Asset Prioritization with GIS

NASSCO, GIS, and
Smarter Asset Management

NEWEA, Boston

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(Session 6)

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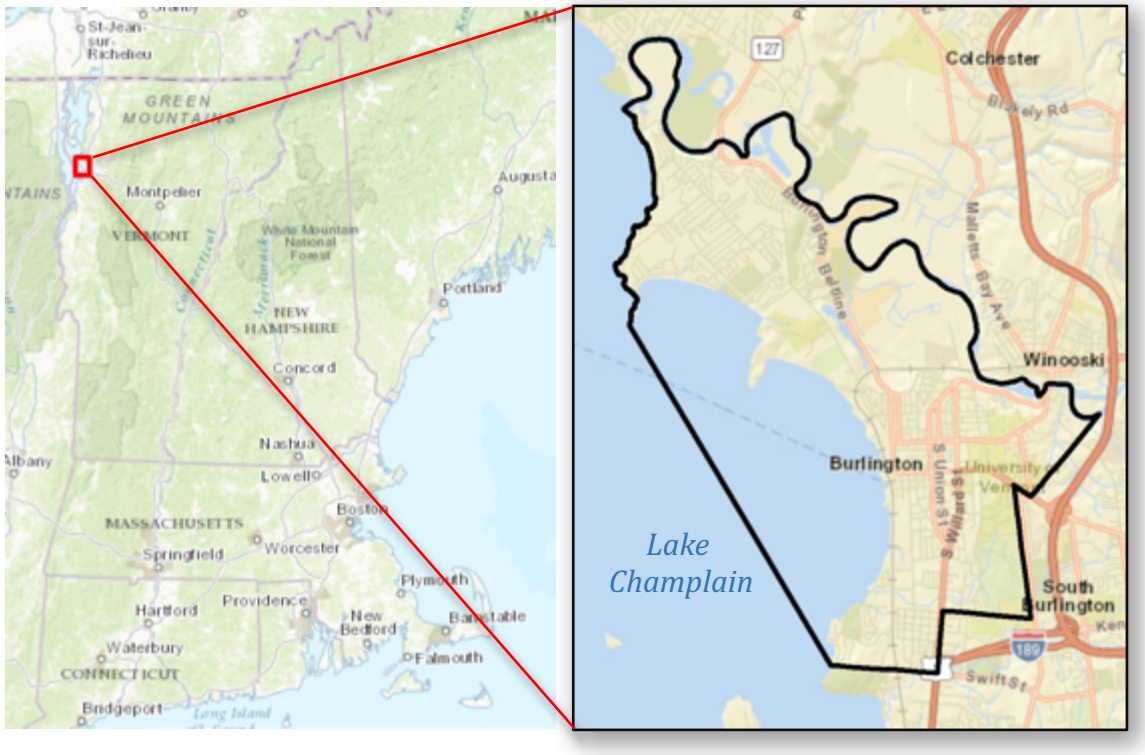
Asset Prioritization With GIS

Burlington, VT

- 127 mi Gravity Sewer
  - 45 mi sanitary
  - 37 mi stormwater
  - 45 mi combined
  - Predominantly Vitrified Clay
  - Circular pipes 8-20”
  - Circular, oval, and box: 21-108”



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Project Overview

- Collection system inspections are part of larger Asset Management effort.
- Inspections will occur over 5 years, approximately 20% per year.
- Year 1 - MOST critical 20% of system.
- GIS analysis will guide decision-making on inspections and prioritization.

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Rationale

- GIS offers tools for Geographic analysis, and visual understanding.
- Analysis considers sewer system attributes, surrounding infrastructure, and environmental factors.
- Process was iterative, with input and buy-in from multiple staff.
- Results are dynamic and can be refined with new information.

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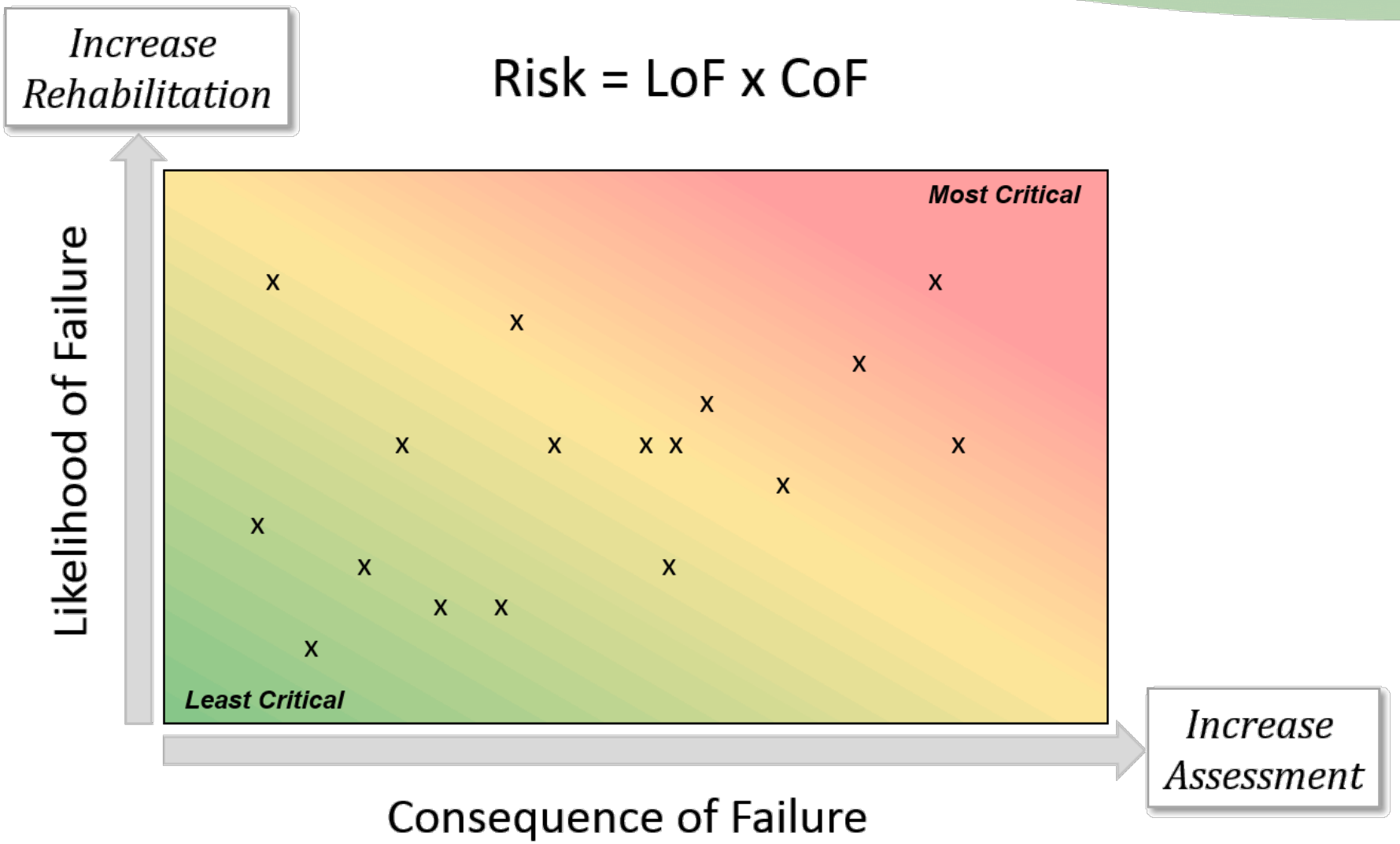

