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Chapter 2: Surveying

Originating Office: U.S. Geological Survey

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757 DM 2

2.1 **Purpose**. This chapter prescribes policy, responsibility, coordination, and procedures for geodetic, cartographic, and cadastral surveys performed by the bureaus and offices of the Department.

2.2 **Definitions**. For the purpose of this chapter, the following definitions apply:

A. Geodetic Surveying. Includes first-, second-, and third-order horizontal and vertical control surveys by precise measurement of distances, angles, and elevation differences; satellite surveys to determine relative and absolute position including elevation difference derived through geoid studies; gravimetric surveys; astronomic observations for latitude, longitude, and azimuth; and computations for latitude, longitude, and azimuth; and computations and adjustments of the field observations.

B. Cartographic Surveying. Includes photoidentification and establishment of field control as needed for specific mapping projects, and the extension of control by photogrammetric aerotriangulation.

C. Cadastral Surveying (Public Lands). Consists of the creation and reestablishment of public land boundaries, the subdivision of these areas and the determination of the amount of area within such surveys; the preparation of the official plat and written record of these surveys to be used in describing lands for patents, leases, or retention for Federal management purposes. Includes the preparation of protracted Federal boundaries over unsurveyed lands and offshore areas on the Outer Continental Shelf. Refer also to 757 DM 2.3C, Public Land Survey System and 2.3D, the Offshore Protraction Survey Program.

2.3 **National Programs**.

A. The National Geodetic Control Networks (NGCN). The NGCN are the responsibility of the National Geodetic Survey Division, Charting and Geodetic Services, National

Ocean Service, NOAA, Department of Commerce, and consist of monumented and described first- and second-order vertical and horizontal geodetic network stations. The vertical network provides accurate elevations, and the horizontal network provides accurate geographic positions. Those networks consist of:

(1) Net Control. The basic frameworks of first-order lines and control.

(2) Area Control. Lines and stations, generally second-order, but also including third-order, that fill in where high density of control is needed.

Note: The networks are not complete, and monuments are subject to attrition. In an effort to support completion and maintenance of the NGCN, OMB directed, through Circular A-16, that Federal agencies should plan their surveys so as to assist in the establishment, densification, and maintenance of the NGCN whenever practical and economical. The Federal Mapping Task Force on Mapping, Charting, Geodesy and Surveying, in its report of July 1973, reaffirmed this charge, and the Department of the Interior has agreed.

B. National Mapping Program (NMP). The NMP is the responsibility of the Geological Survey, as defined in 757 DM 3. It includes those activities necessary to make available a family of maps and basic map data. Cartographic surveying, which is one of those activities, is required, along with geodetic surveying, to assure that the basic maps and map data meet horizontal and vertical accuracy standards as promulgated by the Bureau of the Budget in 1941, revised 1943 and 1947. These accuracy standards appear as Appendix 1 to this chapter. The monuments established under the Public Land Survey System and their data values are used to supplement the geodetic control required in the NMP.

C. Public Land Survey System (PLSS). The PLSS is the responsibility of the Bureau of Land Management (BLM) and is the official system for establishing, reestablishing, and describing the boundaries of the public lands of the United States. The system was authorized by the Land Ordinance of 1785 and includes the creation of land boundaries following a prescribed rectangular pattern, the establishment of monuments in/on the ground, and the preparation of a narrative and graphic record of the survey which, upon official acceptance and approval, becomes a quasi-legal document and enters the public domain. These records are then used in two general areas of local and national importance: they form the basis of and become a part of the patents issued when public lands pass out of Federal ownership; and they form the basis for the overall administration and management of the lands retained in Federal ownership. Modern needs create a demand for more explicit data in these survey records, and sophisticated instruments and methods are used in establishing the survey grid on the ground. The Bureau of Land Management has the authority to survey all Federal interest lands, trust territories, and Indian lands (see 1973 edition, AManual of Surveying Instructions....,@ published by BLM). The legal responsibility of the Department and Bureau of Land Management for physical corner positions ends when all land and mineral rights controlled by the corner positions pass from Federal ownership.

However, under certain conditions, specified in the United States Code, BLM can resurvey in private land areas. Geographic positions

of certain land corners continue as a Federal concern insofar as they relate to the responsibilities of the National Mapping Program (see 757 DM 3) and to other public and Federal automated mapping needs. The BLM Public Land Survey System (PLSS) is the foundation for all legal land parcel descriptions in the public land States, whether Federal, State, local, or private. The BLM Geographic Coordinate Data Base (GCDB) is derived from the PLSS and provides the mechanism for graphic representation of legal parcels and the registration of land records and resources information to a common geographic coordinate reference.

