

# Wet Weather Operating Challenges and Opportunities for CSO Control at a Midwestern Wastewater Treatment Plant

New England WEA

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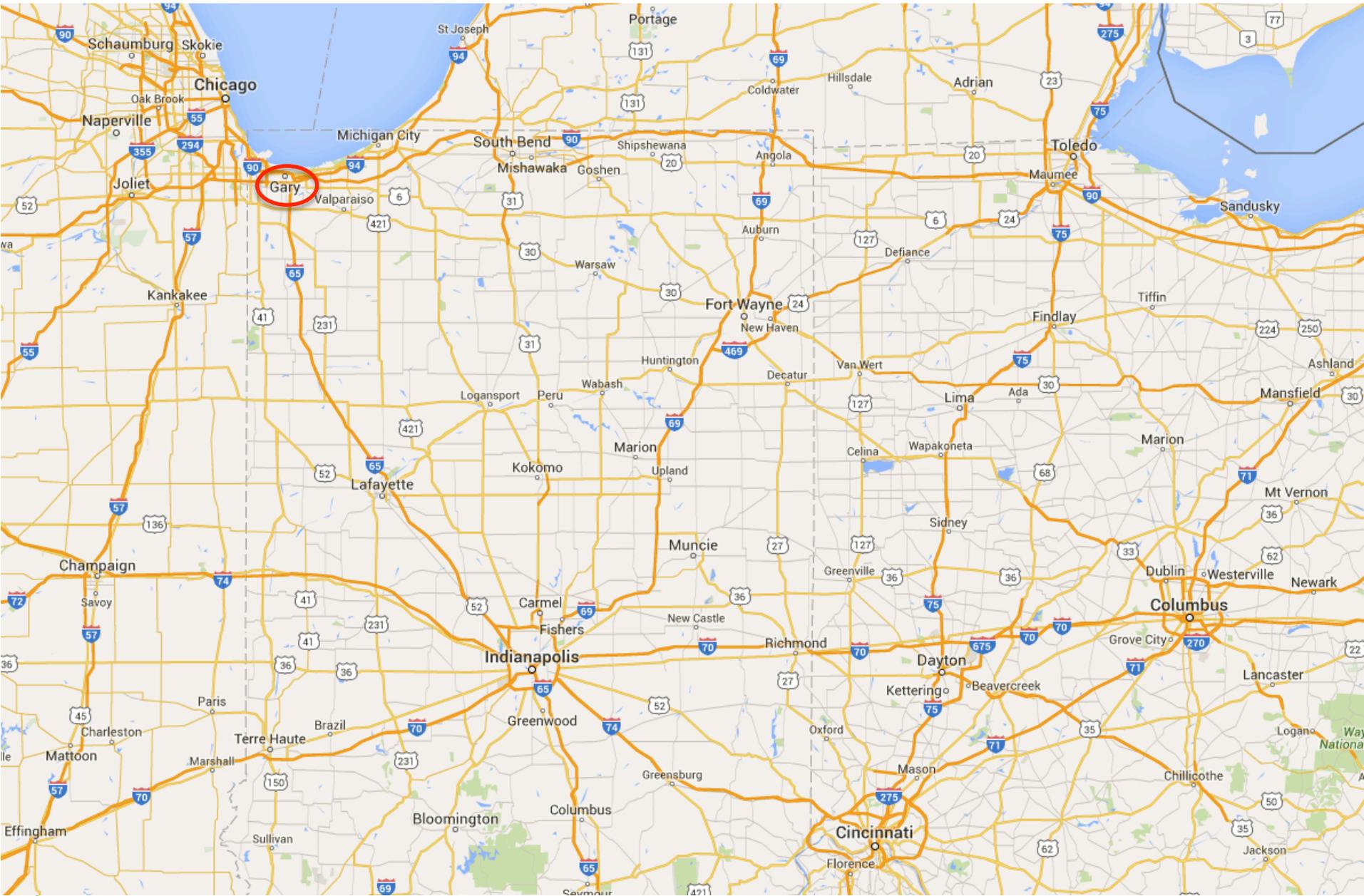
*October 26, 2015*

