



Larson Design Group®

**GIS APPLICATIONS
FOR
WATER/WASTEWATER
OPERATIONS:
MAKING DATA WORK
FOR YOU**

**MATTHEW KALCICH
GIS ANALYST**

OUR SERVICES



YOUR VISION. MADE REAL.

FACILITIES & BUILDING ENGINEERING | TRANSPORTATION | ENERGY | CIVIL | RETAIL DESIGN

OUR OFFICES



New York



Ohio



Pennsylvania



West Virginia

CHALLENGE FOR UTILITIES

- Underground
- Aging infrastructure
- Hard to assess and access
- Planning, maintaining, capital costs
- Leveraging technology
- Knowledge Retention
- Technology adoption of older staff
- Analysis

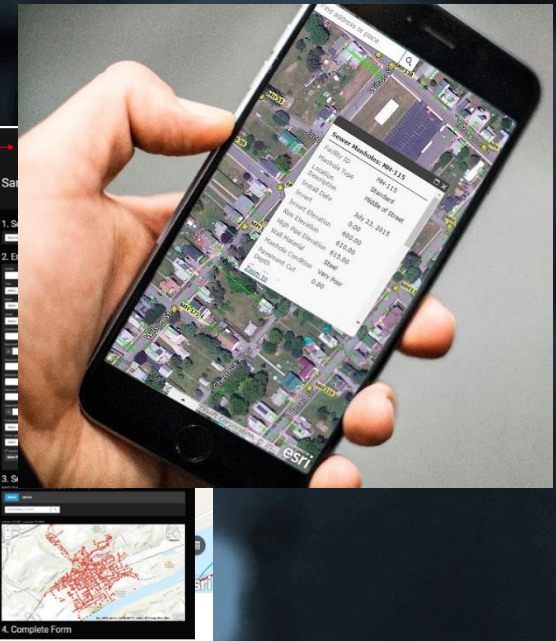
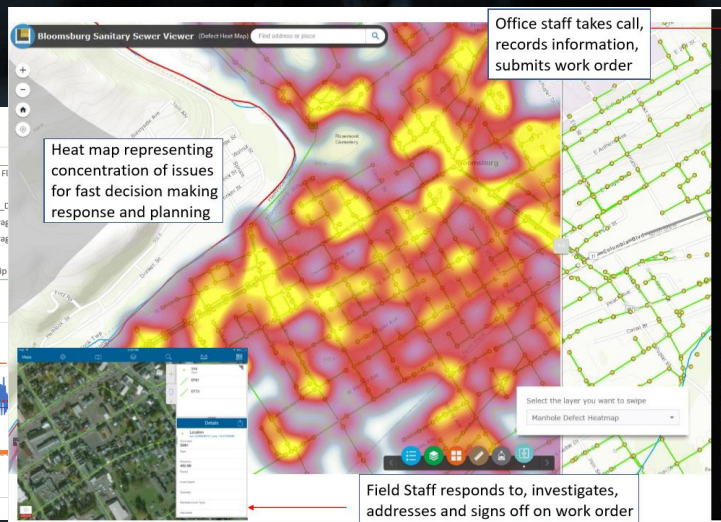
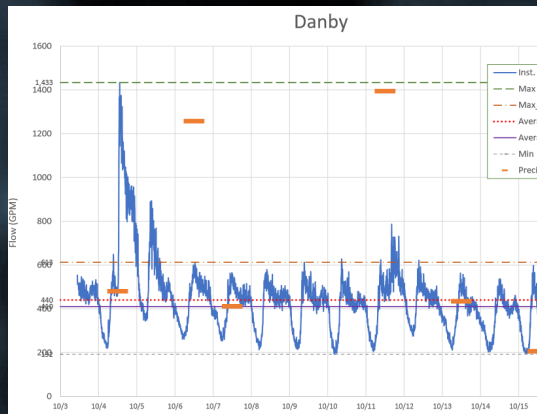


Fiscal years ending December 31	2009	2008	2007	2006	2005	To
(i)						
e	1,721	2,115	1,829	1,889	1,534	
From Operations (a)	3,413	3,977	3,492	3,189	2,706	
il Expenditures, excl Equipment:						
nce of way (rails, ties, surfacing)	1,605	1,561	1,359	1,226	1,053	
al	107	168	141	152	136	
	110	133	105	121	108	
aintenance Cap-Ex	1,822	1,862	1,605	1,499	1,297	
Information Services	83	83	75	65	64	
Terminal and line expansion	86	230	568	450	389	
Total Cash Capital Expenditures (b)	1,991	2,175	2,248	2,014	1,750	
Depreciation	1,537	1,397	1,293	1,176	1,111	6,514
Free Cash Flow (a) - (b)	1,422	1,802	1,244	1,175	956	6,599



GIS AS A SOLUTION FOR THESE CHALLENGES

- GIS gives you a way to visualize the data
- Push it out to mobile devices
- Put it in the hands of field staff, decision makers, the public
- Leveraging a platform that can tie other systems together
- Focused tasks on easy to use applications



ADDITIONAL BENEFITS GIS OFFERS

- Office to field and Field to office workflows
- GIS enables you to make more informed and faster data driven decisions.
- Faster and Easy document retrieval
- Preserves metadata (How the data was collected, accuracy, dates, etc.)
- Accessibility of your data
- All of this makes for improved communication.

GIS give you a way to **tell your story** to your constituents using a combination of maps, data and images.