D. The Offshore Protraction Survey Program. The grid protraction and determination of offshore boundaries on the Outer Continental Shelf are required for management of the Federal offshore mineral leasing program. The Minerals Management Service (MMS) is responsible for the preparation of the official graphic record of such protracted areas, Supplemental Official Block Diagrams, Outer Continental Shelf Official Protraction Diagrams and Leasing Maps.

2.4 **Policy Guidelines.**

A. The Department is committed to support the development and maintenance of the NGCN, the accomplishment of cartographic surveys in support of the NMP, and is bound by statute to carry out and maintain the PLSS.

B. Geodetic control surveys will be connected to NGCN and will be documented and monumented to Federal Geodetic Coordinating Committees (FGCC) standards wherever practical. These standards are titled, AStandards and Specifications for Geodetic Control Networks,@ Department of Commerce, 1984.

C. Geographic positions of PLSS corners will be established by direct ties or by calculation to aid in computer and graphic use of PLSS data.

D. The limits and delineation of the boundaries of the Outer Continental Shelf for natural resource administration, management, and development purposes will be determined by the MMS, following statutory and judicial guidelines.

2.5 **Geodetic Surveying.**

A. Policy. Departmental geodetic surveys will, where practical, contribute to the development and maintenance of the NGCN as well as the control needs of other Interior and national programs. Bureaus with significant survey programs will:

(1) Determine the status of the NGCN in projected areas. If NGCN control is deficient, Bureau plans will be augmented to improve NGCN status if practical.

(2) Connect all second- and third-order surveys to NGCN.

(3) Monument and describe according to Federal Geodetic Control Committee (FGCC) standards.

B. Responsibilities.

(1) Lead Bureau. The Geological Survey (GS) will provide the Department representative to the FGCC and will coordinate the Department=s geodetic survey requirements in cooperation with bureaus and offices and with FGCC. The BLM is, however, a member of the FGCC for cadastral survey matters. Geological Survey will also make Departmental geodetic data available through the National Cartographic Information Center (NCIC) until it is available from the National Geodetic Survey Division (NGSD), at which time the responsibility will be assumed by the National Geodetic Survey Information Center (NGSIC) of NGSD.

(2) Other Bureaus and Offices. Other Interior bureaus and offices will cooperate and coordinate with the Geological Survey in planning and establishing geodetic surveys, and will furnish all new geodetic data to GS for transmittal to NGSD.

(3) National Geodetic Survey Division (NGSD), Charting and Geodetic Services (C&GS), National Ocean Service, NOAA, Department of Commerce. NGSD has agreed to store, retrieve, and distribute geodetic data provided to them in accordance with FGCC standards.

C. Coordination. Bureaus and offices should use one or both of the following approaches:

(1) Long-range Planning. Bureaus and offices should determine the status of NGCN control for planning, with Geological Survey assistance if necessary. They should then review survey plans with GS to determine what modifications might be practical to contribute to NGCN or other control survey needs.

(2) Isolated Surveys. Bureaus and offices should evaluate surveys that do not fit 757 DM 2.5C(1), Long-range Planning, to determine whether they contribute to NGCN. Planning should include consultations with GS on the best procedures to follow.

D. Funding. Wherever feasible, bureaus and offices will absorb extra costs required to execute geodetic surveys to NGCN standards, including monumentation. If funding is not available, the bureau or office and GS will develop plans and means for appropriate action.

2.6 **Cartographic Surveying.**

A. Policy. Cartographic surveys will be conducted in such a way as to contribute to the overall control requirements of the Department as well as to the NGCN wherever practical. Surveys of third-order accuracy or better, performed as part of a cartographic project, are geodetic surveys and will be treated as stated in 757

DM 2.5, Geodetic Surveying.

B. Responsibilities.

(1) Lead Bureau. The Geological Survey is the lead bureau for coordination of the Department=s cartographic surveys.

(2) Other Bureaus and Offices. Other Interior bureaus and offices will cooperate and coordinate with GS in establishing cartographic surveys.

C. Coordination. Bureaus and offices should request the current status of control from the GS for planning, then review their plans with GS to determine what modifications, if any, are necessary to meet NGCN requirements, increase area control coverage, other otherwise meet Departmental survey needs.

2.7 **Cadastral Surveying.**

A. Policy. Departmental cadastral surveying will follow the Manual of Instructions for the Survey of the Public Lands of the United States (1973 edition), and its amendments and supplements published by BLM.