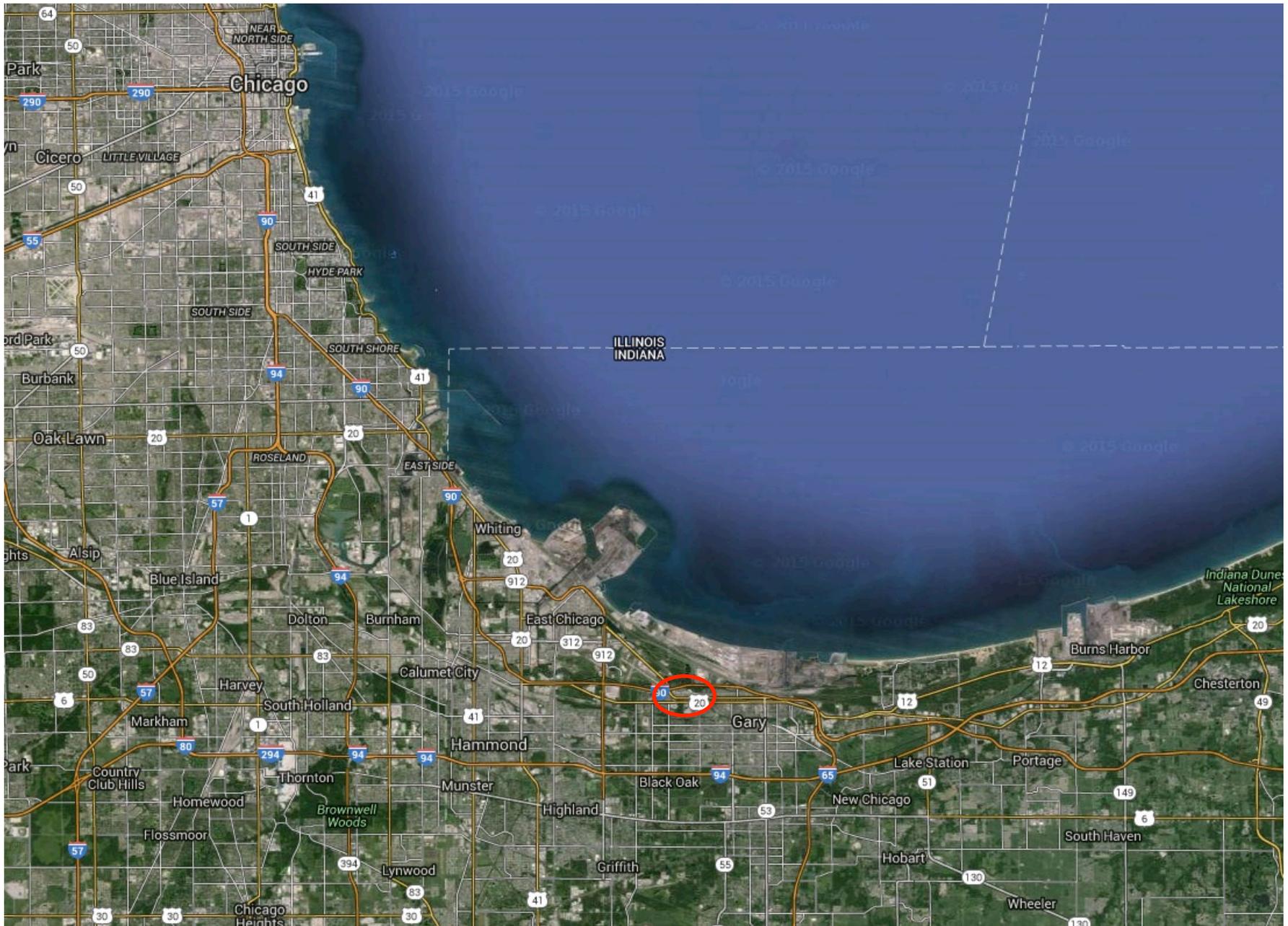


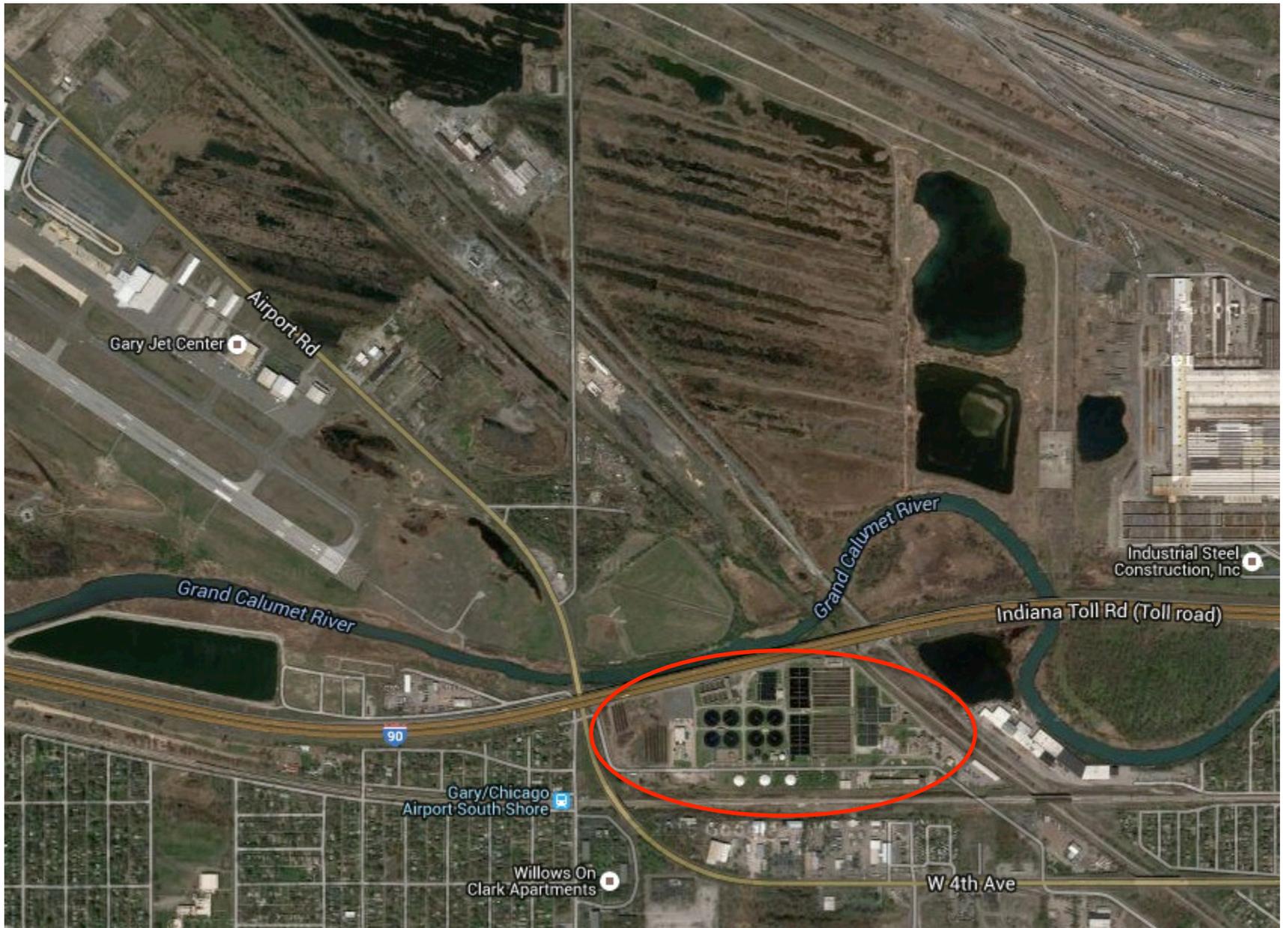
**CDM  
Smith**

# Agenda

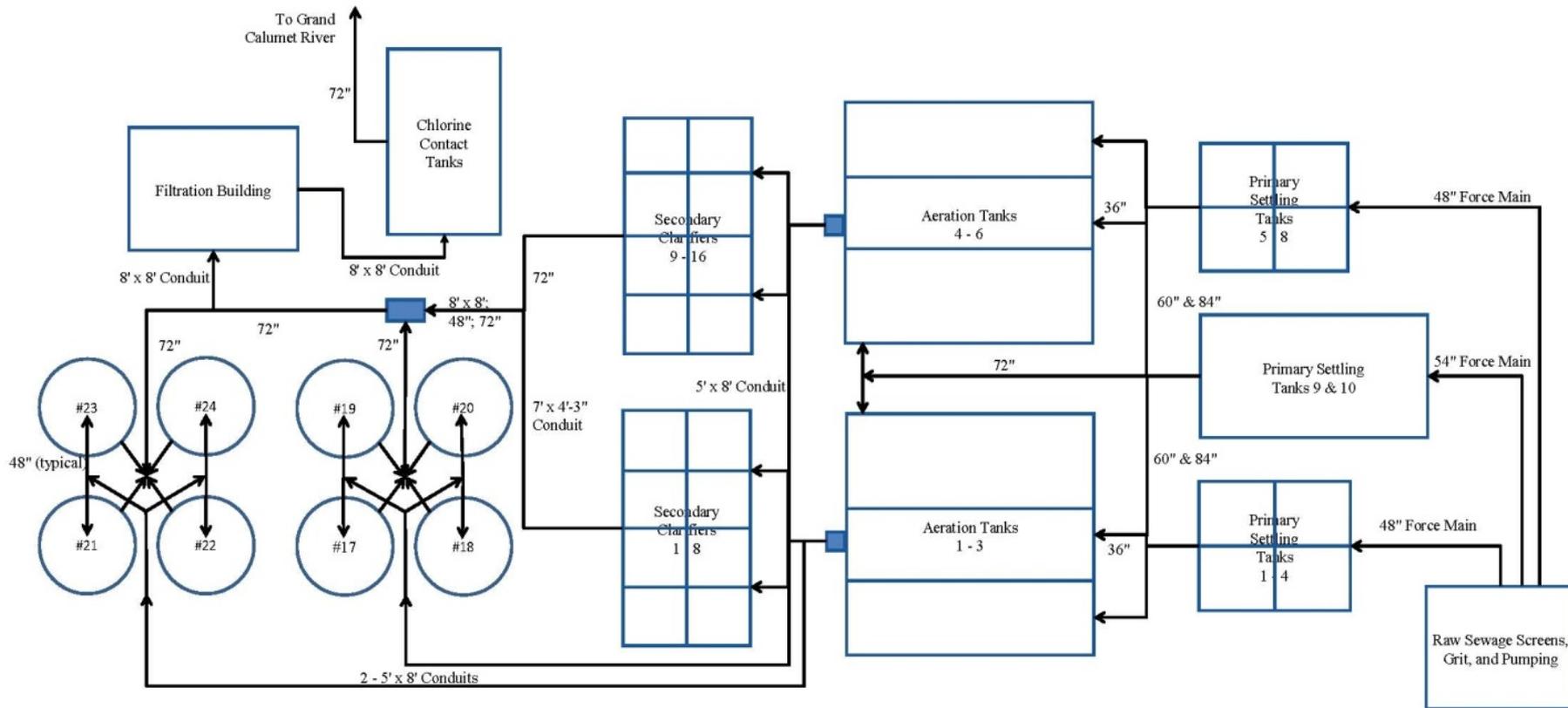
- Location and layout of subject plant and combined sewer collection system – Gary (IN) Sanitary District
- Operating characteristics of plant and collection system
- Plant modeling overview and findings
- CSO control opportunities in the collection system
- Linking plant and collection system operations to optimize the use of existing infrastructure







