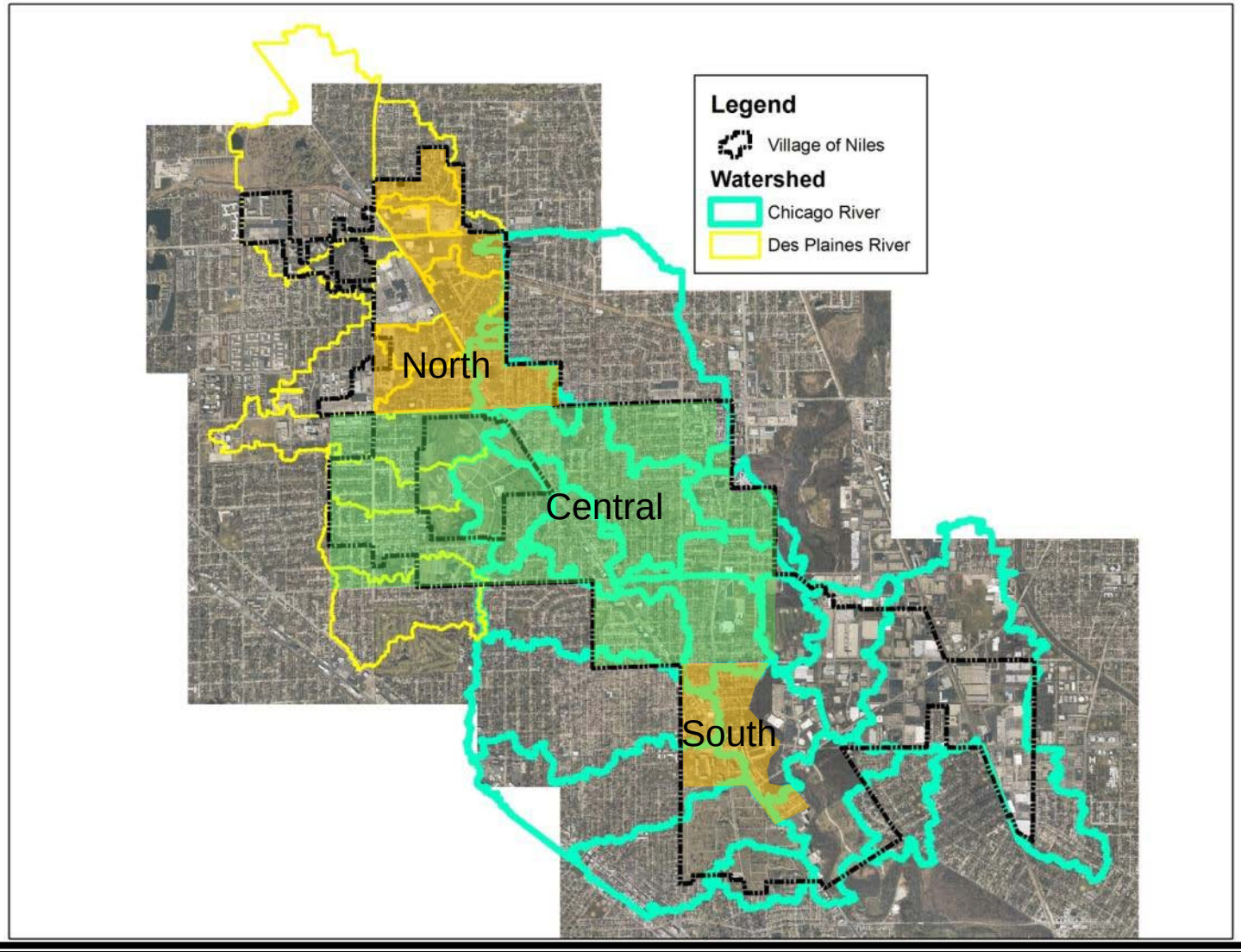
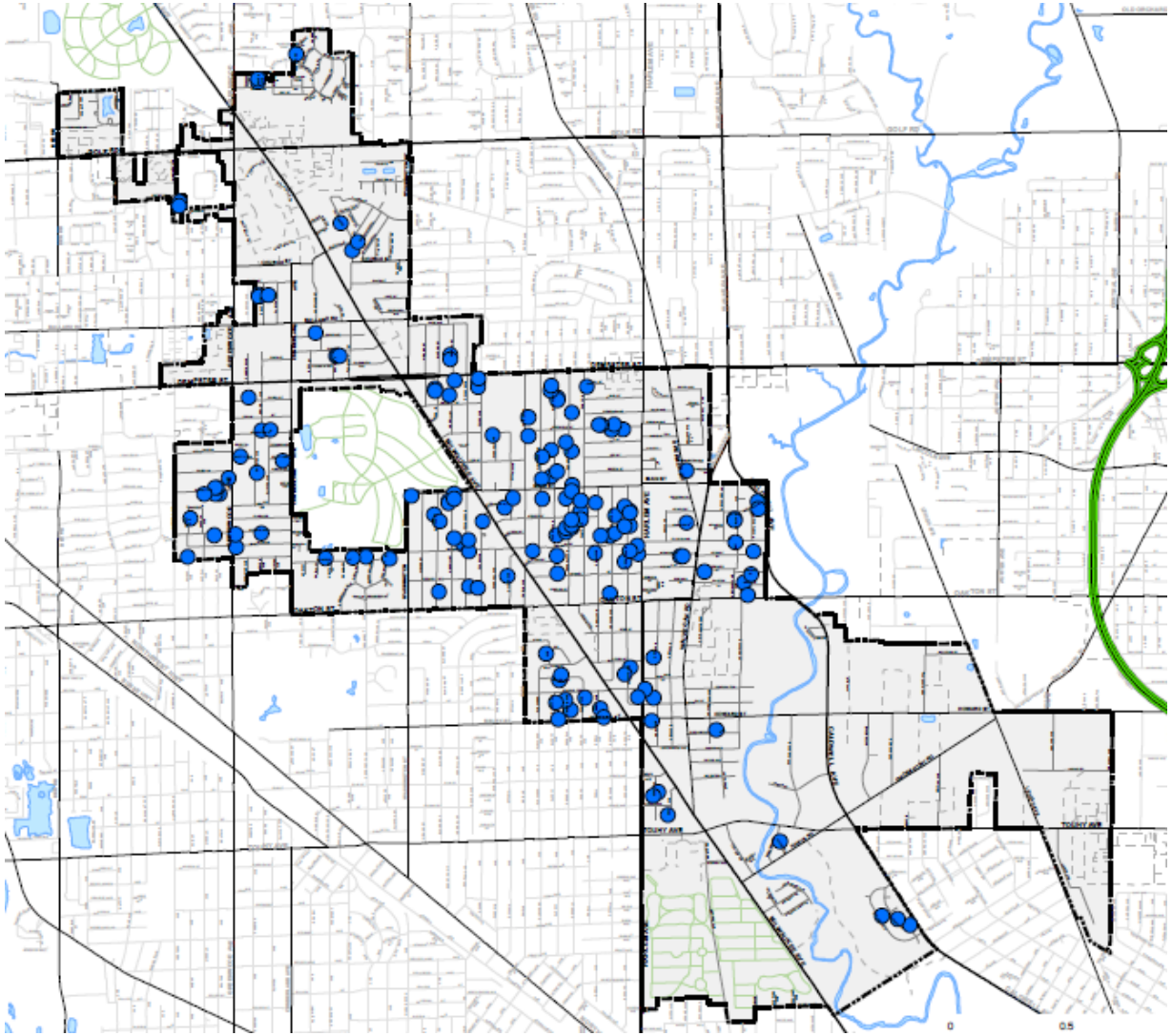
Benefits of 2D Modeling for Urban Stormwater Master Planning Niles, Illinois

