National Park Service
U.S. Department of the Interior

National GIS and Inventory & Monitoring Programs

Specifications for Geospatial and Other Data Deliverables of GIS and Resource Mapping, Inventories, and Studies

Contents

Introduction

National Park Service (NPS), Geographic Information Systems (GIS), Resource Management, Inventory and Monitoring, and other program area projects and activities generate both spatial and tabular data sets. The spatial data sets are incorporated into park, regional, and national databases and made available to a wide range of users. Conformance to certain standards and product specifications is necessary to ensure these data sets are discoverable and usable by data consumers. This document provides general standards for spatial data collection and submission. Park-, network-, region-, and program-level project managers may require further specifications that may vary from project to project. Any deviation from these standards must be approved by the appropriate project manager.

Organizational Justification

The NPS GIS Council (GISC, see http://www.nps.gov/gis/gis_program/gisc_members.html) is responsible for ensuring that standard geospatial data, applications, and systems are implemented by NPS programs, parks, and their partners. The GISC is the official approving body as authorized by the NPS GIS Council (GISC) Charter (2006, http://www.nps.gov/gis/gis_program/gis_council.html) and Director's Order #11A: Information Technology Management (2005, http://classicinside.nps.gov/documents/Directors%20Order%2011A%20v4%2D4%2D05%2Epdf).

The NPS supports and organizes national geographic data development for public consumption through its evolving enterprise GIS (EGIS) program and the NPS Data Store (Data Store), accessible by millions of people via the Internet. The Data Store is a working metadata service and data server that publishes public metadata to the Geospatial One Stop (GOS) and collaborates and integrates with the NPSFocus Digital Library and Research Station. GOS is the official node of the National Spatial Data Infrastructure, required by Executive Order 12906. This national partnership saves each region and program office from having to support a similar infrastructure and develop regional expertise to carry out this federally-mandated service. These activities also reduce demand on individual park, region, and program GIS staff by making these data available to the public and NPS sites through conventional web resources.

I. Deliverables

Complete and verified data for NPS projects shall be delivered via CD-ROM and/or DVD, via electronic data transfer (e.g., e-mail or FTP), or via another method approved by the project manager. CD/DVD should be in -R format, so that it cannot be modified. The products delivered to the project manager shall contain the following items:

A. Required Items

- Descriptive document
- Geospatial data
- Associated data table(s) or relational Microsoft Access database

- FGDC and/or NPS Metadata Profile (preferred) compliant metadata

B. As Specified by contract

- Linked document(s)
- Linked graphics or digital photographs

II. Descriptive Document

A Microsoft Word document (and/or ASCII text file if specified) describing the data set shall accompany any submission and provide all necessary information for understanding the submittal. The document should include, but is not limited to, the following:

- Contents of the CD/DVD or .zip file
- Description of the project, including all related deliverables and any project codes (e.g., RPRS)
- Version and date of the data
- Information on sensitive data issues (if any exist or as appropriate)
- Contact information for those responsible for creating the data and who have the responsibility for maintaining the master version of the data
- A short description of data themes (limited to one to two sentences for each theme)
- Linking fields (to documents, a Microsoft Access database, and/or digital photographs)

Example of a Descriptive Document for a park with alpha code "CODE" that may be used as a template.

A CD-R or DVD-R that contains the following files:
CODEBird.Zip containing the following files:

- CODE_BirdSurvey_Readme.Doc -- known as the Descriptive Document
- CODE_Bird_File_Names.Doc -- naming convention or codes used for file names - if applicable
- CODE_BirdSurvey2000.Doc – a descriptive document for the Code 2000 bird survey.
- CODEBird.e00 – exported ArcInfo Coverage
- CODEBird.lyr – ArcGIS layer file
- CODEBird.xml – FGDC metadata XML format metadata file
- CODEBird.mdb – Microsoft Access database
- CODE_Bird_Data_Dict.Doc – descriptions of attributes and data tables

This first version of bird data was completed on 05/28/02.

None of the information contained in this data set is considered sensitive.

The data were created by Joe Smith of the National Park Service, Some NPS Project, phone – (999) 999-9999.

The Key Field “LocationID” links the Access database and the coverage.

