NOAA's National Height Modernization Program
National Partner Meeting
Silver Spring, Maryland
August 19, 2011

NGS has held meetings with its Height Modernization partners in the past, but a fully attended face-to-face meeting had not been held in some time. The LiDAR workshop event held on August 18 in response to partner concerns was an opportunity to hold such a meeting. With the elimination of earmark funding from Congressional appropriations, it is more important than ever to find ways to collaborate with our partners and constituents to maintain the forward momentum that has been achieved over the past 10 years through the National Height Modernization Program.

Juliana Blackwell, NGS – Welcome, Introductions

Juliana welcomed all the partners, and explained that the day's agenda planned for a relatively informal discussion about Height Modernization (Height Mod or HM) including what we all have accomplished, how we can do things better, and what are some of the applications of HM.

Discussing what HM can do for specific applications is key to helping NGS educate users internally and externally on HM for the nation, especially given today's budget climate. NGS is great at getting in the weeds and talking about the geoid, etc., but we have to do a better job of bringing attention to how HM helps communities and the nation. Juliana said she looks forward to hearing the stories about benefits of HM, such as improvements to floodplain mapping, transportation, other applications relevant to those on the Hill and in local communities. All of these stories will help promote HM at the state and federal level. Partners should also provide input on how we can better manage the national program and how NGS and state partners can work together more effectively.

Juliana mentioned that the previous day was a successful workshop talking about LiDAR and geodetic control, and that this day was focused on HM and the partners in the room. Juliana then asked all to observe a moment of silence for the memory of Dr. Roy Dokka.

Renee Shields, NGS – National Height Mod Program Update

Renee thanked all the partners for attending the partner meeting, and she expressed her hope to continue having partner meetings on a more regular basis. While CA and MT could not attend, all the other state partners were represented.

As Renee has described many times before, she reiterated that the NHMP works to achieve the national goals of (1) access to heights, (2) consistent standards, (3) development of data, technology and tools, and (4) development of a maintainable system. Key to these goals is also the successful transition to the new geopotential/vertical datum.

Recent accomplishments that the NHMP helps support include the continued progress of GRAVD (Alaska collection nearly complete, and the Great Lakes has begun). As Dru Smith mentioned at the Federal Geospatial Summit, there will be pilot projects to help prepare for the transition to the new datums, and the first such pilot project was completed in NC this year to determine how the new datum would affect floodplain mapping programs. Currently, NGS is completing a geoid slope validation survey in Texas where they are collecting GPS, leveling, astro, gravity and LiDAR data for research, papers, and studies. Leveling and GPS observations have been completed to support the next International Great Lakes Datum (IGLD) in addition to the GRAVD efforts

just beginning in that region. HM depends on an updated geoid, so it supported Geoid09 and will continue to support the development of Geoid12. Additional HTDP work has been completed in CA and AK. While VTDP still presents a greater challenge, data from our third LA survey could help support the development of that tool. The ellipsoid heights from the LA survey will be in the National Adjustment of 2011 (NA11), and NGS is working on how to publish the data. Finally, the monthly teleconference now has more value added with the speakers invited to address the needs and interests of the group. Ideas for topics and speakers for future meetings are welcomed.

Future plans for the NHMP include continued support of NGS projects. Renee also plans to create a national plan, strategic plan, and operating plan for the program that will include specificity to the level of things like updating guidelines. The plan will also include forming a group of experts within NOAA to identify gaps in geospatial data (e.g. tide stations, gravity) by evaluating NGS data holdings. As part of this effort, Renee will seek input from advisors and partners who are familiar with local issues. The objective will be to ensure NGS has sufficient data to create an accurate transformation tool. To make transitioning to the new datum as painless as possible, it will be important to have good transformation tools and products. NHMP will also continue to support the modernization of geodetic control datasheets, which will hopefully include a strategy for reporting accuracies and reporting issues in areas we know to be problematic (i.e. significant land movement). Finally, Renee highlighted her intent to continue to engage the regions more over time. The Southeast region currently has a regular teleconference every six months. The Great Lakes region has been very active thanks to high advisor presence and a large number of (previously) funded states; they have a teleconference monthly and a face to face meeting every six months.