Patrick Lach, P.E., CFM, Hey and Associates, Inc.
Steve Vinezeano, ICMA CM, LEED AP Assistant Village Manager

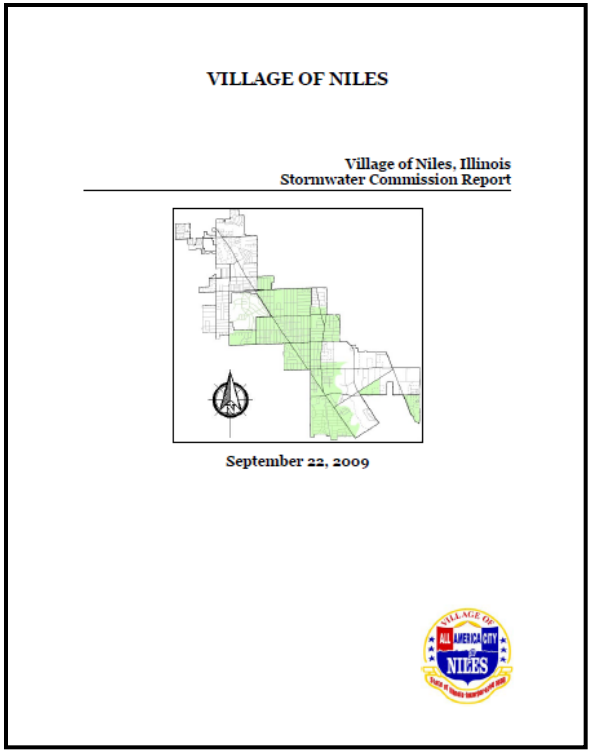
Three Geographic Regions



Homeowner Feedback



Stormwater Commission Report



Stormwater Commission Report 2009

- Homeowner Education Program
- Several immediate stormwater improvements
- Recommended new stormwater regulations
- Converted paper sewers atlases to GIS
- Identified key areas requiring detailed analysis