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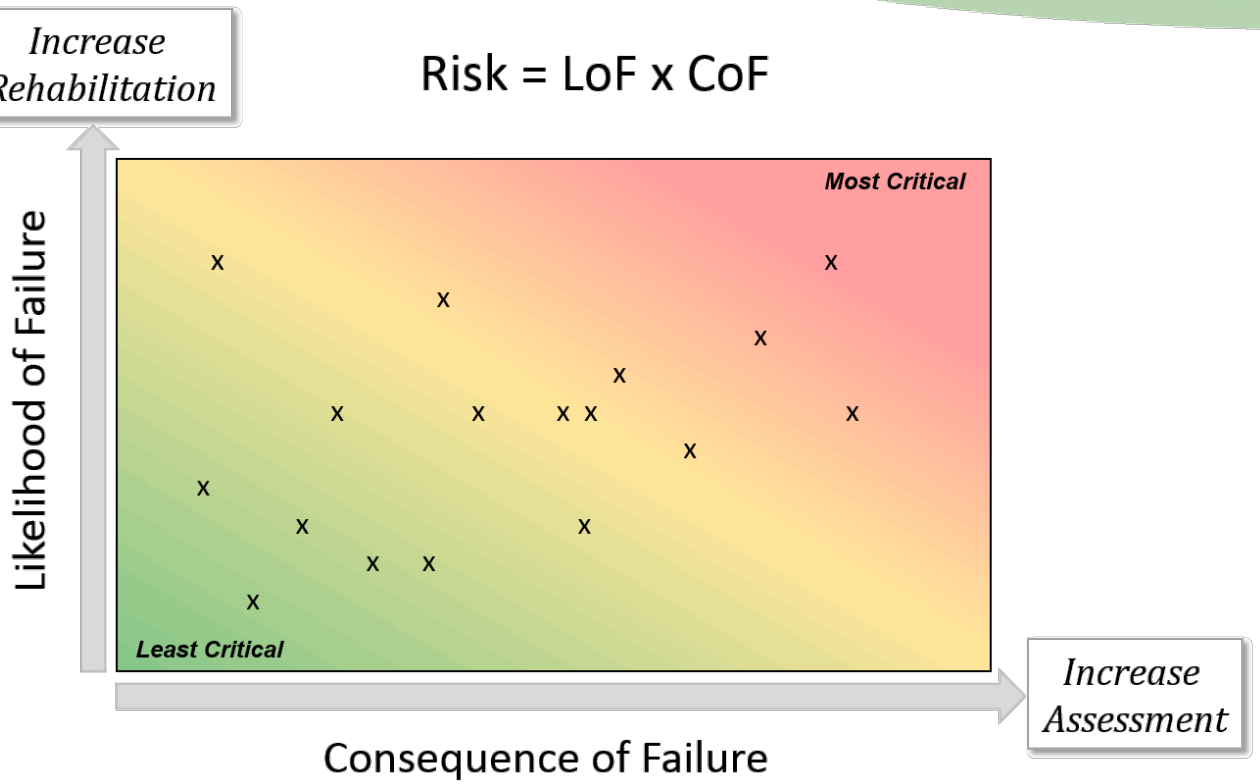

Likelihood of Failure
- Age
- Material
- Condition
- Break History

Consequence of Failure
- Critical Customers affected
- Direct Repair Costs
- Environmental Damage
- Effect on Transportation

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Consequence of Failure

- *Economic Costs*
- *Social Costs*
- *Environmental Costs*

Existing GIS Datasets

- Sewer/Stormwater Pipes
- Manholes/Catch Basins
- Roads
- Parcel/Assessing Data
- Customer Billing Database
- State/Federal Infrastructure Data – schools, hospitals, etc
- Surface Water/Wetlands
- Floodplains
- Other environmental considerations

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Consequence of Failure

Social Costs

- Recreation areas
- Critical customers (hospitals, etc)

Economic Costs

- Pipe diameter
- Pipe depth
- Road classification

Environmental Costs

- Proximity to surface water, wetlands, floodplains
- Known presence of endangered species
- Significant Natural Communities

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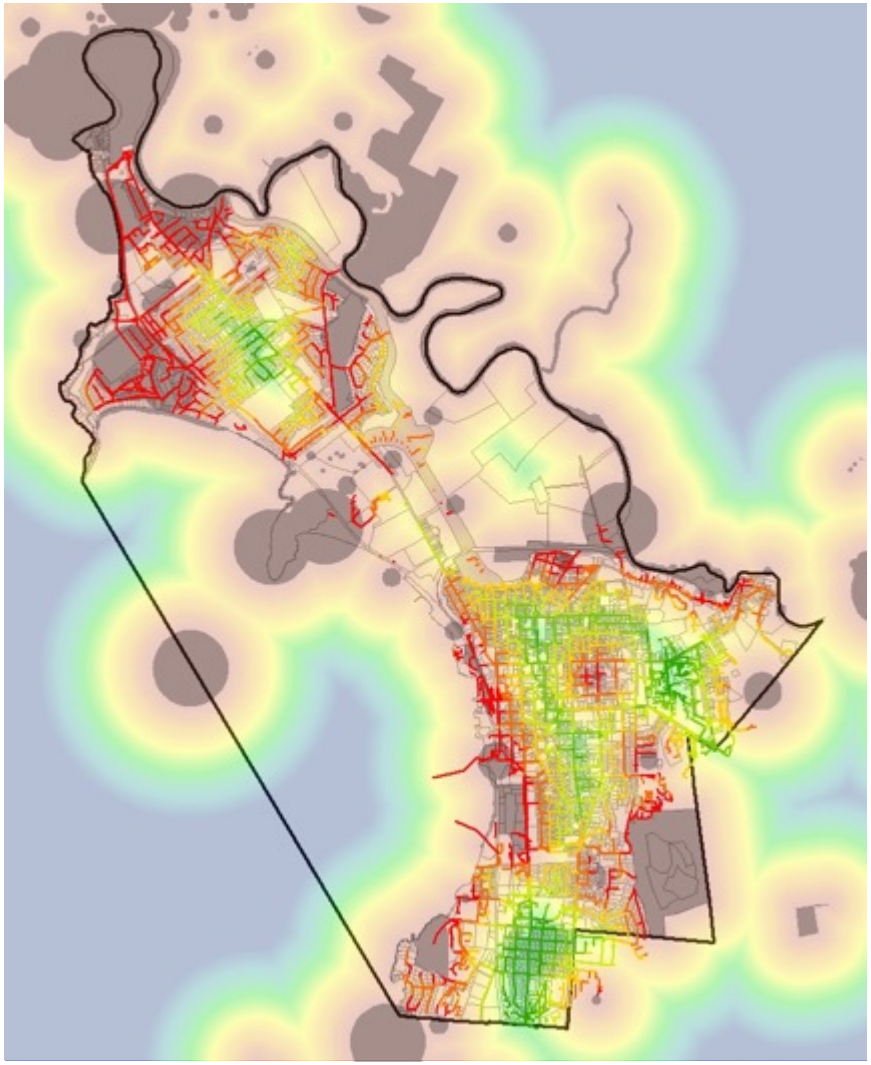
Burlington

