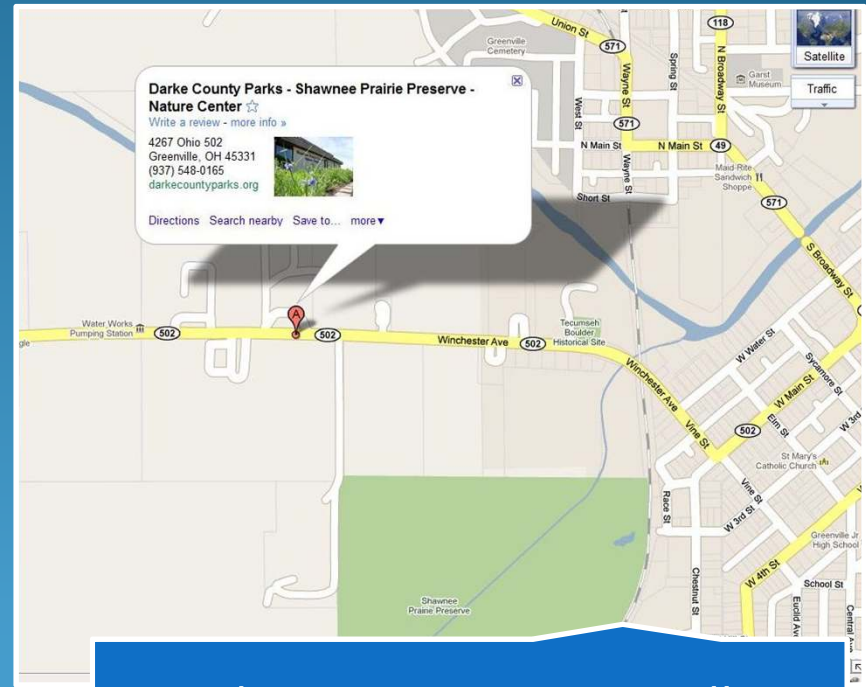


GIS Utility Mapping for Small Communities

Sean Kahlig, E.I.
Project Engineer

GIS – What Is It?

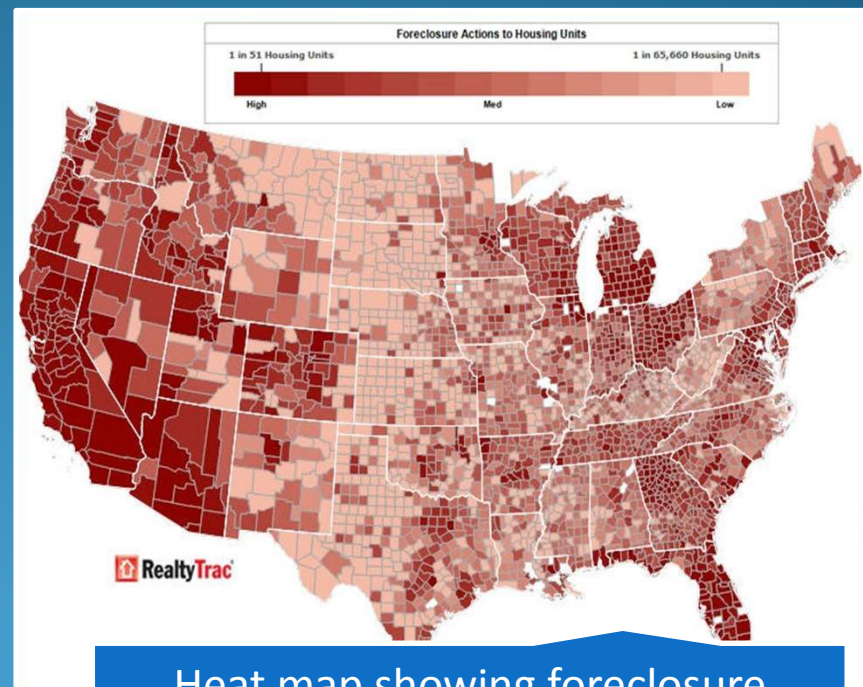
- GIS stands for “geographic information system”.
- “Any system that captures, stores, analyzes, manages, and presents data that is linked to location”
- Used to organize spatial data
- A way of attaching information to location



Google Maps – A GIS we all use

GIS – Why They're Used

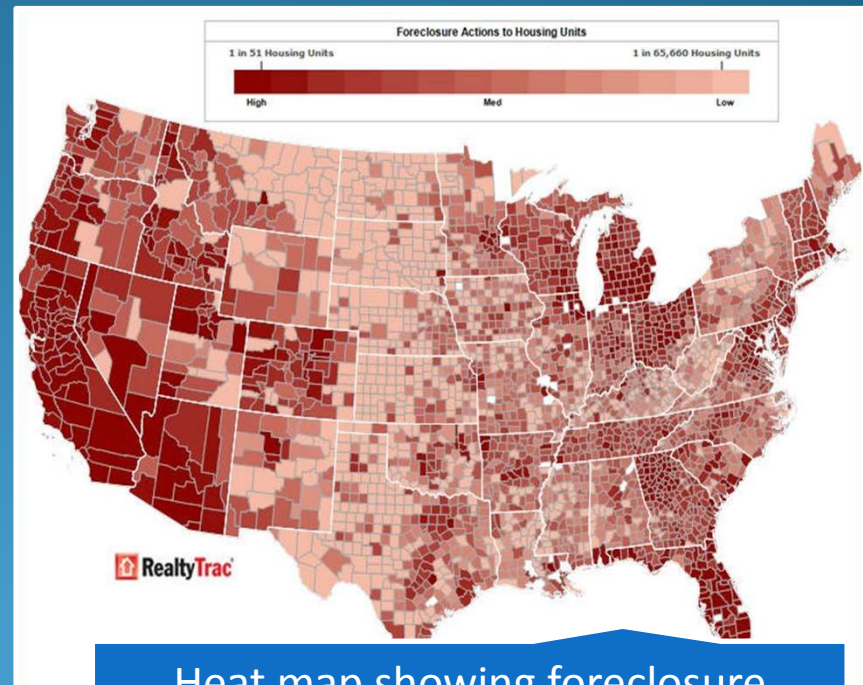
- Logical way to organize and store information
- Makes finding data much, much easier
- Allows users to discover patterns, relationships, and trends
- Promote increased user efficiency and productivity



