Leveraging GIS data and tools for maintaining hydraulic sewer models

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Metropolitan Sewer District of Greater Cincinnati

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- Senior Engineer, Metropolitan Sewer District of Greater Cincinnati
- 14 years of experience with MSDGC SWMM model
- Licensed Professional Engineer: Ohio
- B.S. Civil Engineering, University of Cincinnati
- Interests: Outdoor Activities with my Family
Agenda

- Background
- Challenges and Goals
- Update Process & GIS Tools
- Lessons Learned
Background
Metropolitan Sewer District of Greater Cincinnati

- Serving 855,000 people
- Annual Operating budget: $234 Million
- 290 Square Mile Service Area
- 7 Wastewater Treatment Plants
- 120 Pump Stations
- Over 100,000 pipes and manholes
Background
Cincinnati Area Geographic Information System (CAGIS)

- Established in 1987 as a cooperative agreement
- Centralized data
- “CAGIS offers governments, utilities, companies, groups, or citizens a new, intelligent, and cost effective tool to make informed decisions based on shared data within a standard framework”

http://cagismaps.hamilton-co.org/cagisportal/About/history
Background
Cincinnati Area Geographic Information System (CAGIS)

- Contains most up-to-date information
- Reflecting most recent completed CIPs
- Contains Attributes of all MSDGC Assets
  - Manhole X,Y coordinates
  - Pipe Invert/size Information
Background

System Wide Model

- Developed between 2000-2003 using CAGIS data
- A planning tool to support Capital Improvement Projects (CIP) and Wet Weather Improvement Program (WWIP)
- WWIP – as a result of Consent Decree, over $1.14B of Phase I improvement projects
Background
System Wide Model

- More than 50,000 model pipes
- More than 1,800 miles of modeled sewer
- All sanitary sewers 12” and greater in model
- All combined sewers 18” and greater in model
- Divided into 7 models; one per WWTP
MSDGC’s Challenge

- Maintaining an accurate, up-to-date model
  - Essential for assessing the merits of proposed projects
- CAGIS is continuously updated
- Model attributes vs. GIS attributes

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Project Goals

• Continue to keep SWM up-to-date, including recent completed projects

• Develop GIS Tools that can make update process efficient with built-in quality control

• Provide user with the ability to decide which value to update and which to keep; and document user decisions
MSDGC’s GIS Tools

- Model Input Tool
- Comparison Tool
- Model Updates Decision Support Tool
Model Update Workflow

1. Read Model File into GIS
2. Identify differences between Model and CAGIS
3. Incorporate Updates
4. Export the updated Model
5. Model planning activities: CIP/WWIP
Step 1: Read Model File into GIS

- The SWM is in the U.S. EPA Storm Water Management Model (SWMM) INP file format, a text-based format.
- The model input tool consolidates many different sections from the INP file and creates three GIS layers:
  - Point Layer: Junctions (manholes)
  - Line Layer: Conduits (pipes)
  - Polygon Layer: Subcatchments (drainage areas)
- The model input tool reads the remaining sections of the input file (settings, dry weather loading, rainfall, etc.) and stores these in a database table.
Step 1: Read Model File into GIS – Model Input Tool
Step 2: Identify Differences between Model and CAGIS – Comparison Tool

- Different symbols/colors for Model and CAGIS
- Make both visible simultaneously
- Use direction arrows
Step 2: Identify Differences between CAGIS and Model

- Decision Tree Logic to classify differences
- User-defined thresholds
- Ease of tracking
Step 3: Incorporate Updates – Decision Support Tool

DM Smith Model Update Dockable Window

Table Of Contents

Layers

- Indian_Creek
- Indian_Creek_Jun
- Junction
- Outfall
- 22
- Storage
- 24
- Indian_Creek_Con
- Pipe
- 1
- Orifice
- 21
- Pump
- 23
- nsd_nh
- nsd_sewer

CAGIS - Model Differences:

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Step 3: Incorporate Updates – Decision Support Tool

Update tool presents user with model pipe history.

Differences highlighted.

User may select stock or enter a custom comment.

Multiple pipes may be selected at once.

User chooses whether or not to update the model to match CAGIS.
Step 3: Incorporate Updates

- All comments and model changes are automatically logged in a database
- Documents rational behind decisions
Step 3: Incorporate Updates

- Minor/marginal changes are updated in bulk without manual review
- This is done with queries in Microsoft Access to perform and document the changes
Step 4: Export the Updated Model

- An INP file is exported from GIS using the custom tools
- Exported file is reviewed and debugged
- Model is now available for Step 5: Planning activities for CIP/WWIP
Lessons Learned

- Model Inputs and GIS data are not the same
  - 1:1 relationship between model and GIS is impractical
- Both the model and GIS are evolving, requiring periodic model updates
- GIS can be a powerful tool for keeping the model current
  - Needs a systematic method to streamline the updates and decision making
- Integration with a database to track model changes and decisions allows for tools to streamline the update process
Questions?