III. Spatial Data

There are several ways to represent spatial data in a GIS including points, lines, polygons, or rasters/images. **Determining the appropriate representation(s) for your study involves consideration of scale and study goals. Prior to data collection, these issues should be addressed and resolved in the project study plan in consultation with the project or data manager. Additionally, network and park data management plans may dictate the appropriate format.**

A. File Naming Conventions and Directory Structure

A clear and meaningful file name should be used that conveys the nature of the data, subject, and park unit represented. Data and related file names should not contain spaces or special characters. An underscore may be used to make field names more readable (e.g., Code_birdsurvey). Field names should conform to ArcGIS field naming limitations. If attributes are stored in shapefiles, field names must be 10 characters or less to avoid truncation. The directory structure recommended by the NPS GIS and national I&M programs may be downloaded by clicking on **Recommended GIS File Folder/Directory Structure** at http://science.nature.nps.gov/im/policies/index.cfm.

B. Coordinate Systems

All spatial data collected or submitted for national, regional, or network NPS programs shall be geo-referenced with projection information defined in the data file that is submitted. All spatial data shall be provided in the standard regional-scale projection(s). Park-level data will generally use UTM and NAD83 whereas regional- or national-level data will generally use decimal degrees (double precision with five or more significant digits) and NAD83. See Appendix 1 for details and exceptions. Projection specifications shall be approved by the project manager.

C. Spatial Data Formats

The data format(s) should be clearly stipulated and agreed upon with contractors or cooperators before data collection and processing start. If there are questions about choosing a data format, converting between formats, or using non-standard formats, contact the park, network, region, or program GIS/data managers for guidance before data collection begins.

Vector Data: All vector data shall be supplied as an ArcInfo interchange file (*.E00) and/or ArcView Shapefile, or as an ESRI ArcGIS Geodatabase (GDB) compatible with the current version of ArcInfo or ESRI file-based Geodatabase workspace.

i. *ESRI ArcInfo Coverage/export file* -- Data developed in ArcInfo coverage format should be exported to an Arc Interchange file (.E00 file). ArcGIS 9.x .E00 files should include the metadata (.XML) file from ArcCatalog. All coverages should be created as double precision data sets. If the data set was originally obtained in single precision, convert it to double precision before submitting. All coverages should be topologically clean and correct and shall contain complete, well-defined projection information.

ii. *ESRI Shapefile* -- Shapefile format shall be used only if an ArcInfo coverage format file does not exist. The shapefile format should include, at a minimum, the .SHP, .DBF, .SHX, and .PRJ files. Shapefiles from ArcGIS files should include the metadata (.XML) and projection (.PRJ) files.

iii. *ESRI ArcGIS Geodatabase* -- A geodatabase (GDB--short for geographic database) is a physical store of geographic information inside a relational database management system (RDBMS). Because a personal geodatabase is stored as a Microsoft Access file, data delivered as a GDB file shall be delivered as the Microsoft Access .MDB file that is the GDB. The schema should be supplied by the NPS or the development of the schema should be specifically addressed in the project plan.

iv. *ESRI ArcGIS File Based Geodatabase* -- Data delivered as an ESRI File Geodatabase shall be delivered as the folder somename.gdb containing all the components of the Geodatabase. The schema should be supplied by the NPS or the development of the schema should be specifically addressed in the project plan.

Raster Data: All cell-based data sets or grids shall be supplied as an ArcInfo GRID and/or ArcInfo interchange file, compatible with the current version of ArcGIS. All geo-referenced digital aerial photography and imagery are to be supplied as an ERDAS Imagine File, an 8-bit grayscale GeoTiff, a 24-bit RGB GeoTiff, or a tagged image file format (.TIFF) file with any associated geo-reference information included. Digital aerial photography and imagery may also be acceptable in the data formats specified below:

i. *ArcInfo GRID File* -- This is an ESRI format that supports 32-bit integer and 32-bit floating-point raster grids and is the preferred format for non-imagery raster data. Grids are useful for representing geographic phenomena that vary continuously over space and for performing spatial modeling and analysis of flows, trends, and surfaces. Generally, grid themes should be delivered as .E00 files as stipulated above. It is recommended that large grid themes be submitted as separate compressed workspaces because .E00 files may be extremely large and unwieldy. All data submitted in grid format shall include all well-defined projection files associated with them.

ii. *ERDAS Imagine file* -- Imagine files (.IMG) shall include well-defined projection files that are associated with them. Pyramid files (.RRD) shall be included if available.

iii. *GeoTIFF v1.0* -- This is a raster format with geo-referencing stored in the header of the file. All data submitted in GeoTiff format shall include all well-defined projection files associated with them.

iv. *TIFF* -- TIFF files (.TIFF) shall include world files and all well-defined projection files associated with them.

