

WLIA Standard

Geodetic Control Clearinghouse Report

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Frontispiece

This standard was developed by a Wisconsin Land Information Association (WLIA) Task Force. The Task Force members were:

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The WLIA Geodetic Control Clearinghouse Task Force was formed under the Technical Issues Committee on March 23, 1992. The Task Force's objective is to examine the issues involved with geodetic control information distribution, sharing, and database management. The goals of the Task Force were:

- 1 review data needs,
- 2 identify sources of geodetic control information,
- 3 make recommendations for the responsibility of a clearinghouse,
- 4 suggest a database design,
- 5 suggest methods for maintaining and distributing information, and
- 6 examine and report on data security and integrity issues.

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Executive Summary

Geodetic control points are permanent physical monuments placed in the ground and precisely marked, located, and identified. All geodetic control points have either precise horizontal or vertical positions; some have both. Geodetic control provides a common anchoring framework for positioning information developed for mapping, aerial photography, surveying, and engineering applications and databases.

Traditionally geodetic control has been established and documented by federal agencies including the National Geodetic Survey (NGS) and U.S. Geologic Survey (USGS). Historically, the NGS has developed the procedures and standards for creating and maintaining geodetic control information. These federal data and standards still represent the primary geodetic holding available for inclusion in a geodetic clearinghouse.

However, additional geodetic control points are rapidly being established by state agencies, local governments, and the private sector. In Wisconsin, the Department of Transportation and the Department of Natural Resources are two state agencies active in the production and use of geodetic control. Local governments and the private sector are also increasing their geodetic control densification and positioning activities and will soon be the most active producers of geodetic data.

The recent rise in interest in geodetic control information is due to two parallel developments. First, there is an increased need for geodetic control information to support land records modernization and geographic information systems activities in Wisconsin. Secondly, changing technology and methodology, such as the global positioning system (GPS) and its use, allows geodetic information to be produced faster, more accurately, and at a lower cost than previously possible. Together these factors have generated a tremendous demand for geodetic control data.

Without a means of checking or knowing the data holdings of other organizations, there is a greater likelihood of duplicated effort in establishing geodetic control. To avoid costly or unnecessary production of geodetic control where it already exists, there is a need for a systematic and uniform method of identifying, recording, updating, and accessing geodetic control information.

For nearly 20 years, the point of contact in Wisconsin for federal geodetic control information has been the State Cartographer's Office (SCO). The SCO has a formal relationship with the NGS through a cooperative agreement recognizing the SCO as the NGS Geodetic Data Center for Wisconsin. In addition, the SCO works closely with the NGS State Geodetic Advisor and the Wisconsin Land Information Board in supporting geodetic control data, product, and services activities in Wisconsin.

For non-federal information, such as state agency, local government or private sector geodetic control data, there is not a clearly defined point of contact or means for data sharing. Additionally, the majority of non-federal information is in paper form, varying formats, and is not prepared for distribution or public access.

Therefore, the WLIA Geodetic Control Clearinghouse Task Force proposes the following action items:

1. Support the sharing of geodetic control information through a statewide clearinghouse database fed by the various producers of geodetic data in Wisconsin.
2. Recognize and adopt the proposed Geodetic Control Clearinghouse Standard as a means to provide for the uniform reporting and distribution of geodetic control information in Wisconsin.
3. Forward WLIA Standard 1994-4 to the Wisconsin Land Information Board (WLIB) for inclusion in the county planning and grants-in-aid processes.

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4. Support the continued development of a Geodetic Control Information Clearinghouse using the resources, skills, and experience of the State Cartographer's Office.
5. Include in the Geodetic Control Information Clearinghouse, all geodetic control stations and PLSS (monumented) corners with positions that meet the requirements of FGCS Third Order or higher accuracy classification.