Stormwater Relief Program

Cost Share Programs

- Flood control systems
- Floodproofing

Maintenance and Monitoring

- Slip lining
- Catch basin cleaning
- Flow monitoring

Comprehensive Stormwater Program

Regulatory Program

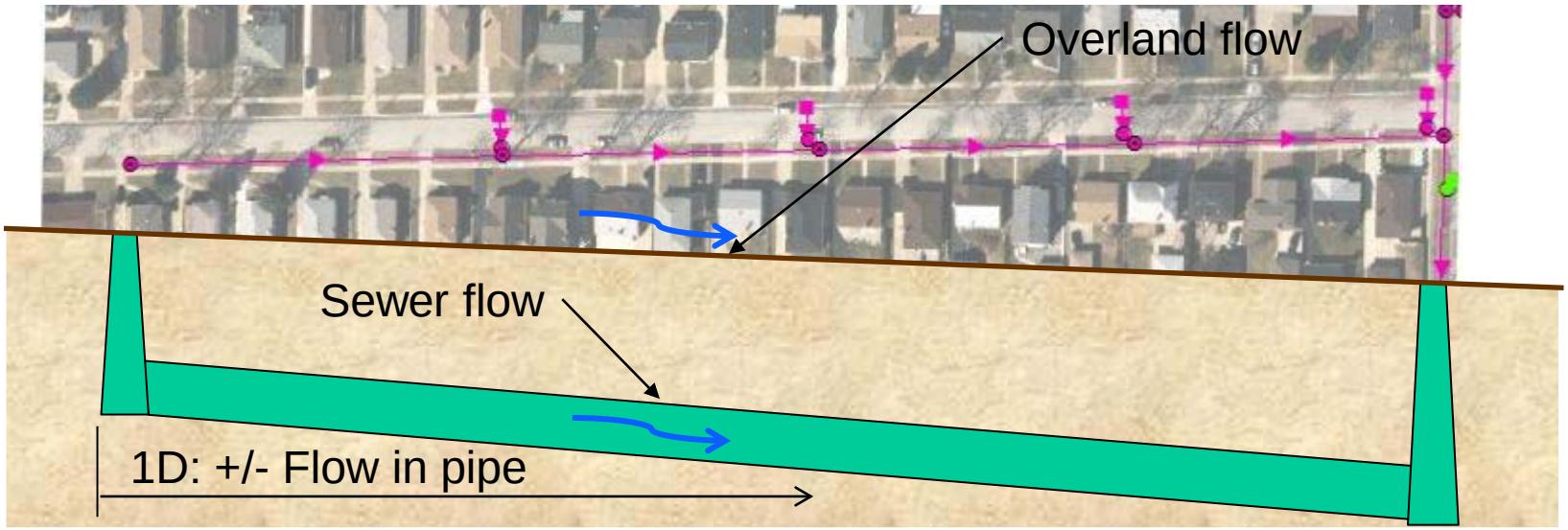
- Niles Ordinance
- County Ordinances
- State/Federal Regulations

Capital Improvements

- Recommended Projects

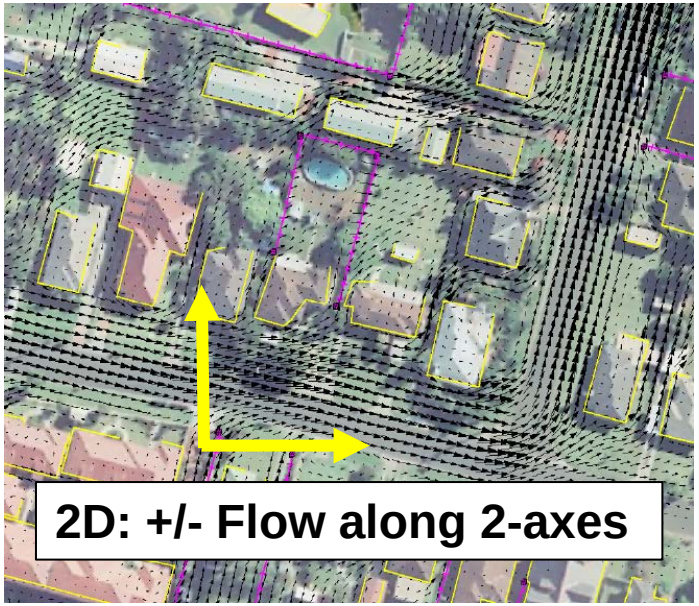
Overview of 2D Modeling

- **Traditional hydraulic models are one dimensional: Water flows only on one axis**
- **Urban modeling with 1D Models such as USEPA SWMM:**
  - **Manually define underground and aboveground flow paths**
- **Typically challenging to convey model results and flood risk**



Overview of 2D Modeling

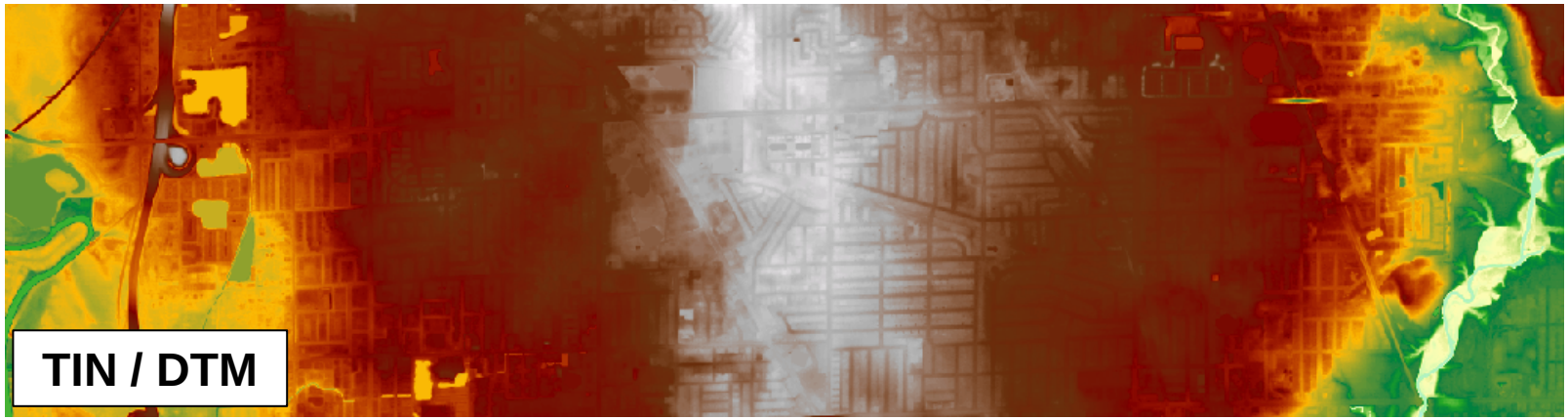
- 2D Model solves for flow in two dimensions
- Solves shallow water equations for modeling tides, storm surges, tsunamis, and river/urban flooding
- 2D Modeling – Use a 2D model for surface flow with a 1D model for typical urban drainage systems (sewers, weirs, etc.)



