

# Curving Concrete Pipe

## What a Relief

GPD GROUP®

# Agenda

1. Speaker Introductions
2. Project Background
3. Analysis & Recommendations
4. Design, Bidding & Construction
5. Q&A

# Speaker Introductions



## Cecilia Mazzei, P.E. (OH)

**Consulting Engineer – Cleveland WPC**

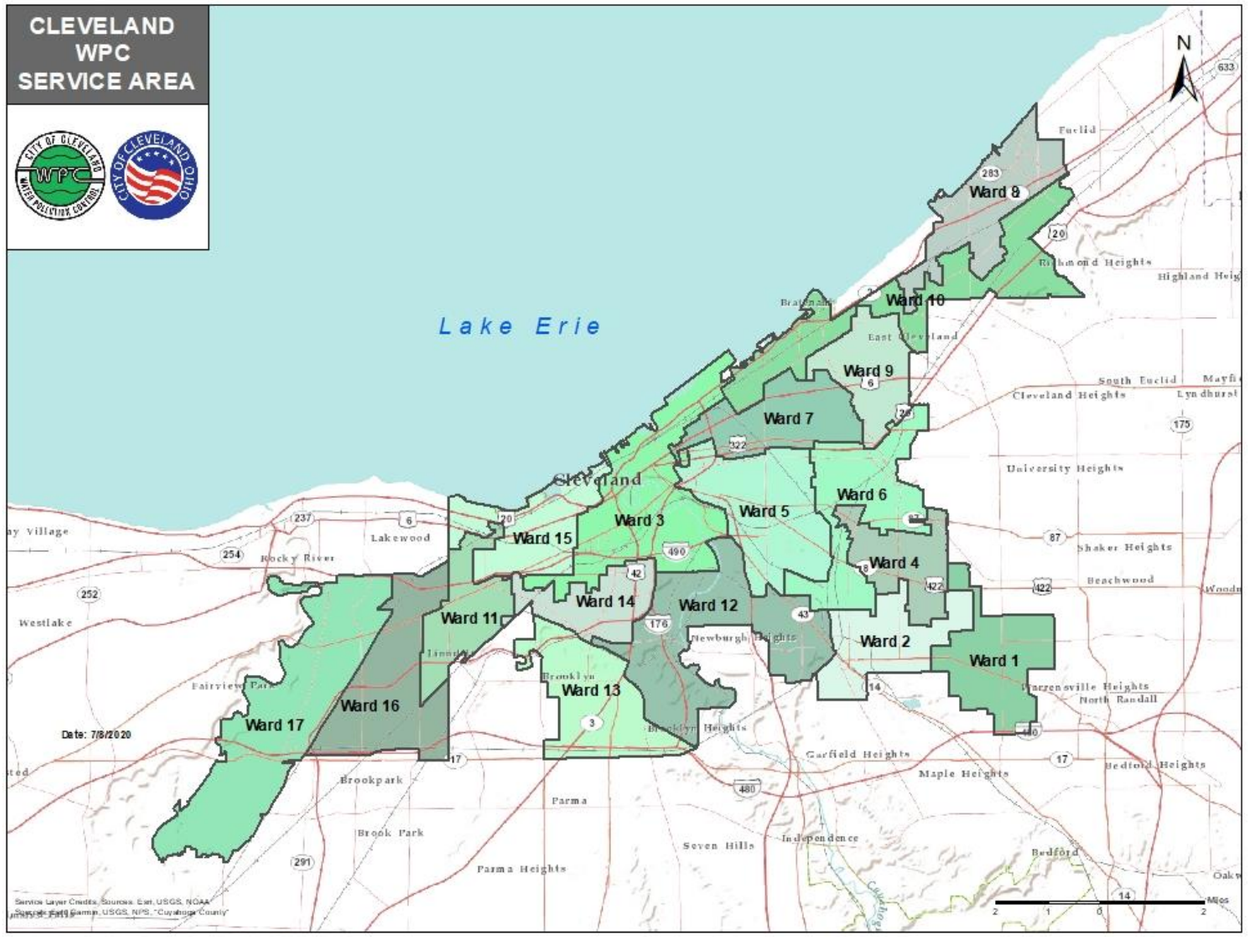
- Bachelor's of Civil Engineering from Cleveland State University
- Master's of Civil Engineering (Water Resources) from Cleveland State University
- Manages WPC's Capital Improvement Program Construction Projects (since 2007)



## Kevin Wojciechowski, P.E., S.I. (OH)

**Civil Engineer – GPD Group**

- Bachelor's of Civil Engineering from The Ohio State University
- Consultant/Designer for WPC Capital Improvement Projects (since 2017)
- WWTP, storm and sanitary conveyance, waterline, and roadway design experience. Additional experience with hydraulic & hydrologic modeling.




