Asset Management Helping to Move the Detroit Water and Sewerage Department into the 21st Century

2018 OWEA Collection Systems Workshop
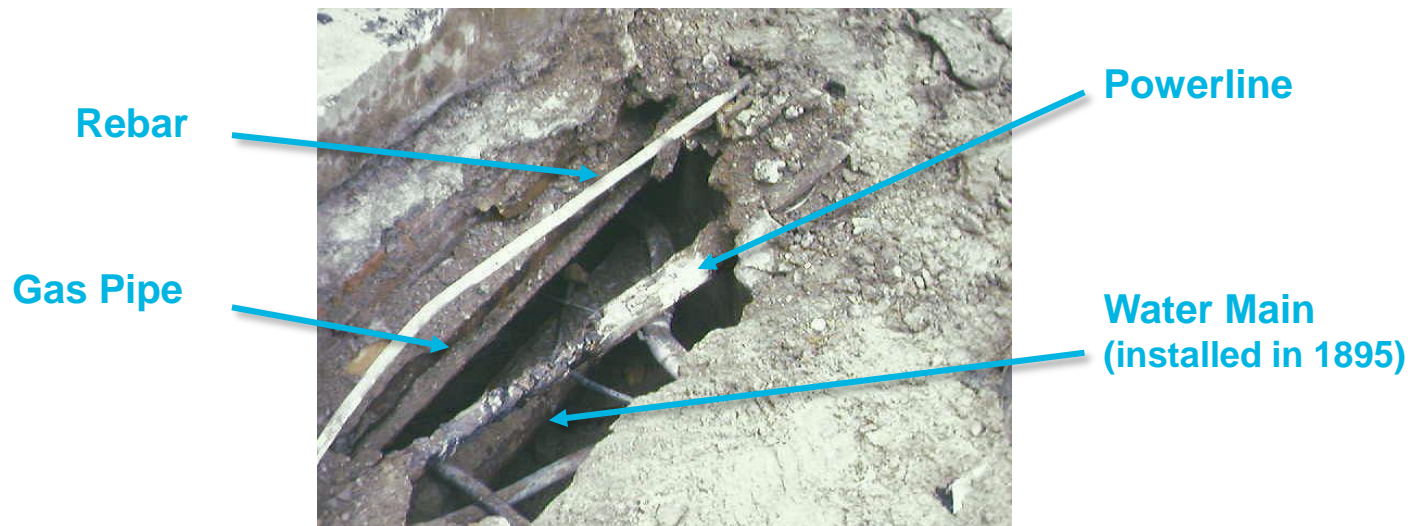
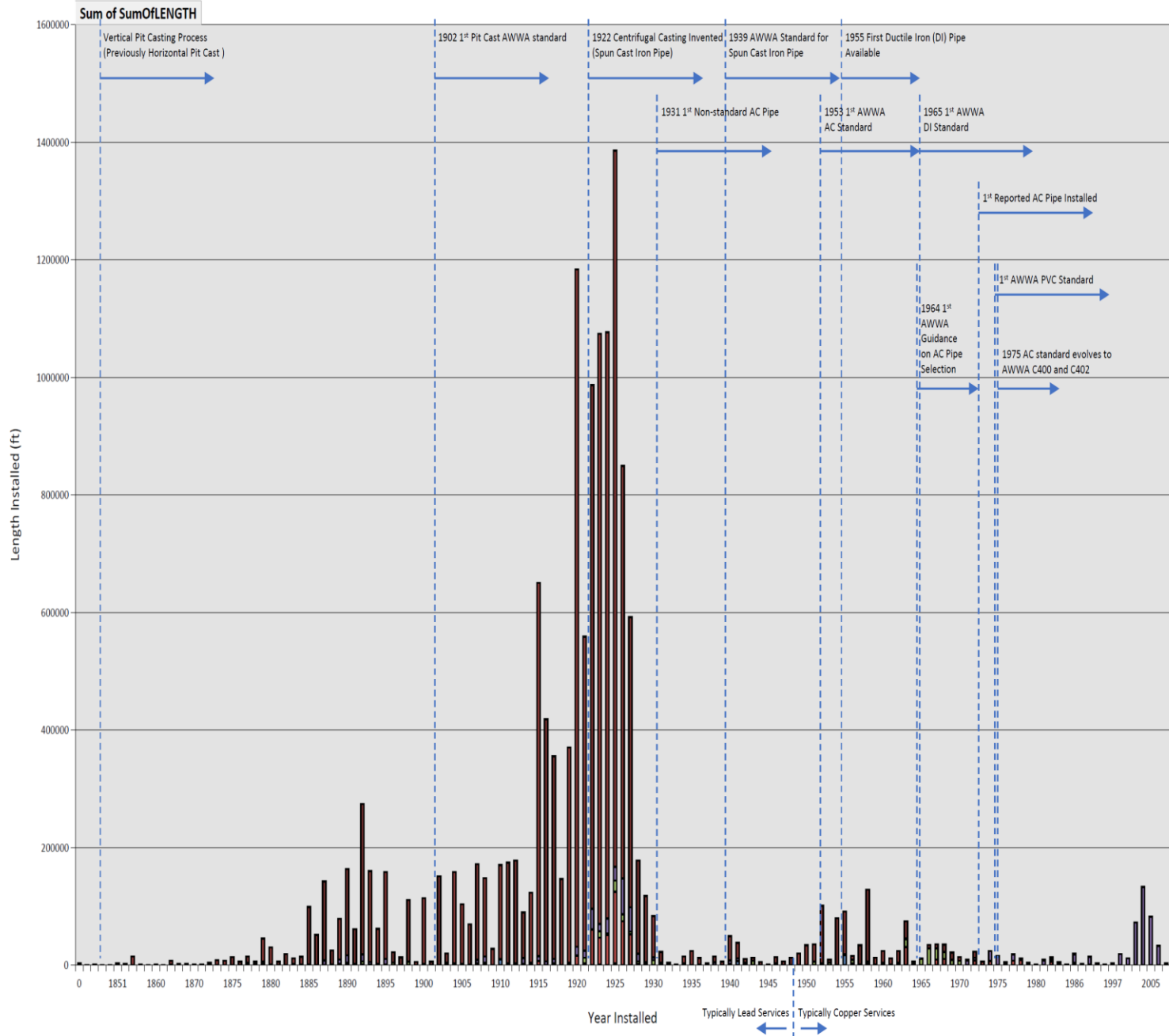CITY OF DETROIT