- Ability to analyze and predict flood extents, depth and velocities while interacting with a traditional 1D model
- Utilize fully dynamic XP-SWMM (based on USEPA SWMM) with XP 2D Module based on TUFLOW
- XP SWMM 2D is FEMA Approved

2D Modeling Data Requirements

- **Typical data needed for Urban 2D Modeling:**
  - **Storm sewer network**
  - **Topography (LiDAR, DTM, TIN)**
  - **Land use (Manning n, infiltration, buildings, obstacles)**
  - **Grid size: Modeling detail versus computation time**
- **Determine parameters to link 1D model (sewers, manholes, inlets) to the 2D model (surface flow)**

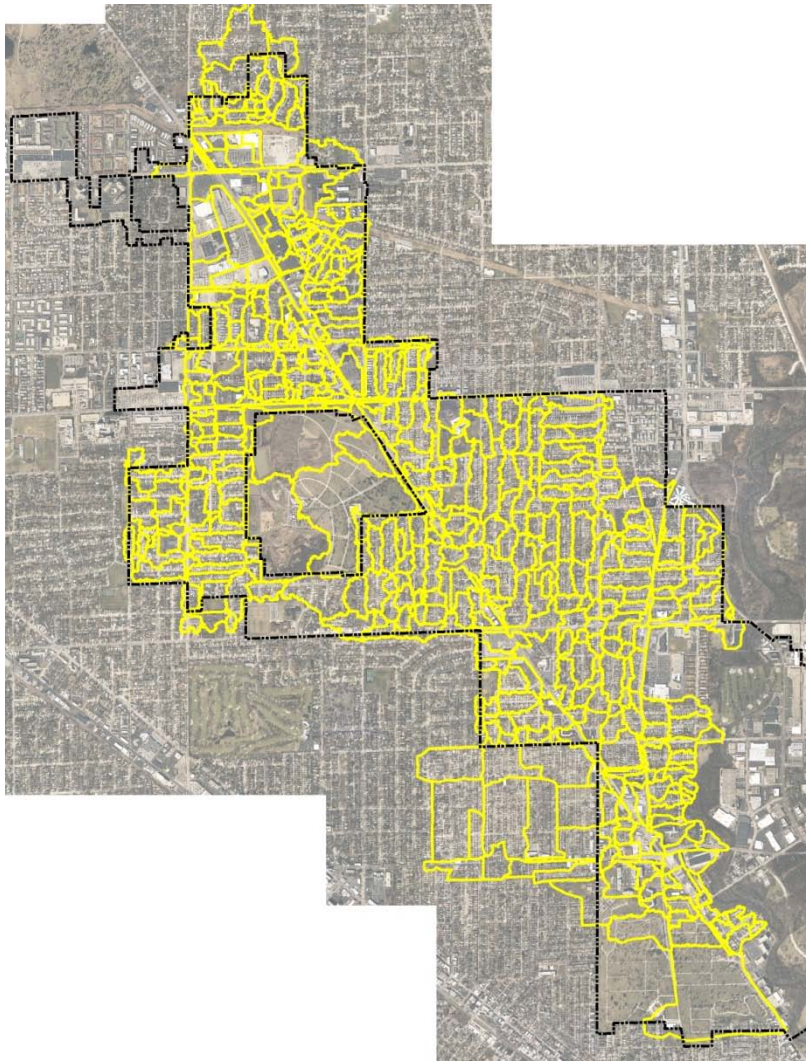


2D Modeling Applied to an Urban Area

- Complex urban hydraulics with combined and separate sewer system extents overlapping
- Need to quickly determine flood risks:
  - Why is it flooding?
  - From where is the water coming?
- Develop potential solutions to alleviate flood risks associated with both underground systems and overland flow
- Need to get buy-in from Village staff and residents for both the existing conditions analysis and the proposed solutions
- Show results and flooding extents instantaneously

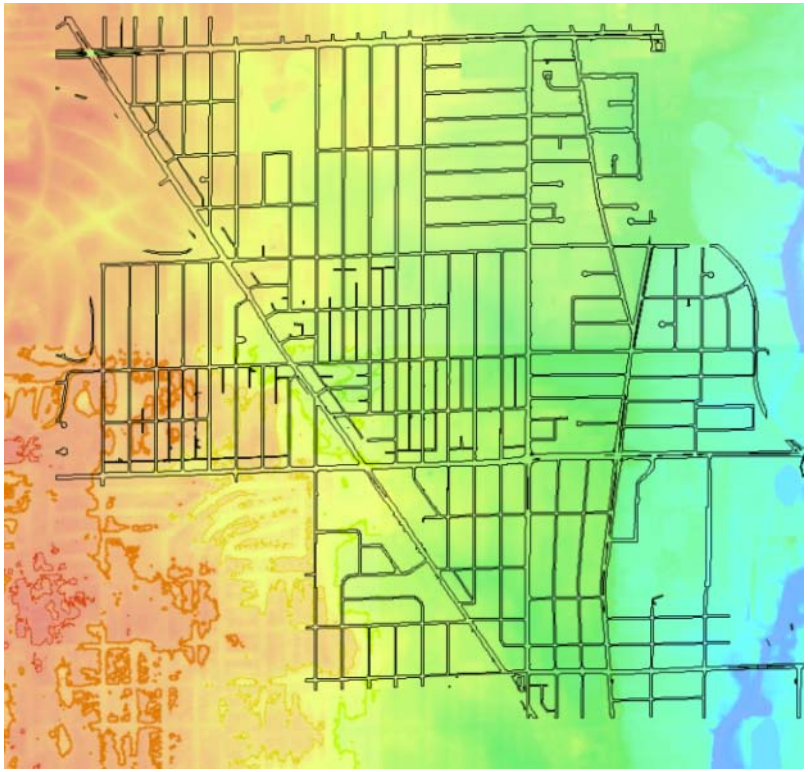
Modeling Overview

- 4.67 square miles
- 550 Subwatersheds
- 5.4-acre Average Area
- Separate and Combined Sewer Areas
- 2 major watersheds (Des Plaines River and Chicago River)
- Outfalls to open channels, other municipal storm systems, TARP