Special Cases:

i. *Computer Aided Design (CAD) files* -- Generally, CAD formats are NOT recommended and **will only be accepted upon the direct specification and approval of the project and/or data managers**. Although some CAD drawings (i.e. building blueprints) do not contain coordinate system information, most define their datum and projection. However, some GIS products do not always

read and interpret this information correctly when the data are imported. Therefore, all CAD export files must contain complete metadata records as defined in section VI of this document. AutoCAD DWG/DXF and MicroStation DGN files may be imported, exported, and directly read in ArcGIS, but all blocks and cells must be exploded before CAD files are submitted for exportation.

a. *DWG format*--Data submitted in DWG format may be exported from AutoCAD using the e-transmit function (this will include all information stored in the drawing). Non-geographic elements such as drawing borders, title blocks, north arrows, and detail drawings should not be included in export files. Place these elements on specific layers or levels in AutoCAD and MicroStation respectively, so they can be isolated when the data is brought into the GIS environment.
b. *DXF format*--Specific elements may be selected for export in the DXF format by checking "Select Objects" under Tools-->Options on the "Save Drawing As" dialog box. This dialog box should also be used to set the decimal places of accuracy to 16 to preserve double precision data quality and to select either an ASCII or a binary format for the DXF export. Several Autodesk products like Land Desktop and Map3D allow for direct export to either ESRI Shapefiles (SHP) or ArcInfo Interchange (E00) formats. Drawings, element/layer combinations like topologies, and/or individual objects exported to ERSI Shapefiles must be specified as points, lines, polygons, or text. Multiple geometry types may be combined into a single ArcInfo Interchange export file.

ii. *Other possible raster file formats* -- Other file formats that may be utilized natively as an ArcGIS layer include: .BMP, .BSQ, .BIL, .BIP, ERMapper, IMPELL Bitmaps, Image Catalogs, .JPEG, JPEG2000, MrSID, and Sun Rasterfiles. However, because applicable header or world files must be included .BMP, .JPEG, and Sun Rasterfiles are unacceptable formats for this application. All aforementioned acceptable formats must include all well-defined projection files associated with them. Again, the appropriate project manager(s) must approve any deviation from the preferred standards discussed above.

D. Collection methods

Digital data may be captured using one or more approaches including, but not limited to, using a GPS (Global Positioning System) for collection or digitizing features from maps or aerial photographs. The appropriate method should be determined in the study plan and after consultation with the project, resource, or data manager.

When using GPS collection, the GPS unit type, model, averaging method used for static mapping (point), error correction technique (type of differential correction used), and GPS quality filters employed shall be recorded in the metadata and discussed in the Descriptive Document.

When digitizing features from maps or photographs, the source, scale, date, and methods (i.e., process steps) shall be recorded in the metadata and discussed in the Descriptive Document.

E. Scale and Spatial Resolution

Project planners should contact appropriate GIS or data management staff for specific scale and

spatial resolution requirements for vector and raster/image data. These requirements should be clearly specified in the contract or cooperative agreement.

F. Horizontal and Vertical Accuracy

All spatial data collected shall be analyzed for their spatial accuracy and shall meet or exceed the National Map Accuracy Standards for the appropriate scale (for more information see http://rockyweb.cr.usgs.gov/nmpstds/nmas.html or Appendix 2). Longitude and Latitude (decimal degree) coordinates for geographic data should be recorded to a minimum of five significant digits to the right of the decimal point and stored in double precision attribute or database fields providing an approximate precision of one meter in CONUS. More decimal places should be used if a higher precision is required.

IV. Attribute Data

Simple attribute data such as that used for map symbolization shall be delivered as part of the ArcGIS feature attribute table. Complex attributes shall be delivered in a well-structured relational database format as a Microsoft Access .MDB file using current versions of Microsoft Access. Map features and database records shall share a common unique identifier or primary key that relates the map feature to the table record.

Because the ArcInfo coverage/shapefile format is not ideal for storage and management of complex relational data such as one-to-many relationships and data normalization NPS project managers may request that relational attribute data be stored either in a separate, well-structured relational database system or in a geodatabase data format.