# Gary Sanitary District Water Resource Recovery Facility (WRRF)

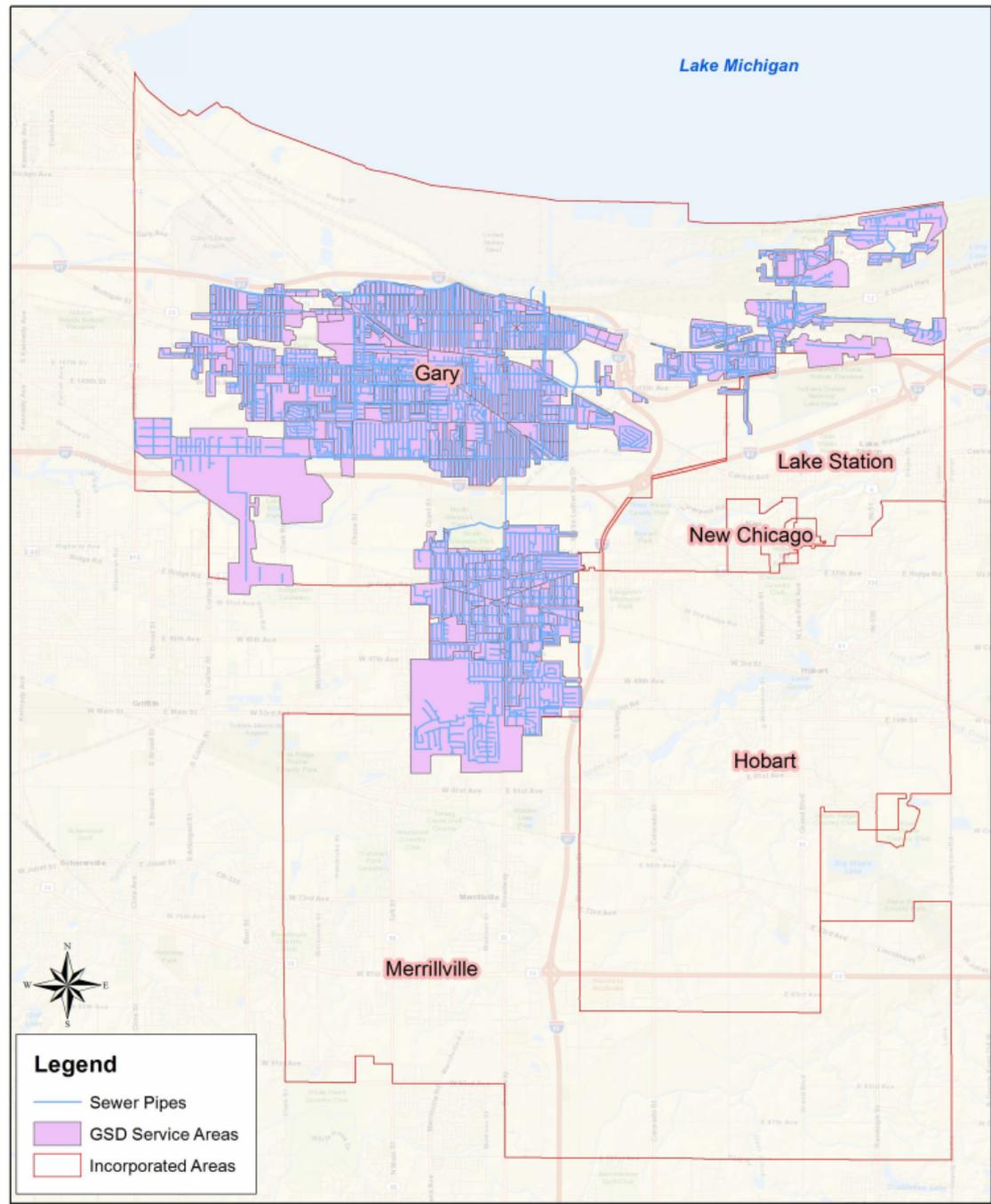


# Gary Sanitary District WRRF

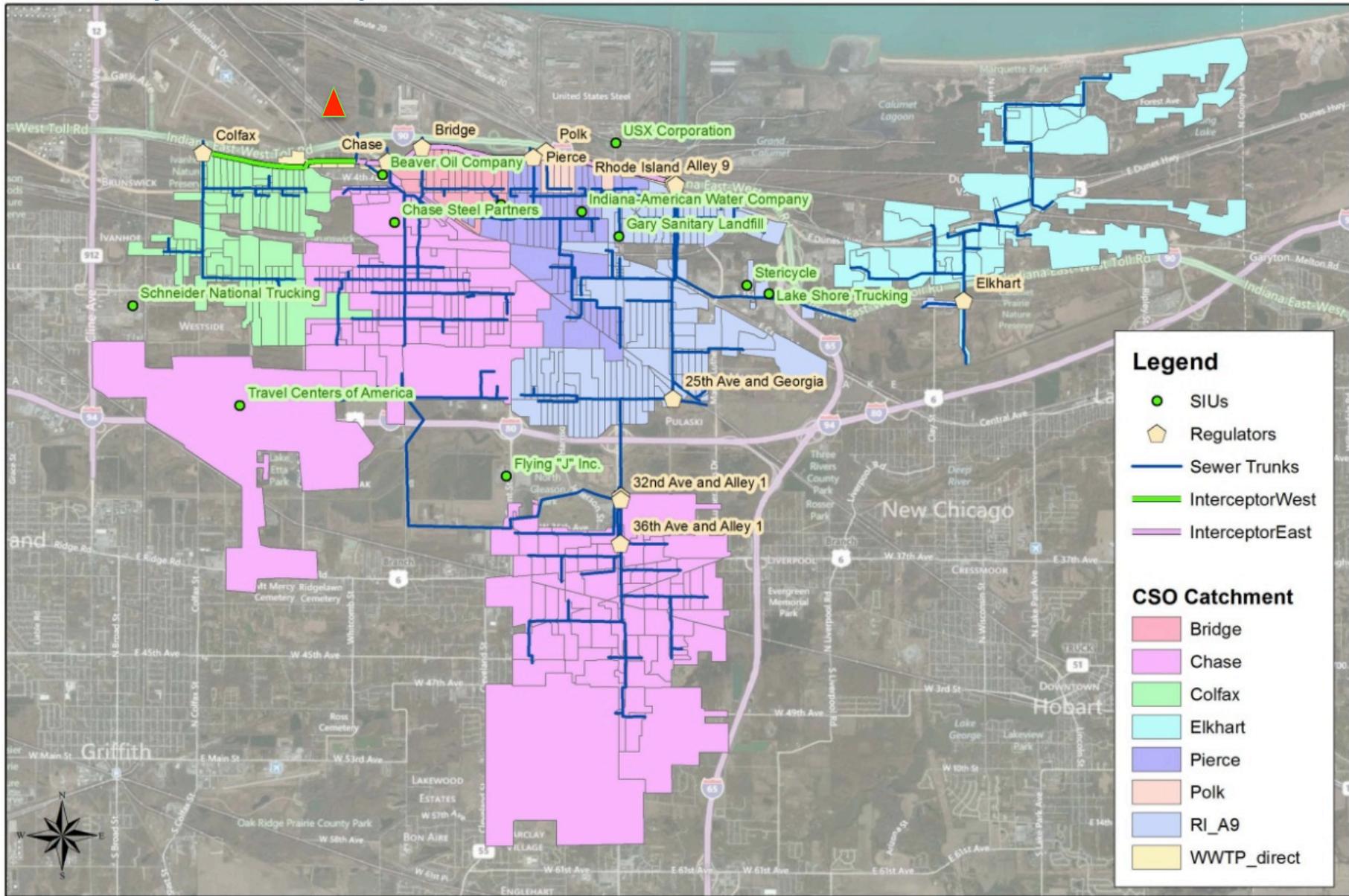


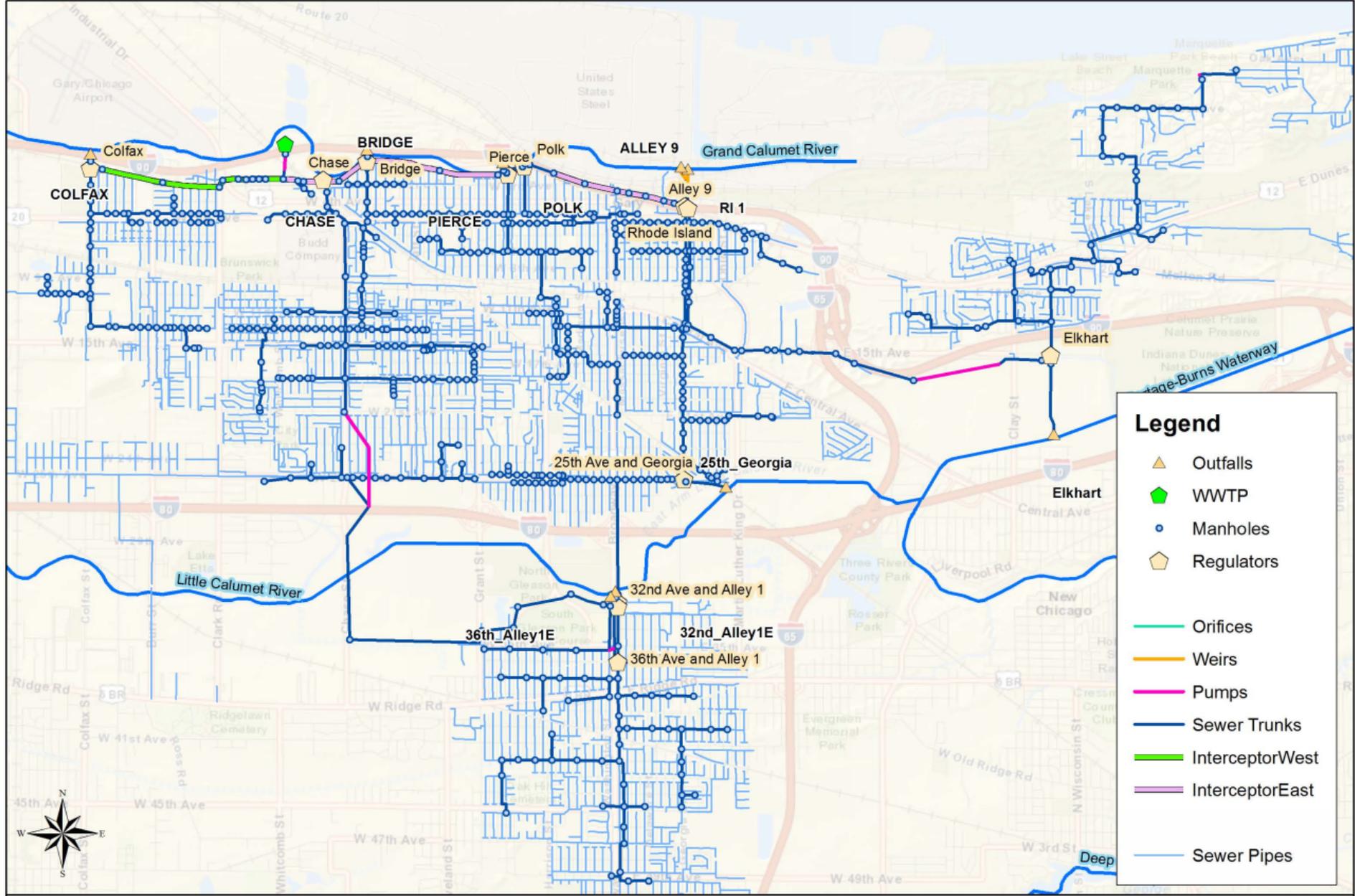
# Gary Sanitary District WRRF Service Area