# Cleveland WPC

Cleveland Cleveland Water Pollution Control is the sewer maintenance division and stormwater manager for the City of Cleveland, Ohio.

- **Our Mission:** To provide superior leadership, excellent customer service and innovative stormwater and wastewater infrastructure management for a safe and sustainable environment.
- **Our Vision:** To be an innovative steward and leader in the stormwater and wastewater industry and a model customer service provider.
- Division in the Department of Public Utilities

responsible for **1,436 miles**
of combined, sanitary, and storm sewers

**43,000**
catch basins

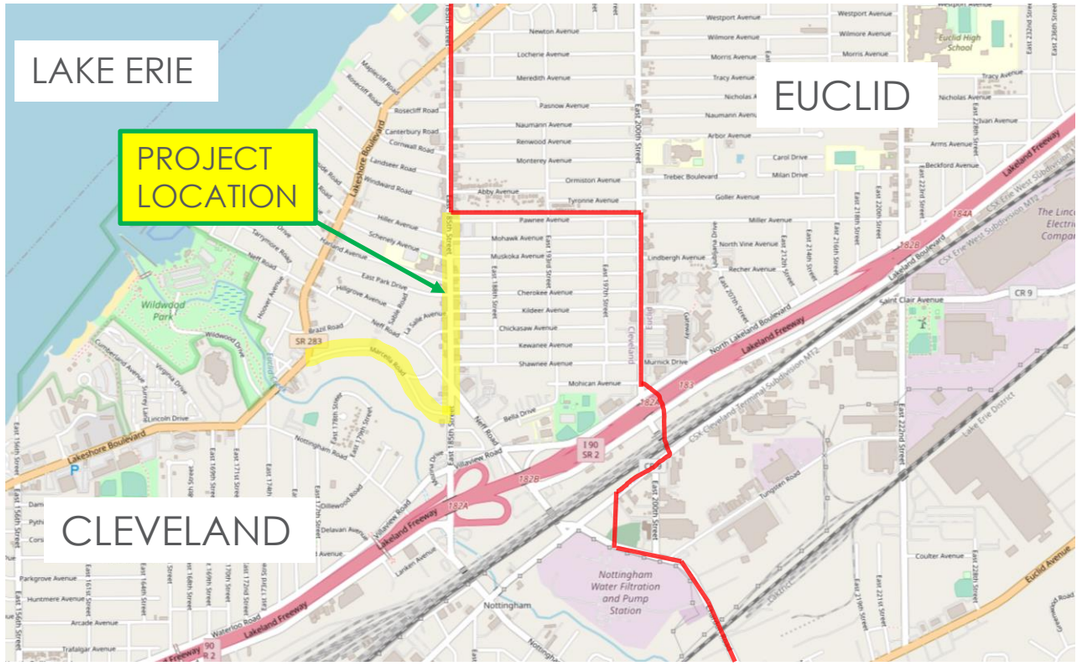
**12**
pump stations

# PROJECT BACKGROUND

# Project Location

## Cleveland, OH

- Northeast corner of Cleveland
- 11 miles east of Downtown
- Borders City of Euclid
- 1,200± residents & 80± businesses within the project area
- $32,000 ± median household income for Cleveland
- $55,500 ± average home value in the project area

