Tommy Thompson, and, late in 1989, the Wisconsin Land Information Board began to meet following the appointment of the Board members by the Governor. Voting members of the Board are defined 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 (DNR); 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. Four representatives chosen from public utilities and private businesses appointed by the Governor to six-year terms, includ-

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.*

ing 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 who is 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 who are selected by the Board shall serve as nonvoting, advisory members of the Board.

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 Wisconsin Legislature that would provide such a funding mechanism. This bill was passed by both houses of the Legislature in March and April 1990 and 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 systems 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 systems 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 in the five subsequent state fiscal years, resulting in a six-year program that under present state law would terminate on June 30, 1996. At that time, the present law requires that the register of deeds filing and recording fee return to the \$4.00 level that preceded the new law.

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. However, such monies can be retained only if: 1) the county has established a Land Information Office, 2) the county has received approval from the Land Information Board of a county plan for land records modernization, and 3) the county uses the monies to develop, implement, and maintain the countywide plans.

The law also 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.

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 such as, 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. 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 environ-

ments, 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, such as parcel identification numbers, legal descriptions, and assessment information, for example, can be entered into a computer through standard keypunch data entry procedures. 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 work station, which consists 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 which allows for determining 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 relative positions 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 a board 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. It 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.

EXISTING AUTOMATED MAPPING AND LAND RECORDS SYSTEMS PERTAINING TO ALL OR PARTS OF WASHINGTON COUNTY

There are several automated mapping and land information systems already in existence whose areas of operation cover all or portions of Washington 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 different map coordinate systems utilized by the different automated mapping operations in the Washington County area 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 three map coordinate systems are in regular use in the Washington County area: the State Plane Coordinate System, the Universal Transverse Mercator (UTM) Coordinate System, and a special derivative of the UTM system called the Wisconsin Transverse Mercator (WTM) Coordinate System. These three systems are all based upon the North American Datum of 1927 (NAD-27), which is, in turn, derived from the Clarke 1866 mapping spheroid. Since these three systems are based upon NAD-27, it is possible, albeit computationally tedious, to translate with mathematical precision coordinates in one of these systems to coordinates in the other.

Recently, the National Geodetic Survey of the National Oceanic and Atmospheric Administra-

tion of the 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 NAVD 88, 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 NAVD 88 will be costly, while offering no improvement in map accuracy or precision for locally oriented large-scale mapping operations.

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 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 digital land use inventory updates for 1980 and 1985. A digital land use inventory update for the base year 1990 is underway and scheduled for completion in 1992. 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 Washington County. The primary Commission system products are land use maps, interpretive soil maps, wetland maps, wildlife habitat maps, floodplain maps, civil division boundary maps, watershed and related analytical hydrologic unit maps, summary areal extent statistics, and thematic maps prepared in support of regional and local

planning activities. 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

Four agencies of state government currently possess and use automated mapping systems: the Department of Transportation, the Department of Natural Resources, the Wisconsin Geological and Natural History Survey, and the Legislative Reference Bureau.

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 Department'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 Department of Natural Resources began building a digital map data collection system in 1980. The initial system was, in effect, custom built by DNR staff who configured purchased hardware components and wrote their own computer software. The system was used primarily in support of the Department's land

acquisition, improvement, and management projects, but was also used to create a statewide inventory of wetlands. Other statewide inventories are in the process of being developed.

The Department of Natural Resources has developed the aforementioned Wisconsin Transverse Mercator (WTM) Coordinate System as a modification of the Universal Transverse Mercator (UTM) System, under which the prime meridian of the UTM projection is shifted three degrees of longitude west in order to keep the entire State within a single zone. Like the UTM System, the WTM System is based on the NAD-27 datum. The Department also utilizes the UTM coordinate system, NAD-27, and the State Plane Coordinate System, NAD-27, for some projects, as well as local coordinate systems on occasion. The Department possesses computer software translation capability between WTM, UTM, and State Plane Coordinate System.

In addition, both the Department of Transportation and the Department of Natural Resources have acquired the proprietary software ARC/INFO and are building geographic information system data bases throughout their respective areas of functional responsibilities. The Department of Transportation continues to perform automated mapping functions on the INTERGRAPH hardware and software system noted above. The Department of Transportation has purchased multiple APOLLO brand work stations for geographic information system use. These work stations are located throughout the State and many are connected through communications networks. Finally, the Department of Natural Resources has acquired the Department of Transportation's original MicroVax system for use in development work along with other work stations. This system will be used to support various geographic information systems residing on personal computers.

The University of Wisconsin-Extension Geological and Natural History Survey is also developing geographic information system capabilities. Digital data bases attendant to such items as bedrock and surficial geology, water supply wells, and water table maps are being developed on a project-by-project basis. The Survey efforts are carried out on personal computers utilizing the ARC/INFO software. The Survey uses the WTM Coordinate System, NAD-27, for its statewide digital mapping activities; for some special projects applicable to portions of the state, the

Survey uses the UTM and State Plane Coordinate Systems, NAD-27.

Finally, the Legislative Reference Bureau recently established a digital data base focused initially on the legislative and other election district redistricting efforts required after the United States decennial census in 1990. The Bureau acquired the TIGER map files from the U. S. Bureau of the Census and is using both IBM and ARC/INFO software, as well as uniquely developed software, in its digital mapping system. The TIGER files were initially built upon a spherical coordinate system of latitude and longitude, based upon the NAD-27 mapping datum. The Bureau has converted those files to the WTM Coordinate System, NAD-27.

Wisconsin Electric Power Company

The Wisconsin Electric Power Company (WEPCo), a subsidiary of the Wisconsin Energy Corporation (WICOR), has developed a digital mapping base upon which to place its electric service network. This effort was based upon INTERGRAPH hardware and software. WEPCo serves all of Washington County except the City of Hartford and the Village of Slinger, which are served by municipally owned utilities.

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

WEPCo has recently completed a project to convert its automated mapping system to IBM hardware and software. All of the base mapping and electric utility network data is now stored in a Geo-Facility Information System (GFIS) data base on a mainframe IBM computer. Maintenance of the data base is accomplished via downloading to personal computers where the updating work occurs. The changes are then reloaded to the GFIS data base on the mainframe computer.

Wisconsin Gas Company

The Wisconsin Gas Company is franchised to serve all of Washington County. The Company installed IBM hardware and software in 1984 to begin its automated mapping activities. It is

currently creating a digital mapping base through a combination of board digitizing and direct digitizing from stereoscopic models.

The development of an automated mapping base in Washington County by the Company is being confined to the cities and villages and to those portions of towns where gas pipeline facilities are in place. That mapping base in Washington County has now been completed. For all that area north of the Village of Germantown and the Towns of Erin, Germantown, and Richfield, planimetric information included in the base was prepared from aerial photography flown in 1987. For the Village of Germantown and the Towns of Erin, Germantown, and Richfield, the photography was flown in 1989. Work efforts are now underway to place the natural gas facility layer on the planimetric base.

Wisconsin Gas is using the State Plane Coordinate System, NAD-27. The Company obtained the spatial reference framework for its automated mapping system from the Regional Planning Commission.

Wisconsin Bell

Wisconsin Bell, Inc., serves all of Washington County, except for the communities of Farmington, Kewaskum, Wayne, Addison, and Slinger. In 1990, Wisconsin Bell reached a decision to acquire an INTERGRAPH system to use for the automated mapping of its facilities. Wisconsin Bell intends to begin its automated mapping work in Washington County in 1992. Wisconsin Bell uses the Universal Transverse Mercator Coordinate System, NAD-27, for its digital mapping system.

General Telephone and Electronics (GTE)

General Telephone and Electronics serves that portion of Washington County not served by Wisconsin Bell, Inc. This company has developed a digital mapping base built upon the TIGER files made available by the U. S. Bureau of the Census. The TIGER files are digitized from U. S. Geological Survey 1:100,000 scale quadrangle maps based upon the spherical coordinates of latitude and longitude, NAD-27.

County and Local Programs

Washington County has not established a digital mapping program insofar as real estate parcels are concerned. The Washington County Real Property Lister does maintain a series of cadastral diagrams by U. S. Public Land Survey

Section for the entire County which depict the location of subdivisions, certified survey maps, metes and bounds parcels, and public rights-of-way. While some of these diagrams reflect field measurements of unknown origin and accuracy related to section corners, the diagrams do not fit the geodetic control framework being put in place to Commission specifications and are not suitable, therefore, for use in building a modernized land records system.

The Washington County Emergency Government Office has installed an emergency management computer software package that contains a digital map of Washington County. This package is called CAMEO (Computer Aided Management of Emergency Operations). The version of the software installed in Washington County operates on a Macintosh personal computer. The software was developed by the National Oceanic and Atmospheric Administration and the City of Seattle, Washington, to provide assistance in fire response and emergency planning for fires involving dangerous chemical substances. In practice, the system is used to provide advance warning of the presence of dangerous chemical substances to fire response personnel, to aid in determining fire equipment requirements, and to aid in developing evacuation plans of nearby residents.

The digital map contained in the package was obtained by optical scanning of a small-scale street base map of Washington County. Therefore, the automated map is not referenced to any map projection. In addition, the package has been enhanced to include more detailed street maps of several communities in the County. Those latter maps were scanned from community profiles prepared by SEWRPC using the State Plane Coordinate System, NAD-27. The maps are not separated into features in the system data base, so individual map features cannot be selectively manipulated or extracted. The primary purpose served by the maps is to provide a general spatial reference for personnel involved in fire response and for the modeling of toxic fume plumes to assist in the planning of emergency evacuation requirements.

Three local units of government in Washington County have begun to take steps to establish digital mapping capabilities. These three programs are as follows:

1. City of West Bend

The City of West Bend has acquired a personal computer-based engineering drafting capability that is housed in the survey section of its Engineering Department. Presently, the system is being used for land survey and engineering drafting applications. In addition, the City has acquired a geographic information system software package entitled, "Earth One." At the present time, however, the City has not developed any applications with this software package.

2. City of Hartford

The City of Hartford has acquired a personal computer based AUTOCAD software system for the primary purpose of automating engineering drafting work. The City intends to undertake programs to map its utility systems.

3. Village of Germantown

In 1985, the Village acquired new digital topographic mapping of about 17 square miles of the Village, replacing conventionally prepared topographic maps at a scale of one inch equals 100 feet. These maps are based upon the State Plane Coordinate System, NAD-27. While that mapping is available in digital form, the digital files are retained by the consulting engineer, Ayres & Associates, Inc., with the Village receiving hard copy products from the digital files. At the present time, the Village has established no in-house capability to store and manipulate the digital map files.

Digital Map Data 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 Washington County may affect the ability to exchange digital map data between different automated mapping sites and systems.

Commercial software products are increasingly available that will provide for the "translation"

of digital map data between specific sets of proprietary automated mapping and 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 data translation cannot be taken for granted. Generally speaking, translations will be most successful between systems that have a high degree of compatibility between basic software instruction sets, data structures, and hardware architectures 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.

All the digital mapping work completed to date within Washington County has utilized map coordinate systems developed on the NAD-27 horizontal datum. Accordingly, it should be possible readily to effect the exchange of such digital map data between the agencies that have developed the data.

Status of Land Information System Planning in Bordering Counties

Washington County is bordered by six counties. Three of those counties, Ozaukee, Milwaukee, and Waukesha, lie within the seven-county Southeastern Wisconsin Region. The remaining three Counties, Sheboygan, Fond du Lac, and Dodge, lie outside that planning Region. County land information system plans have been completed and adopted for both Milwaukee and Waukesha Counties. Such plans were prepared with the assistance of the Southeastern Wisconsin Regional Planning Commission, and are,

therefore, fully consistent and coordinated with the Washington County plan. Similarly, the Regional Planning Commission is assisting Ozaukee County in the preparation of its land information system plan; that plan will also be fully consistent and coordinated with the Washington County plan. Specifically, work completed with respect to the foundational element of survey control, the remonumentation of U. S. Public Land Survey section and quarter-section corners which lie on common boundaries, is known to the Regional Planning Commission and is reported consistently in each of the county plans.

County land information system plans have not yet been completed for Sheboygan, Fond du Lac, and Dodge Counties. Such plans are under preparation and are expected to be completed by mid-1992. Any necessary coordination between the Washington County plan and these three county plans should be effected through the review and approval process carried out by the Wisconsin Land Information Board.

SUMMARY

Over the past 10 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 and which pertain to Washington 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 which recommended 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 administering 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 from July 1, 1990, to 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 grants 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 and land information systems (GIS/LIS). 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/LIS 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 within Washington County whose areas of operation include all or portions of the County. Several of these systems, including those of the Southeastern Wisconsin Regional Planning Commis-

sion and the Wisconsin Electric Power 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, all of which presently are mathematically relatable to the State Plane Coordinate System, North American Datum of 1927. The use of different proprietary products, however, may affect the ability to exchange digital map data between different automated mapping sites and systems readily, since commercial software products may not be available that can "translate" digital map data between different proprietary automated mapping systems.

7. Several local units of government in Washington County have taken initial steps to develop automated mapping systems. The Village of Germantown has obtained large-scale topographic base maps in digital form for a portion of the Village. At the present time, however, the Village maintains no in-house capability to store and manipulate that digital mapping. Consequently, the Village works with "hard copy" output from the digital files stored by an engineering consultant. The Cities of Hartford and West Bend have taken steps to establish in-house computer drafting and mapping capabilities. At the present time, however, no significant efforts have been undertaken to begin to develop an automated base map in either of these two communities. It will be important to coordinate the automated municipal mapping efforts in the County through the preparation of a Washington County land information system plan.

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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. In addition, the chapter describes remonumenting and base mapping efforts previously carried out in the Region and in Washington County which provide the essential base for the establishment of an automated mapping and land information system.

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, being extended later in an evolutionary manner to other applications.

Thus, the development of a more narrowly defined cadastre, or parcel-based land information system, 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 sys-

tems; 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 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 readily added 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 in the science of measurement and is intended to be

utilized as a basis for the collection of earth science data and 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 in the principles of property law, as well as in the science of measurement, and is utilized for the collection of cadastral data and the preparation of cadastral maps, such as real property boundary line maps.

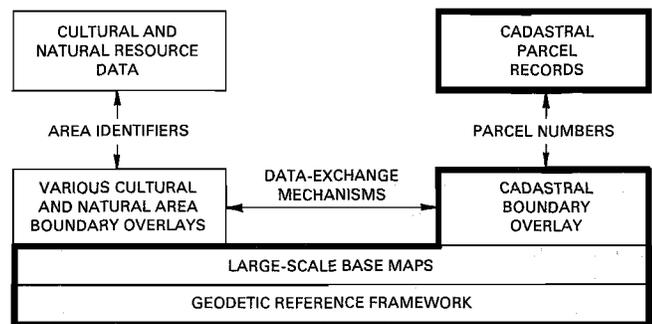
U. S. Public Land Survey System: For most of the United States, the federal government has provided the basic survey control system for cadastral mapping in the form of the U. S. Public Land Survey System. Under regulations imposed by the Congress, the U. S. Public Land Survey System has been extended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

This system is founded in 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; adjoining 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. The "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



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. A limitation on such uses, however, is imposed by the relatively widespread location of

the basic triangulation and traverse stations and 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 flood hazard boundary line locations, to such cadastral-related data as real property boundary line locations, is required. It is also mandatory that field work, data resolution, and information presentation be consistent with the most detailed level of land-related decision-making, that of the individual proprietary parcel. These requirements call for base maps at scales significantly larger than those generally available in the United States 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 for referring to a particular parcel in lieu of a full legal description. There is general agreement that the identifier system used 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 consists of 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 tax assessment and collection records systems.

In Washington County such files include, in addition to the basic property ownership and tax assessment information, such information as onsite sewage disposal and well permits, zoning permits, farmland preservation status, farm operator name if different from property owner, federal and state agricultural program participation status, farm type, livestock type, and field data, including information on erosion potential, cropping practices, and conservation practices.

EXISTING FRAMEWORK FOR THE DEVELOPMENT OF MULTIPURPOSE CADASTRES WITHIN SOUTHEASTERN WISCONSIN

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 in 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 in 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, both nets being 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 accurately correlate real property boundary line information with earth science data. 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 prop-

¹See 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 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 $\frac{24}{25}$ T. 11 N., R. 19 E., WASHINGTON COUNTY, WIS.