V. Quality Control

Accuracy assessments of spatial and attribute data are project specific. Project planners should contact appropriate GIS or data management staff for specific details. QA/QC procedures shall be documented by the Contractor in the appropriate Metadata sections.

VI. Metadata

All data submitted shall include metadata that meets the minimum NPS content standard for metadata. This content standard, the NPS Metadata Profile (see http://science.nature.nps.gov/nrdata/docs/metastds.cfm), contains minimally-compliant FGDC metadata elements (for additional FGDC metadata information see http://geology.usgs.gov/tools/metadata/) in addition to NPS-specific elements. For NPS Profile Metadata Authoring Guidance relevant to natural resource data and XML templates for NPS Profile-format metadata see http://science.nature.nps.gov/nrdata/docs/metahelp/createhelp.cfm and the guidance at http://science.nature.nps.gov/nrdata/docs/metahelp/NR-GISMetadataAuthoringGuidance.pdf

The metadata must be located in the same directory as the data, share the same naming prefix, and when appropriate, be attached to that data. The metadata should be delivered in extensible markup language with an .XML extension.

If applicable, FGDC Biologic Data Profile (BDP) metadata elements should be included in the metadata record (see FGDC Metadata).

The metadata record must be parsed with no errors prior to submission using the Metadata Parser (MP) provided by the FDGC. To learn more about getting started with FGDC metadata or using the MetaParser program see http://geology.usgs.gov/tools/metadata/ or contact your project or data manager. For complete information on FGDC metadata see Geospatial Metadata — Federal Geographic Data Committee.

Recommended metadata authoring tools include:

- ArcCatalog – used in conjunction with the NPS Metadata Editor and Tools
- The NPS Metadata Tools and Editor (a stand-alone or ArcGIS extension) — found at http://science.nature.nps.gov/nrdata/tools/index.cfm) – used to author and parse any type of NPS metadata, including Biological Data Profile metadata

Specifications for the attributes and database tables attached or linked to the spatial data must be documented in the "Entity and Attribute Information" section of the FGDC metadata and include:

- Attribute Label (field name)
- Attribute Definition (field description)
- Field format (not an FGDC field, this field is part of either the ESRI or NPS metadata profile extensions to the FGDC standard)
- Attribute Domain Values (valid values)

Prior to the metadata being loaded into the NPS Data Store, NPS staff shall be responsible for inserting the DOI solicitor-approved NPS data distribution liability statement (found at http://www.nps.gov/gis/liability.htm) and the appropriate NPS Info Tags (found at http://nrdata.nps.gov/profiles/NPS_Profile.xml into the NPS_Information Section of the metadata.

VII. Linked Documents

Project documents such as user manuals, detailed map unit descriptions, and site photographs may be linked to map features through "hot linking." Hot linking (hyperlinking) allows the user to click a map feature and have a related document open and jump to the chapter associated with an attribute of that map feature. To be hot linked (hyperlinked) an associated document shall meet the following requirements:

A. HTML Documents (recommended for most linked topics)

- The document(s) shall be an HTML formatted file.
- The document(s) shall include a table of contents with separate listings and anchors for each "topic" or description that relates to a GIS feature (i.e., extensive textual descriptions of each and every feature of a theme).
- The document shall include a separate tabular list of which "topics" correspond to each linking field value in the GIS theme (i.e., the key values for linking the document to the GIS).

B. Windows Help Files (not recommended for most projects)

- The document(s) shall be a Microsoft Help formatted file.

- The document(s) shall include a table of contents with separate listings and anchors for each "topic" or description that relates to a GIS feature (i.e., extensive textual descriptions of each and every feature of a theme).
- The document shall include a separate tabular list of "topics" that correspond to each linking field value in the GIS theme (i.e., the key values for linking the document to the GIS).

C. Microsoft Word Documents, Adobe Acrobat, and other formats

- The document(s) shall be a Word, Acrobat, or other appropriately formatted file.
- The document(s) shall include a table of contents with separate listings and anchors (if appropriate) for each "topic" or description that relates to a GIS feature (i.e., extensive textual descriptions of each and every feature of a theme).

For more information about linking documents to GIS features, see the NPS Theme Manager at http://science.nature.nps.gov/nrgis/applications/gisapps/gis_tools/8x/thememanager8.aspx.

