Implementing the Standard for the US National Grid in North Carolina

NSDI Cooperative Agreements Program

FGDC-Endorsed Standards Implementation Assistance and Outreach Project

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Executive Summary

The North Carolina Geographic Information Coordinating Council adopted the US
National Grid as a state standard in 2007. The project team advanced the implementation
of the USNG by further developing training and outreach materials and custom files for
GIS users in North Carolina. Outreach included four workshops, two for GIS and two for
non-GIS participants, presentations at two conferences (property mapping specialists and
GIS users), a two-day "train-the-trainer" workshop led by Talbot Brooks for GIS users
and their emergency management counterparts, and a webinar for the National States
Geographic Information Council.

Workshops emphasized hands-on practice in reading a map with US National Grid.
Workshop handouts included a CD with custom GIS files and maps. Project
collaborators expanded their online resources since the beginning of the project, and the
team customized online resources available through www.nconemap.gov .

Workshop participants and project partners expanded their practical applications of
USNG. At the completion of the project, one city had adopted USNG as a city standard,
four cities had completed or drafted USNG atlases, three counties had atlases produced
by Delta State University, and North Carolina had a master address dataset with USNG
as the unique identifier for 4.7 million address points.

Project Narrative

A. Purpose

The purpose of this project was to implement the US National Grid (USNG), an FGDC standard (December 2001) which was adopted by the North Carolina Geographic Information Coordinating Council in 2007. The objectives of the project were to:

- o Engage and train local and state government map users to be able to read maps with USNG and to value the grid as an informative reference for emergency management and other local and state business processes.
- o Enable key professionals to serve as trainers in using and reading the USNG.
- o Expand online and desktop resources that include the USNG for both map makers and map users.

B. Activities

The project activities, completed in July 2009, were the following:

CGIA established a project team for technical advice and implementation assistance based on known interest in USNG and related issues as well as experience with intended workshop participants.

Julie Stamper, Pasquotank County
Talbot Brooks, Delta State University
Drew Fioranelli, City of Asheboro
Ron Adams, staff to the NC E-911 Board
Angie Schulz, Raleigh-Wake 911
Zsolt Nagy, Tom Tribble and Jeff Brown of CGIA
Hope Morgan, NC Division of Emergency Management
Gavin Smith, Center for Natural Disasters Coastal Infrastructure and Emergency
        Management, UNC-Chapel Hill
Steve Strader, USGS Liaison for NC
Tom Terry, Public XY Project

CGIA and the project team developed training materials in preparation for outreach activities:

- o Lesson plans and presentations for GIS users and non-GIS map users
- o Custom NC GIS map templates and base datasets for three UTM zones in NC
- o Practice maps and grid readers (rulers formatted for USNG)

The project team developed North Carolina geospatial datasets (point locations) with USNG coordinates included as an attribute using the Military Analyst GIS tool (free download of extension for ArcGIS). The point locations include:
- o NC public schools
- o NC potential shelters
- o Emergency operations centers

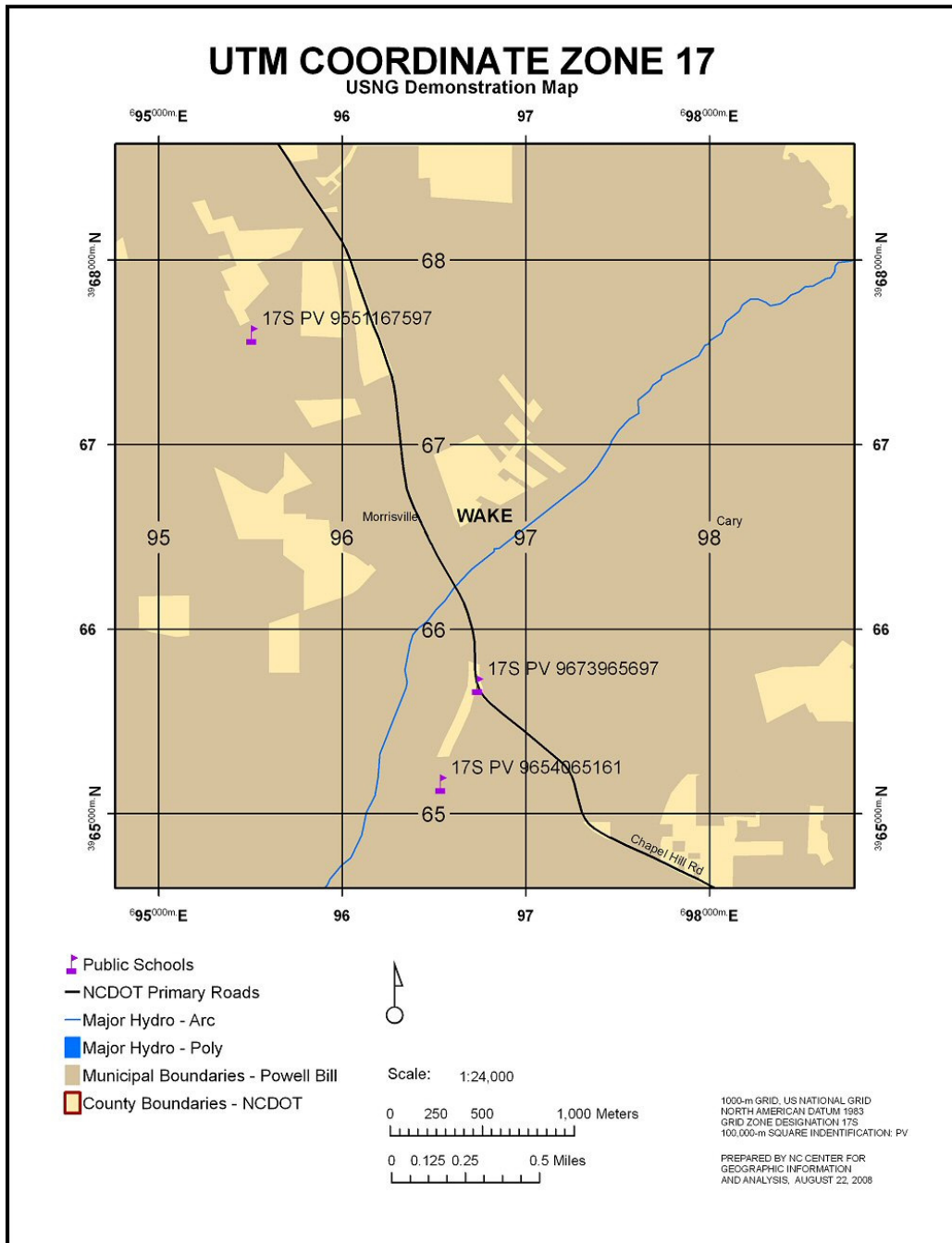For example, public schools are shown on a training map with USNG (Figure 1).

