

# City of Evanston Stormwater Master Plan Update

November 16, 2022

- Background
- Existing Sewer System
- Study Objective
- Data Collection
- Sewer System Model
- Flow Monitoring
- Calibration and Historical Storm Verification
- System Evaluation
- Program Recommendations

# Background

- Long Range Sewer Improvement Program
  - Designed to reduce flow in combined sewer system
- Climate Action and Resilience Plan (CARP) - 2018
  - Addresses need for resilient stormwater management in the face of future climate change
- Stormwater Management Guide - 2019
  - Calls for development of Stormwater Master Plan
- Stormwater Master Plan (SWMP)
  - Awarded to Hey and Associates April 27, 2020

# Background

## CARP – Climate Resilience

### Evanston Climate Hazards

Climate Hazard	By Mid-Century 2050	By End-Century 2075	Summary
Extreme Heat	↑	↑↑	Increase in extremely hot days, over 95°F and 100°F
Shorter Winters	↓	↓↓	Decrease in number of days below freezing
Storms	↑	↑↑	Increase in extreme precipitation events
Drought	?	↑	Increase in drought conditions

### Evanston Climate Impacts

Climate Impact	By Mid-Century 2050	By End-Century 2075	Summary
Infrastructure Stress	↑	↑↑	With increased heat and sever storms physical infrastructure will be tested
Human Migration	?	?	The Chicago region may see an influx of climate refugees
Flooding	↑	↑↑	Higher risk of flooding and associated damage
Invasive Species/ Pests	↑	↑	Increase in invasive species and pests
Air Pollution	↑	↑	Poor air quality and increase in aeroallergens

### Climate Resilience Focus Areas

Green Infrastructure

Health Impacts of Extreme Heat

Resilience Regulations

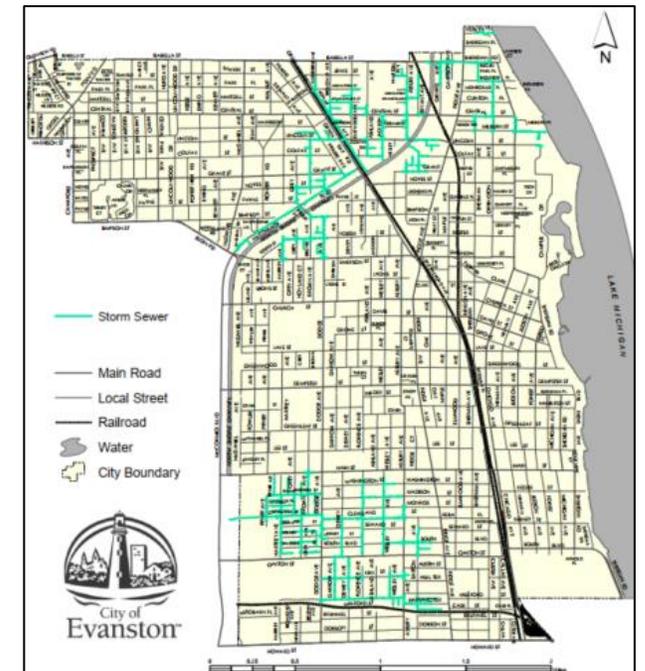
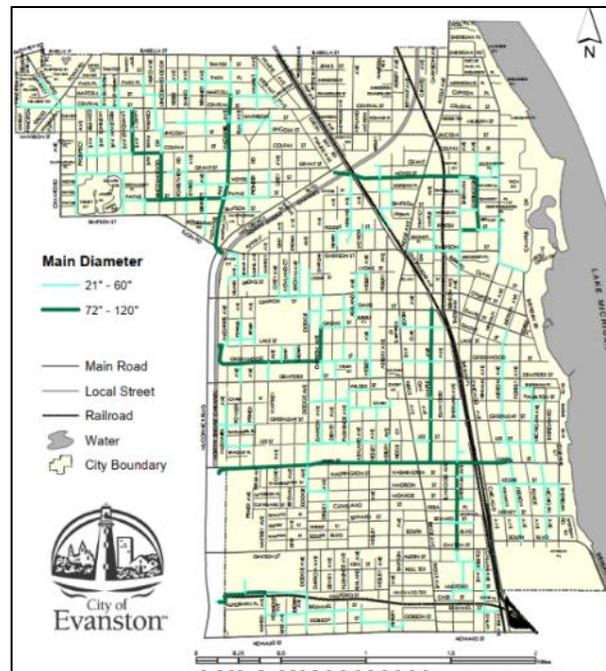
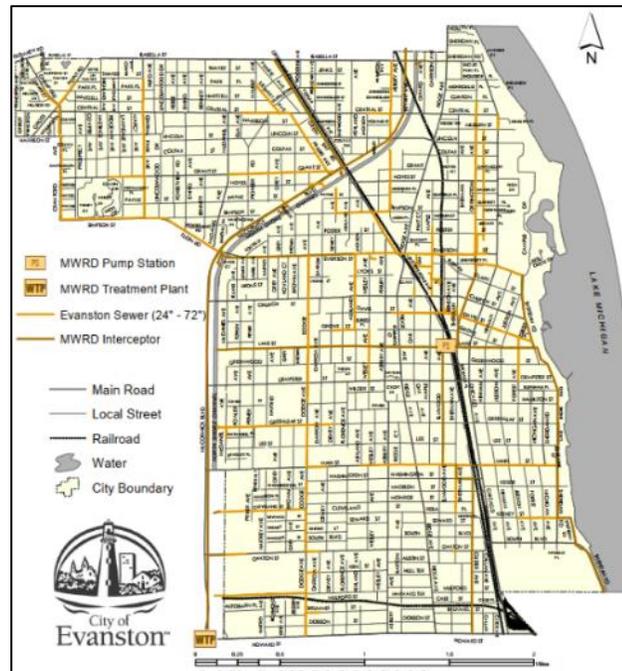
Community Networks and Education

Emergency Preparedness and Management

Vulnerable Populations

# Existing Sewer System

- **Combined Sewers** – sanitary waste and stormwater
- **Relief Sewers** – provide relief capacity to combined sewers and storm sewers
- **Storm Sewers** – stormwater only



# Study Objective

Develop hydrologic and hydraulic model of the City's stormwater system (combined, relief, and storm sewers) to identify and define needed system improvements under existing and future storm conditions.

