2009 NSDI CAP Award

Final Technical Report

Date: March 31, 2011

Agreement Number: G09AC00081

Project Title: Demonstrating the IndianaMap Data Sharing Initiative with four Key Framework Data Layers

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Figure 1 - Participating Counties in green

Project Narrative:

Executive Summary

The Indiana Geographic Information Council (IGIC) is one of thirteen organizations across Indiana collaborating to implement a data sharing initiative with County Government. The primary goal of this initiative is for the local County government GIS data stewards to share their local road centerlines, jurisdictional boundaries, point addresses, and parcel boundaries with the State through Open Geospatial Consortium (OGC) Web Feature Services (WFS) to create four homogeneous statewide data layers within State government, published on the IndianaMap, and available to The National Map.

The IndianaMap Data Sharing Initiative was already underway when this CAP Grant was awarded to IGIC. The Indiana Department of Homeland Security (IDHS) provided $1.37 million dollars of funding ($14,894 for each of Indiana's 92 Counties) to share their local GIS data over the Internet using OGC WFS.

In addition to this significant effort, this CAP grant allowed IGIC and our project partners to focus on details such as support capabilities for the local data development, maintenance and harvesting procedures of these framework data layers. Topics specifically addressed in this grant included:

1.   The Partnership and Outreach Mechanisms Used.

2.   Developing Statewide Minimum Data Standard Guidelines

3.   Supporting the Project Technology

4.   Supporting the Development of an Authoritative GIS County Boundary File

5.   QA/QC and Reports on Harvested Data

The demonstration of this Local -> State -> Federal roll-up of local authoritative local into a seamless statewide GIS demonstrates a viable solution that solves our data interoperability problems, as well as provides a model for other states to emulate to solve similar problems, while also helping advance the Federal goal of establishing a National Spatial Data Infrastructure (NSDI).

The Problem

At the onset of this initiative we recognized that most of the existing Enterprise GIS databases and the Internet map and GIS data servers that Local Government and State Government had or were developing were not interoperable. This interoperability problem became very obvious within the IDHS Emergency Operations Center (EOC) when responding to an emergency event or disaster (See Figure 2). Some of the problems identified included:

- Each has vendor-specific formats and access methods

- Each used different data models

- Access to data often requires significant human interaction from both ends
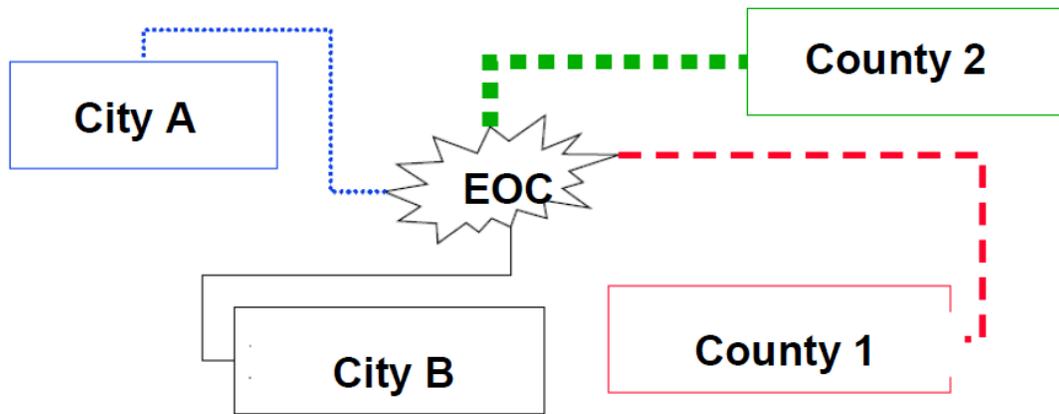
Figure 2 –The IDHS Data Interoperability Challenge

Benefits to Indiana

Indiana's geospatial community has long recognized the benefits of the IndianaMap to support emergency response, economic development, and projects across the state. The bottom-line is that none of these (and most any other event/activity for that matter) stop at jurisdictional boundaries (See Figure 3). Statewide availability of seamless geospatial data layers serves many uses important to the citizens of Indiana.
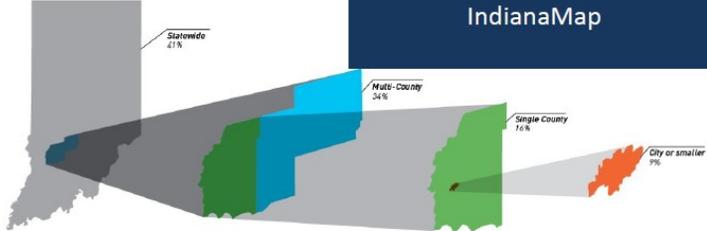

Figure 3

The Solution

The thirteen organizations listed in Figure 4 below collaborated to design, develop and implement a technology process/workflow for sharing data from the local County Government data stewards.
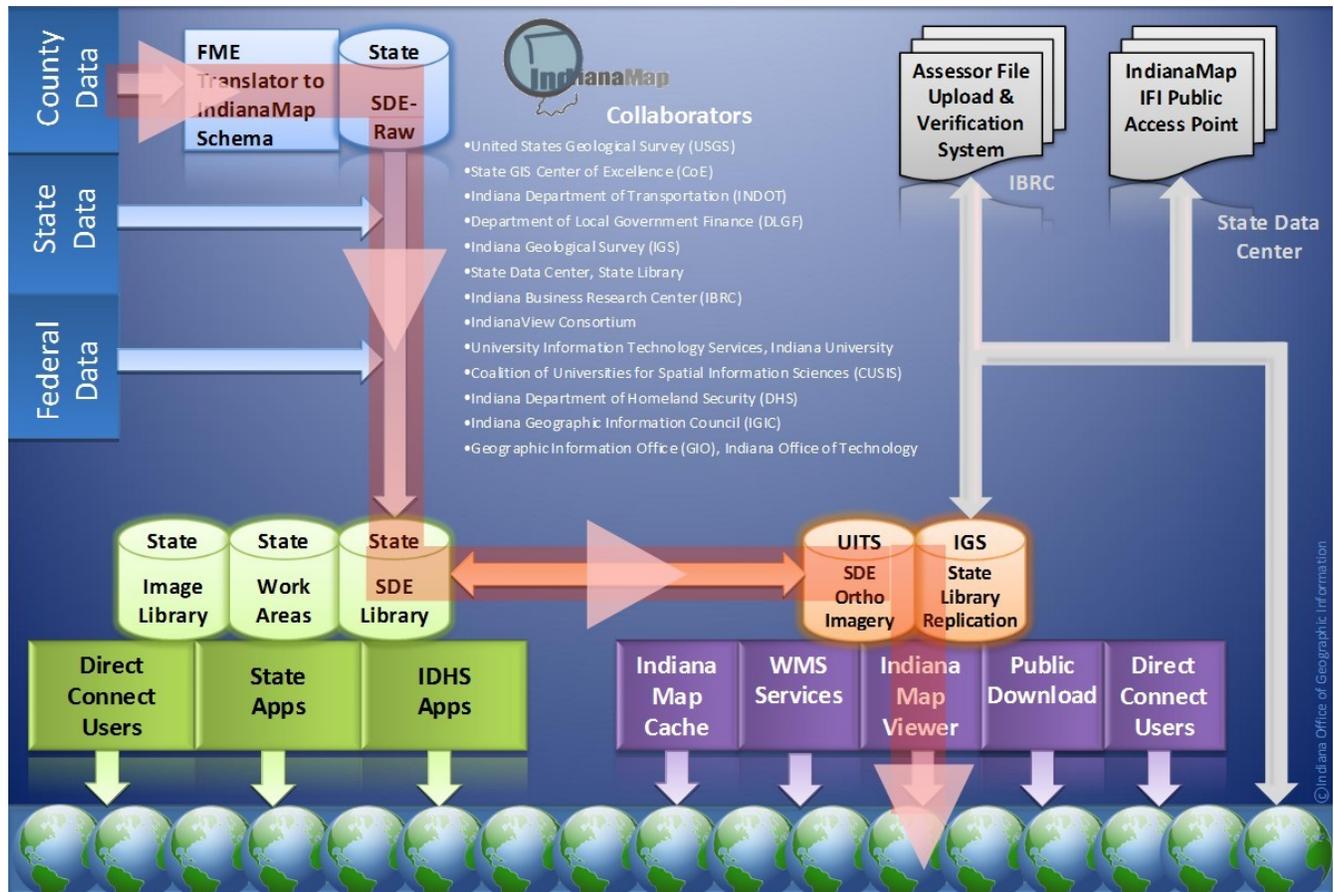

