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CONSULTING ENGINEERS SINCE 1915

STORMWATER ASSET MANAGEMENT:

THE ROLE OF GIS IN ASSET MANAGEMENT

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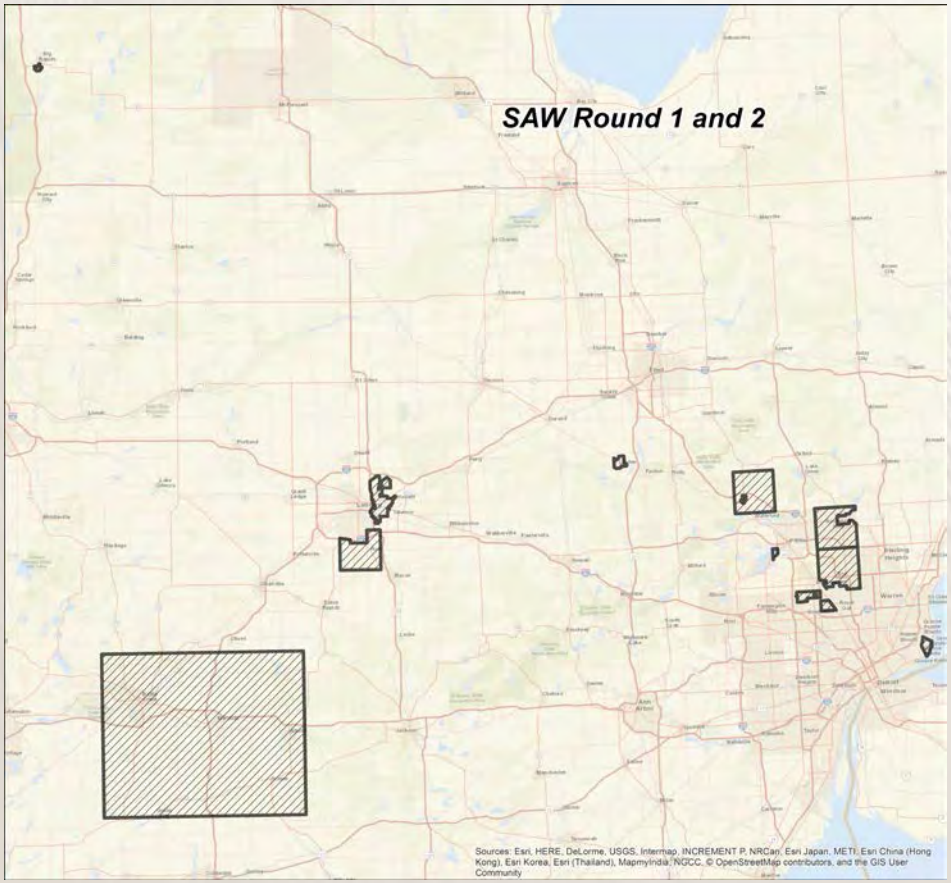
PROJECT LOCATIONS



Berkley
Village of Beverly Hills
Calhoun County
Delhi Township
East Lansing
Ferris
Grosse Pointe Farms
Independence Township
Linden
Rochester Hills
Sylvan Lake
Troy

CITY OF SYLVAN LAKE

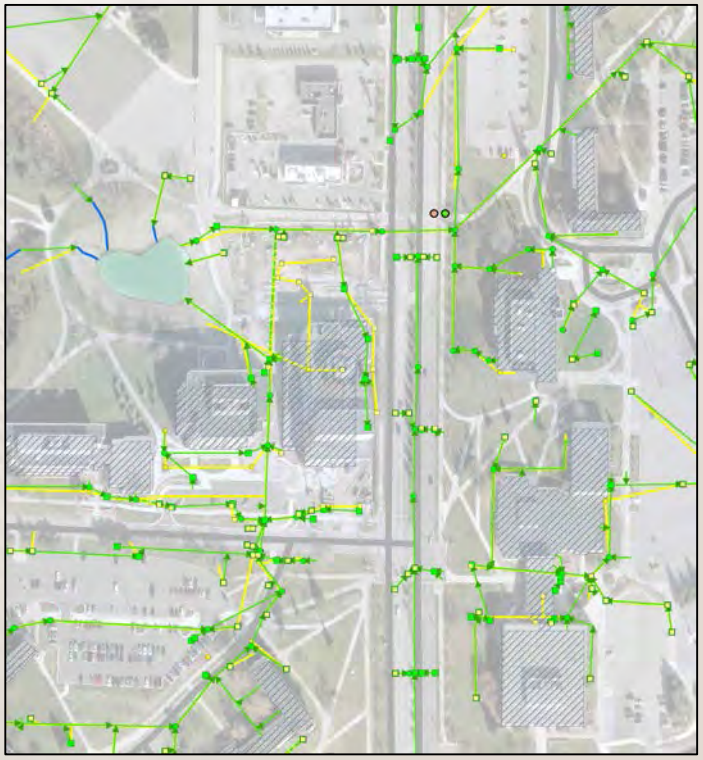
- GIS database for storm sewer:
  - Original GIS database was very incomplete
  - The entire City was mobile mapped (laser scanned) to develop the base for the structures
  - As-built plans utilized to complete the GIS
  - Manhole Inspections updated structure information
  - Televising information updated piping information

CITY OF TROY

- Established Robust GIS System and Practices:
  - Large dense area
  - GPSed with <.15 ft accuracy
  - City Supplied Mobile App for Inspections
  - Live Updates
  - Opted out of using a standard NASSCO inspection form

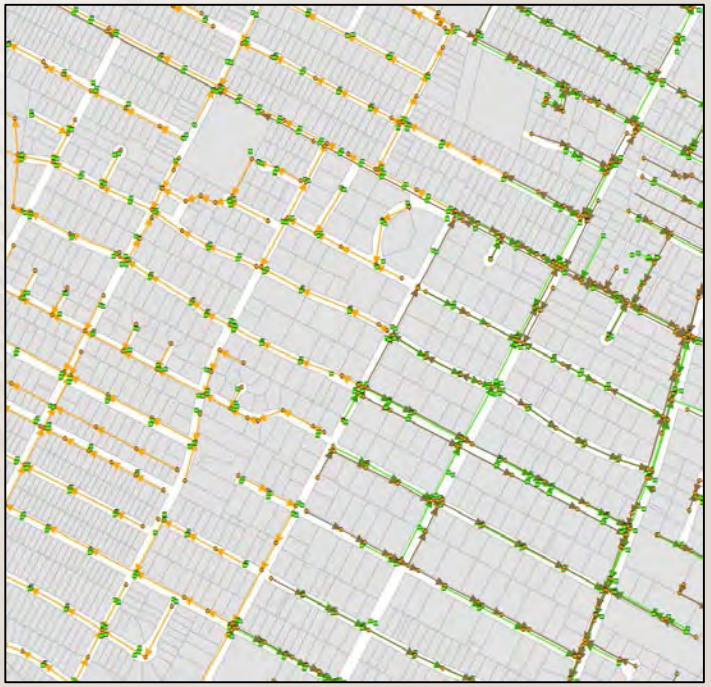
FERRIS STATE UNIVERSITY

- Project Included:
  - Original GIS database was in a SQL/AutoCAD program
  - A Primary Goal was to update GIS
  - Ongoing Pipe Maintenance during GIS development
  - Asset Management Plan determined by Engineers using Excel instead of GIS