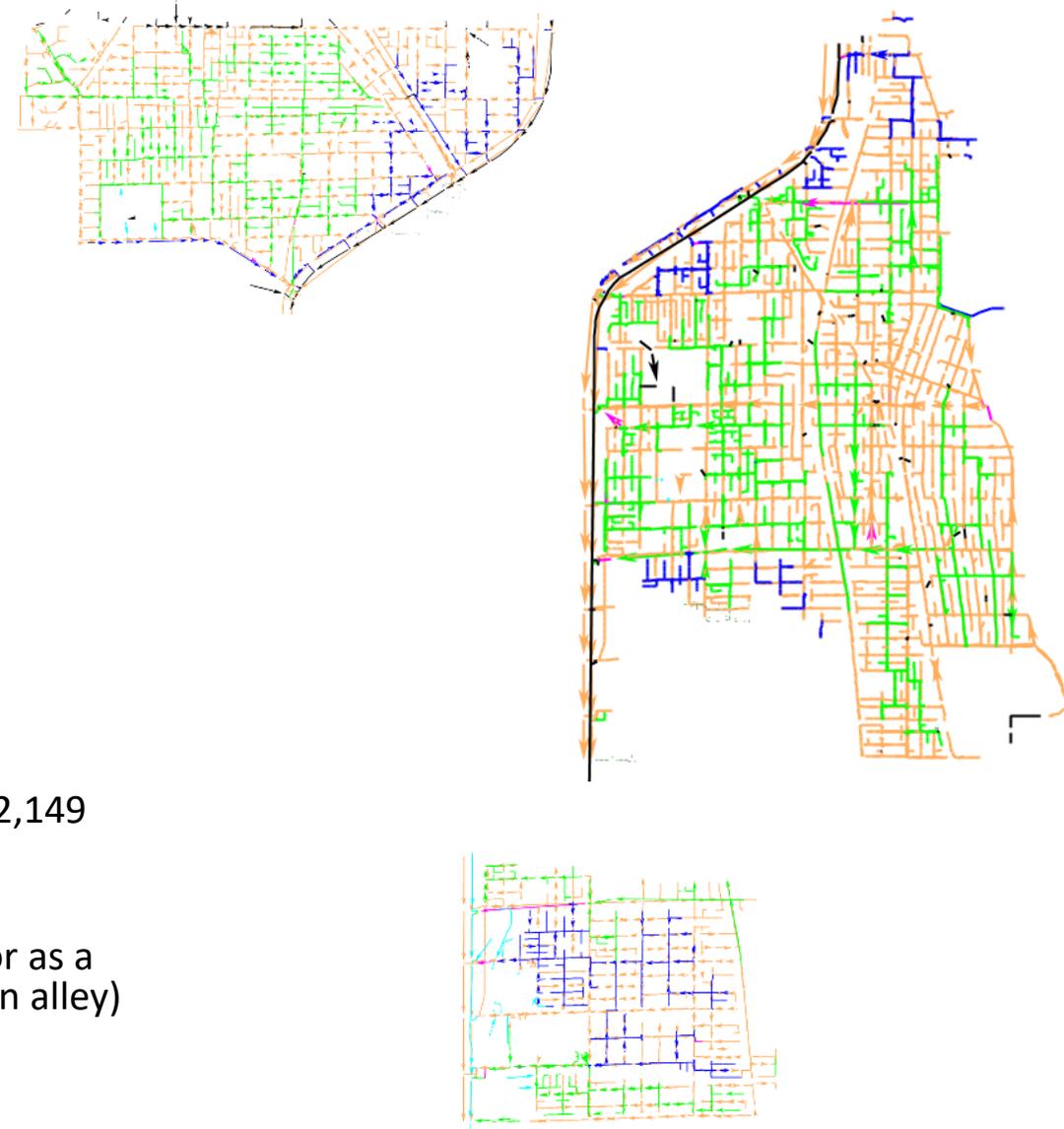
# Data Collection

- Evanston GIS Data and Sewer Atlas
- Historical sewer improvement plans
- Private development stormwater detention records and plans
- MWRD Sewer Permit Files (Database of 1000 records, approx. 20 SPO/WMO permit files requested and received)
- MWRD sewer and connecting structure plans
- Field Survey and Measurements (≈425 structures)



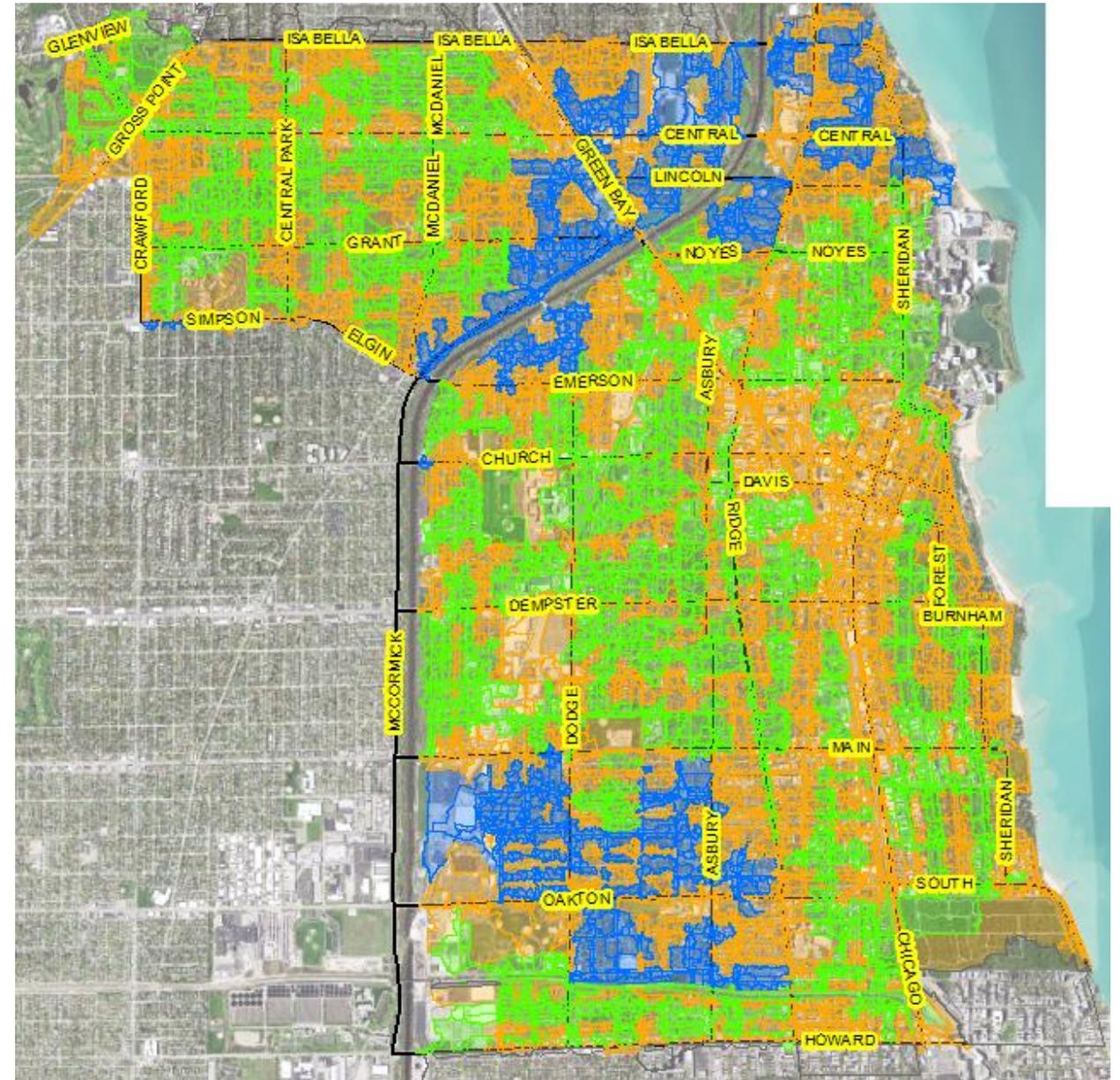
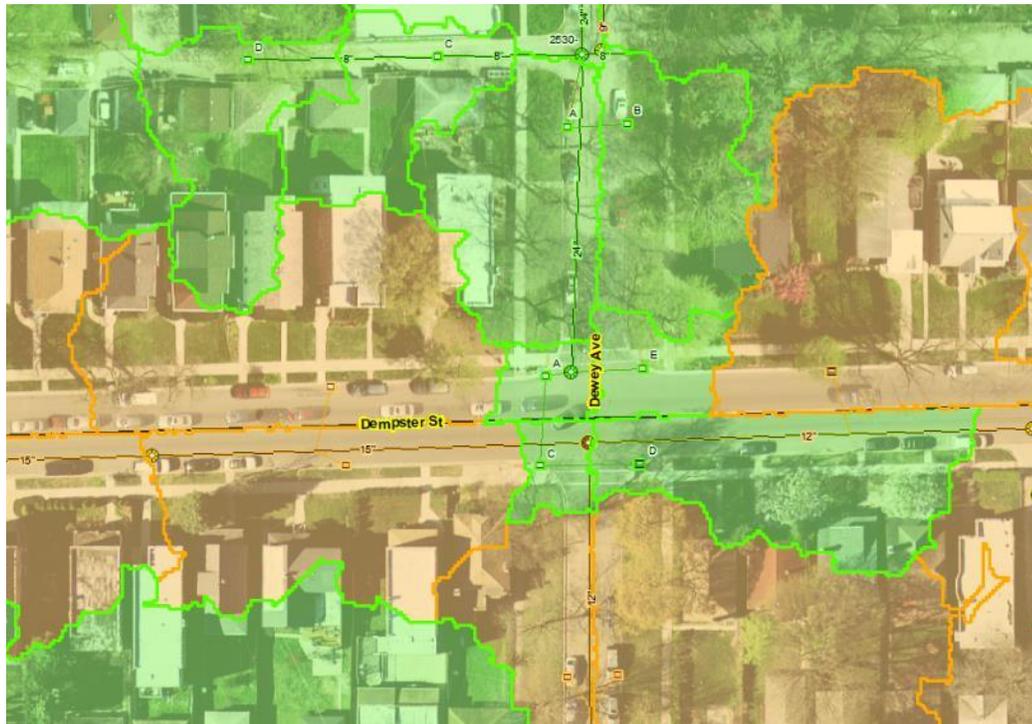
# Model Build