> **Q:** Cliff Mugnier, LSU – We found subsidence rates are non-linear, so I therefore question utility of use VTDP for forecasting positions. It could also be useful to timestamp datasheets
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> **A:** Renee Shields, NGS – We acknowledge these issues are a tremendous challenge as vertical change is such a localized occurrence. Using VTDP to put expiration dates on datasheets could be a good strategy. Renee added that NGS is not using VTDP exclusively to analyze LA data.
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> **Q:** Dan Smith, CO DOT – I am very excited about updates to guidelines, infrastructure gap analysis, and modernized datasheets. Can you speak more about those plans?
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> **A1:** Renee Shields, NGS – While guidelines (i.e. NGS 58/59) do need to be streamlined; there is currently no plan to begin that task in the immediate future. The first step would be to develop a scope of work for projects in different parts of country to do research to update guidelines.
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> **A2:** Renee Shields, NGS – Regarding the gap analysis, I envision a group that could meet monthly, analyzing the gaps in the each part of the country, and would likely bring in local knowledge where contacts are available. I look forward to working directly with the states, generally through a teleconference, though face to face meetings are not outside the realm of possibility. Still, identifying what needs to get done and getting them done are two different things. I hope that gap analysis could be completed in the next 1.5 - 2 years. The group will look at areas known to have issues first, and but will eventually work through the whole country.
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> **A3:** Renee Shields, NGS – Regarding datasheets, as we make modifications, announcements and samples are going to be posted online and sent out to notify vendors and users who may have software or applications that expect certain formats. Changes include the removal of contradictory information, the inclusion of important metadata (e.g. including the geoid model that was used to get GPS-derived heights). Suggestions and recommendations can be submitted directly to Renee who is on the

datasheet committee.

A4: Juliana Blackwell, NGS – NGS is in the process of transitioning its database from SYBASE to ORACLE. It will take time, but the 21th century tool (i.e. ORACLE) will provide the opportunity to enhance ability to see, pull, and access the data in the NGS database.

Q: Dan Smith, CO DOT –How can we get more CORS to Colorado?

A1: Juliana Blackwell, NGS – I suggest identifying benefits to the entire state and answering the question "How much money will it save the state?" For the most part, coming from the federal perspective, NGS will not add a lot of CORS itself. Densifying the network further will likely fall to the states.

A2: Renee Shields, NGS – I want to add that access to the NSRS is changing, so NGS is changing how we provide access.

A3: Ronnie Taylor, NGS – I would like to add that NGS' mandate is to create the foundation that the states can build from. States can build on top of that. That does not have to necessarily be on the county level.

Q: Gene Trobia, AZ State Land Department – Does the gap analysis you are referring to mean geospatial gaps? It would be helpful to identify what kinds of things could be done to fill gaps at a local level so that business cases could be made to justify those improvements.

A: Renee Shields, NGS – Yes, the gaps I'm talking about are in geospatial data.

A: Dave Conner, NGS OH Advisor; Brad Rister, U-KY; and Peter Jenkins, MN DOT – All added that they made a business case that has allowed them to receive State Planning and Research (SPR) federal DOT funding.

NC – Scott Lokken, NGS NC Advisor (for Gary Thompson, North Carolina Geodetic Survey or NCGS)

- NC has saved money and time using HM in place of solely using traditional techniques.
- NC usually completes HM projects at a county-wide level. NCGS identifies areas not included in the most recent geoid model and positions as many bench marks as possible. New CORS sites are upgraded with HM orthometric heights. HM is used extensively for DFIRM maintenance
- NC has 77 CORS in the state. They are NCGS equipment, with partners like USACE, NOAA, and others providing the facilities and IT. All NC CORS collect 1 sec data and archived after about one month to DVDs or portable hard drives. Most CORS are GPS and GLONASS. NC is sharing 7 CORS with SC to extend network across the border. NCGS uses twitter to update users (currently about 300 followers) about RTN status and when individual CORS are off-line.
- NCGS is in process of upgrading their VRS network (i.e. new servers, software upgrade, etc.) making the network more stable and robust. Problems this summer have included issues with air conditioning malfunctions in the server room and users exceeding server capacity. The MYCS CORS positions will be used on the new server providing the ability to compare the realizations in real time.
- Precision Agriculture has added many new users to the network this year. Farmers tend to stay logged on for many hours and through the night. They are a huge new market we should aid. One of my outreach efforts was a partner training workshop with a Precision Agriculture expert from the North Carolina State University. The session was part of an ag education series organized by the state community college network.