1. Purpose

The purpose of the WLIA Geodetic Control Clearinghouse Task Force is to examine the issues involved with geodetic control information distribution, sharing, and database management. The goals of the Task Force are:

1. review data needs,
2. identify sources of geodetic control information,
3. make recommendations for the responsibility of a clearinghouse,
4. suggest a database design,
5. suggest methods for maintaining and distributing information, and
6. examine and report on data security and integrity issues.

In the two years since the inception of this Task Force the use of global positioning system (GPS) technology has resulted in an exponential increase in the production of geodetic control information in Wisconsin. At the same time, there has been a growing concern, both at the state and national level, for the need develop metadata and clearinghouses for rapidly developing geospatial information holdings.

Given these developments, the Task Force focused its efforts on developing a standardized database description that could be used by all levels of government and the private sector to report and organize geodetic control information for data sharing purposes.

2. Background

2.1 Geodetic Control Data and Availability

Interest in geodetic information has increased because of the need for precise horizontal and vertical control to support surveying and mapping activities leading to map products, engineering projects, and geographic information system (GIS) implementation. Increased use of global positioning system (GPS) technology for positioning survey monuments and other objects has also generated a greater demand for geodetic control information. Expanding technologies such as remote sensing and satellite imagery will increasingly use geodetic data to support image registration.

Current sources of geodetic information are many and diverse. In Wisconsin, federal geodetic control information is available from the State Cartographer's Office (SCO). Individual state agencies have varying methods for organizing and distributing geodetic information. Increased activities in local governments and the private sector make the sources of geodetic control information even more dispersed and of varying quality.

Access to existing geodetic control information by government and the private sector helps to encourage the use of common and accepted locational reference systems and standards of accuracy. In addition, it reduces the likelihood of unnecessarily establishing new control points if others already exist in an area.

It is critical that the user community be able to obtain all the necessary geodetic control information from a single source, and in addition, that staff is available to provide the technical support to insure its proper use. Geodetic

control producers are typically not in the position to respond to public inquiries for data and technical assistance. Such inquiries stretch the resources of state agencies and local governments.

2.2 The Wisconsin State Cartographer's Office

In Wisconsin, the point of contact for federal geodetic data is the State Cartographer's Office (SCO). The SCO maintains files on published data for the 20,000 plus NGS and USGS horizontal and vertical geodetic control points in the state, as well as other historical federal control networks used in Wisconsin. National Geodetic Reference system (NGRS) data holdings are complete for information published on the NAD 27, NAD 83(1986), NAD 83(1991), NGVD 29, and NAVD 88 datums.

The SCO has answered public inquiries regarding geodetic control information in Wisconsin for nearly 20 years, averaging about 750 inquiries per year. Those requesting geodetic control information are primarily consulting engineering firms, private surveyors, and county surveyors. Inquiries are answered by mail, phone, fax, and by a bulletin board service.

2.3 The Need for a Statewide Geodetic Control Clearinghouse

Through the Wisconsin Land Information Program (WLIP) locally produced, high quality geodetic data are becoming increasingly common. The philosophy of the WLIP is that this locally generated data should be maintained locally. This report does not address the production of geodetic control, but rather a database standard which can be used to enhance data sharing among the geodetic control producer and user communities in Wisconsin.

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The Task Force recommends that statewide data sharing be achieved through a clearinghouse fed by the various producers of geodetic data in Wisconsin. The information contained in the database would come from many sources, including the National Geodetic Survey, the U.S. Geological Survey, the Army Corps of Engineers, the Wisconsin Departments of Transportation and Natural Resources, County Surveyors and Land Information Officers, City Engineers, utility companies, and private surveying and engineering firms. This database would provide basic geodetic control information and metadata, and direct the user to a source of additional information.

An automated geodetic control database would provide geodetic information in an electronic medium allowing ready data access, modification, and distribution. The data stored in the database should allow the user to:

- Obtain a report of all geodetic control located in a specific area,
- Obtain a computer file of geodetic control descriptive information,
- Obtain a map showing the location of the stations, and
- Obtain an accompanying metadata report.