Figure 1. Training Map with Public Schools and USNG

The project team held five multi-hour trainings that reached more than 100 participants and presented at two statewide conferences:

- o Carolina Urban and Regional Information Systems Association (CURISA) and NC Geospatial Information and Technology Association (NC GITA) in Concord, NC (September 7, 2008). This two-hour workshop for GIS users was led by Julie Stamper, Drew Fioranelli and Jeff Brown. Talbot Brooks was unable to attend as planned due to illness.
- o North Carolina annual meeting of National Emergency Numbering Association and the Association of Public-Safety Communications Officials (NENA-APCO) in Sunset Beach, NC (September 9, 2008). This two-hour workshop for non-GIS users was led by Jeff Brown and Tom Terry. Talbot Brooks was unable to attend as planned.
- o North Carolina annual meeting of the Property Mappers Association in Raleigh, NC (September 30, 2008). This 20-minute segment for a mixture of technicians and managers was led by Jeff Brown.
- o North Carolina GIS Conference in Raleigh, NC (February 20, 2009). Presentation to GIS users by Jeff Brown and Drew Fioranelli, including a hands-on demonstration.
- o North Carolina Emergency Managers Association annual meeting in Sunset Beach, NC (March 10, 2009). Jeff Brown conducted a two-hour training session for emergency managers.
- o Train-the-Trainers Workshop in Salisbury, NC (May 26-27, 2009). Talbot Brooks and Michael Maloney from Delta State University conducted a two-day workshop for GIS practitioners and emergency managers, hosted by Rowan County Emergency Management. Assisted by Jeff Brown and Drew Fioranelli.
- o Chapel Hill-Orange County GIS User Group (June 3, 2009). Jeff Brown conducted a two-hour training session for GIS users including emergency services and facility managers from the University of North Carolina.

The project team distributed the training materials and geospatial datasets noted above to workshop participants on CD. Outreach included descriptions of tools and techniques on the NC OneMap website, links to the training materials and links to partner websites. See www.nconemap.gov.

C. Challenges

The project identified five main challenges based on discussions in workshops and ancillary conversations.

1. The first challenge is to highlight the benefits of using the US National Grid in local government operations and identify the protocol for applying the USNG in emergency preparation and response.

   The USNG provides a framework for consistent, reliable representation of location on the ground, particularly for search and rescue and other emergency response and recovery operations occur. Workshop participants concurred that

local officials may be familiar with all locations in a jurisdiction, but that extensive damage to familiar landmarks and structures may be disorienting. In addition, outside assistance in the form of mutual aid from other local governments or emergency response by state and federal organizations, having little or no familiarity with specific locations, would rely on informative maps. Another workshop participant noted that non-disaster opportunities to benefit from maps with USNG include search within large recreational areas. The workshop by Talbot Brooks highlighted opportunities to include USNG in local and state emergency protocols. Creating and distributing map books for a jurisdiction is a key strategy.

North Carolina has three UTM zones and, therefore, two UTM boundaries. In particular, the eastern UTM boundary (17 and 18) bisects seven counties (See figure below with county boundaries and municipal areas in brown).
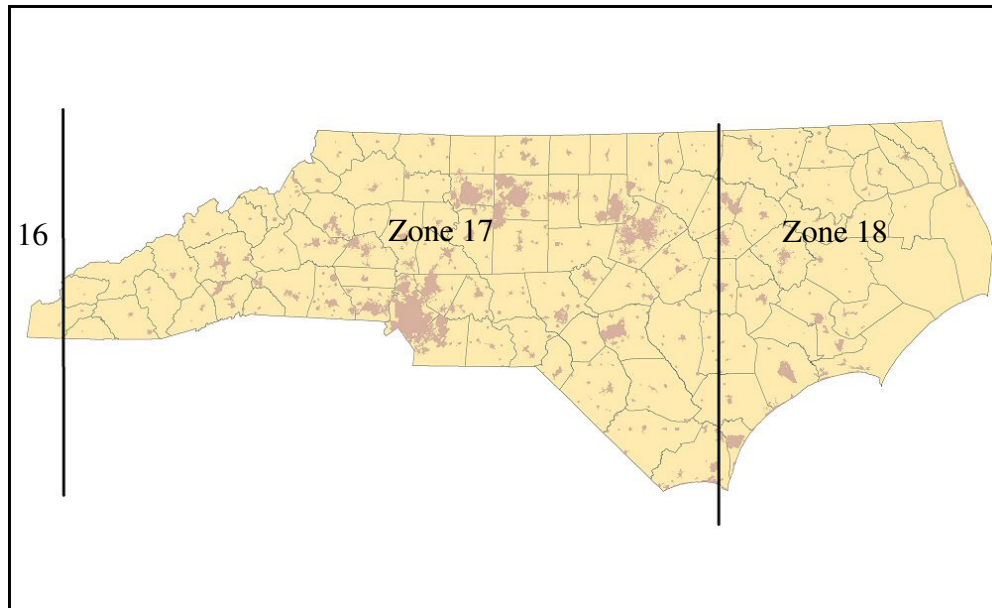
This is problematic for map makers in the counties and cities near a boundary. Workshop discussions addressed the issue to the satisfaction of participants. At zone junctions, the most useful and accurate maps create a "zipper" effect as shown, for example, in the Wilson County, NC map atlas (See http://mississippi.deltastate.edu/ and the tab for USNG atlases and open the PDF for Wilson and see pages 60 and 61). Delta State University has a script (xml) and the latest GIS techniques available to assist in solving the zone junction issue.