- NC performed a statewide ortho-imagery project early this year; the state pooled 911 funds to finance statewide 6 inch pixel aerial imagery. Existing height mod surveys helped expidite QA/QC. HM definitely made the QA/QC cheaper for this photogrammetry effort and other DFIRM maintenance operations.
- NC has also created a new database and web interface that has improved search functions, Google map, visibility charts and mark photos. Other changes include: all data can be exported to a csv file, online recoveries can be submitted, one click access directly to a NGS datasheet. USGS, TVA and other non-NGSIDB marks have been included in the NCGS database. NCGS has developed a series online accessible maps as alternate portal to access positional data..
- NC has a continuing effort to put NAVD88 heights on stream gages.
- In preparation for GRAVD, NC is recovering gravity stations and has made a few new absolute gravity observations.
- NC has an active workshop/outreach program.

  Q: Dave Moyer, WI – Do you charge for your RTN?

  A: Scott Lokken, NGS NC Advisor – Yes, NC charges $500 one-time fee for the RTN. NC is only legally allowed to recover costs from administering the RTN – they cannot make money.

  Q: Gary Jeffress, TXA&M-CC – Do you have problems with cell coverage for the RTN?

  A: Scott Lokken, NGS NC Advisor –Yes, some areas have sparse coverage and probably greater than 90% of user problems are cell coverage related not problems with the RTN.

  C: Renee Shields, NGS –highlighted the effort to update USGS stream gages in NC and encouraged others to do the same.

  C: Dave Zenk, NGS MN Advisor – USGS had $40K to support HM that would update stream gage elevations, and NWS was excited, too.

MI – Michael Barger, Michigan Department of Transportation (M-DOT)

- Michael Barger was assigned to HM just a few months ago replacing Andy Semenchuk who led HM since its inception in MI, and the previous co-PI (Principal Investigator) retired. There has been a learning curve to get up to speed.
- About to begin a HM project in lower MI to tie in 10 stream gages.
- Working with 5 consultants to do geodetic work because have found value in keeping multiple firms involved, even for small projects.
- 91 CORS throughout state; some counties with many, some with one, and some with none. Many are running into funding issues with agencies inquiring what can be cut (i.e. what is not mandated).
- Trying to maintain network geometry even with counties dropping out; there may be a possibility to get funding through at state foundation.
- Plan is to continue densifying HM network; Detroit network is good, Grand Rapids N/S is good, but E/W has errors.
- Very interested in GRAV-D.
- M-DOT is undergoing major transformation and reorganization. Expected to be complete by October – strongly encourage succession planning!
- Maintenance fees are often not in writing, and therefore cut.

SC – Dick Woods, South Carolina Geodetic Survey (SCGS)

- SC has an RTN with 48 stations, and all have HM stations, but only 7 are NGS CORS.
- SC has staff dedicated to geodetic work, so blue-book specs are followed.
- Working with surveyors have found HM stations are used for flood elevations, tying to state plane coordinate systems, and near wells.
- RTN users must use our checkpoints and tie to HM stations nearby.
- 85% of state complete with HM control including coast and some islands.
- Often ask for additional support for fieldwork –always ask, beg and borrow for help.
- 1⁄3 of GPS observations in a project are on BMs because the continual observation improves the geoid.
- Working with USC looking for earth strain movement and not finding any movement.
- Reoccupy PACS and SACS when projects are nearby, and update whole county when they doing a project.
- SC is happy to see new adjustment.

  Q: Jim Richardson, NGS NE Advisor – Does geoid model change much between NC and SC? With every new geoid model, do you re-run your projects with new geoid?

  A: Dick Woods, SCGS – Explained since all projects are blue-booked, all are updated in the NGS with the newest geoid. Geoid 09 seems to work well.

