

SPECIAL ISSUE—COUNTY SURVEYOR SERVICES

REGIONAL PLANNING NEWS



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Coming Next Issue: *Discussion on Survey Datums*

Surveyors, public works engineers, and land information system managers within Southeastern Wisconsin rely upon specific horizontal and vertical survey datums in the conduct of their work. A survey datum may be defined as a system that serves as a basis for the conduct of land and engineering surveys, the calculation of coordinate positions, the preparation of map projections, the coordination of surveys and maps over relatively large areas, and as a referent.

The existing control survey network within Southeastern Wisconsin is based upon horizontal and vertical datums established by the Federal Government in 1927 (NAD27) and 1929 (NGVD29) respectively. In 1973, the Federal Government initiated the development of new horizontal and vertical datums known respectively as NAD83 and NAVD88. Consequently, county surveyors, public works engineers, and county land information system managers are faced with an issue of whether or not to convert the existing legacy control survey networks within the Region from the legacy to the newer datums; and if the decision is to convert, by how best to do so. The complex and costly issue of datum conversion has been addressed by the Commission in SEWRPC Memorandum Report No. 206 and in an addendum to that report. The report presents two quite different means for conversion; one costly and one significantly less costly. The findings set forth in SEWRPC Memorandum Report No. 206 and its addendum with respect to datum conversion, an issue presently facing the counties and municipalities of the Region, will be addressed in summary form in the next issue of this newsletter.

REGIONAL PLANNING COMMISSION COUNTY SURVEYOR SERVICES

INTRODUCTION

Since it became operational in 1961, the Commission has provided technical guidance and advice to its constituent counties and municipalities concerning surveying and mapping practices. The guidance and advice has taken the form of the publication of planning guides on official mapping and land subdivision control; the preparation of contracts and specifications for large scale aerial photography, and topographic and cadastral mapping projects carried out by counties and municipalities within the Region; the creation of a control survey network within the Region to support topographic, and cadastral mapping, and the conduct of land and engineering surveys; the provision of technical guidance and advice concerning the conduct of both plane and geodetic surveys in support of planning and engineering activities; and the provision of the foundational elements for the creation of automated land information and public works management systems within the Region. As the counties and municipalities within the Region acted to implement the Commission recommendations, Commission staff activities in the surveying and mapping area necessarily increased, and the Commission became directly involved in both the conduct of field surveys as well as the administration of control survey and mapping projects for counties and municipalities.

In 1984, State legislation was enacted that required the Commission to act in the capacity of the County Surveyor for Milwaukee County. Given this State mandated responsibility, and the need to maintain a capable staff to perform the County Surveyor function, the Commission offered to also assume that function for other counties of the Region. Based upon the acceptance of that offer, the Commission currently provides County Surveyor services to Kenosha, Walworth, and Waukesha Counties, as well as to Milwaukee County. This provision of County Surveyor services represents an example of the efficient use of shared technical staff, and costly instruments, and the desirable consolidation of public services to reduce costs. To provide these services, it is necessary that a Commission staff member be appointed as County Surveyor by the counties concerned. In addition to providing a County Surveyor for four counties, the Commission provides support services to the Ozaukee County Surveyor.

The office of the County Surveyor has two mandated statutory functions. The County Surveyor is also called upon, from time to time, to provide non-mandated services in support of county government operations including the conduct of county property boundary and other types of surveys such as topographic and wetland mapping services.



Corner monument. Source: SEWRPC

PRIMARY FUNCTION OF A COUNTY SURVEYOR

The primary mandated responsibility of the County Surveyor is the perpetuation of the United States Public Land Survey System (USPLSS) within the county concerned. An understanding and appreciation for the importance of this responsibility requires knowledge about that System. Therefore, a description of that System and of its importance is appended to this memorandum. As noted in the appended description, the continued existence and use of that System depends entirely upon the existence of the physical monuments marking the corners of the System that is, upon the monumentation of the township, section, and quarter section corners which comprise the System. The location of these corners are the basis for the description of all real property boundaries in an area—and for the marking of such boundaries on the ground through the conduct of land surveys. The location of these corners are also the basis for the legal description and location of all city, village, and civil town boundaries, for the description of annexation or other changes to such boundaries, and for the exercise of such land use control measures as zoning and official mapping.