DETROIT Water & Sewerage Department

Agenda

– Detroit's Infrastructure Challenges

– Creation of CIPMO and Program goals

– Asset Management Approach to Infrastructure Renewal
  • Where we are today

– The Road Ahead

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Challenges

– Years of declining population and investment

– Average water and sewer pipe age is 95 years

– Critical need for coordinated Infrastructure renewal

– DWSD reorganization and 2016 formation of GLWA (water treatment and transmission network > 24inches)

Rebar

Powerline

Gas Pipe

Water Main (installed in 1895)

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Summary of Pipe Vintages Found in Detroit

OPERATEDBY
DWSD

Sum of SumOfLENGTH

Length Installed (ft) (y-axis): 0, 200000, 400000, 600000, 800000, 1000000, 1200000, 1400000, 1600000

Year Installed (x-axis): 0, 1851, 1860, 1870, 1875, 1880, 1885, 1890, 1895, 1900, 1905, 1910, 1915, 1920, 1925, 1930, 1935, 1940, 1945, 1950, 1955, 1960, 1965, 1970, 1975, 1980, 1986, 1997, 2005

Vertical Pit Casting Process (Previously Horizontal Pit Cast)

1902 1st Pit Cast AWWA standard

1922 Centrifugal Casting Invented (Spun Cast Iron Pipe)

1939 AWWA Standard for Spun Cast Iron Pipe

1955 First Ductile Iron (DI) Pipe Available

1931 1st Non-standard AC Pipe

1953 1st AWWA AC Standard

1965 1st AWWA DI Standard

1st Reported AC Pipe Installed

1964 1st AWWA Guidance on AC Pipe Selection

1st AWWA PVC Standard

1975 AC standard evolves to AWWA C400 and C402

Typically Lead Services | Typically Copper Services

MATERIAL
- Unk
- ST
- RC
- PC
- DI
- CI
- AC
- (Blank)

Note: Install date, length and material as reported by DWSD's GIS on 11 April 2018. Actual attributes must be verified.

Collection System

- 3,000 Miles

- 200 sink holes or cave-ins/year in past 5 years

- 15% sewers relined in past 20 years to increase integrity and capacity

- Master plan/changed land use requires reconfiguration

- Need for Green Infrastructure integration plan

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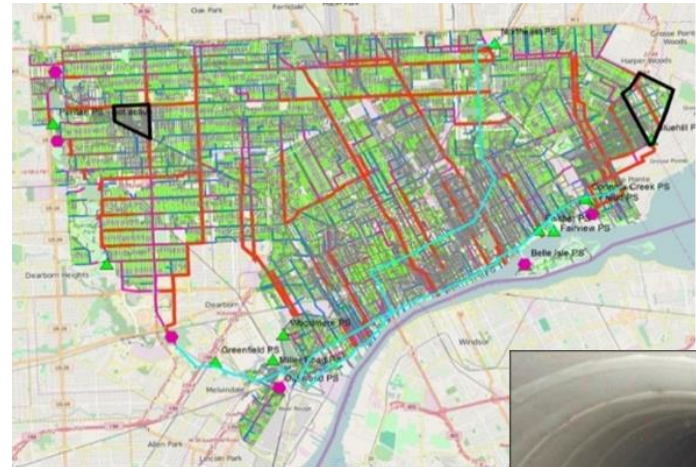
Capital Improvement Program Management Organization (CIPMO)

- DWSD plans $400 Million infrastructure investment over 5 years

- Develop and Manage Capital Improvement Program to:
  - Develop and Train a World-Class DWSD Operations, Management and Technical Team for the Future
  - Bring Economic Value to the City
    - Renew and rehabilitate infrastructure and neighborhoods
    - Reconfigure systems to reflect demographic trends and emerging urban plans
    - Re-Landscape the urban environment, embracing "greening of Detroit"
  - Fully Integrate with Other Infrastructure, Master Planning and Land Use priorities of the City of Detroit

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Technical Objectives

Sewer System Improvement

- Reduce Sinkholes and Cave-Ins
- Reduce Untreated CSOs
- Minimize Dry Weather Inflow and Infiltration
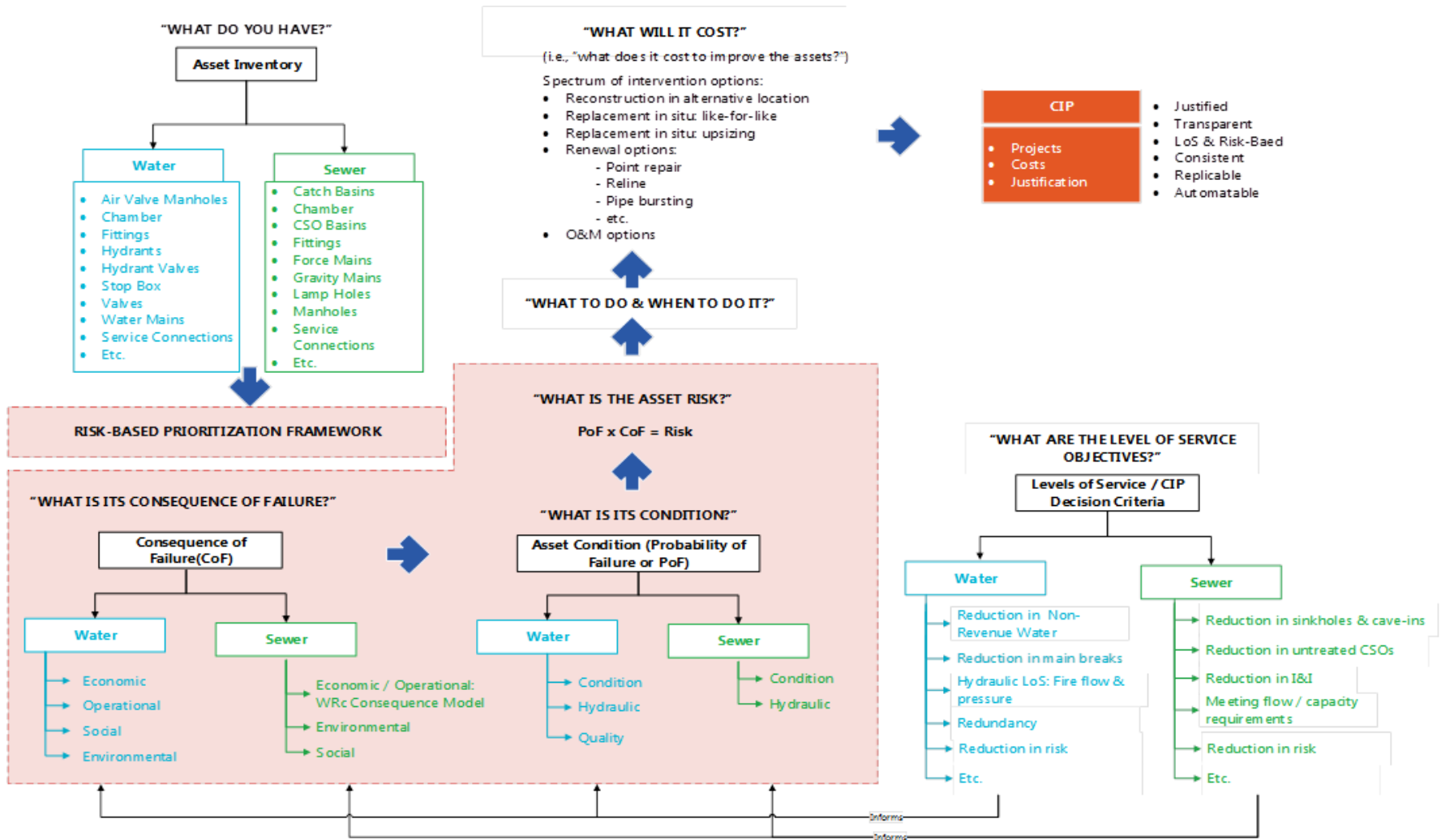- Meet Capacity Requirements
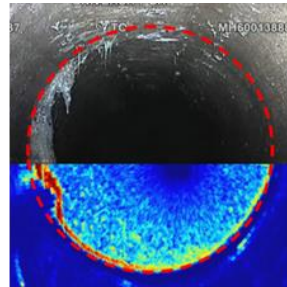
Improve system performance