MS - David Mooneyhan, University of Southern Mississippi (USM)

- Mississippi has 49 CORS, majority of which are GLONASS compatible.
- University of Southern Mississippi (USM) operates an RTN used by the DOT. There are 102 licenses that each permit 1400 hrs of initialized time on the network.
- Challenges center on communication with partners because most folks do not understand why HM is important.
- USM owns equipment at all stations, always same materials used.
- In process of densifying network to shorten some baselines. Also share five stations with LA.
- "Congressional peer-reviewed funding" has been received each year except one since 2003. Plan that DOT will support $250K/year and use it as their reference frame.
- Recently co-located CORS at tide station.
- Important to communicate how CORS benefits the entire state.

LA – Cliff Mugnier , Louisiana State University (LSU)

- LA operates a VRS system with 65 stations, some shared with MS and TX. Charge $3500/year for VRS network, and c ell coverage is a challenge because it is spotty. Access to database maintained at 1-second intervals for additional $1500/year for about ¼ of subscribers to the network.
- Contract in works to offer packaged bundles of VRS subscriptions to tractor dealers who will train users; this taps into the precision agriculture community without straining support.
- Significant downward crustal motion makes absolute gravity observations important: 1⁄3 of CORS have absolute gravity, many with multiple observations showing increases over time and 9.5 mm/yr subsidence rate in New Orleans. Some observations by NGS, most completed by NGA after communicating with local USACE district about the need for absolute gravity.
- Through LA Transportation Research Center, put GPS on large bridges to measure moment by moment deflections of bridges; frequency logging at 20-50 hz. Interest from structural faculty, especially important during hurricane events.
- Also involved with resurveys of hurricane evacuation routes; Parrish managers are very interested in elevations of evacuation routes.

Q: Jim Richardson, NGS NE Advisor – What is the regional extent of subsidence?

A: Cliff Mugnier, LSU – Replied from Houston to Mobile Bay. The rate decreases as you go north. Rate of -5 mm/yr has been observed in Memphis, and E/W transects have been studied in St. Louis. Read NGS Technical Report 50 by Dokka and Shinkle for more information on study that found subsidence highly correlated with expansive soils, sediment deposition, and hydrocarbon depositions. Additional problems are that aquifers and being drawn down, and saltwater intrusion is increasing into rice patties.

TX - Gary Jeffress, Texas A&M at Corpus Christi (TXA&M-CC)

- Specific incident that has shaped current project: Hurricane Ike flooded subdivision destroying 57 houses built last 2 decades. Owners not allowed to rebuild, received 75% value from FEMA, now in floodplain. Caused by a difference of 4 ft on existing BM that had not been resurveyed since 1980s.
- After this incident, Jefferson County began HM elevation project in 2010-11 with $300K. Project selected locations for 20 new BMs, 2 new CORS stations with a partner, 8 Trimble-RS receivers with fixed height antennas. Have completed four sessions following 58/59 standards in March 2011. Not published yet, were waiting on OPUS-Projects, hoping to finalize results in September 2011. Plan to go back to Jefferson County to show results. Also received funding from USACE to replace tide gauge; new sentinel tide gauges that are hurricane resistant and that platform will also house CORS.
- Project at Texas Point TCOON station, completed precise reciprocal leveling and precise trig leveling
- USACE supplying funding to keep TX SRC operational because of interest in recovering elevations and tide gauges along coast.
- No plans to re-observe Galveston right now
- At Beaumont, work will be done to deepen and widen channel, and they want to use CORS on platform to control dredging machinery.

WI - Diane Arendt, Wisconsin Department of Transportation (WI DOT)

- WI has both a passive and active network, both still in latter stages of development
- CORS construction planned to be completed by end of 2012 (78 sites), hopefully with data, too. CORS are established at approximately 50 km spacing. Installing concrete pillars rather than on buildings. Have begun to extend CORS antenna heights to reduce multi-path. CORS sited on DOT facilities or with partners that include airport and waste water treatment plants, schools, few private – excavation contractors, and many municipal or county buildings.
- Now have 900+ users for RTN, but no fee structure. Everything available online including RINEX data for post processing.
- Bench mark passive control network is an in-ground concrete post or disc in bridge every 1.8 miles with much of the state already completed, some published, and some with consultant to complete bluebooking. Additionally, passive network includes GPS network densification of the WI-HARN network that includes Primary, Secondary, and Local networks below the HARN for much of the State. Total passive network, including bench marks, will total approximately 8,000 marks.
- Challenges includes archaeological clearance, internet connections in remote places
- Plan to expand reach to and support of the precision agriculture community

Q: Cliff Mugnier, LSU – Why do you have an emphasis on a passive control network?