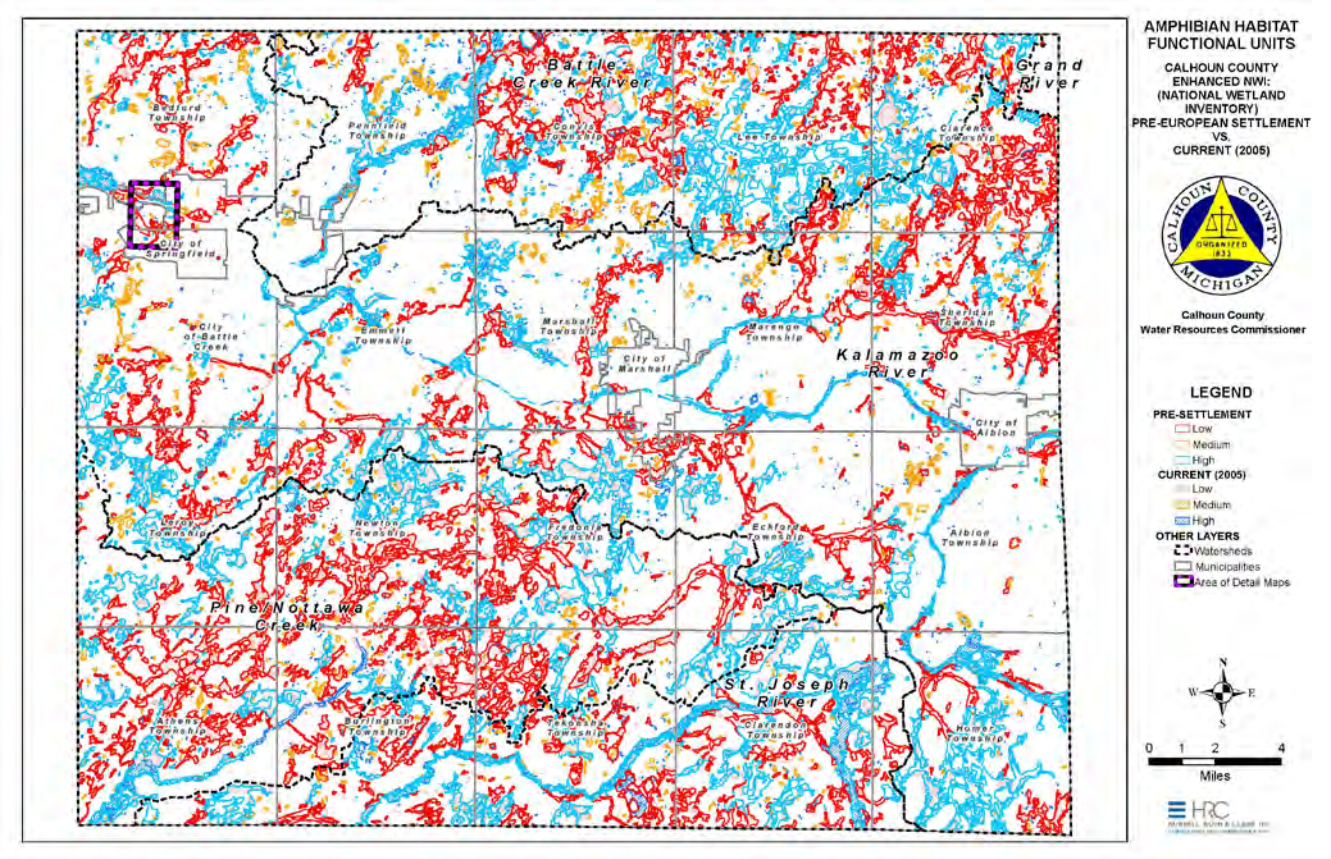
GROSSE POINTE FARMS

- Project Included:
  - Old combined system in half of City
  - Recently (1999) separated system in other half of City
  - Provided contractor with web map to use for CCTV inspections



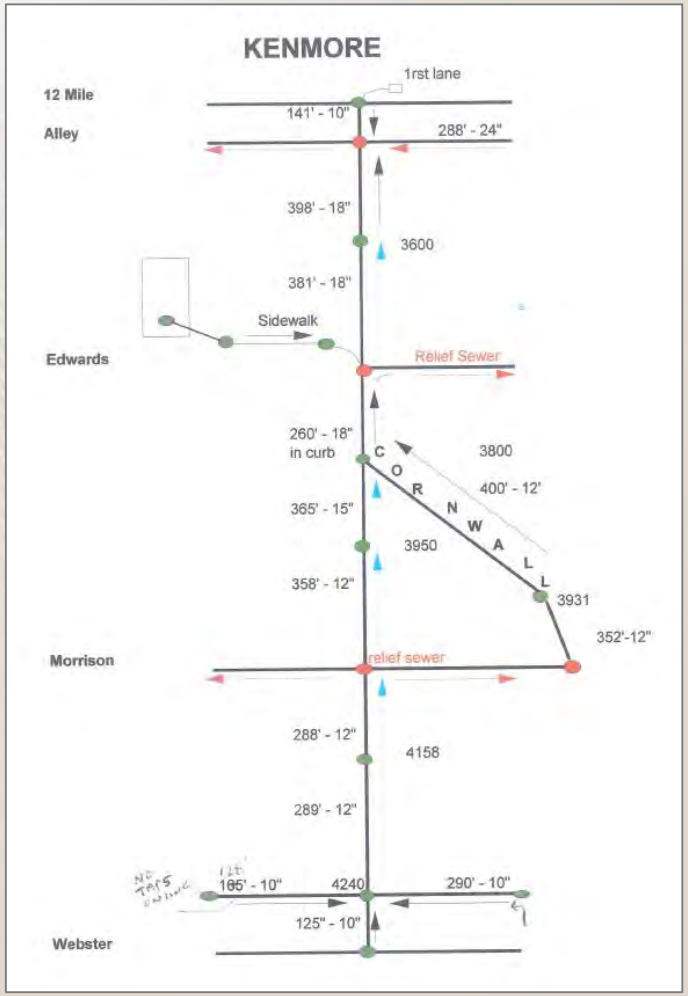
CALHOUN COUNTY

- Drain Inspections
- Drainage District Delineation
- Storm Water Management Plan
- Drainage Guide
- Enhanced National Wetland Inventory



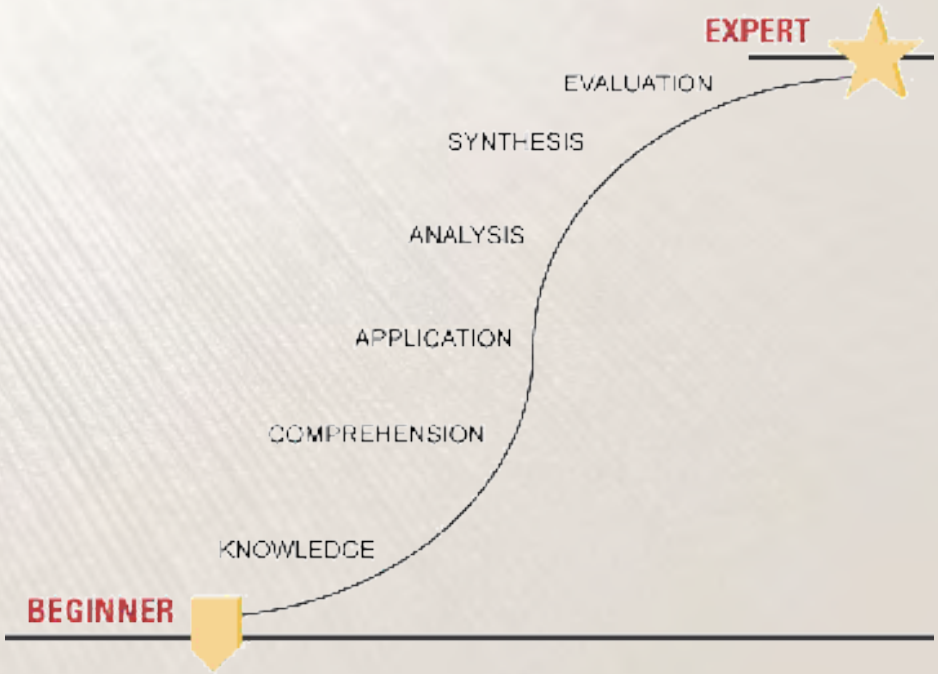
BERKLEY

- Project Included:
  - Google Maps used for initial maps for GPS crew
  - Digitized entire sewer system based primarily on Google Street View, field maps, and field work
  - Locate CIPP candidates