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

STATE PLANE COORDINATES OF: QUARTER SECTION CORNER

NORTH	514,719.95
EAST	2,486,094.24

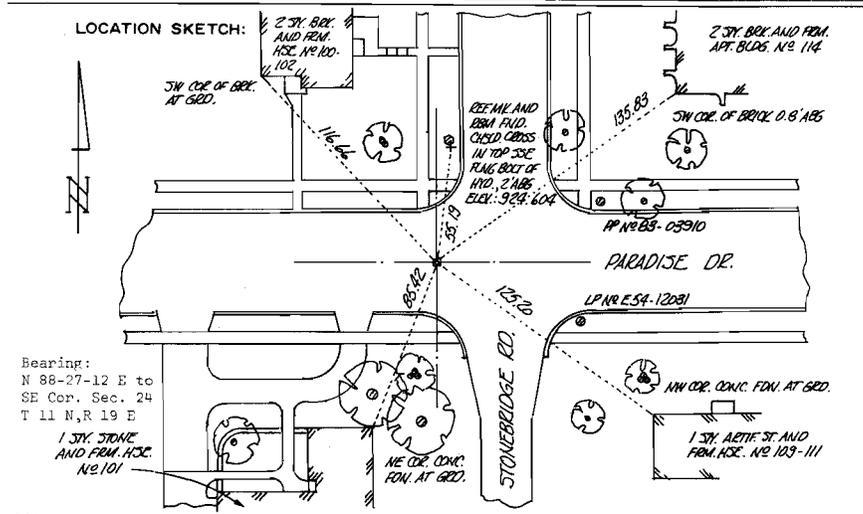
ELEVATION OF STATION: 922.084

HORIZONTAL DATUM: WISCONSIN STATE PLANE COORDINATE SYSTEM, SOUTH ZONE

VERTICAL DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929

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

THETA ANGLE: + 1-15-25



SURVEYOR'S AFFIDAVIT:

STATE OF WISCONSIN) SS I hereby certify that I found a
 WAUKESHA COUNTY) concrete monument with brass cap
 in a cast iron hand hole as set to mark this corner in November 1968
 by Richard E. Huenerbein, S-936, following street reconstruction; re-
 placing a concrete monument with brass cap set to mark this corner in
 the summer of 1966 by Sylvan J. Baudhuin, S-234; replacing in turn an
 old cut limestone monument then marking this corner; that I referenced
 the same as shown hereon; and that this record is correct and complete
 to the best of my knowledge and belief.

DATE OF SURVEY: 10 August 1989 *K. W. Bauer* S - 157
 REGISTERED LAND SURVEYOR

FORM PREPARED BY SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION



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

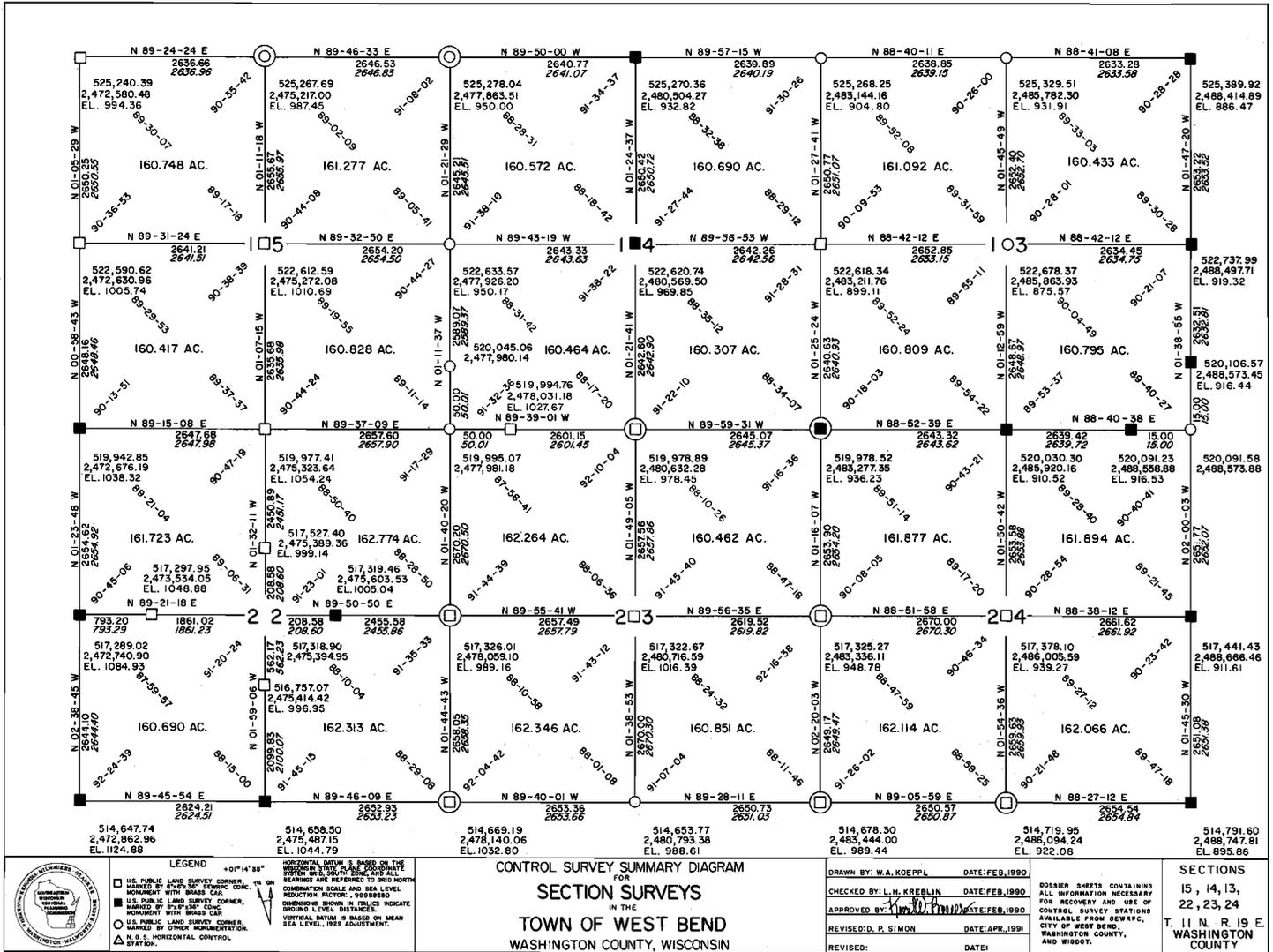
Source: SEWRPC.

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 maps, survey records, and, of cardinal importance, records on existing land survey monumentation and land occupation, in order to arrive at

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

Figure 5

**CONTROL SURVEY SUMMARY DIAGRAM FOR SECTION SURVEYS
IN THE TOWN OF WEST BEND, WASHINGTON COUNTY, WISCONSIN**



Source: SEWRPC.

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.

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 1/40 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 constructions 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.

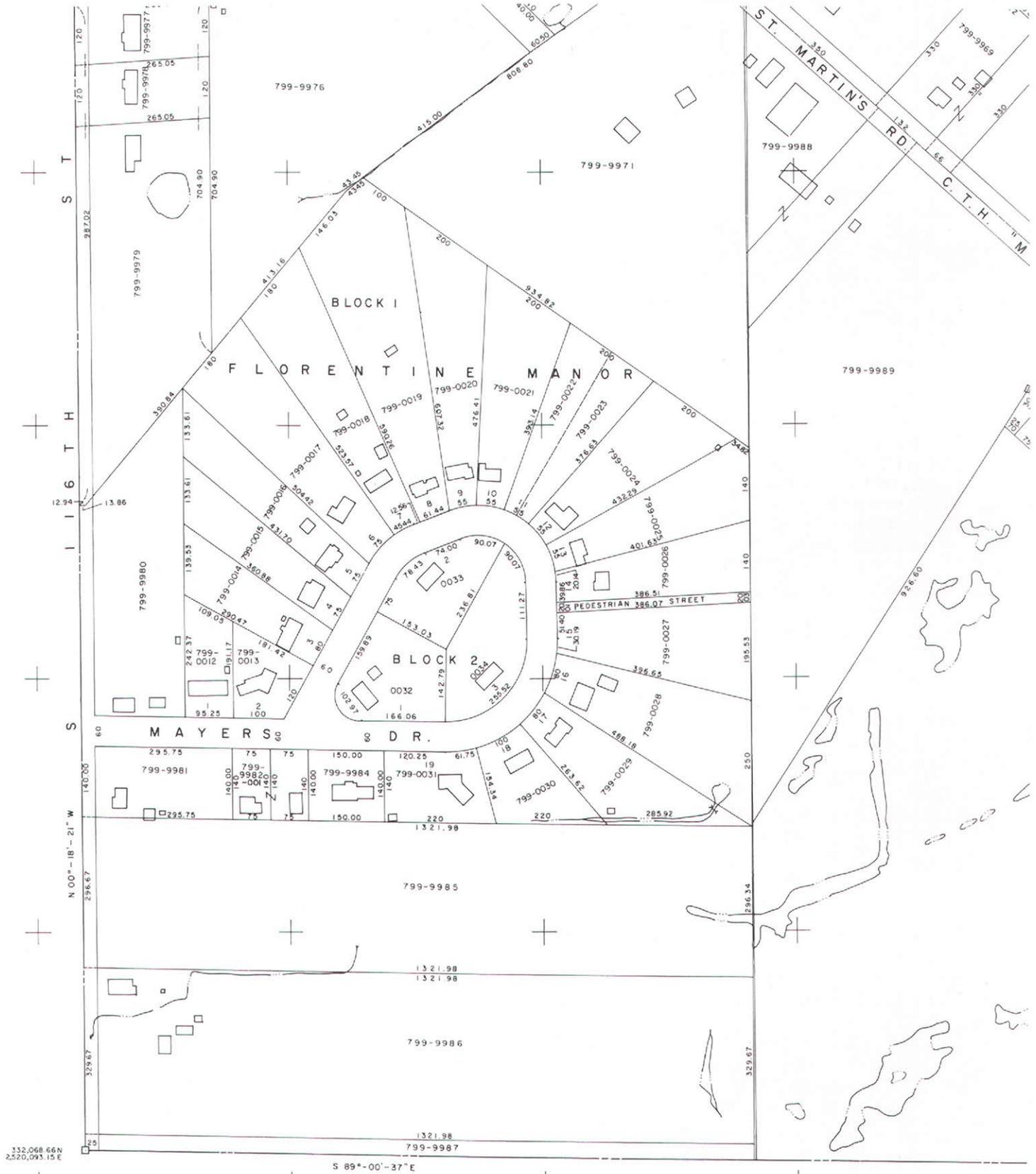
STATUS OF SURVEY CONTROL, LARGE-SCALE TOPOGRAPHIC BASE MAPPING, AND CADASTRAL MAPPING IN WASHINGTON COUNTY

As previously noted, the Regional Planning Commission has long recognized the importance of good large-scale maps to the proper administration of local government functions and has encouraged counties, cities, villages, and towns within the Region to prepare such maps. Over the last 25 years, the Cities of Hartford and West Bend; the Villages of Germantown, Jackson, Kewaskum, and Slinger; and the Regional Planning Commission itself have undertaken large-scale base mapping projects in Washington County (see Table 1). These projects, all of which were carried out according to Commission-recommended specifications, have resulted in the preparation of large-scale topographic base maps for 112 square miles, or about 26 percent of the area of Washington County (see Map 1).

The large-scale base maps were prepared at a scale of one inch equals 100 feet for a total of 82.25 square miles, including mapping projects in the Cities of Hartford and West Bend and the Village of Germantown, as well as mapping accomplished by the Regional Planning Commission along the right-of-way of the West Bend freeway. Such maps were prepared at a scale of one equals 200 feet for a total of 30.25 square miles for mapping projects in the Villages of Jackson, Kewaskum, and Slinger, as well as mapping accomplished by the Regional Planning Commission for the Tri-Lakes area of the Towns of West Bend and Polk and for the Village of Newburg. There is a 0.5 square mile of overlap between these mapping projects, the Village of Slinger having mapped one-half square mile at a scale of one inch equals 200 feet and the City of Hartford having mapped that same area at a scale of one inch equals 100 feet. All of these mapping projects included the relocation, monumentation, and placement on the State Plane Coordinate System of those U. S. Public Land Survey section and quarter-section corners included within the mapping areas.

Figure 7

A PORTION OF A TYPICAL CADASTRAL MAP PREPARED IN ACCORDANCE WITH THE COMMISSION-RECOMMENDED SPECIFICATIONS



Source: SEWRPC.

Table 1

**LARGE-SCALE BASE MAPPING PROJECTS IN WASHINGTON COUNTY
CARRIED OUT ACCORDING TO SEWRPC-RECOMMENDED SPECIFICATIONS**

Project Sponsor	Year ^a	Area Mapped ^a (square miles)	Scale	Planimetric and Topographic Maps	Cadastral Maps	
					Base Sheets Prepared	Maps Completed
Village of Germantown Southeastern Wisconsin Regional Planning Commission	1964 1966	18.75 4.00	1" = 100' 1" = 100'	Yes Yes	No No	Yes No
Village of Kewaskum	1969	2.00	1" = 200'	Yes	No	No
City of Hartford	1974	12.00	1" = 100'	Yes	Yes	Yes
Village of Jackson Southeastern Wisconsin Regional Planning Commission	1975 1976	6.00 13.75	1" = 200' 1" = 200'	Yes Yes	Yes No	No No
Village of Kewaskum	1980	1.00	1" = 200'	Yes	No	No
Village of Slinger	1980	5.50	1" = 200'	Yes	Yes	No
Village of Germantown	1985	17.25	1" = 100'	Yes ^b	No ^b	Yes
City of West Bend	1988	26.25	1" = 100'	Yes ^b	No ^b	No
City of Hartford	1990	4.00 ^c	1" = 100'	Yes	No	No
Village of Slinger	1990	2.00 ^c	1" = 200'	Yes	Yes	No

^aIncludes only most recent mapping. Original mapping may have been updated by the same or other agencies.

^bDigital mapping; base sheets can be readily generated.

^cIncludes an area of 0.50 square mile mapped under both City of Hartford and Village of Slinger sponsored programs.

Source: SEWRPC.

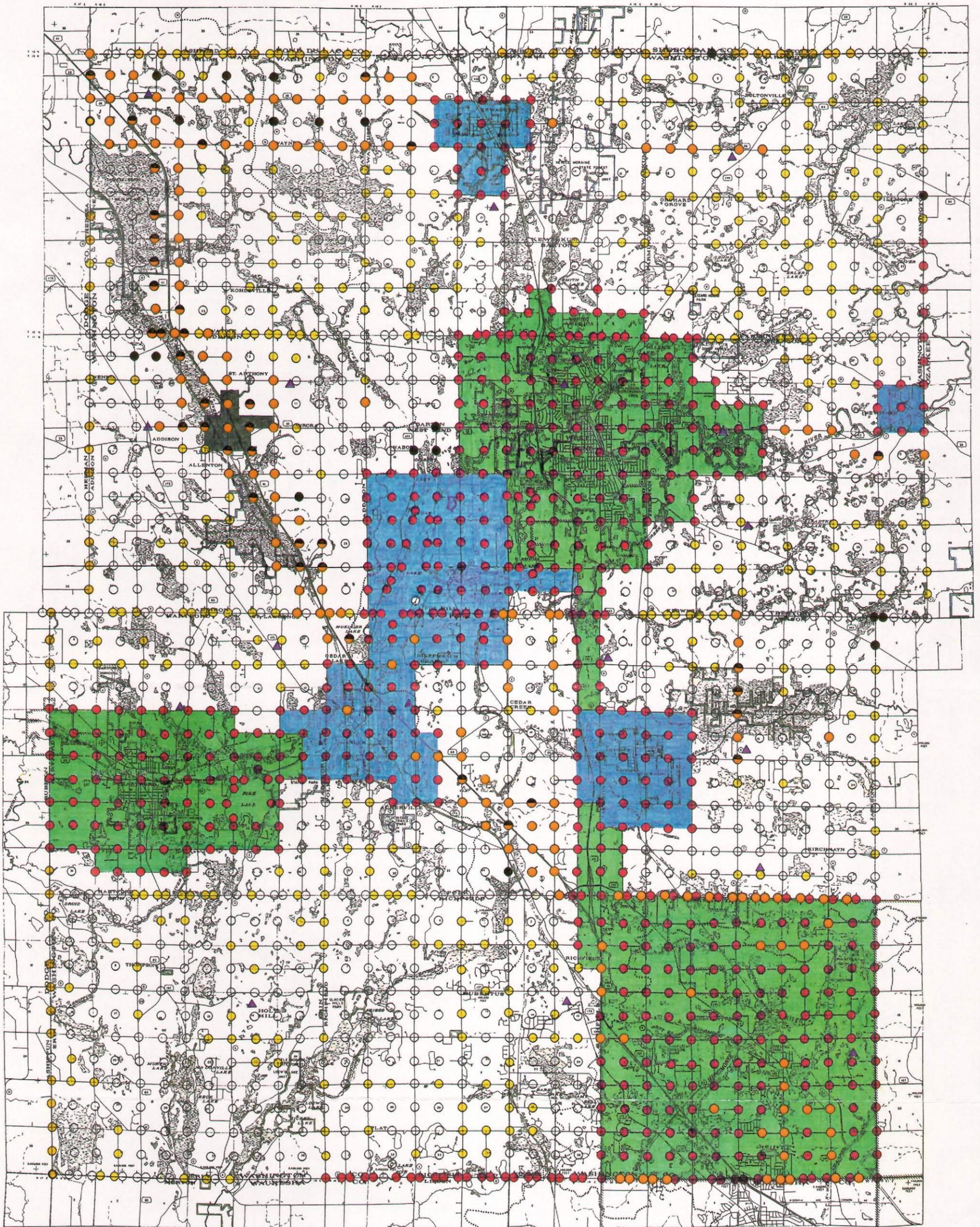
In addition to the foregoing mapping projects, the Wisconsin Department of Transportation, as part of a project involving the reconstruction of the interchange of STH 33 with USH 41, carried out a large-scale topographic mapping program to Commission-recommended specifications. The map sheets were prepared, however, largely for areas that comprise less than whole U. S. Public Land Survey sections.