VIII.Linked Graphics or Digital Photographs

If any linked digital photographs are included with the data set, they should be in a format that is readable in ESRI's ArcGIS. Image types that can be directly hot linked (hyperlinked) to a layer in ArcMap include .GIF, .JPEG/.JPG, MacPaint, Microsoft DIB, Sun Raster files, .TIFF, .TIFF/LZW compressed, X-Bitmap, and .XWD.

Images and graphics shall be organized in a file folder or directory structure that provides a logical hierarchical format. The directory structure recommended by the NPS GIS and national I&M programs may be downloaded by clicking on **Recommended GIS File Folder/Directory Structure** at http://science.nature.nps.gov/im/policies/index.cfm.

Map features with linked graphics/photographs should contain a GIS attribute field that records the relative directory path and file name. The suggested field name is "Images." Map layers should have meaningful names that relate to the map theme and its attributes and digital image file names should be encoded with this value. Any file coding schemes that are used should be documented and included in the Descriptive Document.

Digital photographs should include appropriate metadata documentation in the NPS Digital Metadata Standard. See **NPS Digital Photo Metadata Standard** at http://www.nps.gov/gis/data_info/nps_standards.html for more information. This standard has been integrated with the GPS-Photo Link application available from Geospatial Experts and is recommended for producing both the photo metadata and shapefiles with photos linked to GPS coordinates.

APPENDIX 1: Coordinate Systems

Projection specifications

All projection specification shall be approved by the appropriate Project Manager.

Park Unit Data Standard

In general, the standard projection for most park-level GIS layers is Universal Transverse Mercator with the following parameters:

• Projection	Universal Transverse Mercator
• Zone	Zone value
• Datum	North American Datum 1983
• Spheroid	GRS 1980
• False Easting	0
• False Northing	0
• Units	Meters

EXCEPTIONS TO PARK UNIT DATA STANDARDS

In addition to the system noted above, several NPS units require additional specific standards for data delivery. If the park crosses UTM zone boundaries, it is recommended that only one zone, or a different coordinate system, be used. Parks in Hawaii and other Pacific islands will be in the datum and projection specified by each park. Because of its unique geographic location, the NPS Alaska Region also requires a specific datum and projection as noted below.

Regional and National Data Standard

In general, the standard projection for most regional-level GIS layers is Geographic with the following parameters:

• Projection	Geographic
• Datum	North American Datum 1983
• Spheroid	GRS 1980
• False Easting	0
• False Northing	0
• Units	Decimal Degrees (five significant digits to the right of the decimal point)

EXCEPTIONS TO REGIONAL AND NATIONAL STANDARD

National Capital Region: The standard projection for National Capital Region parks uses the following parameters:

• Projection	State Plane
• Datum	North American Datum 1983
• Spheroid	GRS 1980
• Units	Feet

Alaska Region: The standard projection for Alaska Region parks uses the following parameters:

• Projection	Alaska Albers Equal Area
• Datum	North American Datum 1983
• Spheroid	GRS 1980
• False Easting	0
• False Northing	0
• Central Meridian	-154 00 00
• Standard Parallel	55 00 00
• Standard Parallel	65 00 00
• Units	Meters

APPENDIX 2: National Map Accuracy Standards

The National Map Accuracy Standard may be found at:
http://erg.usgs.gov/isb/pubs/factsheets/fs17199.html and is reproduced below.

Fact Sheet FS-171-99 (November 1999)

Map Accuracy

An inaccurate map is not a reliable map. "X" may mark the spot where the treasure is buried, but unless the seeker can locate "X" in relation to known landmarks, the map is not very useful. The U.S. Geological Survey (USGS) publishes maps and other products at high levels of accuracy. Dependability is vital, for example, to engineers, highway officials, and land-use planners who use USGS topographic maps as basic planning tools.
As a result, the USGS makes every effort to achieve a high level of accuracy in all of its published products. An important aim of its accuracy control program is to meet the U.S. National Map Accuracy Standards.