Figure 4

Through this technology process/workflow, monthly updates from each County are harvested through OGC Web Feature Services (WFS) using an automated extraction, transformation and loading (ETL) process built using Safe Software's Feature Manipulation Engine (FME) software, and Esri's ArcGIS Server and Spatial Database Engine (SDE).

Each participating County hosts a WFS that the State can access on demand to harvest the data layers through the Internet. Harvesting each counties data does not require County staff to do anything to feed their data to the State. Inside the State, each Counties harvested data is homogenized and merged into statewide feature classes for each of the four data layers. These data are then made available inside State Government through an enterprise ESRI SDE library at IOT. The four statewide layers are then replicated from IOT to the IndianaMap SDE library at the IGS. An ETL process at the IGS prepares these data for display on the IndianaMap, for Web Map Services (WMS) access, and for shapefile download. Finally, IGS updates the FGDC public metadata prior to publishing the new layers on the IndianaMap portal.

1. The Partnership and Outreach Mechanisms Used

IGIC created a set of web pages on our site to help educate and provide access to the IndianaMap Data Sharing Initiative program information - http://igic.org/projects/datashare.html

Formal Invitation to Participate

Initially, a formal invitation to participate (See Figure 5) in the data sharing initiative was sent to the Commissioners in all of Indiana's 92 Counties. Copies of this letter were also distributed by IGIC and the GIO throughout the GIS community. A copy of the full letter is provided with the attachments to this report.

STATE OF INDIANA

Mitchell E. Daniels Jr., Governor

June 14, 2008

[Name]
[Address]
[City, IN ZIP]

RE: Request for County GIS Data to build a Statewide Map

Dear Commissioner [Name];

This letter is a formal invitation for your county to join together with us to build a seamless statewide map for the benefit of all Indiana citizens.

The use of geographic information systems (GIS) to assist decision making is expanding in all levels of government. As you may know, the State and others have developed a great deal of GIS data, which is available for use by your county. Some of these data providers are:

- Indiana Geological Survey (http://igs.indiana.edu)
- University Information Technology Services at Indiana University (http://www.indiana.edu/~dms)
- State Data Center at the Indiana State Library (http://library.in.gov)
- Indiana Business Research Center (http://www.ibrc.indiana.edu)
- Indiana Spatial Data Portal at Indiana University (http://www.indiana.edu/~gisdata/index.html)
- Indiana Geographic Information Council (http://www.igic.org)
- Indiana's GIS Inventory (http://in.gisinventory.net)

In addition, over 40 Indiana counties and more than a dozen Indiana cities and towns make their GIS data available for online viewing and/or download. Because of these efforts, it is now possible to realize the vision of a seamless statewide map, which ties together the most current and accurate data available throughout the state. This resource, the IndianaMap, will facilitate a wide range of local, regional, and statewide activities to support our most pressing needs, including:

- economic development
- property tax assessment
- E-911 emergency response
- Homeland Security infrastructure protection and disaster recovery
- FEMA flood map modernization
- water quality management
- parolee and offender management
- transportation planning

In order to increase the benefit of the IndianaMap, the Indiana Geographic Information Office, the Department of Local Government Finance (DLGF), the Indiana Department of Homeland Security (IDHS) and the Indiana Geographic Information Council are requesting your support. In particular, we are asking that you make available to the IndianaMap a minimum subset of four GIS data "layers": land parcels, point addresses, local roads, and jurisdiction boundaries, if available. These data sets are, appropriately, created and maintained by counties but have great value to many other organizations around the state and beyond, especially when integrated into a seamless statewide map.

Figure 5

Reasons to participate

In addition to a formal invitation, the program partners held eight full-day Roadshows around the State of Indiana to reach out to the local communities and educate them on reasons to participate. Some of the facts emphasized were that the locals had created their GIS to make your County Government run more efficiently and to improve their decision making. Participating in this program will help you achieve this by:

- Improving communication with a common operating picture
- Enabling regional collaboration & mutual aid
- Facilitating economic development inquiries
- Potentially lowering insurance rates
- Speeding up disaster response and recovery
- Empowering government and citizens through new applications
- Supporting the IndianaMap
- Increasing County funding by $14,894 from an IDHS grant

County Funding (IDHS Grant Details)

The official name of the grant is IDHS **2007 LETPP WebGIS Grants**. Because the County funds were provided by IDHS, the County EMA Directors had to request the grant. The grant request & budgets were all entered by county EMA Director into IDHS's automated grant system - iGMS. In a number of cases the County EMA and County GIS staff had not worked together prior to this grant opportunity.

The grant requirements were very basic. The County will make the 4 data layers available as Web Feature Service (WFS) for harvesting by the State. The cost of setting up the WFS in each county averaged $5,000. Therefore each County could spend the remainder of grant dollars (around $10,000) on related GIS services, hardware, or software.

We also had to address a local government concern that after the initial grant funding was gone there would not be future funding for the ongoing maintenance of the WFS. IDHS, IOT/GIO, and IGIC committed to working with the feds and other state agencies to continue future funding.   This next round of funding for the participating Counties has already been identified by IOT/GIO.