The monuments marking the corners of the USPLSS are subject to damage, disturbance, and destruction through rural and urban land use development and redevelopment activities; roadway and utility construction and reconstruction; from degradation of the physical monuments themselves as a result of the actions of road salts and frost; and, in some cases, of vandalism. Commission experience indicates that the rate of loss approximates two to three percent of the corners per year, and the Commission staff, working under the direction of the County Surveyor, for the five counties concerned recovers and re-monuments on average over 200 corners per year.

In practice, the work of perpetuating the USPLSS corners typically occurs under one or the other of two situations. The first such situation occurs when, in accordance with State Law, notice is served on the County Surveyor that a corner monument is to be disturbed or destroyed and will require replacement. The second such situation occurs when the County Surveyor is advised by a potential user, or otherwise discovers that a corner monument

has been illegally destroyed without notice. In the first situation, the perpetuation work requires the conduct of a preconstruction survey involving the inspection of the existing monumentation and ancillary witness marks and benchmarks that are to be disturbed or destroyed through the construction activities, the setting of temporary witness marks and benchmarks outside of the construction zone, the measurement of the distances to the temporary witness marks and the transfer of existing benchmark elevations to the temporary benchmarks. Following completion of the construction activities, the corner concerned is re-monumented, new permanent witness marks and benchmarks are set, and the State Plane Coordinates and elevation of the new monument together with the distances to the new witness marks and the elevations of the new benchmarks are obtained by field survey. The lengths and bearings of the quarter section lines emanating from the corners are checked by field survey.

The conduct of such preconstruction surveys requires careful and timely coordination with State, city, village, and town public works officials and with the staffs of public utilities to ascertain the timing of the initiation and completion of the construction activities concerned. Such coordination may also be required with private sector organizations involved in land development or redevelopment projects, and with farmers engaged in such projects as the obliteration of fence and tree lines to expand fields. The coordination is necessary to permit both the conduct of the preconstruction surveys and the placement of the new monuments concerned without, for example, requiring pavement cuts in new pavements for the setting of the monuments.

The second situation requires substantially more work in that the original position of the corner or corners concerned must be determined by high order, traverse or global positioning surveys tied to existing real property boundary lines and corners in the local area, and to the areawide control survey network. The elevations for the new ancillary benchmarks must be determined by often

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SEWRPC Survey Services

Southeastern Wisconsin Regional Land Information System

Typical Cadastral Map

Typical Topographic Map

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The Commission's surveying and mapping staff maintain over 8,000 corner monuments in five Southeastern Wisconsin counties. Each year, staff replace scores of monuments and associated documents that are damaged or destroyed.

Source: SEWRPC

While not usually encountered in practice, there are at least two other situations in which the County Surveyor may be called upon to perpetuate the USPLSS. The first of these is establishment by a county or a municipality of a systematic maintenance program. At the county level such programs may involve the maintenance annually of the corner monumentation within a survey township. At the municipal level such programs may involve part or all of the municipality depending upon its size. Such systematic maintenance is highly desirable and has, in fact, also been carried out from time to time by the Regional Planning Commission. The second such situation is rarely used. It consists of a situation in which the majority of the resident land owners in a section petition a circuit judge to, in effect, order the County Surveyor to locate and monument a specified corner or corners, the location of which is in dispute between land owners. In any case, the remonumentation work requires careful research of the historic record of the corner location over time, careful resurvey work, new monumentation and documentation of the findings, and experience of the County Surveyor concerning the true location of the corner.

State legislation requires that the County Surveyor document the survey work performed in the remonumentation of USPPS corners. As recommended by the Commission, this documentation is in the form of a "Record of USPLS Control Station" form.

The form, as shown in **Figure 1**, contains the location of the corner in the USPLSS, and the State Plane Coordinates of the corner, the elevation of the monument marking the corner, and the location and elevation of ancillary benchmarks. The form includes a location

The form also includes a certificate of the County Surveyor which sets forth the history of the monumentation of the corner concerned, including the date of the original monumentation and the dates of all subsequent remonumentation, the responsible parties involved in the monumentation and remonumentation and the reasons why the remonumentation was necessary. The certification provides invaluable information and assurance to public and private land surveyors, to public works engineers, and to property owners that the corner has been properly perpetuated.

The Office of the County Surveyor also collects and maintains historical records such as field notebooks kept by previous County Surveyors, plats of surveys, and copies of pertinent documents from local private surveyors for use in validating the location of USPLSS corners within the county. The Office of the County Surveyor also maintains control survey summary diagrams, as shown in **Figure 2**, providing the State Plane Coordinates of the USPLSS corners, the lengths and bearings of the quarter section lines, and the areas of the quarter sections for use in the conduct of land and engineering surveys and for development and maintenance of automated land information and public works management systems.