Heat map showing foreclosure activity – July 2010

GIS – Where They're Used

- GIS's are everywhere.
- Any public or private entity that keeps records of large amounts of spatial data probably has a GIS.
- Vast majority are internal GIS's. They're used in-house only.
- Some are made available to the public, primarily through the web.

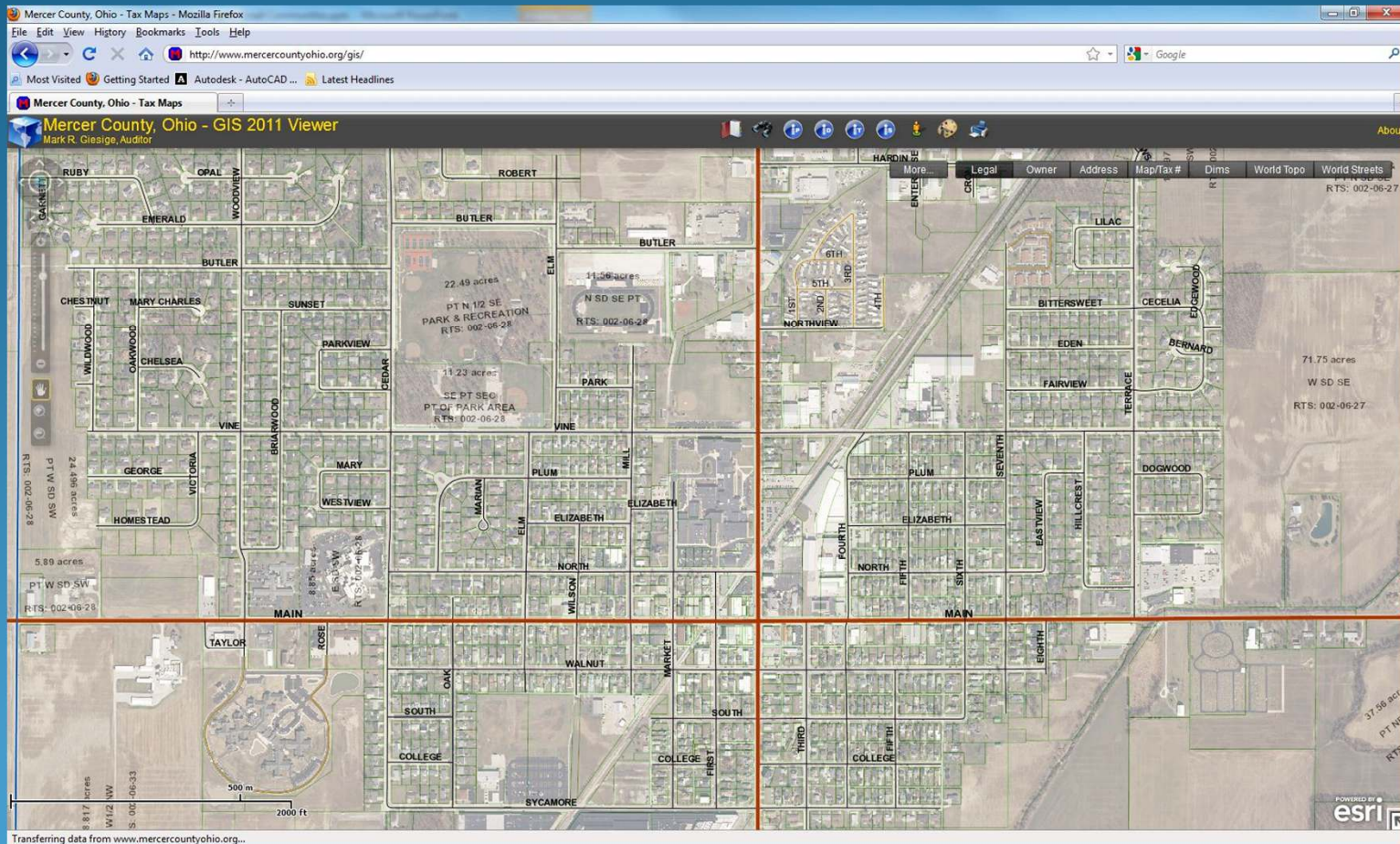


Heat map showing foreclosure activity – July 2010

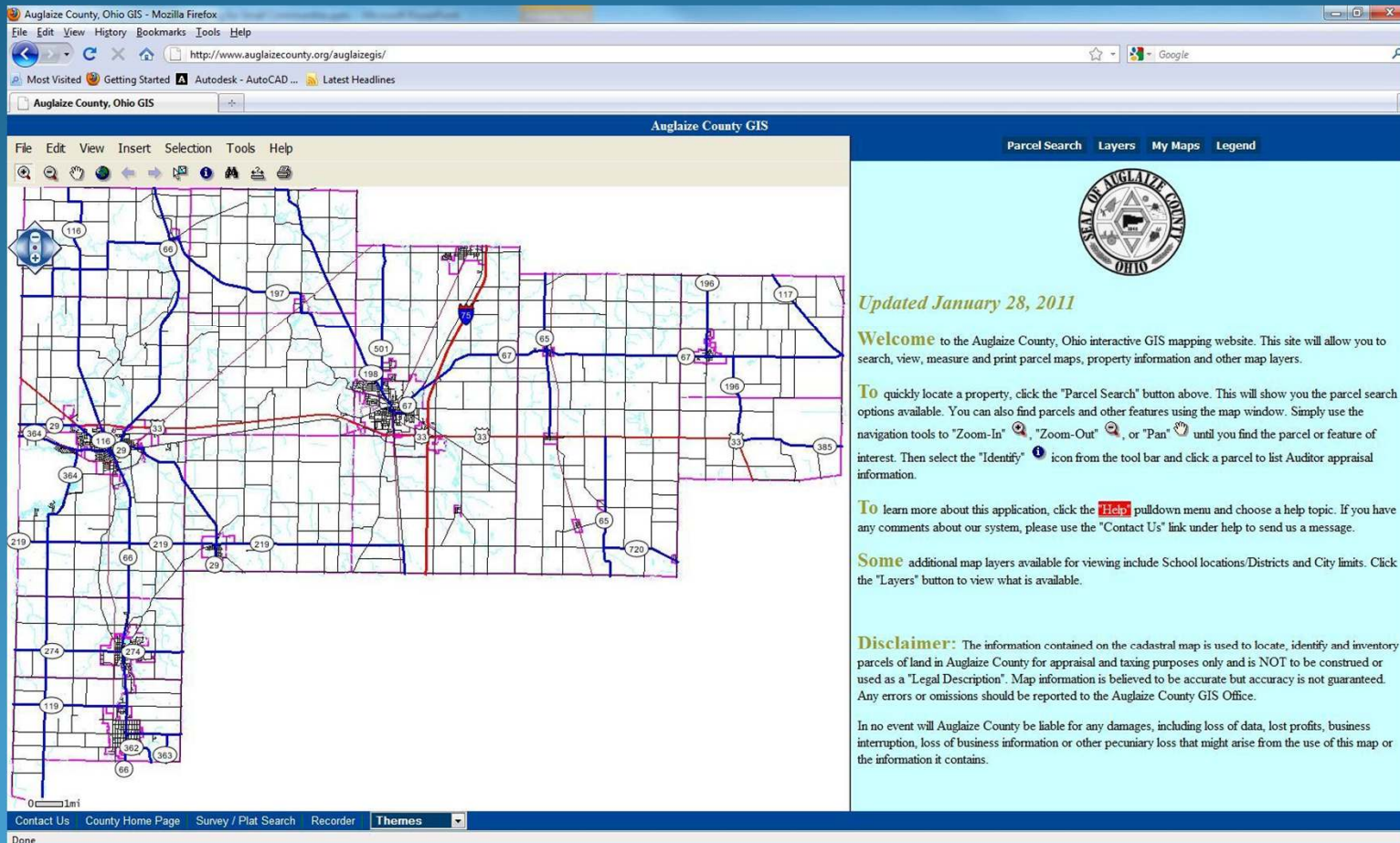
Primary Local Example – County Auditor Mapping Websites

- Used to display county, corporation, and property limits
- Make finding parcel information easy and intuitive
- Can show roadway networks, right-of-way extents, school zones, voting districts, and section boundaries
- Aerial underlays provided for visual reference

Mercer County Auditor's Page – Coldwater, OH



Auglaize County Auditor's Page – County Extents




The screenshot displays the Auglaize County GIS website in a Mozilla Firefox browser. The browser's address bar shows the URL <http://www.auglaizecounty.org/auglaizegis/>. The website's main navigation bar includes links for [Parcel Search](#), [Layers](#), [My Maps](#), and [Legend](#). The central map area shows a detailed cadastral map of Auglaize County, Ohio, with various colored overlays representing different land parcels and features. The map includes a scale bar indicating 0 to 1 mile. The right-hand side of the page features the official seal of Auglaize County, Ohio, and a welcome message dated January 28, 2011. The message provides instructions on how to use the GIS application, including how to search for parcels, view additional map layers, and a disclaimer regarding the accuracy of the information.

Auglaize County, Ohio GIS - Mozilla Firefox
File Edit View History Bookmarks Tools Help
<http://www.auglaizecounty.org/auglaizegis/>
Most Visited Getting Started Autodesk - AutoCAD ... Latest Headlines
Auglaize County, Ohio GIS

Auglaize County GIS

Parcel Search Layers My Maps Legend



Updated January 28, 2011

Welcome to the Auglaize County, Ohio interactive GIS mapping website. This site will allow you to search, view, measure and print parcel maps, property information and other map layers.

To quickly locate a property, click the "Parcel Search" button above. This will show you the parcel search options available. You can also find parcels and other features using the map window. Simply use the navigation tools to "Zoom-In", "Zoom-Out", or "Pan" until you find the parcel or feature of interest. Then select the "Identify" icon from the tool bar and click a parcel to list Auditor appraisal information.

To learn more about this application, click the **Help** pulldown menu and choose a help topic. If you have any comments about our system, please use the "Contact Us" link under help to send us a message.