A: Diane Arendt, WI DOT – It was a historical decision, and there is strong need in north of state. Also, there was a need to level to HARN stations and CORS.

NJ – John Knapp, New Jersey Department of Transportation (NJ DOT)

- NJ has partnered with NJIT and Leica Geosystems, and has established 15 CORS (14 NGS CORS) in 21 counties. The RTN is used exclusively by the DOT.
- Now performing first order leveling to CORS. Using leveling and GPS, established 2 or 3 reference marks no more than 1 km away from CORS; results positive.
- Fees from user licenses that have to be renewed periodically are going to Leica who runs the network. Another fee system is available in which a user pays for a CORS installation and becomes lifetime member with 4-5 licenses. Annual fee is about $1500-2K with 3-4 site licenses, plus 4-5 lifetime licenses at $20-25k per license.
- Hitting level runs that have not been hit since 1920's and finding BMs gone so establishing new marks on public property, installing marks 3 ft deep, and submitting to NGS as level projects.
- Ongoing aerial photogrammetry effort.
- Subsidence in Gloucester county affects CORS, so had to expand level run. Observed 2-3 cm subsidence in past 15 years.

IL – Sheena Beaverson, Illinois State Geological Survey (ISGS)

- HM is in its third year, and always had money federally appropriated.
- Have elected to drop CORS component of plan
- Have ongoing LiDAR; data available for 18 counties, but many problems cropping up that are leading to a lot of trial and error. Will have to work with the agencies that are collecting the data.
- Have leveling work through contracts; to date, 187 new BM, 114 recovered BM, 311 new records.
- Two companies are crossing Illinois with CORS and a RTN.
- Just received $3.5M per year / FHA – SPR funding with a 5-year commitment, IL plans to use the first year $3.5M to install 500 new marks and reach 110 horizontal marks that had never been leveled to.
- LiDAR collection will also continue (20 counties completed so far). FEMA LiDAR available along rivers, and LiDAR collection planned for 30 more counties next year by IDOT.
- Showcase of LiDAR data applications available online that documents 11 real-world uses of Illinois data from a broad range of users including researchers, geologists.
- Current needs - hire staff to QA/QC LiDAR data and generate custom derivative data products.

WA – Dave Steele, Washington Department of Natural Resources (WADNR) and Spatial Reference Center of Washington (SRCW)

- HM program currently in a holding pattern, no projects for last year, but received funds 5 of 8 past years (first NGS/NOAA grant in FY09)
- Spatial reference center acts as advisory group to DNR
- Gained experience building a SRC as non-profit organization, but did not work quite as well as planned and ended up going into state department (DNR) because of unwanted competition with universities
- Initially intended to do bench marks, but realized too expensive and decided to pursue active network at low cost.
- Gavin Shrock planned the active network with 85 stations (83 now in place) around the state, spaced 20-30 km apart near Puget Sound but generally spaced about 75 km apart.
- Found that they needed software nodes to connect into central processing to get high quality data monitoring
- Provide free data for static data, but collect fees for real time users and free licenses for partners; currently have 1500 users.
- Planned primary base station network to support a high precision geoid with a 30-40 km spacing of GPS on BMs. Began with most stable parts of state: open sky prairie to test and build ideas, concepts, multiple GPS sessions 6.5 hrs, small networks, able to analyze marks across counties, found best marks and reference those, and updated many positions. This process complete for 1⁄3 of state.