MAPPING YOUR SYSTEM

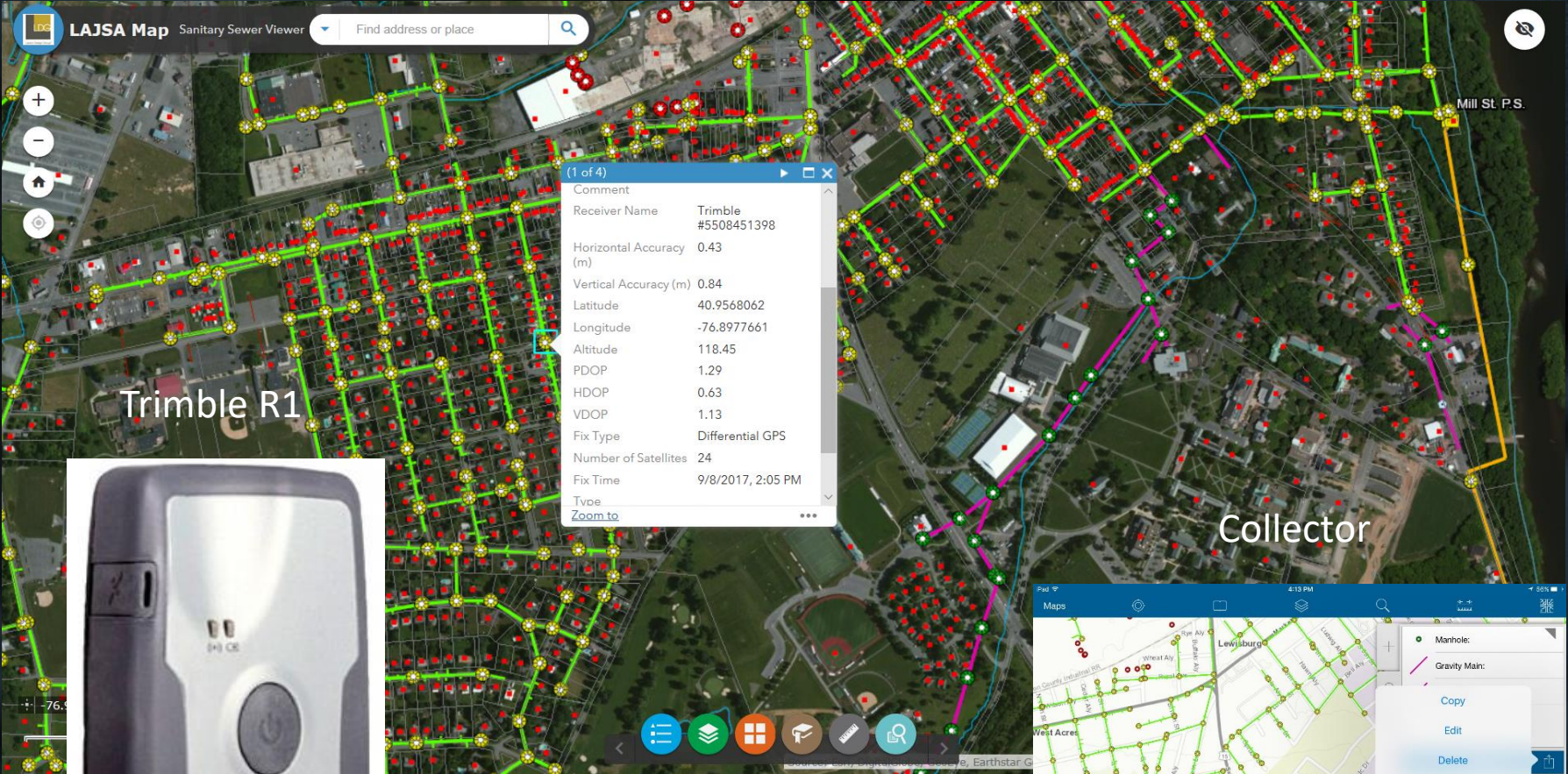
**OFFICE TO FIELD
FIELD TO OFFICE
WORK FLOWS
MAKING TASKS
MORE EFFICIENT**

GIS enables you to
make more informed
and faster data driven
decisions

- Never been easier or cheaper to map your entire system with highly accurate data
- Taking advantage of Collector and high accuracy Bluetooth GPS
- Capture surface representation of the system, snap pictures

FOCUSED APPLICATIONS

LEWISBURG (L.A.J.S.A)



LAJSA Map Sanitary Sewer Viewer

Find address or place

Trimble R1

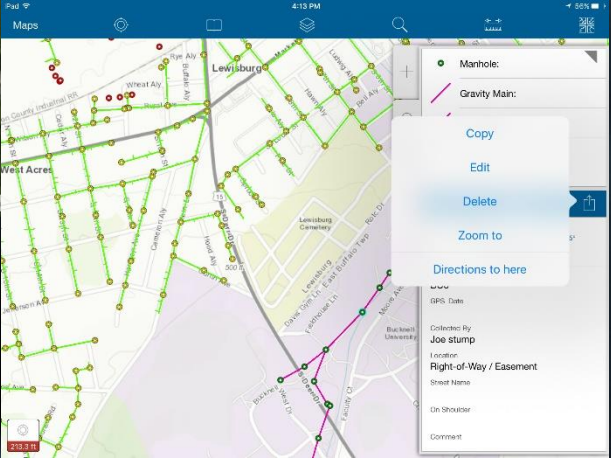
Collector

(1 of 4)

Comment	
Receiver Name	Trimble
#	5508451398
Horizontal Accuracy (m)	0.43
Vertical Accuracy (m)	0.84
Latitude	40.9568062
Longitude	-76.8977661
Altitude	118.45
PDOP	1.29
HDOP	0.63
VDOP	1.13
Fix Type	Differential GPS
Number of Satellites	24
Fix Time	9/8/2017, 2:05 PM
Type	
Zoom to	



Sub Meter Accuracy



Manhole:

Gravity Main:

Copy

Edit

Delete

Zoom to

Directions to here

GPS Data

Collected By Joe stump

Location

Right-of-Way / Easement

Sheet Name

On Shoulder

Comment

AFTER IT IS MAPPED - NOW WHAT?