Develop and Train DWSD staff

Develop new standards, encourage innovation through use of new tools and technology

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Asset Management Underlies CIPMO

Goals / Benefits of Asset Management

– Repeatable process

– Defensible Decisions

– Long-term vision of infrastructure planning

– Direct program to neighborhoods and individual assets that carry the highest risk

– Improve decision-making process as more condition assessment information is collection

– Ability to articulate plans and align CIP with other agencies (roads, gas, electric, land development, etc.) for overall ROW management

– Provides wise use of available funds

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Pilot Program Areas

– Two areas (Cornerstone Village and North Rosedale Park) to initiate the planning, public outreach, design standards, training, and establish the best practices for the rest of the Program
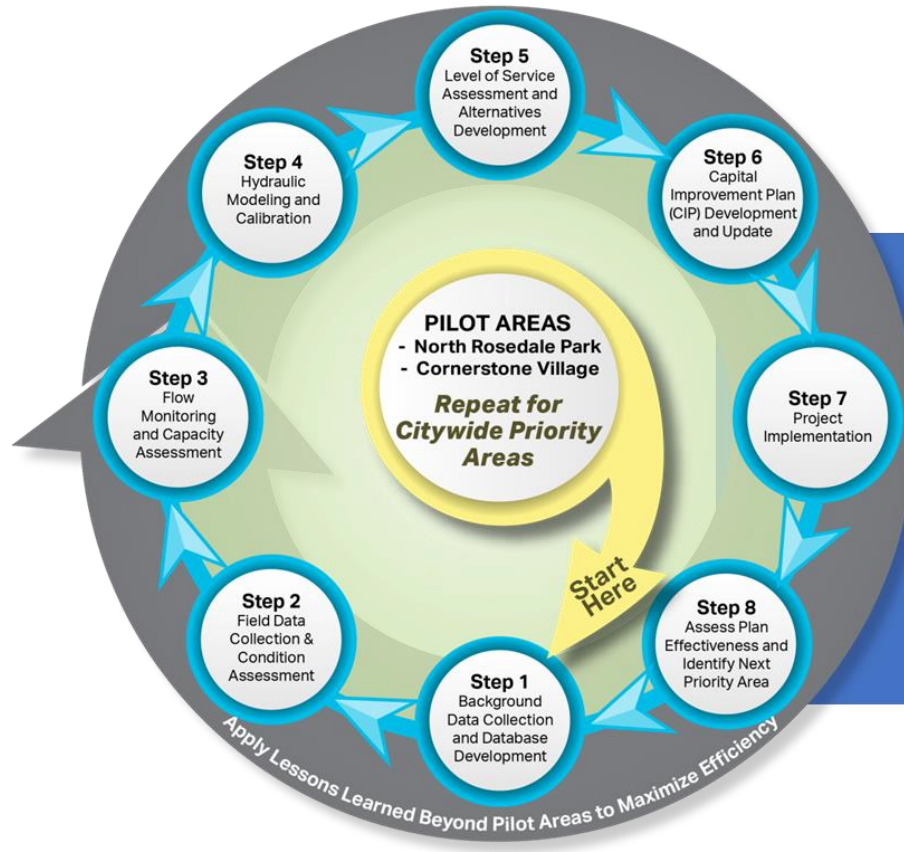