- Challenges exist in remote areas without cell coverage
- $1M would finish primary passive network
- Active control network all funded locally

AL – John Russell, Alabama Department of Transportation (AL DOT), and Bill Bass, Alabama Department of Revenue (AL DOR)

- AL Revenue Department is a heavy user of GIS, and found a lot of funds were used for orthophotography. Then partnered with DOT to get LiDAR and shared products out of many partnerships.
- Estimated that $50M would be needed to get good quality statewide GIS.
- Goal to build better GIS model – find ways to funnel money to counties.
- Theory was by improving the geodetic framework, good data would rise to the top, and more opportunities continue to develop.
- Current plan has 40-50 km HARN densification with first or second order leveling to get good orthometric heights.
- Hesitant to establish CORS network, but put 50th site up in March, and 7 or 8 more are planned to enter NGS CORS network.
- Challenges include site installation and IT problems.
- Funding strategies include joining other ongoing projects and SPR funding was used 2-3 years ago for LiDAR and imagery because FHWA requires that it is GIS related.
- Currently pushing to get things in NGS IDB for next geoid model.
- Moving forward – next big effort will be a focus on outreach/education, especially need to engage private sector and users along with counties, state offices, surveyors, and aerial mapping firms.

Colorado – Daniel Smith, Colorado Department of Transportation (CDOT)

- Reported Height Mod has been a tough sell in Colorado. Early minimal funding ($75K) from NGS enabled CDOT to host a couple of forums where partnership opportunities were explored. Since the funding was small, there were no partnerships generated.
- CDOT has done some leveling and GPS surveys in the fashion of Height Mod, but CDOT has not felt that the benefit is sufficient to justify cost of the additional time and effort for the surveying and bluebooking. The majority of CDOT projects tie to existing CORS, HARNs, and real time networks (4 in the state that they access), and provide the level of accuracy they require.
- Dan is very interested in the gap analysis Renee mentioned and will work with NGS when they get to looking at Colorado.
- Dan suggested the DOT in Colorado might not be the best fit for height mod, and that if another agency or university were identified that could take up the charge, he'd be willing to assist them.
- CDOT is particularly interested in any cost savings ideas to make height modernization affordable.
- Suggestions and ideas Dan heard that he can take back to Colorado included:
    - Educate others on importance of and benefits from height mod
    - Seek CDOT SPR funds to cover costs of data processing and submission of projects to NGS
    - Seek funding from other sources to support projects and CORS, from other federal sources, Congress, and local and private funding opportunities

Arizona – Gene Trobia, Arizona State Land Department

Requested list of attendees for this meeting.

- Reported that early years of AZ Height Mod were done on a relative shoestring. AZ hoped for program support from DOT but have same issues as in CO – they have not realized the true benefit they could receive from improved heights and positioning. Gene is in GIS. His approach tends to focus not on the technology, but what does HM bring to GIS. Benefit cost analysis showed $20 million benefit to state from HM.

- AZ has 19 CORS in place and is getting 4 more.
- Reached out to DHS because of border security issues. Got 2 extra stations for border corridor. Working on GPS issues with the Arizona Counter Terrorism Information Center (AZ Fusion Center). Having an accurate base map is important so the folks on the ground can use their GPS units and can place themselves accurately on the maps they use. This is important near the border where positions can be critical.
- AZHM manages AZCORS network.
- Education is important; AZHM does a lot of outreach and training.
- Height Mod money they get is mostly used as pass through to support county partnerships. AZHM has agreements with counties who can provide a plan for how they would support HM. Most projects densify or readjust networks and support CORS if AZHM puts it in.
- State has contract with Leica so can put CORS up for 12K. Counties can take advantage of this pricing through agreements with AZHM.
- Flood control managers in AZ get it and are looking to set up local RTNs.
- AZHM hears right away when a CORS goes down – interested in what NC said about twitter feed.
- County regional park – interpretive station, solar driven, inside tells the story – teach kids.
- County flood district with FEMA/NGS rural county. Looking at how to use RTN. Department of Water Resources – subsidence because of ground water extractions. There are areas where all BMs subside so often don't catch changes to height of control stations.
- HM has helped in AZ because of creation of geospatial professional org to improve link between geodesy/surveying/GIS – now the different groups work together better.
- Utilities get into this a lot because of their mapping. They are the ones most likely to call if problem with CORS; utilities partner with AZ State Land Dept. and use AZCORS a lot.
- Have concerns over maintaining network – need to be able to do that. Need to communicate business value to folks or can't maintain what we have, let alone move forward.

