The Map Legend

New Mexico Geographic Information Council, Inc.

...reporting on geographic information for and about the Land of Enchantment...

Volume 5, Number 4 *Summer 1994*

Geodata News

U. S. Geological Survey

The U.S. Geological Survey (USGS) is in the process of transferring the majority of digital data distribution functions from USGS Headquarters (Reston, Virginia) to the EROS Data Center (Sioux Falls, South Dakota). EROS Data Center will offer USGS digital data customers two significant customer service enhancements: additional data media formats, and Internet file transfer protocol (FTP) access to a variety of USGS data sets.

Currently the majority of USGS digital data are only available on 9-track magnetic tape media. Customers operating smaller computer platforms must convert USGS data from 9-track tape to compatible media for their systems. The EROS Data Center will be offering digital data customers additional data media options such as 8mm cartridge, floppy disk, and CD-ROM.

EROS Data Center is also offering Internet connected digital data users the option of accessing and downloading a variety of USGS digital data sets. Currently the following data sets for the entire United States are available:

- 1:2,000,000-Scale Digital Line Graphs (DLG)
- 1:100,000-Scale Digital Line Graphs (DLG) Hydrography and Transportation Data Layers
- 1:250,000-Scale Digital Elevation Model (DEM)
- 1:250,000-Scale Land Use Land Cover (LULC)

Customers can download files by connecting to the EROS Data Center server **edcftp.cr.usgs.gov** and transfer data using anonymous file transfer protocol (FTP). Data sets are located in separate directories with files located in subdirectories A-Z based on the first character of the graphic map name. A README file provides detailed information about the data sets.

The following procedures are used to access USGS data:

- FTP to edcftp.cr.usgs.gov.
- Enter "anonymous" at the Name prompt.
- Enter complete Internet address at password prompt.
- Change (cd) to desired data set directory (i.e. cd pub/data/DEM/250)
- Set file transfer mode to binary by typing "binary".
- Transfer selected file(s) to your computer.
- Logoff edcftp.cr.usgs.gov by typing "quit".

Additional USGS data sets will be available as they are loaded on the server; periodically review the FTP account for new data sets.

From the President
Richard Friedman

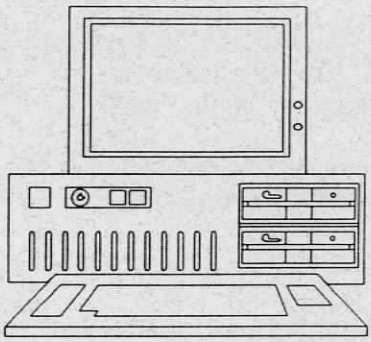
July 1994

Thanks to the foresight of its early leaders, the New Mexico Geographic Information Council now provides an excellent forum for the professional growth of individuals involved in the use of geographic information throughout New Mexico. Over the years the organization has grown from a small group of about 15 members, to an organization of over 200 members. Even though our numbers have grown, we currently have two key positions that we need to fill. We need a new chairperson for the GIS Committee and a chairperson for the Public Awareness/ Education Committee.

Both of these positions are key to the continued success of NMGIC. The GIS Committee has the largest membership of all the standing committees and is responsible for coordinating the Fall Users Exhibit. The Public Awareness/Education Committee produces our quarterly newsletter and is responsible for recruiting for our geography scholarship. We are looking for candidates who are willing and able to put the time and energy into these positions to ensure the continued success of these committees.

The most important qualification for potential candidates is a true desire to serve. I hope that some of our members that have not been actively involved in NMGIC will step forward to fill these positions. If you are interested in serving in one of these positions, or know of someone who would be interested in one of the positions, please feel free to call me at 505 863-9517.

The Map Legend



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Assembly: **Amy Budge**

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Geographic Names Information System CD-ROM is Available

The long-awaited CD-ROM of the Geographic Names Information System (GNIS) database finally is available.

The CD-ROM includes geographic names for all 50 states, including states for which the Phase II inventory (non-USGS names and variants) has been completed. Each record in the feature-based database includes the feature's name, its feature class (stream, summit, populated place, etc.), country, name of the USGS 7.5-minute quad the feature appears on, latitude-longitude coordinates, variants, and a bibliographical reference, as well as other information. The number of records for New Mexico approaches 50,000.