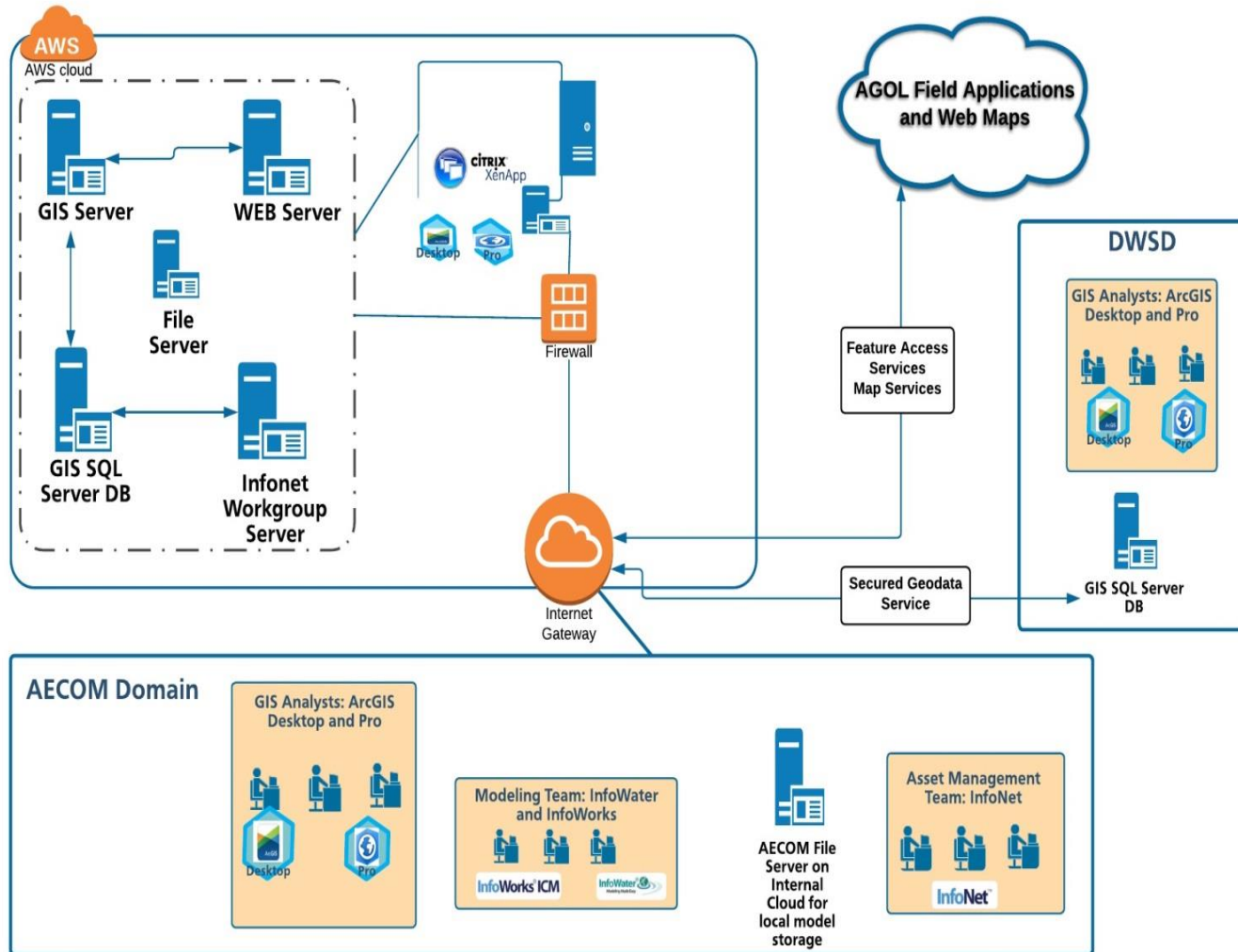**North Rosedale Park**

Cornerstone Village

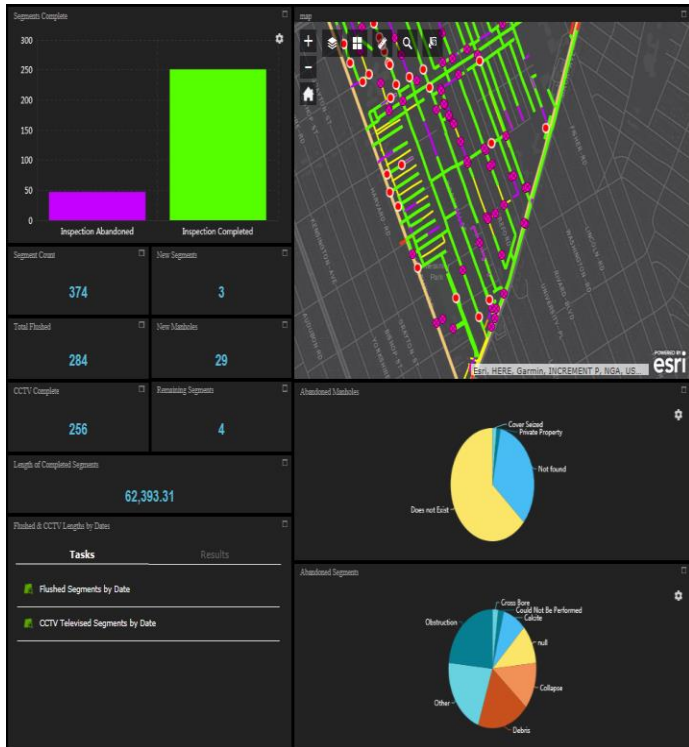AECOM

Pilot Program Establishes the Program Foundation

Benefit to DWSD:

✓ Improved levels of service

✓ Sustainable capital improvements

✓ Minimize life cycle costs

✓ Maximize the value for ratepayers.

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Program Data Integration Approach

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Applications to Support the program

CCTV Tracking Dashboard
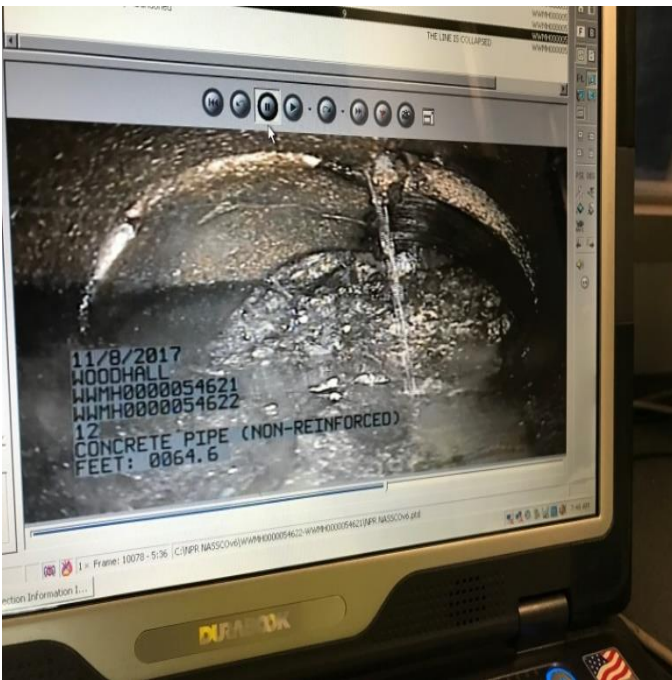
CCTV Contractor Inspection

C-Factor Testing

Leak Detection

Field Data Collection Program

- CCTV Sewer System Inspections (65 miles)
- Panoramo Manhole Inspections
- Sewer System Flow Monitoring