HUGE LEARNING CURVE

- Collector
- NASSCO forms/db
- CCTV data
- Models
- Communication
- Revise, Revise, Revise
- Document Everything

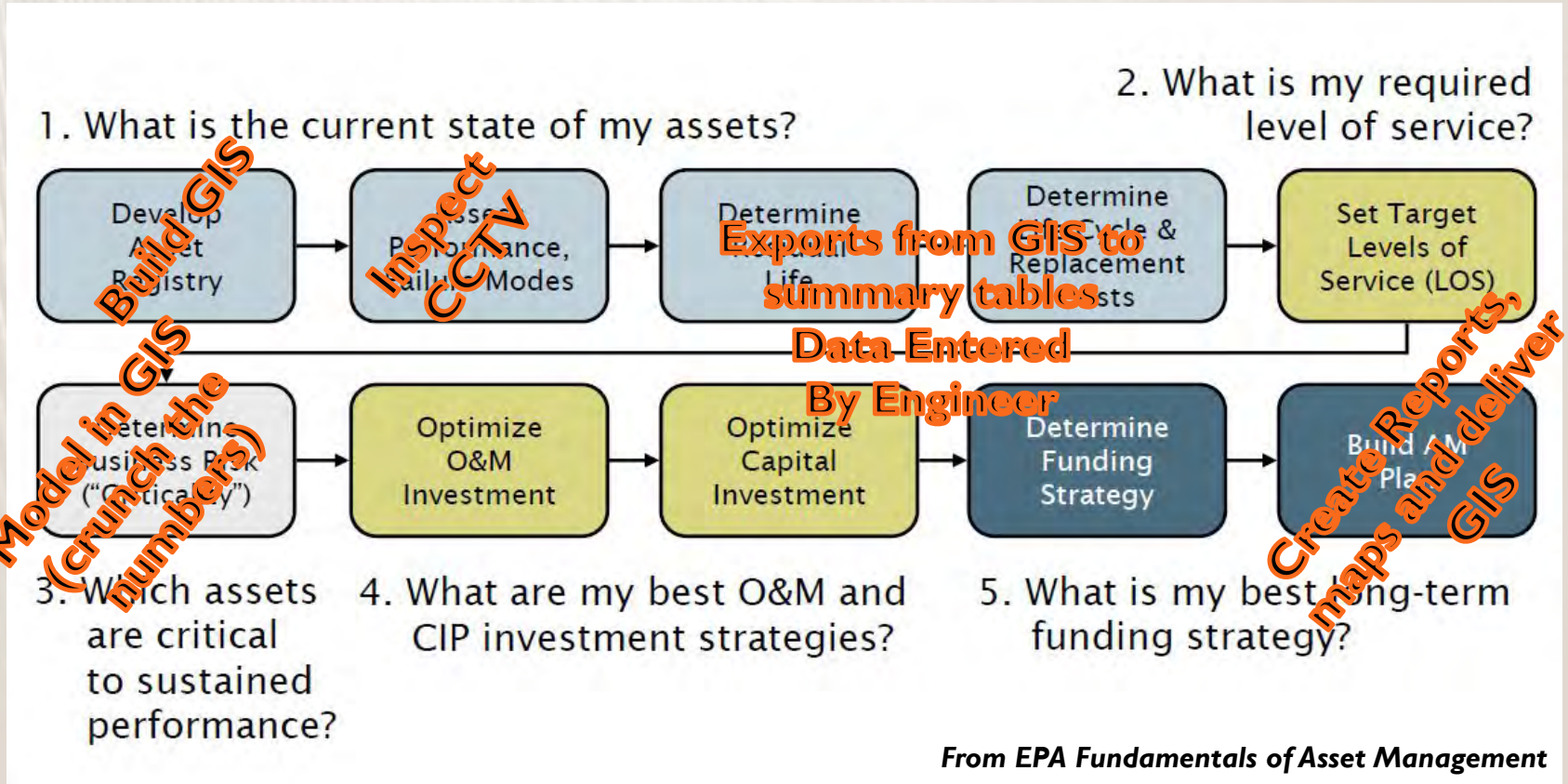


BASIC PROCESS

- Meetings, Communication – try to be involved in all aspects related to GIS or data used in GIS
- GIS/Maps/GPS – try to get the best base to start with
- Inspections – what app/software/who/when
- CCTV – GIS needs direct contact with crew, GIS extension very helpful
- Models/Excel/GIS vs Engineer – who will crunch numbers
- Reporting – maps, summaries, tables, data dictionary
- Deliver to Client – data, collector maps, dashboards, training, Asset Management Plan

ASSET MANAGEMENT

- Develop Asset Management Plan for Sanitary and Storm Sewer Collection Systems: (from the Engineers Perspective)

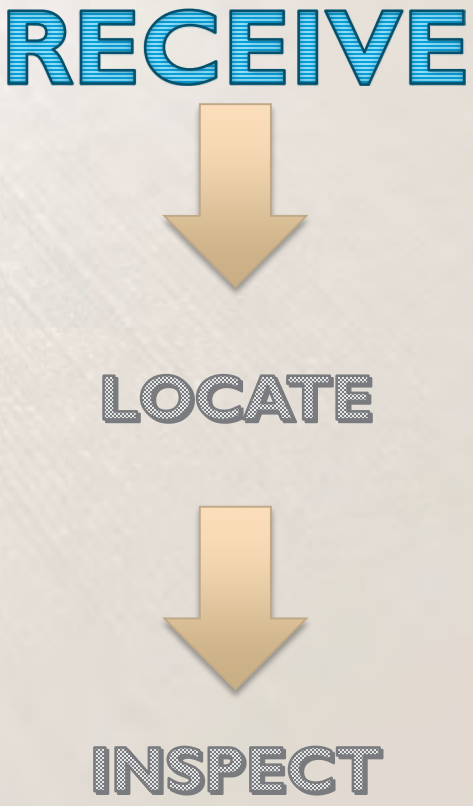


From EPA Fundamentals of Asset Management

GIS IS THE KEY

FIELD WORK PREP

1. Receive GIS from client
   - Usually a geodatabase
   - Occasionally CAD
   - Sometimes NONE!
   - Assess the data
     - Accuracy
     - Completeness
     - Sufficient ID's?



ASSESSMENT OF DATA

AssetID	Diameter	Depth	Material & Pipe Class	In Service Year
S11709	10	7.5647	PVC Truss/ASTM 2640	2016
S11708	10	6.9713	PVC Truss/ASTM 2640	2016
S11707	54	<Null>	PVC Truss/ASTM 2640	0
S11706	27	<Null>	PVC Truss/ASTM 2640	0
S11705	54	<Null>	PVC Truss/ASTM 2640	2012
S11704	27	<Null>	PVC Truss/ASTM 2640	<Null>
S11703	27	<Null>	PVC Truss/ASTM 2640	0
S1170[illegible]	[illegible]	<Null>	PVC Truss/ASTM 2640	0
S1170[illegible]	27	<Null>	PVC Truss/ASTM 2640	<Null>
S1170[illegible]	[illegible]	<Null>	PVC Truss/ASTM 2640	<Null>
S11699	54	<Null>	PVC Truss/ASTM 2640	0
S11698	27	<Null>	PVC Truss/ASTM 2640	0
S11697	54	<Null>	Reinforced Concrete/C76-IV	<Null>
S11696	48	<Null>	Reinforced Concrete/C76-IV	<Null>
S11695	27	<Null>	Reinforced Concrete/C76-IV	<Null>
S11694	42	<Null>	Reinforced Concrete/C76-IV	<Null>
S11693	30	12.7	Reinforced Concrete/C76-IV	<Null>
S11692	42	<Null>	Reinforced Concrete/C76-IV	<Null>
S11671	10	9.8556	ABS Truss/ASTM 2640	1966
S11670	10	11.1757	ABS Truss/ASTM 2640	1998
S11669	10	10.1337	ABS Truss/ASTM 2640	1998
S11668	8	11.669	PVC Truss/ASTM 2640	2016