- XP-SWMM 2D hydrologic and hydraulic model
  - Models flow in the sewers and over the ground
- Three models: northwest, main, and southwest
- Hydrology
  - Catchment delineation (9,500 subbasins)
  - Hydrologic parameters derived from GIS data
    - Land cover
    - Soils
    - Topography
  - Detention basins over 0.4 ac-ft represented
- Hydraulics
  - Pipe networks prepared from sources listed in data collection (12,149 pipes)
  - Multiple inlets to the same manhole were grouped
  - Restrictors are represented as maximum allowable inflow rate or as a hydro-brake curve if there are upstream structures (such as on an alley)



# Catchment Delineation

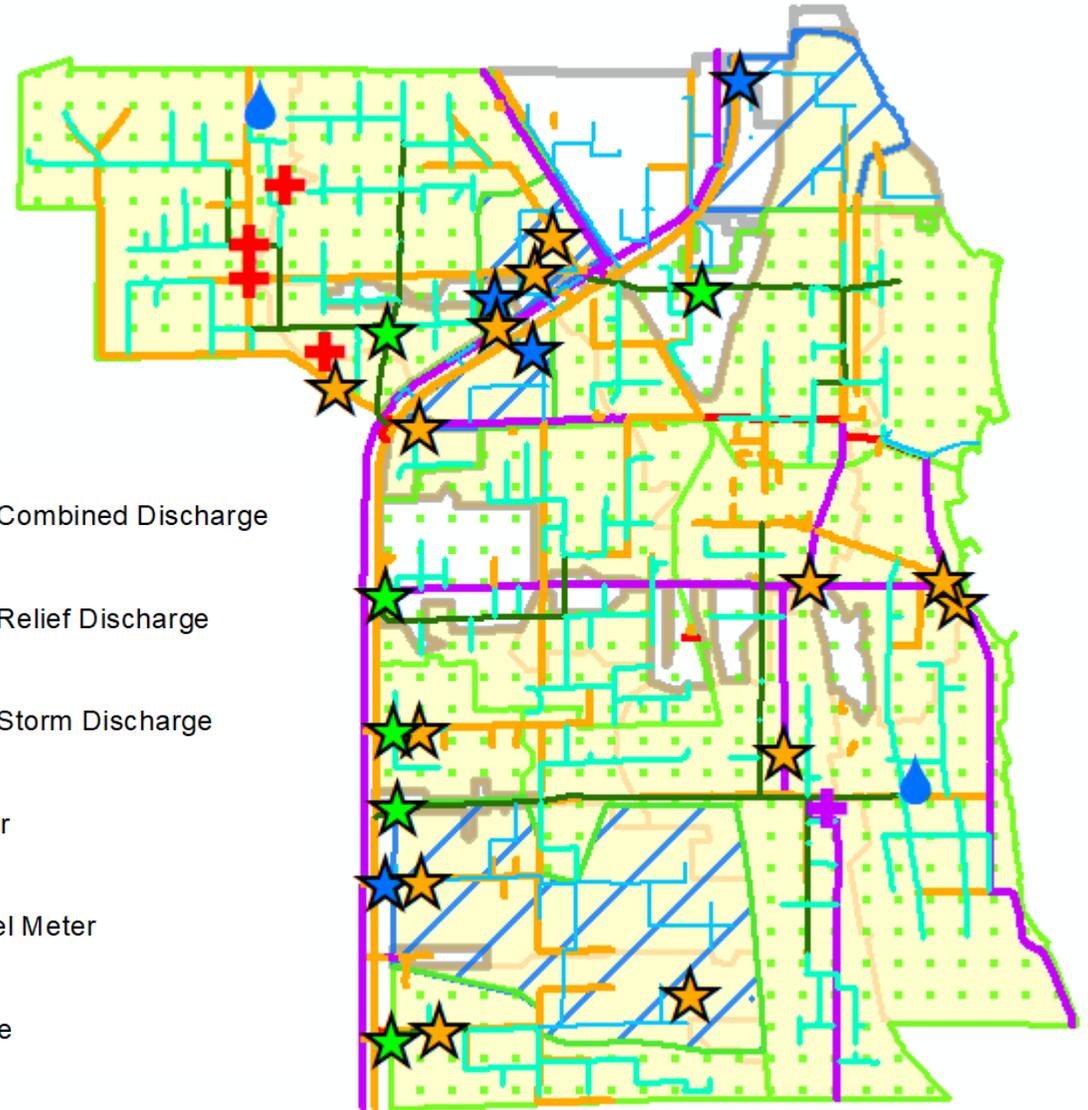
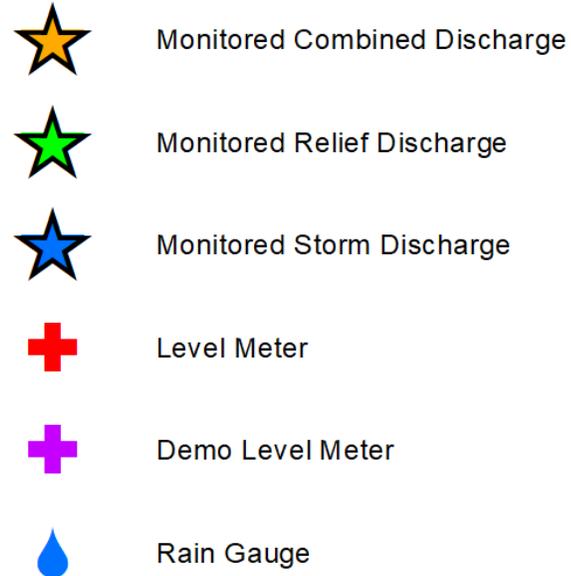
- A catchment was delineated to each open structure



