HIGH ACCURACY REFERENCE NETWORK FOR INDIANA

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The National Geodetic Survey (NGS) has recently completed the final adjustment of the Federal and Cooperative Base Networks (FBN/CBN) for Indiana. Consisting of 169 stations, 26 new and 143 existing National Spatial Reference System (NSRS) control stations spaced at approximately 30 kilometer (23 mile) intervals, the network was observed to A and B-Order accuracy standards (5 mm + 1:10,000,000 and 8 mm + 1:1,000,000) as defined by the Federal Geodetic Control Subcommittee. This network is often referred to as the High Accuracy Reference Network (HARN). Project implementation and coordination were directed by NGS, in cooperation with the Highway Extension and Research Project for Indiana Counties and Cities (HERPICC) and Schneider Engineering/Plumb Tuckett & Associates as the HERPICC GPS consultants, the Indiana Department of Transportation, Indiana University and the Indiana Society of Professional Land Surveyors. Additional GPS network connections were also provided by the Departments of Transportation for Illinois and Ohio. Field operations were conducted between August and September 1997, using Ashtech Z-XII, Lecia SR299, SR399, and Trimble 4000SSE and 4000SSI dual frequency Global Positioning System (GPS) receivers. Most observations far exceeded the 1:1,000,000 proportional accuracy required for the B-Order adjustment. Adjustment of these data completes the national HARN program for all 50 states, the District of Columbia, American Samoa, Guam, Puerto Rico and the Virgin Islands, begun in 1987 by NGS.

In addition to adjusting the GPS data to fiducial stations of the Continuously Operating Reference Stations (CORS) network and existing FBN stations in Indiana, Illinois, Kentucky, Michigan, Ohio and Wisconsin, all existing horizontal control in the State will be readjusted to provide consistency between the HARN and the existing horizontal network. The readjustment will extend into the bordering states to the extent necessary to maintain consistency of the NSRS. Until the completion of the state-wide readjustment, HARN stations will be designated as "SPECIAL STATUS" on NGS data sheets to indicate their positional differences with the existing lower order NSRS stations. Given the current backlog of other HARN statewide readjustments, the Indiana readjustment could require as much as 2 years to complete. The new coordinate values are referred to as North American Datum of 1983 (NAD 83), Adjustment of 1997, and are designated NAD 83 (1997). This designation is necessary to

distinguish between the original NAD 83 Adjustment of 1986, or NAD 83 (1986). Coordinate values, including State Plane Coordinates or Universal Transverse Mercator Grid should be properly labeled to eliminate confusion. Positional changes due to the network improvement vary across the State, but are generally less than 0.5 meter (1.6 feet). Positions and velocities relative to the International Earth Rotation Service (IERS) Terrestrial Reference Frame (ITRF) will also eventually be published for all HARN stations.

Orthometric heights for the HARN were determined by occupying 12 stations with previously determined heights by GPS and 92 bench marks referenced to the North American Vertical Datum of 1988 (NAVD 88). NAD 83 ellipsoidal heights were determined by holding the values published for 4 CORS and 31 existing A and B-Order quality stations in and around the State. Accuracy of ellipsoidal heights determined by these observations vary, and are sometimes less than third-order. Orthometric heights are generally considered to be equivalent to those obtained by conventional vertical angle observations (0.1 meter/0.3 feet).

All GPS surveys performed prior to the HARN, and not submitted to NGS ("Blue Booked") for inclusion in NSRS, should be readjusted from original observations to maintain consistency with NSRS. Lower order coordinate information (e.g. cadastral survey, Photogrammetry, GIS data) can be transformed from NAD 83 (1986) to NAD 83 (1997) using version 2.10 of the NADCON software supplied by NGS, with special transformation grids for the Indiana adjustment (INHPGN.LAS and INHPGN.LOS). The transformation grids will be developed by NGS following the statewide readjustment, and should provide transformation values accurate to an average of 0.06 meter +/- 0.02 meter (0.20 +/- 0.06 feet) across the State. Updated coordinate information and the NADCON software can be obtained from the NGS Information Services Section at (301) 713-3242 and the NGS Internet Home Page at http://www.ngs.noaa.gov.

Questions concerning the HARN and state-wide readjustment or coordinate transformations should be directed to Dave Doyle, NGS Observation and Analysis Division, telephone (301) 713-3178, or email daved@ngs.noaa.gov.