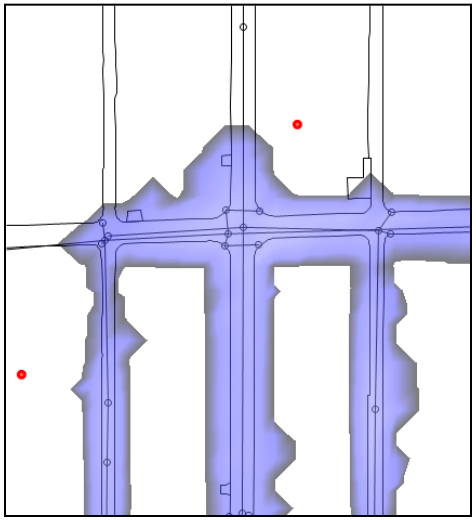
Hydraulic Modeling

- **Began with paper and electronic sewer atlases**
- **Identified problems, survey responses and complaints**
- **Conducted field work**
  - Measured over 380 manholes
- **Model includes 1275 manholes and 32.3 miles of pipe**
- **Utilized state-of-the-art 2D modeling tool to represent surface flooding**

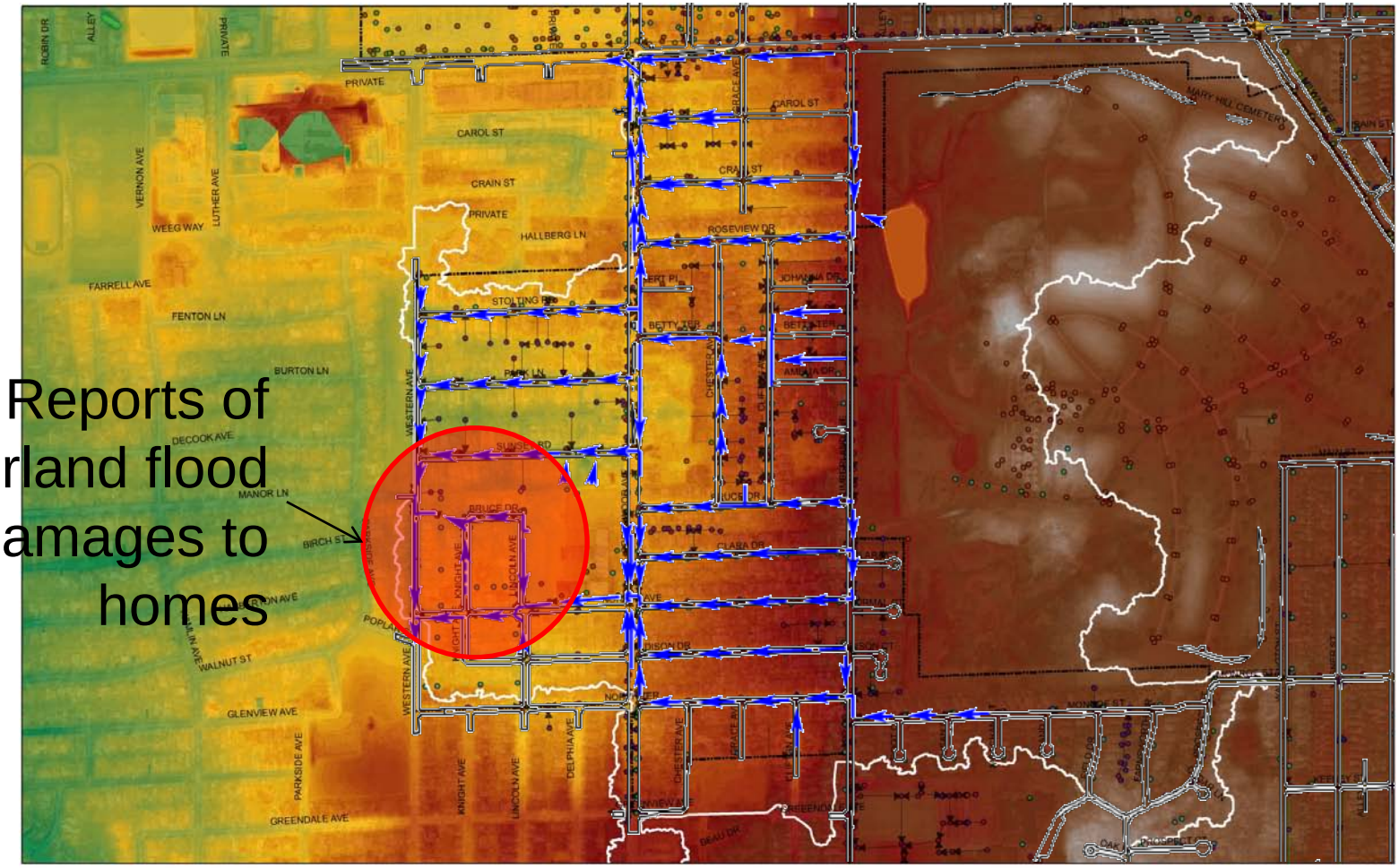


Hydraulic Modeling

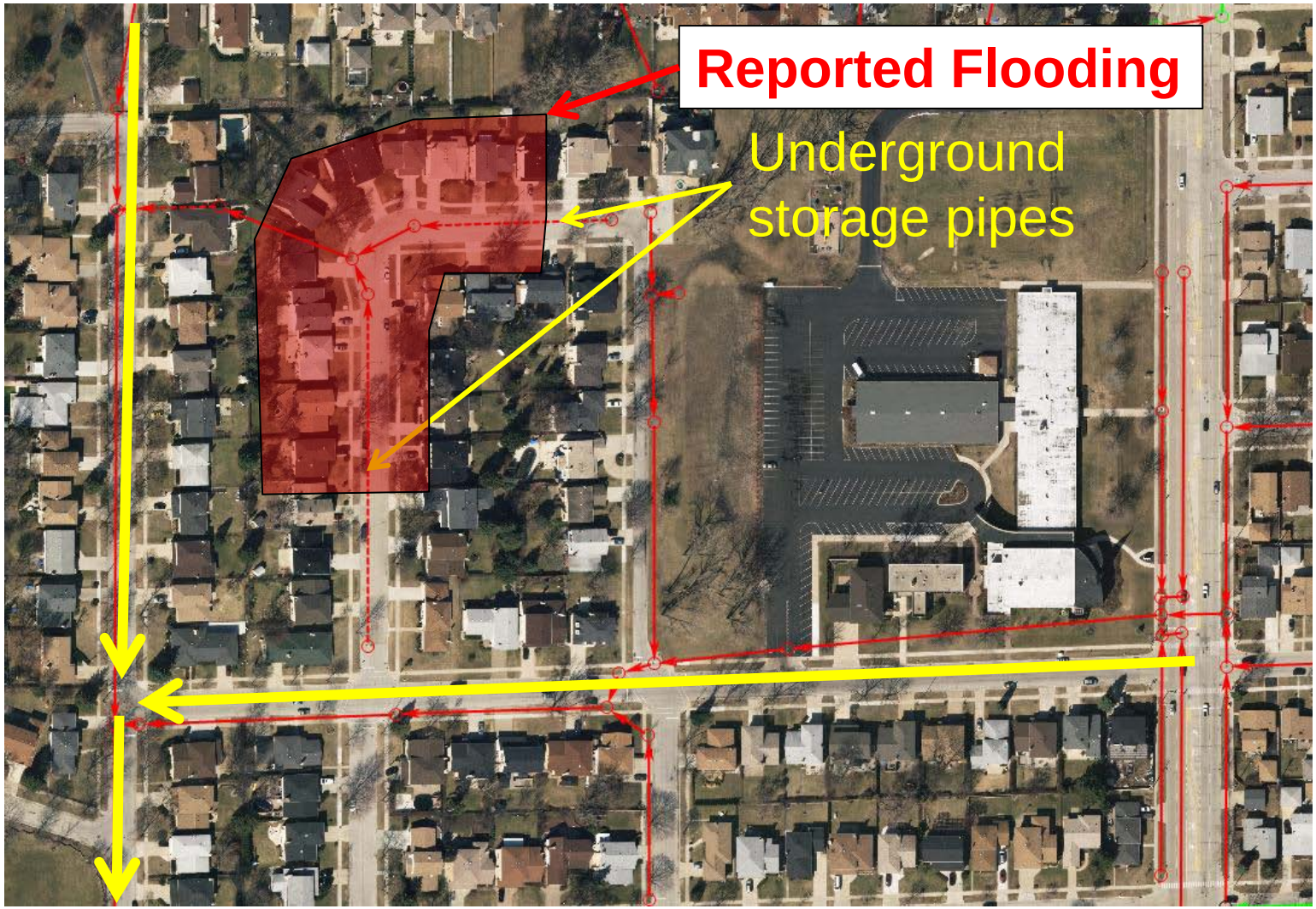
- Modeled September 12-14, 2008 Storm Event
- Evaluated 10-, 25-, 50- and 100-year storm events
- Sewer performance consistent with chronic flooding locations
- Diagnosed causes of flooding problems and developing list of potential solutions