Recommendation: Include explanation of tools and techniques for mapping grids at UTM zone junctions in workshops, and create and distribute map books that display consistent mapping elements across an example jurisdiction in the state.

An issue surfaced during the two-day workshop that is a technicality but could be solved to the benefit of search and rescue operations in North Carolina. The

current NC search and rescue (SAR) standard for Land Search geographic
position referencing is USNG. However, the references state that the "standard
Map Datum for all SAR is WGS84." This means that the reference is actually the
Military Grid Referencing System (MGRS) which is based on the datum WGS84,
and not NAD 1983 (USNG). The horizontal difference is minimal and not
perceivable on 1:24,000-scale maps, but this technicality could be solved by
informing GIS practitioners of the difference in the datums.

The NC Emergency Management reference further states that:
> *"All SAR responders in NC should be familiar with conversion to latitude*
> *and longitude in the DD MM.mmmm format for working with aviation*
> *assets."*
> (http://www.nccrimecontrol.org/Index2.cfm?a=000003,000010,000023,000487,001731)

The conversion to latitude and longitude may not be necessary given the
likelihood that pilots have been trained in MGRS or USNG or both and are
capable of accepting USNG as a standard position reference.

Recommendation: The project team recommends that state emergency managers
adopt USNG as a standard for both land and air search and rescue operations.

2. Another challenge for North Carolina is to clarify the benefit of using USNG in
mapping instead of other familiar grid referencing systems.

Familiar grid referencing systems among state and local government officials
include US Forest Service grids and grids based on NC State Plane Coordinates.
In particular, land records management in North Carolina is closely related to tax
mapping and surveying. The NC Geographic Information Coordinating Council
adopted a state standard for horizontal positioning (NC state plane coordinate
reference system). Practitioners work with NC state plane coordinates on a daily
basis and in some cases have generated grid maps based on coordinates in NC's
single state-plane zone.

The problem is that emergency assistance from federal agencies and other states
benefit from a universally applicable grid reference system. Outside assistants
will probably not have had experience with NC state plane grids. In addition,
maps that include area just outside of North Carolina would not serve as a
meaningful reference in the neighboring state(s). The project team emphasized
that there is no reason to modify geospatial datasets in North Carolina; the USNG
is applied as a publication layer that frames base mapping data for effective
ground navigation.

Recommendation: The project team recommends creation of map atlases for
jurisdictions using USNG as the grid reference in preparation for emergency
response and recovery. The investment of time would pay off in a crisis when
local emergency managers would need the tools to integrate successfully with the
National Guard and other outside aid for which USNG is a preferred reference.

3. The third challenge is to define practical ways to implement the USNG in local government operations that do not replace current business operations and are not perceived as adding to the workload of E-911 communicators and first responders.

Digital maps and online resources are valuable local tools. In addition, hardcopy maps continue to be practical and useful in search and rescue and other emergency operations. The most effective way to implement USNG for emergency operations is production of a map atlas for a jurisdiction. For example, Pasquotank County produced a county atlas that features a street index with reference to USNG grids (see example in Figure 2). The maps have the USNG grid lines displayed over county base maps. The GIS coordinator revised the atlas in September 2008 so that all maps were at a standard scale of 1:24,000 (instead of sizing the map extent to fit page dimensions) for consistency within the atlas and to enable users to apply the grid readers (rulers that use Romer scale V6) to determine USNG coordinates on the maps. Other scales are suitable depending on the base map detail desired.

Talbot Brooks confirmed the utility of USNG map atlases in the field in Mississippi and he placed emphasis on map book creation and standard mapping scales in his training materials. The project team recommends starting with successful applications of USNG that do not require significant changes to E-911 dispatching operations and do not place a burden on E-911 communicators and local emergency managers.

Durham County, following the USNG presentation at the NC GIS Conference, drafted a map atlas with USNG (see example in Figure 3). The City of Asheboro has an atlas in progress and the Town of Chapel Hill began to build an atlas following the NC GIS Conference. In addition, Delta State University created map atlases for Rowan, Dare and Wilson Counties (available online under North Carolina atlases).

The City of Charlotte is in the process of adopting the US National Grid as the city's standard grid reference system (draft May 22, 2009). The workshop by Talbot Brooks deepened the understanding and heightened the enthusiasm of GIS practitioners from Charlotte. The scope of the standard will impact city-produced atlas map books, geospatial technology software and equipment investments, the City of Charlotte Address Repository, and GIS users in the City of Charlotte. It is expected that GIS staff will incorporate the USNG as appropriate in map products and services that include field location and navigation uses.