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Pipe Defects

Pipe Collapse

Pavement depression at collapse site

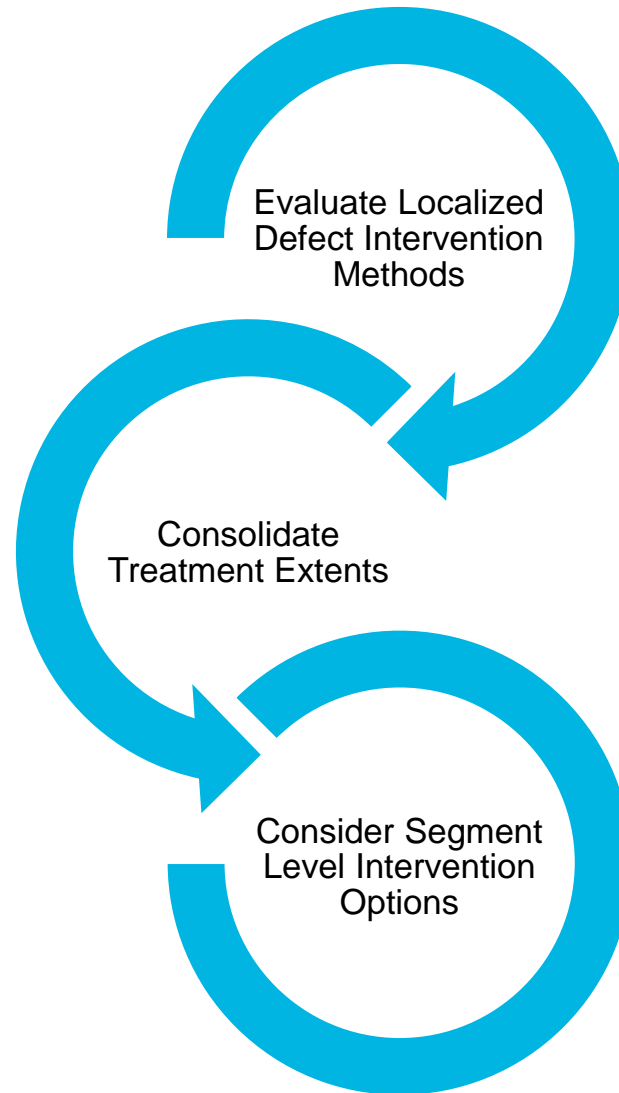Root balls found in lateral, very common in abandoned house lots

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Cross Bores

Cross bore with roots   Excavated gas and sewer lines

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Structural/O&M Treatment Assignment

Evaluate Localized Defect Intervention Methods

Consolidate Treatment Extents

Consider Segment Level Intervention Options

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Wastewater System Rehabilitation by Type
Cost Summary for Both Pilot Areas (Pre-Design)

	Intervention	Cornerstone Village		North Rosedale Park		Total		% of Cost
		Length (LF) / Count	Estimated Cost	Length (LF) / Count	Estimated Cost	Length (LF) / Count	Estimated Cost	
Sewer	Lining	24,748	$ 3,913,730.90	11,052	$ 1,170,406.39	35,800	$ 5,084,137.29	27%
	Lining with External Point Repair	15,690	$ 2,870,362.00	15,098	$ 1,585,077.85	30,788	$ 4,455,439.85	24%
	External Point Repair	384	$ 321,232.18	251	$ 226,530.00	635	$ 547,762.18	3%
	Trenchless Point Repair	3,485	$ 1,775,080.03	1,043	$ 555,826.88	4,528	$ 2,330,906.91	13%
	Full Segment Replacement	3,393	$ 2,889,291.87	2,933	$ 2,234,321.39	6,326	$ 5,123,613.26	28%
	Debris Removal (Flushing) - Immediate	14,074	$ 157,874.05	11,738	$ 116,740.97	25,812	$ 274,615.02	1%
	Debris Removal (Mechanical) - Immediate	140	$ 26,796.16	70	$ 16,038.42	210	$ 42,834.58	0%
	Cutting /Grinding of Taps- Immediate	130	$ 40,594.71	260	$ 88,359.46	390	$ 128,954.17	1%
	Root Control	16,053	$ 112,990.57	26,627	$ 123,751.22	42,680	$ 236,741.79	1%
Manhole	General and/or spot repairs	57	$ 35,625.00	11	$ 6,875.00	68	$ 42,500.00	0%
	Replace chimney only	13	$ 24,375.00	8	$ 15,000.00	21	$ 39,375.00	0%
	Manhole cleaning	36	$ 9,000.00	31	$ 7,750.00	67	$ 16,750.00	0%
	Spray Lining – Structural and for I&I	9	$ 67,500.00	6	$ 37,500.00	15	$ 105,000.00	1%
	Internal grouting of chimney only	11	$ 13,750.00	9	$ 11,250.00	20	$ 25,000.00	0%
	Benching and channel re-construction	5	$ 6,250.00	8	$ 10,000.00	13	$ 16,250.00	0%
	Frame/Cover replacement and/or adjustment	1	$ 625.00	1	$ 625.00	2	$ 1,250.00	0%
	Replace adjusters	1	$ 1,000.00	1	$ 1,000.00	2	$ 2,000.00	0%
	Replacement with new manhole by open cut	-	$ -	2	$ 26,000.00	2	$ 26,000.00	0%
	Total		$ 12,266,077.47		$ 6,233,052.58		$ 18,499,130.05	100%

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Risk-based Field Assessment and Project Prioritization: Maximizing Value for Each Dollar Spent

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Risk Framework – Gravity Main

WRc Consequence Model

Non-Brick and ≤ 36in

Depth (ft)	Repair Cost Factor (RCF) Soil Good	Poor
≤ 6	1	1.5
≤ 10	2	2.5
≤ 13	3	3.5
≤ 17	4	5
≤ 20	5.5	6.5
> 20	7	8.5

Brick OR > 36in

Depth (ft)	Repair Cost Factor (RCF) Soil Good	Poor
≤ 6	4	5.5
≤ 10	7	9
≤ 13	13	16
≤ 17	19	24
≤ 20	26	31
> 20	33	40

Good / Bad soils determined by soil cohesion as per Universal Soil Classification System

Traffic Multiplier (TM)

CFCC Category	Divertible	Non-Divertible
A32 - Minor/Residential	1	1
A31 - Principal	1.9	6.3
A2 - State HWY	2.6	10.8
A1 - Interstate	3.1	13.8
Alley / Backyard	6	

Critical Location

≤ 50 ft Railroad
≤ 50 ft ESA
≤ 50 ft Critical Customer
Under Structure

RCF x TM	Critical	Score
≤ 3	YES	10
	NO	1
≤ 6	YES	10
	NO	5
> 6	YES	10
	NO	10

	Category	Criteria / Information Used
Consequence	Operations / Economic 45%	1. WRc Consequence 2. Blind Connections
	Environmental 25%	1. In SSO/CSO catchment 2. Potential BBUs 3. Proximity to ESA
	Social 30%	1. Census Tract Population Density 2. Employment 3. Near Bus Line
Probability	Condition 50%	1. PACP, or 2. Weibull RUL
	Hydraulics 50%	1. Undersized Pipe 2. High HGL 3. High ADWF 4. Pipe meets 10SS 5. Recorded BBUs