KY – Danielle Kelly, Kentucky Transportation Cabinet (KYTC)

- Presentation given with demo of web site: http://kycors.ky.gov/kynetwork/
- 37 CORS – 22 are owned and operated by KYTC; 1 is owned by a county government and 1 is owned by an engineering firm; partner with surrounding states – 8 from TN, 4 from IN and 1 from WV; 17 (of the KYTC owned) are NGS CORS; new one accepted today; we have 3 more stations ready for submittal and have asked our county and private partners to submit their stations as well; KYTC has 4 more stations scheduled for installation this Fall. Our contractor, GRW, has also completed geodetic leveling to 21 CORS stations and we are waiting for the bluebooking process to be completed.
- have acquired many unexpected and varied users (over 300)– precision agriculture, miners, emergency management, software/hardware developers, surveyors, GPS equipment vendors & manufacturers, utility companies, construction, architects, engineers, environmental consultants, local, county, state & federal government agencies. Variety and growing number of users show development of an infrastructure so decision makers can see value. We are working to make them understand that it is not just surveyors and engineers using the system. We actually had legislators calling the Transportation Cabinet Secretary when the network started having a lot of outages after I left because their constituents were complaining.
- After federal funds dried up, got funds from our state Capital Projects Funds and Road Funds. I submitted proposals for the past two biennium budgets. Those proposals competed for selection within Transportation then made it through the next selection by technical committee comprised of several agencies before being considered by the legislative committee. So far, I've managed to get funds both times (~$ 1.5 million) by tying it in with our need for survey equipment, especially GPS equipment, i.e. make equipment part of the project need. The justification for the expenditure is to save money on design and construction, especially when using machine control for construction and LiDAR for planning and design. We also get software & hardware warranty and support funds from our IT division (~$189K

so far). They have also agreed to purchase the Trimble VRS3Net software (~$90K) for the network.

- The Division of Water and KYTC are getting ready to put out RFP for LiDAR, DOW has been using FEMA funds to acquire LiDAR county by county but can only afford about 12 counties each year. KY has 120 counties - at that rate it would take about 10 years for completion of all counties, so trying to partner with KYTC and others to speed it up. We have also benefitted by seeing a reduction in costs for LiDAR and mapping because our contractors use the RTN which reduces their need to set up base stations for each project. The RTN is free and access to hourly 1-second RINEX files for all stations in our network is free. Require login so they can track users, and have a way to let them know when parts of network are down. 2 RTN stations, KYTA in Paducah and KYTJ in Jackson, were not accepted into CORS because they are on metal roofs, but they are good – get less multipath from these two than we do from several of our NGS approved stations.
- Challenges – cell coverage; educating users of RTN who trust it too much. Getting the word out about the RTN. Also haven't heard anyone mention Light Squared. Encourage anyone who isn't familiar with issue to learn more about it.
- Educational Outreach – I have done presentations on LiDAR at conferences for professional surveyors, transportation engineers, flood plain managers and GIS professionals. I have also done presentations at a couple of KAPS chapter meetings and at our KYTC conference center. The past couple of years, KYTC has really limited conference attendance which has in turn limited the number of presentations I have been able to give.

MN – Peter Jenkins, Minnesota Department of Transportation (MNDOT)

- Handed out report on state network that summarizes control projects MnDOT had done since FY06 .
- Put in VRS but needed to make sure it is used right. Put in control to support tying to NSRS. The VRS is 6 sites away from being completed. Some have been accepted into the national CORS network and some will not make it due to various criteria.
- Interest in heights because of DTMs needing to be consistent.
- For the "Passive Marks for the County Densification Program", we don't have 100% counties. County interest slowing down. Those interested are done.
- Flooding is a big issue in MN. Lots of DOT infrastructure is near streams. Funding is needed. Recommend NGS work with the NWS to get money to forward this type of project. Helps NWS, helps NGS, helps the state's infrastructure.
- MN made mistake in time period when they did not require bluebooking of all projects.

Joe Evjen, NGS – OPUS Improvements

Joe Evjen reviewed the various varieties of OPUS that now has about 1,000 users per day.

Q: John Russell, ALDOT asked about beta page for MYCORS results.