Recommendation: Expand outreach to local practitioners, using the regional workshop approach, and support creation of county atlases with USNG.
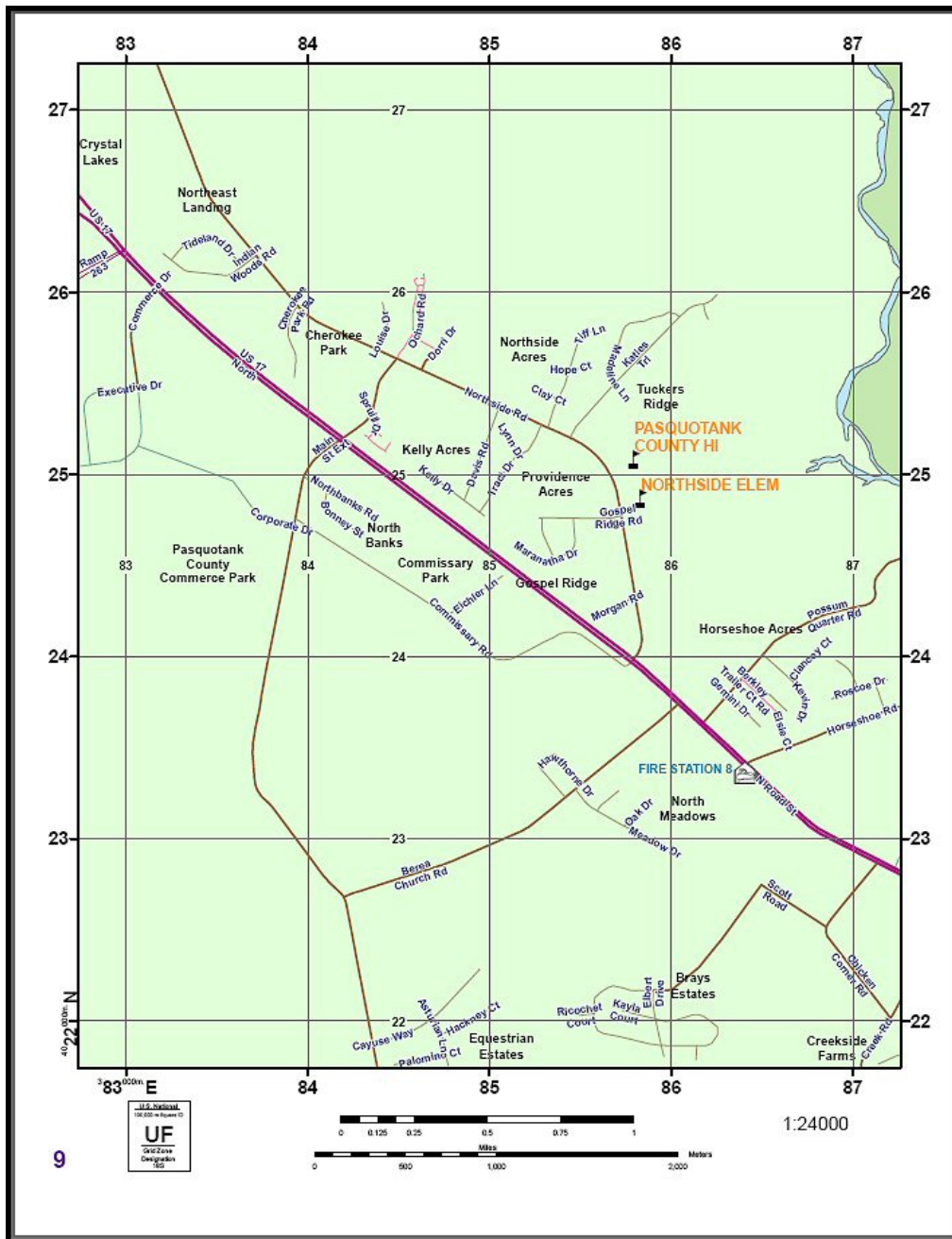
Figure 2. Street Atlas with US National Grid, Sample Page, Pasquotank County, NC
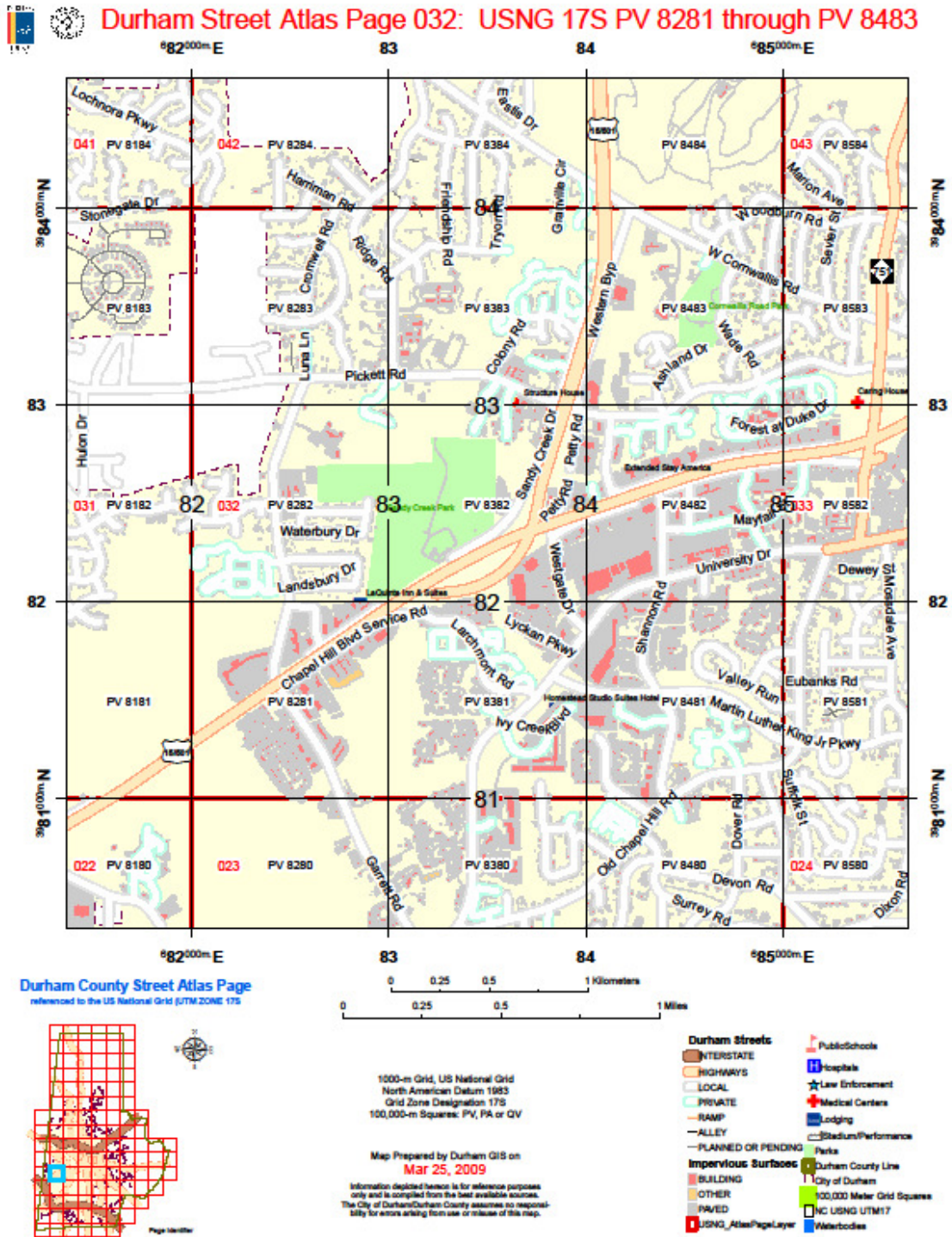
Figure 3. Street Atlas with US National Grid, Sample Page, Durham County, NC