- Now that you have good data
- Now that you spent the money, the time and the effort to map your system
- What do you do with all of this data?
- How do you take advantage of it?
- What's the benefit?



MAKING YOUR DATA WORK FOR YOU

- Collect once and reuse
- Make information accessible to field staff (Mobile apps / ArcGIS Online)
- Stream line communication (Story maps and Dashboards)
- Enhance office to field and field to office work flows (using ArcGIS online, survey 123 and Collector)
- Record information and take photo to reference condition
- Attach documents and drawing to features making them easy to return and accessible from anywhere
- Analysis (capacity analysis / planning / maintenance / capital expenditures)



EXAMPLE TOWN OF ITHACA:

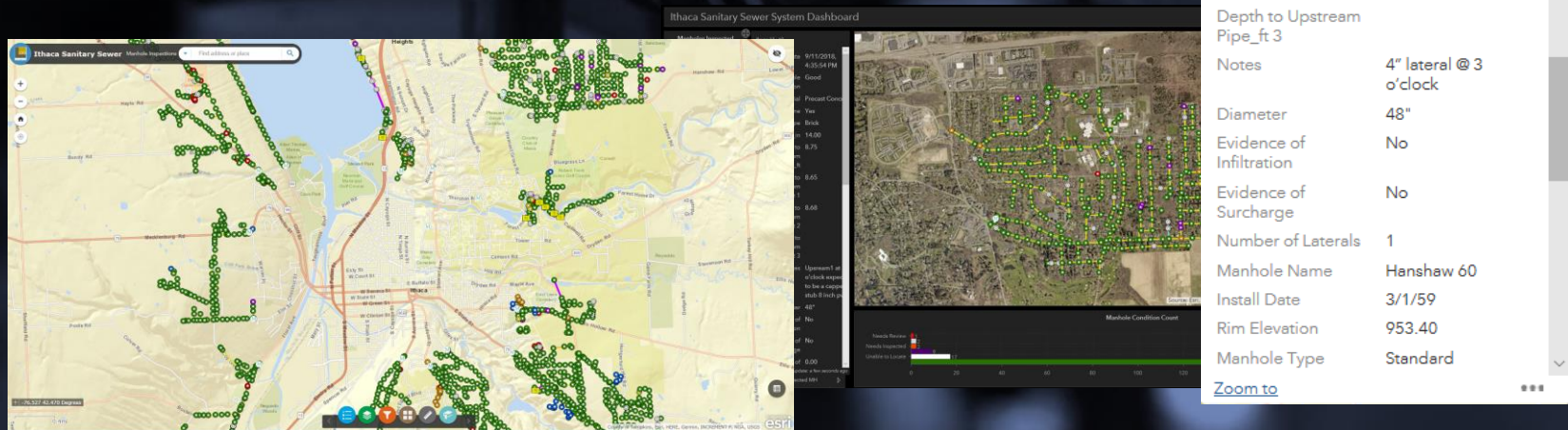


Goals of Project

1. Manhole Inspections
2. Improve Town Mapping
3. Assess current system capacity
4. Assess Future system capacity
5. Identify Areas where there are capacity problems
6. Recommend corrective actions to address current and prepare for future needs

What is needed to meet project goals

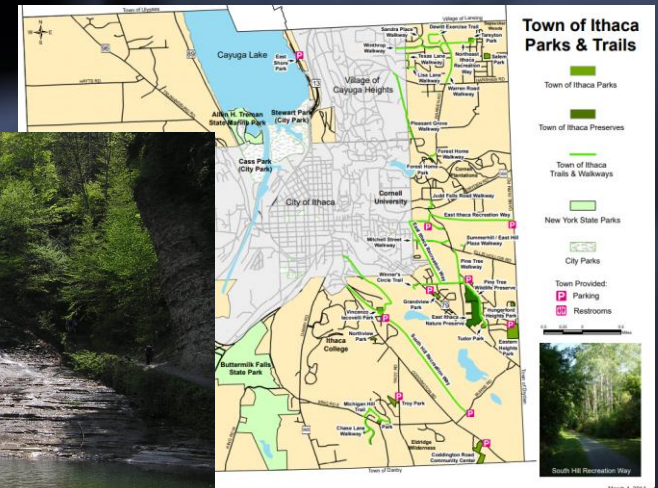
1. Water usage data
2. Flow meters
3. Parcels / comprehensive plan and build out scenarios
4. Inspections (materials, diameter, condition, inverts to pipes, evidence of surcharging etc....)
5. Existing GIS data from Town of Ithaca
6. Survey data to capture X,Y,Z accuracy requirement to a 1/10 of a foot
7. Inflow and Infiltration numbers



Looked at a few options and found that building the solution using GIS software would work best for this project