Population:  
1960 208,000  
2010 157,000

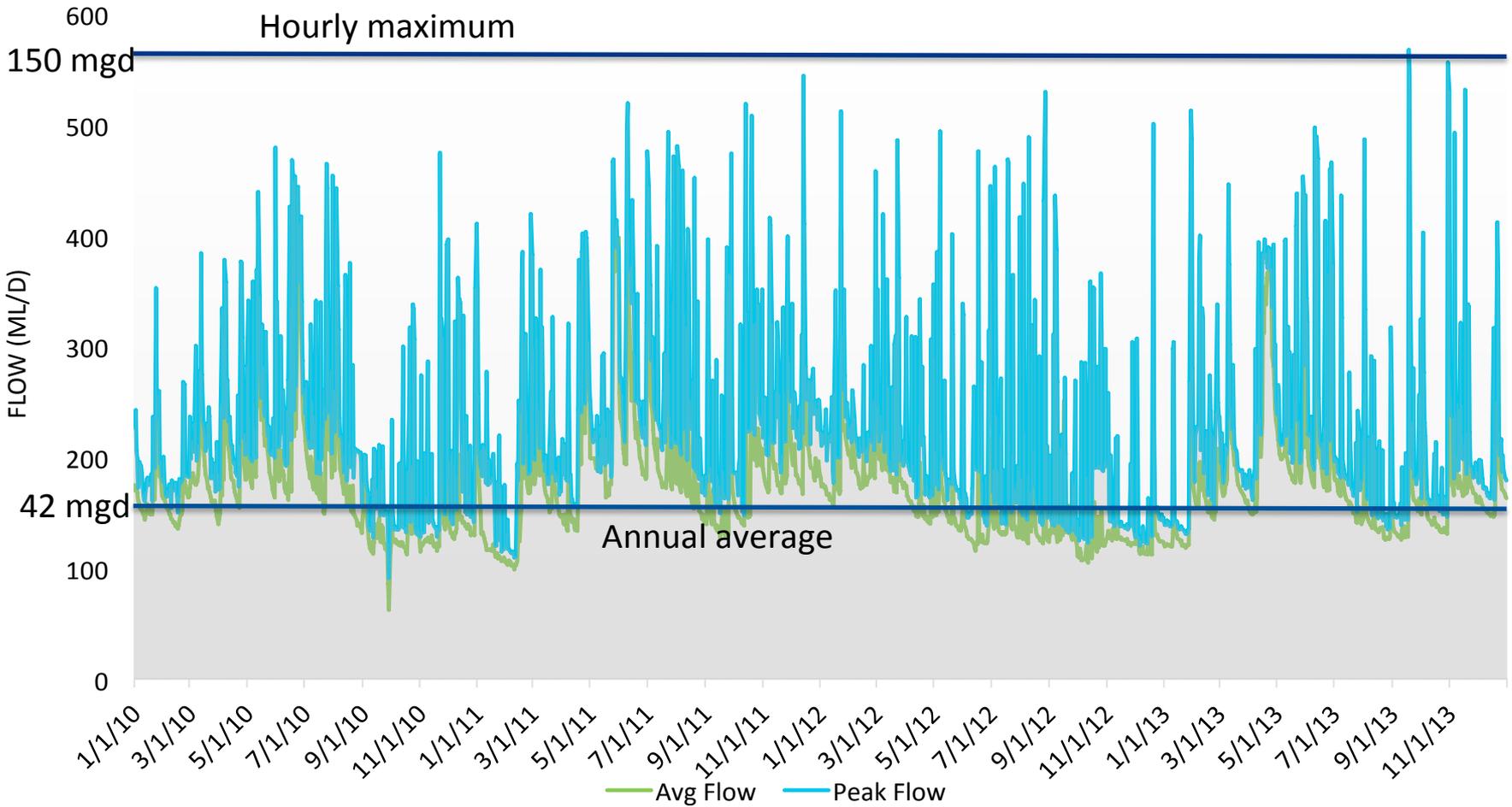


# Gary Sanitary District CSO Catchments and SIUs





# Peak and Average Day Influent Flow



# Flow and Mass Loading Rates – Current Status vs. Basis of Design

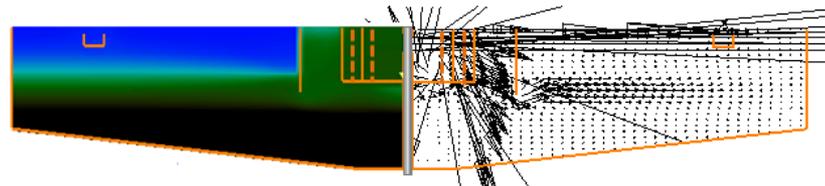
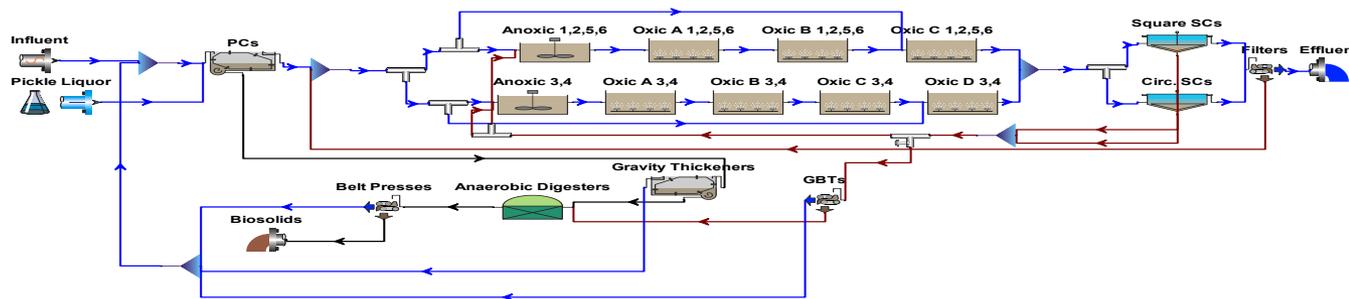
| Influent Flow                        | Current Rates             | Basis of Design Criteria  |
|--------------------------------------|---------------------------|---------------------------|
| Annual Average                       | 159 ML/d (42 MGD)         | 227 ML/d (60 MGD)         |
| Monthly Maximum                      | 269 ML/d (71 MGD)         | 284 ML/d (75 MGD)         |
| Daily Maximum                        | 432 ML/d (114 MGD)        | 454 ML/d (120 MGD)        |
| Hourly Maximum                       | 568 ML/d (150 MGD)        | 680 ML/d (180 MGD)        |
| Total BOD Load in Primary Effluent   | Current Rates             | Basis of Design Criteria  |
| Annual Average                       | 9890 kg/d (21,803 lb/d)   | 18,907 kg/d (41,683 lb/d) |
| Monthly Maximum                      | 16,095 kg/d (35,484 lb/d) | 23,634 kg/d (52,104 lb/d) |
| Ammonia Nitrogen in Primary Effluent | Current Rates             | Basis of Design Criteria  |
| Annual Average                       | 1724 kg/d (3,801 lb/d)    | 2270 kg/d (5,004 lb/d)    |
| Monthly Maximum                      | 2277 kg/d (5,021 lb/d)    | 2723 kg/d (6,005 lb/d)    |

# Influent Data Summary

| Parameter | Flow (ML/d) |       |       | BOD <sub>5</sub> (mg/L) |       |       | TSS (mg/L) |       |       | Ammonia (mg/L) |       |       | Phosphorus (mg/L) |       |       |
|-----------|-------------|-------|-------|-------------------------|-------|-------|------------|-------|-------|----------------|-------|-------|-------------------|-------|-------|
|           | Daily       | 7-d   | 30-d  | Daily                   | 7-d   | 30-d  | Daily      | 7-d   | 30-d  | Daily          | 7-d   | 30-d  | Daily             | 7-d   | 30-d  |
| Average   | 160         | ----- | ----- | 87                      | ----- | ----- | 147        | ----- | ----- | 8.4            | ----- | ----- | 2.1               | ----- | ----- |
| 95th PCTL | 269         | 242   | 223   | 143                     | 124   | 119   | 317        | 290   | 230   | 13.3           | 12.8  | 12.7  | 4.1               | 4.0   | 3.5   |
| 98th PCTL | 336         | 280   | 248   | 173                     | 138   | 126   | 471        | 338   | 250   | 14.4           | 13.8  | 13.5  | 5.7               | 5.2   | 4.5   |
| 99th PCTL | 359         | 311   | 256   | 196                     | 151   | 130   | 580        | 393   | 276   | 15.5           | 14.7  | 13.6  | 7.2               | 5.7   | 4.9   |
| Maximum   | 432         | 364   | 270   | 280                     | 195   | 136   | 1,464      | 549   | 333   | 19.9           | 17.2  | 13.9  | 20.8              | 7.7   | 5.3   |