Some additional map layers available for viewing include School locations/Districts and City limits. Click the "Layers" button to view what is available.

Disclaimer: The information contained on the cadastral map is used to locate, identify and inventory parcels of land in Auglaize County for appraisal and taxing purposes only and is NOT to be construed or used as a "Legal Description". Map information is believed to be accurate but accuracy is not guaranteed. Any errors or omissions should be reported to the Auglaize County GIS Office.

In no event will Auglaize County be liable for any damages, including loss of data, lost profits, business interruption, loss of business information or other pecuniary loss that might arise from the use of this map or the information it contains.

Contact Us County Home Page Survey / Plat Search Recorder Themes

Done

Other GIS Example – Dayton Police Department

The screenshot displays a web browser window with the URL <http://www.daytonohiopolice.com/CrimeMap/index.html>. The page title is "City of Dayton Police Department - Part I Property Crime Map". The main content is a satellite map of Dayton, Ohio, with a red dot indicating a specific location. The map includes a scale bar (0 to 5 km) and the ESRI logo. On the right side, there is a "Toolbox" panel with the following features:

- Choose Crime(s):** Date range from 01/01/2011 to 02/01/2011.
- Select All / Clear All** buttons.
- Update Map (0)** and **Auto Zoom** checkbox.
- Click to select .5 mile Buffer** button.
- Find Address:** Fields for Address, City (Dayton), State (Ohio), and Zip, with a **Find** button.
- Advanced Analytics:** **Heat Map** (with a visibility slider) and **Repeats** (with a **Show Incidents** button).

At the bottom of the browser window, there is a "Search Results" section with a "Show/Hide Results" link and a status message: "Transferring data from server.arcgisonline.com...".

Other GIS Example – NRCS Web Soil Survey

The screenshot displays the NRCS Web Soil Survey interface. At the top, the USDA logo and "Natural Resources Conservation Service" are visible, along with the "Web Soil Survey" title. Navigation links include "Contact Us", "Download Soils Data", "Archived Soil Surveys", "Glossary", "Preferences", "Logout", and "Help". Below this, there are tabs for "Area of Interest (AOI)", "Soil Map", "Soil Data Explorer", and "Shopping Cart (Free)".

The main content area is titled "View Soil Information By Use: All Uses" and includes a "Printable Version" and "Add to Shopping Cart" button. Below this, there are tabs for "Intro to Soils", "Suitabilities and Limitations for Use", "Soil Properties and Qualities", "Ecological Site Assessment", and "Soil Reports".

The "Suitabilities and Limitations for Use" section is active, showing a search bar and a list of categories with expand/collapse icons. The "Crop Productivity Index" category is selected, and its options are visible:

- View Description** | **View Rating**
- View Options** (with expand/collapse icons):
 - Map
 - Table
 - Description of Rating
 - Rating Options
 - Detailed Description
- Advanced Options** (with expand/collapse icons):
 - View Description** | **View Rating**

The map area, titled "Map – Crop Productivity Index", shows a topographic map with a color-coded overlay representing the Crop Productivity Index. The map includes a legend, a scale bar (0 to 2861 ft), and a scale dropdown menu set to "not to scale". The map shows various soil units with labels such as "1095", "1092", "L13A", "887B", and "1092". A scale bar at the bottom of the map indicates 0 to 2861 ft.

At the bottom of the interface, there is a table titled "Tables – Crop Productivity Index – Summary By Map Unit".

Utility Mapping – A Perfect GIS Application

- From earlier: GIS Definition - “Any system that captures, stores, analyzes, manages, and presents data that is linked to location”
- Utilities are comprised of location based objects with specific characteristics, making their information perfectly suited to be kept and viewed in a GIS.
- Most medium to large cities in Ohio (populations over 10,000) already use GIS’s to store there utility information.