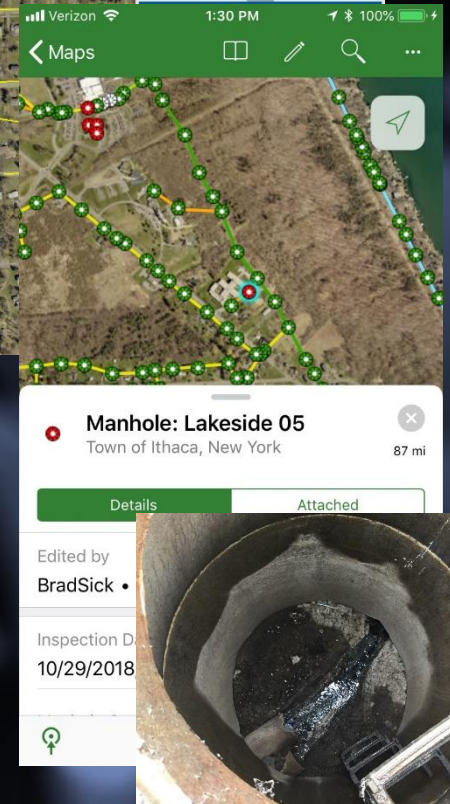
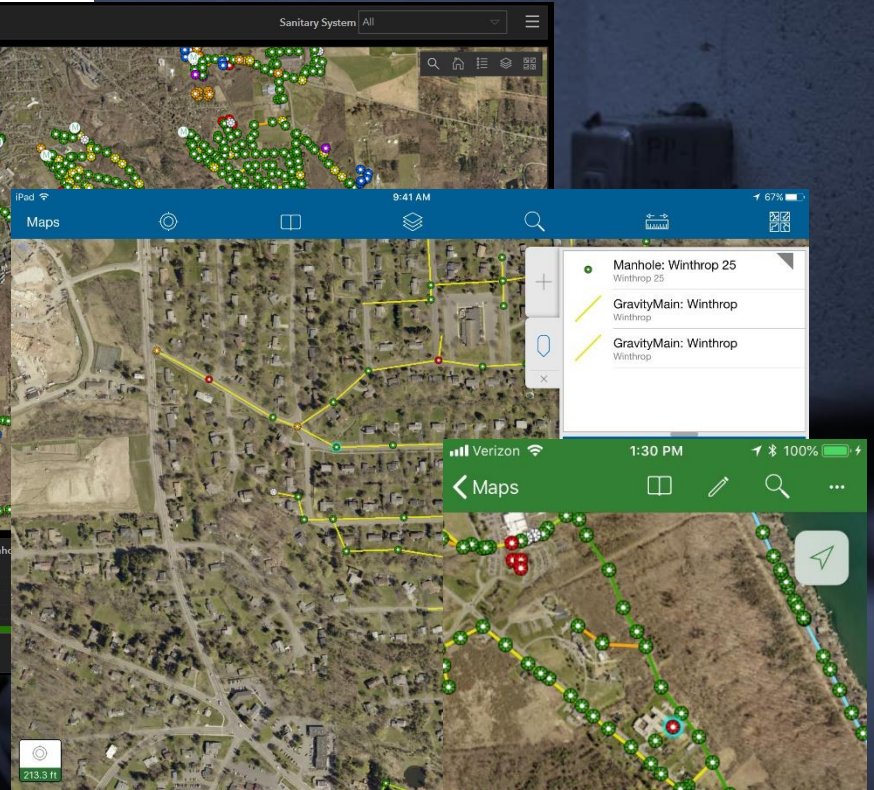
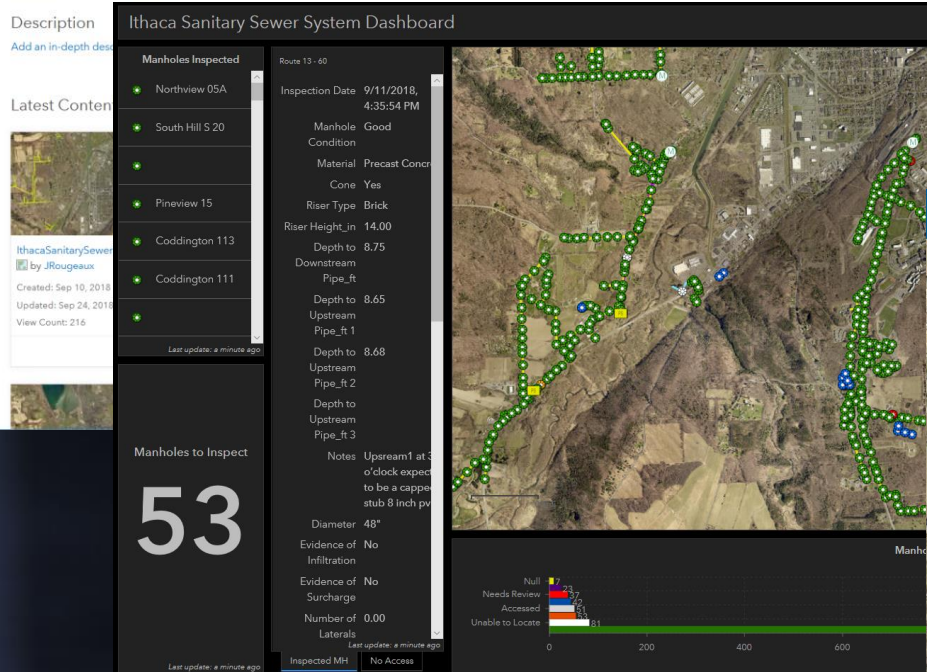
Used enterprise ArcGIS server / SQL database