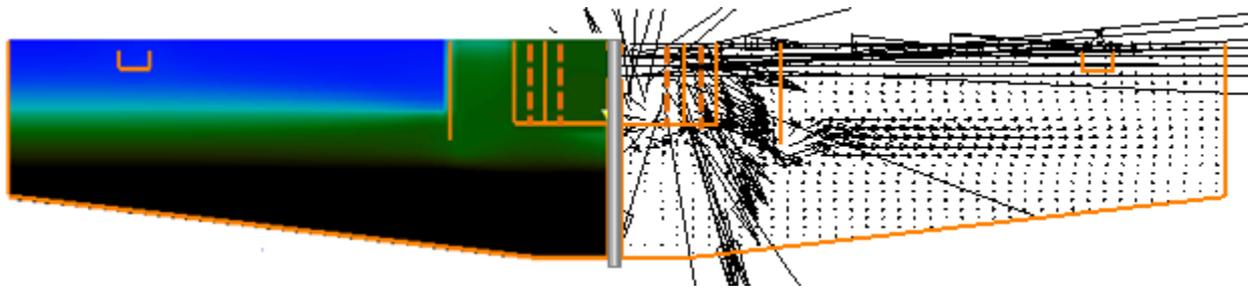
# Plant Modeling Objectives

- Identify process and hydraulic bottlenecks in the WRRF
- Determine cost-effective measures to remediate bottlenecks
- Determine whether design peak hourly flow of 180 mgd can be treated in the WRRF



# Plant Modeling Methodology

- Analyze 4 years of operating data to determine process removal efficiencies and limitations
- Develop liquid train hydraulic model
- Develop whole plant process simulator
- Perform computational fluid dynamics (CFD) model of secondary clarifiers



# Data Analysis Results

**Secondary clarifier performance degrades at flows >454 ML/d (120 mgd)**

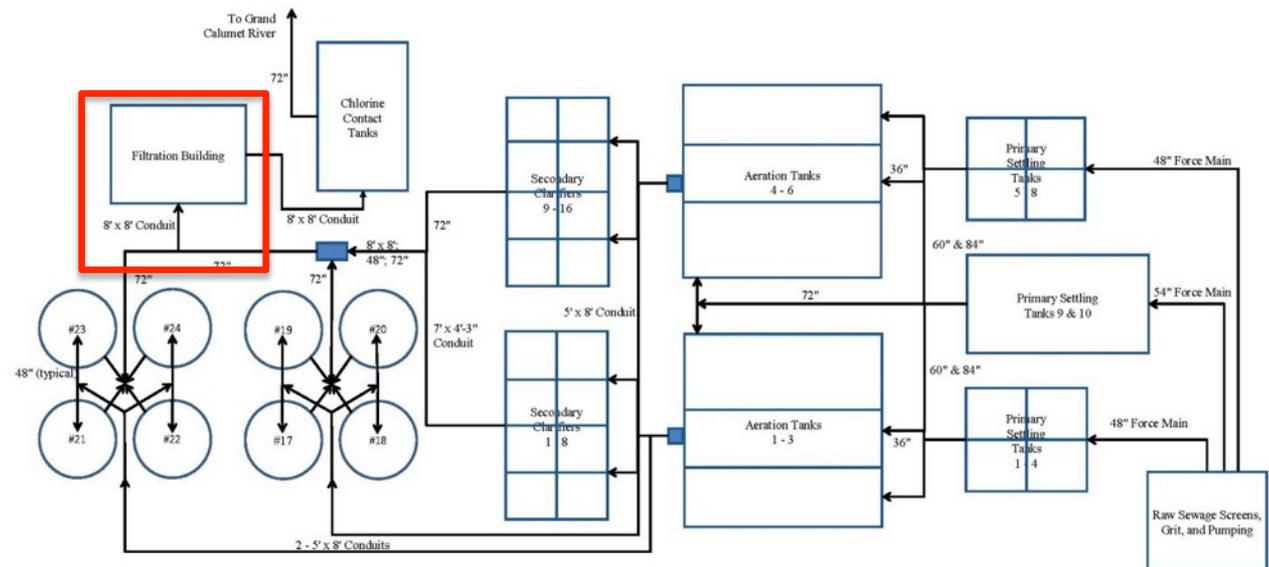
- **Primary clarifier performance at low end of typical values due to dilute influent**
- **Primary clarifier performance unchanged at high flows**
- **Increased primary removals might “starve” the secondary process**