4. The fourth challenge is to find practical ways for commercial software providers to add the USNG coordinates to information that is displayed in commercial E-911 computer aided dispatch (CAD) and GIS software products.

Observation of software providers exhibiting at the North Carolina Annual Meeting of the National Emergency Numbering Association/Association of Public-Safety Communications Officials (NENA/APCO) indicated that at least one provider already displays the Military Grid Referencing System coordinates (equivalent to USNG) in a results window in a CAD interface. The most relevant functionality would be to display the USNG coordinates at a location of interest along with latitude/longitude and other location attributes. If requested, the E-911 communicator could report the coordinates from the display. Providers indicated that the addition of USNG coordinates for a point of interest would not be complicated to add. If USNG were added to the NENA standards, the providers would have an incentive to modify products to meet the requirements.

GIS software providers have varying capability to integrate USNG. ESRI's ArcGIS is the most widely used GIS software among North Carolina local and state agencies according to the NC GIS Inventory (powered by RAMONA)   The ArcGIS software integrates USNG in layout functionality, and offers a free extension (Military Analyst) as a useful tool for USNG. Functionality related to geospatial data projections is essential for easy integration of local and state data into a map layout with USNG grid lines. In addition, Talbot Brooks tested, demonstrated and posted several free software tools that are very useful in map book creation using USNG.

Complete and accurate street addresses are essential for local emergency dispatchers and responders to respond to calls as quickly as possible. The US National Grid is included as a data field in the draft FGDC address standard (http://www.fgdc.gov/standards/projects/FGDC-standards-projects/street-address/).

CGIA demonstrated the practicality and value of applying USNG to a statewide master address dataset (June 2009). CGIA obtained the best available local government geospatial datasets representing address locations, processed the data into address points with standard fields, and calculated the USNG grid address (1-meter grid) to serve as a unique identifier and for reference to future atlases and other products. In addition to a statewide master address dataset, CGIA has a workflow described in a standard operating procedure that can be applied to a range of source datasets.

Recommendation: Continue to highlight and apply the USNG as a grid referencing system in North Carolina projects and data management, and find outreach opportunities to inform commercial software providers. Use national contacts including Tom Terry of the Public XY project to stay current with commercial applications of the US National Grid.

5. An additional challenge is to improve and expand online resources for ready access and ease of use.

Further developments in tools and techniques are ongoing at Delta State University (http://mississippi.deltastate.edu/). This will continue to be a valuable source of tools, guides, samples, datasets, and documents for North Carolina practitioners.

Pasquotank County's GIS website http://www.co.pasquotank.nc.us/GIS includes a section on US National Grid maps and local examples of how to use USNG. The challenge of drawing attention to online resources is exemplified by an anecdote: following participation in the NENA/APCO workshop, the E-911 coordinator in Pasquotank County met with the GIS coordinator again to discuss the use of USNG in the county's Computer Aided Dispatch system.