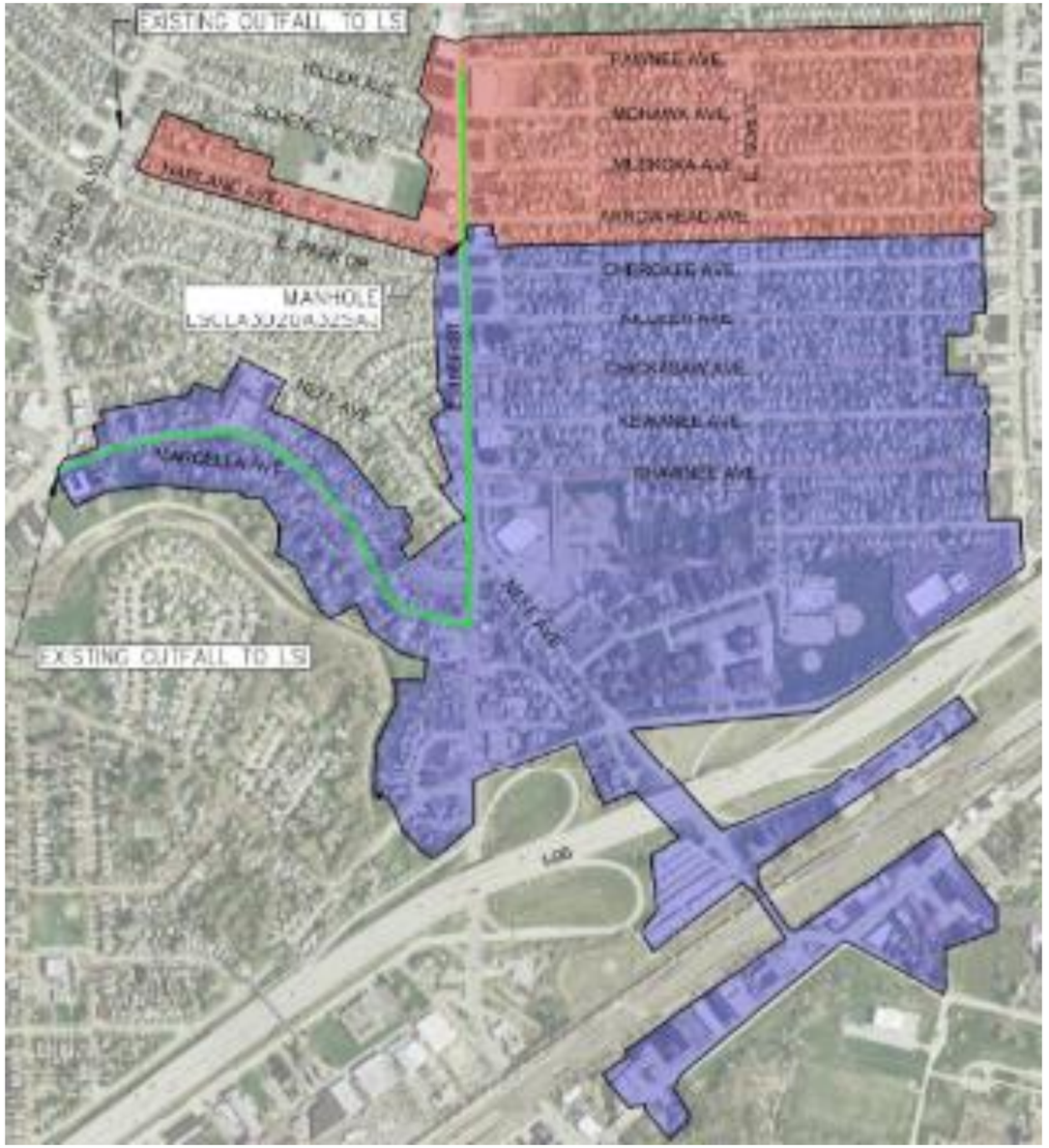





# Project Scope

## East 185th Street & Marcella Road Relief Sewer

- 250+ acre sewershed, known WPC "problem area"
- GPD tasked with:
  - Reviewing previous studies and recommendations
  - Developing a hydrologic model with recommendations to reduce the frequency of flooding
  - Design and development of construction plans



# Project Highlights

## East 185th Street & Marcella Road Relief Sewer

- Project is WPC's largest to date
- $13.9 Million construction cost
- 5,200 L.F. of 48" microtunnel relief sewer
- Longest curved 48" Microtunnel in the U.S.
- Public outreach and notification was crucial
    - Community Meetings w/City Council
    - Bus Rerouting
    - Online & Print Updates
    - Business Street Parking



# Complaint Record

- On WPC “problem area” list for 20+ years
  - Water in Basement (WIB) complaints
  - Street flooding issues




