The City of Tacoma’s GIS-Centric Wastewater Asset Performance Modeling Approach
Tacoma’s Sanitary Sewer – Upfront Information

- Tacoma is located within Puget Sound on Commencement Bay
- Over 90,000 Customers
- 2 Treatment Plants:
  - Central WW Treatment Plant
  - North End WW Treatment Plant
- ~ 700 miles of pipe, some of which are 120 years in age
- Size 6-inch to 66-inch
Tacoma’s Sanitary Sewer – GIS History

• Sanitary GIS History
  • AutoCAD—Oracle database (1990s-2014)
Tacoma’s Sanitary Sewer – GIS History

• Sanitary GIS History
  • 2014 - the move to:
    • ESRI—Oracle database (2014-2015)
    • ESRI—SQL database with LGIM structure (2015-present)
Tacoma’s Sanitary Sewer – Asset Management

• Asset Management History
  • Historically separate programs for each utility
  • Early to Mid-2000s started the formal asset management program for sanitary
  • Manually evaluated each pipe for LOF and COF to develop a risk, lots of spreadsheet
  • Searching for software to make this process faster and easier
  • Mid 2014 Environmental Services consolidated into one Asset Management Group
  • 3/2015 Request for Proposal for “Linear Asset Management Software”
  • 8/2015 Contract completed
  • 12/2015 Training
Tacoma’s planning challenges

- How much renewal does my utility really need? And when?
- What’s too much? What’s too little?
- Why did the pipe fail?
- Was it planned to be replaced soon?
- How to justify rate increases to stakeholders?
- Can we capture knowledge from retiring operations staff?
Traditional Capital Improvement Plan (CIP)

• Challenges
  • “Black Box” – not very defensible or repeatable
    • Complex, customized spreadsheets
    • Manual integration to GIS
    • Hydraulic modeling based
    • Human interpretation
  • Hard to quickly decipher, visualize, and share the results
    • Not intuitive
  • Not easy to integrate with existing data (CMMS, GIS, etc.)
  • Difficult (time consuming and costly) to maintain
Traditional Planning Efforts

- Sewer Rehab
- Hydraulic Modeling
- Green Infrastructure
- CCTV / Survey Data
- O&M
- Past Studies / Known Problem Areas
- Streets Department
- Q&M
GIS Based Effort

Green Infrastructure
Hydraulic Modeling
CCTV / Survey Data
Past Studies / Known Problem Areas

Data Inputs
Analytics
Outputs

Streets Department
Sewer Rehab

Q&M

Past Studies / Known Problem Areas

GIS Based Effort

Green Infrastructure
Hydraulic Modeling
CCTV / Survey Data
Past Studies / Known Problem Areas

Data Inputs
Analytics
Outputs

Streets Department
Sewer Rehab

Q&M
GIS Data
Data Validation

City of Tacoma
W A S H I N G T O N
Baseline Replacement Costs

Survival Probability

Baseline Replacement Cost

Data Inputs
Analytics
Outputs
City of Tacoma

Washington
CCTV Data and Draft Rehab

Data Inputs

Analytics

Outputs
Tacoma’s Consequence of Failure Approach

Data Inputs

- SEW_COF1. Diameter
- SEW_COF3. Street Type
- SEW_COF11. Street Condition
- SEW_COF5. Wetlands
- SEW_COF6.1, Don’t use (easement)
- SEW_COF6.2, Don’t use (parcel)
- SEW_COF6. Easements
- SEW_COF8. Building
- SEW_COF2. Depth
- SEW_COF9. Landfill Cap
- SEW_COF10. Pipe Function
- SEW_COF12. Pavement Index
- SEW_COF13. Highway Freeway
- SEW_COF7.1, Don’t use (distanceSlope)
- SEW_COF7.2, Don’t Use (slope)
- SEW_COF7.3, Don’t use (distanceTree Canopy)
- SEW_COF7. Steep Slope
- SEW_COF7.4, Don’t use (paved street)
- SEW_COF14.1, Don’t use (FR ROW)
- SEW_COF14.2, Don’t use (FRParcel)
- SEW_COF14.3, Don’t use (30 ft from FR CL)
- SEW_COF14. FR
- SEW_COF5.1, Don’t use - 300 ft buffer
- SEW_COF5.2, Don’t use - Wetland buffer by Category I 200 ft
- SEW_COF5.3, Don’t use - Wetland buffer by Category II 150 ft
- SEW_COF5.4, Don’t use - Wetland buffer by category III 75 ft
- SEW_COF5.5, Don’t use - Wetland buffer by category IV 50 ft
- SEW_COF15. Stream
- SEW_COF6.3. Don’t use - COT Property
- SEW_COF15. Ponds
- SEW_COF8.1, Don’t Use - Building Size
- SEW_COF8.2, Don’t use - Distance from Building
- SEW_COF17. 2017 Street Project

Analytics

- Pipe Attribute
- Inspection
- Population Density
- Work Order
- Critical Facilities
- Pipe Inventory
- Intersection
- Multi-Parameter
- Pavement

Outputs
Tacoma’s Likelihood of Failure Approach
Risk Analysis and Prioritization

**Likelihood of Failure**
- Hydraulic Model
  - Pressure Changes
  - Roughness
- Infrastructure Data
  - Age
  - Material
- GIS Data
  - Soil Type
  - Railroads/Fault Lines
- CMMS & Work Orders
  - Break History
  - Repairs/Lining

**Consequence of Failure**
- Hydraulic Model results
- Critical Facilities
- GIS Data
  - Street Paving
- Other
  - Traffic Analysis
  - Community Relations

**Calculation of Risk**

<table>
<thead>
<tr>
<th>Risk Class</th>
<th>Capital Action</th>
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<tbody>
<tr>
<td>Extreme</td>
<td>High Priority in CIP / Yearly Operational Frequency</td>
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<tr>
<td>High</td>
<td>Standard Priority in CIP / Biannual Operational Frequency</td>
</tr>
<tr>
<td>Medium</td>
<td>Low Priority in CIP / 1 in 5 Years Operational Frequency</td>
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<tr>
<td>Low</td>
<td>1 in 10 Years Operational Frequency</td>
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<tr>
<td>Negligible</td>
<td>Wait for a problem to arise</td>
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**Data Inputs**

**Analytics**

**Outputs**

City of Tacoma
WASHINGTON
Repeatable Risk Analysis

### Consequence of Failures

<table>
<thead>
<tr>
<th>ID</th>
<th>Weight</th>
<th>Exponent</th>
<th>Category</th>
<th>Parameter</th>
<th>Description</th>
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<td>Proximity to Fire Stations</td>
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<td>Proximity to Parks</td>
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<td>Critical Facilities</td>
<td>Critical Facilities - Police</td>
<td>Proximity to Police Stations</td>
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<td>Intersection</td>
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<tr>
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<td>Critical Facilities</td>
<td>Critical Facilities - Buildings</td>
<td>Buried under Building</td>
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<td>Max of Vertical Asset</td>
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<td>Avg of Vertical Asset COF</td>
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</table>

### Likelihood of Failures

<table>
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<th>Description</th>
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<tbody>
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<td>Pipe Attribute</td>
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<td>Avg of Vertical Asset LOF</td>
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<tr>
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<td>1.00</td>
<td>Mode of Vertical Asset</td>
<td>Mode of Vertical Asset LOF</td>
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</tbody>
</table>

**Facility Scope**
- Full Network
- Selection
- Zone

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**City of Tacoma**

WASHINGTON
Rehab Planning

Data Inputs

Analytics

Outputs
Rehabilitation & Budgeting Engine

Rehabilitation Plans ...Is it lineable? “To Re-TV, or NOT to Re-TV”
Spatial Viewing of Results
Reporting

Data Inputs

Analytics

Outputs
Results in GIS

Budgeting and Rehabilitation Planning

Based on existing defects, likelihood, and consequence of failure, InfoMaster provides rehabilitation and replacement decisions with tools for building a detailed decision tree.

InfoMaster

Phase 1
Rehab Year: 2015 - 2020
Actions: Replace
Total Cost: 17,547
Total Risk: 336
Developing an Approach for your Utility

- Build on a good GIS base
  - Good asset data (material & age)
  - Spatial data sets
- Add asset management & historical data
  - Type and number of breaks and leaks
  - Link between work activity and affected assets
- Identify risk and performance factors
  - Where failure will impact service?
  - What do you and your customers worry most about?
- Feed back data to asset database (GIS)
  - Internal procedures
  - Leverage existing and new computer technology
Thanks For Joining Us!!!

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