That Old Gray Pipe Ain’t What It Used to Be
Gwinnett County Stormwater System Assessment Program

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Presentation Overview

• Project Background
  – Drivers

• Enhanced Inventory Database

• Capacity Level of Service Analysis
  – System Wide H&H Modeling

• Asset Management Decision Support

• Summary
  – Program Going Forward
Project Background

• Gwinnett County, GA
  – Metro Atlanta
  – 437 Square Miles
  – Population 800,000
• Stormwater Management
  – Stormwater Utility Funded
    • Implemented in 2006
    • $31M Annual Revenues ($2.46/100 sf)
  – Aging Stormwater Infrastructure
    • ~1,350 Miles County-Maintained Pipe
      – >1,000 Miles Corrugated Steel
      – ~500 Miles over 20 Years Old
    – Replacement Value $3 Billion
Project Background

• C&M Practices
  – SOP for Rehab/Replacement of Failed Pipe
    • CIPP or Replace Like Size with HDPE or RCP
    • 18” min
  – Existing Conditions Capacity LOS Unknown
    • Hydraulic Impacts of Rehab/Replacement Unknown
      – Does the existing system meet desired LOS?
      – What upgrades are needed to meet desired LOS?
  – H&H analysis on select systems where history of flooding exists
    • At discretion of Division based on site specific concerns
  – Resource Issue - Manpower and Funding
Project Background

- **Active Asset Management Program**
  - Stormwater Inventory Database
    - Pipes, Structures, Ditches
    - Basic Data – type, size, material, etc...
    - X&Y; No Z
  - Strategic Asset Management Plan
    - Identifies Critical Infrastructure
    - Capacity LOS potential score for ranking (unused)
  - Condition Assessment Inspections

- **Bridge/Culvert CIPs**
  - Floodplain Management Program
  - ~600 County Maintained Bridge/Culvert CIPs identified

- Next Step to Analyze Remaining Pipe Infrastructure
**Project Background**

- **Initiated Program in 2011**
- **Study Extents**
  - Pipe Infrastructure Upstream of 100-acre Floodplain
    - County-Maintained Pipe
    - Hydraulically Connected Non-County Maintained Pipe
  - **Data Collection**
    - Leverage existing SW Inventory
    - Collect Measure Down Depths on all pipe ends except for end sections
  - **Inventory DB Enhancement**
  - **Capacity LOS Analysis**
  - **CIP Planning**
Enhanced Inventory Database

- **System Connectivity**
  - Connectivity from upstream to downstream limits
  - Pipes / Channels / Streams / Ponds

- **Enhanced Database Elevations**
  - Invert Estimation
    - Leverage Terrain using MD Data
  - Pipe Profiles
  - Trench Area Impacts
    - Utilities and Critical Infrastructure
  - Easement Needs
  - Quantities for Cost Estimate Planning
Capacity Level of Service Analysis

- Dynamic rainfall-runoff simulation model
  - Pipe Infrastructure Upstream of 100-acre Floodplain
  - EPA SWMM5 engine (PCSWMM)
  - ArcGIS interface
  - Time varying rainfall
    - Synthetic or observed storms
  - Route hydrograph through the system
Capacity Level of Service Analysis: Sub-Catchments

- **Terrain processing tool**
  - Develop flow lines
  - Delineate sub-catchments
  - Determine representative length and %slope

- **% Impervious**
  - Impervious Coverage intersected with sub-catchments

- **Curve Number Generation**
  - Land Cover
  - Soils Data
Capacity Level of Service Analysis: System Setup

- Import Pipe and Structure Data from Enhanced Inventory DB
  - Structures
    - Type, Rim and Invert Elevations
  - Pipe
    - Size, Material, Invert Elevations, Length
  - Ditches/Channels/Streams
    - Assumed typical sections for roadway ditches
    - Transects from terrain for streams and channels
  - Facility ID
    - Pipe, channel, and structure association
    - Sub-catchment and inlet association
- Assign additional parameters
  - Ponded areas, Loss Coefficients, etc.
Capacity Level of Service Analysis: Modeling

- Determined Existing Capacity LOS
  - System Wide Model
  - Each pipe segment
  - Event Based Storm Return Period
    - 12-hour storm duration
      - HGL contained below ground for closed systems
      - Road/embankment overtopping
Capacity Level of Service Analysis: Modeling

- Rehabilitation/Replacement Scenarios
  - System-wide Model Scenarios
    - Not segment specific
  - Cured-in-Place Pipe Rehabilitation (CIPP)
    - All County-maintained CSP
      - No improvements to non-County
    - Improved hydraulics
      - Maintain pipe diameter (lining negligible)
      - Improved Manning’s ‘n’ (0.015)
  - Determine LOS for this Scenario
Capacity Level of Service Analysis: Modeling

- **Rehabilitation/Replacement Scenarios**
  - System-wide Model Scenarios
    - Not segment specific
  - Replace like-size HDPE or RCP
    - All County-maintained CSP
      - Replace with 18” min diameter
      - Replace arch with equivalent round
      - Match downstream regardless of Ownership
  - Improved hydraulics
    - Improved Manning’s ‘n’ (0.015)
  - Determine LOS for this Scenario
Capacity Level of Service Analysis: Modeling

- Rehabilitation/Replacement Scenarios
  - System-wide Model Scenarios
    - Not segment specific
  - Replace with HDPE or RCP to meet desired LOS
    - Pipes not meeting desired LOS from CIPP/Replace Like Size Scenarios
      - 18” min. diameter
      - Replace arch with equiv. round
    - Closed, Lateral, and Longitudinal Pipes
      - 25-yr Storm LOS
  - Culverts
    - 100-yr Storm LOS
  - Pipe Diameter Upgrades
    - Match diameter downstream regardless of Ownership
Asset Management Decision Support

- **Asset Management Decision Support**
  - Rehab/Replacement Scenarios
  - What's the pipe's existing LOS?
  - What's the LOS if lined (CIPP)?
    - What does that cost?
  - What's the LOS if replace like size with HDPE or RCP (18" min)?
    - Same as CIPP except where pipe diameter < 18"
    - What does that cost?
  - What do we need to do meet the desired LOS
    - What does that cost?

- **Leverage DB, GIS, and Models**
  - Estimate of Quantities
  - Develop Accurate Planning Cost Estimates
Asset Management Decision Support - Quantities

- **Enhanced Inventory Database**
  - Pipe Size, Material, Length
    - Replacement Pipe, CIPP
    - Remove Pipe, Silt Fence, Inversion Setup, Clean Pipe
  - Pipe depth along profile
    - Depth to Top of Pipe
    - Backfill
  - Structure Type, Depth
    - Replacement Structure
    - Remove Structure, Silt Fence

- **GIS Data**
  - Transportation Polygons
    - Roadway, Sidewalk, Driveway Feature Classes
  - Barrier Feature Class
    - Fence
  - Trench Area Polygons
    - Street Cut, Driveway, Sidewalk Removal and Replacement
    - Remainder - Sod
    - Fence Removal and Replacement

- **Populate Database with Quantities**
Asset Management Decision Support – Unit Costs

- **Unit Cost Database**
  - Annual Contractor Prices
  - GDOT Item Mean Summary
  - Engineering Judgment
    - Logical Incremental Price Increases
  - Rolled Up Specific Items into One
    - GP1, GP2 CBs as simple CB
  - Unit Conversion for Specific Items
    - RCB from CY to LF
  - Contingency to Unit Price
    - Incidentals not captured in GIS
Asset Management Decision Support – CIP Tool

- GCSWM Stormwater System CIP Tool
  - ESRI ArcGIS and Microsoft Excel

ArcGIS
- Inventory & Rehabilitation/Replacement Info Database

ArcGIS
- Select conduits/structures
- Select rehabilitation/replacement scenarios

Excel
- Cost breakdown for each conduit/structure under each scenario
- Cost roll-up for each scenario
- Cost comparison between scenarios

Excel
- Unit Costs Database
Asset Management Decision Support – CIP Tool
Summary

- **Asset Management Decision Support Tool**
  - Enhanced DB and GIS Data
  - Model Results
  - Accurate Planning Level Cost Estimates
  - Assist in Rehab/Replacement Decisions

- **Sustainable Models**
  - New Inventory
  - Replaced/Rehabbed Inventory
  - Updated H&H
    - Land Cover Changes
  - Unit Prices/Quantities
Summary

• Going Forward
  – Watershed Studies
    • System Assessment
      – 7 Watersheds Complete (over 440 miles pipe)
      – 3 Watersheds Under Study 2014
      – 7 Watersheds 2015 – TBD
  – Integrate with Floodplain Management
    • Extend Study Extents to Zone AE
    • Update LD models and CIP Planning
  – Align with Condition Assessment Scoring to Identify CIPs
  – DB / Model Maintenance

• Other Potential Applications
  – Forensics
  – Emergency Preparedness
  – Pollutant Loading
  – LID / Green Infrastructure Planning
Questions

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