A: Joe Evjen, NGS - Mentioned side by side pages being available from OPUS so users could get results using MYCORS or using current CORS coordinates. Also for ortho heights there will be geoid incompatibility until GEOID12 is released.

Q: Scott Lokken, NGS NC Advisor – Asked about OPUS projects for height mod projects.

A: Joe Evjen, NGS – Right now use is restricted to trained users. There are also limitations for height mod projects. E.g. you need 2 hr dataset.

Michael Dennis, NGS – Better Positions and Improved Access to NSRS

Michael Dennis provided a detailed review the coming adjustment (NA2011), MYCS (multi-year CORS Solution), the confusion about HPGN and HARN networks, why another adjustment of NAD83 is being done now, when

NA2011 will be available, and future plans and possibilities.

> **Q**: Jim Richardson, NGS NE Advisor – Will DSWorld be updated for new datasheet format?
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> **A:** Michael Dennis, NGS – Formats will be announced and provided in beta form to allow time for developer to modify software. This includes NGS software.

Vicki Childers and Dan Roman, NGS – GRAV-D & Geoid Update
Dr. Vicki Childers and Dr. Dan Roman made this presentation. Nationwide GRAV-D is about 13% complete, Lake Michigan area will be completed this FY and all of Great Lakes and Alaska in FY12. Two geoid models (gravimetric and hybrid) are being used to develop Geoid12, which will be available about the same time as NA2011. GRAV-D data for the earliest surveys, the Alabama Gulf Coast, will be available to the public online shortly.

> **Q:** Dave Steele, WaDNR – Can states help in some way, perhaps collection of data?
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> **A:** Dan Roman, NGS - Difficult to answer. If the state has access to an aircraft at a reduced price, that would be helpful. Unfortunately, like we found out with SC, we often don't have the funding mechanisms in place to pay for the aircraft. Also, one of our geoid modeling specialists, Jarir Saleh, has done an initial evaluation on the gravity data base to determine which surveys seem to pose a problem. The state people could perform new land gravity measurements in the areas of these problem surveys. It would give us new information that could help us fix or replace the old data in these areas.

Juliana Blackwell – Strategic Plan & Ten Year Update
Juliana said a few words about the NGS business model of developing a Strategic Plan annually that is designed to keep NGS on track for achieving the goals outlined in the NGS Ten-year plan. A copy of the strategic Plan was provided to the Height Mod partners for them to look over in detail, but of course the highlights of that plan are about defining and providing the new geometric and geopotential datums, and the tools and guidelines for using them. Juliana reiterated the request for "real world" stories that tell the value of this program to services every taxpayer relies on. Renee added that she can build a web page on the height mod site where these stories are captured.

Renee asked if anyone wanted to mention issues that had not previously been raised. Cliff Mugnier of LSRC mentioned how effective LSU had been with outreach in educating the surveying community, but that FEMA still needed more education on the importance of accurate heights and datums.

Closing comments: Renee asked people what they had heard from other states that they might be able to take home and use. Ideas mentioned included the NC Twitter feed that NCGS uses so users can report base station outages as soon as they happen. Also many states mentioned new user communities that they are reaching and that offer potential partnerships, including lawn care services, wineries, the telematics industries who create derivative products for networks, precision farming, and real time feedback for navigation for cars so they can "drive themselves." Someone mentioned the reference from the LiDAR meeting the previous day to Mercedes Benz whose trucks are being outfitted with maps that include terrain models so the engines can be programmed to increase or decrease power with changes in road slope, ultimately resulting in cost savings for fuel.

Problems mentioned that still need to be addressed for many states included whether and how to charge users for access to real time networks (Michigan). Also mentioned were concerns over biases in legacy data that

‘contaminate’ adjustments when used as control, and at what level can readjustments be done. The recommendation that survey data not submitted to NGS be kept in digital format by agencies so they can do readjustments as needed was reiterated.

Finally Renee asked how often NGS should hold a partner meeting. Many attendees felt that annually would be beneficial. While NGS cannot foresee whether annual meetings would be possible, Renee said she would support annual, or at the very least bi-annual, meetings as resources permit. Based on comments cited here and remarks heard in the course of the day, most attendees felt the meeting was very worthwhile.