- Very involved client (Ithaca liked to be very hands on throughout the project)
- Looked at modeling software, but prices versus our project budget was an issue
- It was easy to share information through ArcGIS Online
- Enhanced communication (client knew where our field crews were)
- set up dashboards, and web apps for clients to access info, monitor, and track collection progress
- Shared feature services through AGOL with the client to address issues and write back





Dynamic Workflows Enhanced Communication

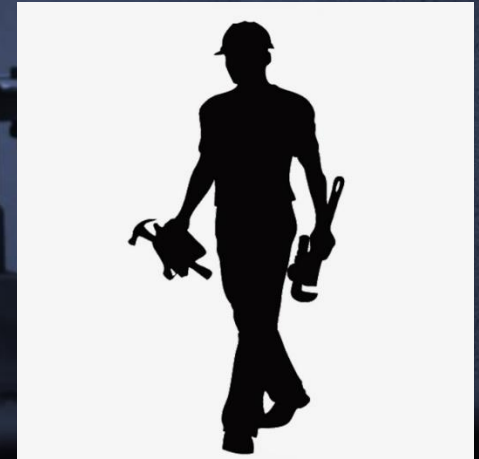


1. Publish maps out to Portal and ArcGIS Online
2. Inspections (locate manholes)
3. Flag issues / unable to access
4. Town staff uses apps to address issues, locate missing, and gains access to manholes
5. Survey staff uses Explorer to locate manholes

GIS Professional



Town Worker



FIELD WORK FLOW

Web GIS

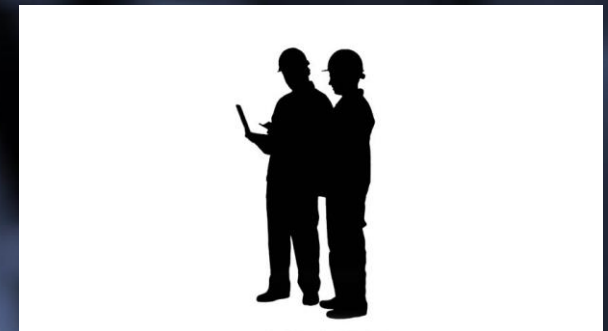


Survey Crew



Mobile GIS

Inspections



PROCESSING AND BUILDING OUT DATA

Survey pick up RIM elevation = z value to 1/10 ft accuracy

We measured invert looking for depth of Upstream and Downstream

Move existing data (inspection data) to survey data. Split pipes at manholes

Automation Collected data used throughout the entire process

- Inverts used in slope
- Type used for roughness
- Diameter used for capacity
- Length used in slope and capacity



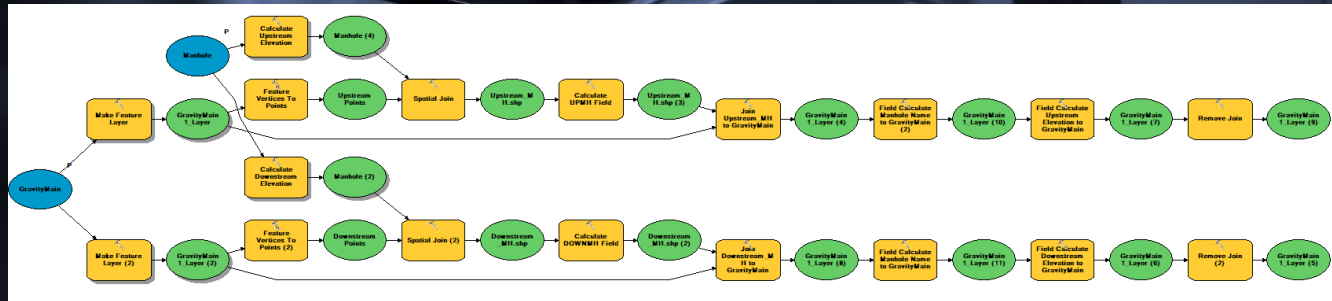
Preparing the data

Manning's Equation:

$$Q = \frac{1}{n} \times (D)^2 \times \left(\frac{D}{4}\right)^{\frac{2}{3}} \times \left(\frac{USI-DSI}{L}\right)^{\frac{1}{2}} \times 523.82$$

Push Manhole information over to gravity mains

Automation



Slope

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$



Capacity

Manning's Roughness Coefficients		
Asbestos Cement	0.011	
Cast Iron	0.014	
Clay Tile	0.013	
Ductile Iron	0.013	
Polyvinyl Chloride	0.010	
Steel	0.012	
Vitrified Clay	0.015	
Concrete	0.015	