The NC OneMap project team added three functions to the NC OneMap viewer (www.nconemap.gov) related to the US National Grid as illustrated in Figures 4 through 9. The map viewer now displays USNG coordinates, at the bottom of the map, for mouse-over locations. The second function is a query tool into which a user may enter USNG coordinates, generating a point and label on the map. The third function is the display of USNG coordinates in the results of an address look-up. These NC OneMap functions will serve as a resource and raise awareness of the USNG as a reference tool for geospatial data in North Carolina.
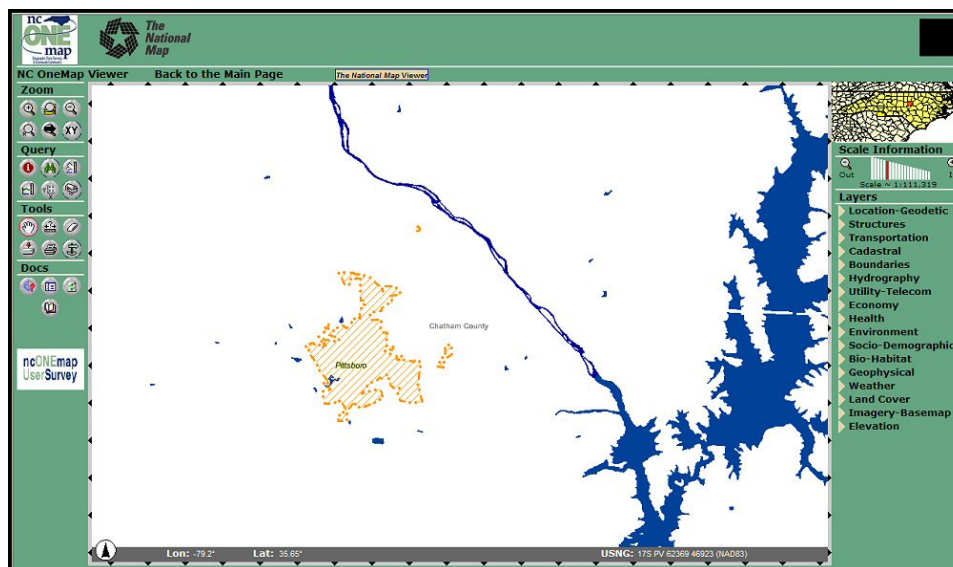

Figure 4. NC OneMap Viewer, September 30, 2008, with USNG Coordinates Displayed on the Lower Right for Mouse-Over Location of Interest
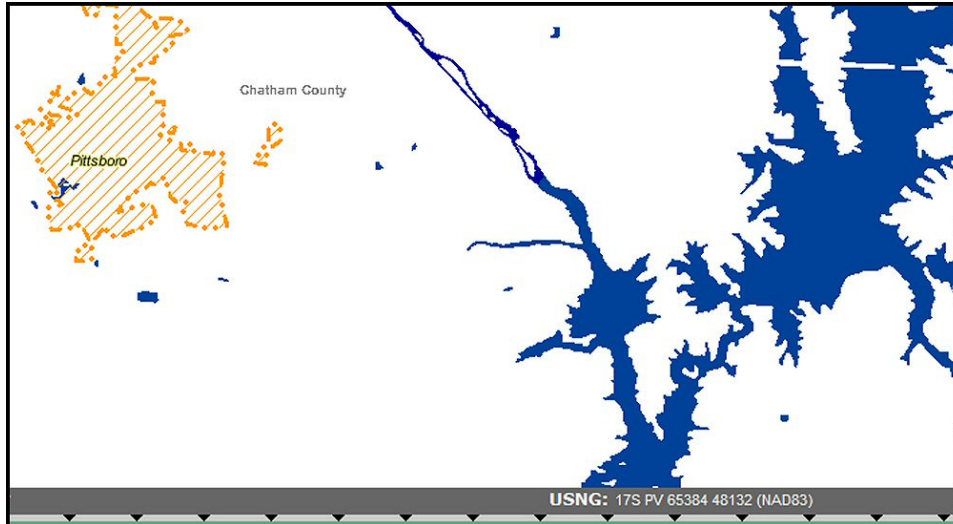
Figure 5. Detail Showing USNG Coordinates on Lower Right for Mouse-Over Location of Interest
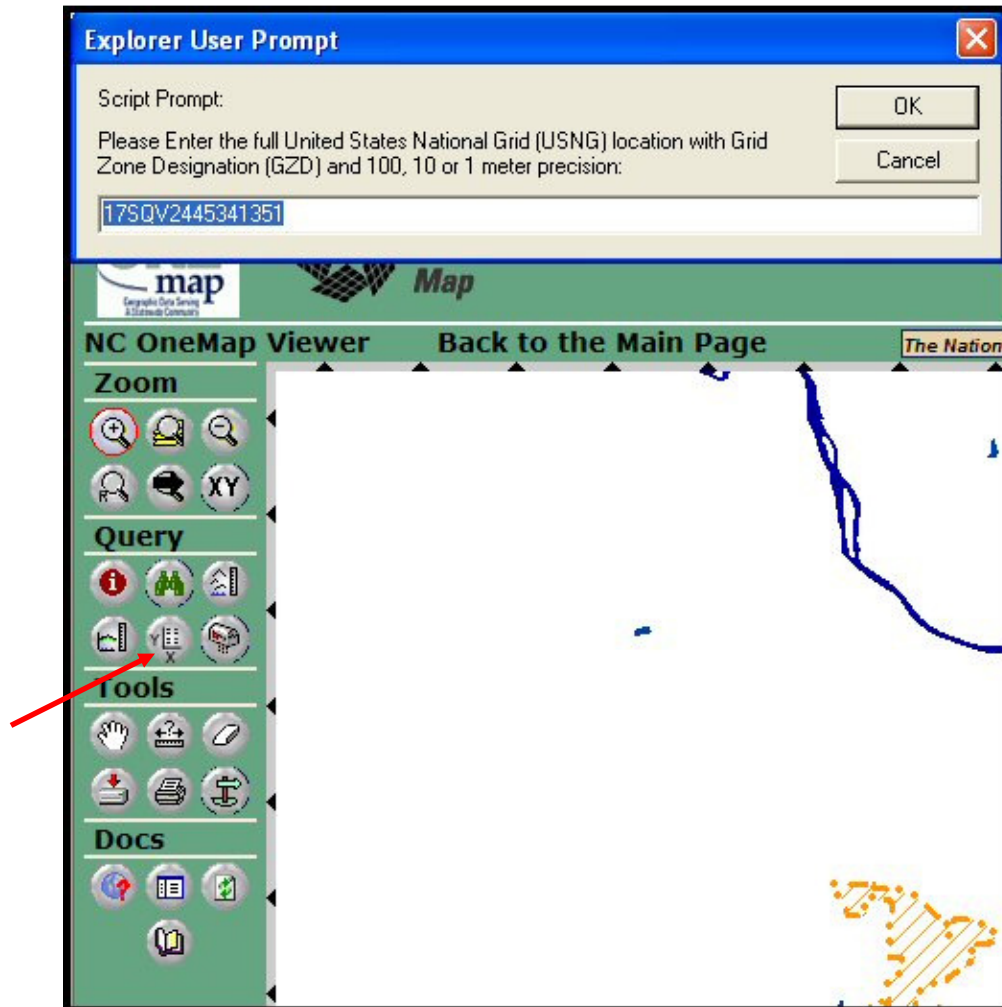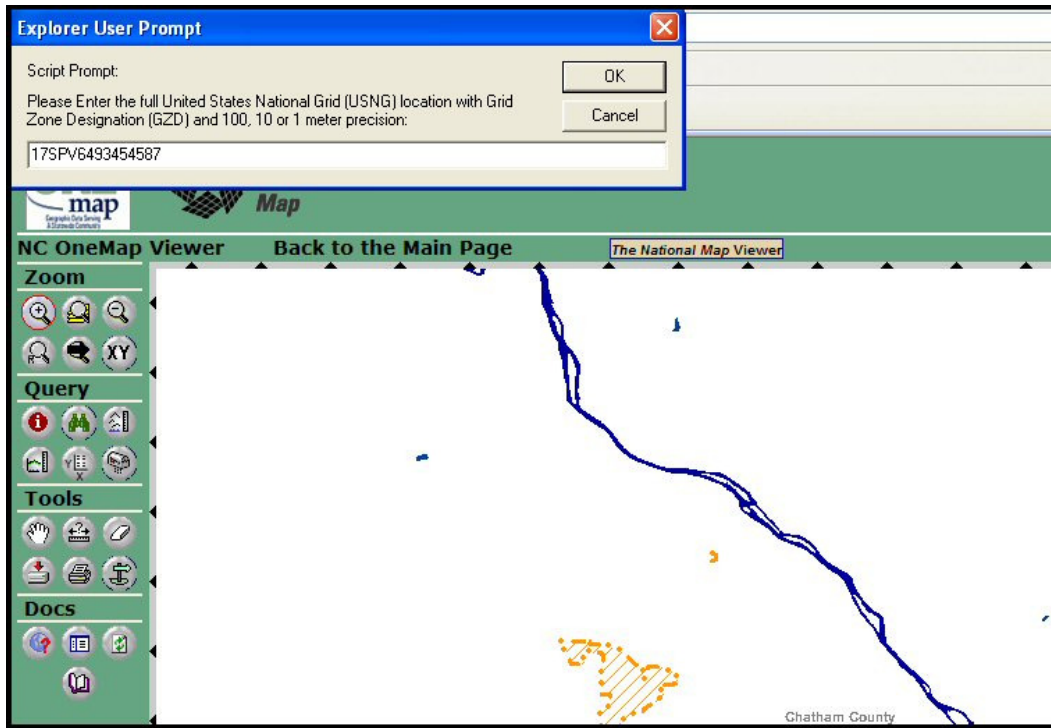