The CD-ROM costs $57 and comes with a manual and bundled sotware; all that is required by the purchaser is a CD-ROM reader. The CD-ROM can be ordered from USGS Earth Science Information Centers (ESICs); New Mexico's ESIC is at the UNM Earth Data Analysis Center (EDAC) under the management of Amy Budge, 277-3622. The CD-ROMs can also be ordered from the national ESIC in Reston, Virginia, by calling 1-800-USA-MAPS.

Mapping Partnership

USGS and the Bureau of Land Management, Oregon State Office, have agreed to share resources to cooperatively produce 1:24,000-scale digital line graphs (DLGs) and digital elevation models (DEMs) in northeast Oregon. This partnership provides digitized mapping data to support the GIS analysis requirements of BLM's Columbia River Ecosystem Management Initiatives. The first priority project area covers approximately 10,000 square miles (180 7.5-minute quadrangles). The Interagency Agreement for this project has been drafted and is currently being reviewed by both agencies.

Randle Olsen, Chief, Rocky Mountain Mapping Center, Denver, Colorado, 303 236-5825

USGS Facilities Move in Denver

A building renovation project has begun at the Denver Federal Center. A GSA contract was awarded to M.A. Mortenson Company, and construction began in late January. The project will modify and add office and production space to the warehouse facility that currently houses the USGS published product storage and distribution operation. The renovated building will then house all 450 employees engaged in the National Mapping Program at this site. Construction is scheduled for completion in the spring of 1995; the Mapping Center relocation, by the late summer of 1995.

Marilyn Myers, Assistant Chief, Rocky Mountain Mapping Center, Denver, Colorado, 303 236-5826

Computer Image Mapping

On February 14, 1994, the USGS began public distribution of digital orthophoto quadrangle (DOQ) data. DOQs are digital images prepared from aerial photographs. The data are being produced in cooperation with other Federal and State agencies for use in geographic information system (GIS) applications such as revision of maps, vegetation and timber management, transportation routing and habitat analysis, environmental impact assessment, facility management, and groundwater and watershed analysis. Inquiries on the availability of DOQs for specific areas may be directed to any USGS Earth Science Information Center or may be obtained by calling 1-800-USA-MAPS.

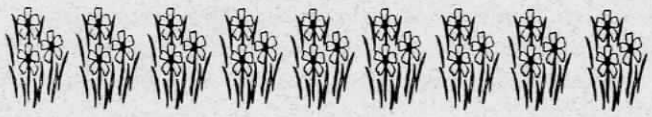
Teresa A. Dean, Chief, National Digital Cartographic Data Base Office, Reston, VA, 703 648-5582

GSD/ISD News

GIS Training Classes

GSD/ISD sponsored Advanced ArcInfo and ArcInfo with AML classes in July. The classes were taught by ESRI and were held at SUN Microsystems in Albuquerque. GSD/ISD brings in classes based on demand and user community interest. The most rapidly growing class demand at this point is for Intro to ArcInfo. Please contact Ann Gibson (505 827-2046) to express interest in, or make suggestions about, any future GIS classes.

Keep on the lookout, or get your name on the list, for an ArcView2 class which is ***tentatively*** scheduled for the November/December 1994 timeframe. If this class happens as planned, there will be one two-day session in Santa Fe and another two-day session in Albuquerque. It is anticipated that the cost per student per session will be $300 (based on a ten student minimum per session).



Geodetic Datums Exposed
Part One - Horizontal Datums

by William Stone
New Mexico State Geodetic Advisor, National Geodetic Survey
and NMGIC Global Positioning System Committee Chairman

A geodetic datum is a set of numerical quantities which specifies a positional coordinate system and a mechanism for accessing the system. Datums provide the fundamental frameworks to which positional information is referenced. They play a vital role in surveying, mapping, geodesy, and related disciplines. Due to the importance of datums to geographically referenced data, a basic understanding of them is desirable. In this article, I will summarize the essential concepts of datums and present some specific details of currently used geodetic datums in the United States.

Historically, horizontal and vertical geodetic datums have been developed separately from each other. A horizontal datum provides the system for computing and expressing a point's latitude and longitude, or related quantities such as state plane or other planar system coordinates. The basis for a horizontal datum is a mathematical surface, an ellipsoid, which approximates the shape of the earth. Geodetic computations can be performed on an ellipsoid, as opposed to the topographic or gravitational (geoid) surfaces, which are too irregular to support the calculations. A vertical datum defines the surface or reference level to which elevations or other height quantities are related. With the advent of three dimensional positioning technologies, such as the Global Positioning System (GPS), some applications utilize positions expressed in a single three dimensional system.

