



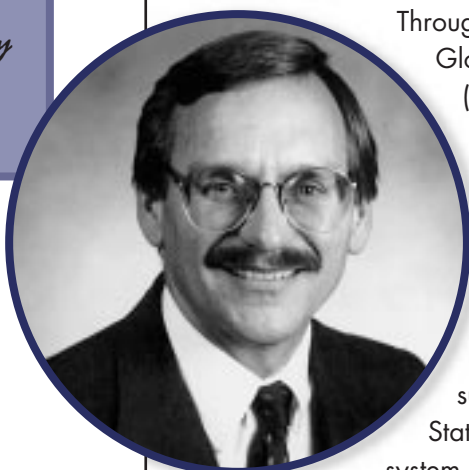
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COMMON STUMBLING BLOCKS IN THE USE OF STATE PLANE COORDINATES

JAMES E. KOVAS PS, PE

Throughout the 1990s, the Global Positioning System (GPS) has seen an exponential rise in the number of Professional Surveyors using this versatile technology. In most cases, the use of GPS equipment and software means that surveyors are using the State Plane coordinate system as the datum upon which their control framework is built.

Clients are frequently requesting State Plane coordinates as deliverables for parcel maps, utilities and community Geographic Information Systems (GIS).

In Michigan, the State Plane coordinates for maps and GIS databases are mostly based upon the North American Datum of 1983 (NAD83) or, sometimes, the North American Datum of 1927 (NAD27). The origin of the coordinates also depends upon which State Plane Zone you are in. The South Zone covers the state up to about Clare; the Central Zone covers from about Clare to Mackinaw City and the North Zone covers the Upper Peninsula.

The increasing acceptance of GPS and State Plane coordinate systems by Professional Surveyors and their clients has resulted in some common stumbling blocks. These stumbling blocks are caused by a lack of information and/or experience pertaining to State Plane coordinate systems here in Michigan. Below are the most common stumbling blocks I have dealt with in the past ten years along with guidelines to help pinpoint the problem.

METRIC UNITS TO FEET (INTERNATIONAL OR U.S.?)

Most adjustment programs use meters as the basic unit of measure when computing distances, elevations and final coordinates. The problem comes when the Surveyor is asked by the client to deliver the final coordinates in feet. The Surveyor's first question should be — International feet or U.S. Survey Feet? The Michigan State Plane Coordinate Act requires surveyors to deliver coordinates in units of meters or International Feet as a rule. But many clients have existing maps and database systems built on U.S. Survey foot (e.g. The Corp of Engineers). **If coordinates in the wrong foot units**

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are delivered you will most easily see a difference in the Easting coordinate for a set of known points or lines in your database. (The difference in the Northing coordinate is usually less than a foot and thus harder to detect). The difference in Easting coordinate varies depending on which Zone you are in as follows:

- South Zone: will have a difference of about 26 feet
- Central Zone: will have a difference of about 40 feet
- North Zone: will have a difference of about 53 feet

DATUM: NAD83 (WHAT ADJUSTMENT YEAR?)

Every five to ten years, the geodesists working for the National Geodetic Survey (NGS) find that they have enough new geodetic measurements from across the country to perform a new simultaneous least squares adjustment of all monuments on the North American Datum of 1983. This new adjustment results in new State Plane coordinates for all NGS monuments in the country. What this means to surveyors and their clients in Michigan is that the coordinates they have been using for a monument named "ALPHA" (for example) are now outdated and have been replaced by new, more precise coordinates for "ALPHA." The practical result of this new adjustment is that surveyors working in two neighboring counties using coordinates from the same datum (e.g. NAD83) but different adjustment years, must be aware of the situation. For example, Oakland County adopted NAD83 (1986) coordinates (the adjustment year is in parenthesis) for their GIS system and Wayne County adopted NAD83 (1994) coordinates for their GIS. **The result is that the same monument on the county line between Oakland and Wayne will have coordinates that differ by about 70 centimeters (2 feet +/-).** This difference in coordinates varies across the state depending upon where you are in each Zone. When obtaining control coordinates look for the adjustment year after the datum (e.g. NAD83 (1986) and use coordinates from the same adjustment year in your project adjustment.

A sampling was made of several monuments in each zone to determine an approximate range for the coordinate shift [NAD83(1986) to NAD83(1994)] as shown below.

