



# Great Lakes Height Modernization Consortium Program and Accomplishments

Height Modernization is the establishment of accurate, reliable heights using global positioning satellites (GPS) technology in conjunction with traditional leveling, gravity, and modern remote sensing. Funding comes from the individual states or the National Geodetic Survey (NGS), part of the National Oceanic and Atmospheric Administration (NOAA), which provides funding to states for this effort through grants.

Each state customizes its program to meet its particular needs. Common program elements include:

- Continuously Operating Reference Systems (CORS) that continually receive GPS and other satellite signals to provide Real-Time 3D corrections to other GPS users, improving the accuracy of GPS units. IN, MI, MN, OH and WI are well along in developing their networks.
- Classical leveling and installation of benchmarks to replace those lost over the years or to densify the network. This is a major effort in all states.
- High-resolution digital elevation model of the earth's surface developed through such remote sensing tools as light detection and ranging (LiDAR). This as a major component of the Illinois and Iowa programs.

The Consortium is a core group of state and federal agency representatives, whose mission is to support NGS's National Height Modernization Program (N-HMP). The Consortium provides support by organizing, coordinating, and otherwise supporting projects and activities that further the mission and goals of the N-HMP. Regional goals and activities include: organizing and hosting conferences, educational forums and Web sites; pursuing regional grant applications; developing projects and techniques to address the unique HMP issues region-wide; and analyzing and documenting specific benefits of the HMP to Consortium states.

## Accomplishments

**Illinois** first received funding in FY08 and has received just over \$1.8M to date through NGS. Illinois has:

- Completed leveling along 4 lines totaling 300 kilometers in northern Illinois
- Made LiDAR data for eleven counties available on-line
- Established data sharing agreements for LiDAR data for six additional counties
- Acquired LiDAR data for Kendall County, to complete data coverage for northeastern Illinois
- Supported expansion of the private sector CORS networks through hosting installations at DOT facilities
- Conducted extensive outreach on-line and at conferences and meetings

**Indiana** has spent \$778K of state funds on their program, operated through the Department of Transportation. Indiana has:

- Established a network of 45 CORS stations (InCORS)
- Is Submitting seven InCORS to NGS to become part of the national network
- Planned a statewide network of benchmarks, including recovering existing benchmark and installing new ones.

**Iowa** has received \$1.87M of state funds through their Department of Transportation for CORS and \$4.3M through a partnership for LiDAR. They have:

- Established a statewide network of 80 CORS stations (IaRTN), which has been fully operational since February 2009
- Completed 85% of their LiDAR project anticipate finalizing the collection in spring 2010. This project is funded by a partnership among the Iowa Department of Transportation (IDOT), Department of Agriculture and Land Stewardship (IDALS), Department of Natural Resources (IDNR), and the Natural Resources Conservation Service (NRCS). The data collected have a vertical accuracy of 18.5cm on bare ground and 37cm in heavy vegetation. Data are freely available to the public.

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**Michigan's** program is run through the Department of Transportation, in partnership with NGS and other governmental units. Its ultimate goal is to provide a 3D statewide network of reliable National Spatial Reference System data using the existing CORS stations. Michigan has received \$ 2.5 M from the Department of Transportation and to date has received \$ 80 K from NGS. Michigan has:

- Over 4000 KM of high precision leveling.
- 300 additional B-order and 450 1<sup>st</sup> order GPS monuments.
- Updated elevations at 3 NOAA water level gages.
- MDOT and NOAA CO-OPS partnership with a state of the art water level gage in Mackinaw City.
- Installation of 8 CORS for agricultural use at the request of multiple county agencies.

**Ohio's** program is managed by the Ohio Department of Transportation's Office of Aerial Engineering [www.dot.state.oh.us/Divisions/ProdMgt/Aerial](http://www.dot.state.oh.us/Divisions/ProdMgt/Aerial). This network supports real-time survey-grade accuracy statewide to registered users via cell phone or wireless modem. Ohio has also performed data collection for a research project in collaboration with The Ohio State University to analyze and examine the GEOID model for Ohio in an effort to identify the existing accuracy and improvement opportunities. Ohio has:

- 54 Continuously Operating Reference Stations (CORS) which are part of the National CORS network.
- LiDAR and high-resolution imagery data are available for the entire state as a result of the Ohio Statewide Imagery Program (OSIP). Standard OSIP products include Color Orthophotography, Digital Elevation Model (DEM), and LiDAR. More information is available at [ogrip.oit.ohio.gov/ServicesData/StatewideImagery/tabid/86/Default.aspx](http://ogrip.oit.ohio.gov/ServicesData/StatewideImagery/tabid/86/Default.aspx)
- Plans to continue improvement efforts including; leveling to CORS monuments from First Order NGS level lines, establishing additional absolute gravity stations, acquiring GNSS antennae with absolute calibrations, and testing of GNSS equipment to identify potential vertical issues.

**Pennsylvania's** program is also supported through the Department of Transportation and combines a CORS network with geodetic control. Pennsylvania has:

- 21 NGS CORS sites in operation, with 14 operated by PennDOT. Plans are to expand the network statewide, with three sites to be added in 2010.
- A geodetic control database at [www.penndotpams.org](http://www.penndotpams.org) that has geodetic control monument datasheets for PennDOT, various PA county GIS departments, USGS, and NGS. PennDOT does not "NGS blue-book" all of its projects, due to time and funding constraints.
- Observed its High Accuracy Reference Network (HARN) in 2000, which produced approximately 130 stations. Since 2000, additional stations have been added in various areas throughout the state – mainly horizontal stations. Densification is still needed for many areas, especially vertical benchmarks.

**Wisconsin** launched their HMP in 1998 with a pilot project funded by the Wisconsin Department of Transportation (WisDOT). Wisconsin's program is following a long range HMP that includes both passive and active networks, with mark setting of GPS, bench mark, and CORS (continuously operating reference stations). Through 2009, WisDOT has invested nearly \$18 million, about two-thirds of which have come from grants for NOAA's National Geodetic Survey. They have:

- Completed 10,900 km of double-run leveling, with plans for approximately 4,300 additional km.
- Completed the GPS survey of nearly 2,600 stations with plans for approximately 1,100 additional stations.
- Installed over 3,900 GPS and bench marks, with more than 1,000 additional marks planned.
- Completed GPS and leveling projects and submitted to NGS for over 50% of the state.
- Begun operation of the WISCORS network in July of 2008, with 35 stations currently operational. Five (5) stations will be added shortly with a 29 additional stations will be installed in 2010 and 8 in 2011 for a total of 77 statewide. Tentative plans have also been made to link WISCORS with a possible 22 CORS in the adjoining states of Illinois, Iowa, Michigan, and Minnesota. As of March 2010, 400 users have signed on as users of the no-fee service.