An important component of a datum is the mechanism for accessing the framework. This generally takes the form of a network of monumented points whose horizontal positions and/or elevations are rigorously determined relative to the datum. By making GPS or classical measurements between these control stations and unknown points, the positions/elevations of the unknowns can be determined, relative to the known points that are occupied, and hence, relative to the datum as well.

In 1927, the U.S. Coast and Geodetic Survey (USC&GS) began work on a project to compute a consistent set of coordinates for the approximately 25,000 monumented points that existed in the national horizontal geodetic control network at the time. This adjustment process involved the analysis and combination of various field observations, including horizontal and vertical angles, distance measurements, and astronomic azimuths. The task took five years to complete and resulted in the establishment of the North American Datum of 1927 (NAD 27), with the coordinates of the monumented points being referenced to this datum. The reference ellipsoid used as a basis for the NAD 27 was the Clarke 1866 ellipsoid, which had been used for many years prior to the NAD 27 adjustment.

NAD 27 served as the basis for horizontal positions in the United States for several decades. During this time, geodetic surveys were performed by various organizations and were tied into the NAD 27 network. As surveying technologies improved over the years, newly performed work was often recognized to be of superior accuracy compared with the original network. In the early 1970s, a study concluded that the time had come to perform a new adjustment of the horizontal control network. The study identified many shortcomings of the NAD 27, including the force fitting of new surveys to a, sometimes, inferior network; the absence of control points along the Atlantic Seaboard in the original network; inferior quality distance and azimuth observations; weak survey connections between Alaska and the Lower 48; actual movement of some stations due to tectonic activity; and the loss of many stations due to construction, erosion, and vandalism.

The need for a new adjustment having been confirmed, a project was undertaken to define a new horizontal datum and to perform the readjustment process. This work was completed by the National Geodetic Survey (successor to the Coast and Geodetic Survey) in 1986 and resulted in the North American Datum of 1983 (NAD 83). This effort included the computation of horizontal positions for about 250,000 points in the National Geodetic Reference System (NGRS), based on a least squares adjustment of hundred of thousands of classical survey measurements. The adjustment also included measurements utilizing doppler satellite techniques, very long baseline interferometry, and even a handful of GPS observations. An important component of the NAD 83 project was the definition of a new reference ellipsoid, the Geodetic Reference System of 1980 (GRS 80). GRS 80 provides a good approximation to the shape of the earth on a global scale, contrasted with the Clarke 1866 ellipsoid which models the earth well only in the North American region. Due to the advent of GPS and other extraterrestrial technologies, the globally shaped ellipsoid was chosen over the more local model.

The shift between NAD 27 and NAD 83 positions ranges from close to zero in the Great Lakes area to 30-40 m along the east coast of the United States to about 100 m along the west coast. In the Four Corners states, the differences are in the 40 to 70 m range. The magnitude of these shifts illustrates the importance of an awareness of what datum is being utilized for a project. The difference can be ignored for only very small scale mapping related activities.

Due to distortions that existed in the NAD 27, the transformation between it and the NAD 83 is quite nonlinear and cannot be rigorously expressed in equation form. The National Geodetic Survey has developed a computer program, NADCON, which performs a modeled transformation between datums. (A program produced by the Army Corps of Engineers, CORPSCON, utilizes NADCON but also performs the conversion between geodetic, state plane, and Universal Transverse Mercator (UTM) coordinates.) The NADCON program is based on survey points in the national network that have positions based on both datums. Its performance is generally proportional to the density of NGRS survey control points in an area. The accuracy of the transformation is on the order of 15 cm at the one sigma level. NADCON is appropriate for many mapping-related activities but should not be used when rigorous geodetic accuracy is required. The only way to maintain geodetic accuracy in the conversion between datums is to perform a rigorous mathematical adjustment of survey measurements constrained to published coordinates on the desired datum.