Each of the base mapping programs identified in Table 1, including the Wisconsin Department of Transportation STH 33/USH 41 mapping program, involved the relocation and monumentation of U. S. Public Land Survey corners, together with the establishment of horizontal and vertical survey control for such corners. In addition, mapping programs in neighboring Ozaukee and Waukesha Counties have accom-

plished monumentation and survey control work attendant to U. S. Public Land Survey corners located along common boundaries with Washington County. Other programs conducted by the Wisconsin Department of Transportation and the Washington County Surveyor have contributed significantly to the U. S. Public Land Survey corner monumentation and control survey program in Washington County.

The status of that corner monumentation and control survey program is summarized in Table 2 and on Map 1. There is an estimated total of 2,005 U. S. Public Land Survey section and quarter section corners in Washington County, including the centers of the sections. The collective efforts of the units and agencies of government concerned as described above have resulted in a total of 593 corners, or nearly

STATUS OF LAND AND CONTROL SURVEY NETWORK AND
LARGE-SCALE MAPPING IN WASHINGTON COUNTY: NOVEMBER 1991



LEGEND

U. S. PUBLIC LAND SURVEY CONTROL NETWORK

- CORNER NOT RECOVERED
- CORNER RECOVERED
- CORNER RECOVERED; HORIZONTAL CONTROL ESTABLISHED
- CORNER RECOVERED AND MONUMENTED
- CORNER RECOVERED AND MONUMENTED; HORIZONTAL CONTROL ESTABLISHED
- CORNER RECOVERED AND MONUMENTED; HORIZONTAL AND VERTICAL CONTROL ESTABLISHED
- ▲ USC & GS TRIANGULATION OR TRAVERSE STATION

LARGE-SCALE PLANIMETRIC AND TOPOGRAPHIC MAPPING

- MAP SHEETS COMPILED BY U. S. PUBLIC LAND SURVEY ONE-QUARTER SECTION; 1" = 100' SCALE, 2' CONTOUR INTERVAL
- MAP SHEETS COMPILED BY U. S. PUBLIC LAND SURVEY ONE-QUARTER SECTION; 1" = 200' SCALE, 2' CONTOUR INTERVAL
- MAP SHEETS UNRELATED TO U. S. PUBLIC LAND SURVEY SYSTEM; 1" = 100' SCALE, 2' CONTOUR INTERVAL

Source: Washington County Surveyor and SEWRPC.

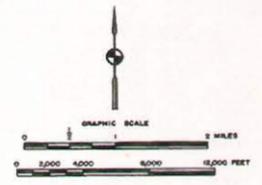


Table 2

STATUS OF U. S. PUBLIC LAND SURVEY CORNER MONUMENTATION AND CONTROL SURVEY PROGRAM IN WASHINGTON COUNTY: NOVEMBER 1991

Item	Amount
Estimated Total Corners ^a	2,005
Corners Relocated and Monumented and Horizontal and Vertical Control Established by:	
Southeastern Wisconsin Regional Planning Commission	141
Bordering Counties	38
Local Governments	414
Total	593
Percent of Total Corners	29.6
Corners Relocated and Monumented and Horizontal Control Established by:	
Wisconsin Department of Transportation	88
Southeastern Wisconsin Regional Planning Commission	8
Washington County	17
Bordering Counties	3
Local Governments	44
Total	160
Percent of Total Corners	8.0
Corners Relocated and Horizontal Control Established by:	
Wisconsin Department of Transportation	27
Washington County	6
Total	33
Percent of Total Corners	1.6
Corners Relocated and Monumented ^b	410
Percent of Total Corners	20.4
Corners Relocated	19
Percent of Total Corners	0.9
Summary	
Corners Relocated and Monumented	1,163
Percent of Total Corners	58.0
Corners with Horizontal Control	786
Percent of Total Corners	39.2
Corners with Vertical Control	593
Percent of Total Corners	29.6

^aIncludes all corners along boundary counties.

^bMost of these corners were monumented by the Washington County Surveyor. Some of these corners were monumented by bordering counties and by WisDOT.

Source: SEWRPC.

30 percent of the total of all such corners in the County, having been relocated, monumented, and placed on the State Plane Coordinate System to Commission specifications, including the establishment of elevations for the corners and for attendant reference benchmarks. An additional 160 corners have been relocated, monumented, and placed on the State Plane Coordinate System, but elevations have not been, as yet, obtained for the corners. The Wisconsin Department of Transportation and the Washington County Surveyor have relocated 33 additional corners and have established horizontal control for these corners; however, these 33 corners have not as yet been monumented. A total of 410 additional corners have been relocated and monumented by the Washington County Surveyor and the county surveyors of bordering counties. Finally, a total of 19 corners have been relocated by the County Surveyor, but have yet to be monumented.

In summary, then, 1,163 corners, or about 58 percent of all corners in the County, have been relocated and monumented. Horizontal control data and attendant State Plane Coordinates have been established for 786 corners, or about 39 percent of the total. Vertical control data has been established for a total of 593 corners, or nearly 30 percent of the total.

While a great deal of work to establish a proper survey control network has been accomplished in Washington County, it is important to recognize also that there are continuing maintenance needs attendant to that network. U. S. Public Land Survey section and quarter-section monuments are disturbed, broken, and destroyed from time to time, and attention needs to be given to maintaining the system of monuments and survey control data that has been put in place. In recent years, such maintenance efforts have been undertaken with the assistance of the Regional Planning Commission on a systematic basis in the Hartford, Slinger, and West Bend areas of the County. A similar maintenance effort needs to be undertaken for the Village of Germantown. The Regional Planning Commission provides assistance to local governments in carrying out such maintenance programs.

The status of cadastral mapping in Washington County as of the end of 1991 is summarized on Map 2. Three communities—the Cities of Hartford and West Bend and the Village of German-

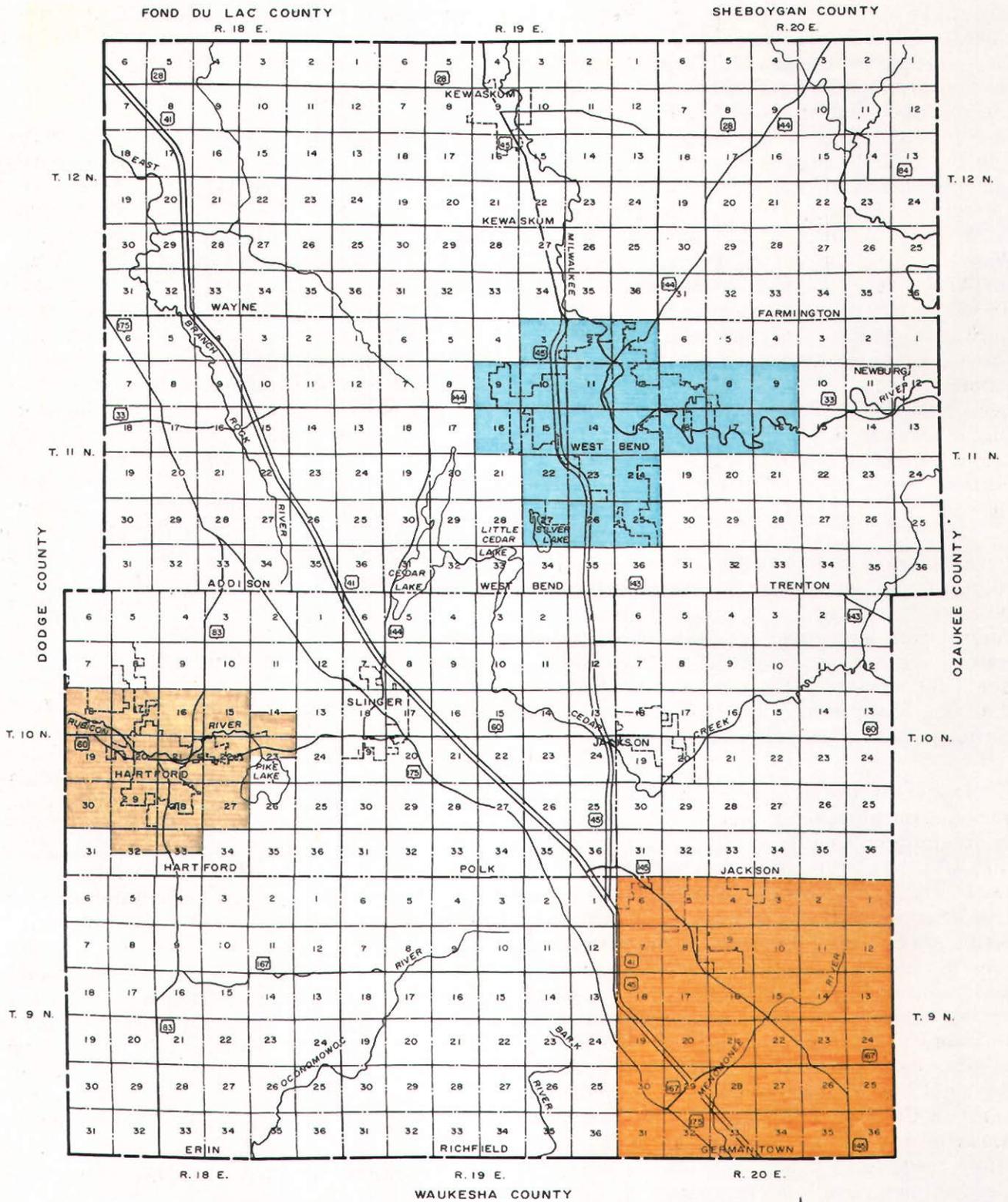
town—have established large-scale cadastral mapping programs. The status of these programs is summarized as follows:

1. City of Hartford
Using the cadastral base sheets which were derived from the aforereferenced large-scale topographic mapping effort, the City of Hartford has compiled cadastral maps at a scale of one inch equals 100 feet. To date, such maps have been completed for 14.25 square miles. The maps are kept current by the City Engineering staff. These maps should meet Commission-recommended specifications and need only be converted to digital form to provide the basis for an automated land information system.
2. City of West Bend
Using the geodetic control framework developed as part of the aforereferenced large-scale topographic base mapping program, the City of West Bend has compiled cadastral maps at a scale of one inch equals 200 feet for a total area of 23 square miles. These maps do not fully meet Commission-recommended specifications; however, it is believed that through additional augmentation work this mapping could meet those specifications and then be converted to digital form as the basis for an automated land information system.
3. Village of Germantown
Using the geodetic reference framework developed as part of the aforereferenced large-scale topographic mapping program in the Village, the Village has prepared cadastral maps for the entire 36-square-mile Village area at a scale of one inch equals 100 feet. For convenience, the Village had the original one inch equals 100 foot scale maps reduced and compiled to a set of one inch equals 200 foot scale maps, one for each U. S. Public Land Survey section. The Village maintains current the smaller scale set of maps.

At the present time then, the three large-scale cadastral mapping programs in Washington County have resulted in such maps being prepared for a total area of about 73.25 square miles, or nearly 17 percent of Washington County. None of those maps are presently available in digital form.

Map 2

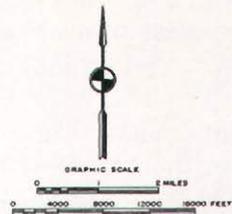
STATUS OF CADASTRAL MAPPING IN WASHINGTON COUNTY: 1991



LEGEND

- 1" = 100' COMPILATION SCALE; COMPOSITED TO 1" = 200' SCALE; MAINTAINED CURRENT AT 1" = 200' SCALE
- 1" = 100' COMPILATION SCALE
- 1" = 200' COMPILATION SCALE

Source: SEWRPC.



PARCEL IDENTIFICATION SYSTEMS IN WASHINGTON COUNTY

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. There are four separate parcel identification systems being used in Washington County at the present time (see Figure 8). Each of these systems is briefly described as follows:

1. City of Hartford

The format of the parcel identifier system in the City of Hartford is "AABBCC-DDDEEE." "AA" is a two-character numeric field that identifies the parcel as being located within the City of Hartford. The code number is "36." "BB" is a two-character numeric field that identifies the U. S. Public Land Survey section in which the parcel is located. "CC" is a two-character numeric field that identifies the quarter section in which the parcel is located. "DDD" is a three-character numeric code that identifies a block in which the parcel is located. "EEE" is a three-character numeric code that constitutes the basic parcel number.

2. City of West Bend

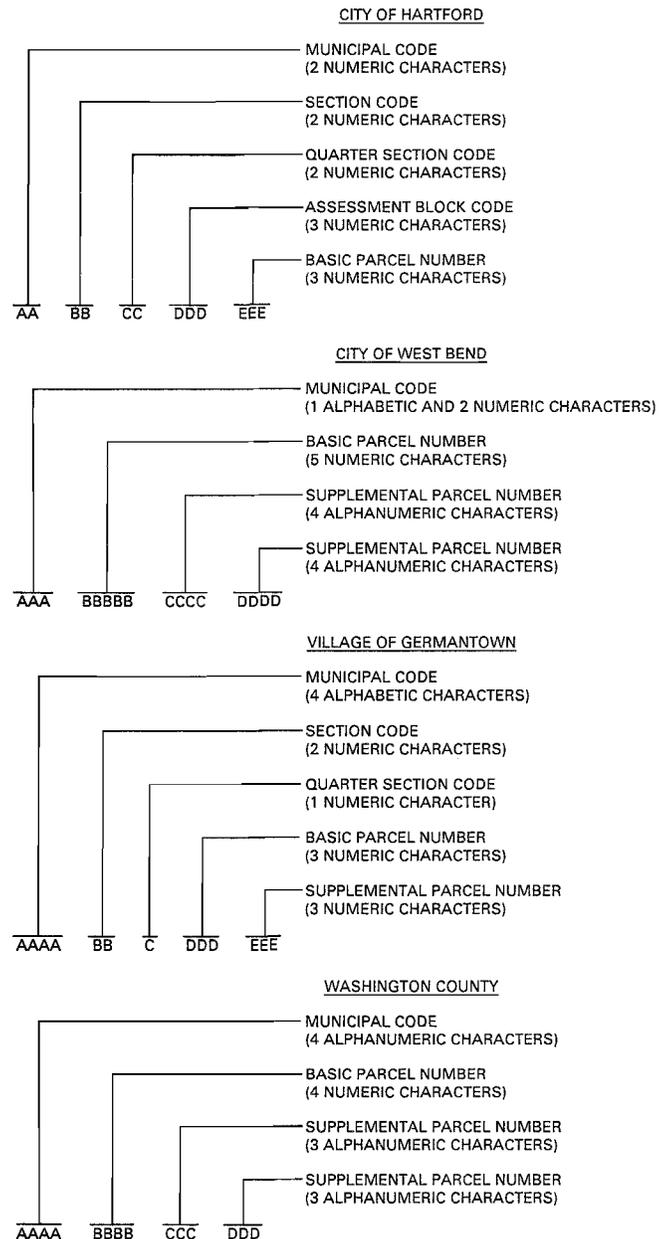
The format of the parcel identifier in the City of West Bend is "AAABBBBBCCCC-DDDD." "AAA" is a three-character field containing one alphabetic character and two numeric characters. This field identifies the parcel as being located in the City of West Bend. "BBBBB" is a five-character numeric field that constitutes the basic parcel number. "CCCC" is a four-character field that can be either alphabetic or numeric and identifies a redivision of the original parcel or, in cases involving condominiums, a building number or letter. "DDDD" is a second supplemental parcel identifier of four characters that are either alphabetic or numeric. The code is used to identify units within a condominium building.

3. Village of Germantown

The format of the parcel identifier in the Village of Germantown is "AAAABBC-DDDEEE." "AAAA" is a four-character

Figure 8

PARCEL IDENTIFICATION SYSTEM IN WASHINGTON COUNTY: 1991



Source: SEWRPC.

alphabetic field containing the municipal code for the Village of Germantown. "BB" is a two-character numeric field identifying the U. S. Public Land Survey section in which the parcel is located. "C" is a one-character numeric field identifying the U. S. Public Land Survey quarter section in which the parcel is located. "DDD" is a

three-character numeric field setting forth the basic parcel number. "EEE" is a three-character numeric field that is used to identify condominium units within a building.

4. Washington County

The format of the parcel identifier used by Washington County for the remaining local units of government in the County is "AAAABBBBCCDDDD." "AAAA" is a four-character field identifying the municipal code, using either alphabetic or numeric characters. "BBBB" is a four-character field identifying the basic parcel number. "CCC" is a three-character field that can be alphabetic or numeric and identifies either subsequent divisions of an original lot or a condominium building. "DDD" is a three character field that can be either alphabetic or numeric in nature used to identify condominium units within a building.