Rare and Endangered Species

Distance Calculation

Applied to Pipes



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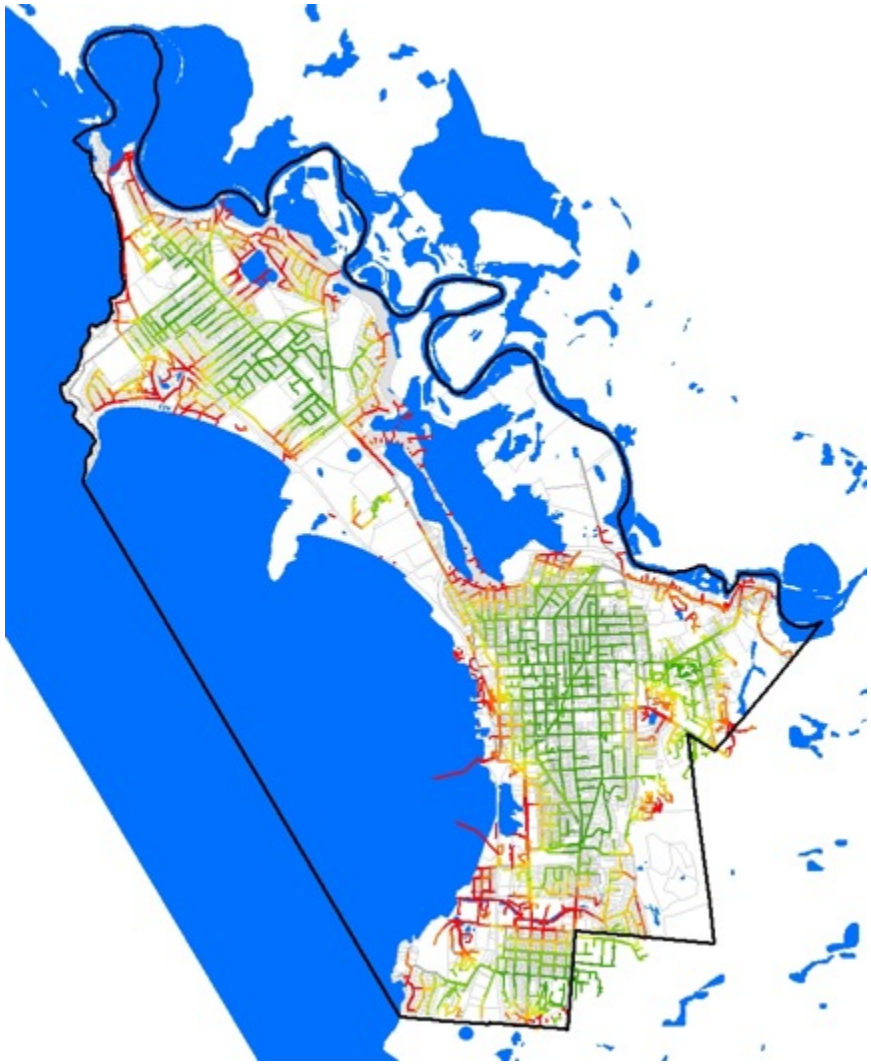
Surface Water, Wetlands, and Floodplains

Buffered and Applied to Pipes



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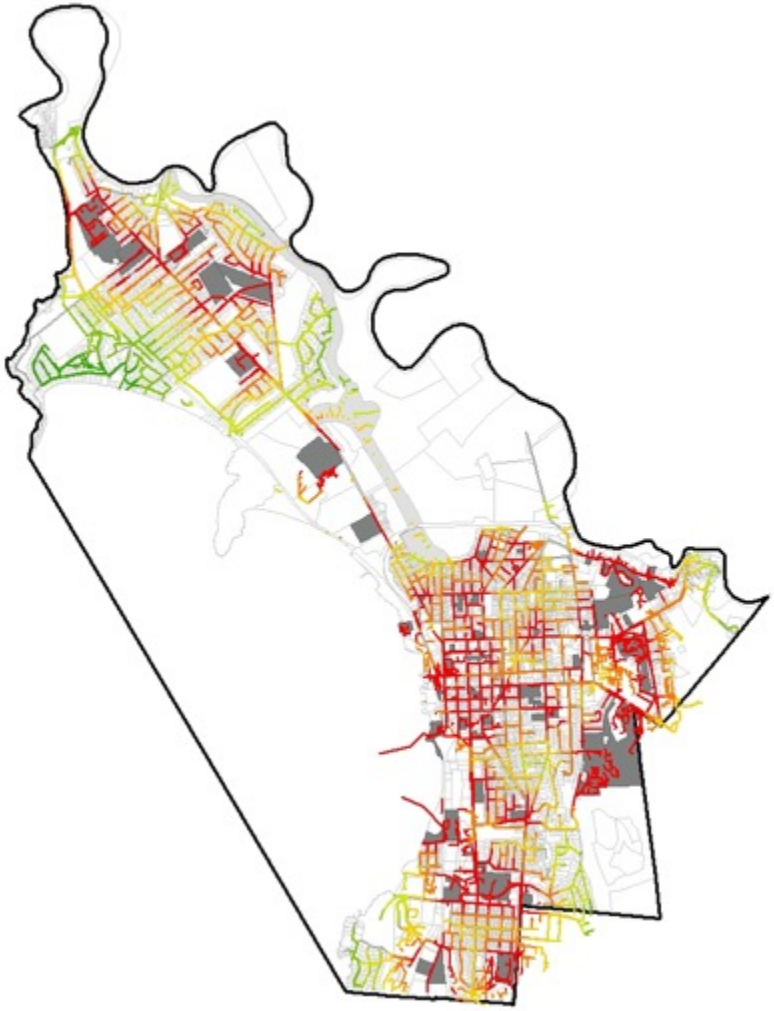
Critical Customers