GPS surveying technology was just starting to come on-line around the completion of the NAD 83 project. Over the next few years, GPS equipment, software, and procedures developed rapidly. It soon became fairly routine to perform measurements whose accuracy often exceeded that supported by the NAD 83 network. This situation has motivated a program of improving the accuracy of NAD 83. NGS is working cooperatively with states in utilizing GPS to update the NAD 83 network. The resulting upgrades to the NAD 83 network have been referred to by various names, including High Accuracy Reference Networks (HARN) and High Precision Geodetic Networks (HPGN). NGS recently decided to refer to the aggregation of these statewide networks as the Federal Base Network. The Federal Base Network is the fundamental tier of the National Spatial Reference System, to which NGS is transitioning from the existing National Geodetic Reference System.

Upgrade projects, contributing to the Federal Base Network, consist of the positioning of a fairly sparse (spacing of 75-125 km) network of stations to a high level of accuracy with GPS. The nominal relative horizontal accuracy for these points is 8 mm plus 1 part per million (Federal Geodetic Control Subcommittee (FGCS) Order B classification). A subset of the stations is positioned to a relative accuracy of 5 mm plus 1 part per 10 million (FGCS Order A). The level of positional accuracy provided by these network upgrades is about an order of magnitude increase over the previous, conventionally surveyed, network. The positions of points in the upgraded networks are still referenced to the NAD 83 datum. To identify the coordinates as being derived from a different adjustment than the original NAD 83 network, they are labelled with the year of the adjustment. For instance, an upgraded network that was adjusted in 1992, such as in New Mexico and Arizona, would have station coordinates tagged "NAD 83 (1992)." Original NAD 83 positions are labelled "NAD 83 (1986)" since that adjustment was performed in 1986.

In order to bring the original NAD 83 network and the GPS-derived upgrades into consistency with each other, GPS observations are performed to tie the networks together. These connections allow NGS to use the upgraded station positions as a basis for recomputing positions for the stations in the original network. This process removes many of the distortions that may be present in the original NAD 83 network and results in new NAD 83 coordinates for most all stations in a project area, typically an entire state. The new positions have a datum label like the upgrade network, e.g. "NAD 83 (1992)."

It is now not sufficient enough to know which datum, NAD 27 or NAD 83, a position is referencing. One must also be aware of which adjustment is involved in NAD 83 positions, the original 1986 adjustment (NAD 83 (1986)) or the upgrade adjustment (NAD 83 (199x)). For states in which the readjustment has been performed, a new version of the program NADCON has been generated to allow conversions to and from the upgraded NAD 83 network as well as the original NAD 83 and NAD 27.

The World Geodetic System of 1984 (WGS 84) is another datum that is utilized frequently these days. WGS 84 is a Department of Defense construct that is primarily a three-dimensional system with the absolute positioning of points playing a major role in its development. In contrast, NAD 83 is a true network system in that every point in NAD 83 is "connected" to every other point via a combination of survey observations. WGS 84 is the system to which GPS satellite positions and related information are referenced. The geometric figures of the earth, or ellipsoids, on which NAD 83 and WGS 84 are based are slightly different. This difference, while geodetically significant, is negligible for most mapping applications.

For further information, contact William Stone, New Mexico State Geodetic Advisor, National Geodetic Survey, % Albuquerque Public Works/Survey Section, 400 Marquette NW, Room 401, Albuquerque, NM 87102; telephone: 505 768-3606.

Summary of Current Federal Geographic Data Committee Projects

Coordination in States

During 1993, the FGDC sponsored a series of discussions with representatives named by various national groups representing state and local government interests. These groups included the National Governors' Association, the Council of State Governments, the National Conference of State Legislatures, the National States Geographic Information Council, the National Association of Counties, the National League of Cities, the U.S. Conference of Mayors, the International City/County Management Association, and the National Association of Regional Councils. The meetings were facilitated by the U. S. Advisory Commission on Intergovernmental Relations. The discussions resulted in a report that strongly recommended that each state form a council to support geospatial data coordination. Some councils already exist in an official or an ad-hoc capacity. The membership of some councils include other levels of government and the private sector, others are predominantly state agencies. The FGDC is encouraging the formation of such councils to foster communication about geospatial data, to act as a consortium for development of standards, and to provide a means to consolidate funding for geospatial data. FGDC staff have given presentations in more than two dozen States about FGDC activities, and the numerous state representatives have attended FGDC sponsored meetings. FGDC has recently contracted with the National States Geographic Information Council (NSGIC) to conduct a survey of existing entities and means of coordination related to geospatial data within states.