Figure 6. USNG Look-Up Query Tool in NC OneMap

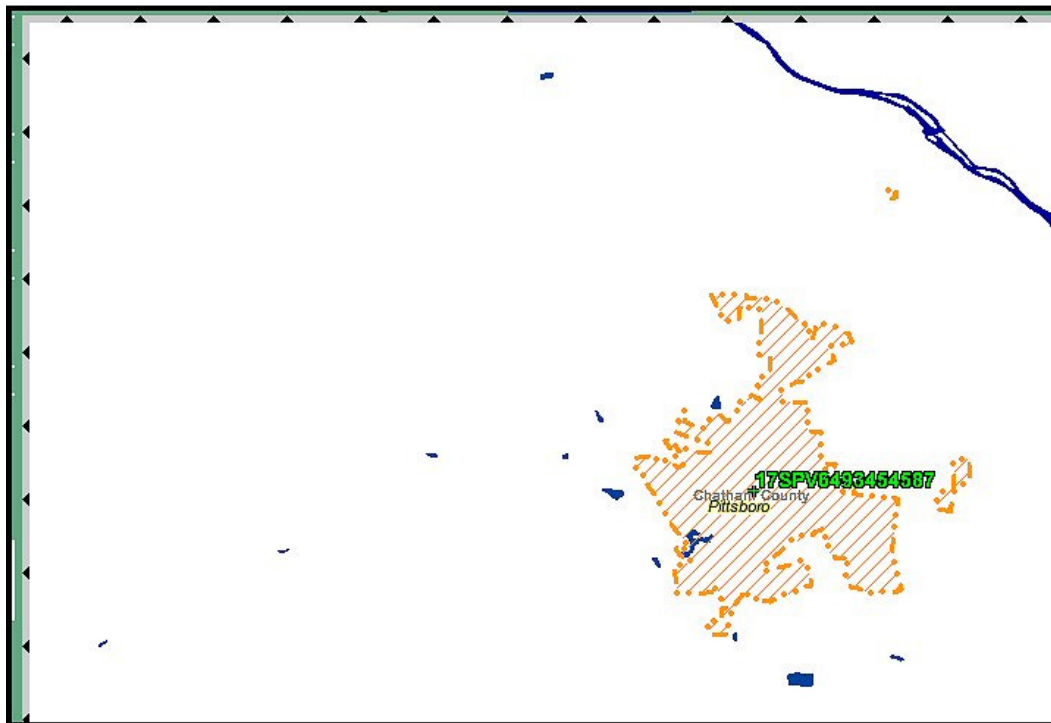**Figure 7. Entry Box for USNG Coordinates of Interest**