3. Definitions

Clearinghouse	A central source for reference information that combines information derived from multiple sources.
FGCS	Federal Geodetic Control Subcommittee, formally known as the Federal Geodetic Control Committee (FGCC), is made up of eleven federal agencies and departments. The FGCS coordinates federal geodetic data.
GIS	Geographic Information System: Comprised of spatial data and related information stored in a computer and retrievable in the form of maps and data. The system allows for sorting and layering information and numerous selection and analytical options.
NGS Blue Book	A multi-volume set of books entitled <i>Input Formats and Specifications of the National Geodetic Survey Data Base</i> . These reference volumes provide details on what data and formats are necessary to have geodetic data included in the National Geodetic Reference System (NGRS) database.
Metadata	Systematic information about the data used for cataloging and classification of data. The Federal Geographic Data Committee (FGDC) has approved a metadata content standard for digital spatial data. This has been adapted for use with federal geodetic control information by the NGS.

4. The Geodetic Control Database Standard

To facilitate sharing geodetic control information in an efficient manner, the Task Force recommends a uniform standard for reporting and sharing geodetic control information. The standard will provide guidance to those establishing databases and will facilitate the exchange of information between databases.

The standard is designed as a conceptual, or business level, data model for a geodetic control database to be used in a statewide clearinghouse, as well as a model for use by those interested in exchanging data with the clearinghouse.

4.1 Limitations of Accepted Data

Many survey points have coordinate values assigned to them but are not established or monumented to geodetic standards. For example, Public Land Survey System (PLSS) corners often serve the dual purpose of monumenting land boundaries as well as providing local control for surveying and mapping.

The Task Force recommends including in the statewide geodetic control clearinghouse, geodetic control stations and PLSS (monumented) corners with positions that meet the requirements of FGCS Third Order or higher accuracy classification. This does not reflect upon the legal status of a geodetic point as a PLSS monument since the monument's legal status is independent of a coordinate value. The Task Force further cautions that PLSS monuments are subject to being moved for legal surveying purposes.

A statement describing how the point was classified for accuracy is included in the database and needs to be evaluated by the database user to determine the point's appropriateness for the user's application. The clearinghouse is proposed to act as a repository and source of information, and not as a mechanism for the review of the quality or classification of the survey work.

4.2 Database Contents

Each database record will contain the latitude and longitude value of the point referenced to the NAD 83 (1991) datum adjustment, and/or the orthometric height of the point (in meters) referenced to the NAVD 88 datum. Data not referenced to NAD 83 (1991) or NAVD 88 may be converted to the required common base. The data originator should be contacted to verify all locations and quality.

Each record will also contain the metadata necessary for the evaluation and use of the point. This metadata includes information concerning data quality, lineage, contact persons, and monument and station descriptions.

4.3 Relational Chart Indicating Required and Optional Fields

Appendix A contains a diagram of the entities and their connections. This diagram illustrates ten primary entities and their associated attributes that will be included in the clearinghouse. The GIS Location in the diagram in Appendix A would be the clearinghouse spatial representation of the point, necessary to manage the geodetic data.

Within each entity the diagram also indicates recommended mandatory attributes. The mandatory attributes are:

- Station Name
- Station Description
- Description Date
- Latitude
- Longitude
- Orthometric Height (meters)
- Date of Position
- Data Source
- Accuracy Order
- Accuracy Statement
- Data Quality Statement
- County
- Mark Code
- Setting Code
- Stamp
- Agency/Firm Set
- Date Set
- Contact Agency/Firm
- Contact Person
- Contact Address
- Contact Telephone Number

4.4 Database Field Names and Definitions

Appendix B contains the definitions of the attributes shown on the diagram in Appendix A. These definitions may need to be expanded when the database is implemented.

5. Further Discussion

5.1 Use of the Standard

The primary use of this standard is to facilitate the sharing of geodetic control information in Wisconsin. This sharing may occur among public and private sectors, units within a governmental department, departments within a governmental jurisdiction, or among two or more jurisdictions. The sharing may occur among several jurisdictions at one level of government or vertically among different levels of government. Data sharing is important in all of these scenarios, and this standard is intended to provide the framework which will allow data sharing to occur at any of these levels or contingencies.