- South Zone: Differences in the Northing range from 2cm to 18cm (0.1" to 0.6")
Differences in the Easting range from 25cm to 70cm (0.8" to 2.2")
- Central Zone: Differences in the Northing range from 8cm to 24cm (0.3" to 0.8")
Differences in the Easting range from 2cm to 14cm (0.1" to 0.5")
- North Zone: Differences in the Northing range from 12cm to 24cm (0.4" to 0.8")
Differences in the Easting range from 2cm to 26cm (0.1" to 0.9")

New adjustments from NGS are likely in the year 2002 or 2003. So, although this next adjustment will likely result in only a few centimeters in coordinate shift compared to NAD83 (1994) coordinates, it is always important to keep your eye on the parenthesis containing the adjustment year.

DATUM AND STATE PLANE ZONE

If you find a very large discrepancy (millions of feet or millions of meters) between the existing data base coordinates and the coordinates being delivered, look for the following differences in Easting coordinate to try and pinpoint the problem.

If the problem is related to the coordinates being on the **wrong datum (NAD27 or NAD83) look for the following differences in Easting coordinates:**

- South Zone: approximately 11,100,000 feet (3,400,000 meters)
- Central Zone: approximately 17,700,000 feet (5,400,000 meters)
- North Zone: approximately 24,250,000 feet (7,390,000 meters)



Brian Berdanier,
Chair, GIS Director,
Ottawa County

A Message from the Quality Committee

ANNOUNCING STATEWIDE AWARD PROGRAM

I would like everyone, as you begin to read this message, to sit back for a moment and contemplate the purpose of this consortium that we belong to. What does the consortium stand for? What are its goals and its objectives? What truly is, if you will, the strategic plan of this IMAGIN that we belong to? This is what the Quality Committee had to think through, as we worked back and forth to come up with the first ever IMAGIN award categories. These awards are in essence what we felt were ways to acknowledge those individuals and organizations that embrace the embodiment of what IMAGIN stands for.

In developing the nomination process and the award categories we also wanted to recognize that as we improve our access, we also need to build our awareness of these same networks. So, this is it. It's a chance, not only for others to recognize what is happening in the GIS world, but an opportunity for you to show them. If you have done what I asked in the opening sentence, I think you will find that the award categories truly do go to the core of what this consortium stands for.

As we announce these award categories, I would also like to commend the members of this committee for the time they have spent developing the program. We took this on over the holidays, never met in person, and actually used the technology available to us as we bantered back and forth via email. Each one of us was putting in our two cents worth every time someone came up with a new idea or a varied theme on an existing idea. Look for more to come in the future as we grow with GIS.

If the problem is related to the coordinates being in the **wrong NAD83** State Plane zone for those surveyors working in the border areas between South to Central or Central to North zones **look for the following differences in Easting coordinates:**

- South to Central zones:
6,560,000 feet
(2,000,000 meters)
- Central to North zones:
6,560,000 feet
(2,000,000 meters)

These are only the most common stumbling blocks for surveyors and their clients just getting used to the State Plane coordinate system. The above guidelines will hopefully help to pinpoint and correct problems while merging new coordinate data into existing data bases.

James E. Kovas is a member of the Geodetic Control/GIS Committee of MSPS and is the GPS/Survey Manager for Wade-Trim in the Flint office. This article is reprinted from the January/February issue of the Michigan Professional Surveyor publication.

Who Is Doing What in

GRAND TRAVERSE COUNTY

Locate on the map:

- Population: 72,072
- Geographic Coverage: County-295,099 acres/461 Sq. Miles
- Number of Staff: 3 Full time
- Yearly Budget: \$160,295

GIVE A STATUS OF YOUR PROGRAM

The GIS Needs Assessment was completed for Grand Traverse County in December of 1994. This was funded by the Coastal Management Program and Grand Traverse County. Subsequent to that report, the county developed the parcel ownership layer in-house in 1995. Soon after, the County developed a real time link (ODBC driver) between the parcel map and the assessment and tax administration databases. The parcel map/tax administration databases have been updated and archived for each year since. The county also contracted to have a Parcel Database Design for ArcInfo developed. Other data layers developed in-house include a road centerline layer; a road right-of-way easement layer; public lands; county commissioner districts; school districts; sewer lines; wastewater capacity model; water wells; zip code areas; and zoning districts. There are various other GIS related layers in use by county employees that were acquired through other sources.