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 Washington County:

1. Completion of the Geodetic Reference Framework

The most basic need to be addressed in the Washington County land information system plan is the completion of the geodetic reference framework which combines the U. S. Public Land Survey and the State Plane Coordinate Systems. More particularly, a need exists to relocate and monument the remaining 842 U. S. Public Land Survey section and quarter-section corners, including centers of sections, that have not been relocated to date; to monument the 52 U. S. Public Land Survey corners that have previously been relocated, but not monumented, by the County Surveyor; to obtain horizontal survey control data for the 1,219 U. S. Public Land Survey corners for which such data

have not been obtained to date; and to obtain vertical survey control data for the 1,412 U. S. Public Land Survey corners for which such data have not been obtained to date.

2. Large-Scale Base Maps

A need exists to complete large-scale topographic base mapping throughout Washington County. As noted earlier in this chapter, large-scale topographic base maps have been prepared for about 112 square miles, or about 26 percent of the total area of Washington County. The remaining 324 square miles of the County need to be mapped. All such mapping must be available in digital form.

3. Cadastral Overlay

A need exists to prepare cadastral maps for the entire area of the County. Such maps should be prepared as "overlays" to the topographic maps in order to permit the accurate correlation of earth science and cadastral information. As noted earlier in this chapter, the Cities of Hartford and West Bend and the Village of Germantown have completed such cadastral maps. All cadastral mapping completed to date in the County, totaling about 73 square miles, must be reviewed for conformance with the recommended standards for cadastral mapping set forth in the following chapter of this report and, as necessary, the existing cadastral mapping should be enhanced to fully meet such standards and then converted to computer-readable form. In those cases where the standards cannot be met, the mapping should be redone over time. In addition, maps should be completed to the recommended standards for the remaining areas of Washington County, totaling about 363 square miles.

4. Parcel Number

A need exists to assign common parcel identifiers to all real property ownerships in order to facilitate the storage and retrieval of various parcel-related data. The existing parcel identification systems in Washington County need to be reviewed and revised with reference to the data interchange standard attendant to parcel numbering systems promulgated by the Wisconsin Land Information Board.

5. Land Information Files

A need exists to create a series of land information files containing information related to the topographic and cadastral maps through the parcel identifiers. Such files may provide data on, among others, soils, flood hazard, land use, zoning, ownership, and valuation. In addition to the files already created by Washington County and referenced earlier in this chapter, new files may be created and, as appropriate, graphic representation of the data made possible.

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 Washington 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 cadastral 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 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 both the U. S. Public Land Survey System and the State Plane Coordinate System. The large-scale maps and related 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 cadastral within the Region, furnishing the first two of the five elements of such a cadastre and a part of the third element.

3. Through large-scale topographic mapping programs conducted by the Cities of Hartford and West Bend; the Villages of Germantown, Jackson, Kewaskum, and Slinger; and the Regional Planning Commission, topographic maps at scales of either one inch equals 100 feet or one inch equals 200 feet, with a two-foot contour interval, have been prepared to Commission-recommended specifications for about 112 square miles, or about 26 percent, of the area of Washington County. Each of the projects so carried out included the relocation, monumentation, and placement on the State Plane Coordinate System of those U. S. Public Land Survey corners included in the mapped area. Within the context of the conceptual framework of a multipurpose cadastre, then, two of the five elements, geodetic reference framework and large-scale base maps, have been completed for substantial portions of Washington County.
4. There are an estimated total of 2,005 U. S. Public Land Survey section and quarter-section corners in Washington County, including the centers of the sections. Taking into account surveying and map-

ping efforts conducted by the units and agencies of government operating in Washington County, a total of 593 corners, or nearly 30 percent of all such corners in the County, have been relocated, monumented, and placed on the State Plane Coordinate System to Commission specifications. An additional 160 corners have been relocated, monumented, and placed on the State Plane Coordinate System, but without vertical control; an additional 33 corners having been relocated and placed on the State Plane Coordinate System, but without monumentation. A total of 410 additional corners have been relocated and monumented; 19 additional corners have been relocated but not yet monumented. In summary, then, 1,163 corners, or about 58 percent of all corners in the County, have been relocated and monumented. Horizontal control data in the form of State Plane Coordinates have been obtained for 786 corners, or about 39 percent of the total. Vertical control data have been obtained for a total of 593 corners, or nearly 30 percent of the total.

5. Large-scale cadastral mapping efforts have been undertaken by the Cities of Hartford and West Bend and the Village of Germantown. Together, these maps encompass an area of about 73 square miles, or nearly 17 percent of the total area of the County. All the mapping completed to date will have to be reviewed to ensure that such mapping meets the specifications recommended by the Regional Planning Commission. It is believed that most of the work completed to date, should it not meet such standards, could be enhanced to meet the full set of recommended specifications. Once these specifications are met,

such mapping must be converted to digital form to provide the basis for an automated land information system.

6. There are four separate parcel numbering systems used in Washington County. The Cities of Hartford and West Bend and the Village of Germantown administer their own systems within their municipal jurisdictional limits. Washington County administers a system applicable to the remaining local units of government in the County. The systems administered by the City of Hartford and Village of Germantown relate parcels to the U. S. Public Land Survey one-quarter section; the systems operated by the City of West Bend and Washington County do not relate parcels to the quarter section in which they are located.
7. The basic needs to be addressed in the Washington County land information system plan include the completion of the geodetic reference framework to provide the foundation for an automated land information system; the completion of large-scale topographic base maps throughout the County; the completion of cadastral maps throughout the County, including any necessary enhancement of existing cadastral mapping; the conversion of all map data to computer-readable form; the review and revision as may be necessary of the individual parcel numbering systems in the County to ensure that they meet the standards promulgated by the Wisconsin Land Information Board; and the creation of land information files related to the topographic and cadastral maps through the parcel identifiers.

Chapter IV

RECOMMENDED AUTOMATED MAPPING AND LAND INFORMATION SYSTEM FOR WASHINGTON 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 Washington 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 Washington County. The elements of such a system have been identified and the status of implementation of those elements within Washington County has been reported.

This chapter sets forth a recommended automated mapping and land information system plan for Washington 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 begin to continue building the land information system, including consideration of system development costs and sources of potential revenue; and proposed organizational arrangements to carry out that program.

PROGRAM GOALS AND OBJECTIVES

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

1. To implement in Washington County, over time, a multipurpose, multi-user, parcel-based, 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 Washington County, the local units of government in Washington County, and the various public and private utilities operating in Washington 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 entry, retrieval, and exchange of data by and 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 focus available fiscal resources on efforts to continue the development of the geodetic reference framework throughout the entire County, and to revise the parcel identification system in the County in accordance with the guidelines for parcel numbering systems set forth by the Wisconsin Land Information Board.
2. To encourage local units of government in Washington County who desire to move at a more rapid pace toward establishing new, or refining existing, automated mapping and land information systems 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.
3. To facilitate applications by Washington County and by local units of government in Washington County for state grants in support of the development of the recom-

mended automated mapping and land information system for Washington County.

4. 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 Washington County.

PLANNING PERIOD

The planning period for this initial land information system plan for Washington County is the five-year period beginning January 1, 1992, and extending through December 31, 1996. The end of the planning period generally corresponds with the expiration of the current state law regarding the Wisconsin Land Information Program and the funding of that program through supplemental Register of Deeds recording and filing fees.

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 sys-

tems 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 Washington County assume that the following set of elements would be developed for joint use: a survey control network, large-scale topographic base maps, and a cadastral map overlay with parcel identifiers. Discussions held over the past several years among local operators of automated mapping systems indicate 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, tax assessment, and various types of statistical analyses, among others. It is envisioned, however, that 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 agreed-upon system is 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 Washington 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 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 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 that the Commission-recommended survey control network and large-scale topographic base maps already exist throughout a large portion of Washington County, and that such data are already being utilized by units of government and certain utilities in both analog and digital mapping. Accordingly, this program should be pursued over time in the remainder of Washington County, and it should be considered the standard for common use.

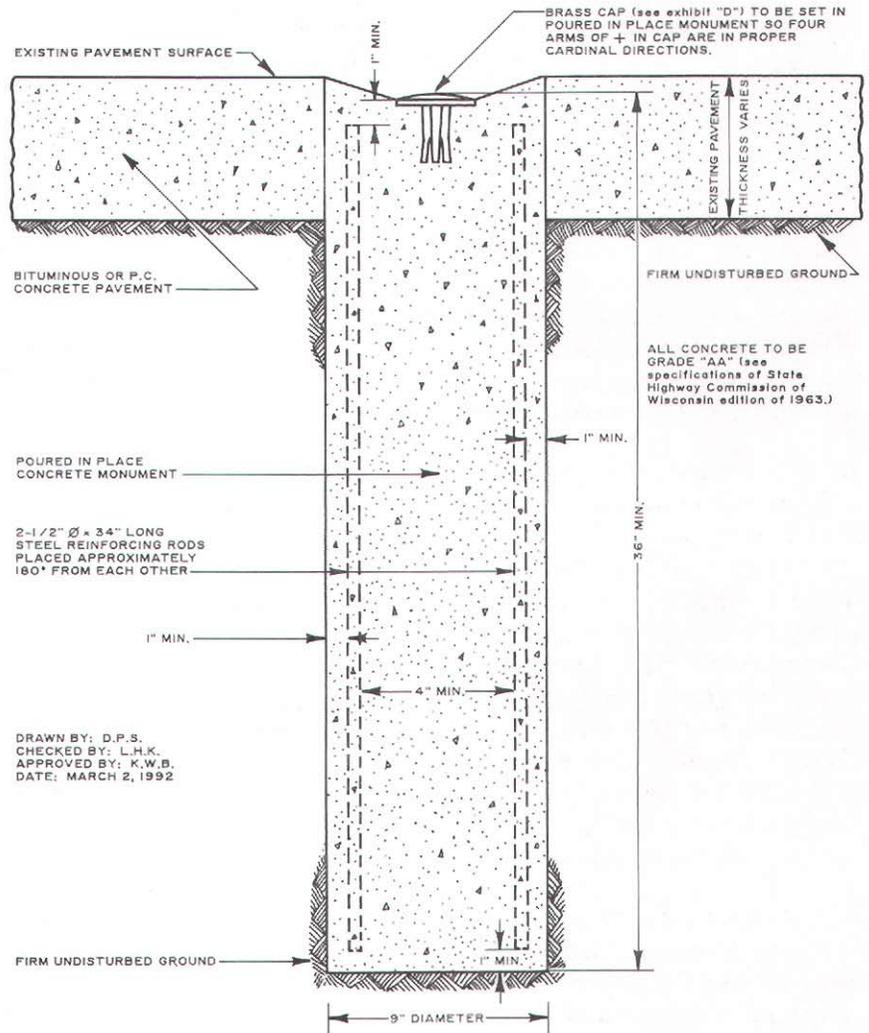
Control Surveys: The horizontal control survey work to be completed in Washington County should include the recovery, or relocation, and monumentation of the 842 U. S. Public Land Survey corners not previously recovered or relocated and monumented, including section and quarter-section corners and centers of sections; as well as the monumentation of the 52 U. S. Public Land Survey corners that have previously been relocated but not yet monumented by the County Surveyor. The specifications for the relocation and monumentation of U. S. Public Land Survey corners recommended by the Regional Planning Commission and documented in Chapter III of this report are

incorporated by reference herein as the specifications for work in Washington County, subject to the supplemental specifications for monument installations in the traveled way of streets and highways and in shallow or unstable ground (see Figures 9 and 10).

Subsequent to the recovery or relocation and monumentation of the U. S. Public Land Survey 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 between, 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. In some cases, the use of Global Positioning System technology to establish coordinate values may be more cost-effective than traversing and should accordingly be utilized. Such horizontal survey control work needs to be completed for 1,219 corners in Washington County.

The vertical control survey work to be completed 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 eventually 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

Figure 9
DETAIL OF ALTERNATIVE CONTROL SURVEY MONUMENT (POURED IN PLACE) INSTALLATION IN SURFACE TRAVELED WAY OF STREETS AND HIGHWAYS



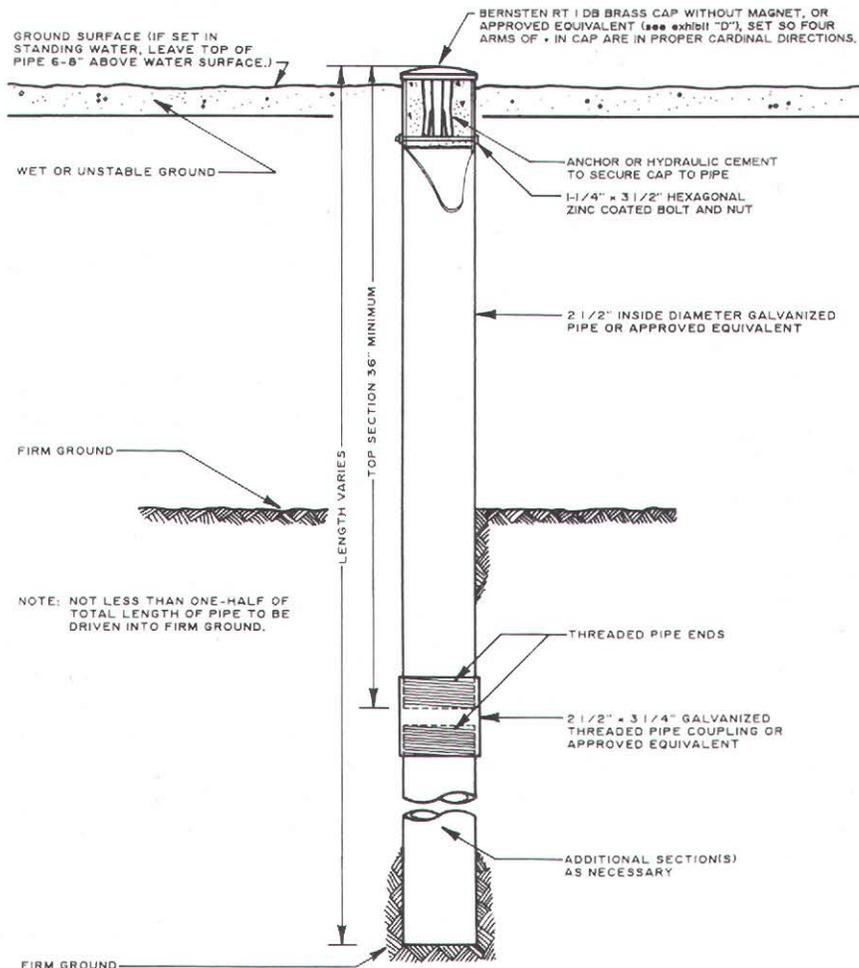
Source: SEWRPC.

for the monuments marking the section, quarter-section, and center of section corners throughout the areas remaining to be mapped, and these monuments should serve as permanent bench marks, each monument being supplemented by at least one reference bench mark. Such vertical control survey work needs to be completed for 1,412 corners in Washington County.

Large-Scale Topographic Base Maps: For those areas of Washington County where large-scale base maps have yet to be prepared, such maps should be acquired in digital form. The digital map files should be prepared to National

Figure 10

**DETAIL OF ALTERNATIVE CONTROL SURVEY MONUMENT
INSTALLATION IN SHALLOW WATER OR UNSTABLE GROUND**



Source: SEWRPC.

Map Accuracy Standards at a scale of 1:2400 (one inch equals 200 feet). 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 will be in error by more than a full contour interval.

In some cases, local communities may desire to undertake large-scale base mapping at a scale of 1:1200 (one inch equals 100 feet). Local governments in Washington County desiring to obtain topographic maps at this larger scale should be encouraged to do so. As a matter of policy, Washington County should encourage such large scale base mapping through a cost sharing program whereby the County would share the cost of the base mapping effort with the requesting local government.

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.
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 are shown on the maps.

In addition to ultimately obtaining in digital form new topographic base maps for all areas of Washington County not yet so mapped, those large-scale maps prepared by local governments in the County and by the Regional Planning Commission in past years in conventional form should be converted to an automated format through both 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, the Cities of Hartford and West Bend and the Village of Germantown have prepared cadastral maps for portions of the County, although not all of this mapping fully meets the specifications set forth below, and none of the mapping is presently in digital form.

Each cadastral map should cover one U. S. Public Land Survey Section at a scale of 1:2400. In those cases where base mapping is obtained at a scale of 1:1200, the cadastral overlay map should also be prepared at that scale, and each cadastral map would cover one U. S. Public Land Survey quarter section. 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 likewise should 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 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 Third Order, Class I 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 should 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 is to 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. Parcel identification numbers.

For all properties other than those contained in a recorded subdivision plat or certified survey map, the following map annotation is to 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. Parcel identification numbers.

Once the cadastral maps are completed, they are ready for digitization. All line features are digitized directly from the cadastral maps. Textual information, including the parcel identification number, is key entered from the cadastral maps and placed in its approximate location on the digital maps.