2. Developing Statewide Minimum Data Sharing Standards
The invitation to participate and the subsequent grant funding opportunity provided the basic guidelines for the minimum graphic and non-graphic (attributes) expected for each of the four framework data layers being harvested. These specifications are:

Point address data (excluding personal information e.g., names and phone numbers)
- Address Number
- Street Name Prefix
- Street Name
- Street Name Suffix
- Place Name (e.g., city, town, unincorporated area)
- State Name (IN)
- Zip Code

Parcel data (<u>excluding</u> personal information e.g., names, phone numbers)
- GIS Parcel Number (State number) as defined in 50 IAC 23-20-4
- Parcel Number (County number) as defined in 50 IAC 23-20-4, if available and different from GIS Parcel Number

Local governmental boundary data
- Boundary Type (municipality, precinct, tax district, school district, etc.)
- Boundary Name (name/identifier of municipality, precinct, tax district, school district, etc)

Street centerline data
- Street name
- Address maximum and minimum number ranges for left and right side of street, if available

3. Supporting the Project Technology

OGC Web Feature Services (WFS)

A Basic Web Feature Server can handle 3 types of operations:

> ***GetCapabilities.*** Describes using an XML-encoding the capabilities of the service, e.g. the features that are available and the supported transactional operations.

> ***DescribeFeatureType.*** Provides a description of the structure of a one, many, or all feature types (i.e. the schema that describes the attributes).

> ***GetFeature.*** Provides access to features based on a filter that constrains the request using spatial and non-spatial parameters.

As part of the process to test OGC compliant WFS URLs and to help document and evaluate the features and attributes available from each harvesting source, IGIC developed a Web Feature Service (WFS) Summarizer tool and deployed it on our web site. http://www.igic.org/wfs/
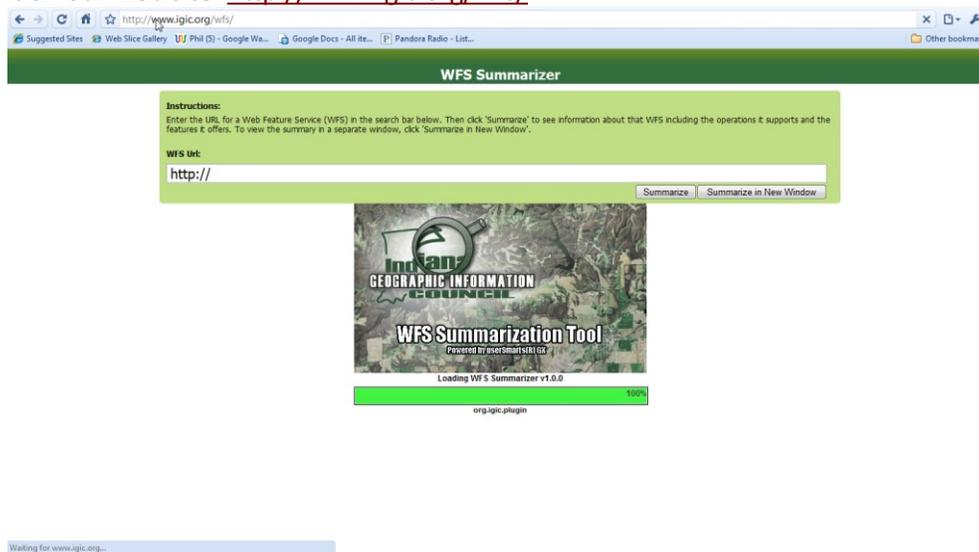
Figure 6 – WFS Summarizer Web Page

This tool is freely available for use by anyone visiting the URL. It will provide a complete summary of the URLs WFS <u>Capabilities</u> and <u>Describe</u> each feature, as well as provide a <u>Get Feature</u> count of all entities available.

Figure 7 – Sample WFS Summarizer Report

ETL Data Harvesting Technology Used

Safe Software's Feature Manipulation Engine (FME) is used to perform all Get Feature (Harvesting) and translation of the data provided to the target model, and loading the resulting data into the State's Esri SDE production database for internal State use and for distribution to the IndianaMap.
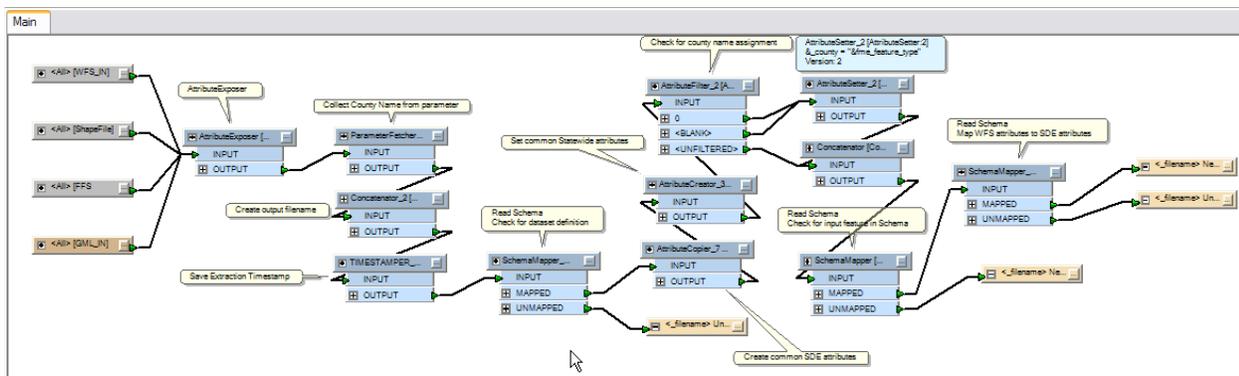