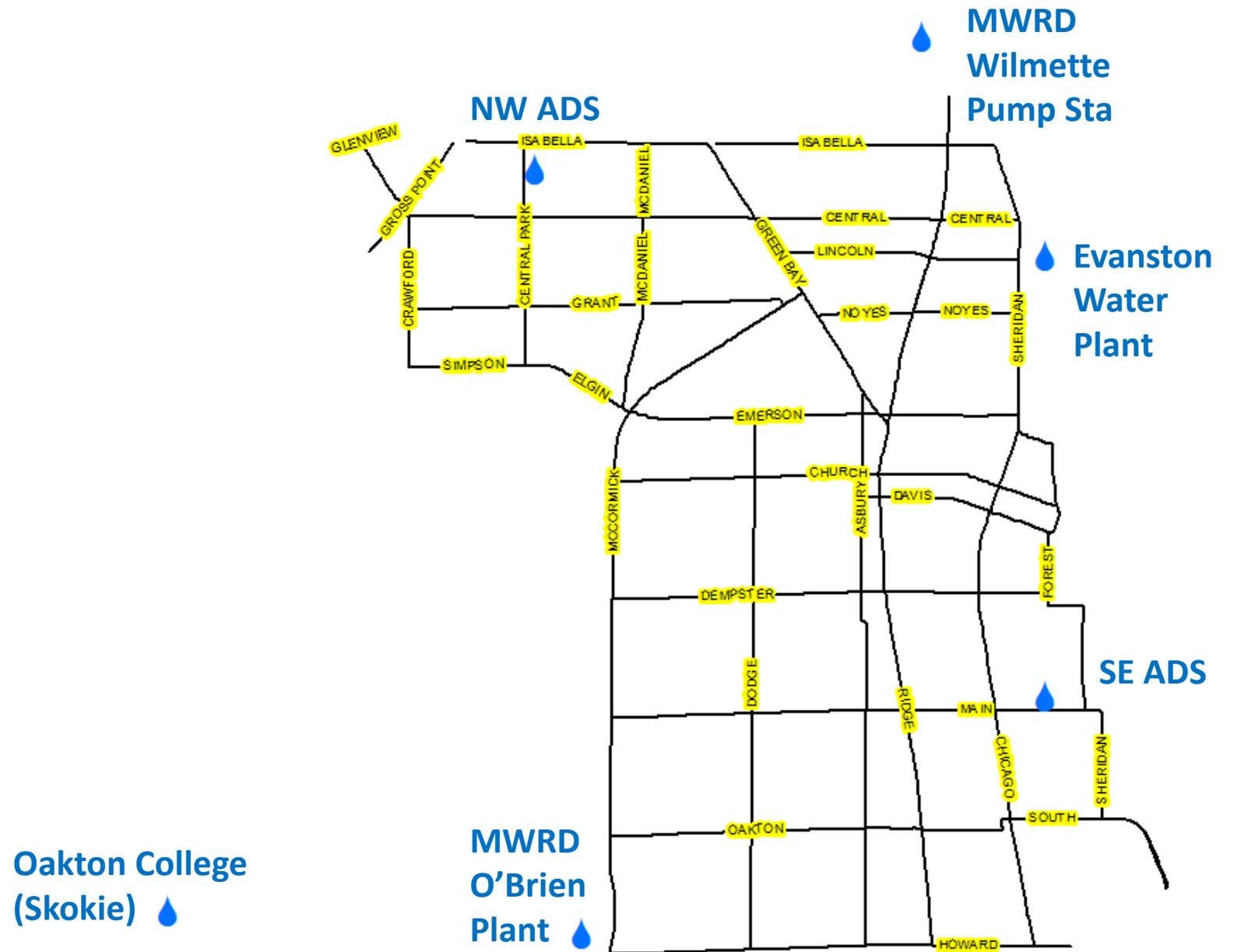
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# Flow Monitoring

- Temporary rain gauges at 2 locations
- Flow meters installed at 23 locations
- Level meters installed at 4 locations
- Experimental surface water meter installed at 1 location



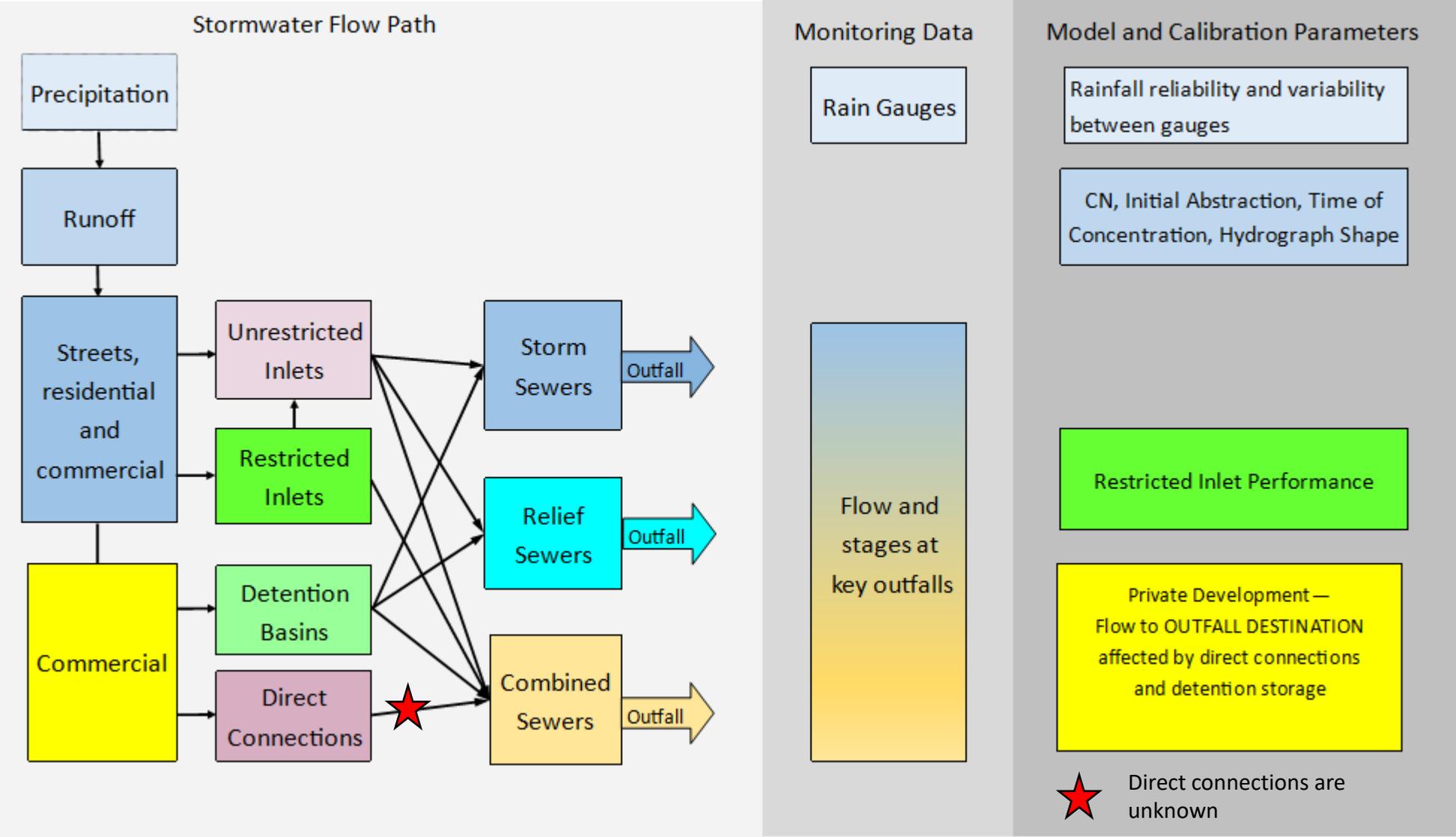
# Rain Gauge Locations



# Calibration and Historical Storm Verification

- Calibration Events
  - **June 20, 2021**  
1.45 to 1.75 inches of rain in 60 to 90 minutes  
Flood Frequency: 1-year to 2-year event
  - **August 10, 2021**  
0.65 to 0.95 inches of rain in 60 minutes  
Over 1 inch of rain in the preceding 24 hours  
Flood Frequency: 3-month to 4-month storm  
All gauges installed/active
- Historical Storm Verification
  - **April 17, 2013**  
4.83 inches of rain over 26 hours  
Flood Frequency: 5-10 year event
  - **September 14, 2008 (regionally significant storm)**  
7.66 inches of rain over 38 hours  
Flood Frequency: 25-50 year event