The proper perpetuation of the USPLSS corners and of the attendant witness marks, benchmarks, and control survey data, requires both a strong sense of responsibility and commitment as well as technical expertise. It was the lack of commitment to the perpetuation of the system, particularly in the first half of the twentieth century, that led the Commission to recommend substantial reinvestment in the system by each constituent county. Such reinvestment in the later part of that century was required to restore the system to readily usable form. Moreover, the individual who serves as County Surveyor must possess a high level of technical expertise not only in land surveying, but given the integration of the USPLSS and the National Geodetic Control Survey system within the Region also in geodetic surveying. Such expertise needs to include knowledge of “state-of-the-art” instrumentation and technology, including total station and global positioning instrumentation and technology. Such expertise is also required relative to the software used to perform the computations and adjustments needed to create and maintain both the horizontal and vertical control survey networks. Most importantly, however, the County Surveyor must possess in depth knowledge about real property boundary law, local land surveying practices, and the principles governing the perpetuation and use of the USPLSS.

Under Wisconsin law, County Surveyors also have a responsibility to provide a repository for the filing of all “ordinary” land survey plats prepared by private surveyors operating within the county and for making these plats readily available to interested parties. Land subdivision plats and certified survey must be recorded with the County Register of Deeds. To meet this requirement effectively and efficiently, the system used by the Commission indexes and files the plats of survey received from private surveyors by USPLSS quarter section, date, name of surveyor, and name of owner of the land concerned. In Kenosha, Walworth, and

RECORD OF U. S. PUBLIC LAND SURVEY CONTROL CORNER

U. S. PUBLIC LAND SURVEY CORNER

16 15
21 22 T 5 N, R 21 E, MILWAUKEE

COUNTY, WISCONSIN

HORIZONTAL CONTROL SURVEY BY:
VERTICAL CONTROL SURVEY BY:

AERO-METRIC ENGINEERING, INC.
AERO-METRIC ENGINEERING, INC./SEWRPC

YEAR: 1993
YEAR: 1993/1999

STATE PLANE COORDINATES OF:
NORTH
EAST

SECTION CORNER

329,885.22
2,533,357.57
761.697

ELEVATION OF STATION:

HORIZONTAL DATUM: WISCONSIN STATE PLANE COORDINATE SYSTEM, SOUTH ZONE
NORTH AMERICAN DATUM OF 1927

VERTICAL DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929

THETA ANGLE: +01-22-03

CONTROL ACCURACY:

HORIZONTAL: THIRD ORDER, CLASS I

VERTICAL: SECOND ORDER, CLASS II

LOCATION SKETCH:

Bearing: S 00-28-28 E
To E ¼ Cor. Sec. 21, 5-21

SURVEYOR'S AFFIDAVIT:

STATE OF WISCONSIN(N)

MILWAUKEE(COUNTY)

SS

As Milwaukee County Surveyor, I hereby certify that I set a concrete monument with SEWRPC brass cap to mark this corner, replacing a cast iron plug with cross set in the concrete pavement to mark this corner in November 1957 by Laverne F. Cook, S-998, State Highway Commission of Wisconsin Project Engineer; following highway reconstruction in 1958 by the concrete pavement to mark this corner in 1944 by the Milwaukee County Highway Department following highway reconstruction; replacing a cast iron plug with cross set in the then existing concrete pavement to mark this corner in 1915 by the Milwaukee County Highway Department following highway reconstruction; replacing a cut limestone monument set to mark this corner in 1878 by Jonathan C. Crouse, Surveyor; replacing in turn a wood post set to mark this corner in June 1836 by Elisha Dwellie, Deputy United States Surveyor, in the conduct of the original United States Public Land Survey; that I referenced the same as shown herein; and that this record is correct and complete to the best of my knowledge and belief.

Kurt Bauer
REGISTERED LAND SURVEYOR

DATE OF SURVEY:

7 May 1992

REVISED:

30 September 1999

12 March 2001

S - 157

FORM PREPARED BY SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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U.S. PUBLIC LAND SURVEY SYSTEM

The present economy of the United States is quite fundamentally based upon the concept of property or sense of ownership—more precisely defined as the exclusive right to control an economic good. One of the most important forms of property is real property, which takes the form of rights in land—the commodity traded in the real estate market. Exercising this privilege of ownership in land, along with the concomitant duties, requires the identification of the property concerned on the surface of the earth. That task is the object of land surveying and of the U.S. Public Land Survey System (USPLSS).