Gravity Main Risk
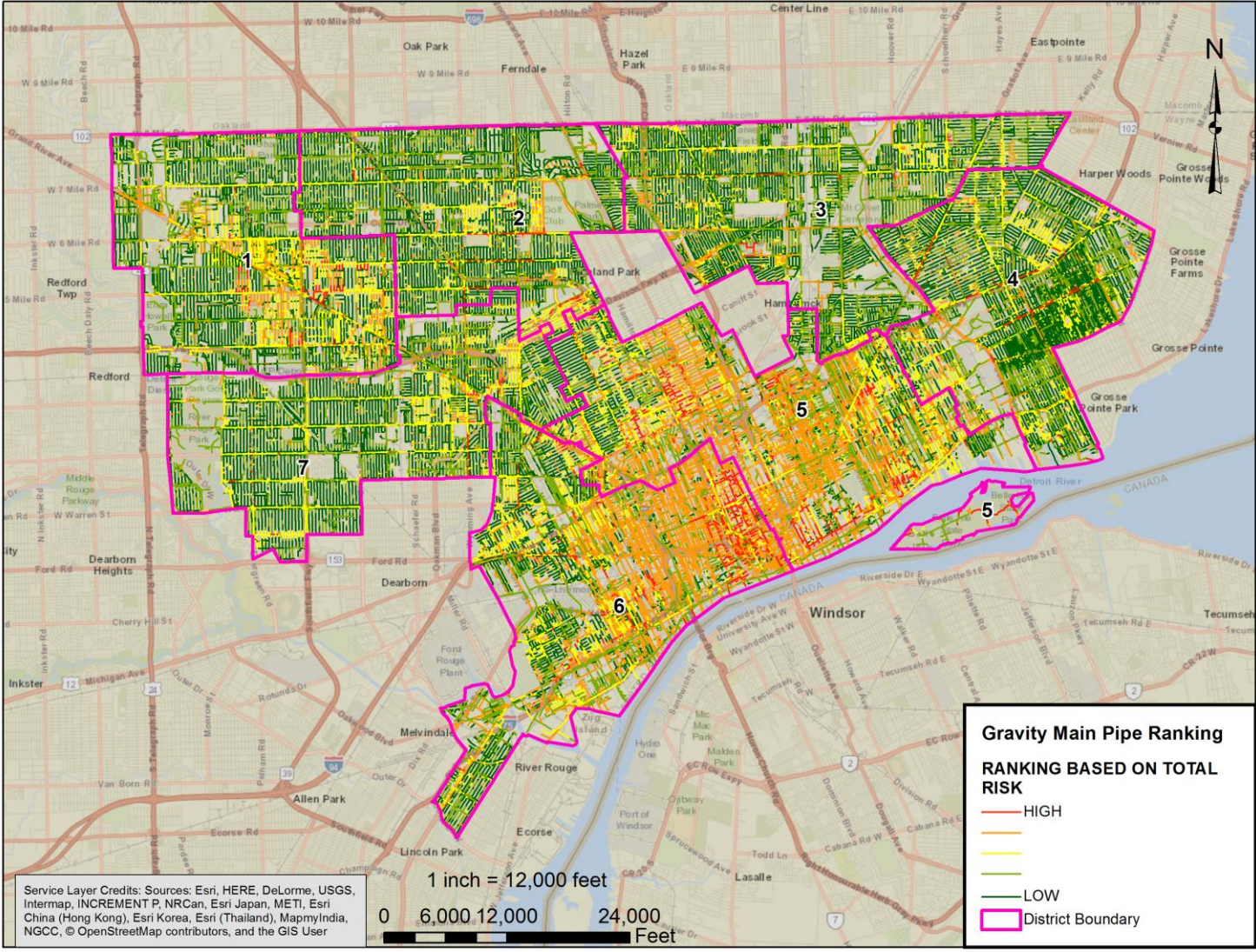
Neighborhoods by Gravity Main Risk

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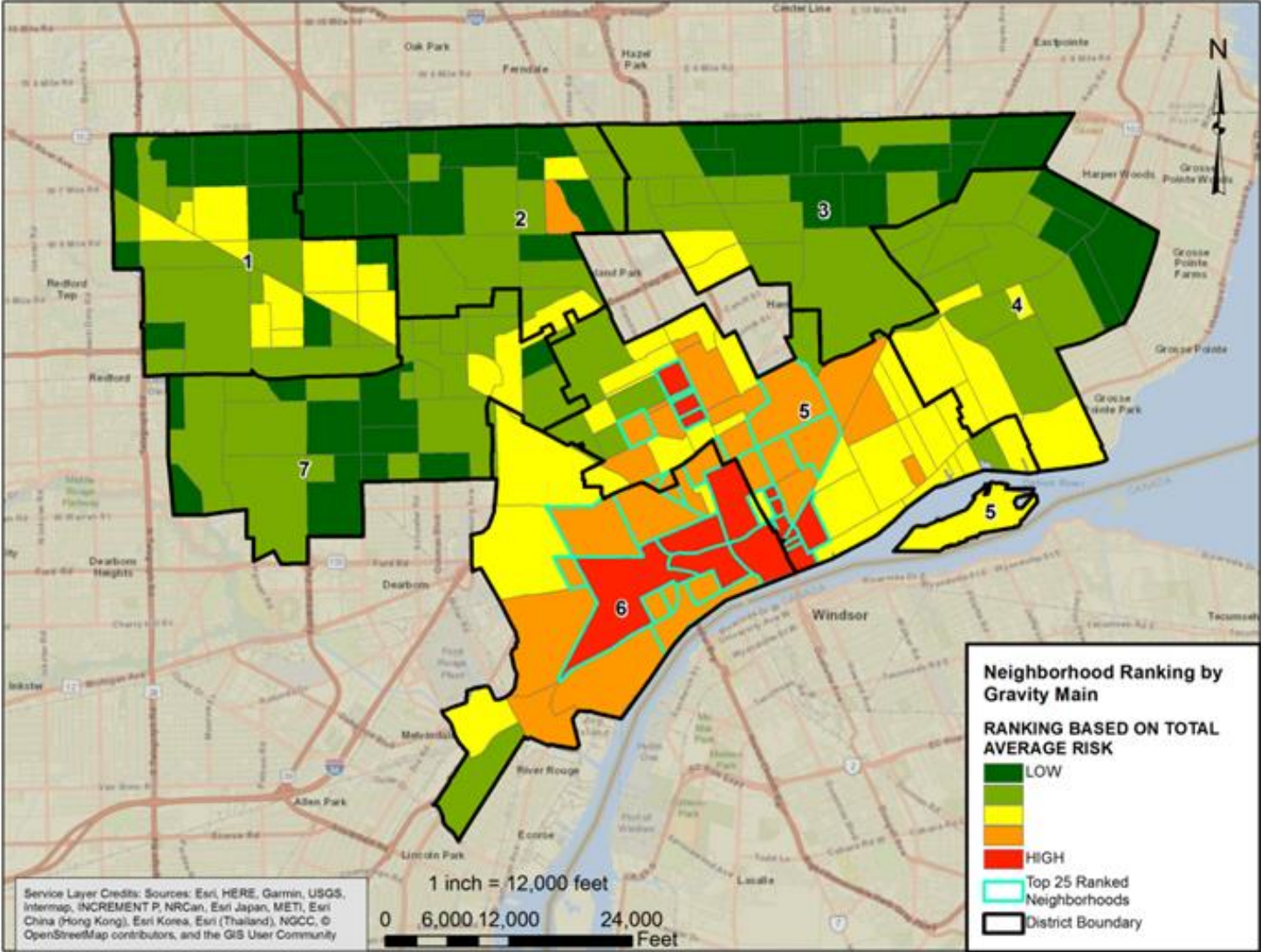
Top 25 Neighborhood Ranking—Integrating Risk and Additional Considerations