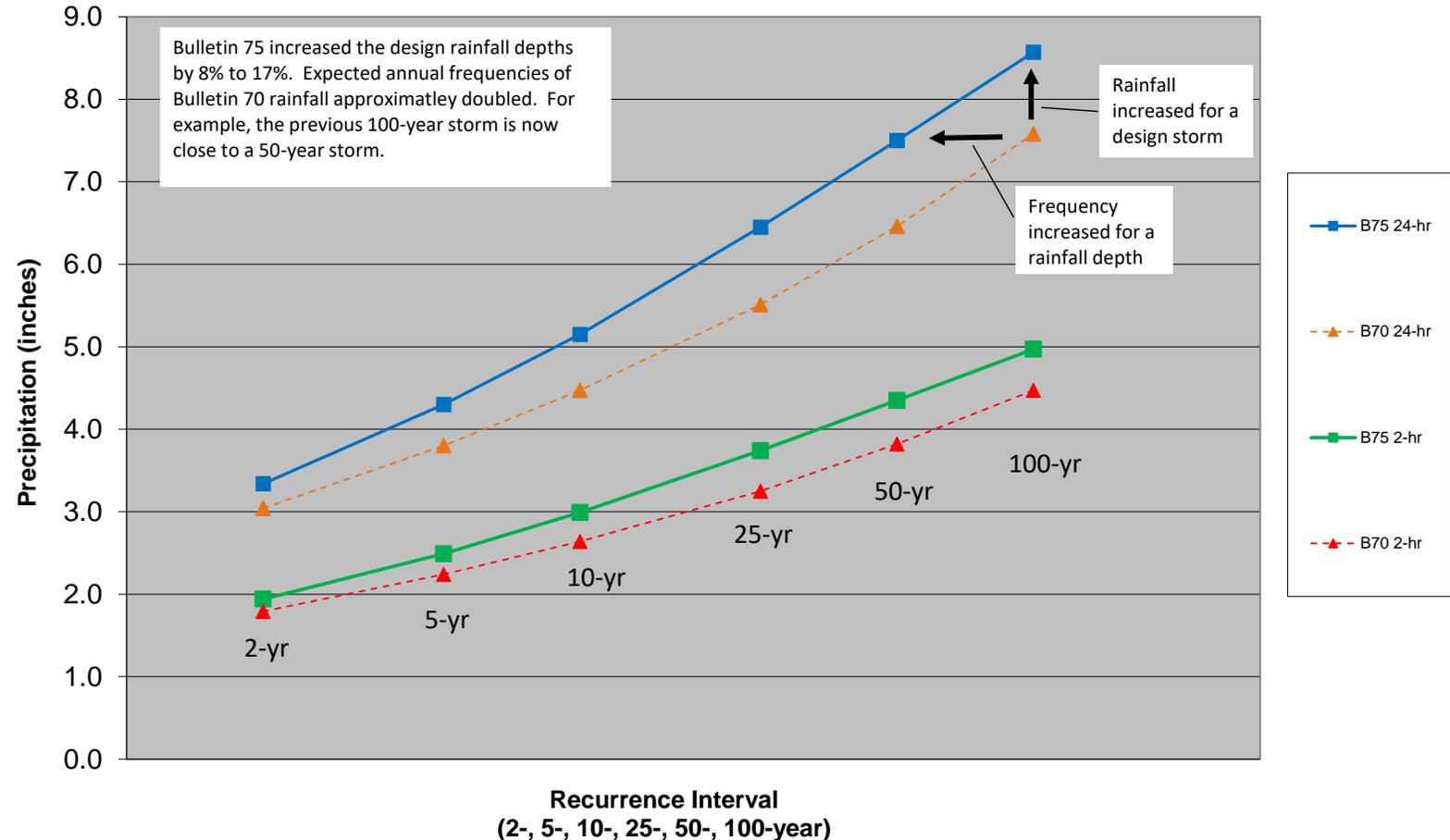
# Calibration Flowchart



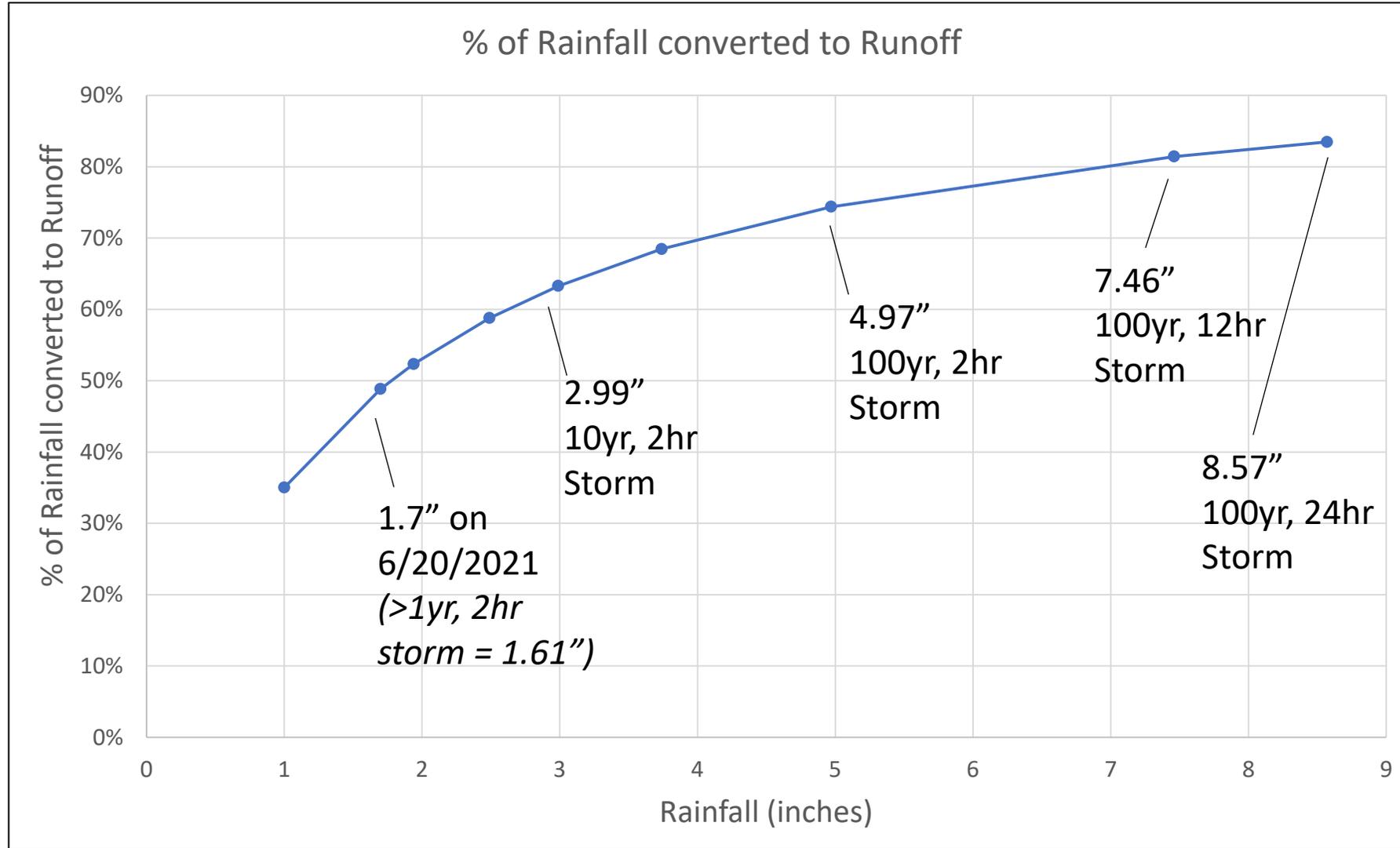
# Bulletin 75 Design Storm Rainfall

- Precipitation Frequency Study update published in 2020
- Adopted by MWRD for use in Cook County
- 8% to 17% rainfall depth increases
- Predicted frequency of Bulletin 70 rainfall depths approximately doubled