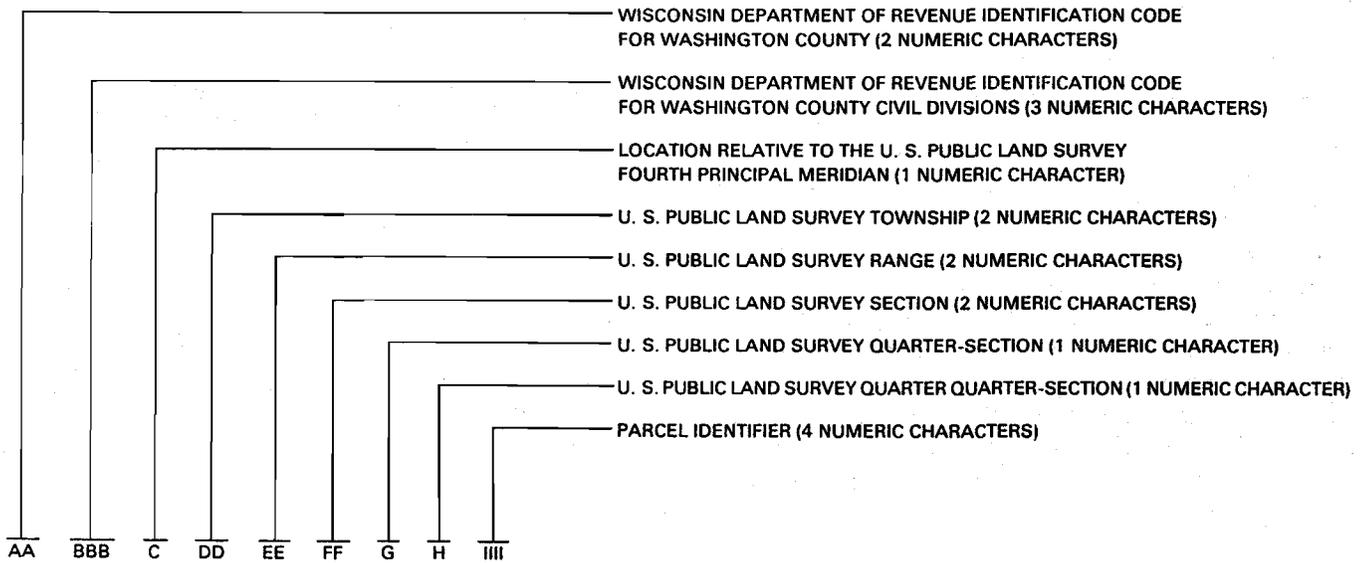
With respect to those cadastral maps already prepared by the Cities of Hartford and West Bend and the Village of Germantown, such maps need to be reviewed to determine the extent to which the maps do not meet the above specifications. Such review should determine the effort needed to enhance the existing cadastral mapping to meet such specifications.

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 schemes utilized in Washington County were described in Chapter III. The current systems do not locate each parcel to the U. S. Public Land Survey quarter-quarter section as recommended by the Wisconsin Land Information Board. Accordingly, it is proposed that the current Washington County parcel identification numbering systems be converted to the parcel identification numbering system proposed by the Wisconsin Land Information Board. This parcel identification numbering system utilizes certain components of the Wisconsin Department of Revenue parcel numbering system as set forth in the 1990 Department of Revenue publication, Property Assessment Manual. This system is related to the U. S. Public Land Survey System (USPLS). The parcel identification numbering system consists of an eighteen-character identifier made up of nine discrete fields. Only numeric charac-

Figure 11

RECOMMENDED WASHINGTON COUNTY PARCEL IDENTIFICATION NUMBERING SYSTEM



Source: SEWRPC.

ters are used and zeros are used in lieu of blanks. The format of the parcel identifier, as shown in Figure 11, is "AABBBCDDEEFFGHIIII".

"AABBB" is a five-character, two-field, sequence that identifies the county and minor civil division in which the parcel is located. Both the county code "AA" and the minor civil division code "BBB" are identified in the 1990 Wisconsin Department of Revenue publication, Property Assessment Manual.

"CDDEEFFGH" is a nine-character, six-field, sequence that identifies the location of the parcel with reference to the U. S. Public Land Survey System (USPLS). "C" locates the parcel relative to the Fourth Principal Meridian of the USPLS, with the number "2" indicating a parcel located east of the meridian and the number "4" indicating a parcel located west of the meridian. All of Washington County is located east of this meridian. "DDEE" establishes the USPLS township in which the parcel is located, with "DD" is the number of townships north of the USPLS base line, in this case the Wisconsin-Illinois border, and "EE" is, in the case of Washington County, the number of townships east of the Fourth Principal Meridian. "FF" identifies the USPLS section in which the parcel is located. "G" identifies the quarter-section in

which the parcel is located, with "1" indicating the northeast quarter, "2" indicating the northwest quarter, "3" indicating the southwest quarter, and "4" indicating the southeast quarter. "H" is an optional field in the Wisconsin Land Information Board system which Washington County can consider using. This field identifies the quarter quarter-section in which the parcel is located where "1" indicates the northeast quarter of the quarter-section, "2" indicating the northwest quarter of the quarter-section, "3" indicating the southwest quarter of the quarter-section, and "4" indicating the southeast quarter of the quarter-section.

"IIII" is the basic parcel number, which is unique within the USPLS quarter quarter-section.

This sequence of 18 characters provides for the unique identification of a parcel within both Washington County and the State of Wisconsin. The use of this system is recommended as the standard for Washington County's land information system.

Property Ownership and Assessment Records

The property ownership and property tax assessment records maintained by Washington County already exist as computer-readable files. These files contain such information as an abbreviated

legal description, owner's name and mailing address, acreage of the property if available, and assessed value of the land and any improvements to that land. These records can be readily integrated into an automated mapping and land information system in Washington County utilizing a 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 from the digital map files to the existing computer files of ownership and assessment records for the purpose of "reading" them.

While the property ownership records are presently computer-readable, the design of the system regarding the way in which the name and address files are structured, as well as a lack of consistency in how names and addresses are entered into the computer file, creates certain problems in the use of that file particularly in connection with sorting for various types of mailings and communications. These problems result in costly, duplicative mailings. To eliminate these problems will require modifications to the design of the system and the development of standards for consistency in entering name and address data into the file, which should eventually be linked to the parcel identifier of the automated cadastral map.

Soil Unit Maps

Digital soil unit maps already exist for all of Washington 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 proposed for Washington County, they are already "integrated" with the other land information being specified for that system.

Land Use

Digital historic and current land use information for Washington County already exists for the entire 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 1985. These maps are currently being 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 proposed for the Washington 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 base mapping process and in 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, the limits of the 100-year recurrence interval floodplains can be delineated by the Regional Planning Commission on the large-scale topographic base maps based upon flood profiles prepared by the Commission as a part of its watershed planning programs. This information would then need to be digitally captured. Through the application of the statutory definition, the limits of shorelands in Washington County on the large-scale topographic base maps should also be determined and digitally encoded.

Other Information Layers

When the automated mapping base is fully developed for Washington County, it should be expected that Washington County Departments will begin developing information layers to take advantage of the capabilities of the automated land information system. The development of an information layer, however, requires that a link be maintained between the data included in the information layer, which can be graphically displayed, and a particular Washington County file or record of activity. That link is the parcel identification number.

One example of a useful information layer would be the graphic display of those parcels for which Washington County has issued a sanitation permit that involves a sewage holding tank. The land information system would, for example, permit a rapid inquiry as to the location and geographic distribution of holding tank permits in the area draining to a particular water resource such as Big Cedar Lake. The system

would show graphically not only the location of those parcels in relation to each other and to Big Cedar Lake, but would also permit the inquirer to readily obtain a list of file numbers where more detailed information on each holding tank permit could be obtained. If Washington County were also to install a document imaging system as a supplement to the land information system, the inquirer could "call up" the individual documents in the county file for viewing on a computer screen. Thus, a land information system, particularly when combined with a document imaging system, eliminates much tedious and time-consuming work involved in responding to data inquiries.

The foregoing example is but one of many that could be cited to illustrate the potential use of an automated land information system. Within the Land Use and Park Department, additional information layers could relate to floodplain zoning permits and shoreland zoning permits. Within the Land Conservation Department, such information layers could relate to cropping practices, conservation practices, and soil erosion potential. The County Sheriff could use such a system to graphically display and analyze traffic accident and other types of law enforcement activity. The County Treasurer could develop an information layer attendant to tax delinquent properties. The possibilities for developing such information layers to assist County Departments in their day-to-day work are virtually limitless.

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 Washington 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 is intended to apply to map feature elements rather than to data that may relate to map features. The National Research Council model, proposed as the model to guide the creation of the recommended automated mapping system for Washington 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.

COST ESTIMATES TO CREATE THE RECOMMENDED AUTOMATED MAPPING AND LAND INFORMATION SYSTEM BASE FOR WASHINGTON COUNTY

While recognizing that the fiscal resources available for land records modernization will be limited and that the development of the recommended automated mapping base for Washington County will require a period of time longer than the five-year planning period selected for this report, the Washington County Land Information Board desired that cost estimates attendant to the creation of the entire base be included in the plan document. In this way, all parties concerned will have a good understanding of the capital investment required to complete an automated mapping base that is suitable for a multi-user environment of the most demanding kind. Accordingly, Table 3 summarizes the cost of completing the recommended automated mapping base for Washington County, taking into account the geodetic reference framework, base mapping, and cadastral mapping work completed to date in the County as reported in Chapter III. These costs do not, however, include such commonly desired overlays as zoning or school or election district boundaries.

The estimated cost of completing the entire automated mapping base in Washington County approximates \$3.8 million. Of this total, about \$1.5 million, or 40 percent, is required to complete the geodetic reference framework, including the recovery or relocation and monumentation of

public land survey corners and the establishment of State Plane Coordinates and vertical elevations for those corners; about \$1.6 million, or an additional 41 percent, is required to prepare in digital form one inch equals 200 feet scale topographic base maps for about 324 square miles within the County that have not yet been so mapped, and to convert the existing topographic base mapping in the County, which approximates 69 square miles, to digital form; and the remaining \$0.7 million, or 19 percent, is required to enhance existing cadastral maps covering about 73 square miles to meet the recommended standards and to compile new digital cadastral maps for about 363 square miles.

POTENTIAL SOURCES OF REVENUE TO SUPPORT PROGRAM

There appear to be four potential sources of revenue that could be used to support the work efforts needed to build the recommended automated mapping and land information system base for Washington County. These four sources are:

1. Register of Deeds Filing and Recording Fees

By the end of the five-year planning period in 1996, it is estimated that a total of about \$371,900, or about \$74,390 annually, will become available to Washington County from the State-mandated supplemental Register of Deeds recording and filing fees (see Table 4). This includes the fees that have been accumulated through January 1, 1992, by Washington County, which total nearly \$75,000, plus estimated receipts for the years 1992 through 1996. The estimates assume that the average number of recordings and filings that occurred over the period 1985 through 1991 will continue over the next five years. The total number of recordings is estimated at about 16,500 annually.

The number of annual recordings subject to document filing fees may be expected to vary with changes in the national and local economies, interest rates, tax legislation, and in urban and rural land market activity. Experience in Southeastern Wisconsin indicates that fluctuations of about 10 percent more or less than the

Table 3

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

Program Element	Description of Work Needed to be Completed	Average Unit Cost of Work	Total Cost to Complete Work
Geodetic Reference Framework	Recover as necessary and monument 894 U. S. Public Land Survey corners	\$275 per corner ^a	\$ 245,850
	Establish state plane coordinates for 1,219 U. S. Public Land Survey corners	\$650 per corner	792,350
	Establish vertical elevations for 1,412 U. S. Public Land Survey corners	\$350 per corner	494,200
	Subtotal	--	\$1,532,400
Large-Scale Base Maps	Prepare digital 1" = 200' scale topographic base maps for 324 square miles	\$4,100 per square mile	\$1,328,400
	Convert planimetric features of existing 1" = 200' scale topographic base maps to digital form for 30 square miles	\$500 per square mile	15,000
	Convert planimetric features of existing 1" = 100' scale topographic base maps to digital form for 39 square miles	\$750 per square mile	29,250
	Convert hypsometry of existing 1" = 200' scale topographic base maps to digital form for 30 square miles	\$2,000 per square mile	60,000
	Convert hypsometry of existing 1" = 100' scale topographic base maps to digital form for 39 square miles	\$3,000 per square mile	117,000
	Subtotal	--	\$1,549,650
Cadastral Maps	Enhance existing 1" = 100' scale cadastral maps in the Village of Germantown for 36 square miles containing 5,690 parcels and convert to digital form	\$12.50 per parcel	\$ 71,125
	Enhance existing 1" = 100' scale cadastral maps in the City of Hartford for 14 square miles containing 2,645 parcels and convert to digital form	\$12.50 per parcel	33,063
	Convert and enhance existing 1" = 200' scale cadastral maps in the City of West Bend to 1" = 100' scale for 23 square miles containing 7,662 parcels and convert to digital form	\$15.00 per parcel	114,930
	Compile 1" = 200' scale digital cadastral maps for 363 square miles containing 27,873 parcels	\$17.50 per parcel	487,778
	Subtotal	--	\$ 706,896
--	Total	--	\$3,788,946

^aDoes not include the costs associated with the in-kind contributions of the Washington County Highway Department crews and equipment.

Source: SEWRPC.

Table 4

ANTICIPATED REVENUE FROM RETAINED REGISTER OF DEEDS RECORDING AND FILING FEES IN WASHINGTON COUNTY: 1992-1996

Year	Amount
Accumulated Fund Balance:	
January 1, 1992	\$ 74,938
Estimated Receipts: 1992	66,000
Estimated Receipts: 1993	66,000
Estimated Receipts: 1994	66,000
Estimated Receipts: 1995	66,000
Estimated Receipts: 1996	33,000
Total	\$371,938
Average Annual Revenue: 1992-1996	\$ 74,390

NOTE: The estimated receipts assume an average annual rate of 16,500 document filings over the period 1992-1996. This rate approximates the average annual number of filings over the period 1985-1991.

Source: SEWRPC.

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.

2. State Grants from Wisconsin Land Information Board

Upon approval of the Washington County land information system plan, Washington County will be eligible to apply for state grants of up to \$100,000 to support work program activities consistent with the plan. The state grant program has recently been activated and as presently structured provides two opportunities annually for eligible county and local governments to submit applications. As more and more county and local governments in the State become eligible for such monies, the competition for these grants is expected to become intense.

The Wisconsin Land Information Board has established a grant application review process that includes an evaluation and ranking of all applications submitted. The ranking is based upon a point scoring

system. Points are assigned based upon criteria that relate to categories of integration and cooperation as measured by the number of governmental units and agencies involved; the focus of the project on completing a foundational element of the plan; the consistency of the project with the adopted county land information system plan; the likelihood of project success as measured by the local funding commitment to the project, as well as by the performance of the applicant in completing projects; and the extent to which the project results in tangible completed end products. While Washington County is expected to become eligible to compete for such state grants, the work program should be structured in such a way as to not be dependent upon grant monies.

3. Contributions by Local Governments and Utilities

A third potential source of revenue to support the recommended Washington County work program consists of contributions by local governments in the County and by public and private utilities operating in the County. Depending upon the intensity with which a local government wishes to secure an operational automated mapping base for local planning, engineering, and other municipal purposes, that local government may be willing to commit local monies toward that end.

4. County Tax Levy

Washington County has not had a program focused on the preparation of large-scale topographic cadastral maps based upon the mapping specifications long recommended by the Regional Planning Commission. From time to time, Washington County has, however, provided fiscal support to the County Surveyor to undertake land survey work associated with large-scale mapping programs being carried out by cities and villages within Washington County. Early in 1992, the Washington County Surveyor secured a commitment from the County to make available regularly to that Office, over at least the next five years, \$25,000 annually in support of a program to recover or relocate and monument U. S. Public Land Survey section and quarter-section corners in the County. Accordingly, for the

purposes of this planning effort, a minimum of \$25,000 annually in Washington County tax levy monies may be assumed to be available for the land survey effort necessary to support completion of the geodetic reference framework element of the recommended automated mapping base for Washington County.

In addition to the \$25,000 annually to support remonumentation activities, the County has committed to \$10,000 annually to enable the County Surveyor to maintain properly the system of monuments once they are in place. It is envisioned that from this supplemental budget, the County Surveyor will be able to undertake not only routine monument maintenance work, but also remonumentation work on an as-needed basis in those portions of Washington County not specifically identified below for systematic completion of land survey work in the following work program.

PROPOSED WASHINGTON COUNTY WORK PROGRAM: 1992-1996

County Program to Continue Development of Geodetic Reference Framework

Given the limitations on the potential revenue sources cited in the foregoing section of this chapter, it is proposed that Washington County, over the five-year period 1992 through 1996, focus its available resources on work efforts to complete the required geodetic reference framework as a basic first step in developing an ultimate automated mapping base for the County. More specifically, it is proposed that the basic Washington County program consist of the following two elements:

1. The completion by the County Surveyor of the land survey work involving the recovery or relocation and monumentation of U. S. Public Land Survey section corners, using a county tax levy budget in the amount of \$25,000 annually. The specific areas to be targeted by the County Surveyor in each of the five years during the planning period are shown on Map 3. Based upon the land survey work remaining to be completed in these target areas, each area represents about \$25,000 worth of anticipated work effort. With this level of

effort, about 50 percent of the required land survey work could be completed over the five-year period.