Figure 8 – FME Main Harvesting Model / Script
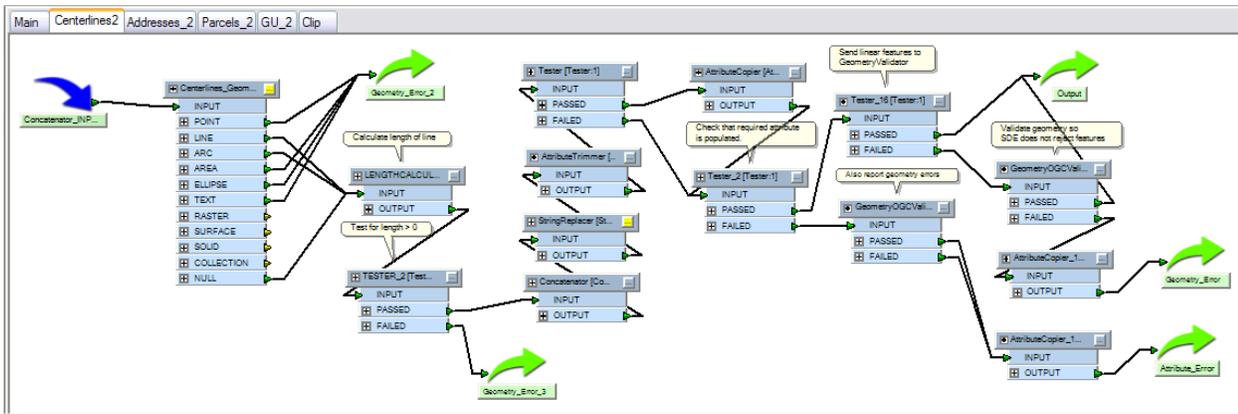
Figure 9 – FME Centerline Geometry and Attribute Validation and Merging Model / Script
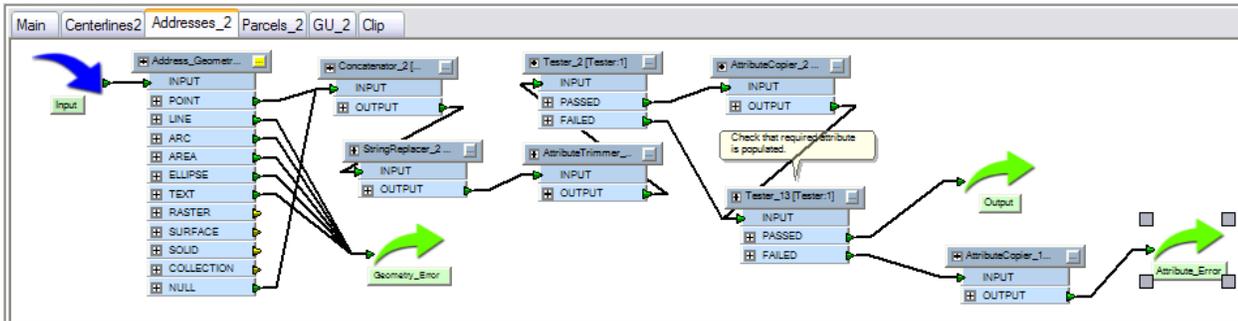

Figure 10 – FME Point Address Geometry and Attribute Validation and Merging Model / Script

Figure 11 – FME County Harvesting Summary Report

4. Supporting the Development of an Authoritative GIS County Boundary File

One issue we knew existed when we started this project was that there was not a single authoritative GIS County Boundary file in existence for the State of Indiana. Therefore we fully expected to see graphic edge-matching issues between the street centerline, parcel, and jurisdictional boundary files harvested from adjoining counties. Before we can address this problem, we need to develop an authoritative GIS County boundary file first. Part of this projects effort has been to assist the State in the design development of a single authoritative GIS County Boundary file and to be used by the County and State data stewards. NOTE: This is a GIS file to support creation of statewide seamless GIS layers; **it is not** a professional land surveyed County Boundary file. Ongoing work on this task includes:

- IGIC's Boundaries, Cadastral and PLSS Workgroup have developed a model, and workflow to build new authoritative County Boundary Polygon, Point and Line Layers for the IndianaMap (See Figure 11). These are:

    - New County Boundary Point and Line Layers for IndianaMap - Using the Legal descriptions of the Counties to identify the Corners and lines that make up the County Boundary. Develop a shapefile of these and an ongoing county boundary point/line Maintenance and Stewardship program.

    - New County Boundary Polygon Layer for the IndianaMap - The new county boundary polygon file will be re-generated from the county line layer when updated and published to the IndianaMap.
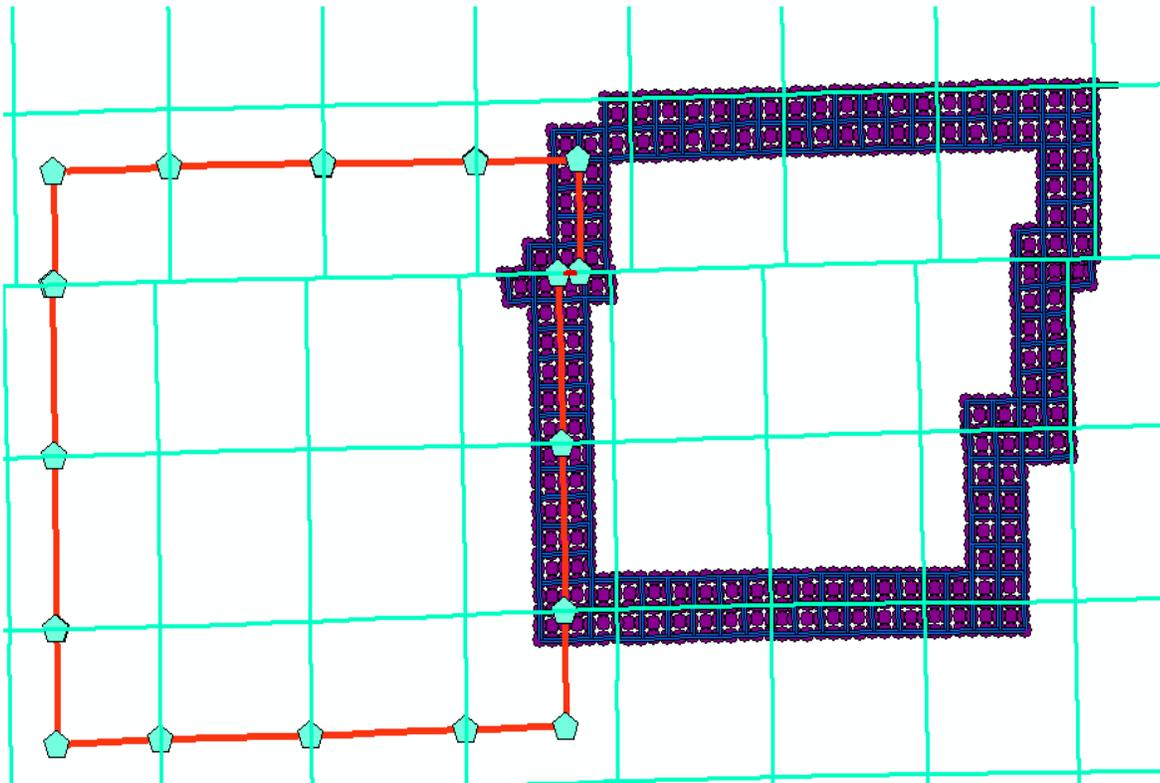
Figure 12 – GIS County Boundary File Point and Line Components

Work by the State to develop this NEW & IMPOROVED statewide County Boundary GIS data file(s) is still in progress. Most recently the Indiana Land Records Office is working with IGIC to complete this task.

5. QA/QC and Reports on Harvested Data

We have been and continue to work with each monthly data harvest to develop and improve our automated QA/QC processes to evaluate the harvested Framework WFS data, and to develop reports that summarize the results in a meaningful and usable way.