Bulletin 75 Design Rainfall Update (versus Bulletin 70)  
Northeastern Illinois



# Calibration Storms and Design Events



Storm	# Times Exceeded at O'Hare in last 20 years
1.7" over 2 hours (1-2 yr storm)	13
2.99" over 2 hours (10 yr)	2
4.97" over 2 hours (100 yr)	1
7.46" over 12 hours (100 yr)	0
8.57" over 24 hours (100 yr)	0

# System Evaluation

Criteria	How is it Measured?
Sewer Surcharge Risk	Hydraulic grade line (HGL) from model results at nodes are compared to a “typical” basement depth.
Structure Flood Risk	Overlay inundation boundaries with structure limits.
Water Quality Protection	Determine risk of CSO at outfall locations

# Basement Depth Estimation



## Basement Depth Estimate

Street to Lowest Adjacent Grade	= +1.5'
Lowest Adjacent Grade to First Floor	= +2.5'
<u>First Floor to Basement</u>	<u>= -8.0'</u>
Total Offset	= -4.0'

# Water Surface Profile (Depth = -4.9 feet)

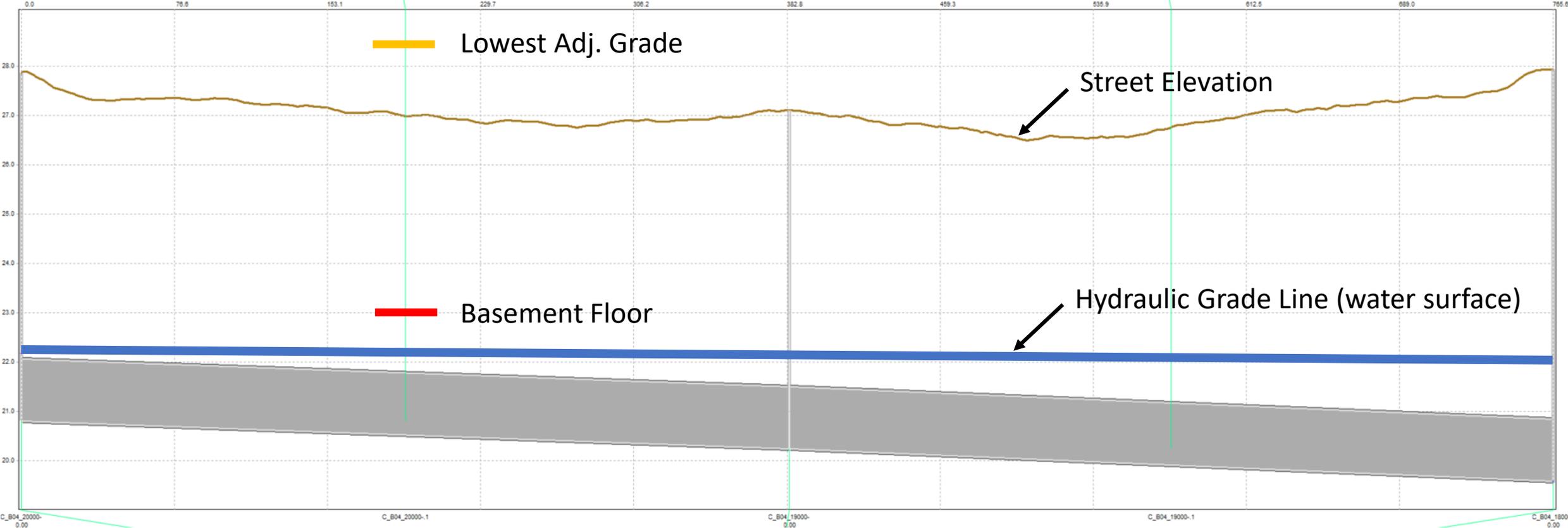
— First Floor

— Lowest Adj. Grade

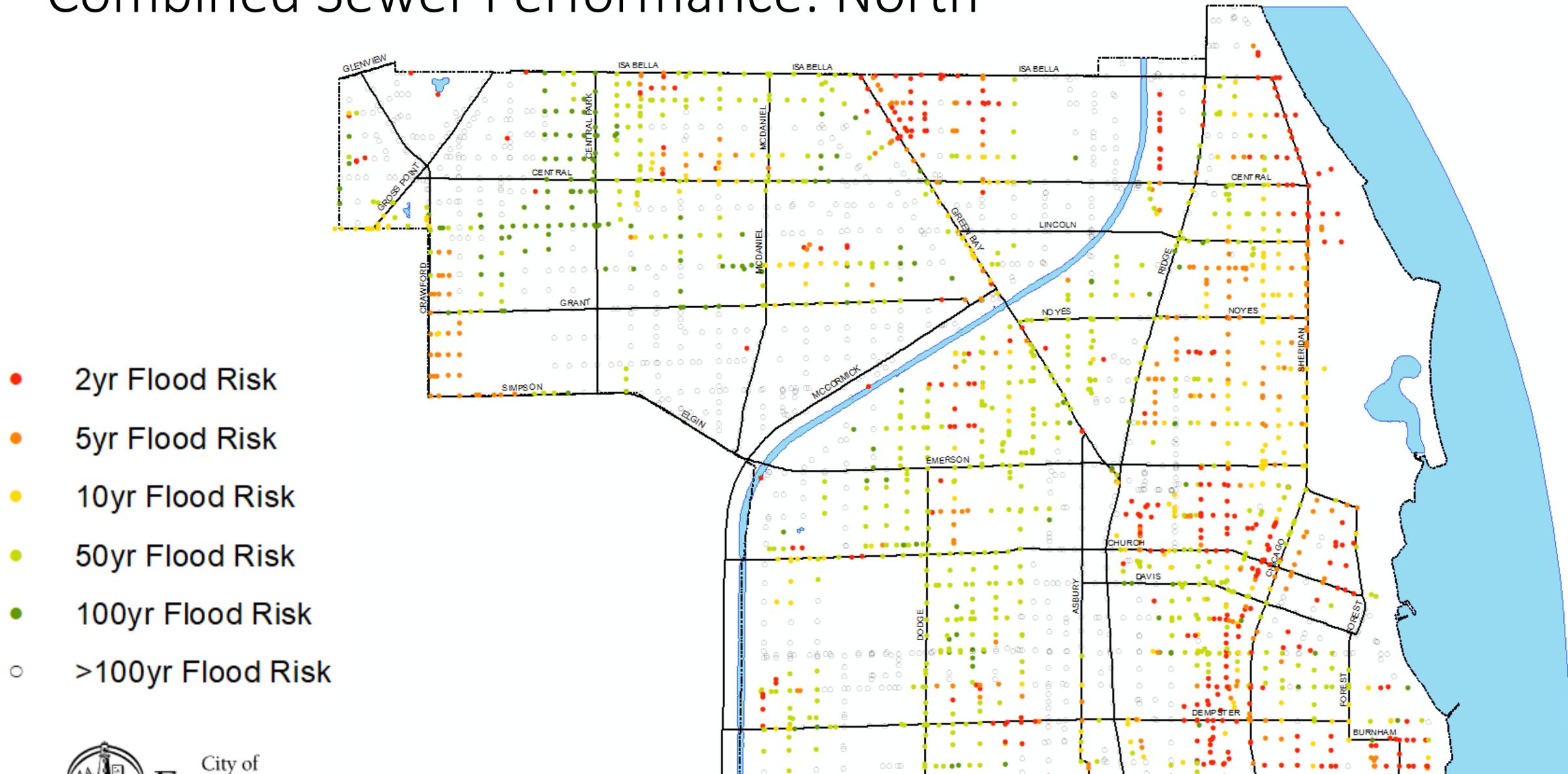
— Basement Floor

Street Elevation

Hydraulic Grade Line (water surface)