Clearinghouse Prototype Test

Over the past two months, the FGDC Clearinghouse Working Group sponsored a national prototype test of a distributed, on-line geospatial data clearinghouse. Test participants consist primarily of federal and state government representatives. Nearly two hundred individuals of public and private organizations have expressed interest in and are following progress on the test. The prototype consists of using the FGDC-developed spatial metadata standard to document data, "serving" that documentation to the Internet, and using search and query software tools over the Internet to find and access data sets. Results to date indicate that easier user interfaces and substantially more training and education are needed to facilitate use of the clearinghouse. The prototype test will be formally evaluated, and recommendations for developing the clearinghouse will be suggested.

Digital Geospatial Data Framework Activities

Two major activities are underway to further development of a framework of digital geospatial data for the Nation. The framework is a set of digital geospatial data that is useful to a broad variety of users within any geographic area. The effort will concentrate on data that can be produced cost-effectively in a reasonable period of time. Framework data are data that form the basis for registration or reference of other geospatial data sets. Framework data include digital orthographic imagery, elevation, spatial representations of transportation, hydrography, administrative and political boundaries, and cadastral reference systems. These data shall be tied accurately to the surface of the Earth using standard geographic referencing systems. The FGDC has formed a Framework Working Group of federal, state, and local government representatives to refine the concept and develop a plan for funding and implementation of the framework. Additionally, the FGDC has contracted with the National Center for Geographic Information and Analysis to incorporate academic and other sector perspectives into development of the framework.

Communication

Communication between the FGDC and the community is vital to the success of the National Spatial Data Infrastructure (NSDI). The means of communication include public meetings and written materials. The FGDC sponsors meetings and sessions in conjunction with major GIS conferences. These sessions include general discussions about the makeup and direction of the NSDI and presentations on technical subjects, such as classification standards, metadata, and the clearinghouse. In the future, general meetings on the NSDI will be phased out in favor of sessions on specific activities that have visible goals, such as standards development and the clearinghouse. To complement the public meetings, the FGDC produces the FGDC Newsletter, reports of meetings, and technical reports. Titles in work include a strategic plan for federal agencies' wetlands mapping and inventory activities, a technical report comparing federal agencies' current wetlands mapping efforts, and the needs of federal agencies for ground transportation data. Training materials are planned on the metadata standard and the clearinghouse. Reports are made available in paper form and electronically through the Internet.

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Calendar

August 7-11, 1994. *URISA-94*, Milwaukee, Wisconsin. Contact: URISA, 900 Second Street NE, Suite 304, Washington, DC 20002. Telephone: 202 289-1685. Fax: 202 842-1850.

August 26-29, 1994. *Mapping and Remote Sensing Tools for the 21st Century*, Sheraton Washington Hotel, Washington, DC. Contact: ASPRS, 5410 Grosvenor Lane, Suite 210, Bethesda, MD 20814-2160. Telephone: 301 493-0290. Fax: 301 493-0208.

September 12-16, 1994. *International Geographic Information and Resource Technology Seminar*, Toronto, Canada. Contact: J. Michael Power, Natural Resources Canada, Petawawa National Forestry Institute, P. O. Box 2000, Chalk River, Ontario, Canada K0J 1J0. Telephone: 613 589-2880. Fax: 613 589-2275.

September 26-28, 1994. *Seventh Annual Rocky Mountain Groundwater Conference*, Las Vegas, Nevada. Contact: Dr. Paul Seaber, Desert Research Institute, P. O. Box 19040, Las Vegas, NV 89132-0040. Telephone: 702 895-0487. Fax: 702 895-0427.

September 26-28, 1994. *The First Federal Geographic Technology Conference, Exposition, and Data Mart*, Washington, DC. Contact: 1-800 GIS-WRLD (1-800 447-9753).

September 27-29, 1994. *GIS in the Rockies*, Golden, Colorado. Contact: GIS in the Rockies, P. O. Box 13887, Denver, CO 80201-3887. Telephone: 303 932-2488.

October 25-27, 1994. *GIS/LIS '94 Annual Conference and Exposition*, Phoenix, Arizona. Contact: GIS/LIS, 5410 Grosvenor Lane, Suite 100, Bethesda, MD 20814. Telephone: 301 493-0200.