| Neighborhood	Average Sewer Risk Score	Length Weighted Average Risk (LWAR)	Total Sewer Length (ft)	Rank	PDD 20-Minute Neighborhood	Current / Recent Planning Study	Recent Demolition Activity*	Council District	PDD Score	Planning Score	Demo Score	Total	Final Rank
Downtown	18.20	19.35	186,785	1	Yes	Yes	No	6	1.6	1.6	0	21.40	2
Greektown	17.76	18.50	10,035	2	Yes	Yes	No	5	1.6	1.6	0	20.96	3
Midtown	17.31	18.84	118,974	3	Yes	No	Yes	6	1.6	0	1.6	20.51	6
Brewster Douglas	16.87	17.11	13,950	4	Yes	Yes	Yes	5	1.6	1.6	1.6	21.67	1
New Center Commons	16.31	16.54	21,436	5	Yes	No	No	5	1.6	0	0	17.91	8
Foxtown	16.21	16.86	21,108	6	Yes	Yes	No	6	1.6	1.6	0	19.41	13
New Center	16.18	16.72	18,495	7	Yes	No	No	5	1.6	0	0	17.78	14
North Corktown	16.17	17.19	93,757	8	Yes	No	Yes - very little	6	1.6	0	0	17.77	15
Lafayette Park	16.11	16.88	46,477	9	Yes	Yes	Yes - very little	5	1.6	1.6	0	19.31	9
Brewster Homes	15.90	17.23	13,172	10	Yes	Yes	Yes	5	1.6	1.6	1.6	20.70	4
Southwest Detroit	15.80	15.84	329,888	11	Yes	Yes	Yes - very little	6	1.6	1.6	0	19.00	10
Piety Hill	15.63	15.75	35,322	12	Yes	Yes - partially	Yes	5	1.6	0	1.6	18.83	5
Corktown	15.60	16.79	89,987	13	Yes	Yes	Yes	6	1.6	1.6	1.6	20.40	11
Hubbard Farms	15.27	15.82	22,748	14	Yes	Yes	Yes	6	1.6	1.6	1.6	20.07	16
Virginia Park	15.17	15.71	2,987	15	Yes	Yes	No	5	1.6	1.6	0	18.37	7
LaSalle Gardens	15.16	15.15	36,578	16	No	No	Yes	5	0	0	1.6	16.76	17
Medical Center	15.11	15.03	24,409	17	Yes	No	No	5	1.6	0	0	16.71	18
Poletown East	15.07	15.36	209,584	18	Yes - partially	No	Yes	5	0	0	1.6	16.67	12
West Woodbridge	15.04	15.34	25,726	19	Yes	Yes - partially	Yes - very little	6	1.6	0	0	16.64	19
Michigan-Martin	14.98	14.51	26,629	20	No	No	Yes	6	0	0	1.6	16.58	20
McDougall	14.94	15.16	130,678	21	Yes - partially	No	Yes	5	0	0	1.6	16.54	21
Chadsey Condon	14.90	14.92	183,411	22	No	No	Yes	6	0	0	1.6	16.50	22
Core City	14.86	15.46	158,249	23	No	No	Yes	6	0	0	1.6	16.46	23
Wayne State	14.73	15.25	43,290	24	Yes	No	No	6	1.6	0	0	16.33	24
West Side Industrial	14.69	15.61	74,524	25	No	No	Yes	6	0	0	1.6	16.29	25