The county currently employs one GIS Coordinator and two GIS technicians. The county has also provided in-house ArcView training to county personnel, Traverse City employees, and Township personnel. There are three committees which have been working on successful GIS implementation in Grand Traverse County. The GIS Implementation Committee composed of township representatives, county department heads, NWMCOG, GIS staff, vendors, and others which meets once a month; a GIS County Team composed of county

GIS and Spatial Technology?

department heads and staff which meets once a month; and a GIS Technical Committee that meets as needed.

The application of GIS technology in many Grand Traverse County Departments, such as the Drain Commission, Planning, Administration, Health Department, Construction Code, Gypsy Moth, 9-1-1, and Equalization, has been made with exceptional results. The mapping of impervious surface coverage for watershed monitoring and land use planning was selected as a Poster Presentation at the Coastal Zone 97 Conference. The Wastewater Capacity model was demonstrated at the Seventh Annual Imagin Forum. A land value analysis tool was developed for the Equalization Department. Digitization of the spray blocks for the Gypsy Moth Control Program received a letter of appreciation from the Gypsy Moth Coordinator. Much work and analysis was done for the Affordable Housing Task Force — also very well received. Since users generally outnumber developers in a GIS system, it is important that it is structured to allow ease of use by individuals who are not “techies”. This continues to be a concern for the county and applications are continually being sought to help in this regard.

Software utilized in GIS implementation in Grand Traverse County are ArcView 3.1; ArcInfo 7.2 (Windows NT); Novell 5.0; Resource Software (Equalization); BS&A (Appraisals); Tin; Grid; COGO; and Network. ODBC links have also been made to the AS/400 which houses many department’s databases. The county also uses several ArcView custom and “shrink wrapped” extensions such as LabelEase; a map printing extension, Resource-Link and Equal-Link, as well as a new Enhanced Geocoding extension.

DESCRIBE ANY NEW PROJECTS OR ACTIVITIES

The county is currently completing two projects commenced in 1999. ESRI’s Spatial Database Engine (SDE) acquisition and installation and an Enhanced Geocoding Application. Four new projects are slated for the Year 2000.

In 1992, the Master Street Index was computerized and the MIS Department used voter registration as the first application to have address verification against the Master Street Index. In 1998, GIS developed a Road Centerline Layer using the Master Street Index as a guide. The addresses in Resource Software were geocoded to the Road Centerline Layer and on the first attempt approximately 75% of the addresses were



successfully geocoded. This low match rate was determined to be caused by ArcView’s address parsing functions incorrectly interpreting valid road names and was considered unacceptable. As a result of the poor match-up, an Advanced Geocoding Extension for ArcView was developed. The purpose was to achieve higher match rates for Equalization, 9-1-1, Construction Code, and other users of the county’s Road Centerline Coverage. This application contains the ability to select a parcel as well as geocode which is important when some parcels are not located on the road that they are geocoded to.

Grand Traverse County requested a proposal for acquisition, installation, configuration, and end-user training of ESRI’s Spatial Database Engine (SDE) on a centralized geographic data server. This server and the software loaded on it will provide a highly scalable, centralized repository for the county’s GIS database. It will be accessible to users throughout the enterprise via the county’s existing LAN resources.

The county is in the process of switching from NAD27 to NAD83 .

The county will be using LIDAR technology on the Boardman River Hazard Mitigation Project. Mitigation involves working with and providing funding to landowners to either elevate

structures, install flood protection measures, or acquire property.

The county will also be working to implement an intranet GIS application for non-technical staff using a very simple, user friendly GIS data view and query tool built from ESRI's MapObjects and MapObjects LT software.

WHAT WOULD YOU DO DIFFERENTLY IF YOU HAD TO START OVER?

If Grand Traverse County had to start over, two major items would, hopefully, be handled better. The assessors in Grand Traverse County do not utilize a permanent parcel numbering system which has created major headaches which have never been fully resolved. A more concerted effort should have been made to make that happen. Some units have now adopted a permanent parcel numbering scheme but until they all do, it is still a problem. Number two, when the parcel ownership layer was developed, the subdivision layer should have been created at the same time. The GIS technician responsible for parcel maintenance has found this situation to be difficult and the department has not found the time to remedy the situation. We also should have made a stronger effort to incorporate the re-monumentation program earlier in parcel ownership development. We have learned a lot since December of 1994 and the list could get rather large. If you had all the money and resources to do everything the way you would like to do it the first time, some time and resources could have been saved but generally, GIS Implementation has gone well.