GEOMETRIC NETWORK

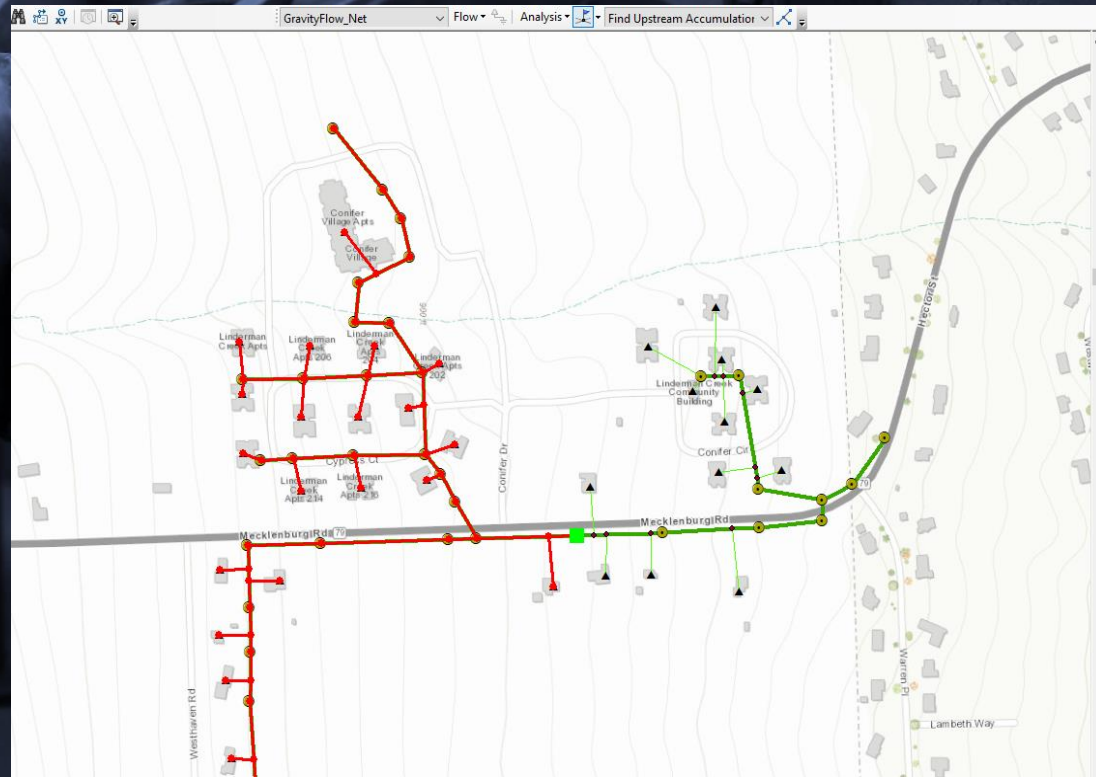
Populate service connection with a peak discharge number GPM

Build out Geometric network

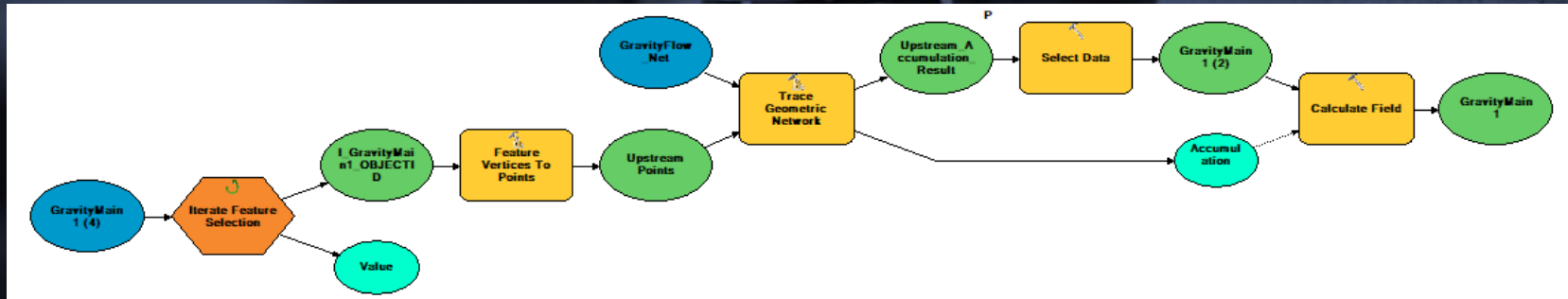
Upstream traces and accumulations to determine what the peak flow would be on that given pipe section.

Run this on existing data to determine the current flow vs. the capacity.

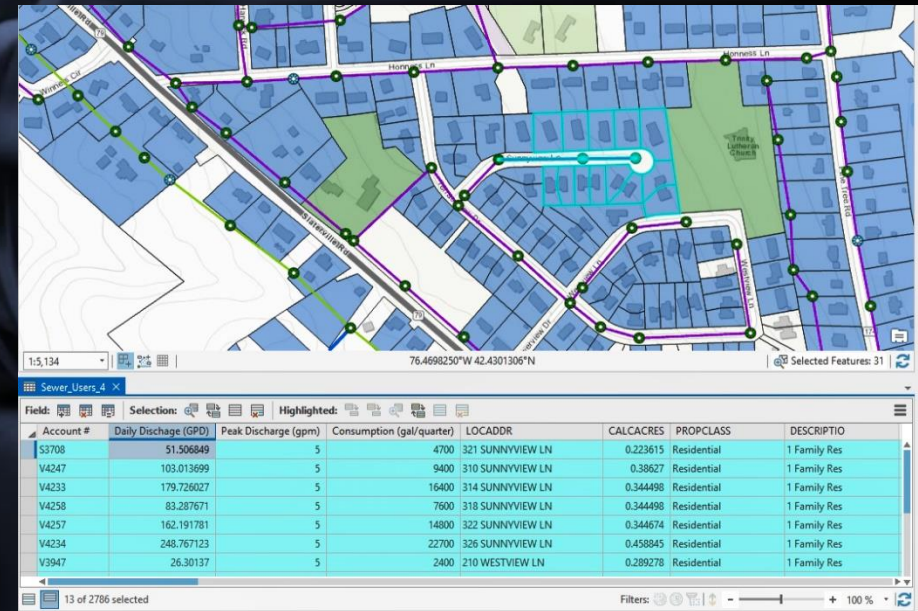
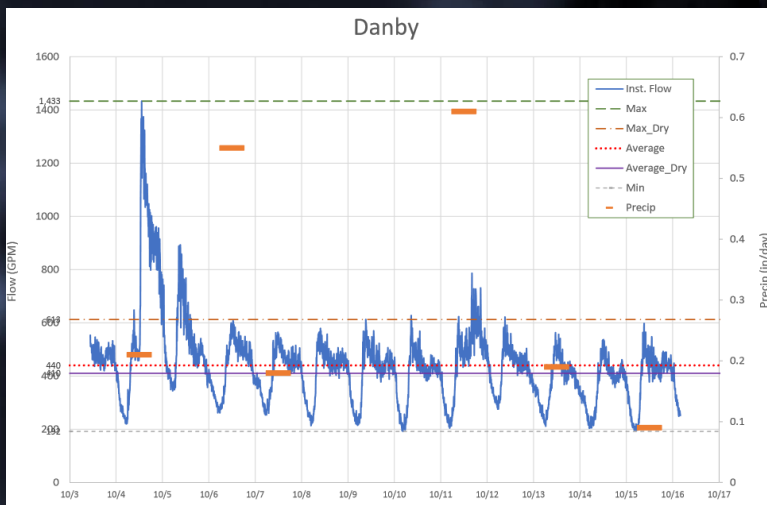
Drop a point at the end of a line, connect the lateral, and populate what a new subdivision would contribute. This would return the future flows vs. the capacity.