**64%**
**Positive Dye Transfers**

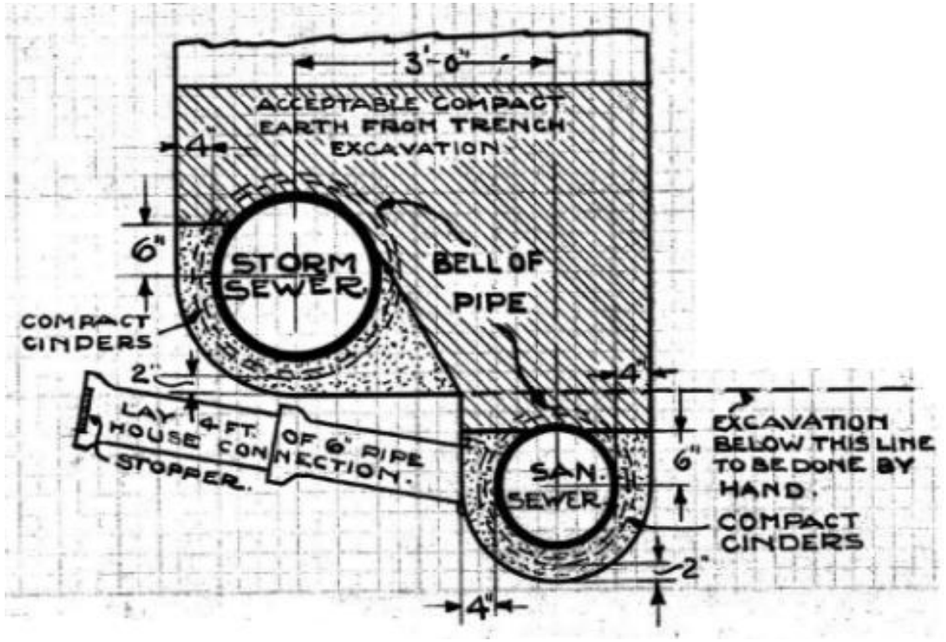
**44%**
**Downspouts Connected to Sanitary**

**1,000**
**Parcels with WIB Potential**

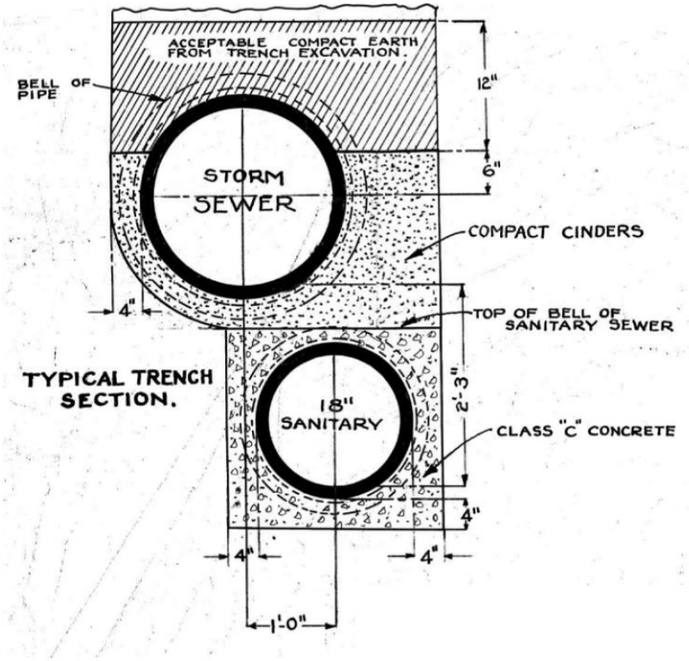


# Project Area History

- Common Trench Sewers – Built in 1924
- Marcella Sanitary Sewer – Lined in 2006




- 1999 – SSES Report
- 2002 – Cleveland Community Report
- 2015 – SSES Study
- 2017-2018 – Hydraulic Modeling