# Combined Sewer Performance: North



# Combined Sewer Performance: South

- 2yr Flood Risk
- 5yr Flood Risk
- 10yr Flood Risk
- 50yr Flood Risk
- 100yr Flood Risk
- >100yr Flood Risk



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# Combined Sewer Performance Potential for Sewer Surcharge

Model Area	% Nodes with Hydraulic Grade Line within 4' of Street Surface*				
	2-year Storm	5-year Storm	10-year Storm	50-year Storm	100-year Storm
Main	14%	25%	36%	62%	65%
Northwest	6%	14%	21%	36%	47%
Southwest	3%	8%	10%	19%	23%

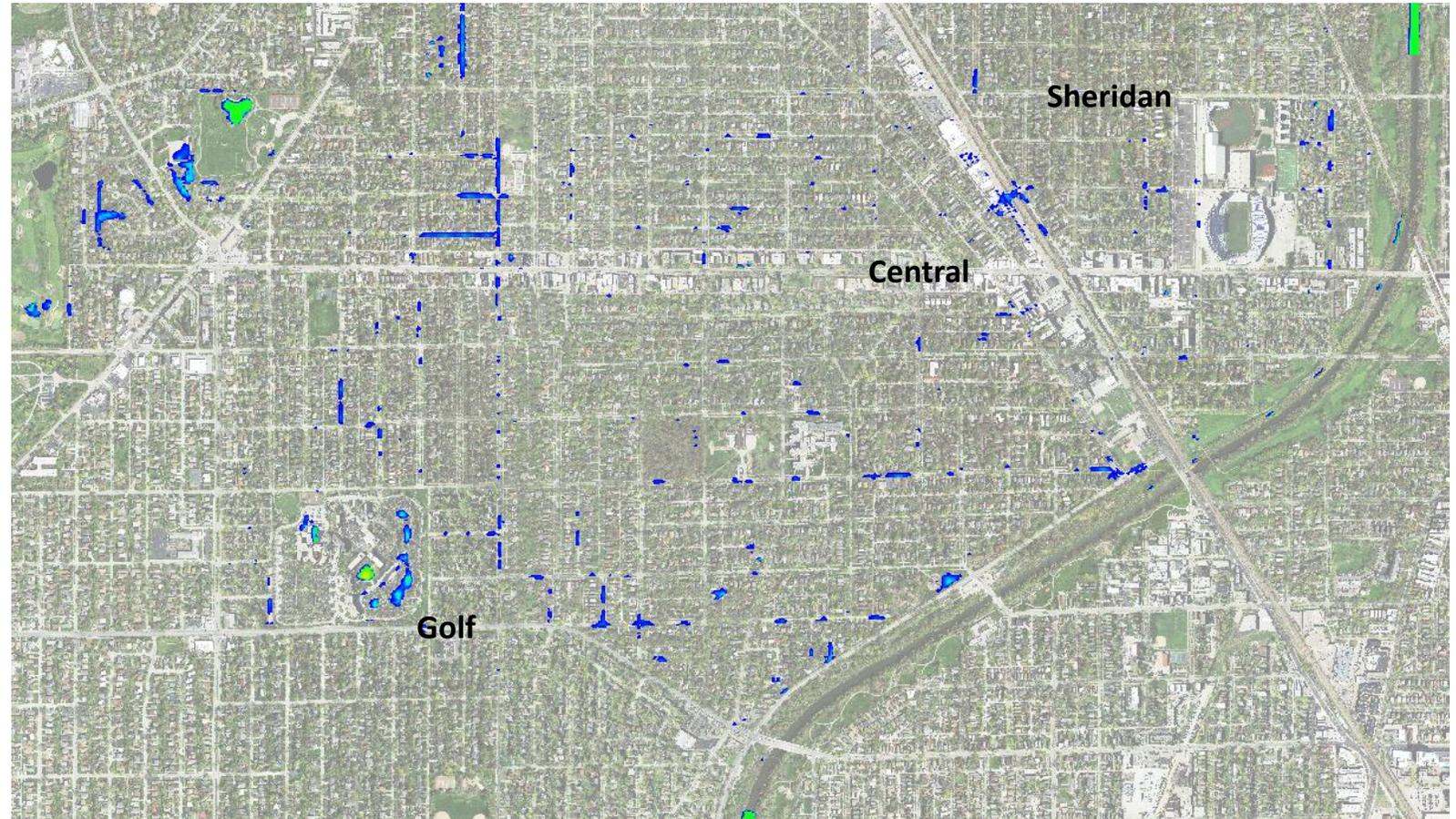
\*Percentage of locations where the existing combined sewer is underperforming. Properties with low basements and/or no private flood controls may have an increased risk of basement backups.