An initial QA/QC process has been put in place as part of the overall process and includes checks to insure:
- Ability to successfully access and harvest data through WFS
- Gaps or Missing data
- Geometry Errors in harvested data
- Adherence of the harvested data to the Minimum Data Standards
- Attribute Assessment (key values present)
- Metadata Assessment & updates

Keeping in mind the following limitations:
- No edge matching required or expected (No authoritative GIS County boundary exist)
- Different capture rules result is anomalies that are not necessarily errors

An example of differing capture rules is shown in Figure 13 below. The red highlighted Right-of-Way features below are actually captured as Parcel features. The Counties data capture rule for ROW is to collect them on the parcel layer and assign a blank Parcel ID to identify them as a ROW.
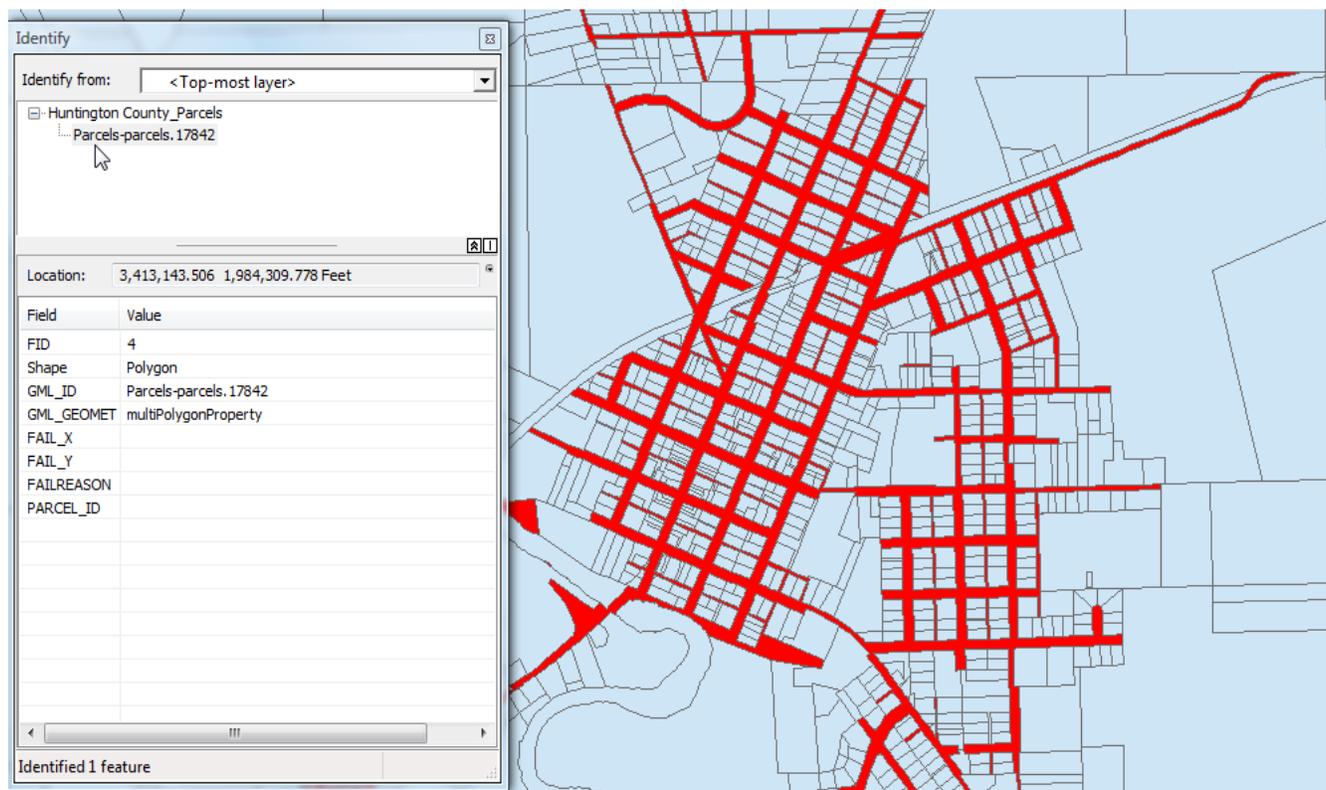
Figure 13

The example in Figure 14 below illustrates different street centerline capture rules between Marion County and Johnson County Indiana. The county line is the centerline of the E/W road. Distinct differences in the definition of centerline can be seen on both the E/W road and the N/S road

Figure 14

Data Harvesting Metrics - Data Development Timeline

Growth of program participation has been steady. The graph below illustrates new County level participation over a one-year period of the program. Note that Counties were able to apply for the grant money over an extended period of time, and implementation of the WFS was on their own development schedule. Several Counties stood up their WFS using in-house resources, while a large number of Counties contacted out the setup and hosting of the WFS to their existing GIS vendors. GIS vendors included WTH Technologies, The Schneider Corporation, 39 Degrees North, and The Sidwell Company.

Date	Participation Count
7/14/2008	1
7/28/2008	2
8/5/2008	5
8/18/2008	7
8/22/2008	9
8/28/2008	10
9/12/2008	11
9/16/2008	12
9/26/2008	13
9/29/2008	14
10/2/2008	15
10/5/2008	17
10/24/08	19
10/27/08	20
11/5/08	22
11/6/08	23
11/12/08	24
12/1/08	25
12/3/08	26
12/9/08	27
12/23/08	29
1/5/09	33
1/20/09	34
1/27/09	36
2/2/09	37
2/9/09	46
2/10/09	47
2/11/09	48
2/20/09	49
3/6/09	50
3/9/09	51
3/13/09	52
4/29/09	55
5/5/09	58
5/13/09	63
5/15/09	64
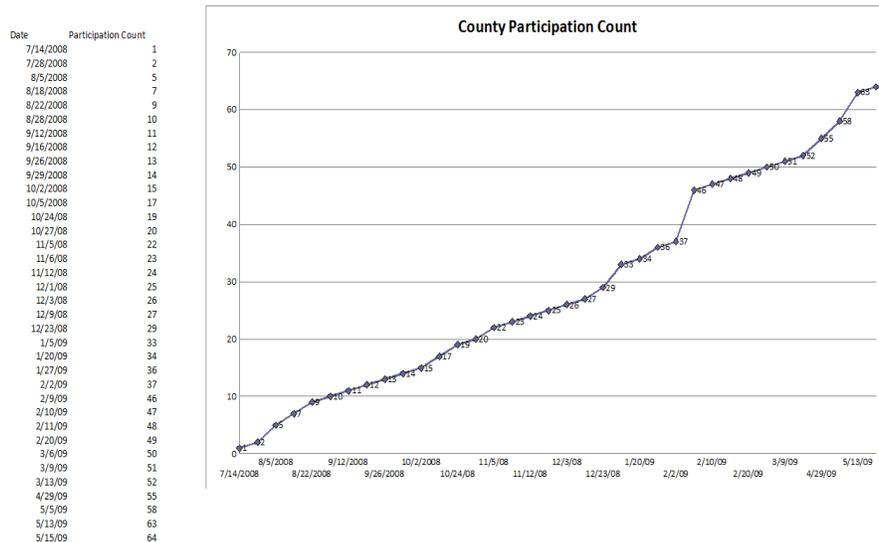
Figure 14