Overview of 2D model results



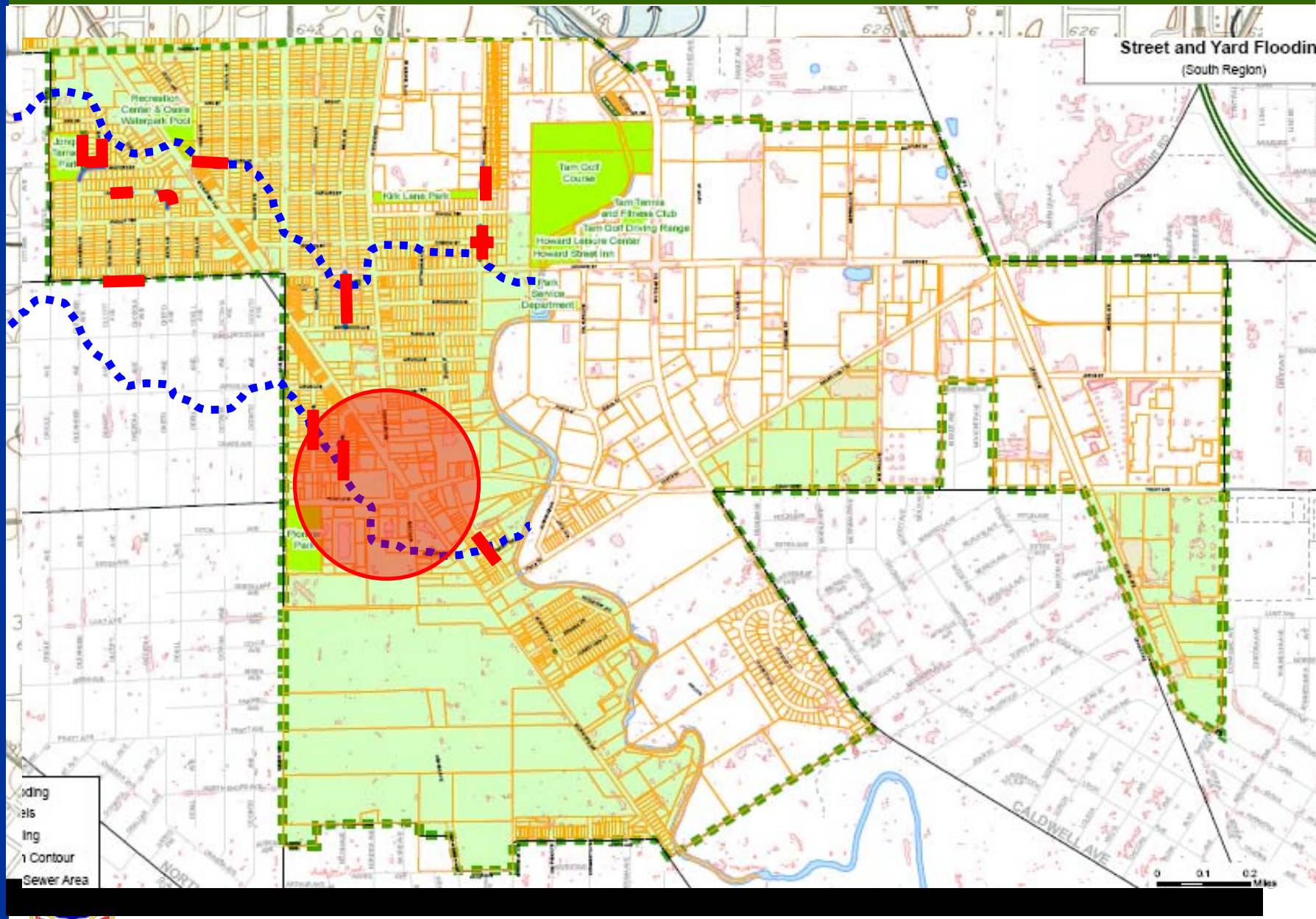
Overview of 2D model results



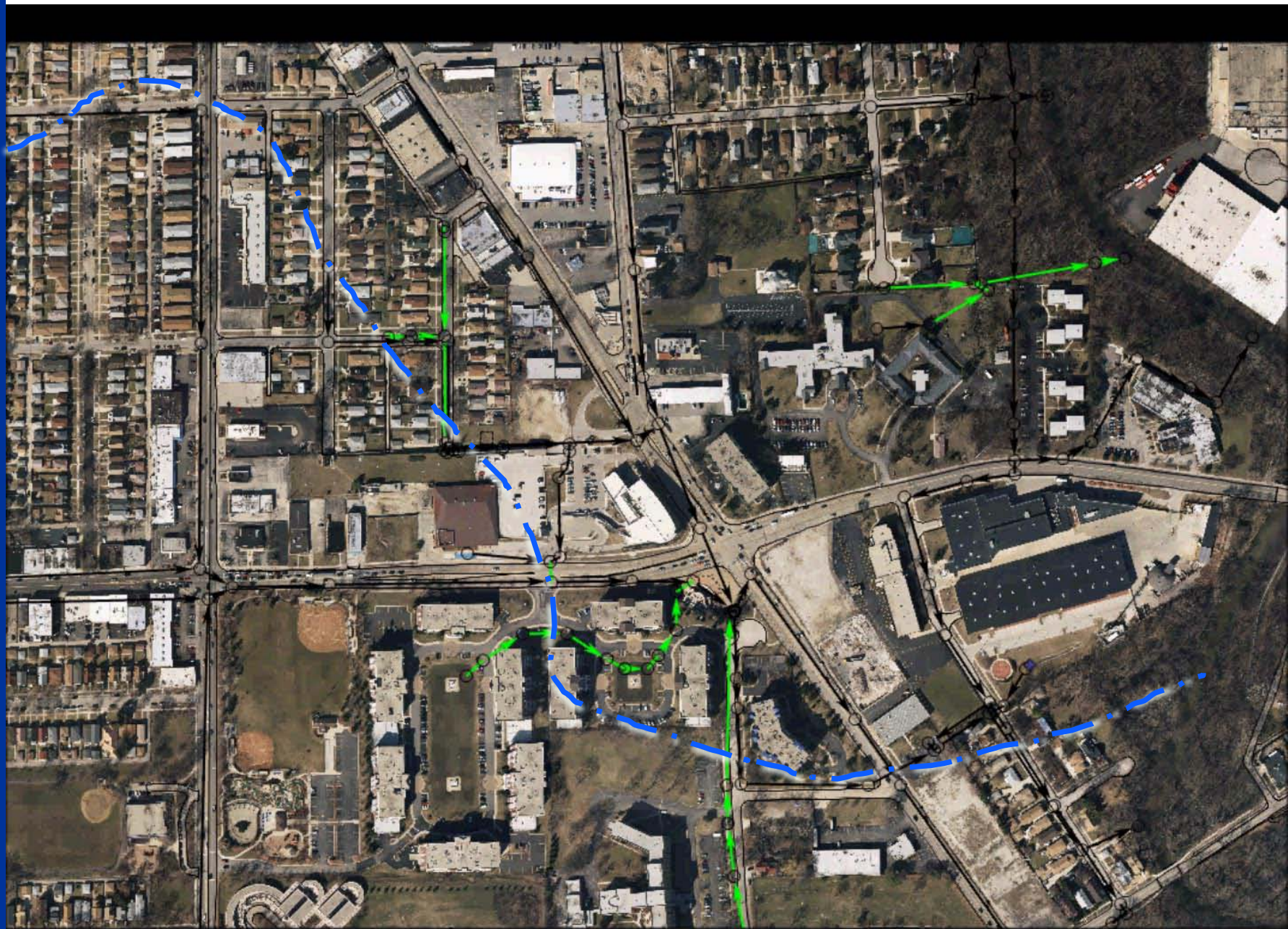
Overview of 2D model results

Overview of 2D model results

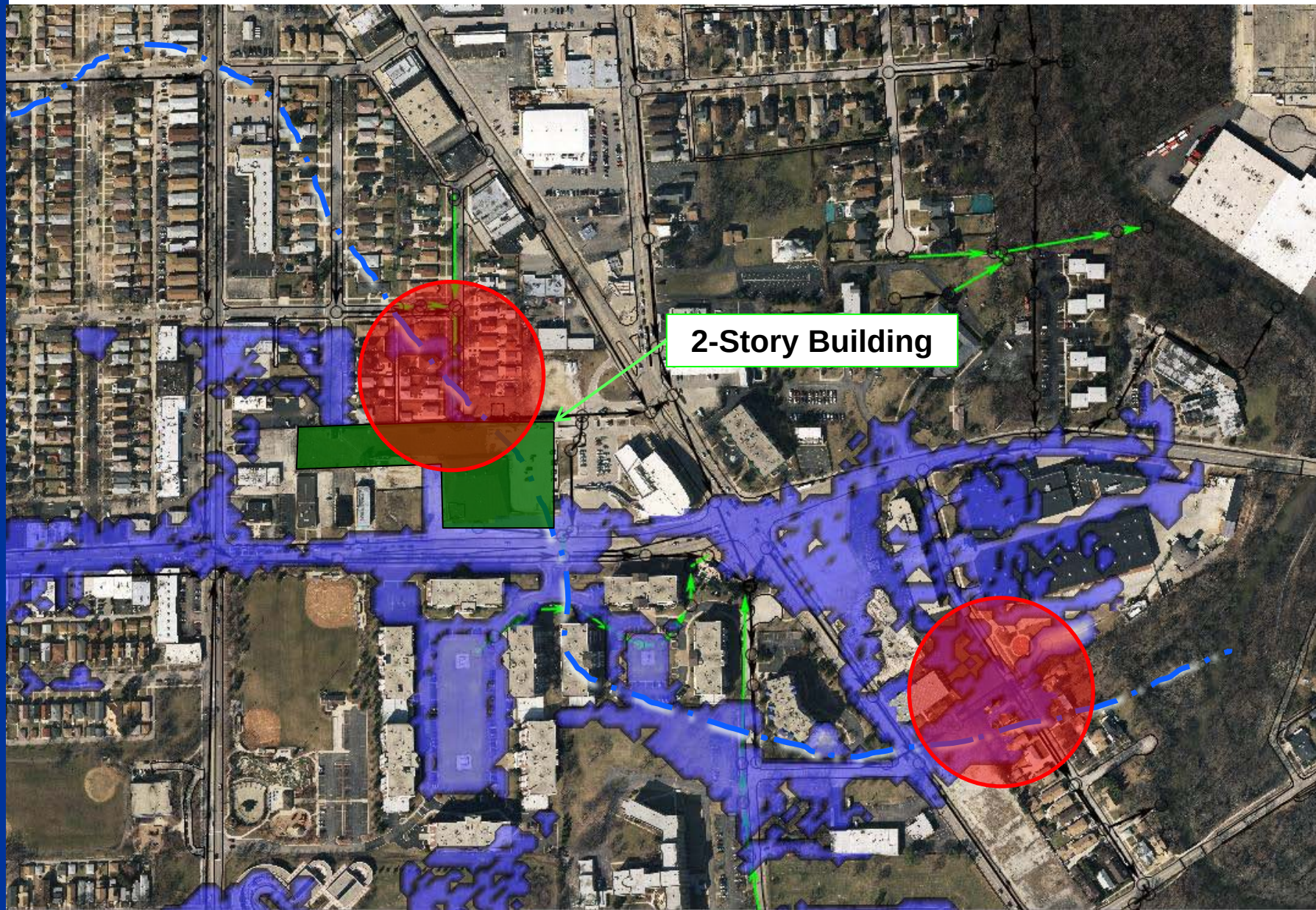
Overview of 2D model results



Overview of 2D model results



Overview of 2D model results



Benefits of 2D Modeling

- Immediate and dynamic flood extent results
- More efficient to setup when compared to traditional modeling procedures. (Computation time is typically higher for 2D)
- Accounts for all potential overland flow paths
- Accurately accounts for depressional storage
- Better results integration with GIS
- Better ability to communicate the results (how and why?)

Discussion and Questions