357 ft

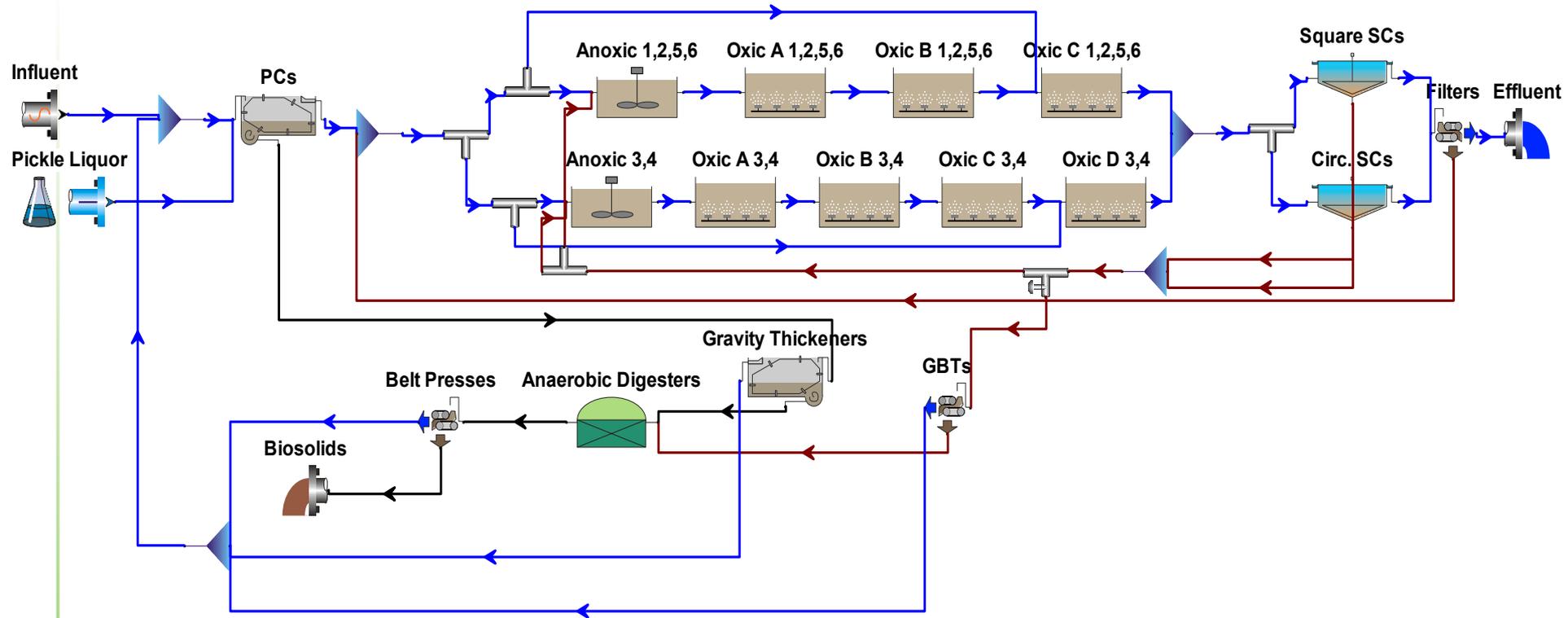
Google earth

# Results of Hydraulic Model

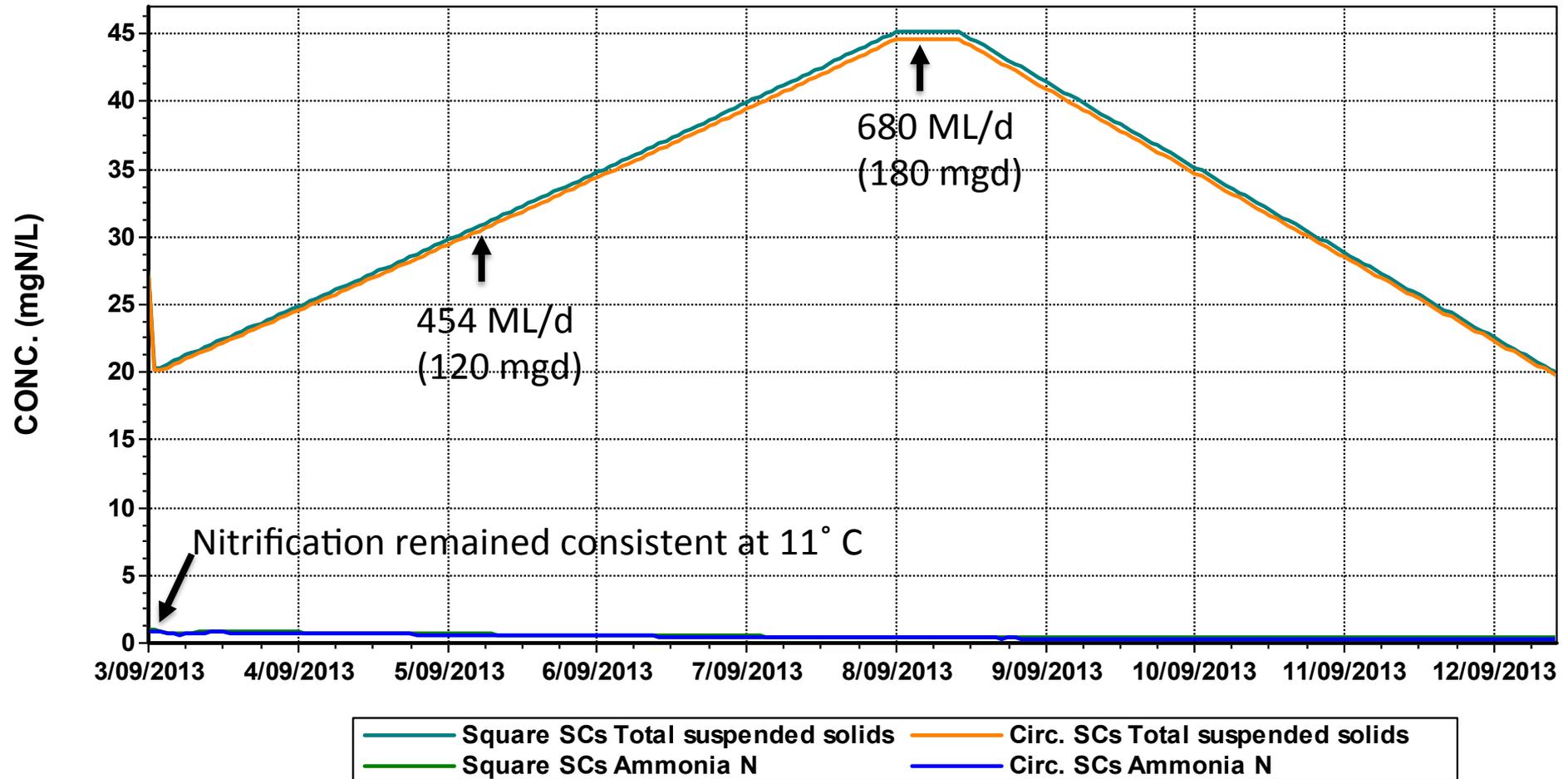
- Secondary clarifier effluent piping and pre-filter algae screen limit flow to 454 ML/d (120 mgd)
- Recommendations:
  - Increase size of effluent piping
  - Increase size of bypass around algae screen



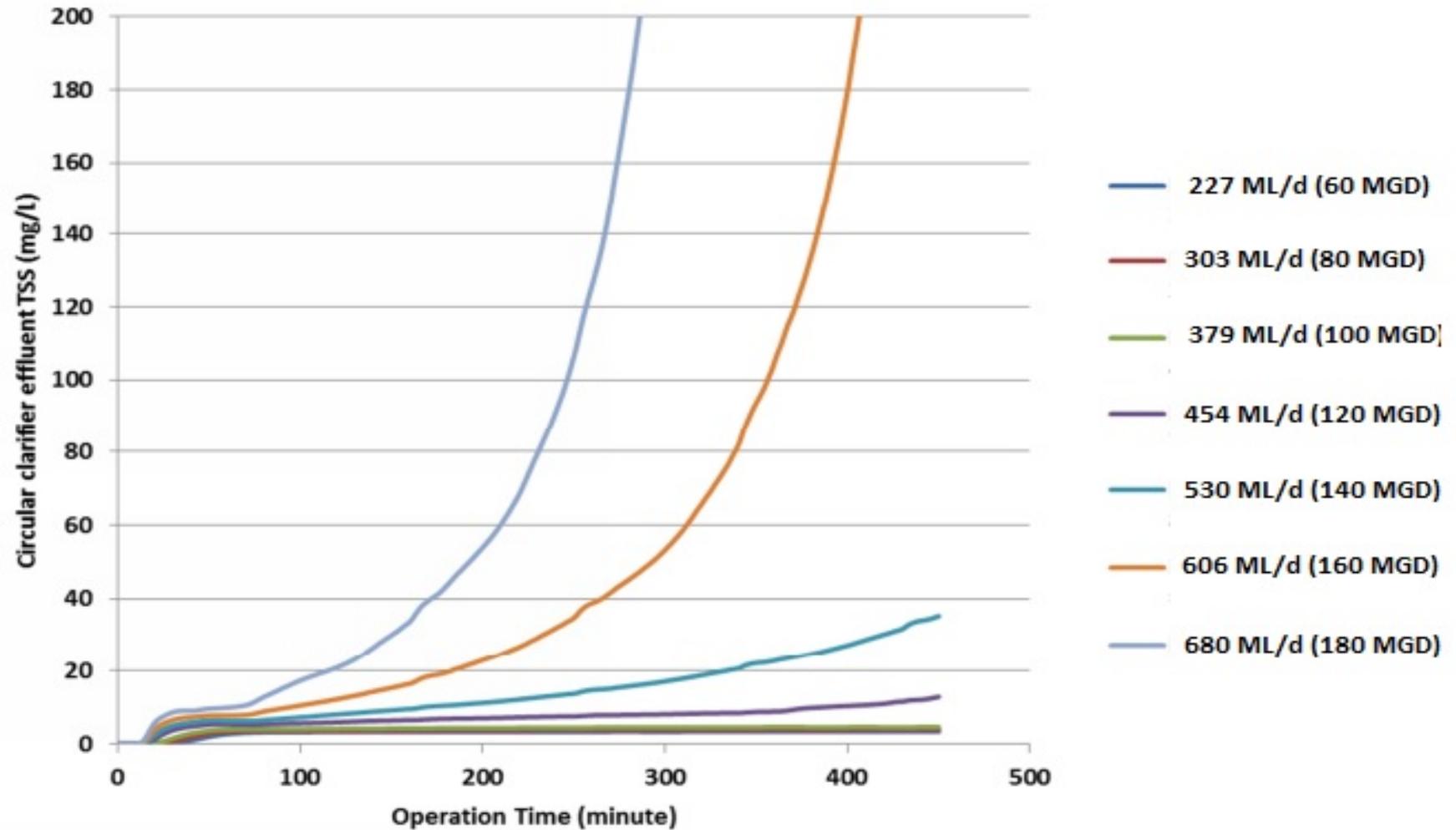
# WRRF Process Dynamic Simulator



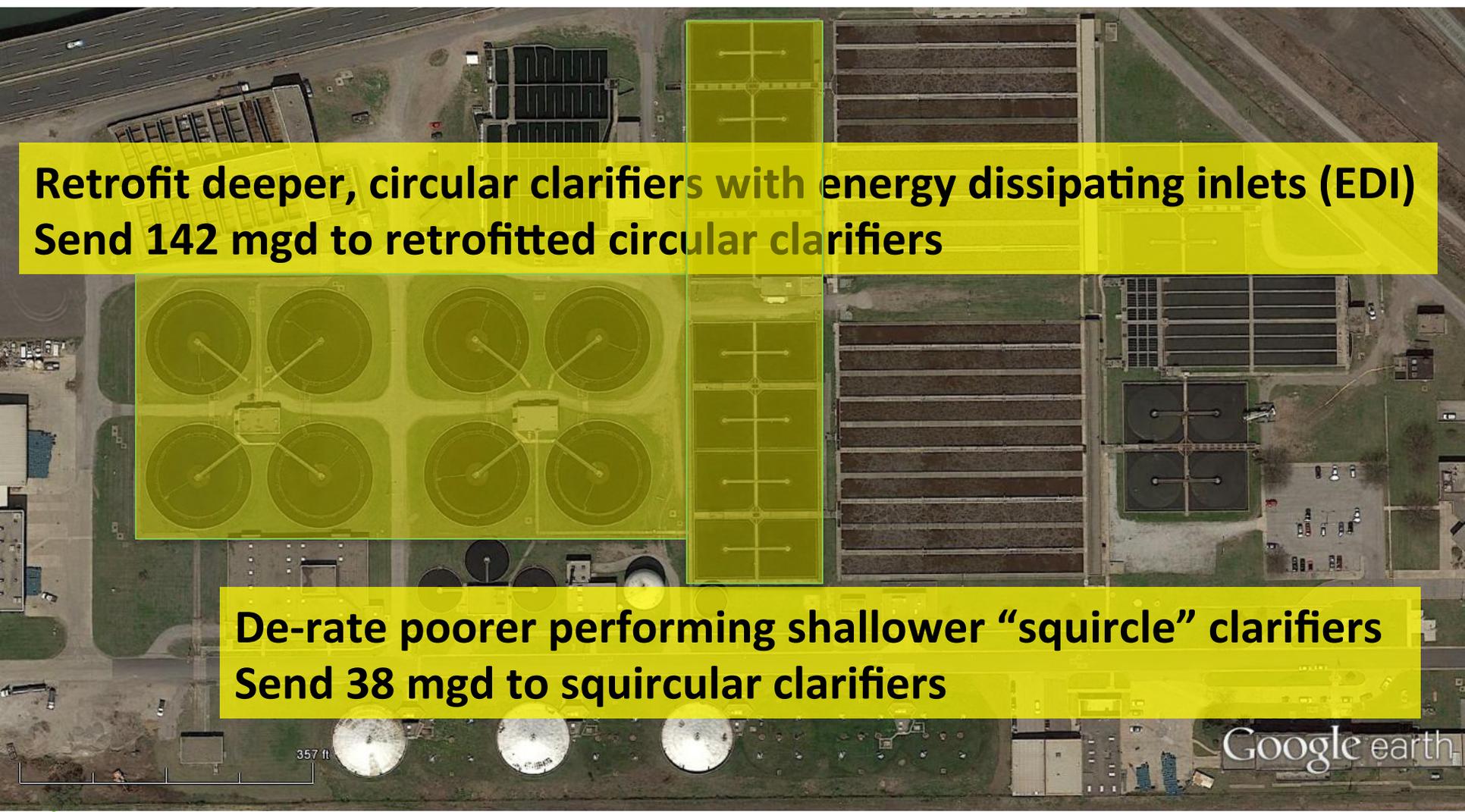
# Results of Process Simulation



# Results of CFD Model



# Secondary Clarifier Recommendations



**Retrofit deeper, circular clarifiers with energy dissipating inlets (EDI)  
Send 142 mgd to retrofitted circular clarifiers**