Data Harvesting Metrics – Current Results

As of December 31, 2011 85 Counties have committed to the initiative and 83 Counties have been harvested. The current total number of features harvested is:

- 6,725 Jurisdictional Boundaries

- 496,440 Street Centerlines Segments

- 2,389,153 Address Points

- 2,847,409 Land Parcels

Data Distribution

All four data layers are harvested on a monthly basis and published within the State of Indiana, and to the general public through…

- The IndianaMap (http://www.indianamap.org)

- OpenAddresses.org (http://www.openaddresses.org)

IndianaMap Viewer
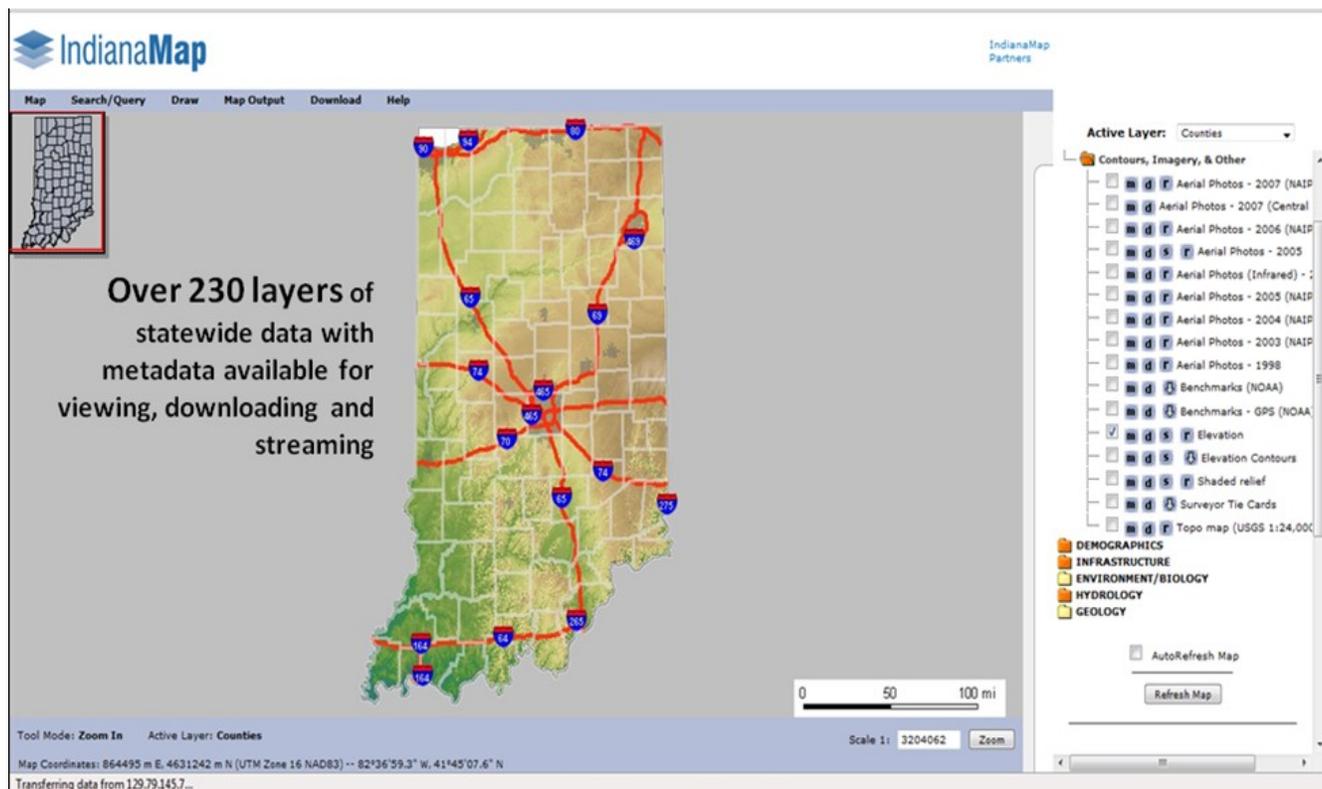
Figure 15
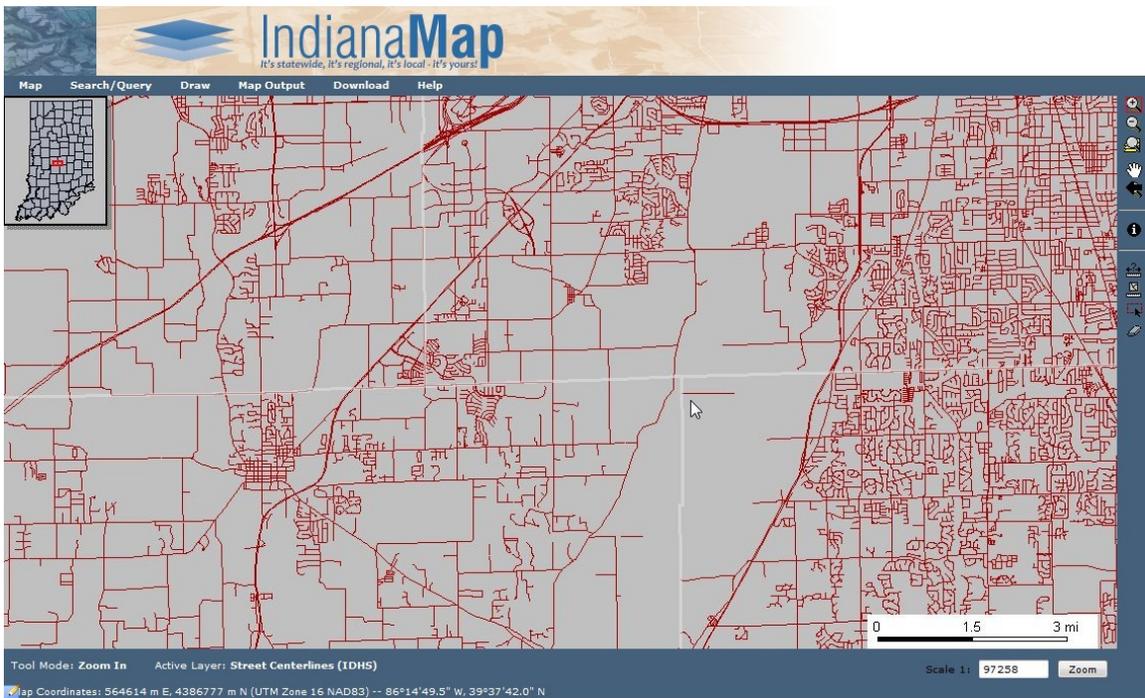
Figure 16

Figure 17

IndianaMap Services

These data are also available as OGC Web Map Services (WMS) and Esri ArcIMS Services through the IndianaMap.

