

# Map Accuracy



U.S. Department of the Interior  
Geological Survey  
National Cartographic  
Information Center

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 or positions, the map is not very useful.

The U.S. Geological Survey publishes maps, orthophotomaps, and other products of high levels of accuracy. Dependability is vital, for example, to engineers, highway officials, and land-use planners who use the Survey's topographic maps as a basic planning tool.

As a result, the U.S. Geological Survey 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 insuring the accuracy of both location (the latitude and longitude of a point) and elevation (the altitude above sea level), the American Society of Photogrammetry — a scientific association of photogrammetrists who work with aerial photographs — set up a committee in 1937 to draft accuracy specifications. Sparked by this work, agencies of the Federal Government, including the Geological Survey, began their own inquiries and studies of map 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 produced maps. The standards were revised several times, and the current version was issued in 1947. (This version is printed on the reverse side of the handout.)

As applied to the U.S. Geological Survey 7.5-minute quadrangle topographic map, the horizontal accuracy standard requires that the

positions of 90 percent of all points tested will be accurate within 1/50th of an inch (0.05 centimeters) on the map. The vertical accuracy standard says that the elevations of 90 percent of all points tested should be correct within half of the contour interval. On a map with a contour interval of 10 feet, therefore, the map will correctly place 90 percent of all points tested within 5 feet (1.5 meters) of the actual elevation.

Except for small-scale series, all maps produced by the U.S. Geological Survey carry the statement, "This map complies with National Map Accuracy Standards." Other exceptions involve areas covered by dense woodland or always obscured by fog or clouds; in those areas, aerial photography is unable to provide the detail needed for precise mapping. The Geological Survey tests enough of its maps, as described below, to make sure that the instruments and procedures the Survey uses are producing maps that meet the U.S. National Map Accuracy Standards.

## Unavoidable Factual Errors

There are certain kinds of errors in mapmaking that are almost unavoidable. These have to do with factual rather than mathematical matters. The items most subject to errors are names and symbols of features, and the classifications of roads or woodlands.

Mapmakers cannot apply a numerical value to this kind of information; they must rely on local sources for their information. Sometimes the information is wrong. Sometimes names change or new names and features are added in an area. U.S. Geological Survey cartographers and editors check all maps thoroughly and, as a matter of professional pride, attempt to keep factual errors to a practical minimum.

## How the Survey Maintains Map Accuracy

In 1958, the Survey began testing the accuracy of its maps systematically. At the outset of this program, the Survey tested at least 10 percent of the maps it produced. Today, because of technological advances in mapping techniques, only a small sampling of maps are tested 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 chosen at random, U.S. Geological Survey experts select 20 well-defined points; a typical point would be a crossroads. Field teams then are dispatched to the chosen sites to establish the positions of the 20 points, using the most sophisticated field surveying techniques. Vertical tests are run separately to determine precise elevations. The findings are reported back to the Survey, and the map is checked against the field survey results. If the map is accurate within the tolerances of the U.S. National Map Accuracy

Standards, it receives certification and is published with the statement that it complies with those standards.

By such rigorous testing of some of its maps, the Survey is able to determine that its general procedures for collecting map information are working well enough to assure a high level of map accuracy.

## 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. 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, railroads, etc.; corners of large buildings or structures (or center points of small buildings); etc. In general what is well-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 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. 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 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 aforesaid shall omit from their legends all mention of standard accuracy.

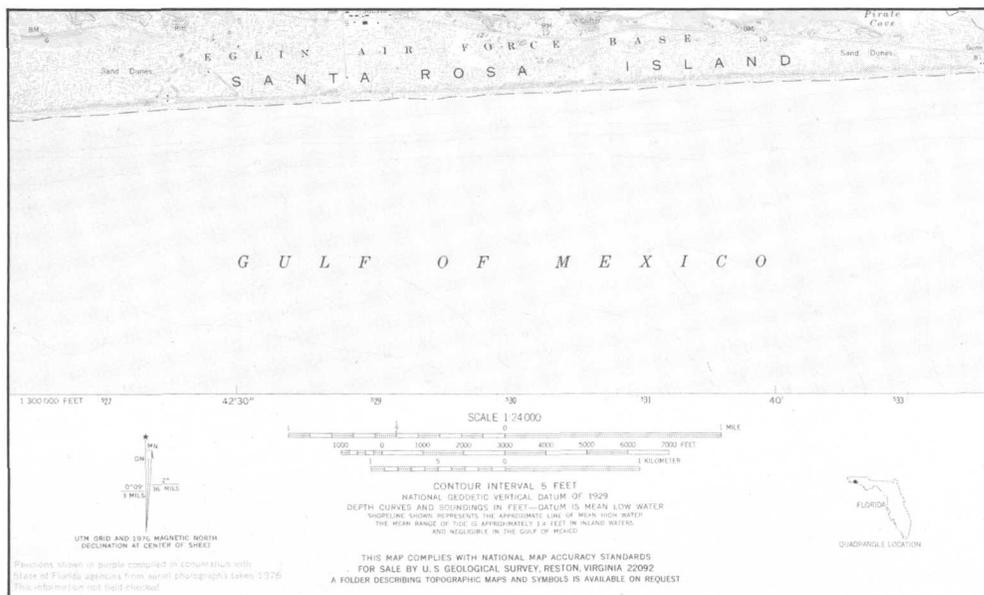
6. When a published map is a considerable enlargement of a map drawing (manuscript) or of a published map, that fact shall be stated in the legend. For example, "This map is an enlargement of a 1:20,000-scale map drawing," or "This map is an enlargement of a 1:24,000-scale published map."

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 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 1/2 minutes, or 3 3/4 minutes in size.

## How To Obtain More Information

If you want to know more about this subject or more about maps, please send your inquiry with your name, address, organizational affiliation, and telephone number to:

National Cartographic Information Center  
U.S. Geological Survey  
507 National Center  
Reston, Virginia 22092  
Telephone: 703-860-6045



or contact the following office:

