



# LVL\_DH, and Tidal and Orthometric Elevations

Renee Shields

Have you ever wondered why your leveled height between two bench marks frequently doesn't match the height difference calculated from the two published North American Vertical Datum of 1988 (NAVD 88) elevations from the NGS data sheets? Or how tidal datum heights for tidal bench marks relate to NAVD 88 elevations? Well, the NGS Geodetic Tool Kit can provide answers to your questions. Two applications of the Tool Kit, "LVL\_DH," and "Tidal and Orthometric Elevations," calculate these relationships for you. And you don't have to download the software; the computations are done on NGS computers.

NAVD 88 bench mark elevations published by NGS are defined in a Helmert orthometric height system that corresponds to the orthometric heights computed from Global Positioning System (GPS) measurements (apart from occasional small systematic shifts) after applying the proper geoid height model, such as the values provided by GEOID99. Helmert orthometric heights are obtained from leveling measurements by adding a small correction, called a Helmert *orthometric correction*. But, surveyors want to check their leveled heights directly against differenced published heights. Therefore, in a reverse process, program "LVL\_DH" converts the differenced NAVD 88 orthometric elevations of two bench marks into a leveled height by subtracting the Helmert orthometric correction from the differenced published values. In many parts of the country (*i.e.*, in flat terrain at low elevations), the orthometric correction is so small as to be insignificant.

## How to Request the Graph

NAVD 88 heights are orthometric heights of bench marks relative to a defined geodetic vertical datum. Tidal elevations are heights based upon local tidal datums determined over a 19-year National Tidal Datum Epoch. The Tool Kit application "Tidal and Orthometric Elevations" provides a graph of the relationship between the National Geodetic Vertical Datum of 1929 and NAVD 88 orthometric height and the various tide levels, *e.g.*, Mean Low Low Water (MLLW), Mean High Water (MHW), etc., for any tidal bench marks which are common to the NGS vertical geodetic network. There are two ways to request the graph. The user can enter a

station identifier known as a Permanent Identifier (PID) which is available on the datasheet, or a latitude/longitude range in which to search for qualifying bench marks. For the first option, the user first identifies a bench mark which is common to both vertical databases by retrieving datasheets from either NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) at <http://co-ops.nos.noaa.gov/benchmark.html>, or from the NGS database at <http://www.ngs.noaa.gov/datasheet.html>. Both kinds of datasheets display the PID. The Web page for this Tool Kit application is at [http://www.ngs.noaa.gov/cgi-bin/ngs\\_opsd.prl](http://www.ngs.noaa.gov/cgi-bin/ngs_opsd.prl). The user enters the PID or latitude/longitude range for the area of interest and clicks the Submit button. The program accesses the data from the two databases and plots a vertical bar graph displaying the tide levels and the difference values of the NAVD 88 and

NGVD 29 elevations which need to be applied to the published orthometric height in order to relate it to MLLW.

Applications NGS hopes to add to the Tool Kit in the future include a dynamic height computation and a vertical datum conversion program. For the DYNAMIC\_HT, the user will input a NAVD 88 height at a point and the gravity value determined using the same gravity model that was used in the NAVD 88 adjustment, and will be provided with a Dynamic or, where relevant, an IGLD 85 height for that point. The VDATUM program will enable the user to convert a height between any two of 27

different vertical datums, including geodetic vertical datums, tidal datums, and many 3D datums, such as varieties of WGS 84 and ITRF datums. Watch the NGS website for these additions to the Tool Kit.

Additional information on these and other applications in the NGS Tool Kit can be found at the NGS internet site at <http://www.ngs.noaa.gov/TOOLS/>. Please take advantage of the NGS Tool Kit. You can read about other Tool Kit applications in future issues of *Professional Surveyor*. ▽

**RENEE SHIELDS** has been a geodesist with the National Geodetic Survey for 23 years, and is currently involved with Network Analysis of the NSRS and outreach activities for the Height Modernization initiative.