# ANALYSIS & RECOMMENDATIONS

# Hydraulic Modeling

## Flow Monitoring

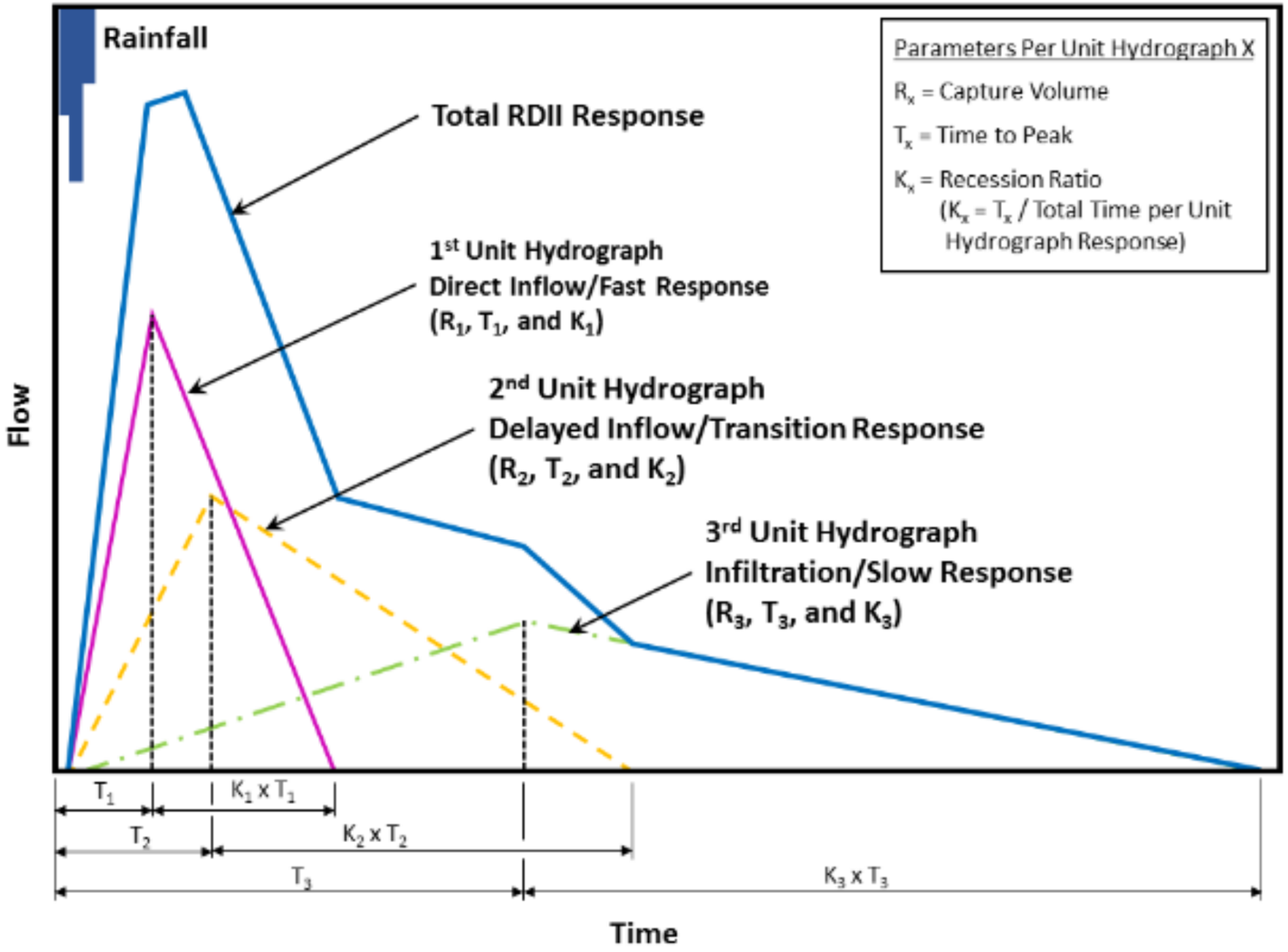
- 8 locations (SAN1001 – SAN1008) were monitored in 2014-2016
- Additional 7 locations (SAN1009-SAN1015) were monitored in 2017 - 2018
    - Flow monitors were located to confirm capacity issues along E. 185th and the side streets east of E. 185th