100% 97% 35% 65% 40%

FIELD LOCATION

2. Various methods of collecting a structures location.

- Survey grade GPS
- Google Street View
- Use of photos
- As-Builts
- Mobile Lidar

SURVEY GRADE GPS

- Most SAW GPS work was done using survey grade GPS units.
- Connects to CORS towers
- Receives RTK corrections
- 99% of GPS points collected where within 0.15 ft accuracy

GOOGLE STREET VIEW

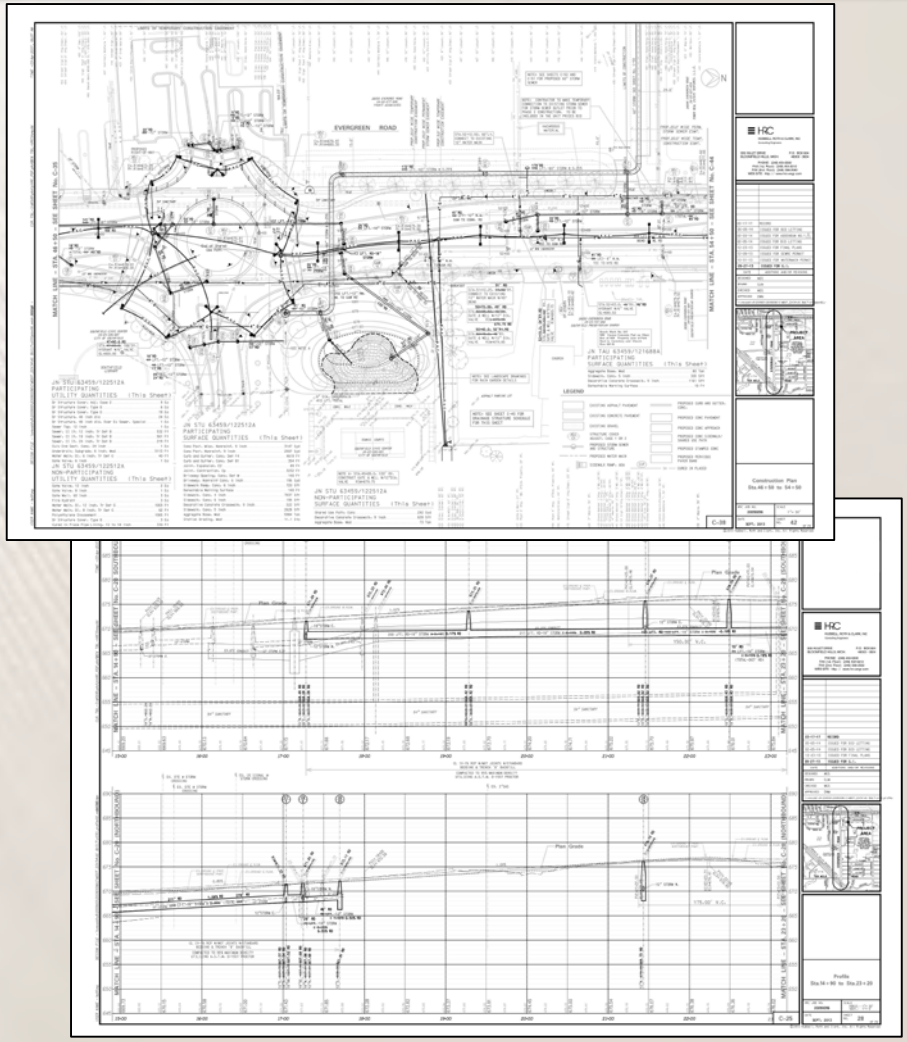
- Used to assist in heads up digitizing
- Good starting point if data is missing in GIS
- Good for collecting X & Y but not Z
- Followed up with GPS

LOCATION PHOTO

- A photo is taken during the inspection that shows the structure and a near by land mark
- The landmark is found in the aerial and the structure is placed in reference to its location in the photo
- Client found CCTV work to be a higher priority than GPS

AS-BUILTS

- Useful for populating other attribute information
- Allows us to view the other surrounding utilities
- Profiles can be used to verify elevations and flow



MOBILE LIDAR

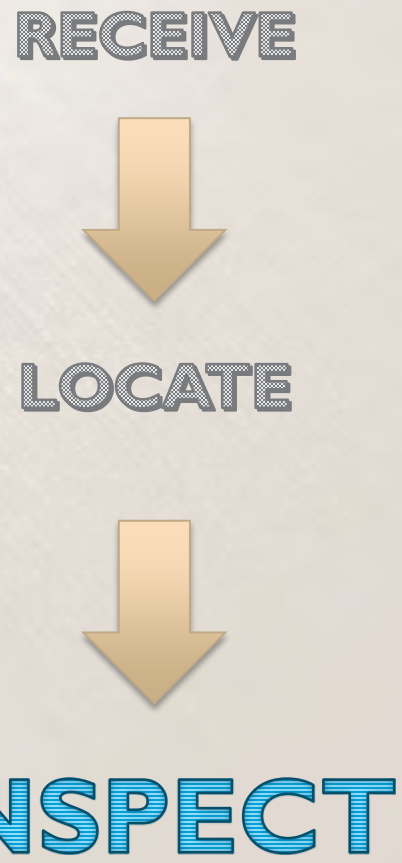
- Mobile Lidar Scanning
  - Creates point cloud data
  - Scans everything within range
  - Extract utility data through

    AutoCAD/Microstation
  - Level of accuracy

    Map grade – Survey Grade

METHODS OF COLLECTION

- Collector for ArcGIS
  - Provide clients with own user names for personal access
  - Create dashboards to show project status
- Used custom made apps
  - Allowed for live access to clients network



MACP INSPECTIONS

- Typically use a hybrid version of both NASSCO's level 1 and level 2 inspections
- Examples of additional fields used