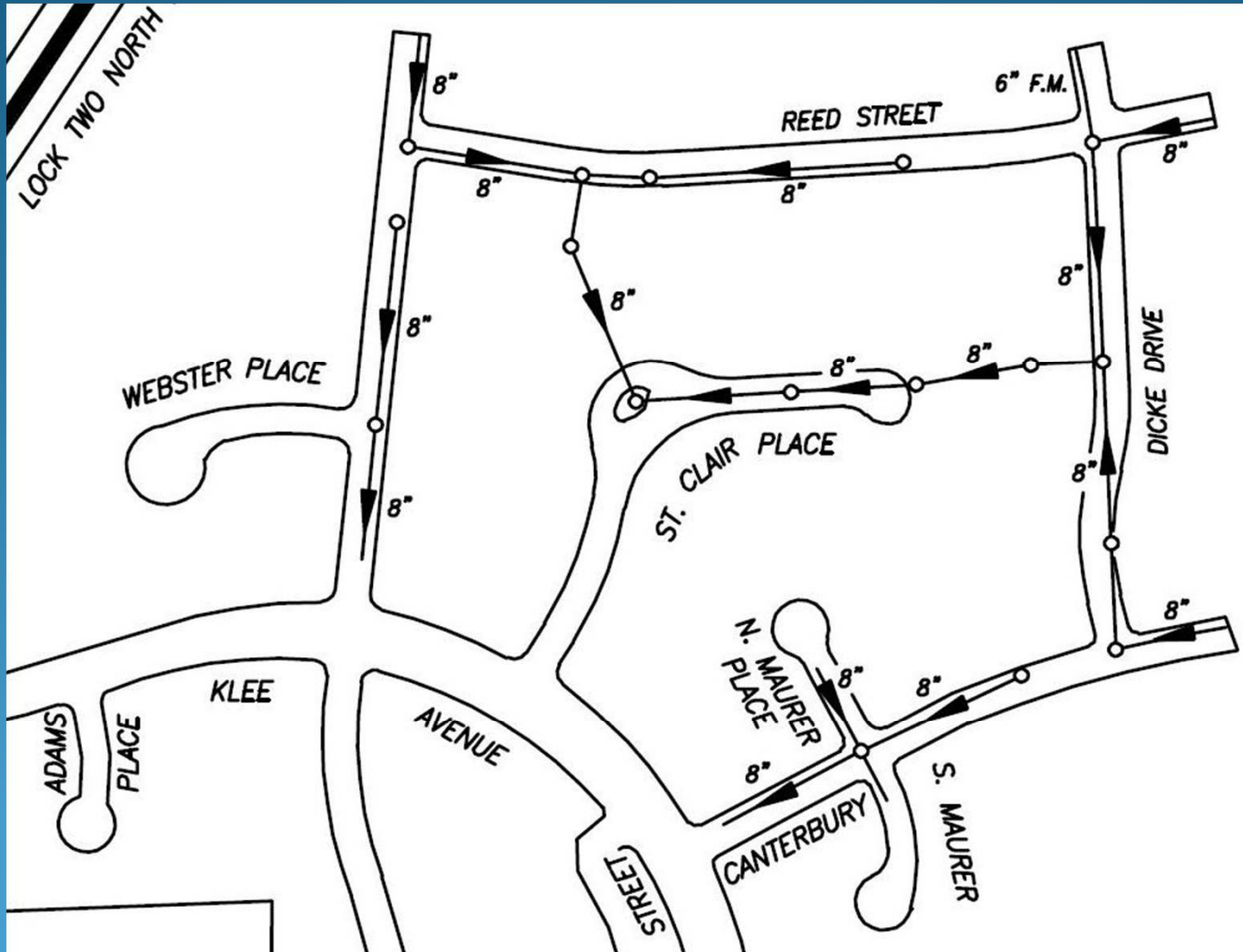
Utility Maps in Small Villages – Current State

- Many small communities don't have up to date maps.
- Often, vital information about utilities isn't recorded anywhere.
- When public works employees retire, much of the knowledge of the utility systems is gone with them.

Utility Maps in Small Villages – Traditional Map Shortfalls

- Only include mains, not laterals or service connections
- Utility feature (pipes, valves, manholes, laterals, etc.) locations are approximate ($\pm 10'$? $\pm 20'$? $\pm 50'$?).
- Maps aren't tied to any real world coordinate system.
- Important information such as depth, material, age, and condition isn't recorded.
- More of a general schematic than anything
- Paper maps only – not interactive
- Maps are static – not easily changed

Traditional Sanitary Sewer Map



Mapping with GIS – A Better Way

- Keep track of laterals and service connections, not just main lines
- Utility feature locations are precise ($\pm 2'$ or better).
- Maps are tied to real world coordinate systems.
- All pertinent information such as depth, material, age, and condition can be recorded.
- Knowledge of utilities isn't limited to the memory of public works employees.
- Electronic maps – interactive, easily accessible
- Maps are dynamic – easy to visually modify

Mapping with GIS – Immediate Benefits

- Ability to quickly and accurately locate all parts of utility networks
 - Answer customer questions without a field visit
 - Accurately mark feature locations
 - Quickly locate features during emergencies (water valve buried under snow during a main break)
- Use maps to guide infrastructure improvements
 - Highlight oldest areas of a storm sewer system
 - Display all sanitary sewer pipes in poor condition
 - View all small diameter water mains
 - Highlight clay sewer mains

Mapping with GIS – Immediate Benefits (Continued)

- Save on engineering costs for infrastructure projects
 - Cut survey costs where manhole data already known
 - Plans developed more quickly due to accurate and readily accessible utility information
- Save on construction costs for infrastructure projects
 - Know locations and depths of utility lines
 - Know which lines are abandoned and which are active
 - “To tie-in or not to tie-in, that is the question”
 - Minimize change orders due to fewer field surprises

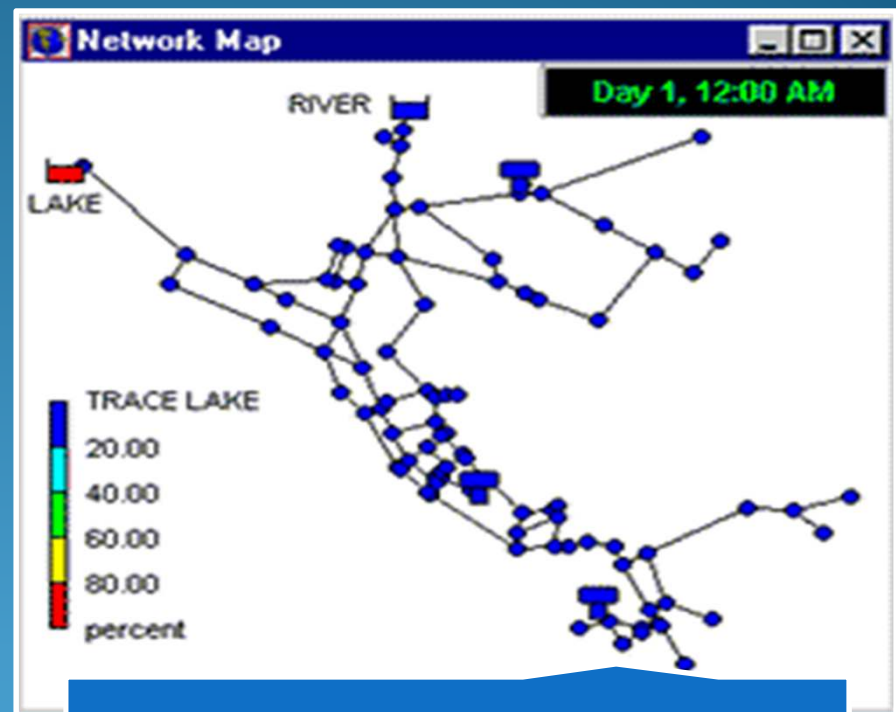
Mapping with GIS – Immediate Benefits (Continued)