# Hydraulic Modeling

## Calibration

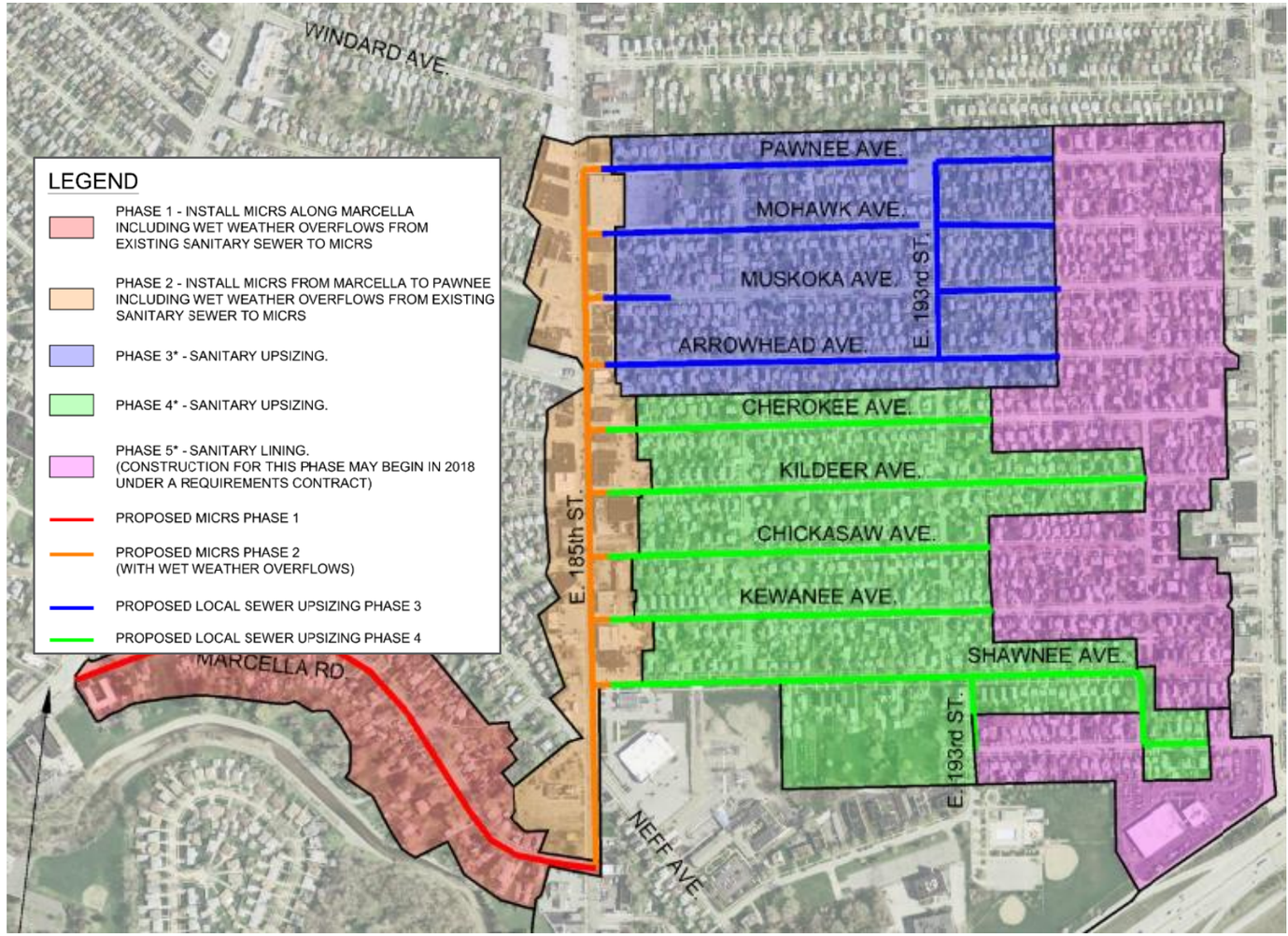
- Used rain events of differing return periods from each monitoring period to calibrate the model.
  - RTK Method was used to estimate amount of stormwater entering the sanitary system.
  - Approximately 34% - 43% of the stormwater flows entered the sanitary sewer during wet weather.



# Hydraulic Modeling

## Evaluation

- Evaluated prior relief sewer study options and determined that the relief sewer was the best option for the area.
    - Historically low I/I reduction when replacing/ lining sewers.
    - NO work outside of R/W
    - Allows the existing main along E. 185$^{th}$ to remain undisturbed.
    - Consistent with Northeast Ohio Regional Sewer District (NEORSD – Regional Sewer Authority, similar to ALCOSAN) planning efforts. NEORSD stubbed 48" wet weather interceptor sewer at westerly end of Marcella Rd.



# Hydraulic Modeling

## Results & Recommendations

- During dry weather, flows were not excessive
- Sanitary Sewer overflow directed to proposed relief sewer when flows were at least 3" above peak dry weather depths.
- The model estimated that after installation of Phase 1 & 2, nearly 60% of the peak flow would be conveyed by the relief sewer.
    - Additional phases could increase this estimate to nearly 90%.
    - Removing flow from the existing sanitary will help to reduce surcharging and the frequency of WIBs, however the existing system must be able to convey these peak flows.

| Overflow Structure | Location | Existing Pipe Size (in.) | Pipe Slope (%) | Max DWF (cfs) | Max Dry Weather Depth (in.) | Proposed Min. Depth until Overflow to MICRS (6" min.) | Freeboard (3" min.) | Max. Flow in Existing Pipe until Overflow (cfs) |
|---|---|---|---|---|---|---|---|---|
| MH-E11A | Pawnee / E185 | 12 | 0.21 | 0.10 | 2.64 | 6 | 3.36 | 0.69 |
| MH-E10A | Mohawk / E185 | 12 | 0.26 | 0.11 | 2.16 | 6 | 3.84 | 0.77 |
| MH-E9A | Muskoka / E185 | 12 | 0.25 | 0.12 | 2.64 | 6 | 3.36 | 0.76 |
| MH-E8A | Arrowhead / E185 | 12 | 0.31 | 0.18 | 2.40 | 6 | 3.60 | 0.84 |
| MH-E7A | Cherokee / E185 | 12 | 0.24 | 0.04 | 1.32 | 6 | 4.68 | 0.74 |
| MH-E6A | Kildeer / E185 | 12 | 0.35 | 0.10 | 1.92 | 6 | 4.08 | 0.90 |
| MH-E5A | Chickasaw / E185 | 15 | 0.23 | 0.19 | 2.88 | 6 | 3.12 | 0.86 |
| MH-E4A | Kewanee / E185 | 15 | 0.35 | 0.19 | 2.40 | 6 | 3.60 | 1.06 |
| MH-E3A | Shawnee / E185 | 15 | 0.22 | 0.28 | 3.72 | 7 | 3.28 | 1.16 |