MAP SERVICE NAME	SHORT DESCRIPTION	LONG DESCRIPTION
statewideMain	IndianaMap	More than 200 statewide layers showing information about coal, environment/biology, geology, hydrology, and infrastructure/demographics
IHAPIMain	Indiana Historical Aerial Photos	Historic aerial photos, aerial photos indices
fw_boundaries_govt_units	Framework - Government Boundaries	State, county, municipal, and other government boundaries
fw_cadastral	Framework - Cadastral	The basis for all land ownership mapping, used to show current rights and interest in real property (parcels) and cadastral reference systems (e.g. Public Land Survey System (PLSS), and Townships and Section lines)
fw_elevation	Framework - Elevation	Topography and elevations of land surfaces, including elevation contours and Digital Elevation Model (DEM) surfaces
fw_geodetic_control	Framework - Geodetic Control	Reference system of officially surveyed and monumented Benchmarks and GPS control points
fw_hydrography	Framework - Hydrography	Surface water features such as lakes, ponds, rivers, streams, canals, and shorelines from the high-resolution National Hydrography Dataset (NHD)
fw_ortho_imagery	Framework - Orthoimagery	Indiana orthophotography (aerial photos) for 1998, 2003, 2004, 2005, 2006, and 2007
fw_transportation	Framework - Transportation	Roads, trails, railroads, waterways, and airports; may include street centerline and address range information

Figure 18

The National Map

All harvested data is freely available, registered in GOS and the Ramona Inventory, but unlike the USGS's National Hydrography Database (NHD), there are no tools available for IGIC to post new or updated information on the parcel, address point, street centerline of jurisdictional boundary data layers for inclusion in the National Map.

OpenAddresses.org
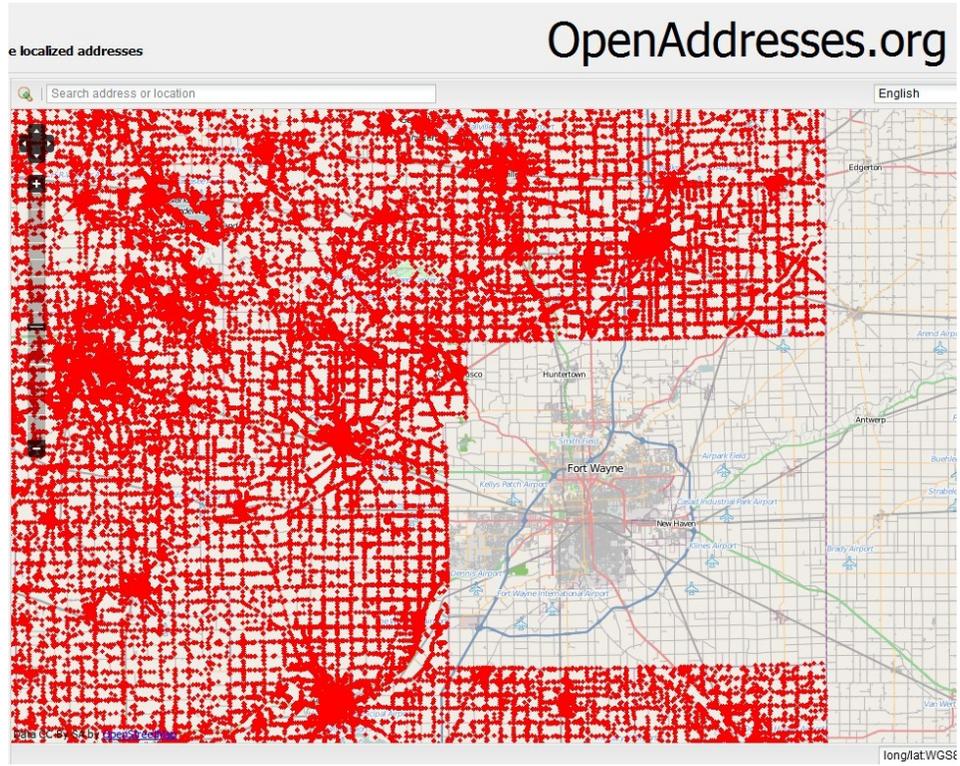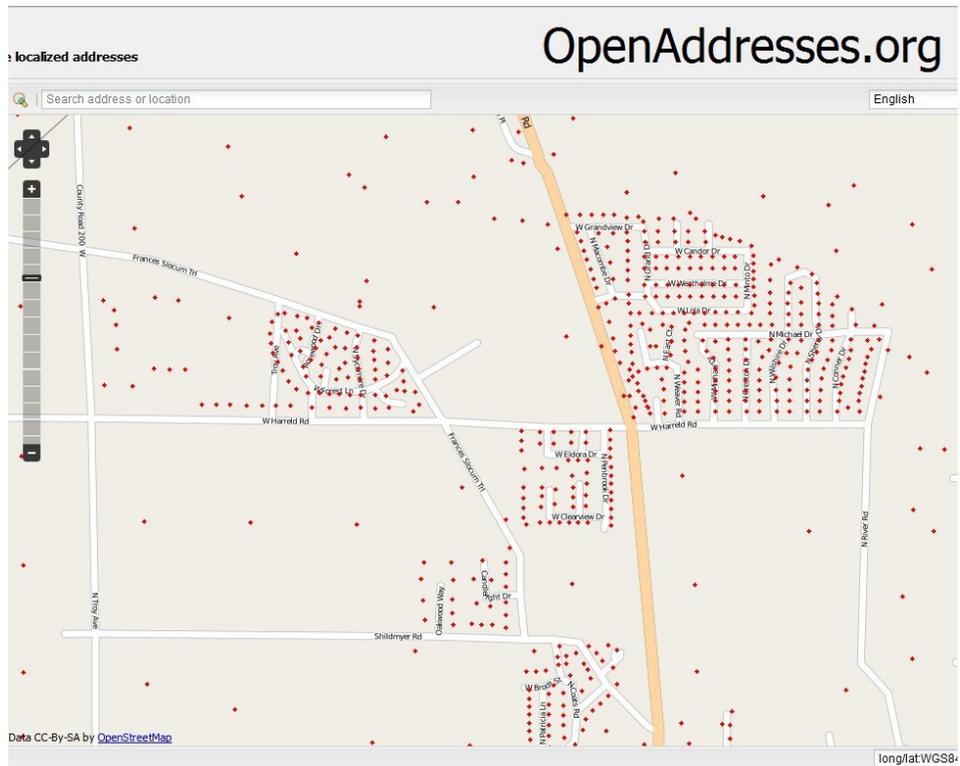
Figure 19

Figure 20

Project Presentations

This data sharing initiative was already underway when this CAP Grant was awarded. Among other things, this grant allowed us to expand our project outreach opportunities through a number of venues:

Regional Roadshows

Eight (8) full-day Roadshows were held around the state to explain participation, funding and the technology behind this data sharing initiative. Attendees included County government elected officials, GIS/IT staff, the public and representatives from private industry.