National Map Accuracy Standards

To find methods of ensuring the accuracy of both location (the latitude and longitude of a point) and elevation (the altitude above sea level), the American Society for Photogrammetry and Remote Sensing - an organization actively involved in the science of making precise measurements from photographs (photogrammetry) and acquiring information from aerial photographs and satellite image data (remote sensing) - set up a committee in 1937 to draft accuracy specifications. Sparked by this work, agencies of the Federal Government, including the USGS, began their own inquiries and studies of map accuracy standards. In 1941, the U.S. Bureau of the Budget issued the "United States National Map Accuracy Standards," which applied to all Federal agencies that produce maps. The standards were revised several times, and the current version was issued in 1947. (The standards are printed at the end of this factsheet.)

As applied to the USGS 7.5-minute quadrangle topographic map, the horizontal accuracy standard requires that the positions of 90 percent of all points tested must be accurate within 1/50th of an inch (0.05 centimeters) on the map. At 1:24,000 scale, 1/50th of an inch is 40 feet (12.2 meters). The vertical accuracy standard requires that the elevation of 90 percent of all points tested must be correct within half of the contour interval. On a map with a contour interval of 10 feet, the map must correctly show 90 percent of all points tested within 5 feet (1.5 meters) of the actual elevation.

All maps produced by the USGS at 1:250,000 scale and larger are prepared by methods designed to meet these accuracy standards and carry the statement, "This map complies with National Map Accuracy Standards." Exceptions to this practice involve areas covered by dense woodland or obscured by fog or clouds; in those areas, aerial photographs cannot provide the detail needed for precise mapping. The USGS tests enough of its maps to ensure that the instruments and procedures the Survey uses are producing maps that meet the U.S. National Map Accuracy Standards.

How the Survey Maintains Map Accuracy

In 1958, the USGS began systematically testing the accuracy of its maps. Presently, accuracy testing is performed on 10 percent of the mapping projects at each contour interval as a method

of controlling overall quality. It is rare for a 7.5-minute map to fail the test, but this happens on occasion.

In testing a map, the USGS experts select 20 or more well-defined points; a typical point would be the intersection of two roads. Positions are established on the test points by field teams using sophisticated surveying techniques to determine positions from aerial photographs. Field survey methods are the only tests accepted for official accuracy testing. Positions must be obtained by surveys of a higher accuracy. Vertical tests are run separately to determine precise elevations. The mapped positions are checked against the field and (or) photogrammetrically determined positions results. If the map is accurate within the tolerances of the U.S. National Map Accuracy Standards, it is certified and published with the statement that it complies with those standards.

By such rigorous testing of some of its maps, the USGS is able to determine that its procedures for collecting map information ensure a high level of map accuracy.

Factual Errors

There are other kinds of errors in mapmaking. Names and symbols of features and classification of roads or woodlands are among the principal items that are subject to factual error. Mapmakers cannot apply a numerical value to this kind of information; they must rely on local sources for their information. Sometimes the local information is wrong. Sometimes names change or new names and features are added in an area. The USGS cartographers and editors check all maps thoroughly and, as a matter of professional pride, attempt to keep factual errors to a minimum.

"Errors" resulting from selection, generalization, and displacement are necessary results of mapping complex features at reduced scales. In congested areas, large buildings may be plotted to scale and the smaller buildings may have to be omitted; in showing buildings of irregular shape, small wings, bays, and projections usually are disregarded, and the outline is shown in general form. At map scale, it may not be possible to show each of several closely spaced linear features in its correct position. In such cases, one feature, such as a railroad, is positioned in its true location and others, such as parallel roads or rivers, are displaced the minimum amount necessary to make each symbol legible or are omitted to make the highest priority symbol legible.

United States National Map Accuracy Standards

With a view to the utmost economy and expedition in producing maps that fulfill not only the broad needs for standard or principal maps, but also the reasonable particular needs of individual agencies, the Federal Government has defined the following standards of accuracy for published maps:

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 to positions of well-defined points only. Well-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 and railroads; corners of large buildings or structures (or center points of small buildings). In general, what is well-defined will also be determined by what is plottable on the scale of the map with-in 1/100 inch. Thus, while the intersection of two roads 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 not be practicable within 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. This class would cover timber lines and soil boundaries.

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 by 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 a 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: "This 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 (manuscript) or of a published map, that fact shall be stated in the legend. For example, "This map is an enlargement of a 1:20,000-scale map drawing," or "This map is an enlargement of a 1:24,000-scale published map."

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 use to which the map is to be put, shall conform to latitude and longitude boundaries, being 15 minutes of latitude and longitude, or 7.5 minutes, or 3.75 minutes in size.