# Construction Method Analysis

## Open-cut v. Tunneling

- Contractors for construction method feedback, and cost impacts
    - Open-cut
    - Traditional Tunneling (up to 60’ Ø)
    - Microtunneling (2’ - 5’ Ø)
- Preliminary construction costs for Microtunneling were nearly 22% higher than open-cut construction, WPC decided the additional costs were justified.
    - Impact to community
        - Tunneling reduces the duration of detours, size of work zone.
        - Open-cut requires an ever-moving construction zone.
    - Tunneling avoids the need to expose aging infrastructure.
    - Tunneling avoids the need to cut though and reinstall lateral connections. (100± water services, 200 ± sewer laterals)



# DESIGN, BIDDING & CONSTRUCTION

# Design

## Key Design Decisions

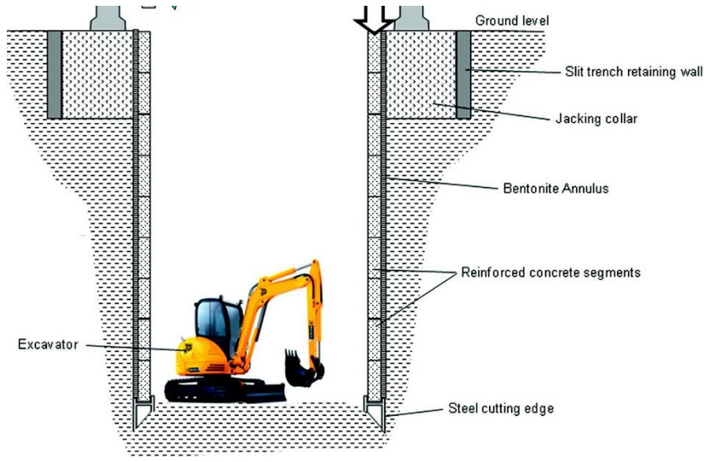
- Tight radius down to 1,000’ could be applied to 48” tunnels, reducing the number of launch and receiving shafts needed on Marcella Rd.
    - Existing sewer has 14 manholes due to curved road.
    - Curved tunnelling only required 4 manholes.
- The entire 5,200’ of relief sewer was constructed as 48”.
    - Initially 2 pipe sizes were proposed. The time and equipment required to change pipe sizes, offset the cost savings of the decreased pipe size.