2. The completion of the recommended horizontal and vertical control survey work within targeted areas in Washington County as shown on Map 4. This work would be supported with the retained Register of Deeds recording and filing fees which have been estimated to approximate \$74,390 annually over the five-year planning period. At the end of that period, about 29 percent of the required control survey work would be completed. This work would be accomplished by a qualified control survey engineer retained directly by Washington County or through the Regional Planning Commission acting as agent for the County.

The amount of work required in each of the five project areas shown on Maps 3 and 4 as expressed in terms of the number of U. S. Public Land Survey corners concerned is identified on Table 5. The combined land survey and control survey work program approximates \$100,000 annually, and, thus, represents a work effort of about \$0.5 million over the five-year planning period.

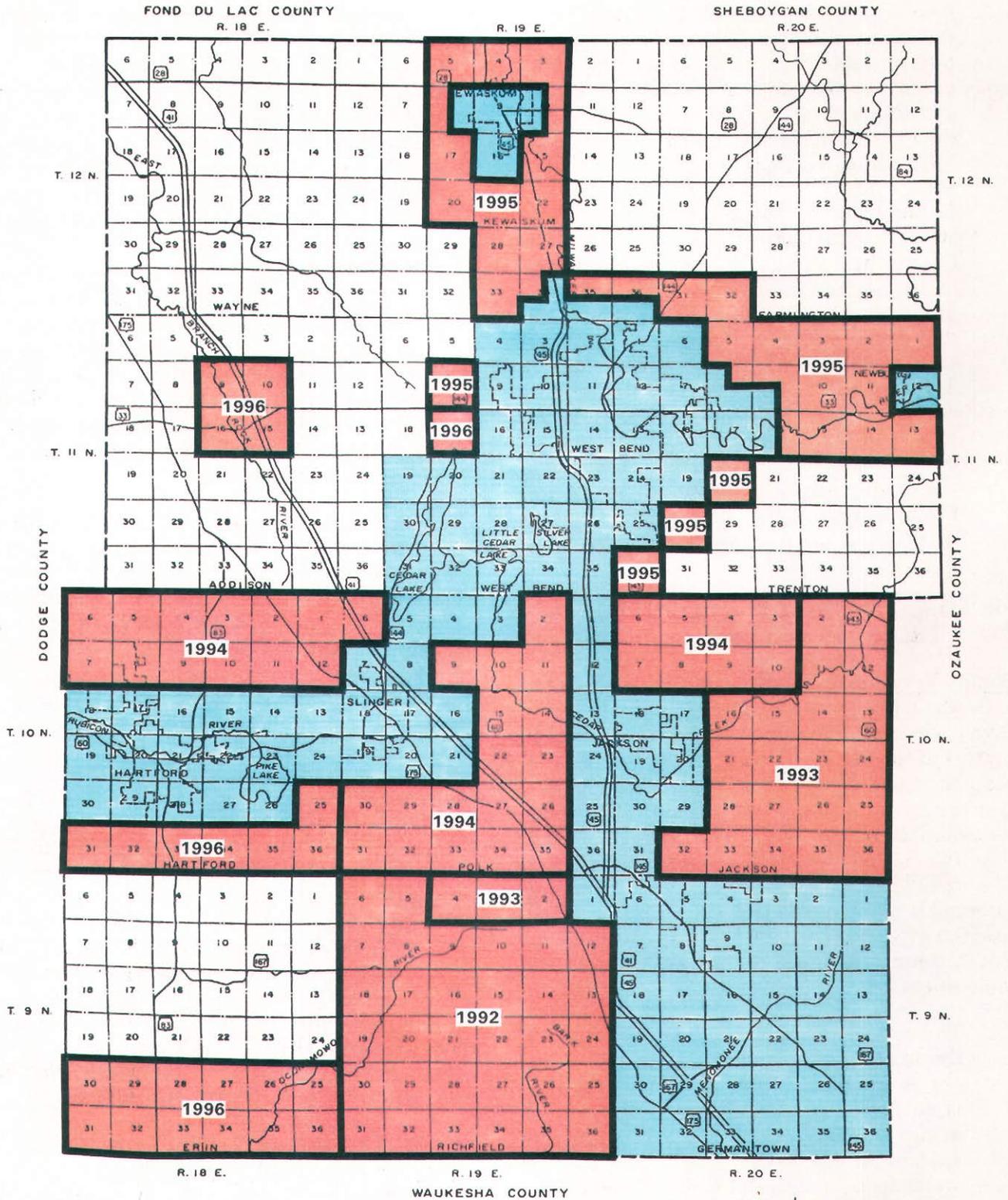
It is recommended that Washington County take advantage of every opportunity available during the planning period to apply for a state grant in support of the proposed work program. It is further recommended that such grant monies be targeted to additional combined land survey and control survey work efforts in accordance with the state grant program rules. Map 4 identifies those additional areas of Washington County for which state land information system grants should be sought; each of the five state grant priority areas shown on the map encompasses about \$100,000 worth of combined land and control survey work efforts (see Table 6).

Potential Local Programs to Complete Automated Mapping Base

It is recognized that over the five-year planning period one or more local units of government in Washington County may desire to proceed independently with completion of an automated mapping base for a portion of the County as the foundation of the land information system for that community. It is recommended that Wash-

Map 3

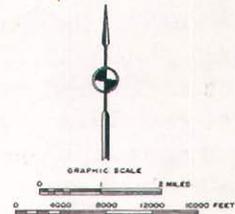
AREAS PROPOSED FOR COMPLETION OF LAND SURVEY WORK IN WASHINGTON COUNTY: 1992-1996



LEGEND

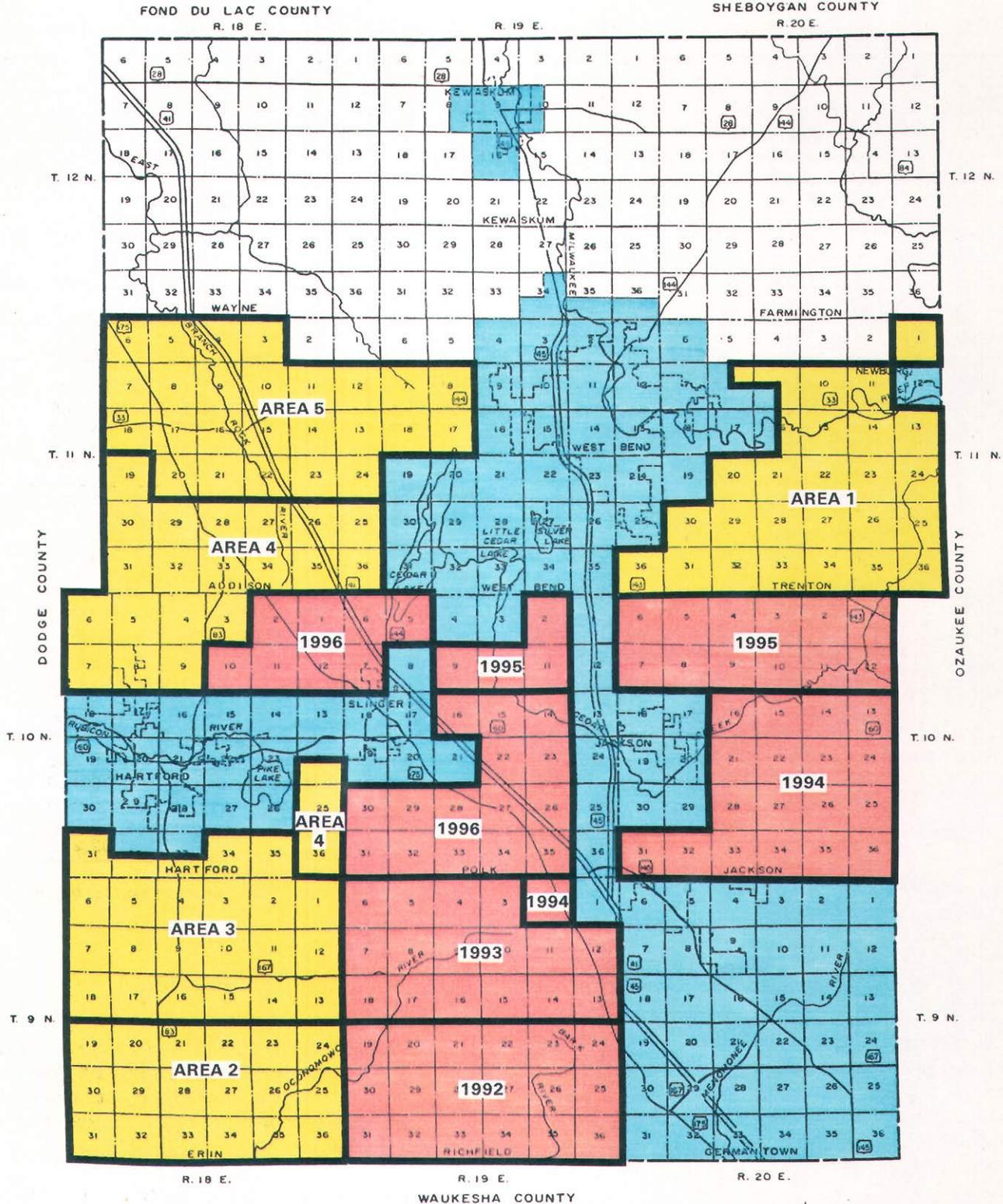
- AREA COMPLETED PRIOR TO 1992
- AREA PROPOSED TO BE COMPLETED WITH COUNTY SURVEYOR FUNDS

Source: SEWRPC.



Map 4

AREAS PROPOSED FOR COMPLETION OF CONTROL SURVEY WORK IN WASHINGTON COUNTY: 1992-1996



LEGEND

- AREA COMPLETED PRIOR TO 1992
- AREA PROPOSED TO BE COMPLETED WITH COUNTY LAND INFORMATION FUNDS
- AREA PROPOSED TO BE COMPLETED WITH POTENTIAL STATE GRANT FUNDS (LAND SURVEY AND CONTROL SURVEY)

Source: SEWRPC.

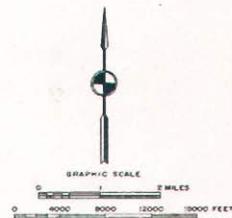


Table 5

PROPOSED WASHINGTON COUNTY REMONUMENTATION AND CONTROL SURVEY PROGRAM: 1992-1996

Year	Work Required (related to U. S. Public Land Survey corners)	Estimated Cost
1992	Relocate and monument 90 corners	\$ 24,750
	Establish State Plane Coordinates for 74 corners	48,100
	Establish vertical elevations for 75 corners	26,250
	Total	\$ 99,100
1993	Relocate and monument 92 corners	\$ 25,300
	Establish State Plane Coordinates for 75 corners.	48,750
	Establish vertical elevations for 78 corners	27,300
	Total	\$101,350
1994	Relocate and monument 95 corners	\$ 26,125
	Establish State Plane Coordinates for 71 corners	46,150
	Establish vertical elevations for 88 corners	30,800
	Total	\$103,075
1995	Relocate and monument 90 corners	\$ 24,750
	Establish State Plane Coordinates for 71 corners	46,150
	Establish vertical elevations for 84 corners	29,400
	Total	\$100,300
1996	Relocate and monument 92 corners	\$ 25,300
	Establish State Plane Coordinates for 63 corners	40,950
	Establish vertical elevations for 92 corners	32,200
	Total	\$ 98,450
Total	Relocate and monument 459 corners	\$126,225
	Establish State Plane Coordinates for 354 corners	230,100
	Establish vertical elevations for 417 corners	145,950
--	Total	\$502,275

NOTE: See Maps 3 and 4 for the geographic location of the proposed land survey and control survey work, respectively.

Source: SEWRPC.

Washington County support any such local effort to the extent possible, provided that the local effort meets the standards and specifications set forth earlier in this chapter for the development of an automated mapping base. Support by Washington County is envisioned to consist of the following:

1. The redirection, as may be necessary, of available County resources for completing the geodetic reference framework from one or more of the land survey and control survey work areas identified on Maps 3

and 4, respectively, to that area of Washington County where a local unit of government wishes to proceed on its own with the development of an automated mapping base.

2. County support for a state grant from the Wisconsin Land Information Board to aid in the development of a local land information system.
3. County financial support from tax levy sources to provide matching monies to help

Table 6

**PROPOSED ADDITIONAL REMONUMENTATION AND CONTROL
SURVEY PROGRAM DEPENDENT UPON STATE GRANT FUNDS**

Area	Work Required (related to U. S. Public Land Survey corners)	Estimated Cost
1	Relocate and monument 33 corners	\$ 9,075
	Establish State Plane Coordinates for 90 corners	58,500
	Establish vertical elevations for 96 corners	33,600
	Total	\$101,175
2	Relocate and monument 16 corners	\$ 4,400
	Establish State Plane Coordinates for 95 corners	61,750
	Establish vertical elevations for 95 corners	33,250
	Total	\$ 99,400
3	Relocate and monument 43 corners	\$ 11,825
	Establish State Plane Coordinates for 87 corners	56,550
	Establish vertical elevations for 87 corners	30,450
	Total	\$ 98,825
4	Relocate and monument 36 corners	\$ 9,900
	Establish State Plane Coordinates for 87 corners	56,550
	Establish vertical elevations for 97 corners	33,950
	Total	\$100,400
5	Relocate and monument 48 corners	\$ 13,200
	Establish State Plane Coordinates for 77 corners	50,050
	Establish vertical elevations for 108 corners	37,800
	Total	\$101,050
Total	Relocate and monument 176 corners	\$ 48,400
	Establish State Plane Coordinates for 436 corners	283,400
	Establish vertical elevations for 483 corners	169,050
--	Total	\$500,850

NOTE: See Map 4 for the geographic location of the proposed land survey and control survey work.

Source: SEWRPC.

local governments cover the cost of completing land and control survey work and preparing digital topographic and cadastral base maps in the manner recommended in the plan. A local government seeking county financial support would also have to seek a state grant from the Land Information Board. As presented to that Board, the project desirably would seek 50 percent state cost-sharing monies to be matched by 25 percent county tax levy monies and 25 percent local tax levy monies. Depending upon the grant offer

made by the Board, if any, that percentage distribution of costs could change, but in no event would the anticipated county contribution exceed the local contribution. In order to meet the schedule for preparation of the Washington County budget, any local unit of government in the County seeking such county financial support would have to make its proposal known to the County Land Information Board no later than August 1 in any year for consideration for County funding during the next calendar year.

Conversion of Parcel Identification Numbers

Early in the planning period, Washington County should conduct a study of the present system of identifying parcels. This study should identify how the current parcel numbering systems in Washington County should be adapted to meet the unique parcel identification numbering system promulgated by the Wisconsin Land Information Board, and how the conversion effort should take place. The study should, in particular, identify how the parcels can be coded at least to the U. S. Public Land Survey one-quarter section. It is recommended that this work effort be undertaken by the County Land Information Board under the direction of the County Register of Deeds. The work should be done in cooperation with the local units of government in the County. No new costs to the County should be entailed in this effort, which can be completed by existing county staff.

Revision of Property Ownership Records

It is proposed that Washington County undertake a work effort to revise the existing computer-readable property ownership records. Such revisions would relate to the design of the system in which the names and addresses of property owners are structured and to the provision of consistency in how names and addresses are entered into the file. The objective of the work effort would be to revise the names and addresses of property owners to permit a ready sorting of the file that will avoid duplicative property owner lists, particularly for mailings. It is envisioned that this work effort will involve computer programming efforts, the development of a coding manual to be used as a standard throughout Washington County by those performing the tax listing function, and undertaking numerous revisions of the existing file in accordance with that name and address coding manual. It is recommended that this work effort be undertaken by the County Land Information Board under the direction of the County Data Processing Director. The work should involve the County Tax Lister, and the Assessors in the Cities of West Bend and Hartford and the Village of Germantown, who perform the tax listing work in those communities, and representatives of other local units of government in the County with an interest in this matter. No new costs to the County should be entailed in this effort, which can be completed by existing county staff.

Determination of Specifications and Standards for Digital Conversion

While the foregoing work program does not call directly for the County to sponsor work efforts to develop digital automated mapping bases, Washington County should sponsor a technical study to develop and document specifications and standards for the conversion to digital format of the survey control network, large-scale planimetric and topographic maps, and real property boundary line maps. Such specifications and standards should be in place before any local unit of government in the County undertakes a work effort to complete a digital base map for that community. Accordingly, it is recommended that this technical study be undertaken at the beginning of the planning period. In part, this work effort involves defining the digital "layers" of information to be developed. As a first step in this work effort, Table 7 includes an initial set of such digital "layers." This initial set should be reviewed and revised as necessary. Coordination with a similar work effort in Milwaukee County is recommended. It is recommended that this task be undertaken by the County Land Information Board under the direction of the County Data Processing Manager. No new costs to the County should be entailed in this effort, which can be completed by existing county staff with the assistance of the Regional Planning Commission staff.

State Grant Applications

It may be expected that both Washington County as a unit of government and perhaps one or more local units of government within Washington County will, over the five-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, be found to be consistent with the program objectives and standards set forth in this document. It is recommended that upon such a finding Washington County submit to the Wisconsin Land Information Board any application by a local unit of government in the County with a recommendation for approval. It is further recommended that the Washington County Board of Supervisors formally delegate to the Washington County Land Information Board all responsibilities attendant to the review and filing of County and local applications for state grants.