**De-rate poorer performing shallower “squircle” clarifiers  
Send 38 mgd to squircular clarifiers**

# Summary of Recommendations for Improved Plant Operations

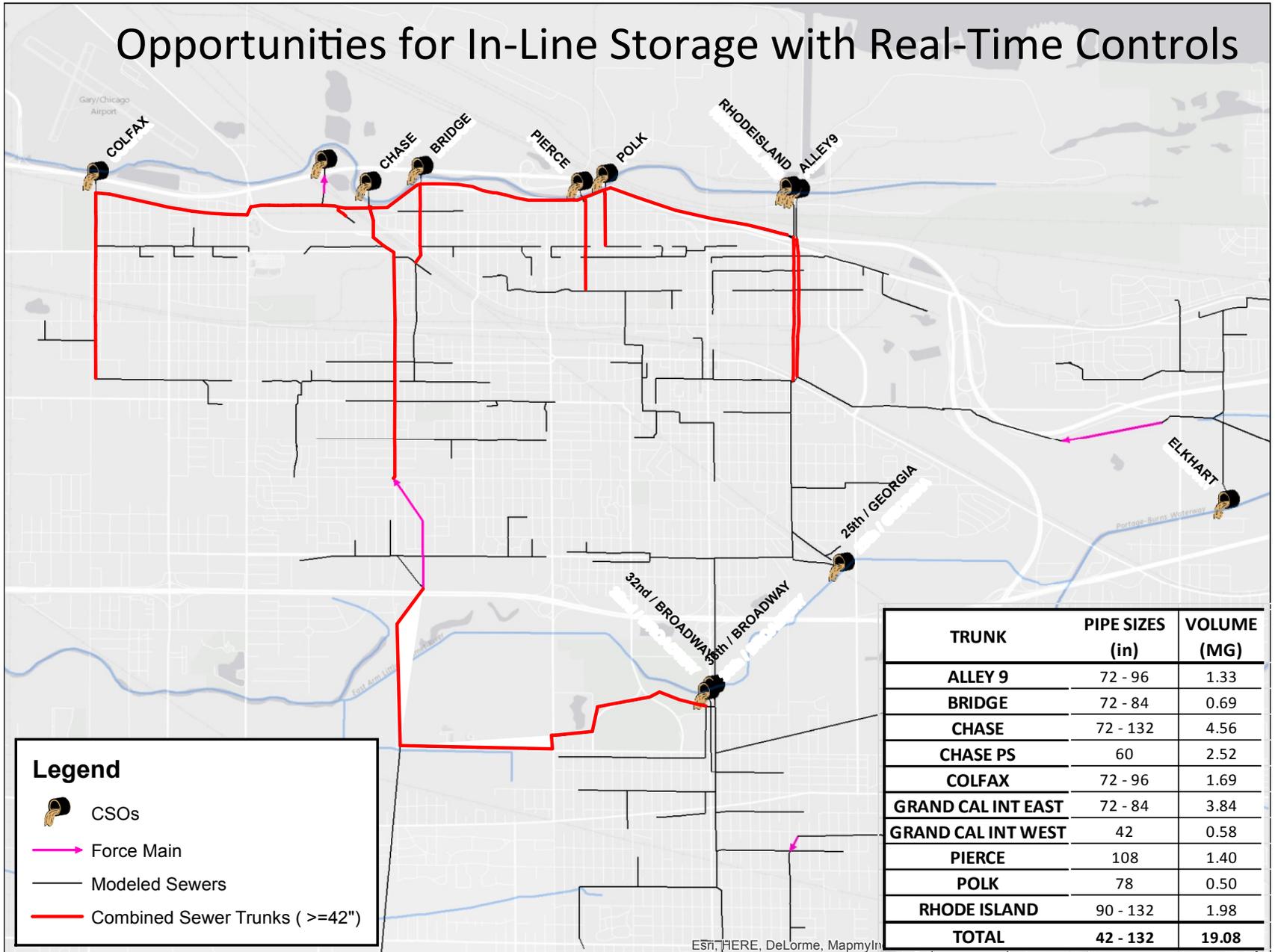
- Alleviate hydraulic bottlenecks at secondary clarifier effluent piping and algae screen
- Retrofit circular clarifiers with EDI

 This will allow the Gary WRRF to treat 180 mgd and reduce bypassing significantly

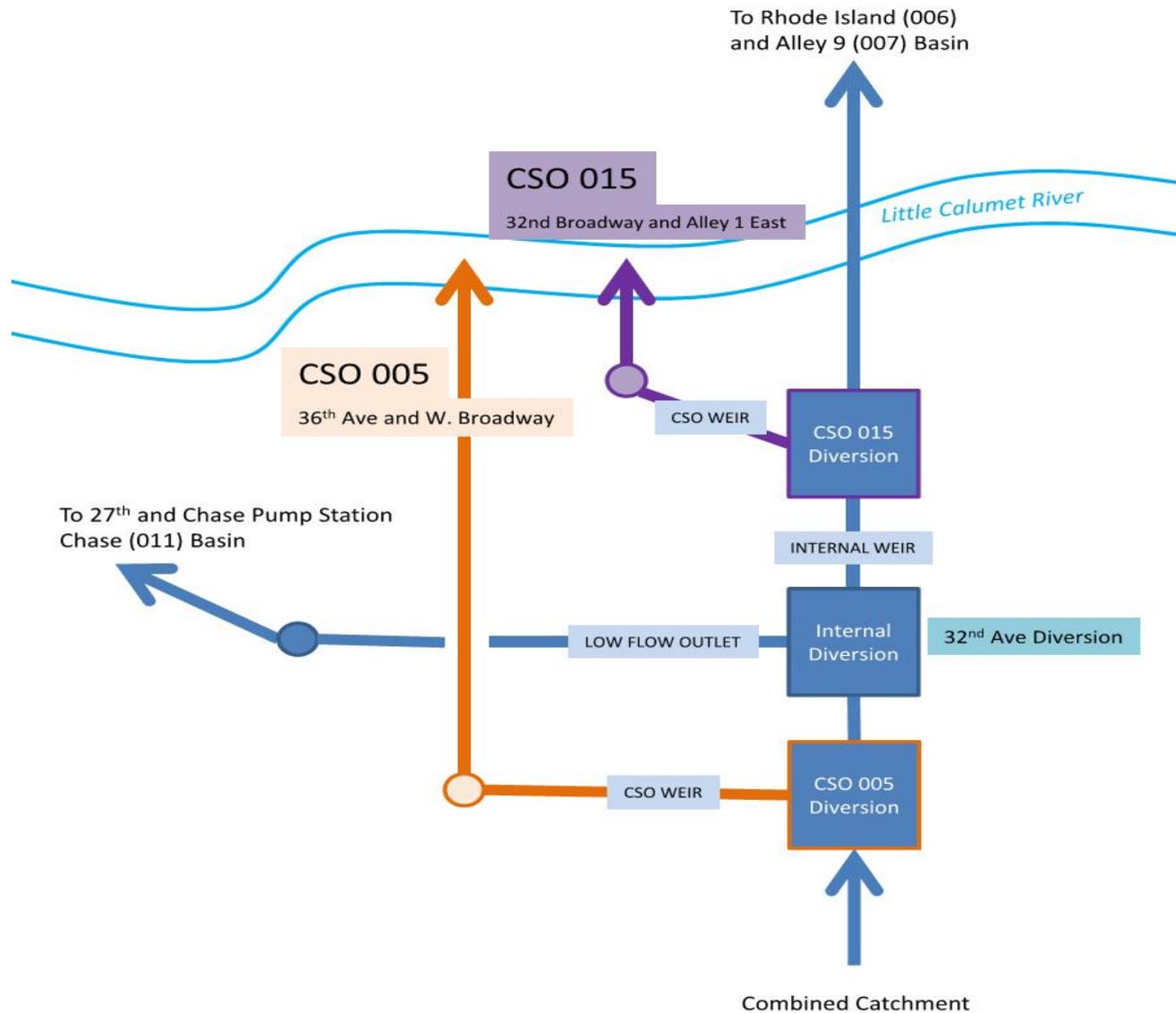
# Next Steps – Long-Term CSO Control Plan Development