Figure 8. Location of Interest on the Map with USNG Coordinates

Goto	Address	X	Y	USNG
Goto	66 Oakwood Dr, Chapel Hill, NC 27517	-79.021505	35.916044	17S PV 78517 76445 (NAD83)

Figure 9. Third Function: Addition of USNG Location in Results Window from Address Look-Up Tool in NC OneMap

In September 2009, the NC OneMap website (www.nconemap.gov) provided public access to project deliverables. Files include training materials, geospatial datasets for base maps and grids, sample map templates, sample map images, application development code used in NC OneMap, and USNG standards.

Activities planned after the performance period include a report to the Statewide Mapping Advisory Committee of the NC Geographic Information Coordinating Council, integration of USNG with new geospatial (point) datasets added to NC OneMap, and maintenance of resources and links on www.nconemap.gov.

Recommendation: Use the North Carolina coordination structure to promote USNG as a state standard, demonstrate practical applications, and maintain online access to tools and materials that support best practices among state and local GIS users and emergency managers.   Share examples and tools with other states by continuing to participate in the National States Geographic Information Council.

D. Supplement for FGDC-Endorsed Standards Implementation

The development approach for structuring and organizing implementation resources was to obtain and synthesize materials from project collaborators, customize materials as necessary for a North Carolina audience, and develop new resources to support GIS users and potential trainers.

Delta State University, Pasquotank County, the Public XY Project and NC Emergency Management had slide presentations, printable maps, GIS datasets, map layout guides, and grid readers ready to share with the project team. CGIA drafted lesson plans for GIS and non-GIS workshops based on FGDC templates courtesy of Lynda Wayne (GeoMaxim), the NSDI Training Program Manager. The project team reviewed the lesson plans and made modifications, particularly to the lesson plan for emergency communicators and responders.

The team combined and customized the ingredients to produce presentation materials to fit the lesson plans and to tailor handouts to supplement the sessions. FGDC presentation templates were useful as a framework. In addition, CGIA developed GIS files specific to the three UTM zones in North Carolina and created simple map templates for application by local GIS users. Additional work is needed on packaging materials for potential trainers.

The materials were reviewed by the collaborators listed above as well as the City of Raleigh's E-911 trainer, Angie Schulz, prior to the first workshop. Although testing was not carried out before the first workshop for GIS users, feedback from that session guided modification of workshop materials to clarify some of the concepts before the second workshop. For subsequent workshops and presentations, the project team clarified the content with additional graphics and simplified slides.

The collaborative assistance from Talbot Brooks and Delta State University was invaluable for the North Carolina project. His hands-on experience in search and rescue combined with his mapping know-how is compelling. He and his colleagues developed and refined tools and techniques during the North Carolina project, shared the knowledge and materials, and delivered an effective workshop in Rowan County. North Carolina learned and applied and is positioned to make more progress in implementing the US National Grid statewide.

Careful review and comments by Brigitta Urban-Mathieux and Julie Binder Maitra of the Federal Geographic Data Committee were timely and insightful throughout the project.

Feedback on Cooperative Agreements Program (to be completed for the final report)

What are the CAP Program strengths and weaknesses?

> The strengths include the programs adherence to, promotion of, and support for development of geospatial data standards. The concept of a "federal standard" carries weight among state and local geospatial practitioners who want to do the right thing and are grateful for the thinking, definitions, and framework achieved at the federal level.

> The only apparent weakness is the magnitude of available funds for cooperative agreements. For this project, the funds were sufficient for the achievements, but the project team could have reached more emergency responders and map makers across the state with a larger project and increased the impact.

Where does it make a difference?

> The program has made a difference in North Carolina through a series of agreements that have supported state initiatives. The agreements build on one another. For example, NC participants in a train-the-trainer session related to the metadata standards a few years ago brought a similar approach to the workshops held on USNG. Also, the state has established NC OneMap as a vehicle for materials such as those developed in this project.

Was the assistance you received sufficient or effective?

> Yes, and timely as well. The materials related to lesson plans and presentations were particularly useful early in the project. The project management assistance, including the project time extension, was very efficient. The clear set of report requirements and the posting of project reports give states the opportunity to produce consistent and complementary products.

What would you recommend that the FGDC do differently?

> It should be noted that somewhat larger grant awards could support more intensive projects and generate more benefits in some cases.

Are there factors that are missing or additional needs that should be considered?

> For some projects there would be value in a project team giving a presentation to FGDC to clarify outcomes and discuss implications for national programs and initiatives.

Are there program management concerns that need to be addressed, such as the time frame?

> No, the program management was appropriate and effective within a reasonable time frame. In the case of the USNG project, a no-cost time extension, readily accommodated by FGDC, enabled the NC team to take advantage of workshop opportunities late in the spring of 2009 what would have been missed if the project had ended as scheduled.

If you were to do this again, what would you do differently?

> The project was not as successful in influencing state emergency managers as anticipated. Follow-on projects would need to find ways to communicate the value of USNG in state-level response and recovery operations.