After the Revolutionary War, the newly created Federal Government found itself owner of a vast unsurveyed and unmapped territory extending westward from the original thirteen eastern seaboard states to the Mississippi River, and eventually to the Pacific Coast. In the belief that the wide land ownership would result in the highest productivity for the nation, it became national policy to sell this public domain to private owners for settlement and development. The original deed, or patent, from the U.S. Government thus became the basis for all subsequent ownership in any chain of title.

In order to facilitate the sale of the public lands, it was necessary to provide a certain, yet simple and convenient, method of land description and identification. To this end, the USPLSS—also known as the rectangular land survey system—was devised. The USPLSS is a brilliantly devised system providing a simple, yet unambiguous, means of writing a legal description for each and

every parcel of land in an area covered by the system. Under the system, parcels of land as small as five acres can be unambiguously described in a short single line of text. The system depends, however, upon being able to identify in the field the location of the original monuments established by the Government surveyors prior to the transfer of the land from the Federal Government to private ownership. Federal law required that the land be surveyed and monumented by the Federal Government before sale and occupation. Therefore, completion of the Government Surveys became the first step in the settlement and development of an area such as southeastern Wisconsin.

Under the USPLSS, the primary unit of land division is the survey township, a nominally 36 square mile rectangular area. The secondary unit of subdivision is the section—a subdivision of the township—a nominally one square mile, or 640 acre, area. These units are illustrated in **Figure A-1**. These subdivision units are located with respect to a set of coordinate axes consisting of an initial point, a prime meridian through that point, and a baseline surveyed as a parallel of latitude through the initial point. The sections as laid out by the Government surveyors can be readily further subdivided into one-quarter sections being a nominal area of 160 acres. The government surveys were completed within what is now the Southeastern Wisconsin Region in 1836. Substantial cedar posts were set by the Government Surveyors to mark the corners of the system. The Government Surveyors' field notes were then converted to township plats—maps—that displayed the surveyed distances and bearings of the quarter-section lines, and the areas of the sections as surveyed. The instructions to the Government Surveyors provided that as the township, range, and section lines were run, notes were to be kept indicating where such lines crossed streams and water courses, together with the width and direction of flow; intersected lake shores which would then be meandered; entered and left wetlands; and entered and left woodlands. The Government Surveyors also had to make notations concerning the principal species of the woodlands, the types and fertility of the soils present, and the presence of gravel, stone, and other mineral deposits. The USPLSS thus provided not only a simple, unambiguous means for describing and locating real property boundaries, but also provided the first maps and natural resource inventories of the vast areas covered by the surveys. It is interesting to note that the Commission has utilized the survey notes and township plats to create an accurate map of the surface water systems, wetlands, woodlands, and prairies of the Region as these features existed prior to settlement and development by Europeans.