Buffered and Applied to Pipes



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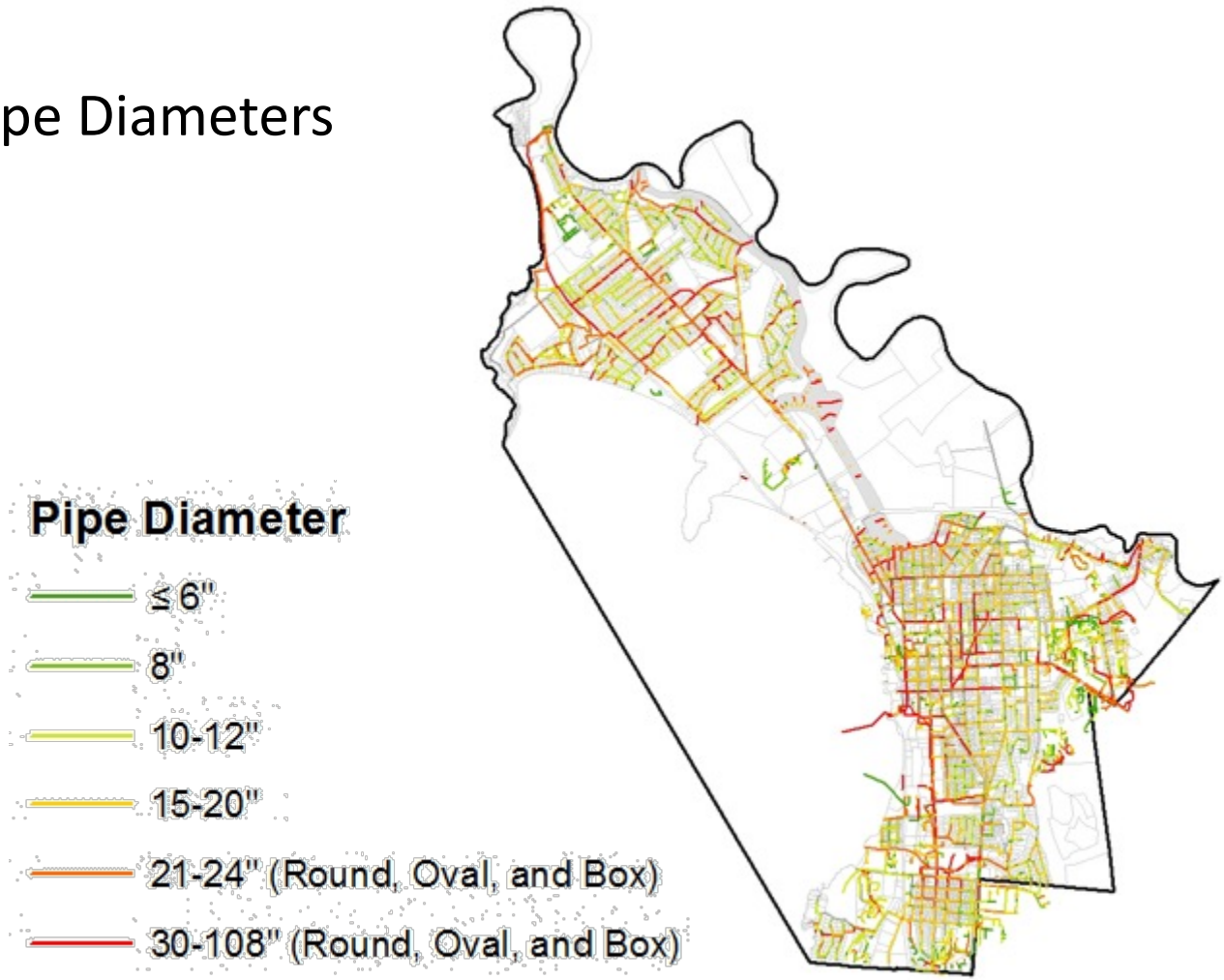
Pipe Diameters



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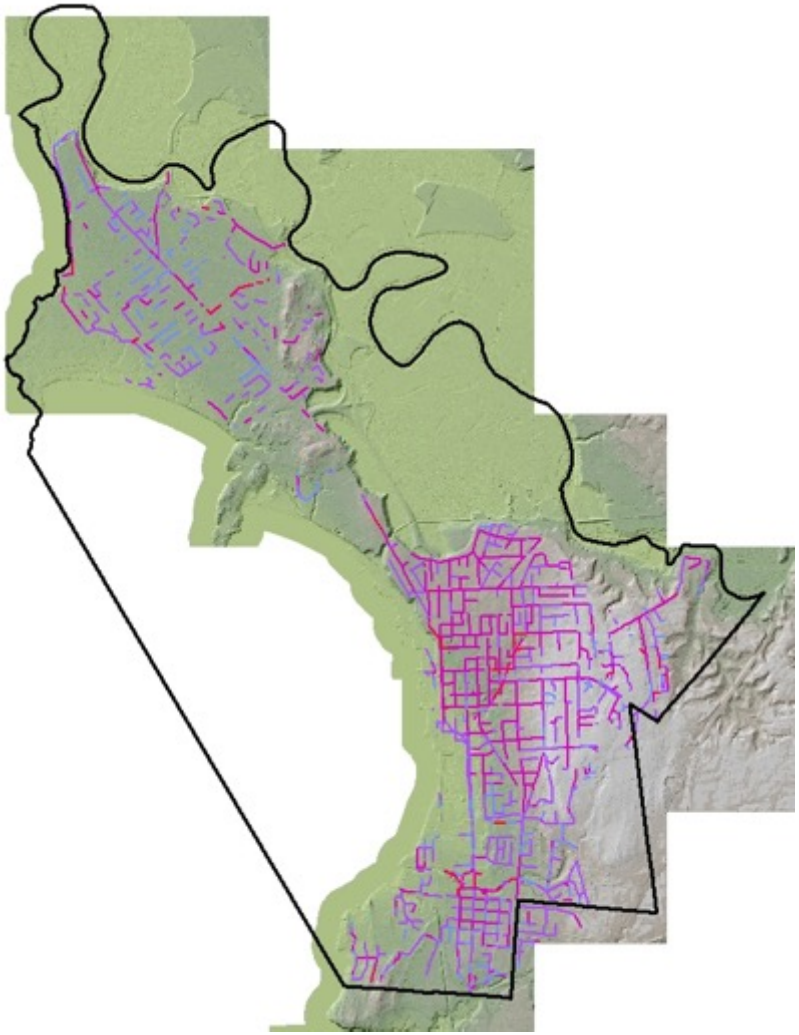
Pipe Depth