High Risk Sewer Gravity Mains
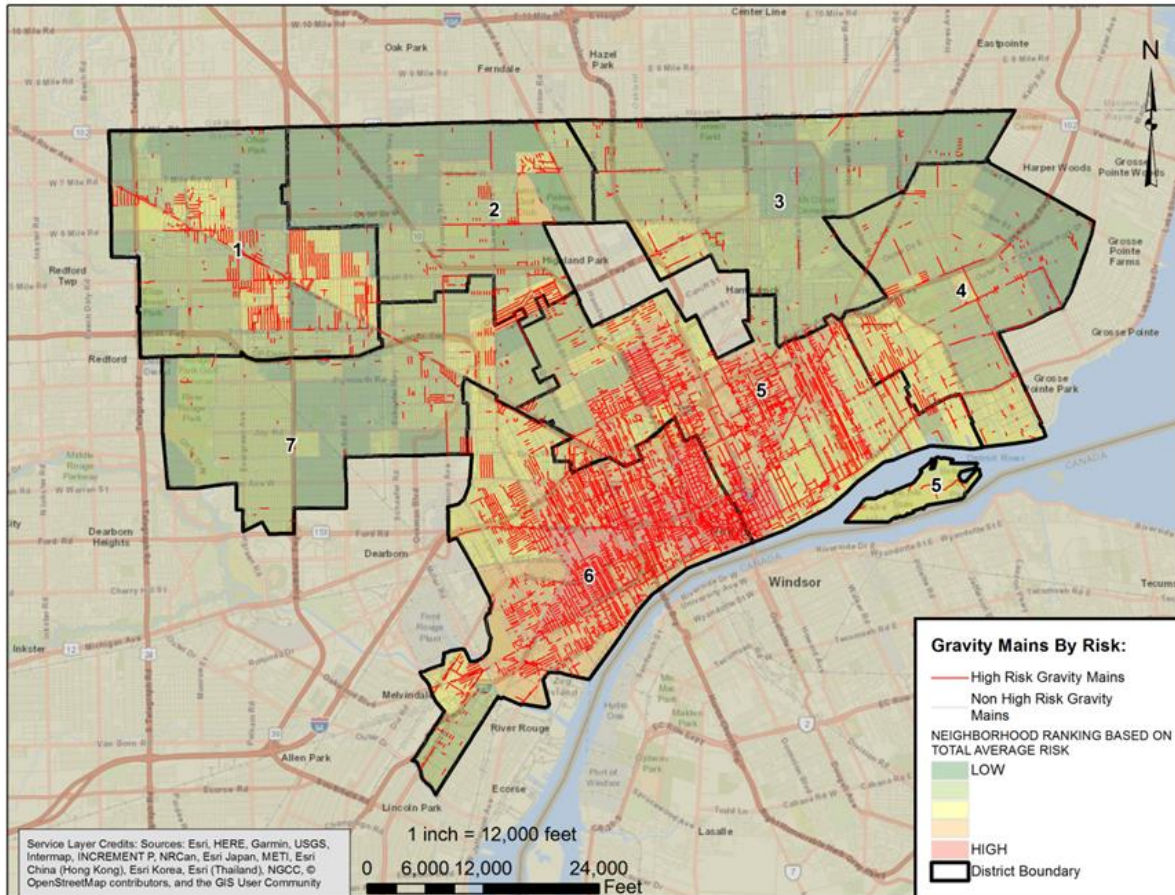
Sewer

Consequence of Failure	1	Future Assessment	Schedule Assessment	Assess Soon	Assess Now	Assess Now
	2	Future Assessment	Future Assessment	Schedule Assessment	Assess Soon	Assess Now
	3	Future Assessment	Future Assessment	Future Assessment	Schedule Assessment	Assess Soon
	4	Fix on Failure	Fix on Failure	Fix on Failure	Future Assessment	Schedule Assessment
	5	Fix on Failure	Fix on Failure	Fix on Failure	Future Assessment	Future Assessment
		1	2	3	4	5

Probability of Failure

Miles of Pipe

716	23%
228	7%
1158	36%
1033	32%
45	1%
3179	

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Data Uncertainty

- For every COF/POF element assign qualitative measure of uncertainty
  - 0 to 1 scale

- Example:
  - RUL estimates: 1
  - Critical customer location: 0

- Propagate uncertainty through risk model (COF, POF, Risk)

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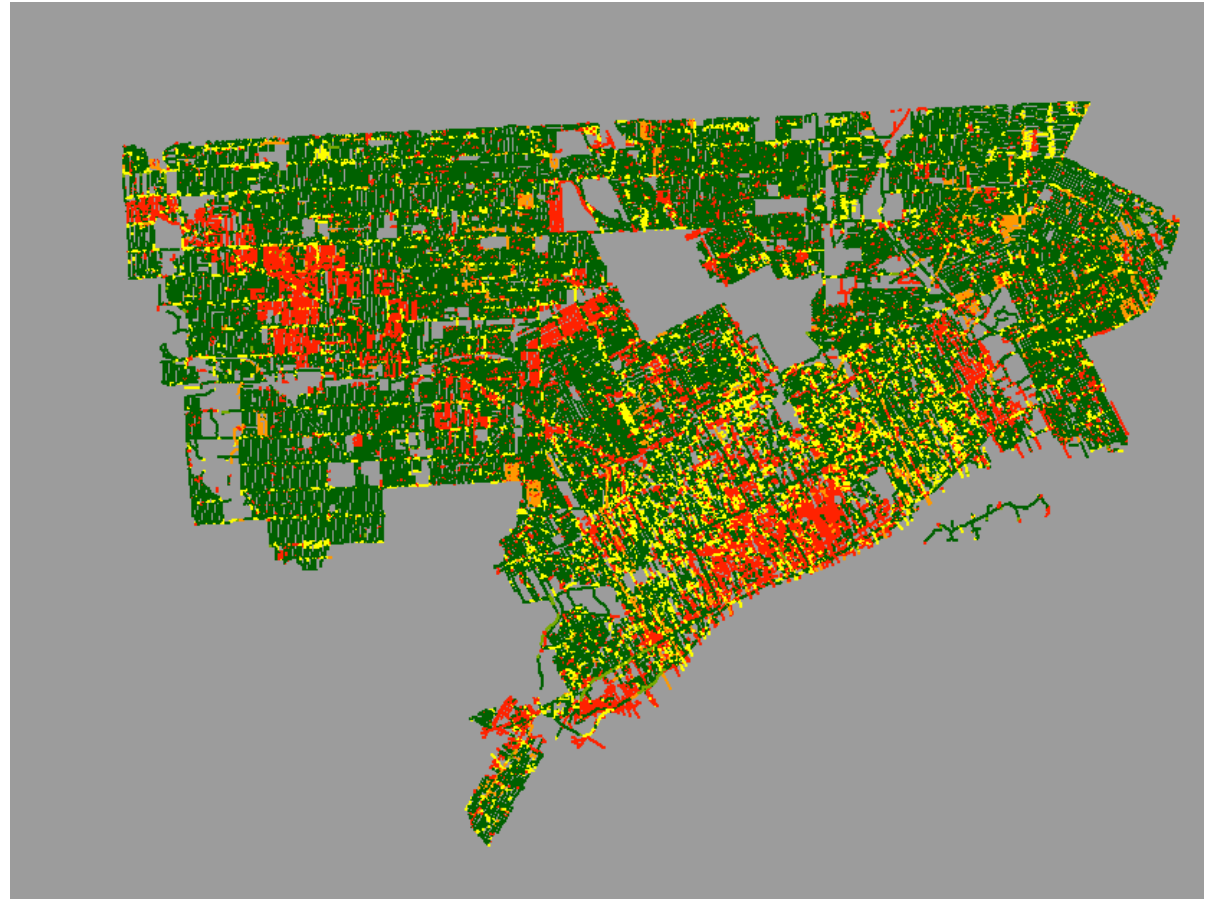
Going Forward

- Moving on to field work next set of pilot areas
  - Condition assessment of high risk pipes
- Develop detailed design for initial pilot areas
- CIP project delivery
- Documenting of lessons learned
- Risk model 2.0 (and 3.0, 4.0, …)
  - Improve data quality
    - Updated asset attribute data
    - Updated external COF data
  - Close the loop on risk model COF/POF
    - Revise remaining useful life models using condition assessment
    - Integrate data from hydraulic model
- Integrate INFOMASTER with other enterprise level systems (GIS, INFONET, CITYWORKS)

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Detroit Has Already Made Good Progress…
but we're just getting started

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Questions and Answers

Christopher Pawlowski, AECOM

Palencia Mobley, DWSD