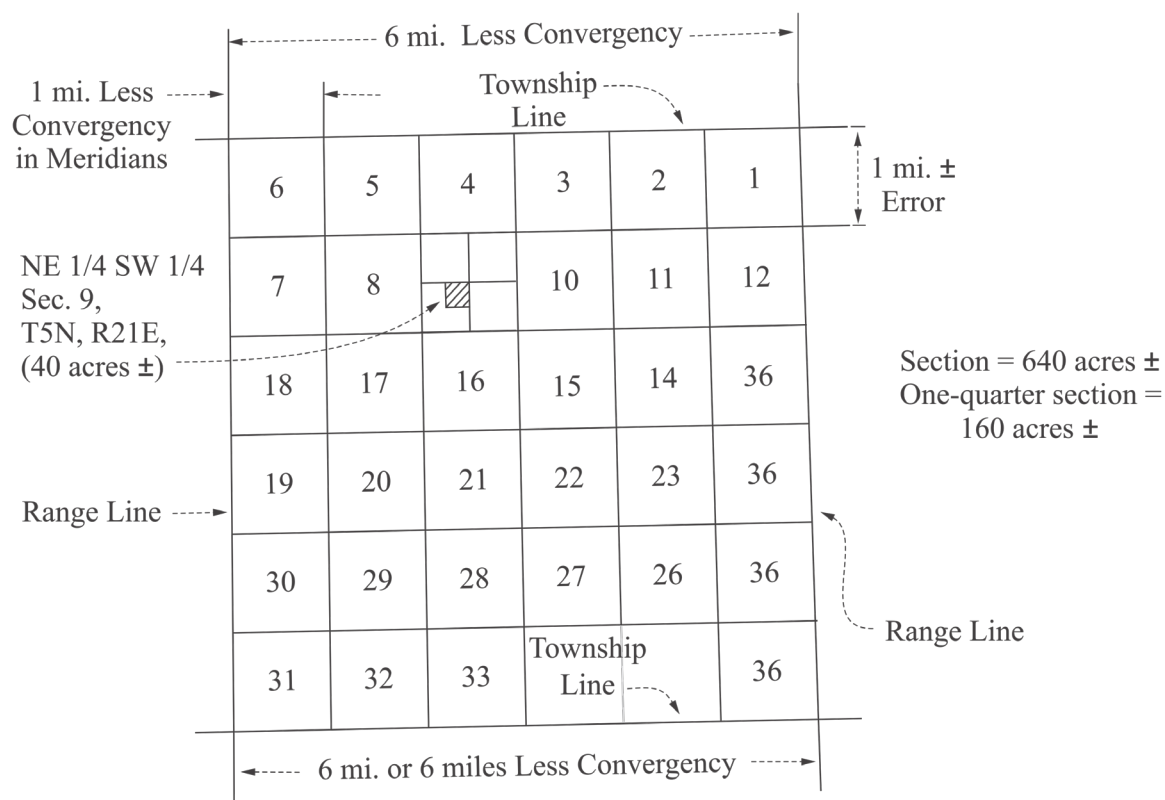
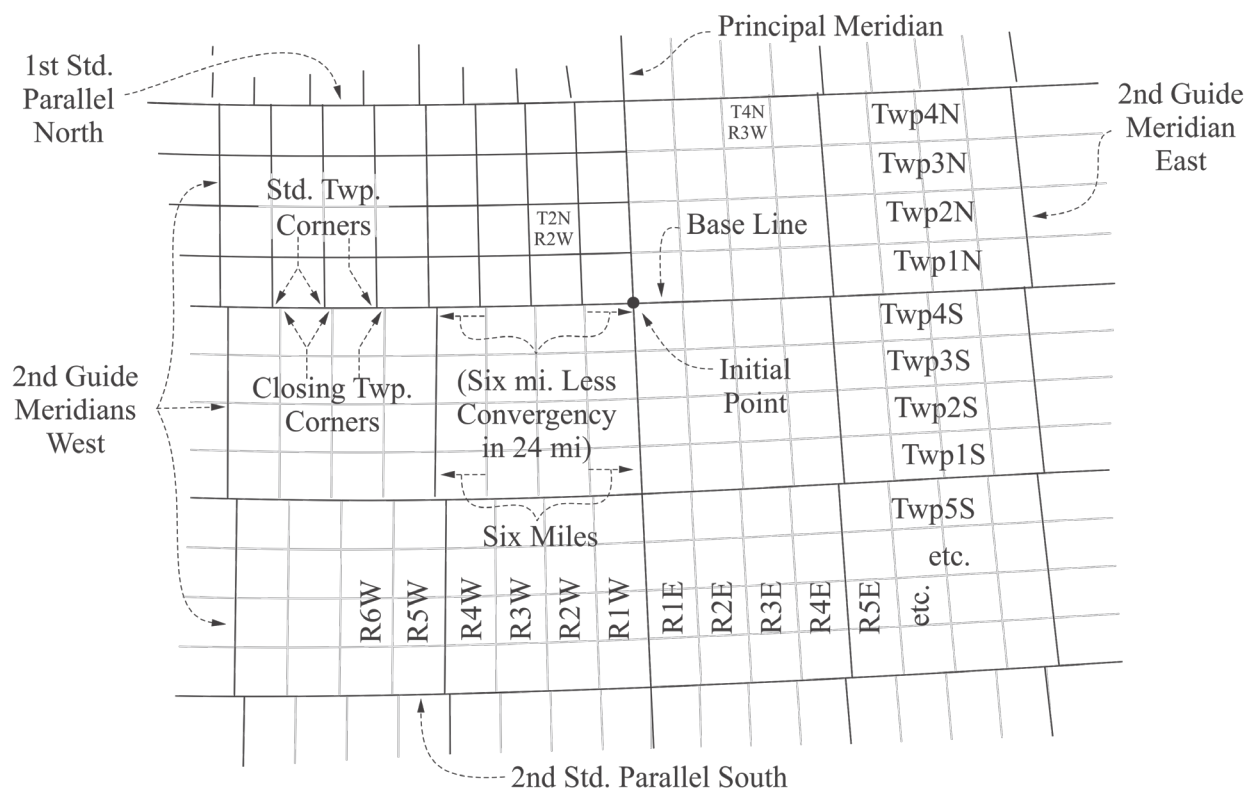
Upon completion of the surveys, the Federal Government turned the field notes and township plats—in effect the system—over to the states for preservation and use. In Wisconsin, the task of preserving the system was delegated by law to the counties which were expected to provide a County Surveyor to perform this function. The continued use of the USPLSS in the conduct of land and engineering surveys requires that over time the County Surveyors replace the original cedar posts marking the corners of the system with more substantial monuments including cut limestone monuments, and, under Commission practice, reinforce concrete monuments with brass caps. The Office of County Surveyor was originally required to be filled by election, but now is more usually filled by County Board appointment. In any case, State law requires a County Surveyor to be a licensed professional surveyor.