Table 7

**PROPOSED INITIAL SET OF DIGITAL LAYERS OF INFORMATION
UNDER THE WASHINGTON COUNTY LAND INFORMATION SYSTEM PLAN**

Multipurpose Cadastre Element	Information Category	Digital Information Layer
Geodetic Reference Framework	Map projection system	<ul style="list-style-type: none"> ● 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	<ul style="list-style-type: none"> ● U. S. Public Land Survey corners and monument symbols and state plane coordinates ● U. S. Public Land Survey section and quarter-section lines and grid lengths and grid bearings
Large-Scale Base Maps	Natural features	<ul style="list-style-type: none"> ● 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 ● Wooded areas and their associated lettering ● Other depression contour lines ● Spot elevations and associated lettering ● Water surface elevations and associated lettering ● U. S. Public Land Survey corner elevations
	Cultural features	<ul style="list-style-type: none"> ● 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 ● 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 boundary	<ul style="list-style-type: none"> ● 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 7 (continued)

Multipurpose Cadastre Element	Information Category	Digital Information Layer
Overlays (continued)	Cultural area boundary	<ul style="list-style-type: none"> ● Civil division boundary lines and their associated text ● Land use polygons ● Zoning district polygons ● Shoreland district polygons
	Natural area boundary	<ul style="list-style-type: none"> ● Floodplain polygons ● Soil mapping unit polygons
Identifiers	Parcel numbers	<ul style="list-style-type: none"> ● Washington County real property parcel identification numbers
	Area identifiers	<ul style="list-style-type: none"> ● SEWRPC land use codes ● Local jurisdiction zoning district identifiers ● SCS soil mapping unit identifiers
Land Information Files	Cadastral parcel records	<ul style="list-style-type: none"> ● Real property ownership records ● Real property assessment records ● Real property tax records ● Permits
	Cultural Data	<ul style="list-style-type: none"> ● Civil division areas ● Land use areas ● Zoning district areas
	Natural resource data	<ul style="list-style-type: none"> ● SCS soil suitability and characteristic records

^aAssumes 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.

PROPOSED ORGANIZATIONAL ARRANGEMENTS

Institutional Structure to Conduct Program

The following institutional structure is recommended to carry out the aforescribed work program during the period 1992 through 1996:

1. It is recommended that all activities connected with the development of the proposed Washington County automated mapping base be under the policy direction of the Washington County Land Information Board. That Board was designated by the Washington County Board of Supervisors as having policy responsibility for land information matters. It is further recommended that the Washington County Register of Deeds, as the designated County Land Information Officer, work with the Land Information Board in carrying out the recommended work program.

The County Land Information Board should oversee the conduct of the proposed land survey and control survey work programs in the southern portion of the County in the manner identified on Maps 3 and 4, should sponsor the study required to identify the best way to convert the existing parcel identification numbering systems in the County to the state-recommended system, and should sponsor the technical study required to determine specifications and standards for digital mapping in the County. The County Land Information Board should also serve as the point of contact with local units of government in the County for any efforts by those local units of government to create automated mapping bases are concerned. In this respect, the County Land Information Board should communicate to the County Board of Supervisors any proposal by a local unit of government in the County to

seek county cost sharing monies in support of the completion of an automated base map for that community.

2. It is recommended that the Washington County Land Information Officer serve as the agent for Washington County in preparing and submitting grant applications by Washington County that seek state grants from the Wisconsin Land Information Board. It is further recommended that the Land Information Board serve as the body for reviewing any applications submitted by a local unit of government in Washington County for state funds in support of land information system development work. If the Land Information Board 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 Board 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 giving any suggestions that the Board might have to modify the application to make it consistent with the plan.

Public Access to Records

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

As Washington County in future years completes the automated mapping base described in this plan, it may be expected that additional data sets, or "flat files," will be added to that base. Some of those data sets may consist of data that under Wisconsin law is to be kept confidential in order to protect individual rights of privacy. As such information is developed over the years, Washington County should explicitly address considerations regarding public access to these additional sets of information.

Administrative Considerations

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

1. Relationship to Wisconsin Land Information Program
By adopting the Washington County Land Information System Plan set forth in this document, Washington County agrees to observe and follow the Wisconsin Statutes concerning the Wisconsin Land Information Program.
2. Access to Books, Records, and Projects
By adopting the Washington County Land Information System Plan set forth in this document, Washington County agrees to grant 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 Washington County Land Information System Plan set forth in this document, Washington County agrees to prepare an annual report on the status of plan implementation and to submit that report to the Wisconsin Land Information Board.
4. Plan Update and Revision
By adopting the Washington County Land Information System Plan set forth in this document, Washington County agrees to revise, update, and extend the Washington County plan during calendar year 1996.

SUMMARY

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

1. It is the goal of Washington County to implement, over time, a multipurpose, multi-user automated mapping and land information system, following 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. It is also the goal of Washington County to assist in the modernization of the land records system by establishing a parcel identification system consistent with that recommended by the Wisconsin Land Information Board.
2. The planning period for the initial land information system plan for Washington County is the five-year period beginning January 1, 1992, and extending through December 31, 1996. It is intended that as much work as possible in completing the geodetic reference framework for the recommended automated mapping base for Washington County be completed by the end of that planning period, recognizing, however, that there are fiscal constraints.
3. The recommended standards for the automated mapping and land information system for Washington 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 Washington 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 Washington 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 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 total cost of completing the entire recommended automated mapping base for Washington County is estimated at \$3.8 million. Of this total, about \$1.5 million, or about 40 percent, is required to complete the geodetic reference framework, including the recovery, or relocation, and monumentation of U. S. Public Land Survey corners and the establishment of State Plane Coordinates and vertical elevations for such corners; about \$1.6 million, or an additional 41 percent, is required to prepare large-scale topographic base maps to complete the entire County; and the remaining \$0.7 million, or 19 percent, is required to compile cadastral maps for the County and to convert those maps to digital form, as well as to enhance existing cadastral maps in the County to meet the recommended specifications.
5. Four potential sources of revenue were identified to support the recommended work program. These include the supplemental Register of Deeds recording and filing fees mandated under the Wisconsin Land Information Program, potential state grants from the Wisconsin Land Information Board, contributions by local governments and utilities, and county tax levy

monies. The Register of Deeds filing and recording fees retained by Washington County are anticipated to total about \$371,900 over the five-year planning period, or about \$74,390 annually. State land information program grants of up to \$100,000 can be sought twice annually under present rules. At the present time, no local government or public or private utility in the County has come forth with a firm commitment to provide additional funds to support the program. Also at the present time, county tax levy monies in the amount of about \$25,000 annually are proposed to be made available to the County Surveyor to recover, or relocate, and monument the U. S. Public Land Survey corners in the County.

6. The County Land Information Board has recommended that Washington County focus its available resources over the five-year period 1992 through 1996 on work efforts to complete the required geodetic reference framework as a basic first step in developing an ultimate automated mapping base for the County. More specifically, the Board has recommended that the County Surveyor complete the recovery or relocation and monumentation of U. S. Public Land Survey section corners in a number of areas throughout the County, using a county tax levy budget in the amount of \$25,000 annually. With this level of effort, about 50 percent of the required land survey work can be expected to be completed over the five-year period. In addition, all the retained Register of Deeds recording and filing fees, which would approximate \$74,390 annually, are recommended to be targeted at a control survey program to establish the State Plane Coordinates and vertical elevations of the remonumented corners. This work would be focused in the southern one-half of Washington County. At the end of the planning period, about 29 percent of the required control survey work would be completed. The Board also recommended that Washington County take advantage of every opportunity to apply for a state grant in support of the land survey and control survey work efforts. To the extent that Washington County would receive

such grant monies, the Board recommended that the monies be expended to conduct joint land survey and control survey work programs to the extent that the additional resources would permit.

7. The County Land Information Board also recognized that local units of government in the County may desire to proceed independently with completion of an automated mapping base for a portion of the County. The Board recommended that Washington County support, to the extent possible, such locally focused work efforts, including the redirection as may be necessary of available county resources for completing the land survey and control survey work, county support for a state grant in aid of the development of such a local land information system, and county financial support from tax levy sources to cover the cost of undertaking land survey and control survey efforts and preparing the digital topographic and cadastral base maps, as long as such work would be undertaken in the manner recommended in the plan. County tax levy support of such a local initiative would be contingent upon seeking a state grant for the project and would be limited to matching the local monies provided. Local governments would have to notify the County by August 1 of a given year of such a request in order to receive consideration for funding in the next calendar year.
8. The County Land Information Board also recommended that three related work activities essential to the modernization of land records in the County be undertaken over the next five years. These activities consist of a special technical study to agree upon specifications and standards for the conversion to digital format of the survey control network, of the large-scale topographic base maps, and of the real property boundary line maps; the conduct of a study to determine how best to convert the existing Washington County parcel numbering systems to the unique parcel identification numbering system promulgated by the Wisconsin Land Information Board; and the conduct of a work effort to revise the name and address fields of the present property ownership files.

9. Upon approval of the Washington County land information system plan by the Washington County Board of Supervisors and by the Wisconsin Land Information Board, local units of government in Washington 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 Washington County plan. All local applications for state grants should be reviewed by the County Land Information Board. Upon a finding by that Board that an application is consistent with the Washington County plan, the application should be forwarded

to the Wisconsin Land Information Board with a favorable recommendation for approval.

10. In order to meet the administrative standards and requirements promulgated by the Wisconsin Land Information Board, Washington County by adopting this document agrees to observe and follow the Wisconsin Statutes regarding the Wisconsin Land Information Program; to permit the Wisconsin Land Information Board access to books, records, and project materials for inspection and audit; 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 Washington County plan by the end of calendar year 1996.

Chapter V

SUMMARY AND CONCLUSIONS

INTRODUCTION

On March 21, 1991, the Washington County Board of Supervisors requested that the Southeastern Wisconsin Regional Planning Commission assist the County in the preparation of a plan for land records modernization, focusing on the development of an automated mapping and parcel-based land information system. That request was preceded by the creation, on June 12, 1990, of a Washington County Land Information Office. To oversee the activities of that Office, the County Board created a County Land Information Board. That Board consists of the Chairman of the County Board, the Chairman of the County Park and Planning Commission, the Chairman of the County Finance Committee, the County Corporation Counsel, the County Real Property Lister, the County Surveyor, the County Auditor, the County Land Use and Park Administrator, the County Register of Deeds, the County Conservationist, a representative of the abstractor and title insurance interests in the County, a representative of the utility interests in the County, and one representative each for cities, villages, and towns. The County Board also designated the County Register of Deeds as the official contact person for the County Land Information Office.

This report sets forth the findings and recommendations of the Land Information Board. The Board 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 Board also reviewed the accomplishments to date of public and private efforts to create automated mapping and land records systems covering all or portions of Washington County.

The Land Information Board concluded that a modernized land records system in Washington 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 Board also concluded that the land modernization efforts of Washington County should include the conversion of the existing Washington County and municipal parcel identification systems to the uniform system recommended by the Wisconsin Land Information Board.

The plan set forth in this document is recommended to the Washington County Board of Supervisors for adoption. Upon adoption of the plan, the Land Information Board 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, Washington 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, Washington County would be in a position to submit applications for the state grants in support of the activities specified in the plan. Finally, local units of government in Washington County would also be in a position to submit applications for state grants. Such applications under state law would have to come through Washington County and be endorsed by

the County so that any state funds expended are directed to 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 Washington 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 Washington 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 Washington County program, large-scale means one inch equals 200 feet scale, two-foot contour interval topographic maps, although those local units of government in the County that desire to prepare one inch equals 100 feet scale, two-foot contour interval topographic maps should be encouraged to do so. In either case, these maps should meet 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 Washington County ultimately be provided by the County and that such elements be made available in digital, i.e., computer-readable, form. These elements collectively would constitute the automated mapping base. Building upon that base, Washington 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 supplemental land information files required to support the particular functions of the public and private agencies concerned. It is recognized that resource constraints will prohibit the full development of the automated mapping base by Washington County in the relatively near future. Accordingly, the Land Information Board encourages those local units of government in the County which may desire to do so to proceed at their own pace with the development of the automated mapping base attendant to their jurisdictional area. Such base, however, should be constructed in accordance with the standards recommended in the Washington County plan.

Once the automated mapping base has been completed, county departments can begin developing information layers to take advantage of the capabilities of an automated land information system. For example, one information layer would be the graphic display of those parcels for which Washington County has issued a sewage holding tank permit. The land information system could show the location of those parcels graphically in relation to each other and to, for example, a particular drainage area. The system could also display the file numbers attendant to each permit, thus enabling the rapid retrieval of detailed permit data. Other information layers could relate to floodplain zoning permits, shoreland zoning permits, cropping practices, conser-

vation practices, soil erosion potential, traffic accident locations, and tax delinquent properties, to name but a few of many such possibilities.

The recommended standards for the automated mapping and land information system for Washington 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. These standards have been used for many years throughout the Region, including Washington 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 Washington County automated mapping and land information system; the recovery, or relocation, and monumentation of U. S. Public Land Survey 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 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.

STATUS OF DEVELOPMENT OF AUTOMATED MAPPING BASE

The following summarizes the status of the development of the recommended automated mapping base in Washington County as of November 1991:

1. The Regional Planning Commission, Washington County, and certain local units of government in the County have collectively contributed to the development of the required geodetic reference framework over the past three decades. Of the estimated 2,005 U. S. Public Land Survey corners in Washington County, 593 corners, or about 30 percent, have been relocated and remonumented and fully coordinated through the establishment of horizontal and vertical survey control data

to the recommended specifications. An additional 160 corners have been relocated and monumented with attendant horizontal control survey data. An additional 33 corners have been relocated with the attendant horizontal control; however, these 33 corners have not yet been monumented. An additional 410 corners have been relocated and monumented by the Washington County Surveyor or others; however, no horizontal or vertical control survey data have been established for such corners. Finally, a total of 19 corners have been relocated by the Washington County Surveyor, but have yet to be monumented. In total, then, 1,163 corners, or about 58 percent of all corners in the County, have been relocated and monumented. Horizontal control data and attendant State Plane Coordinates have been established for 786 corners, or about 39 percent of the total. Vertical control data has been established for a total of 593 corners, or about 30 percent of the total.

2. Through large-scale topographic mapping programs conducted by the Cities of Hartford and West Bend; the Villages of Germantown, Jackson, Kewaskum, and Slinger; and the Regional Planning Commission, topographic maps at scales of either one inch equals 100 feet or one inch equals 200 feet, with a two-foot contour interval, have been prepared to the recommended specifications for about 112 square miles, or about 26 percent of the area of Washington County. These mapping programs have included the relocation, monumentation, and placement on the State Plane Coordinate System of those U. S. Public Land Survey corners included in the mapped area.
3. Large-scale cadastral mapping efforts have been undertaken by the Cities of Hartford and West Bend and the Village of Germantown. Together, these maps encompass an area of about 73 square miles, or nearly 17 percent of the total area of the County. It is believed that most of the work completed to date could be enhanced to meet the full set of recommended specifications. Upon meeting such specifications, the mapping needs to be converted to digital form.

RECOMMENDED PLAN

The recommended Washington County land information system plan was prepared for the five-year period 1992 through 1996. This planning period generally 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 the State's fiscal year 1996. It would be desirable to complete the entire automated mapping base recommended for Washington County by the end of 1996. The Land Information Board recognizes, however, that there are fiscal constraints that will preclude reaching that goal by the end of this initial five-year planning period.

The total cost of completing the entire recommended automated mapping and land information system base for Washington County is estimated at \$3.8 million. Of this total, about \$1.5 million, or about 40 percent, is required to complete the geodetic reference framework, including the recovery, or relocation, and monumentation of U. S. Public Land Survey corners and the establishment of State Plane Coordinates and vertical elevations for such corners; about \$1.6 million, or an additional 41 percent, is required to prepare large-scale topographic base maps to complete the entire County; and the remaining \$0.7 million, or 19 percent, is required to compile cadastral maps for the County and convert those maps to digital form, as well as to enhance existing maps in the County to meet the recommended specifications.

The Land Information Committee identified four potential sources of revenue to support the recommended work program. These include the supplemental Register of Deeds recording and filing fees mandated under the Wisconsin Land Information Program, potential state grants from the Wisconsin Land Information Board, contributions by local governments and utilities, and county tax levy monies. The recording and filing fees are expected to total about \$371,900 over the five-year planning period, or about \$74,390 annually. State grants of up to \$100,000 can be sought twice annually under present rules. At the present time no local government or public or private utility in Washington County has come forth with a firm commitment to provide additional funds to support the program. Also at the present time, county tax levy monies in the amount of about \$25,000

annually are proposed to be made available to the County Surveyor to recover, or relocate, and monument the U. S. Public Land Survey corners in the County.