- Apply for grants, estimate initial project costs, and submit EPA documentation more quickly
- View utility maps overlaid on all sorts of other maps/layers, including: zoning areas, floodplains, roads, parcels, soils, political boundaries, and aerial photos
- Quickly identify service areas and addresses that would be affected by closing a specific valve or by a line break

Mapping with GIS – Immediate Benefits (Continued)

Use maps to create utility network models

- Water
 - Identify low pressure areas in the system
 - Determine how the addition of a loop or a larger diameter main would affect system performance
- Storm
 - Analyze performance of storm network as a whole
 - Determine undersized areas of the system



EPANET Water Distribution System Model

Building GIS Maps: A 2-Step Process

- Step 1: Data Collection
 - Field surveying
 - Record drawings
 - First-hand knowledge
- Step 2: Data Migration
 - Converting survey data, record drawing data, and personal accounts into a GIS format

Completed GIS Maps – Now What?

KEEP THEM MAINTAINED!!!

- Document changes within the utility systems as they are made/discovered
- Locate all new and previously undiscovered/unlocated features during construction
- Update maps monthly, quarterly, or yearly with changes

GIS Maps – Data Collection Costs

Cost is frontloaded in the data collection:

- A lot of work to collect all necessary information
- Costs depend on level of information desired and amount of accurate information already available.
- Economies of scale
- Example: Sanitary sewer system containing 400 manholes, 400 main lines, 1,200 laterals, and 1,200 cleanouts
 - 3,200 Features x \$6/Feature = \$19,200 (Guestimate!)
- Don't try to do it all at once.
 - Set a goal to map one utility per year (or every two or three years).

GIS Maps – Maintenance Costs

Maintenance costs are minimal:

- Updates associated with large projects are just incorporated into the project with minimal additional costs.
 - Use topo data collected for project for existing feature locations (as long as tied to coordinate system).
 - Design data can be used for new features (as long as field modifications are minimal).
 - Field locate additional features where necessary during and after construction.
 - Can typically be paid for by project funding sources

GIS Maps – Maintenance Costs (Continued)

- Other updates, such as those associated with small repairs, can be made periodically.
 - Monthly, quarterly, or yearly
- Example: 2 street reconstructions were completed in a village during 2010. Topo and design data was tied to state plane coordinates, as well as as-built data. A dozen small repairs in the village were also documented throughout the year. At year's end the village storm, sanitary, and water maps were updated to reflect these changes. The updates took 3 days to complete. The village was charged \$1,500.

Things to Keep in Mind...

- Building GIS maps is a long-term investment.
- The longer the maps have been in service, the more beneficial (and accurate) they become, and the greater the return on investment.
- Underground utilities and their histories become more complex with each passing project. It will be cheaper to map utilities now than later.
- Each time unmarked utility lines are hit or unnecessary repairs to abandoned sewers are made, money is being wasted that could have been spent on GIS maps

Things to Keep in Mind...

EPA NPDES Stormwater Phase II Rule

- Published December 8, 1999
- Requires small Municipal Separate Storm Sewer Systems (MS4s) located in urban areas to develop and follow a stormwater management program
- 6 specific criteria that need to be met, including “Illicit Discharge Detection and Elimination”
 - Requires the development of accurate storm sewer maps and watershed delineations
- Most municipalities use GIS mapping to meet program requirements
- In the not too distant future, all MS4s could fall under similar regulations

GIS – After the Bare Essentials

- Once the utilities are mapped (“base maps”), the possibilities are endless.
- Base maps can be integrated with many aspects of local government.
- Limited only by your bank account



GIS Possibilities

Once base maps are completed, a village could...

- Link base maps to customer billing databases
- Locate existing service connections with coordinates in the GIS using a GPS unit
- Link engineering plans, photos, inspection reports, hand drawings, equipment manuals, etc. to base maps
- Integrate maintenance and repair programs with the GIS
- And on and on...