The standard is focused on semantic or definitional considerations such as content and form of the geodetic database, rather than specific system level considerations such as format and protocol. The Task Force recognizes the importance of the latter standard, but defers this to a later step in the WLIA standards development process.

The proposed standard is designed for use in developing data exchange arrangements among users and is not a standard designed to support the building of data systems. Therefore, several points regarding this standard may need clarification:

First, this standard is intended to be part of the Wisconsin Land Information Network (WLIN) and is part of a proposed clearinghouse function.

Second, this standard is not an implementation standard. Those in need of an implementation standard will need to locate or develop a standard at the more detailed system level noted above.

Third, this standard is recommended as a voluntary standard.

5.2 Effective Development of the Standard

The development of the geodetic control database standard described in this document is only a first step in its long term, effective use. Additional steps that need to be taken include:

- the development of a system level standard, including technical formats, database design, and data classification,
- the provision of training in the use of the standard,
- the provision of user guides for system users, and
- the continual refinement of the standard as required by future needs and developments.

Similarly, the establishment of the clearinghouse described in this document requires appropriate staff, hardware, and software. An ideal scenario would include a database compiled from various federal, state and local government, utility, and private sector data, and the dissemination of that data via a modem, network, or fax. To do this would require:

- that the scope and functions of the clearinghouse be further and clearly defined, including staffing, space and equipment,

- that institutional arrangements be addressed, including data sharing agreements and attention to maintenance, security, and access issues, and
- that the system level design of the database be developed and refined.

Given the existing role, records, relationships and experience of the State Cartographer's Office, the Task Force recommends the expansion of that office's services as Wisconsin's Geodetic Control Information Clearinghouse.

6. Recommendations

The Task Force recommends that WLIA take the following actions:

1. Support the sharing of geodetic control information through a statewide clearinghouse database fed by the various producers of geodetic data in Wisconsin.
2. Recognize and adopt the proposed Geodetic Control Clearinghouse Standard as a means to provide for the uniform reporting and distribution of geodetic control information in Wisconsin.
3. Forward WLIA Standard 1994-4 to the Wisconsin Land Information Board (WLIB) for inclusion in the county planning and grants-in-aid processes.
4. Support the continued development of a Geodetic Control Information Clearinghouse using the resources, skills, and experience of the State Cartographer's Office.
5. Include in the Geodetic Control Information Clearinghouse, all geodetic control stations and PLSS (monumented) corners with positions that meet the requirements of FGCS Third Order or higher accuracy classification.

7. References

Bacon, Myron et al., 1990, WLIA Technical Committee Summary Report on Geodetic Datums for Wisconsin, 21 pp.

Croswell, Peter L., (1992) URISA Status Report on GIS Data Standards, presented at GIS/LIS 92, San Jose, CA, November.

Danielsen, Diann, 1992, "Modeling a Statewide Clearinghouse for Geodetic Control Information," Surveying and LIS Seminar, Department of Civil and Environmental Engineering, University of Wisconsin-Madison, May.

Eiber, Tom, and Les Maki, 1991, "Is there a need for a Central Data Repository?", Minnesota Department of Natural Resources, Land Management Information Center (LMIC).

Federal Geographic Data Committee, Federal Geodetic Control Subcommittee, draft, June 24, 1994, "Digital Geospatial Metadata for Geodetic Data", 24 pp.

Fontaine Company, 1992, "A Preliminary Design and Strategic Plan for Implementing the Coast and Geographic Information Network (CAGIN)," Columbia, South Carolina.

Gorg, David, 1992, "MN/DOT Geodetic Database Development," GIS/LIS Proceedings, Volume 1, pages 282-292.

Hoyle, Dixon, and David Gorg, 1992, "Minnesota Geodetic Control Distribution," WLIA General membership meeting presentation, Eau Claire, Wisconsin.