FLOW DURING PEAK DISCHARGE AUTOMATE



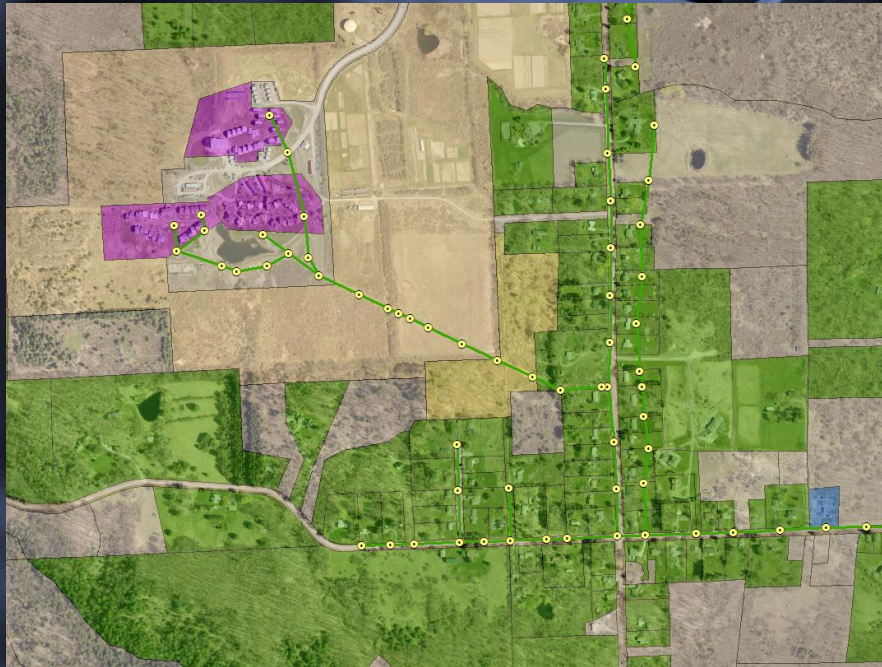
Unique Inflow and infiltration number
GPM / Per foot of Pipe based upon
flow meter data and some other
information



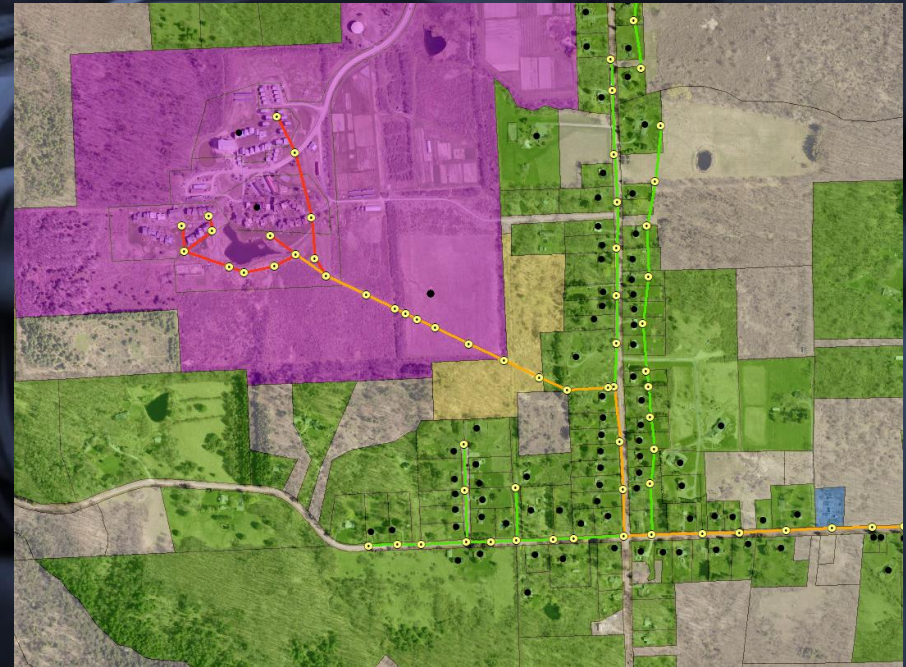
Water usage data
tied to parcel /
structure data