B. Responsibilities.

(1) Lead Bureau. The Bureau of Land Management is responsible for the administration, coordination, and execution of the PLSS. This includes the establishment and maintenance of a system for the storage and dissemination of survey data for use by local and national realty, land title, and mapping interests. BLM is developing an automated Geographic Coordinate Data Base (GCDB) of all corner positions established or reestablished under, or directly related to, the PLSS. BLM is the custodian of the official U.S. public land survey records and maintains public information centers in these states which still have active cadastral survey programs and in Washington, D.C. BLM is responsible for establishing a direct line of cadastral survey data communication to the Department=s National Mapping Program (GS) on a continuing basis (see 757 DM 2.3B, National Mapping Program).

(a) BLM responsibilities include the segregation by survey of valid private rights acquired from a variety of public land laws including the general mining laws.

(b) BLM is also authorized (43 USC 773) to perform PLSS surveys for other Federal departments and agencies, State and local Governments, and certain private interests.

(2) Minerals Management Service is responsible for determining the Federal offshore boundaries on the Outer Continental Shelf for minerals management purposes.

(3) All Interior bureaus and offices will coordinate their

cadastral surveying needs with BLM. They will report to BLM all actions taken which serve to change the official PLSS records. The Bureau of Reclamation has specific authority to conduct cadastral surveys on certain public lands withdrawn for reclamation purposes under BLM instructions and with BLM approval. BLM is specifically required to execute cadastral surveys for the Bureau of Indian Affairs on Indian reservations.

C. Coordination. All bureaus and offices shall submit their requirements for cadastral surveys to BLM with adequate lead time for program implementation. BLM working through the ICCC will determine the appropriate action necessary to satisfy the needs of each request. This may include the use of existing survey data or original surveys or resurveys by BLM. In those cases where BLM authorizes other agencies to perform the actual survey work, BLM will provide the necessary instructions, guidance, and official approval of the records. The records of such surveys will then also enter the public domain.

D. New (original) cadastral surveys requested by the Interior bureaus and other Federal agencies will normally be funded by BLM. Most resurveys required by non-BLM agencies will require reimbursement to BLM.

2.8 **General Coordination.** In accordance with responsibilities assigned in this Chapter, GS and BLM will:

A. Coordinate surveying needs of bureaus and offices for geodetic or cartographic and cadastral surveys, respectively.

B. Assist other bureaus and offices in long-range planning for surveys.

C. Provide technical guidance and assistance, as appropriate, where needed to attain Departmental objectives.

UNITED STATES NATIONAL MAP ACCURACY STANDARDS

With a view to the utmost economy and expedition in producing maps which fulfill not only the broad needs for standard or principal maps, but also the reasonable particular needs of individual agencies, standards of accuracy for published maps are defined as follows:

1. Horizontal accuracy. For maps on publication scales larger than 1:20,000, not more than 10 percent of the points tested shall be in error by more than 1/30 inch, measured on the publication scale;

for maps on publication scales of 1:20,000 or smaller, 1/50 inch. These limits of accuracy shall apply in all cases to positions of well defined points only. AWell defined@ points are those that are easily visible or recoverable on the ground, such as the following: monuments or markers, such as bench marks, property boundary monuments; intersections of roads, railroads, etc.; corners of large buildings or structures (or center points of small buildings); etc. In general what is Awell defined@ will also be determined by what is plottable on the scale of the map within 1/100 inch. Thus while the intersection of two road or property lines meeting at right angles, would come within a sensible interpretation, identification of the intersection of such lines meeting at an acute angle would obviously not be practicable with 1/100 inch. Similarly, features not identifiable upon the ground within close limits are not to be considered as test points within the limits quoted, even though their positions may be scaled closely upon the map. In this class would come timber lines, soil boundaries, etc.

2. Vertical accuracy, as applied to contour maps on all publication scales, shall be such that not more than 10 percent of the elevations tested shall be in error more than one-half the contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale.

3. The accuracy of any map may be tested by comparing the positions of points whose locations or elevations are shown upon it with corresponding positions as determined by surveys of higher accuracy. Tests shall be made by the producing agency, which shall also determine which of its maps are to be tested, and the extent of such testing.

4. Published maps meeting these accuracy requirements shall note this fact in their legends, as follows: AThis map complies with national map accuracy standards.@

5. Published maps whose errors exceed those aforestated shall omit from their legends all mention of standard accuracy.

6. When a published map is a considerable enlargement of a map drawing (Amanuscript@) or of a published map, that fact shall be stated in the legend. For example, AThis map is an enlargement of a 1:20,000 scale map drawing,@ or AThis map is an enlargement of a 1:24,000 scale published map.@

7. To facilitate ready interchange and use of basic information for map construction among all Federal mapmaking agencies, manuscript maps and published maps, wherever economically feasible and consistent with the uses to which the map is to be put, shall conform to latitude and longitude boundaries, being 15 minutes of latitude and longitude, or 7 1/2 minutes, or 3 3/4 minutes in size.
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