To this day, the USPLSS remains in constant use in the conduct of land and engineering surveys. State law requires all new land subdivision plats and certified survey maps to be tied by distance and bearing to USPLSS corners. With the exception of lot surveys



Source: SEWRPC

FIGURE A-1
U.S. Public Land Survey System



This figure illustrates the construct of the U.S. Public Land Survey System. This system provides the basis for all land surveys in much of the United States. Its Perpetuation and use depends upon the preservation of the monuments marking the section and quarter-section corners.

in previously platted areas which can be indirectly tied through block corners to the USPLSS, most land and engineering surveys are tied directly to the USPLSS. Ties to the system are particularly important in the location of rights-of-way for arterial street and highway facilities and for electric power, oil, and natural gas transmission pipelines.

The Government surveys did not determine the location of the monumented corners by spherical coordinate position, that is, by latitude and longitude. Therefore, the use of the USPLSS is thus entirely dependent upon the existence of the physical monuments marking the corners of the system. This dependence upon monuments as opposed to the use of coordinate positions is the only significant weakness in an otherwise virtually perfect system. The Commission, very early in its existence, addressed this weakness by recommending the conversion of the USPLSS within the Region to a comprehensive control survey network. The Commission recommended that this be done by determining through high order geodetic surveys the coordinate positions of the monumented USPLSS corners. The coordinate system recommended for this purpose by the Commission is the State Plane Coordinate System based upon the North American Datum of 1927, an integral part of the National Geodetic Control Survey System. State Plane Coordinates are, in fact, an expression of latitude and longitude. By in this way combining the two systems—the USPLSS and the National Geodetic Control Survey System—the control survey network within the Region provides a monumented station of known position on both systems at approximately one-half mile intervals throughout the Region. The

Commission recommended control survey network also includes a vertical component. The elevations of this component are referred to the National Geodetic Vertical Datum of 1929, also known as mean sea level. The elevations are provided for the monumented horizontal control survey stations and to certain accessories thereto.

The Commission recommended control survey system not only facilitates the conduct of engineering and land surveys throughout the Region, but also provides for the coordination of such surveys throughout the seven county planning region. Importantly, it also provides the foundation for the preparation of accurate and readily correlatable topographic and cadastral maps and thereby provides the foundation for the creation of automated parcel based land information and public works management systems useable by private as well as public agencies within the Region. The coordination of surveys on an areawide basis is particularly important for the conduct of certain planning and engineering efforts, including the conduct of watershed hydraulic inventories; the determination of flood flows and stages; the delineation of flood hazard areas; the mapping of wetlands; the sound development of areawide sanitary sewerage, water supply, and stormwater management systems; the preparation of accurate as-built plans and profiles of constructed facilities; and, the collection of certain types of planning data such as land use data on a reliable areawide basis. Such replacement requires research of the historic record of the corner locations over time, and careful resurvey work, new monument placement, and documentation of the work.



Source: SEWRPC

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One Region, Focusing on Our Future

VISION 2050 is SEWRPC's land use and transportation planning effort for Southeastern Wisconsin.

Learn about VISION 2050 at www.vision2050sewis.org.

Follow us on Twitter at [@vision2050sewis](https://twitter.com/vision2050sewis).

The **Southeastern Wisconsin Regional Planning Commission** is the official advisory areawide planning agency for land use and infrastructure for the seven counties in the Region.

More information can be found at www.sewrpc.org.

Please contact us at sewrpcnews@sewrpc.org.



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