IF YOU HAD THE GIS GURU STANDING IN FRONT OF YOU — WHAT QUESTIONS OR PROBLEM WOULD YOU HAVE HIM/HER SOLVE?

We have had consistent problems with annotation. Annotation developed in ArcInfo does not work well for the

majority of our users utilizing ArcView. We would be happier campers if a magic potion for annotation could be had. Without expensive mapping software, tax map creation is difficult and time consuming — advice here would be appreciated.

WHAT VALUABLE PIECE OF INFORMATION HAVE YOU LEARNED THAT YOU WOULD YOU LIKE TO SHARE WITH THE GIS COMMUNITY?

We have been much more successful in GIS Implementation in Grand Traverse County by providing data free of charge to other County Departments, Townships, Villages, Traverse City, Traverse City Light & Power, Grand Traverse County Road Commission and Grand Traverse County Soil Conservation District rather than worrying about trying to promote making money with GIS. By working in collaboration with various entities on projects, several grants have been sought and received which help considerably in the development of applications. Grand Traverse County has already been awarded over \$400,000 in grants for various GIS projects for the Year 2000 including ESRI's Livable Communities Grant, State Police Emergency Management Division and FEMA for the Boardman River Hazard Mitigation Project and a grant from the Grand Traverse Band of Ottawa and Chippewa Indians for an Intranet application.

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Land Use Classification

Many will remember in the late 1970s and early 1980s when the Michigan Department of Natural Resources Michigan Resource Inventory System (MIRIS) partnered with county governments to map land use and land cover. That was done with a numeric classification system. Today there have been several efforts to update/change the numeric classification system, each with little input from local government or users. More recently a number of county and local governments have been updating the land use/cover maps, followed up with a change analysis of their community. However the use of changed/updated numeric

classification system has made some change analysis problematic. Other communities have simply continued to use the circa 1970s MIRIS land use/cover classification system. IMAGIN has now partnered with Michigan State University's Center for Remote Sensing to work on creating a land use/cover classification system which both has updated features and retains direct comparability to the circa 1970s classification system. That effort is divided into three parts:

1. The very technical aspects up updating (registration to what base, type of air photography imaging being used and so on).
2. The update of the numeric land use/cover classification system (one system for land use and land cover, or separate; the categories used, minimum mapping size, and so on).
3. An inventory of communities which have already done updates. This is not generally known — other than in that community. This effort is to learn what has been done so far. Each of these topics is being discussed in detail at a virtual meeting. Please feel free to view the discussion, and add your comments. It can be seen at <http://www.imagin.org>.

Census 2000 Participant Statistical Areas Program

Many GIS users are excited about the upcoming release of Census 2000 data. With the 2000 Census just around the corner the Census Bureau is offering local participants the opportunity to delineate statistical areas for tabulation in the Census 2000. The Statistical Area Program includes:

- Census Tracts
- Census Block Groups
- Census Designated Places
- Census County Divisions

The 1990 Census offered a similar opportunity, however the Census Bureau required local data users to organize a census statistical area committee. For Census 2000, the Census Bureau is not requiring the formation of a formal committee, but rather requesting that one agency take a lead role in coordinating the effort.

Growth is the greatest factor for new delineations of Census boundaries. As an example a Census Tract in the United States, Puerto Rico, and the Virgin Islands must have a minimum population of 1,500, a maximum population of 8,000, with the optimum population at 4,000. With many units experiencing growth rates in the twenty percentile it is very important that we all participate. Supplying the Bureau with accurate

information improves the prospect that planning for our region is reasonably addressed.

For additional information regarding the Participant Statistical Areas Program check out their web site at www.census.gov/geo/www/psapage.html

Oops!

Our apologies to Barry County. Our GPS system went on the fritz and mislocated Barry County on the map. Barry County should have been located as shown:



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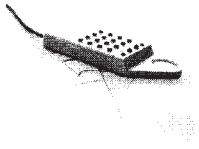
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