Manholes with Invert Elevs (M)

Pipes with Invert Elevs (ft)

Surface Elevations (LiDAR)



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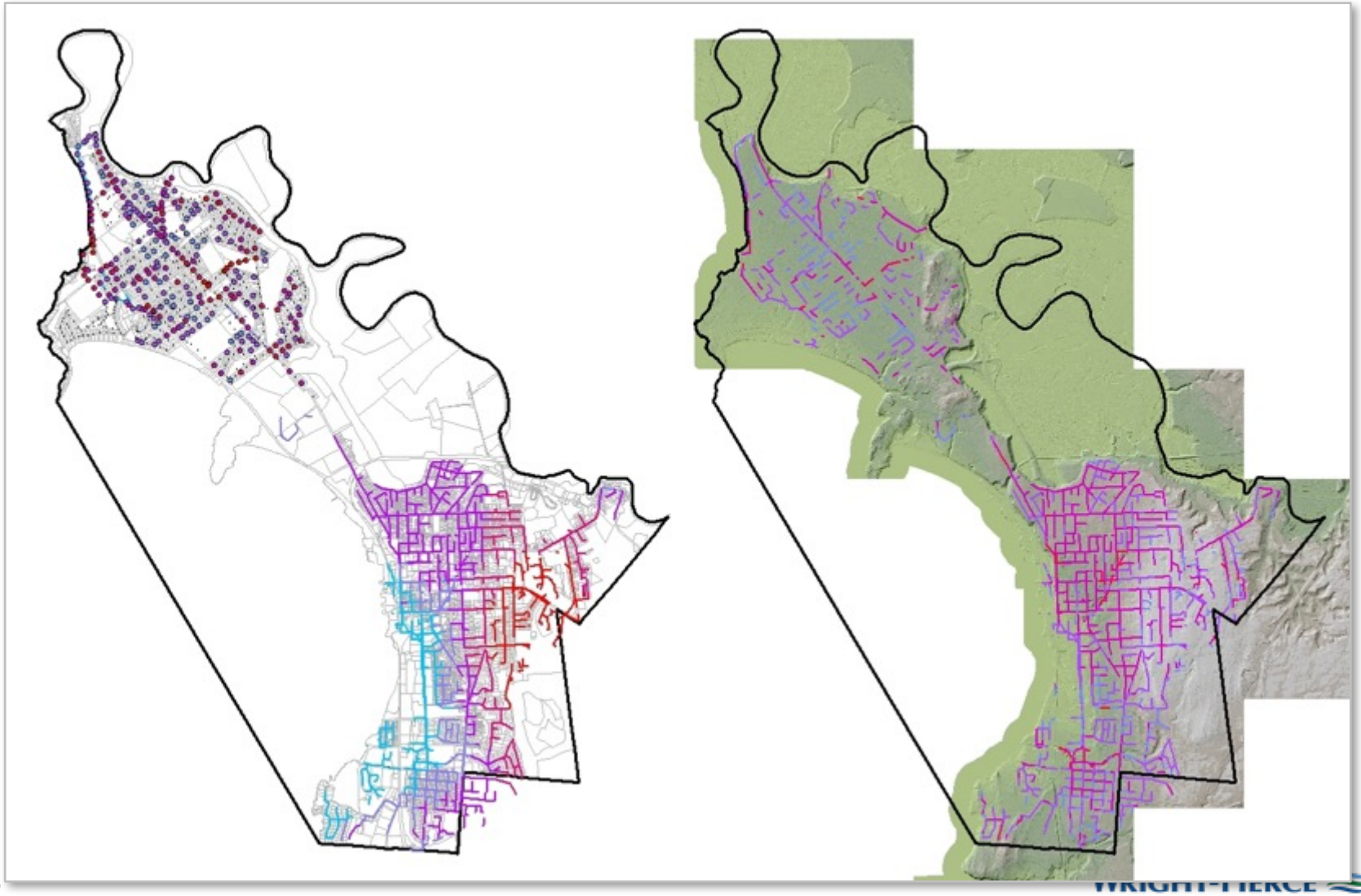

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70 YEARS 1917 - 2007

Additional Consequence of Failure Considerations:

- Bike & Pedestrian Path –
  Treated as a Major Road

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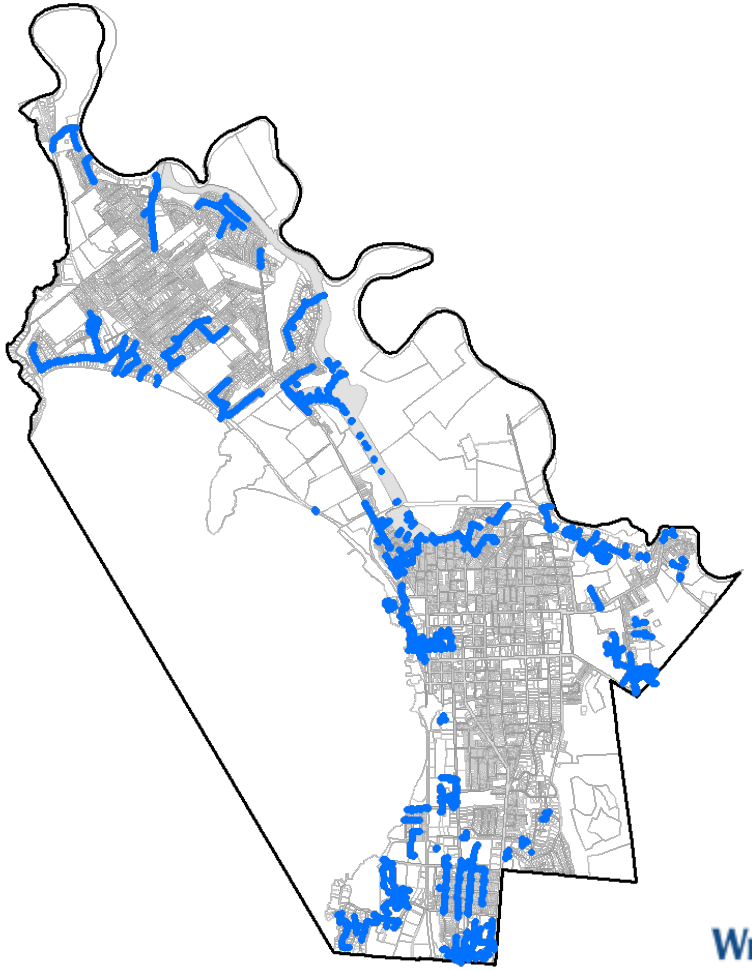
Additional Consequence of Failure Considerations:

- Bike & Pedestrian Path – Treated as a Major Road
- Storm Drains and Outfalls – Treated as Streams



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Consequence of Failure: Weighted Prioritization

Social Costs
(15%)

- Recreation areas (*50%*)
- Critical customers (hospitals, etc) (*50%*)

Economic Costs
(50%)

- Pipe diameter (*33%*)
- Pipe depth (*33%*)
- Road class (*33%*)

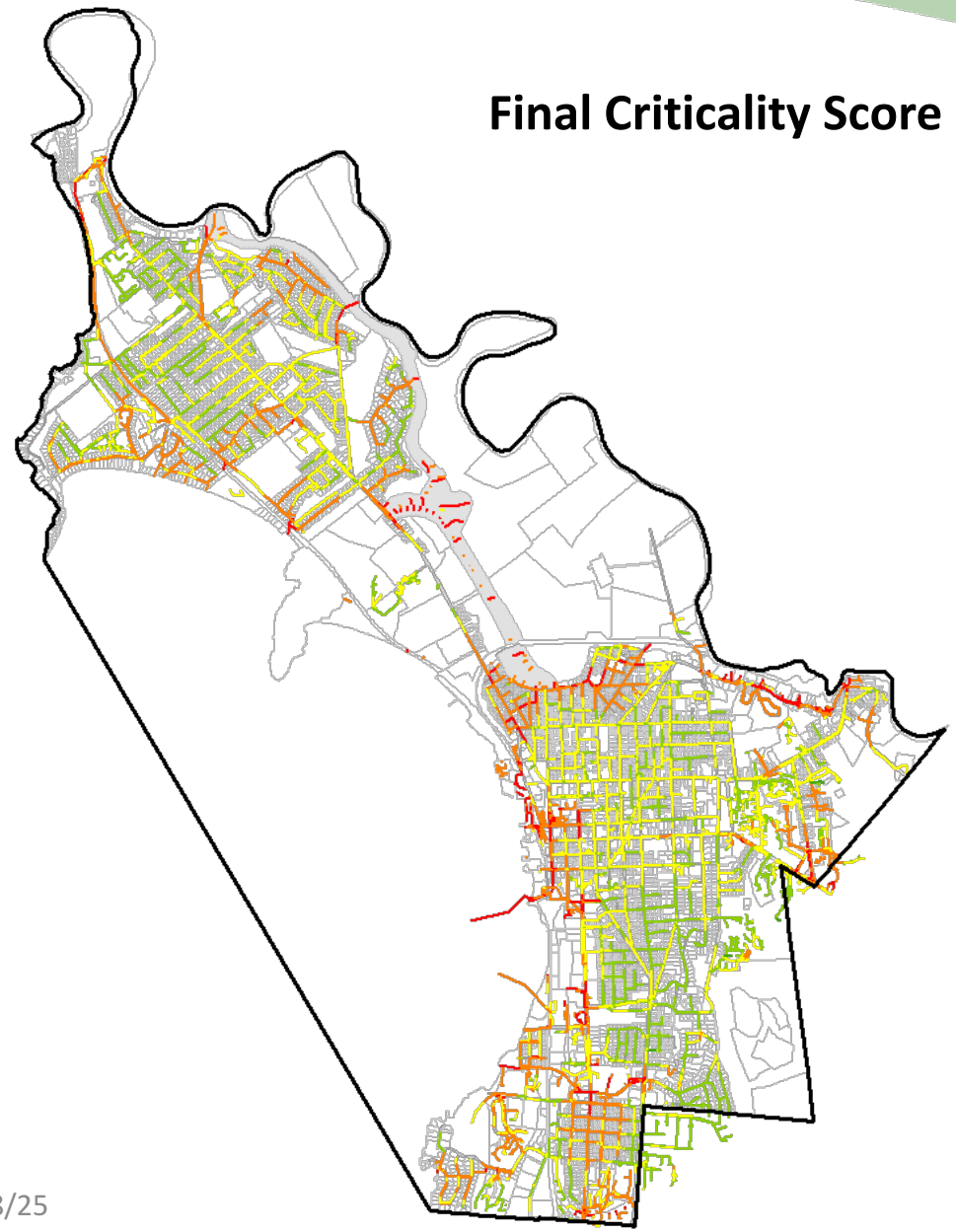
Environmental Costs
(35%)

- Proximity to surface water, wetlands (*80%*)
- Known presence of endangered species (*10%*)
- Significant Natural Communities (*10%*)

Overall Weights for Aggregation

Water	*28.00%*	Recreation Areas	*7.50%*
Pipe Diameter	*16.67%*	Critical Customers	*7.50%*
Pipe Depth	*16.67%*	Endangered Species	*3.50%*
Road Class	*16.67%*	Sig. Nat. Coms.	*3.50%*

Final Criticality Score



Table

Final Criticality

Score_Social	Score_Economic	Score_Environmental	Criticality
0.579356	0.555556	0.70122	2.874856
0.645428	0.388889	0.68945	2.426905
0.60283	0.555556	0.697275	2.893497
0.590455	0.555556	0.695506	2.881245
0.697369	0.444444	0.610067	2.590308
0.269283	0.888889	0.988634	5.001861
0.265989	0.722222	0.932151	4.218312
0.262962	0.722222	0.808451	3.647657
0.269544	0.555556	0.86672	3.43529
0.343282	0.388889	0.97756	3.561483
0.395649	0.555556	0.97193	4.105067
0.300536	0.388889	0.980908	3.525121
0.445459	0.777778	0.977641	4.82016
0.564182	0.611111	0.97785	4.427142
0.504537	0.611111	0.981737	4.37591
0.395649	0.444444	0.981372	3.777682
0.453617	0.555556	0.693634	2.756911
0.398176	0.555556	0.695264	2.708041
0.299094	0.666667	0.994601	4.365784
0.367569	0.666667	0.995388	4.427906
0.541151	0.388889	0.690087	2.333457

1 (0 out of 7040 Selected)

Final Criticality

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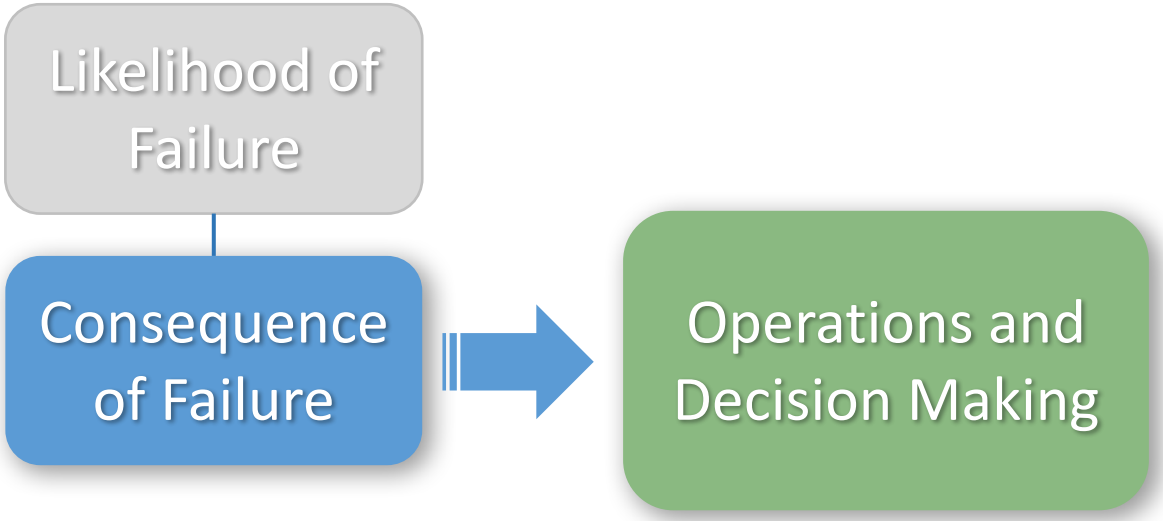

Additional factors for prioritization:

- Known Problem Areas
- Break History
- Paving Plan

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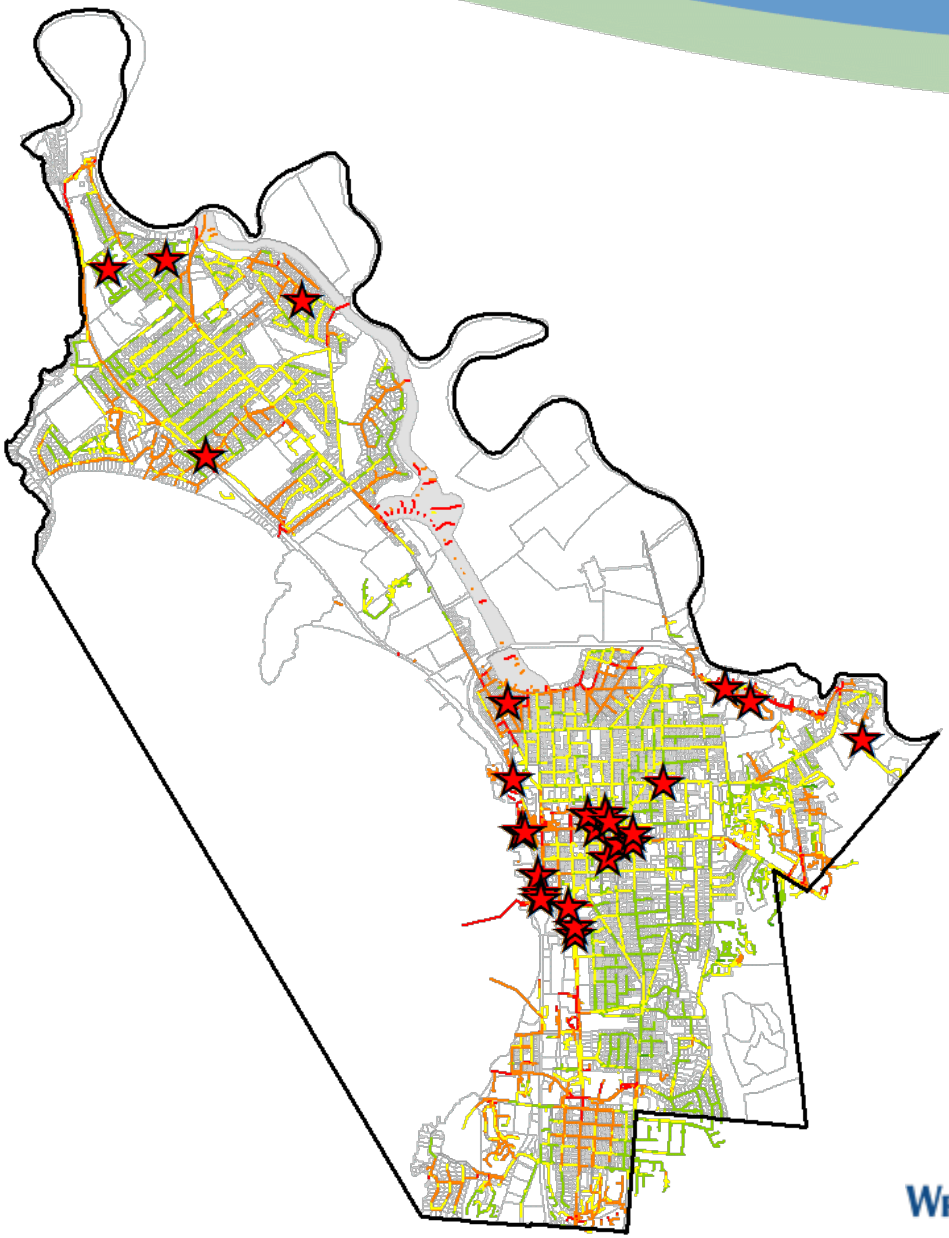
Problem Areas



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Final Selection of Pipes To Be Inspected