Minnesota Department of Natural Resources, 1992, "PLS Corners Control Point Inventory System," Preliminary Draft, March.

Minnesota Department of Transportation, 1992, "MnDOT Geodetic Database Documentation," Geodetic Unit, March.

Moyer, D. David and Bernard J. Niemann, Jr., 1993, "The Why, What and How of GIS Standards: Issues for Discussion and Resolution," URISA Journal, Vol. 5, No. 2, pp. 28-43.

Wisconsin Land Information Association, 1992, WLIA Standard 1992-1, "Guideline for Standard Development".

Appendix A

Relational Chart Indicating Required and Optional Fields

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Appendix B

Database Field Names and Definitions

POSITION

Latitude	Latitude of the point referenced to the NAD 83 (1991) datum adjustment.
Longitude	Longitude of the point referenced to the NAD 83 (1991) datum adjustment.
Height	Orthometric height (in meters) of the point referenced to the NAVD 88 datum.

DATA QUALITY

Accuracy Order	The order and class of accuracy for the point. (e.g., 2nd Order Class I)
Accuracy Statement	The supporting data or reasons for assigning the above order and class of accuracy.
Data Quality Statement	A statement about the reliability of the position.
Error Ellipse X	The x value of the error ellipse.
Error Ellipse Y	The y value of the error ellipse.
Error Ellipse XY Units	The units in which the xy values for the error ellipse are measured.
Error Ellipse Angle	The counter clockwise rotation to the north for the x axis of the error ellipse.
Error Ellipse Angle Units	The units in which the error ellipse angle is measured.
Standard Error	The root mean square error of the least squares adjustment.

LINEAGE

Date of Position	The date the position was established.
Data Source	The source from which the data was obtained.
Data Entry Date	The date the data was entered into the database.
Data Entry Person	The name of the person who entered the data into the database.

CONTACT

Contact Agency/Firm	The agency or firm to be contacted for more information.
Contact Person	The name and/or title of the person in the agency or firm to be contacted for more information.
Contact Address	The address of the agency or firm to be contacted for more information.
Contact Phone	The phone number (with area code) of the agency or firm to be contacted for more information.
Contact Fax	The fax number (with area code) of the agency or firm to be contacted for more information.

GIS LOCATION

GIS Management Location	The position of the point as reflected on the graphic base.
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NAMES

Record Key	Automatically generated key for the database.
NGS PID	The point identifier used by NGS for this point.
DOT Point ID	The point identifier used by the Dept. of Transportation for this point.
DNR Point ID	The point identifier used by the Dept. of Natural Resources for this point.
Other ID	Any other unique point identifier used for this point.
Bridge ID	The bridge identification number used by the Dept. of Transportation.
DOT Project ID	The Financial Operating System (FOS) project ID used by the Dept. of Transportation.

LOCATORS

County	The county in which the point is located.
Closest City	The closest city, village, or place to the point.
Roadway	The closest highway, county trunk, or city road to the point.
Section	The PLSS section in which the point is located.
Township	The PLSS township in which the point is located (including N).
Range	The PLSS range in which the point is located (including E or W).
Quad Name	The name of the quadrangle map on which the point can be located.
Quad Series	The quad map series corresponding to the map in Quad Name.
Quad ID	The USGS identifier corresponding to the map in Quad Name.

MONUMENT

Mark Code	The NGS code for the surface mark.
Setting Code	The NGS code for the mark setting.
Stamp	The text of the monument stamping.
Agency/Firm Set	The name of the agency or firm responsible for setting the monument.
Date Set	The date the monument was set.

RECOVERY

Station Name	The name of the station.
Station Description	The information necessary to identify and locate this point (including the "to reach").
Description Date	The date of the station description.
Recovery Note	The information describing a recovery of the point (including condition).
Recovery Date	The date of the recovery note information.

COMMENTS

Comments

Additional information about this point.