# Model Sensitivity Table: Buildings with Surface Flood Risk

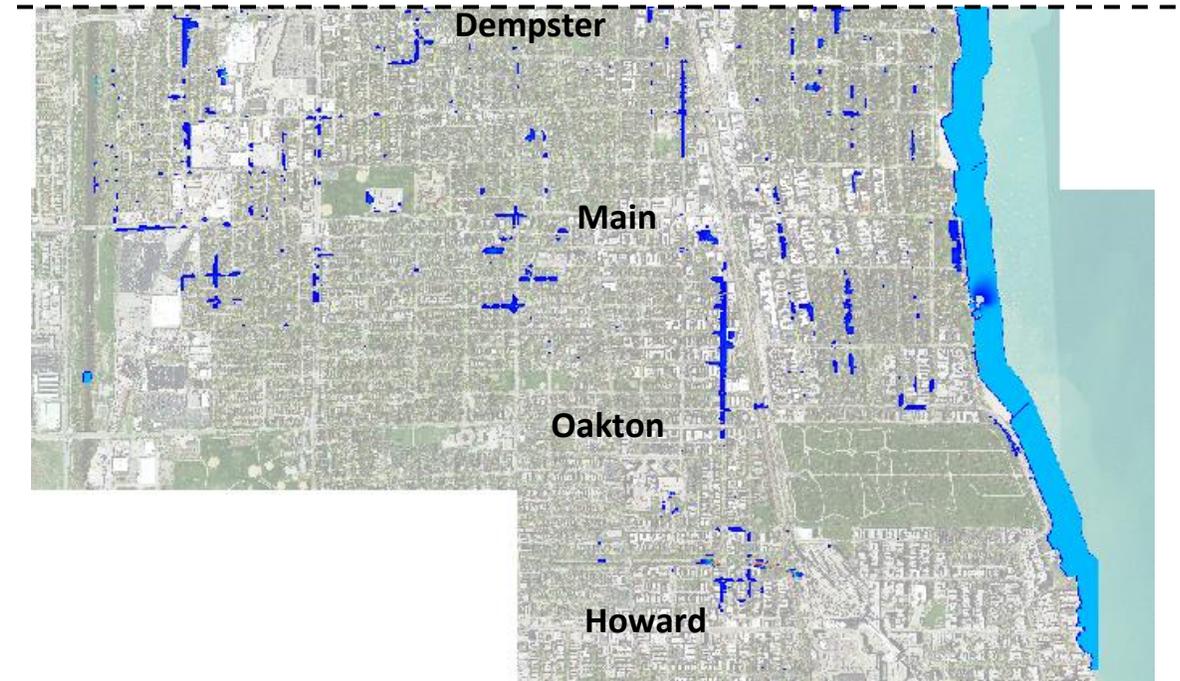
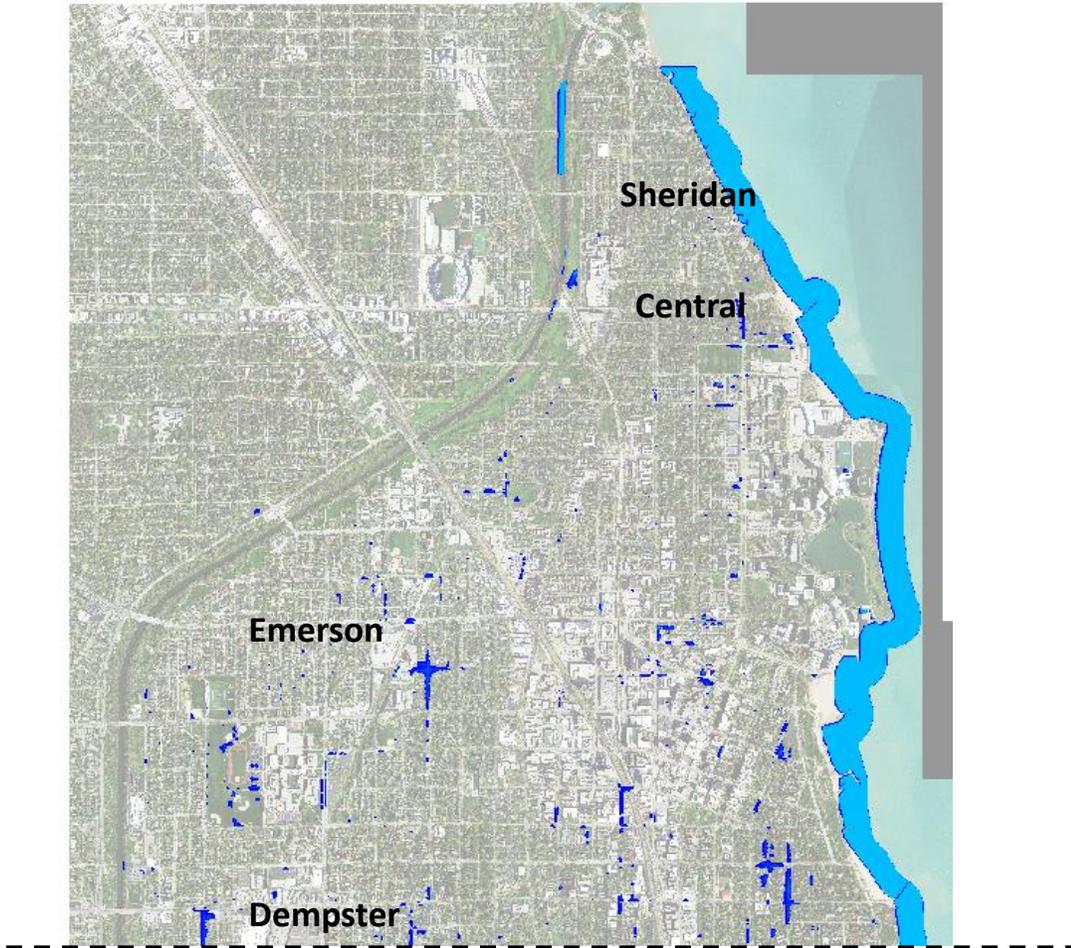
	100-year Event	10-year Event
Northwest Model	23	2
Main Model	130	34
Southwest Model	9	9

# Northwest Model 100-year Event

- 23 Buildings with potential surface water flooding risk



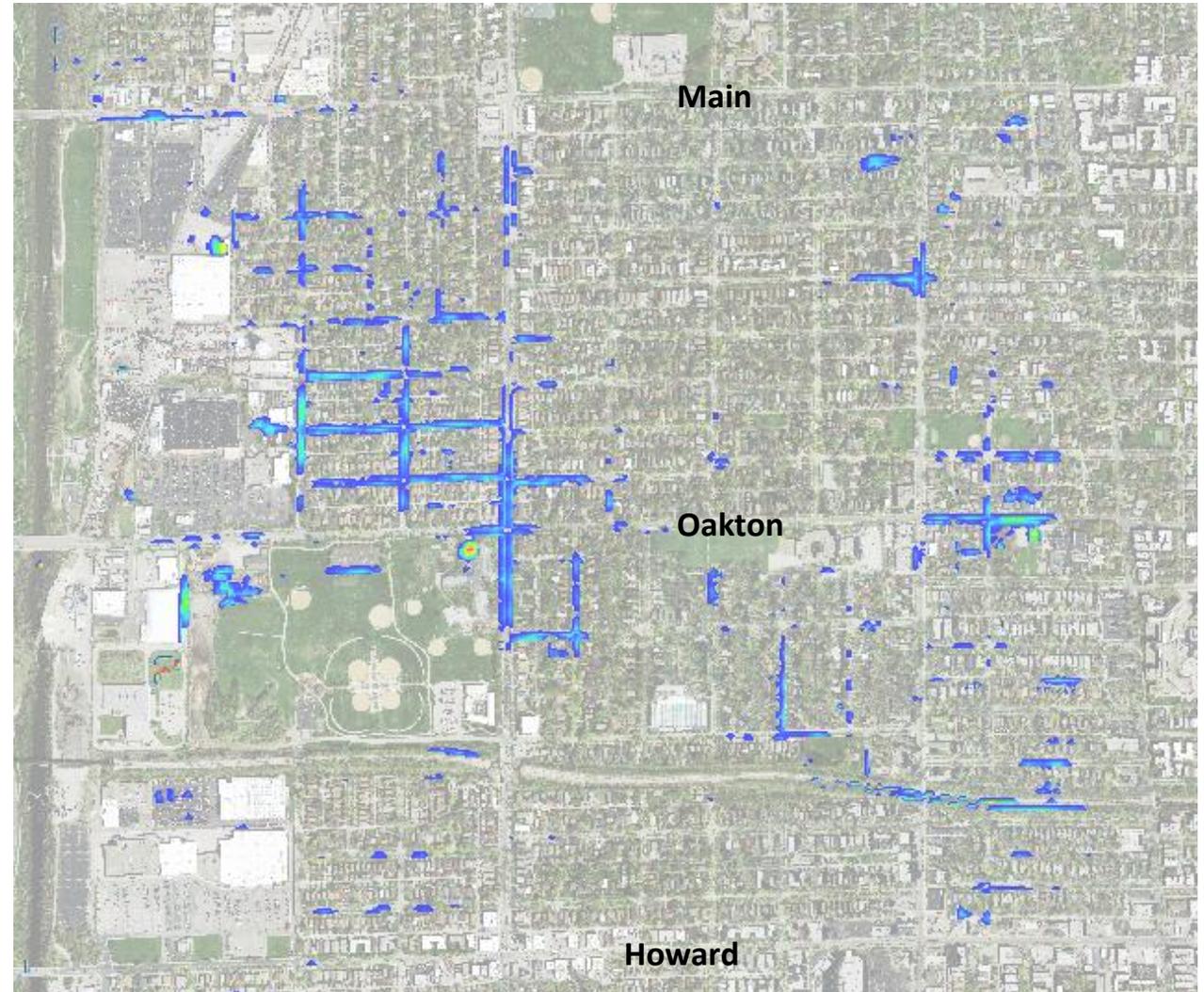
# Main Model 100-year Event



- 130 Buildings potential surface water flooding risk

# Southwest Model 100-year

- 9 Buildings potential surface water flooding risk



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# Stormwater Program Recommendations

## Regulatory

- Detention requirements
- Private property plumbing code requirements
- Property transfer inspections

## Private System

- Overhead sewers
- Sanitary sewer backup prevention
- Sump pumps
- Lot Drainage
- Floodproofing

## Public System

- Capital Improvements
  - 2 concept projects
- Green infrastructure program
- Future monitoring

Thank you for attending!

Questions?