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Sewer Inspections

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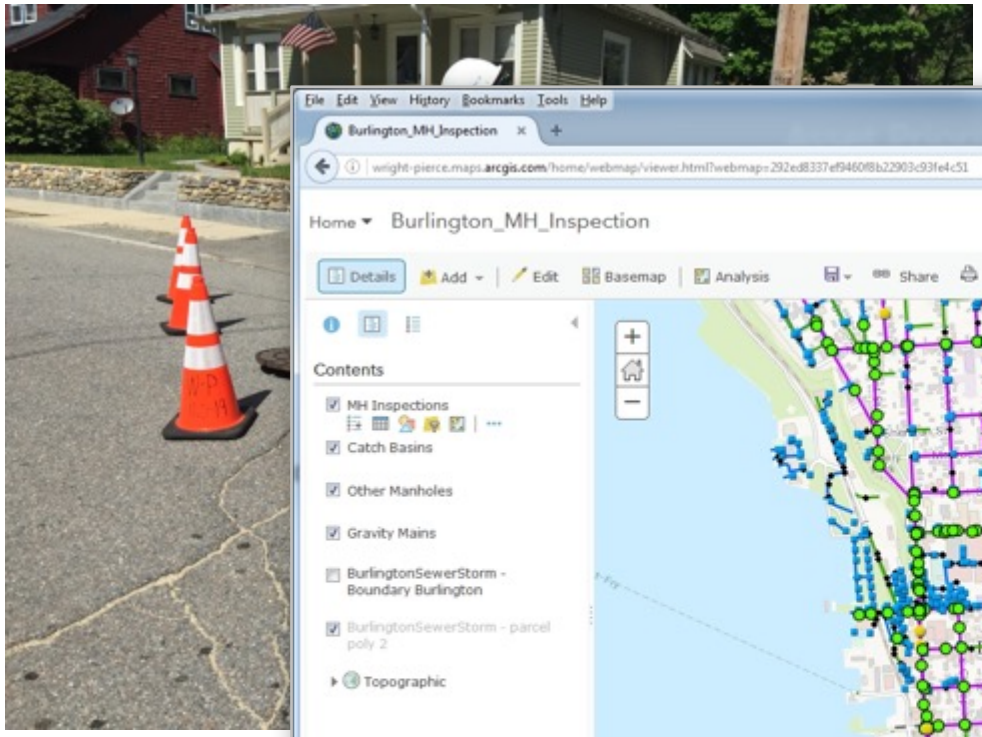
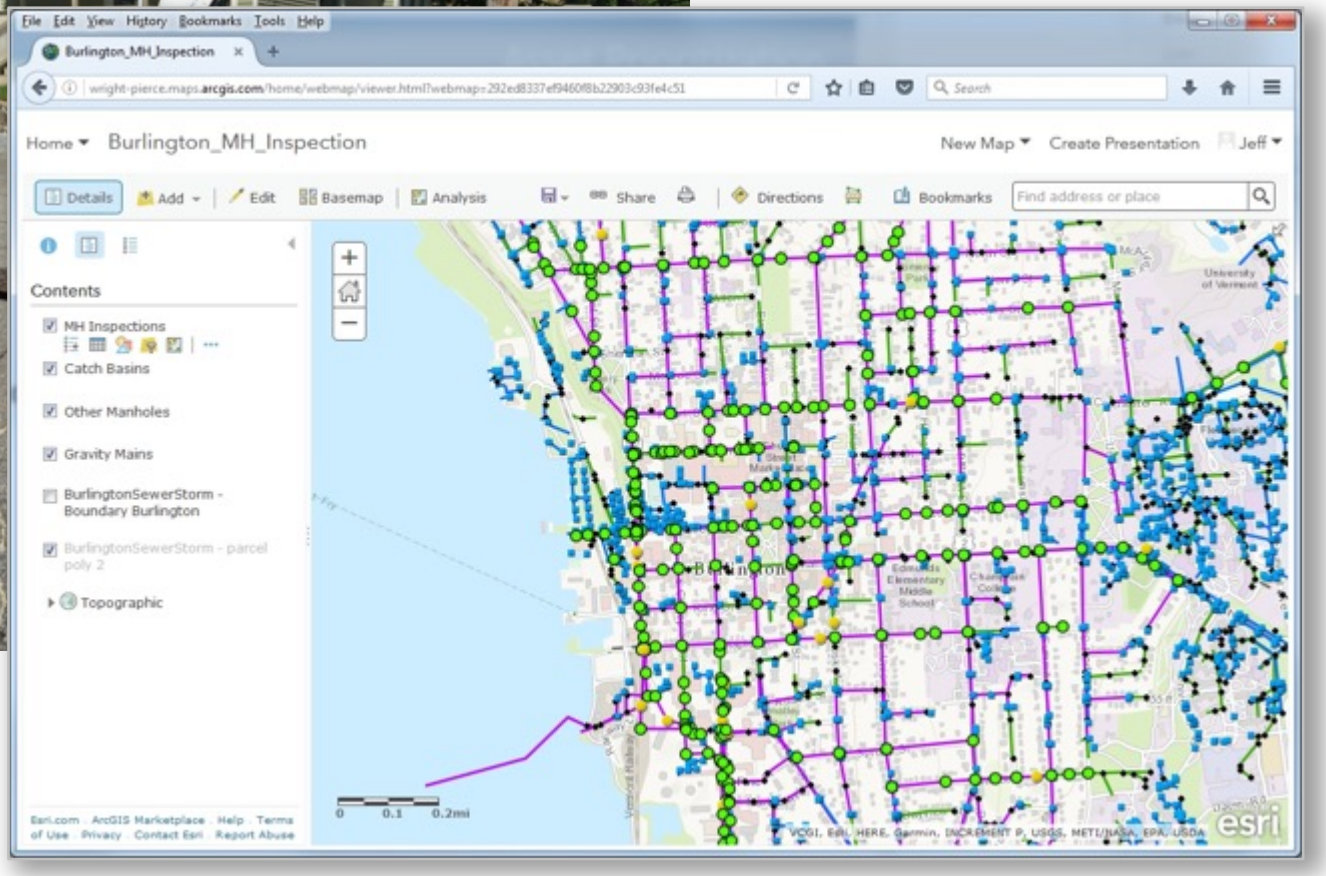
Sewer Inspections



ArcGIS Online for Logging Inspections



WRIGHT-PIERCE Engineering a Better Environment 70 YEARS

Summary

- ☑ Prioritization using diverse infrastructural and environmental considerations.
- ☑ Industry-standard methodology, customized with input from the City management and crews.
- ☑ 550 Manholes and 134,000’ of pipe identified for inspection (2016-2017).
- ☑ Prioritization is defensible, easily revised, and can be clearly presented.

Moving Forward

- Inspections will inform Likelihood of Failure (LoF) analysis.
- LoF will be combined with results of this CoF analysis to create a total Risk score.
- Risk assessment will be used to steer appropriate action:
  - *Inspections*
  - *Cleaning*
  - *Rehabilitation*
  - *Replacement*

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Thanks to:

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