The County Land Information Board has recommended that Washington County focus available resources over the five-year period 1992 through 1996 on work efforts to complete the required geodetic reference framework as a basic first step in developing an automated mapping base for the County. More specifically, the Board recommended that the County Surveyor complete the recovery or relocation and monumentation of U. S. Public Land Survey section corners throughout several portions of Washington County using a county tax levy budget in the amount of \$25,000 annually. With this level of effort, about 50 percent of the required land survey work can be expected to be completed over the five-year period. In addition, all of the retained Register of Deeds recording and filing fees, which would approximate \$74,390 annually, are recommended to be targeted at a control survey program to establish the State Plane Coordinates and vertical elevations of the remonumented corners. This work would be focused in the southern one-half of the County. At the end of the planning period, about 29 percent of the required control survey work would be completed. Finally, the Board recommended that any state land information system grant monies that may be obtained by Washington County be expended to conduct joint land survey and control survey work projects in targeted areas to the extent that the additional resources would permit.

The Land Information Board also recognized that local units of government in the County may desire to proceed independently with completion of an automated mapping base for a portion of the County. The Board recommended that Washington County support, to the extent possible, such locally focused work efforts, including the redirection as may be necessary of available county resources for completing the land survey and control survey work, county support for a state grant in aid of the development of such a local land information system, and county financial support from tax levy sources for undertaking land survey and control survey work and for preparing digital topographic and cadastral base maps, so long as such work would be undertaken in the manner recommended in the plan. County

tax levy support of such a local initiative would be contingent upon seeking a state grant for the project and would be limited to matching the local monies provided. Local governments would have to notify the County by August 1 of such a request in order to receive consideration for funding in the next calendar year.

The County Land Information Board also recommended that three related work activities essential to the modernization of land records in the County be undertaken over the next five years. These activities consist of a special technical study to agree upon specifications and standards for the conversion to digital format of the survey control network, of the large-scale topographic base maps, and of the real property boundary line maps; the conduct of a study how best to convert the existing Washington County parcel numbering systems to the unique parcel identification numbering system promulgated by the Wisconsin Land Information Board; and the conduct of a work effort to revise the name and address fields of the present property ownership files.

It is recommended that the Washington County Land Information Board oversee all work associated with the development of the Washington County automated mapping base over the next five-year period. Finally, the Land Information Board also recommends that Washington County commit to meeting all of the administrative requirements for county land information

programs established by the Wisconsin Land Information Board. In particular, Washington County should prepare and submit to that Board an annual report on the status of plan implementation. Furthermore, Washington County should commit to revise, update, and extend this plan by the end of calendar year 1996.

CONCLUDING STATEMENT

The Washington County Land Information Board 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 ultimately usable by all Washington County departments, by local governments in Washington County, and by public and private utilities. The plan includes technical specifications for the mapping work involved; a five-year program to continue the development of the geodetic reference framework for the County; a proposed effort to convert the Washington County and local parcel identification systems to the state-recommended system; and a recommended organizational structure for the conduct of the required work. The Land Information Board recommends that the plan and program set forth herein be approved by the Washington County Board of Supervisors and that work efforts proceed over the next five years in accordance with the outline and organizational structure recommended in this report.

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APPENDICES

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APPENDIX A

WASHINGTON COUNTY LAND INFORMATION SYSTEM PLAN

(Set forth in the format specified by
the Wisconsin Land Information Board)

A. INTRODUCTION

1. Land Information Office

On June 12, 1990, the Washington County Board of Supervisors established a Land Information Office. The County Board also established a Land Information Board to oversee the activities of that Office. On December 10, 1991, the County Board designated the County Register of Deeds as the official contact person for the Land Information Office. The present Register of Deeds is:

Mrs. Dorothy C. Gonnering
Register of Deeds
Washington County Courthouse
432 E. Washington Street
West Bend, Wisconsin 53095
Phone: (414) 335-4318

2. Participants in the Planning Process

The planning process was overseen by the County Land Information Board. That Board consists of the following: the Chairman of the County Board, the Chairman of the County Park and Planning Commission, the Chairman of the County Finance Committee, the County Corporation Counsel, the County Real Property Lister, the County Surveyor, the County Auditor, the County Land Use and Park Administrator, the County Register of Deeds, the County Conservationist, a private abstractor active in the County, a local planner representing cities in the County, a local assessor representing villages in the County, a local engineer representing towns in the County, and a representative of the private utilities operating in the County. Staff assistance in preparing the plan was provided by the Southeastern Wisconsin Regional Planning Commission. The membership of the Land Information Board is reproduced on the inside front cover of this report.

B. CURRENT ACTIVITIES AND INVENTORY

The County Land Information Board determined that the focus of the land records modernization plan would be on the development of an automated mapping and parcel-based land information system. The following summarizes the current activities and inventory of work efforts attendant to that system.

1. Existing Automated Mapping and Land Records Systems

a. SEWRPC

The SEWRPC, which encompasses Washington County in its jurisdictional area, maintains an extensive digital data base of land use and natural resource inventory data. This includes land use maps, soil maps, wetland maps, wildlife habitat maps, floodplain maps, civil division maps, and watershed maps, among others. The SEWRPC uses the State Plane Coordinate System, NAD-27, for its digital mapping work.

b. WEPCo

The Wisconsin Electric Power Company, which serves virtually all of Washington County, maintains a digital mapping base upon which it has placed its electric service network. The WEPCo uses the UTM Coordinate System, NAD-27, for its digital mapping work.

c. Wisconsin Gas Company

The Wisconsin Gas Company serves all of Washington County. The Company has developed an automated mapping base for most of its franchised area and is currently placing its facilities on that base. The Company uses the State Plane Coordinate System, NAD-27, for its digital mapping work.

d. Wisconsin Bell

Wisconsin Bell serves most of Washington County and is scheduled to begin automated mapping work in the County in 1992 using the UTM Coordinate System, NAD-27.

e. Washington County

Washington County has not yet established a digital mapping program. The County maintains a series of cadastral diagrams for U. S. Public Land Survey sections. Because those diagrams do not fit the recommended geodetic control framework, they are not suitable for use in building a modernized land records system.

f. Local Governments

Three local units of government in Washington County are beginning to establish automated mapping capabilities. The Cities of West Bend and Hartford have acquired personal computer based engineering drafting software for the primary purpose of automating engineering drafting work. The Village of Germantown has obtained about 17 square miles of digital topographic mapping, but at present has no in-house capability to store and manipulate the digital map files.

2. Status of Remonumentation and Control Survey Work

There are 2,005 U. S. Public Land Survey section, quarter section, and center of section corners in Washington County. A total of 1,163 corners, or about 58 percent, have been relocated and monumented. Horizontal control data in the form of State Plane Coordinates have been obtained for 786 corners, or about 39 percent. Vertical control data have been obtained for a total of 593 corners, or nearly 30 percent (see Map 1, page 29).

3. Status of Base Mapping

Through a series of large-scale topographic base mapping programs coordinated by the Regional Planning Commission, topographic maps at scales of either one inch equals 100 feet or one inch equals 200 feet with a two-foot contour interval have been prepared for 112 square miles, or about 26 percent of the area of the County (see Map 1, page 29).

4. Status of Cadastral Mapping

Large-scale cadastral mapping efforts have been undertaken by the Cities of Hartford and West Bend and the Village of Germantown. Together the completed maps encompass an area of about 73 square miles, or nearly 17 percent of the area of the County (see Map 2, page 32).

5. Existing Parcel Numbering Systems

The Cities of Hartford and West Bend and the Village of Germantown administer local parcel numbering systems within the limits of their jurisdictions. Washington County administers a system applicable to the remaining area of the County. The Hartford and Germantown systems currently relate parcels to the U. S. Public Land Survey one-quarter section. The West Bend and Washington County systems do not relate parcels to the quarter section in which they are located.

6. Recent Budget Expenditures for Land Records Projects

Over the past three years, the following monies have been expended for land records modernization activities in the County:

<u>Project Name</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>Total</u>
City of West Bend				
Mapping Project	\$74,000	\$ 55,968	\$ --	\$129,968
City of Hartford				
Mapping Project	--	42,425	--	42,425
Village of Slinger				
Mapping Project	--	14,879	--	14,879
County Surveyor				
Remuneration Program	<u>25,000</u>	<u>20,000</u>	<u>20,000</u>	<u>65,000</u>
Total	\$99,000	\$133,272	\$20,000	\$252,272

7. Needs Assessment

The County Land Information Board determined that the following basic needs exist with respect to land records modernization in the County:

- a. The completion of the geodetic reference framework, including relocating and monumenting all U. S. Public Land Survey corners and obtaining State Plane Coordinates and vertical elevation data for such corners.
- b. The completion of large-scale topographic base mapping for the 324 square miles not yet mapped.
- c. The preparation of cadastral maps as "overlays" to the topographic maps to permit the accurate correlation of earth science and cadastral data.
- d. The conversion of the existing parcel numbering systems in Washington County to meet the data interchange standard attendant to parcel numbering systems set forth by the Wisconsin Land Information Board.
- e. The creation over time of a series of land information files, including—but not limited to—soils, flood hazard areas, land use, and zoning.

C. GOALS AND OBJECTIVES

1. Goals

The County Land Information Board adopted the following two basic goals:

- a. To implement a multipurpose, multi-user, parcel-based, automated mapping and land information system consisting of 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.

- b. To design a common automated land information system for the County so as to ensure economy and efficiency in the development and use of that system and so as to ensure the ready entry, retrieval, and exchange of data by and between the various users of the system.

2. Objectives

To meet these goals, the Board adopted the following specific objectives:

- a. To lay out a course of action that will focus available fiscal resources on efforts to continue the development of the geodetic reference framework in the County.
- b. To revise the parcel identification systems in the County in accordance with the guidelines for parcel numbering set forth by the Wisconsin Land Information Board.
- c. To encourage local units of government in Washington County to move forward at a more rapid pace to complete automated land information systems.
- d. To facilitate applications by the County and local units of government in support of state grants-in-aid of developing the recommended automated mapping system.
- e. To encourage partnership efforts between governments and utilities that will contribute toward the development of the recommended mapping system.

3. Planning Period

The Land Information Board recognized that the foregoing goals and objectives would not be fully reached during a reasonable short-term planning period. The Board then determined to set as the planning period for an initial land information system plan the five-year period beginning January 1, 1992, and extending through December 31, 1996. The Board determined that it would scale its work program for that planning period to the resources anticipated to be made available.

D. MODERNIZATION AND IMPLEMENTATION PLAN

The following describes the recommended modernization and implementation plan for land records established by the Washington County Land Information Board for the planning period.

1. Foundational Elements

a. Geographic Frameworks (Base Map)

- 1) Washington County intends to continue using the large-scale mapping and survey control systems recommended by SEWRPC. Each U. S. Public Land Survey section, quarter section, and center of section corner will be relocated and monumented; high order control survey traverses will 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; and vertical control surveys will be completed to determine elevations for each monument. Coordinates of the corners will be computed upon the Wisconsin Coordinate System, South Zone, (NAD-27). The procedures and accuracy of the horizontal control surveys will conform to the specifications for NGS Third Order, Class I Traverses. The vertical control survey work will be based upon National Geodetic Vertical Datum 1929 Adjustment (NGVD-29). The procedures and accuracy of the vertical control surveys shall conform to the specifications for NGS Second Order, Class II level circuits.
- 2) Large-scale topographic base maps will be prepared to standard SEWRPC specifications which incorporate National Map Accuracy Standards. The standard base map scale for Washington County is one inch equals 200 feet, two-foot contour

interval, although local units of government are encouraged, should they so desire, to proceed with larger scale, one inch equals 100 foot topographic mapping.

- 3) Over the five-year planning period, it is anticipated that Washington County—using available resources consisting of county tax levy monies and retained Register of Deed's filing fees—will complete land survey work in the areas identified on Map 3, page 52, and control survey work in the areas identified on Map 4, page 53. Map 4 also identifies the additional areas for which land and control survey work could be completed depending upon the availability of state grants from the Wisconsin Land Information Board. It is also possible that local units of government in the County will proceed with locally focused land and control survey and topographic mapping programs during the five-year period.

b. Parcels

1) Cadastral Maps

Washington County has accepted the standard SEWRPC specifications for the preparation of cadastral maps. While it is not expected within the planning period that Washington County will sponsor specific projects to prepare cadastral maps, it is possible that some communities will follow the lead of West Bend, Hartford, and Germantown in preparing such maps. Each cadastral map shall cover one U. S. Public Land Survey section where base mapping has been obtained at a scale of one inch equals 200 feet, and one U. S. Public Land Survey quarter section where base mapping has been obtained at a scale of one inch equals 100 feet. The cadastral map shall utilize the State Plane Coordinate System as the map projection. 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. 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 should 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.

2) Parcel Identification

Every parcel identified on a cadastral map shall have a unique parcel identification number assigned to it. During the planning period, Washington County intends to create a uniform countywide parcel identification system that relates each parcel, at a minimum, to the quarter section of the U. S. Public Land Survey System.

3) Parcel Administration

Washington County intends during the planning period to revise the existing computer readable property ownership records so as to provide consistency in how names and addresses of property owners are structured and entered into the file. This work effort will involve computer programming, the development of a coding manual, and file revisions.

c. Wetlands Mapping

Washington County intends to incorporate into its ultimate land information system digital wetlands maps prepared by SEWRPC. Those maps are based upon the Wisconsin Department of Natural Resources wetland maps. It is not anticipated, however, that Washington County will be in a position during the five-year planning period to accomplish this task.

d. Soils Mapping

Washington County intends to incorporate into its ultimate land information system the digital soil survey maps prepared by SEWRPC. Those maps are based upon the U. S. Soil Conservation Service soil survey maps. It is not anticipated, however, that Washington County will be in a position during the five-year planning period to accomplish this task.

e. Zoning Mapping

While Washington County intends to ultimately develop a zoning mapping "layer" in its land information system, any work on this element has been deferred for further consideration during the next planning period. Local units of government, however, may undertake the development of a zoning mapping layer during the planning period. That layer must be based upon and related to, as may be appropriate, the cadastral maps, the wetland maps, and the floodplain maps developed as part of the topographic base maps.

f. Institutional Arrangements

1) Policy Oversight

All activities to be conducted in connection with the development of the proposed Washington County automated mapping base will be under the policy direction of the Washington County Land Information Board. As the designated contact person for the Washington County Land Information Office, the Register of Deeds will work with the Land Information Board in carrying out the recommended work program.

2) Land Survey Work

All land survey work will be carried out by the County Surveyor. The present County Surveyor is: Mr. Ronald H. Greve, N88 W16752 Main Street, Menomonee Falls, Wisconsin 53051, telephone: (414) 251-8141.

3) Control Surveys

Washington County intends to contract with the SEWRPC to administer the control survey work program. The Commission in turn will engage a consulting engineering firm to perform the work. The Commission will provide administrative and quality control services at no cost to the County. The appropriate contact person in this respect is: Mr. Kurt W. Bauer, Executive Director, SEWRPC, 916 N. East Avenue, Waukesha, Wisconsin 53187-1607, telephone: (414) 547-6721.

4) Potential Agreements with Local Governments

The plan provides an opportunity for local governments to enter into cost sharing agreements with Washington County to carry out aspects of the proposed automated mapping base. From time to time local units of government may approach Washington County for such a cost sharing agreement. The County Land Information Board will review each proposal and make an appropriate recommendation to the County Board. The County Board will determine whether or not to enter into such an agreement.

g. Communications, Education, and Training

1) Dissemination of County Plan

The County Land Information Board will disseminate copies of the adopted land information system plan to all local governments in the County and to other interested parties as may be appropriate. This will communicate the County's intent to sponsor, over time, the cooperative development of an automated mapping base.

2) Education and Training

With respect to the proposed work effort to renumber parcels in Washington County to conform to the parcel numbering system recommended by the Wisconsin Land Information Board, the County will conduct training sessions attendant to the new system for both county and local government personnel. In addition, with respect to the County's effort to revise the name and address fields of the current property description system, the County will conduct appropriate training sessions for local government personnel, as soon as a coding manual has been developed.

h. Public Access Arrangements

Washington County will make all data developed under the automated base mapping program available to public and private interests upon reasonable requests. The Register of Deeds is recognized as the official custodian of all such data and will prescribe forms and the manner in which such data may be requested. In accordance with state law, Washington County reserves the right to charge reasonable costs associated with fulfilling such requests.

3. Data Interchange Standards

Washington County recognizes that there are informal exchange standards currently being used to share digital data, and encourages the use of such informal standards to promote data use and integration. Washington County also recognizes that formal data interchange standards may be proposed from time to time. When such formal standards are recommended by the Wisconsin Land Information Board, the Washington County Land Information Board will evaluate such recommendations.

Washington County does accept the data interchange standard proposed by the Wisconsin Land Information Board with respect to parcel identification numbering systems. During the five-year planning period, Washington County will convert its current parcel identification numbering systems to a common system that will be consistent with the system shown on Figure 11, page 44, and recommended by the Board.

4. Administrative Standards

Washington County explicitly agrees to the following administrative standards:

- a. Washington County agrees to observe and follow the Wisconsin Statutes concerning the Wisconsin Land Information Program.
- b. Washington County agrees to grant the Wisconsin Land Information Board, upon reasonable notice, access to books, records, and project materials for inspection and audit purposes.
- c. Washington County agrees to prepare an annual report on the status of plan implementation and to submit that report to the Wisconsin Land Information Board.
- d. Washington County agrees to revise, update, and extend the County plan during calendar year 1996.