Case Study – Hudson, OH

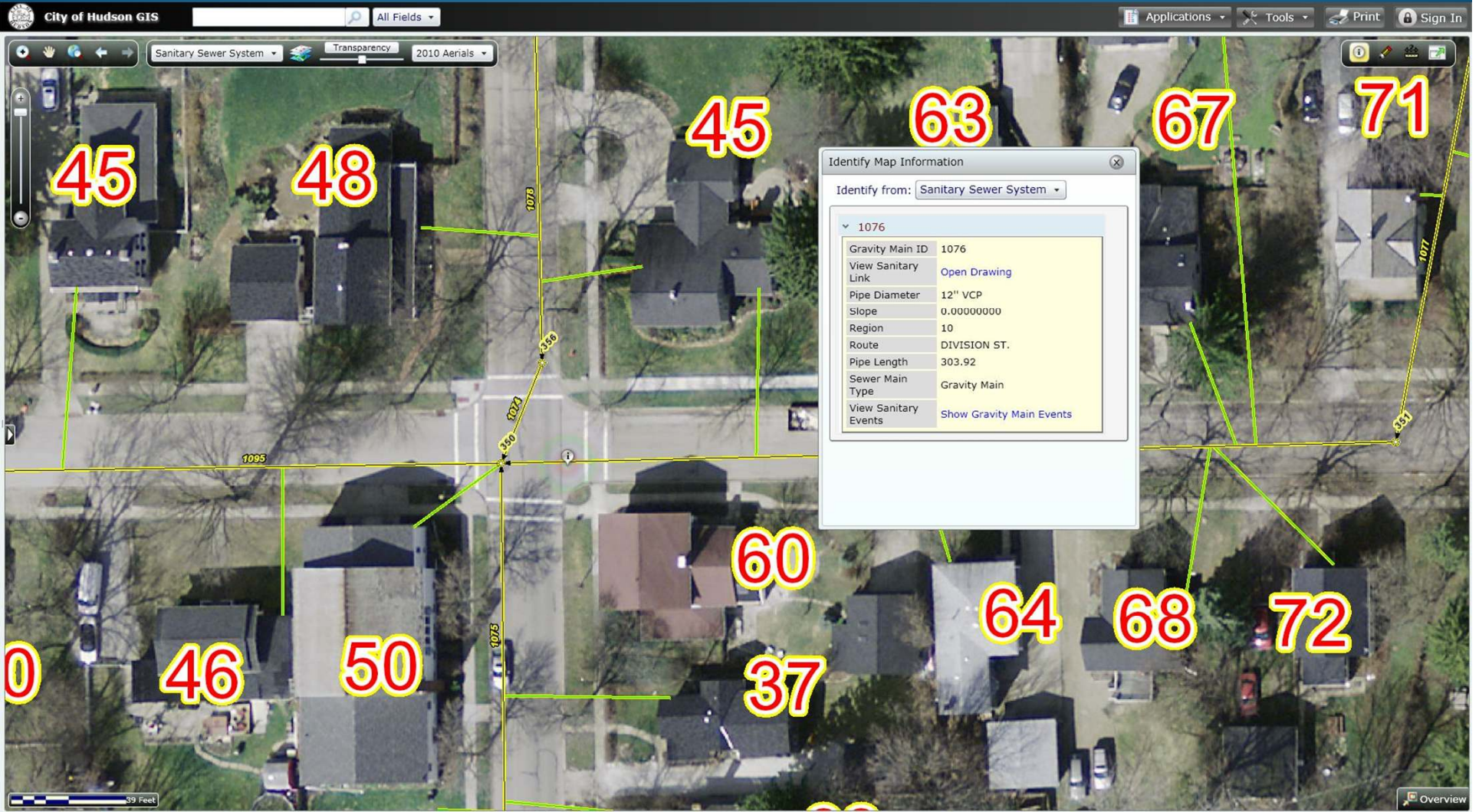
- Located near Cleveland, OH
- Population ≈ 23,000
- 3 fulltime GIS/IS employees
- Annual GIS budget ≈ \$150,000
- Funded by all 16 municipal government agencies



Hudson GIS Functionality

- Accessible by all government departments through intranet
- Quickly access water, sewer, and storm infrastructure information, as well as many other data sets
- Analyze utility networks for system maintenance and expansion
- Conform to EPA Phase II Stormwater Rule
- Notify residents of public works projects, such as street reconstructions and water shutoffs
- Develop land use plan for city
- Deploy resources for both emergency mitigation and response
- Answer residents questions using digital maps and spatial information
- Use to view floodplain information, process public works department work order requests, provide information for the community golf course, view sewer TV videos, view cemetery plot data, etc.

Sanitary Sewer – General Info



Sanitary Sewer – Design Drawing



Sanitary Sewer – Work History

Data Table - Mozilla Firefox

http://gis.hudson.oh.us/HudsonSL/WebForms/PopUpTable.aspx?Title=SanitaryLines_Event_History&

Data Table

Activity History for Gravity Main ID: 87413707

Show or Hide Fields:
By clicking this button you are able to add and remove fields from the table: (Simply drag and drop fields into or out of the floating panel)

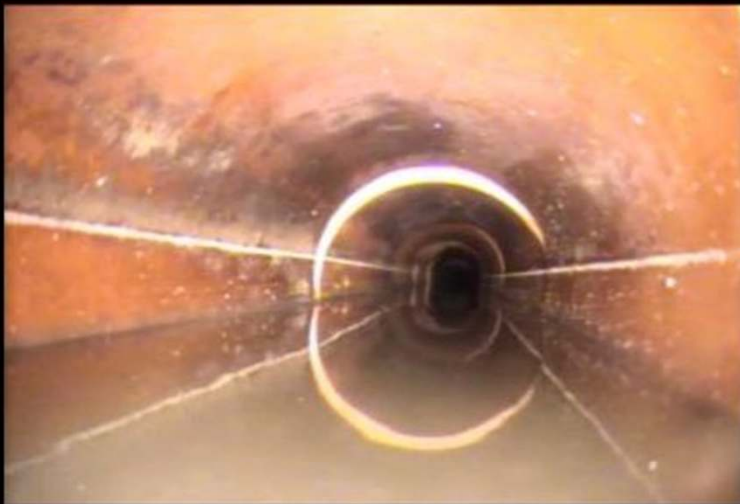
Export Table:

Show/Hide Fields Window Export to PDF Export to XLS Export to RTF Export to CSV

Drag a column header here to group by that column

Work of Status	Start Date	End Date	Work Activity	Work Completed By	Associated Work O
Completed	6/1/2006 12:00:00 AM	6/1/2006 12:00:00 AM	Liner Sliplining	Engineering Dept. - Capital	
Completed	5/20/2010 12:00:00 AM	5/20/2010 12:00:00 AM	Jetting	TV Truck Crew	SANSEWER-527
Completed	5/17/2010 12:00:00 AM	5/17/2010 12:00:00 AM	Televise	TV Truck Crew	
Completed	1/1/1927 12:00:00 AM	1/1/1927 12:00:00 AM	Install	SSchroyer	

Sanitary Sewer – Television



Sewer Observation Information

Project Name: E. Streetsboro St. 09_07_10
Category: CRACK
Code: FC
Code Description: Fracture Circumferential
Time of Observation: 2 minute(s) 51 seconds
Photos:
Date of Observation: 9/10/2010 12:47:23 PM

Sewer Line Information

Gravity Main ID: 1061
Pipe Diameter: 8 inch
Length: 306.774988
Upstream Manhole ID: 261
Downstream Manhole ID: 257
Sanitary Sewer Construction Drawings: [Open Drawing](#)

00:00:01 | 00:40:49




Hudson GIS – Estimated ROI

- \$80,000/year (5%) savings on engineering and design work due to reduced planning, surveying, design, and change orders
- \$19,000/year savings on utility markings (1,500/year) by public works department due to ease of access of information
- No more “loss of institutional knowledge” due to retiring employees
- Public access to the GIS through the internet greatly reduces the number of calls to city departments and time spent compiling public record requests.

Small Community GIS - Obstacles

- FUNDING, FUNDING, FUNDING
 - A village with 2,300 people instead of 23,000 might have a GIS budget of \$15,000 instead of \$150,000.
 - Can't afford to hire in-house GIS professionals
 - Professional GIS software requires robust computers to run and well trained employees to use.
 - Hardware and software are expensive.
 - GPS equipment is a substantial investment and requires training to operate.
- Village employees are already stretched thin and are wearing multiple hats.
 - Don't have time to tackle big new projects or learn new software
- Hard to find qualified utility operators in rural areas, even more so ones that are proficient with GIS software

Mote & Associates – Our Take

- Small communities will benefit from GIS, but their needs are somewhat different than larger cities.
- Don't need all of the bells and whistles of an enterprise system
- Getting base maps in GIS format is a great start 
- We can help
 - Have survey equipment, hardware, software, and expertise to get utilities mapped
 - Located locally
 - No travel expenses
 - Right around the corner if help is needed
 - Allow village employees to focus on already busy schedules

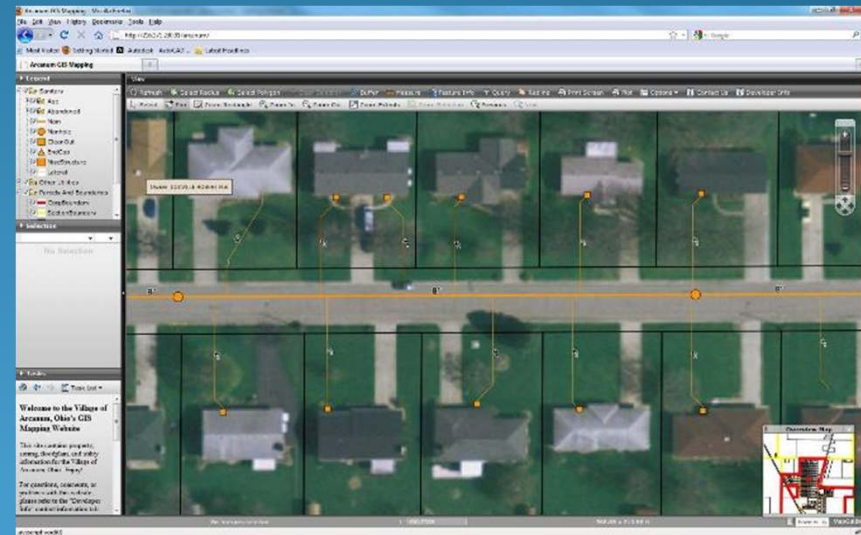
Our Goals

- Prepare GIS maps for villages
 - Existing records
 - Field surveys
- Keep GIS maps maintained
 - As-built surveys
 - Update maps by project, monthly, quarterly, yearly, or as needed
- Provide professional quality printouts, small and large scale, upon request
- Help villages transition to more advanced GIS if desired
 - Integrate pictures, drawings, and other useful information
 - Turn over all map maintenance to village

Making Village GIS Maps Accessible to Everyone – Put Them Online

Create mapping website specifically for village

- Complete content control – personalized for village
- Rapid updates
- Hosting Cost \approx \$100/month depending on bandwidth requirements



Demos

- Village of Arcanum
- Village of New Bremen

Summary

- Most small communities don't have comprehensive utility maps. Utility information is hard to find or lost entirely when employees retire.
- GIS maps can adequately capture utility information and provide many benefits to small communities.
- GIS mapping is an investment that can be expensive upfront but cost-saving in the future.
- Mote & Associates can help meet villages' mapping needs.
- Everyone can enjoy the benefits of GIS mapping by putting the maps online.