Chimney depth

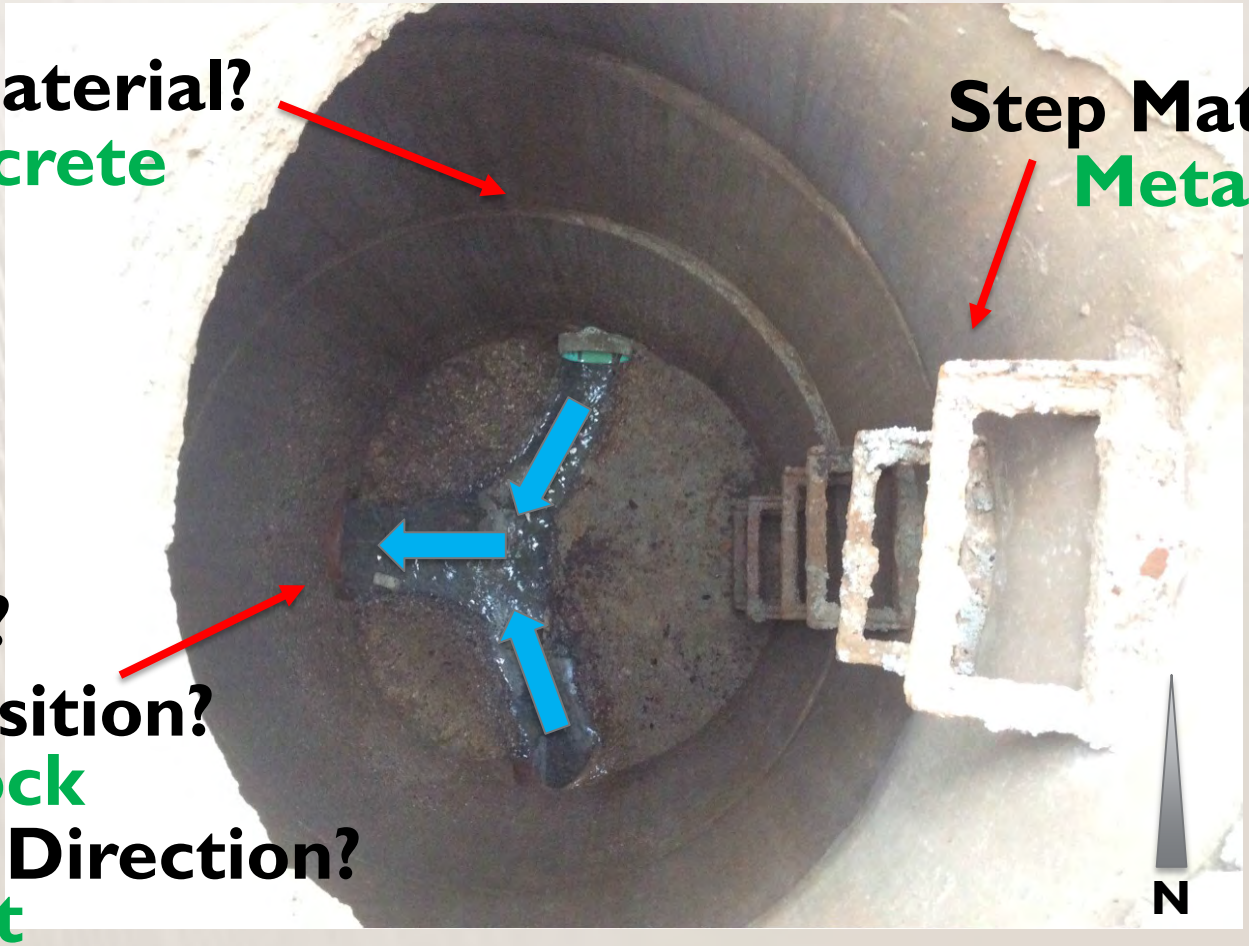
Chimney condition

Cone condition

Wall diameter

Pipe cardinal direction

A PEAK INTO A SEWER



Wall Material?
Concrete

Step Material?
Metal

Pipe 1?

Clock position?
6 o'clock

Cardinal Direction?
West

ADDITIONAL DATA

- In order to perform the final analysis some additional GIS data is needed.
  - Soil
  - Road centerline
  - Hydrology
  - Critical Areas
  - Pervious/Impervious
  - Zoning

ANALYSIS DIFFERENCES

- The final variables that will be used in the analysis are dependent on the client.

	AGE	DEPTH	DIAMETER	MATERIAL	SOIL	SURFACE COVER	CRITICAL AREA	NEAR WATER	NEAR RAILROAD	LOCATION
POINT PLACE	X	X	X	X	X	X	X			
BIKINI BOTTOM	X	X	X	X	X	X	X	X	X	
SUNNY TOWN		X	X			X	X			X

ANALYSIS DIFFERENCES

Grosse Pointe Farms

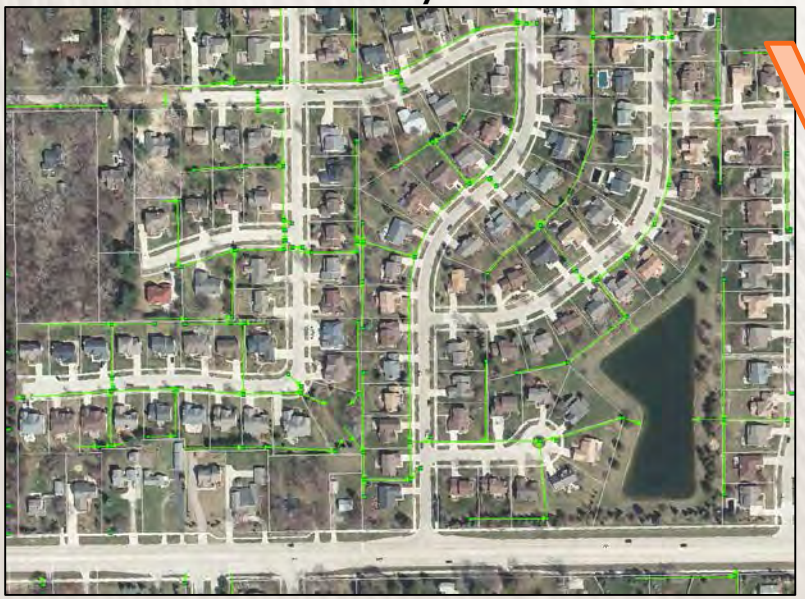
VS

Berkley

The location of natural features can effect the analysis model

ANALYSIS DIFFERENCES

Troy



VS

Linden

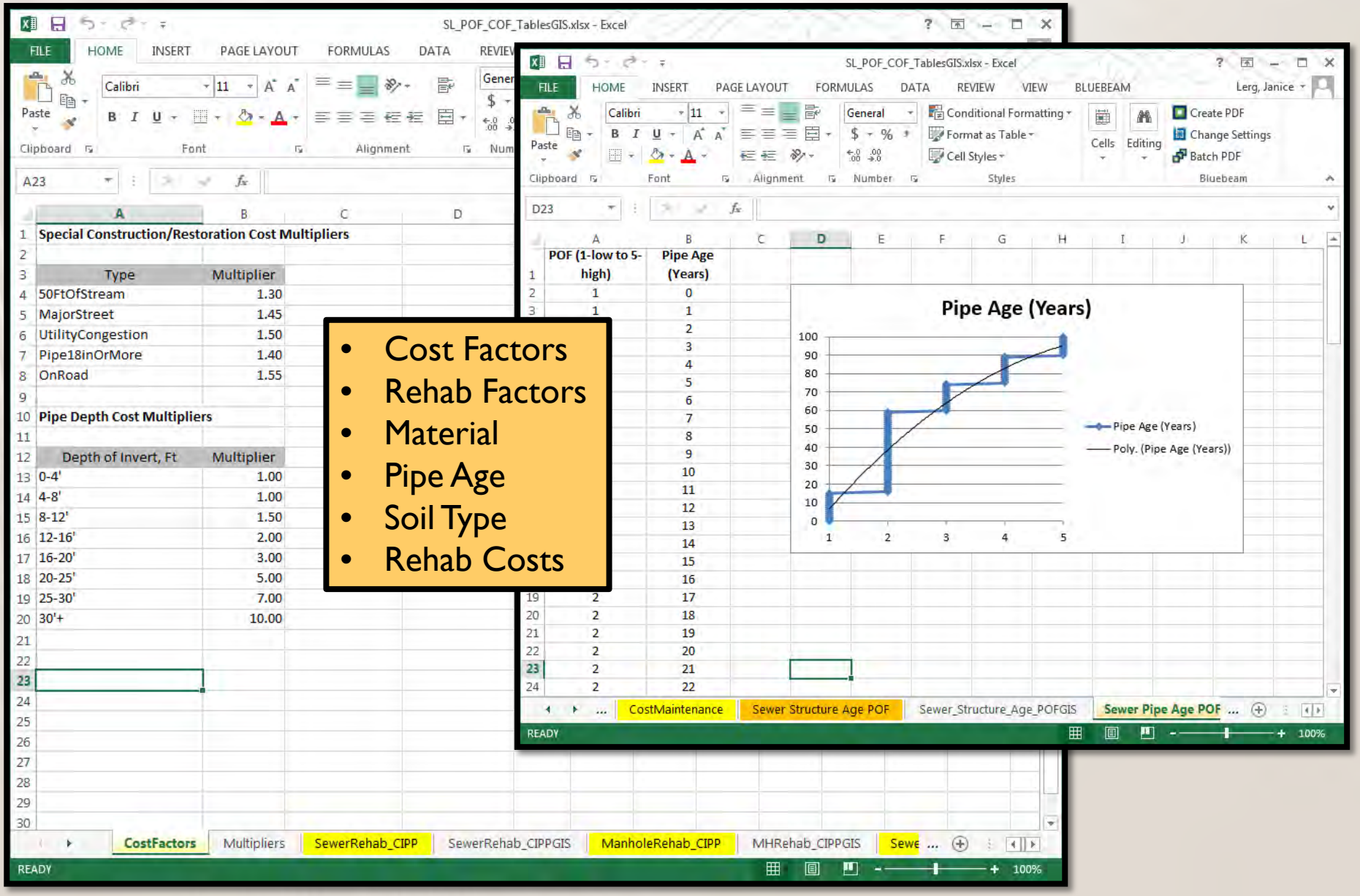
The location of the sewer structures can effect the analysis model