ANALYSIS RESULTS

Current



Future



ROI

- Benefit of collecting data that gets fed into the GIS model ... a seamless flow of data
- Explore different build out scenarios
- Help planners understand the complexity and the capacity of underground networks
- See key areas that will act as a bottle neck and plan for capital expenses
- Helps everyone make more informed data driven decisions



EXAMPLE TVMA (SURVEY 123 APPLICATIONS)



THE PROBLEM

- The problem is there is a lot of illegal connections on this part of the sewer system during a moderate rain event the pump station reaches capacity, causing a lot of wear and tear extra maintenance costs, and overflow issues

THE SOLUTION

The screenshot displays a mobile application interface for 'TVMA Inspection Dashboard'. The app is running on a device with a Verizon carrier, 2:56 PM, and 100% battery. The interface is divided into several sections:

- Top Bar:** 'Drainage Area' dropdown set to 'All'.
- Left Panel:**
 - Infractions of 60+ days:** A list of addresses with red dots indicating infractions: 555 Mockingbird Ln, 22 Robin Rd.
 - Most Recent Inspections:** A list of addresses with green dots indicating recent inspections: 441 main st, 1177 creek side Ln, 47 Lowe St, 123 Maple St, 1234, 229 Nelson st, Foggy, 460 long lane, jersey shore pa, 1234 market st, 1234, 1234 Matt St, 3 Earnhardt Ln, 999 Poplar Ave, 123 1st St, 111 Maple St.
 - Total Inspections:** A large display showing '19'.
- Map:** A satellite map showing the inspection area. A pop-up window displays details for a specific inspection:
 - Name:** Matthew Kalcich
 - Sump Pump:** Yes
 - Sump Pump tied to Sewer:** No
 - Down Spout tied to Sewer:** No
 - Floor Drain tied to Sewer:** No
 - Water Evident in Basement:** No
 - Dye Inspection:** No
 - Type:** Polyvinyl Chloride
 - Roots:** No
 - Condition:** Good
 - Inspection Date:** 11/7/2018, 7:59 PM
 - Notification Date:** 11/7/2018, 7:59 PM
 - Follow Up Date:**
 - 2nd Inspection Date:**
 - Status:** OK
- Right Panel:**
 - TVMA_Property_Inspections:** The app's logo and name.
 - Basement Inspection:** A detailed view of the inspection results.
 - Sump Pump:** ☒ Yes, ☐ No
 - Sump Pump tied to Sewer:** ☒ Yes, ☐ No
 - Down Spout:** ☐ Yes, ☒ No
 - Floor Drain t:** ☒ Yes, ☐ No
 - Photo:** A photo of the basement interior with a red circle highlighting a 'Connection ok'.

- **Solution use GIS to notify property owners of inspection**
- **Use Survey 123 to quickly assess basement and laterals**
- **Use Operations Dashboards to manage the project, track infractions, progress, and to be notified when an action needs to be followed up on.**

THE PROCESS

- Start from existing GIS data
- Define questions
- Set up Survey 123 forms
- perform basement and lateral inspections with Survey 123 app
- ArcGIS Online
- Operations dashboards where manager can access data, get prompted on an action, and reference the infractions

The screenshot shows a mobile application interface for 'TVMA_Property_Inspections'. At the top, the status bar shows 'Verizon', signal strength, Wi-Fi, time '3:12 PM', and battery '99%'. The app header is green with a white 'x' icon and the title 'TVMA_Property_Inspections' followed by a hamburger menu icon. The form contains several sections: 'Drainage Area' with a radio button selected for 'Railroad Street'; 'Name' with a text input field containing 'Matthew Kalcich' and a clear 'x' button; two expandable sections, 'Basement Inspection' and 'Lateral Inspection', each with a right-pointing triangle icon; 'Inspection Date' with two dropdown menus showing 'ember 8, 2018' and '3:11 PM' and a clear 'x' button; and 'Notification Date' with two dropdown menus showing 'mber 12, 2018' and '3:11 PM' and a clear 'x' button. A green bar at the bottom features a white checkmark icon.

Verizon 3:12 PM 99%

TVMA_Property_Inspections

Drainage Area
☒ Railroad Street

Name
Matthew Kalcich

Basement Inspection

Lateral Inspection

Inspection Date
ember 8, 2018 3:11 PM

Notification Date
mber 12, 2018 3:11 PM

RETURN OF INVESTMENT

The authority did this very project with paper 10 years ago

- When folks got around to it they inspected a property (no structure)
- No action or follow up was taken on any of the infractions
- All of the paper documents have since been lost
- Hundreds of manhours and tens of thousands of dollars was wasted.
- Pumps got worse and had to be repaired
- Quick inspections, less disruptive to property owner
- Take detailed photo of an infraction
- These applications will save time in the field, organize data, track progress, and remind staff when an action needs to be taken on an infraction.





Larson Design Group®

**GIS APPLICATIONS
FOR
WATER/WASTEWATER
OPERATIONS:
MAKING DATA WORK
FOR YOU**

Mkalcich@Larsondesigngroup.com

Phone: 570-323-6603 x 3422

www.larsondesigngroup.com

**MATTHEW KALCICH
GIS ANALYST**

QUESTIONS