Presentations to Affiliate Organizations

IGIC and the Indiana GIO held special meetings and presentations on our data sharing initiative at various statewide annual conferences of these organizations:

- Association of Indiana Cities and Towns

- Association of Indiana Counties

- Elected Officials Associations (County Surveyors, County Assessors, and County Recorders)

Presentations to Geospatial Professionals

- Statewide local GIS Coordinator's Forum

- Regional GIS Groups - North East Indiana (NIGIC), North West Indiana (NWI GIS Forum), and Central Indiana (IMAGIS – Indianapolis Mapping and Infrastructure System).

- National States Geographic Information Council (NSGIC) 2010 Annual Conference, Minneapolis, MN – Invited presentation by USGS.

Early Value

We are already seeing some early ROI through a number of initiatives to take advantage of these new statewide data layers. These county data sets are currently existing or planned components of:

- The new Indian State Police computer aided dispatch system

- "Who Are Your Legislators" application (Secretary of the State)

- The Indiana Broadband Mapping project (Indiana office of Technology)

- Flood Analysis (Indiana Department of Natural Resources)

- Wetlands Mitigation Application (Indiana Department of Natural Resources)

- National and State land information companies (Various private firms)

- State Real-estate Members organizations (Metropolitan Indianapolis Board of Realtors)

- Utility Locate mapping base data (Indiana811)

Project Challenges

USGS Relationship

We have no way to directly share these four data layers with The National Map. We enjoy an excellent working relationship with the USGS through our Indiana State Liaison, David Nail, and with our other contacts at USGS at the Federal level. In the past we have had MOU agreements with the USGS for sharing our IndianaMap data with the National Map, but program and technical changes within the USGS over the years have basically made these data sharing agreements non-functional. Currently the State of Indiana is finalizing a formal agreement with the USGS for NHD Stewardship and maintenance, but we have no agreements in place or planned for any other IndianaMap data layers.

Next Steps:

IndianaMap Upgrade

We are in the process of upgrading our IndianaMap platform from Esri ArcIMS to ArcGIS Server 10. This upgrade will be completed later this summer, and will significantly improve the access and interoperability of these data with the public and with other web mapping applications.

Developing New IndianaMap Geospatial Data Models

IGIC's Streets/Addresses, and Cadastral Framework Workgroups have initiated the design of new IndianaMap Geospatial Data Models for Point Address and Road Centerline features based on the newly released 2010 FGDC addressing model.

These standards are being re-designed to better support future applications using these multi-source GIS data layer, while also supporting advanced Geospatial Data Model design, and honoring County Government's unique Business Rules and Capture/Maintenance Rules for these data.

In the future we hope to migrate these datasets into this new model to help support advanced geocoding, routing applications, and also to support feature level updates using geo-synchronization services.

Developing Advanced QA/QC Processes and Reporting Tools

In the future, we hope to expand the QA/QC process that is in place to include:

- Advances Attribute Assessment

- Horizontal Accuracy Assessment

- Topology Assessment (Internal and with Neighboring Counties)

- Develop advanced Error Reporting and a Problem/Resolution process to allow the data stewards to collaborate with adjoining counties on the resolution of any edge-matching or overlap issues (graphic and attributes)

- Based on monthly harvesting results the FGDC Metadata records for each data layer on the IndianaMap are updated. This currently is a manual process, but we hope to automate making these basic updates in the future.

Ongoing / Future Funding

The State GIO has already identified 3 years of additional funding for local governments to continue their participation in the program and the maintenance of their Web Feature Services to support our ongoing monthly on-demand harvesting.

Conclusion

The project team continues to improve, tweak and finalize the overall workflow and process, while also working with the seven uncommitted counties to encourage their participation in the program. We do not expect all 92 of Indiana's Counties to participate, so we will prepare a plan to fill in the holes with the best available State or Open data sources available.

We see the enhancement and expansion of best practices coming from regular reporting of harvesting, processing and testing results. We see this step as an added-value benefit to each individual data steward. Having a separate group independently process and test each data layer on a regular basis will allow the individual data stewards to readily identify issues and to improve the overall quality, integrity, accuracy, and overall value of each data set over time. Through this regular feedback the data stewards will know exactly where attribution, topology, or edge-matching issues exist within their data set or between their data and adjacent data sets. It is in our best interest to allow each stakeholder to review and address these issues as they have the need and opportunity. As necessary, stakeholders can work one-on-one with neighboring jurisdictions under mutual-aid or other existing agreements to address any problems in common areas. These regular efforts will also help identify any specific (larger) data conversion or data management projects for potential funding by the GIO through the State IndianaMap fund.

Attachments

(1) A copy of the companion PowerPoint presentation given at the NSGIC 2010 Annual Conference in Minneapolis, MN is attached.

(2) A copy of the formal invitation to participate letter (See Figure 5) is attached.

Appendix

Cooperative Agreements Program Feedback

What are the CAP Program strengths and weaknesses?

Program Strengths: We believe the CAP program is a tremendous tool to develop Federal to State/Local partnership to share and develop geospatial knowledge, technology, and data. Not only does the CAP program help State's get their local organizational and framework data business plans in place through the 50-States Initiative, but through grants like this it helps support and advance local projects and programs to identify best practices that can potentially have a wider regional or national impact.

Program Weaknesses: Simple - not enough funding! More and larger CAP grants are needed. The CAP Program already leverages existing funds multiple times over. Expanding CAP funding and the number of grants would provide tremendous additional value to the FGDC members and to the State/Local grant recipients across the country.

Where did this cooperative agreement "make a difference" to your State?

The Indiana Geographic Information Council is a not-for-profit 501(c)(3) members-organization of GIS professionals from across Indiana. We rely on grants like this to continue our work of building and maintaining the IndianaMap. The CAP funding directly supported IGIC, as well as our project partners (the State of Indiana GIO, and Indiana Geological Survey) with the development and publishing of these important local government data layers to the IndianaMap.

Was the assistance you received sufficient or effective?

The assistance was very effective! Was it sufficient –No! We had several schedule extensions that allowed us to continue working on ongoing [and new] data harvesting and publishing efforts, but these extensions were all at no-cost. These additional costs were over-and-above our original match, in this case we were able to absorbed these costs to accomplish additional results, but additional CAP funds would have also helped!

What would you recommend that the FGDC do differently?

Expand CAP funding and grant opportunities.

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

USGS and other agency annual budget funding for Cooperative / Partnership grants like the CAP program need to be increased and not decreased or eliminated. The ROI of this program for both the Federal and State/Local partners is significant and has been clearly documented, yet the DOI & USGS Executive Management in charge of budgeting doesn't seem to get it, or are just not willing to fight for it!

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

All of the CAP project and program management staff and resources were easy to work with. We requested several no-cost time extensions to the project and they were easily granted.

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

This is not directly related to the CAP funding for the project, but we would have sought additional grant / cooperative agreement funding from other sources in parallel with this project to more aggressively fund the development of added-value data products from our raw data harvests.

- END OF REPORT -