GIS IS THE KEY

CONDITION/CRITICALITY

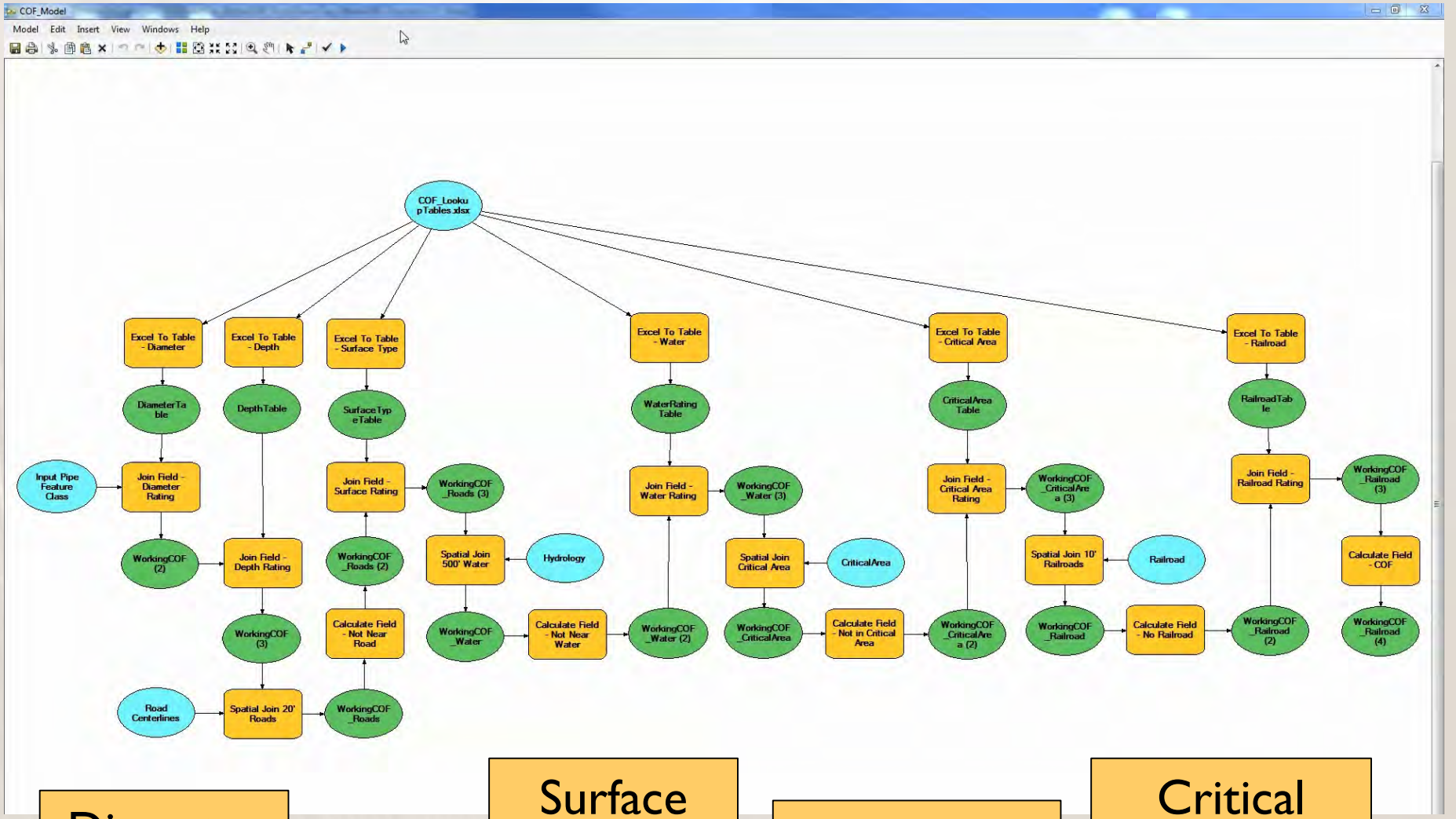
- Condition of asset used to estimate **Probability of Failure (POF):**
  - May include factors such as age, soil type, material of construction, CCTV scores
- Criticality determined to estimate **Consequence of Failure (COF):**
  - May include location (surface water, railroad), surface type (road/grass), customers/flow, critical areas
- Business Risk Evaluation **(BRE)** = POF x COF

Using GIS to develop POF/COF/BRE:



- Cost Factors
- Rehab Factors
- Material
- Pipe Age
- Soil Type
- Rehab Costs

Using GIS Model Builder to develop COF:



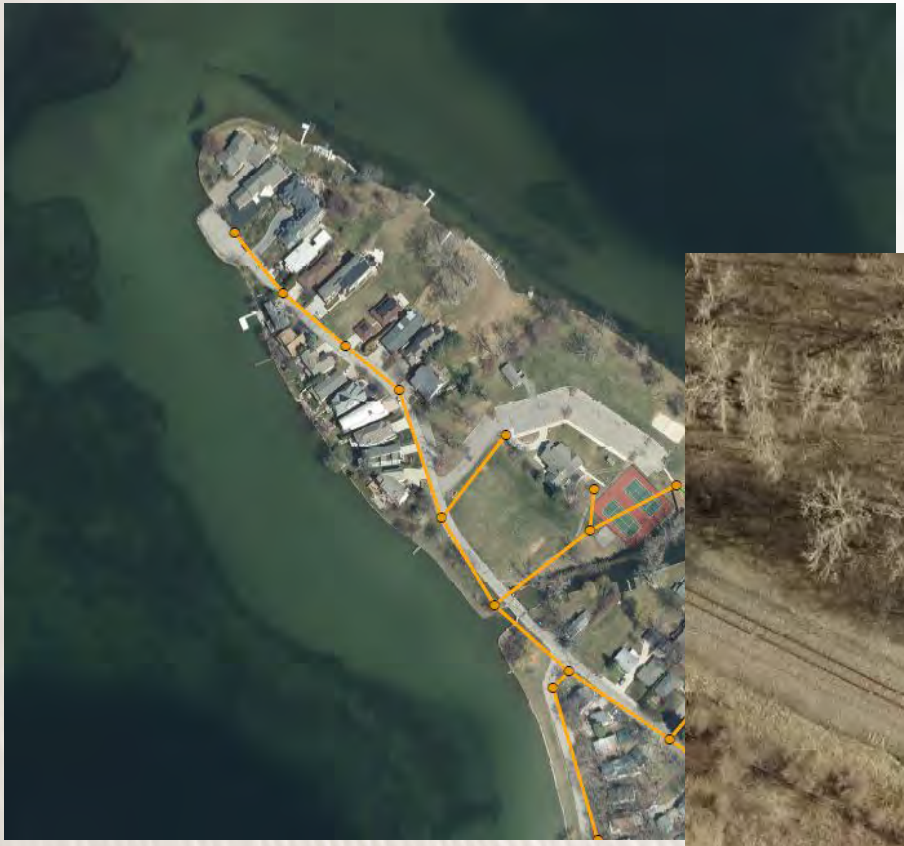
Diameter

Depth

Surface Type

Proximity to Water Body

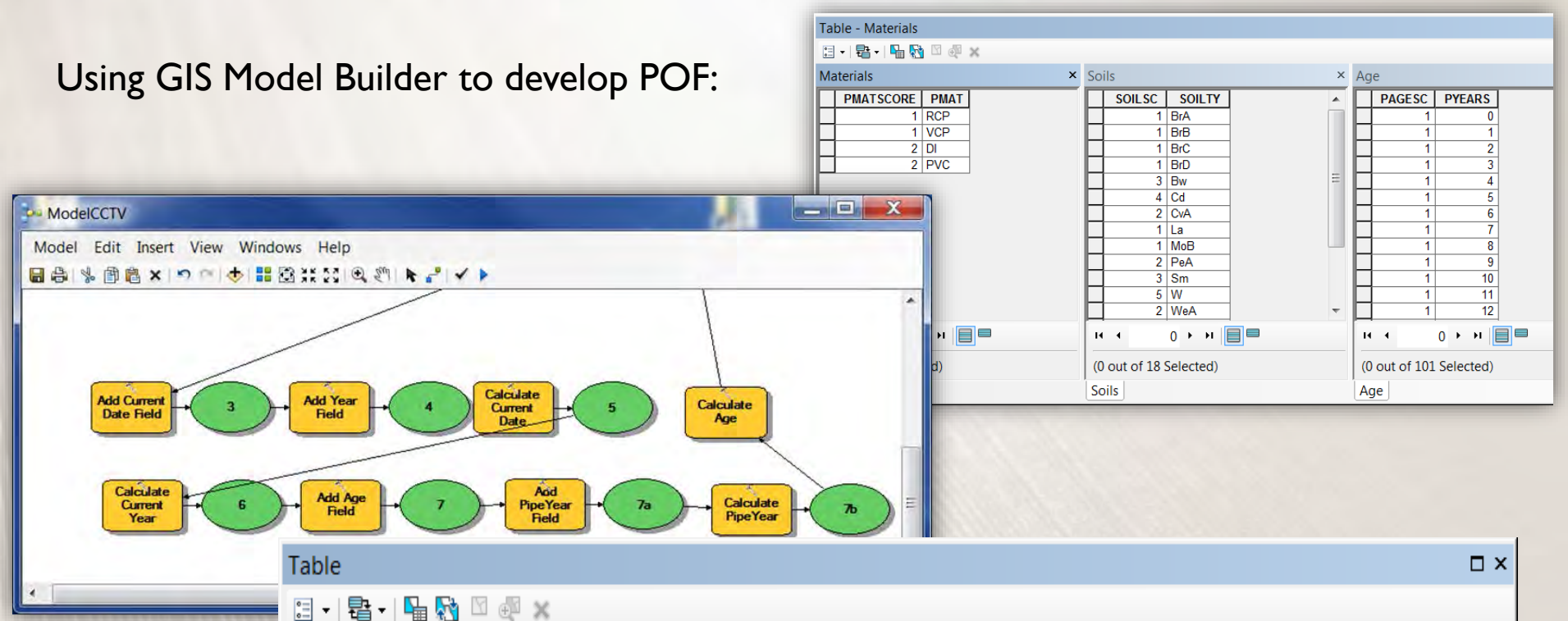
Critical Areas



Close to Water

Near Railroad

Using GIS Model Builder to develop POF:



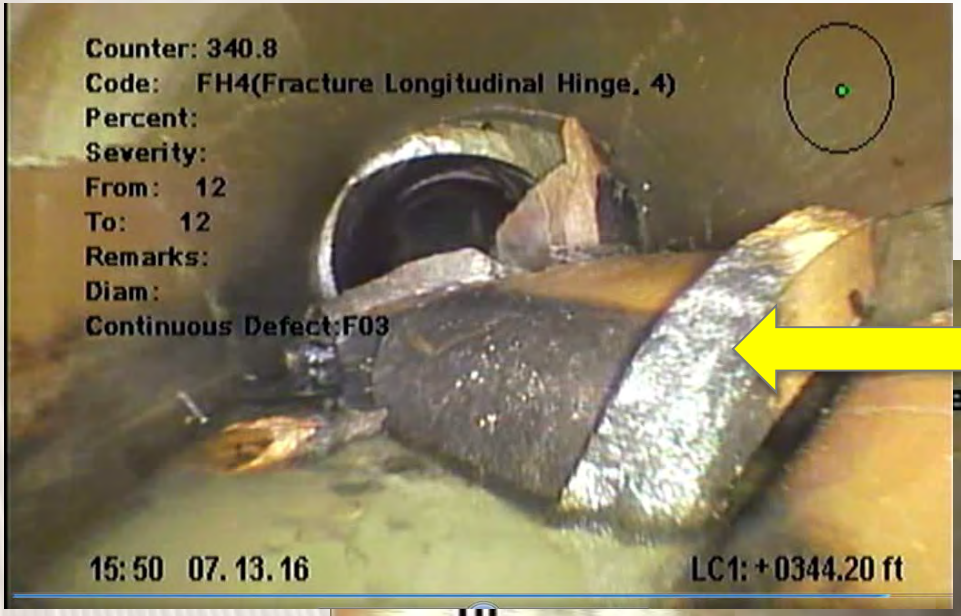
Table

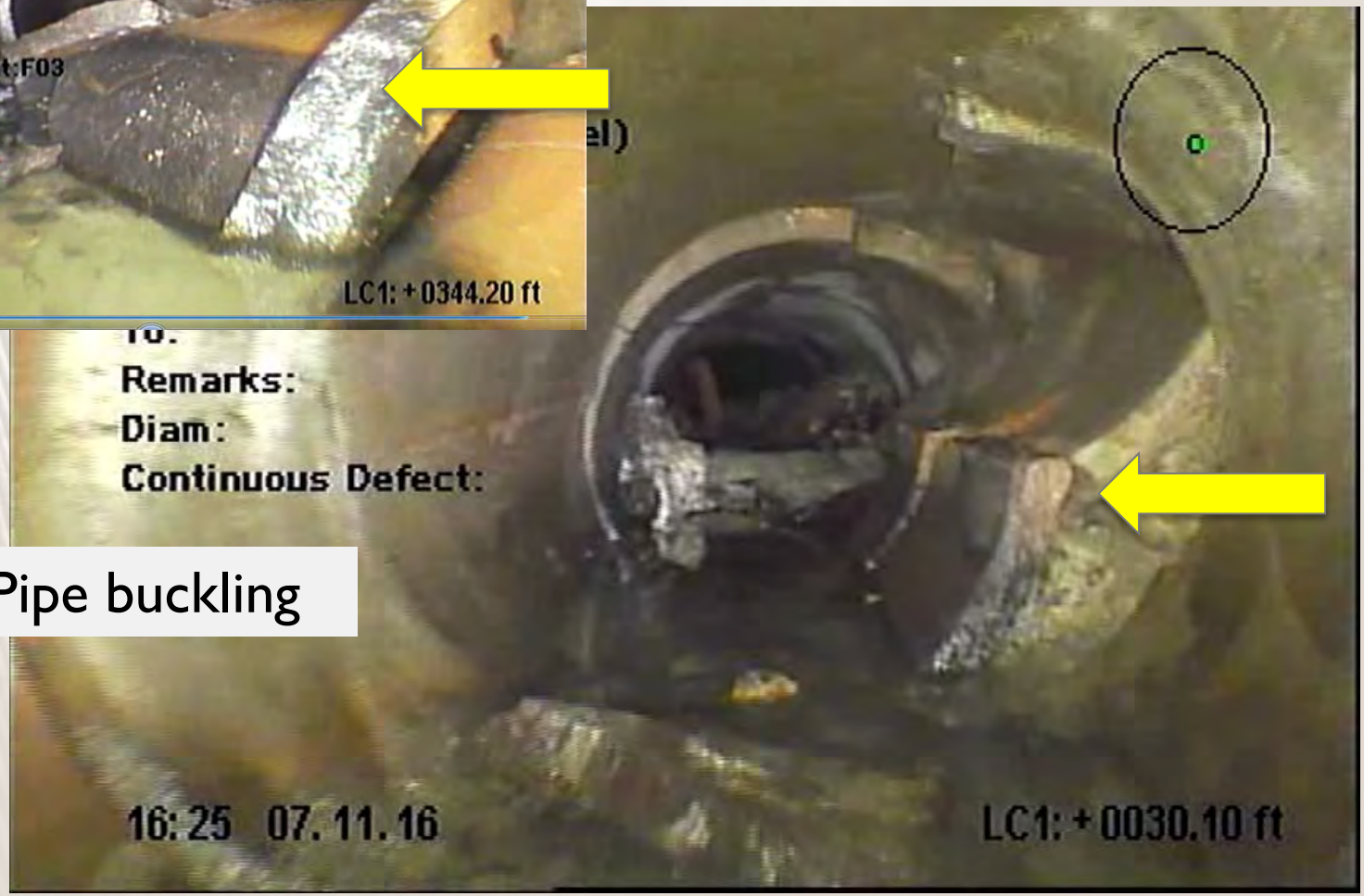
BRE

PipeID	MUSYM	SOILSC	Mat	PMATSCORE	Age	PAGESC	Struct	OM	Overall	POF	COF	BRE
P1020	62B	2	RCP	1	66	3	4100	4212	4312	3.64	2.3	8.372
P1028	63A	2	RCP	1	66	3	2100	900	2100	1.98	1.4	2.772
P1030	63A	2	RCP	1	66	3	1100	900	1100	1.48	1.5	2.22
P1091	62B	2	RCP	1	66	3	900	1100	1100	1.42	2.3	3.266
P1092	62B	2	CMP	3	66	3	3800	900	3800	2.93	2.5	7.325
P1093	41B	1	RCP	1	66	3	4300	4112	4412	3.67	2.5	9.175
P1094	41B	1	RCP	1	66	3	1200	900	1200	1.48	2.3	3.404
P1109	62B	2	RCP	1	66	3	3327	900	3327	2.59	2.7	6.993
P1110	62B	2	RCP	1	66	3	2211	900	2211	2.04	3.5	7.14
P1115	62B	2	CMP	3	66	3	2100	900	2100	2.08	2.3	4.784
P1119	62B	2	RCP	1	66	3	5221	900	5221	3.54	2.3	8.142


Cracks/Holes in Structure

Pipe Collapse





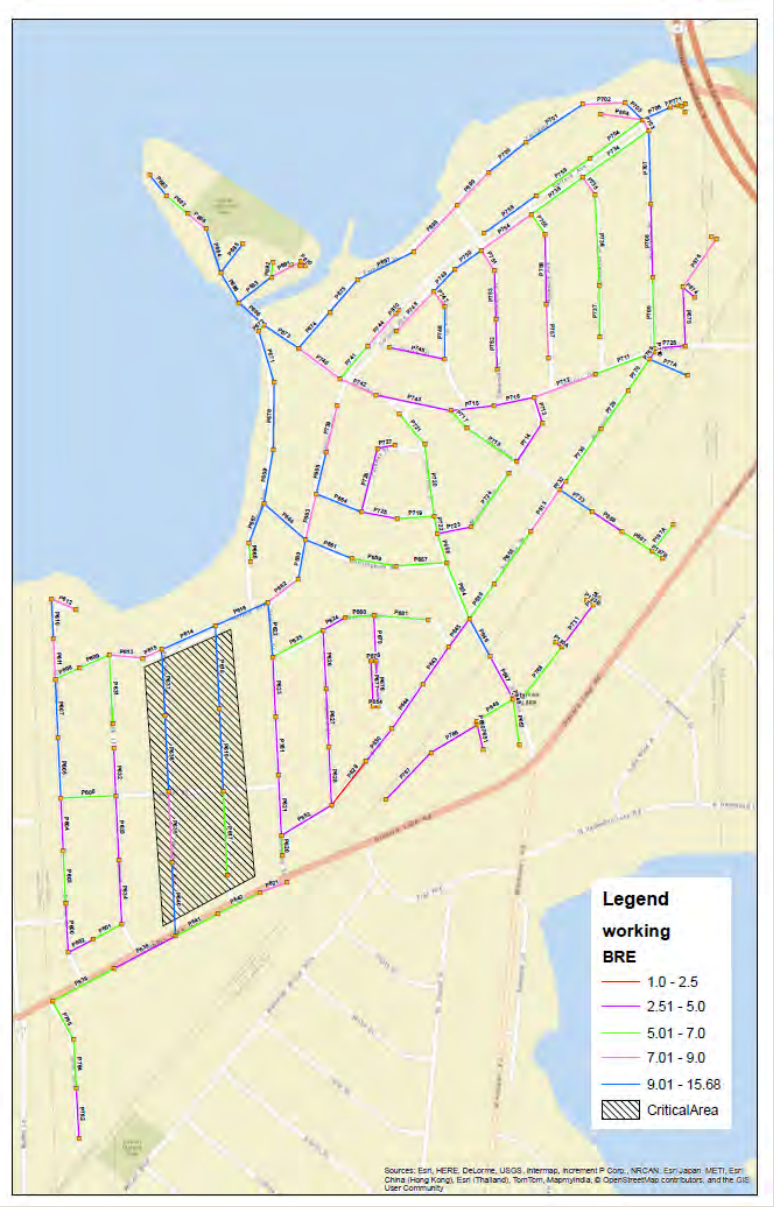
- Pipe buckling

Using GIS to develop BRE:

BRE = POF x COF

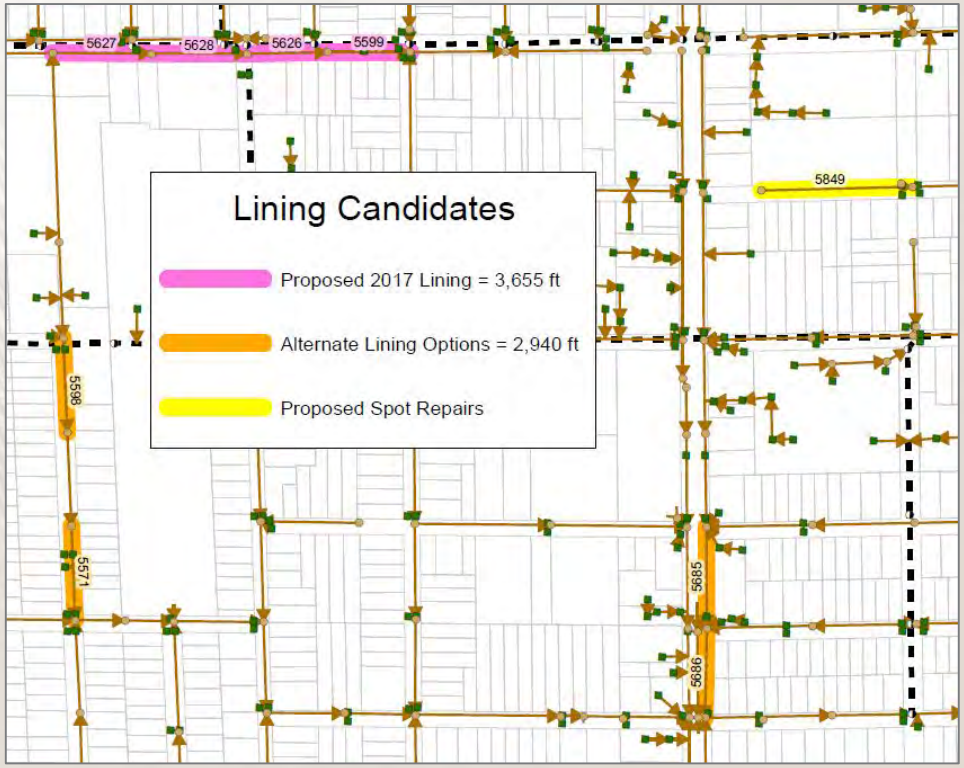
- Map identifies areas with BRE score results
- Also indicating any "critical" areas

⇨ Starting point to further refine and develop CIP and/or O&M costs



LINING CANDIDATES

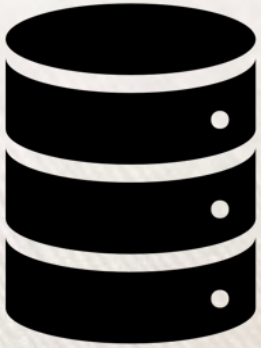
- Combination of BRE and PACP quick score
- Review CCTV data to confirm findings



GIS IS THE KEY

DELIVERABLES

- Geodatabase
- ArcGIS Online data
- Dashboards
- Training
- Reports
- CIP/AMP





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QUESTIONS