- Evaluate real-time controls (RTC) for complex combined sewer collection system
- Combine RTC in collection system with improved plant operations to optimize total system flow capture/treatment during wet weather
- Evaluate use of green infrastructure and other source controls to reduce wet weather flow rates
- Maximizing use of existing infrastructure is expected to save hundreds of millions of dollars for Gary Sanitary District ratepayers

# Opportunities for In-Line Storage with Real-Time Controls

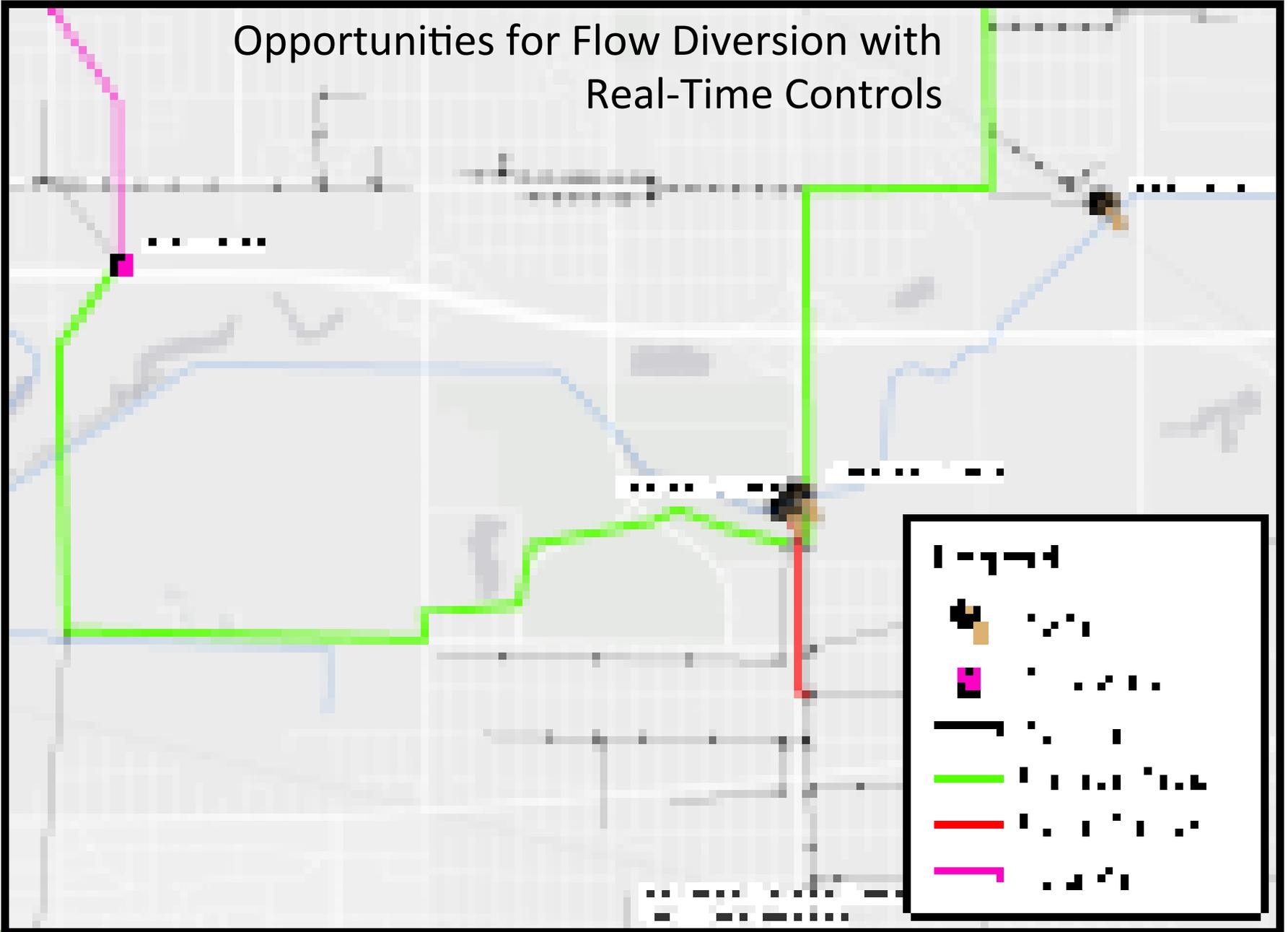


ESRI, HERE, DeLorme, MapmyIn

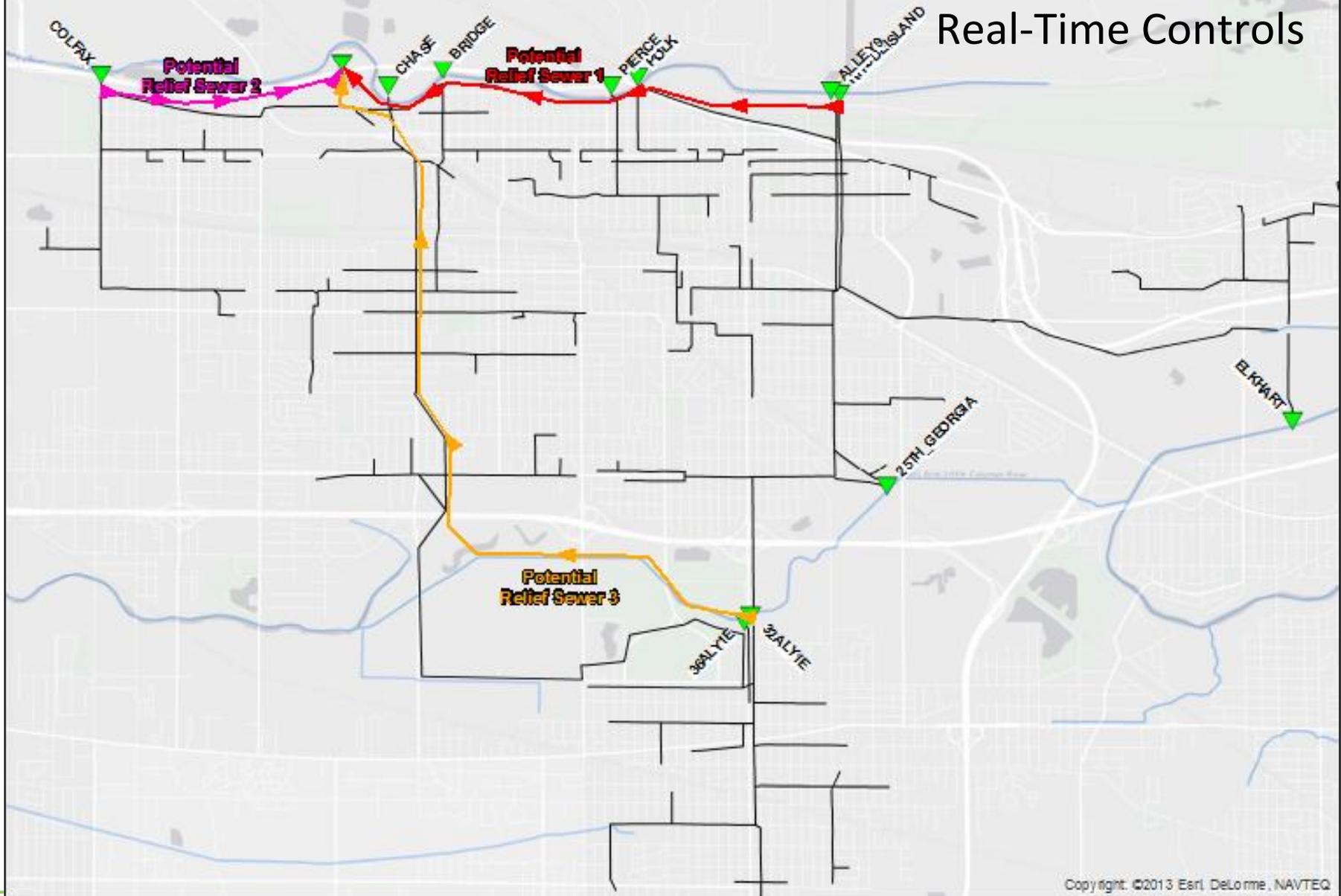


Schematic of diversions and CSOs near 32<sup>nd</sup> Avenue Diversion

# Opportunities for Flow Diversion with Real-Time Controls



# Opportunities for Flow Diversion with Relief Sewer and Real-Time Controls



# Conclusions

- Decreasing base wastewater flow presents both challenges (dilute influent issues) and opportunities (additional capacity during wet weather)
- Plant modeling showed that peak influent rates can be increased 20% (from 150 mgd to 180 mgd)
- Combining the use of:
  - (1) real-time controls in the combined sewer collection system to deliver additional wet weather flow to the plant with
  - (2) modest plant improvements and operational changes to treat additional wet weather flow at the plantwill enable cost-effective control of CSO impacts.



Questions?