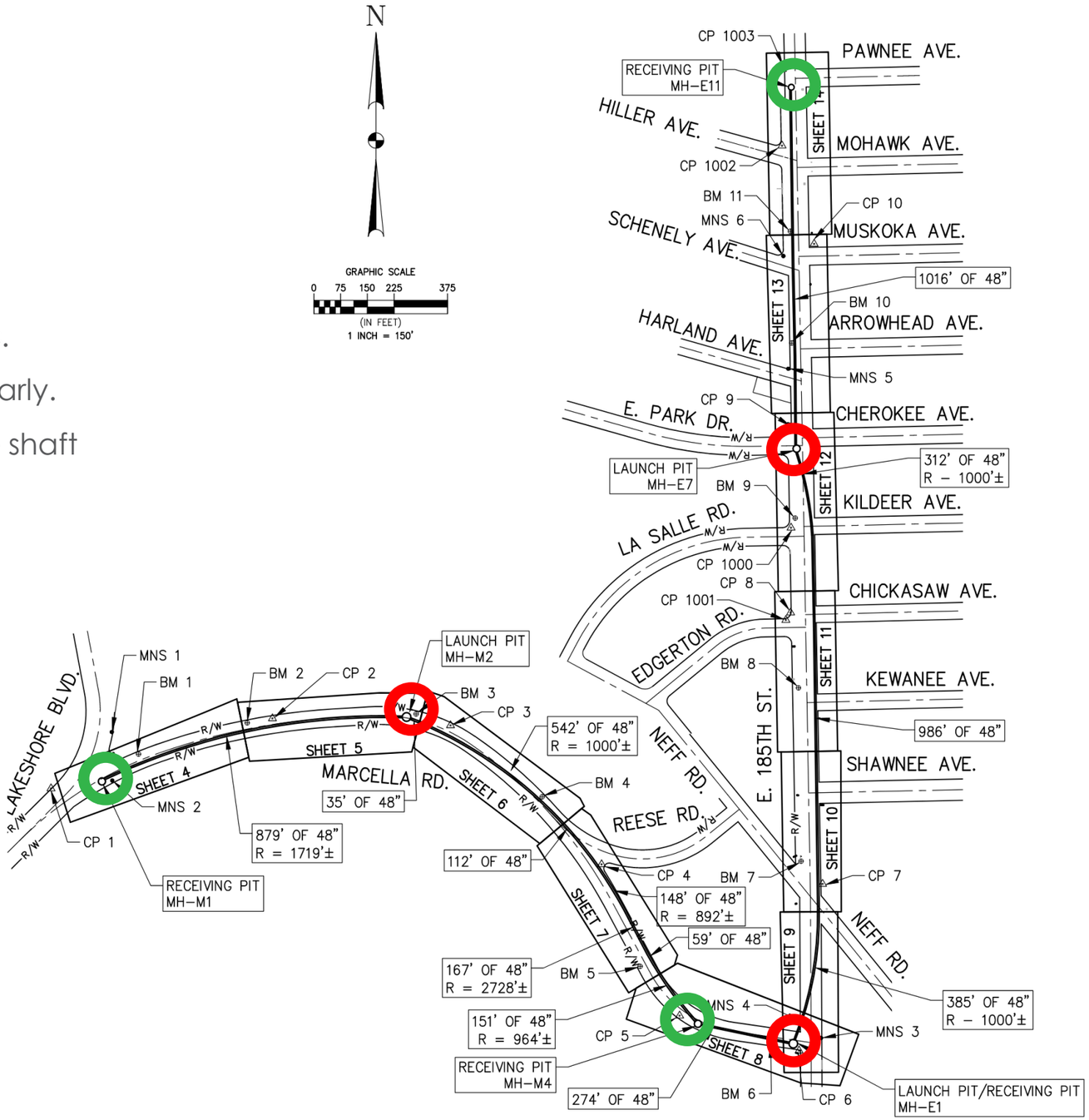
# Shaft Locations

## Launch & Receiving Pits

- Launch Pits (24‘Ø)
- Receiving Pits (20‘Ø)
- Locate such that Launch pits can launch from both directions.
- Keep clear of overhead utilities if possible or start relocation early.
- Pits constructed with caisson sinking method. Excavator in the shaft to clear any obstructions from the cutting head.





# Bidding

## Items of Note

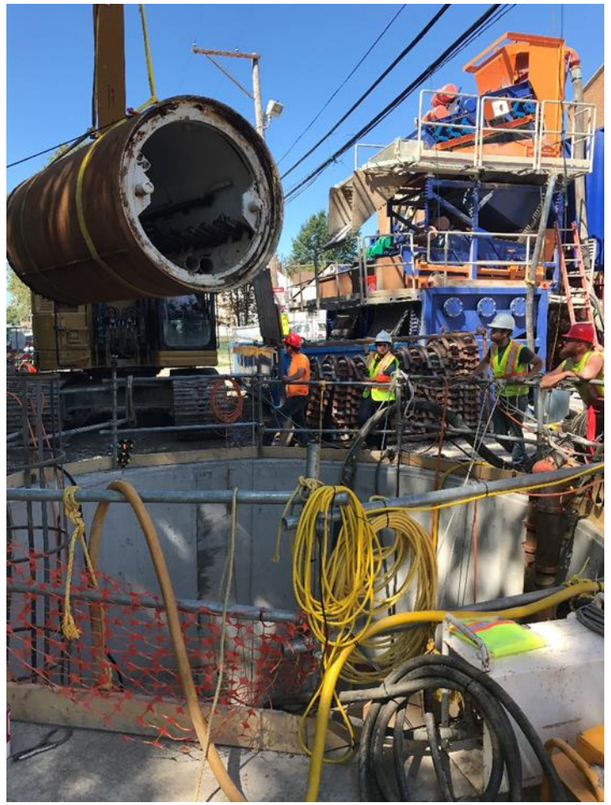
- Trenchless installation of 48" Relief Sewer bid item and specification was kept open to all contractors to determine microtunnel boring method.
- To protect the contractor and residents, video inspections of basements were offered to property owners within proximity to the tunneling.
    - Also included weekly surveying at grade to further ensure settlement wasn't an issue.
- Allowances are key to prevent surprise COs
    - Rescue shafts may be necessary ($350,000)
    - Contaminated Soils and Water (±1%, $100,000)
    - Utility Relocation (±2%, $250k)
    - Standard Contingency (10%)

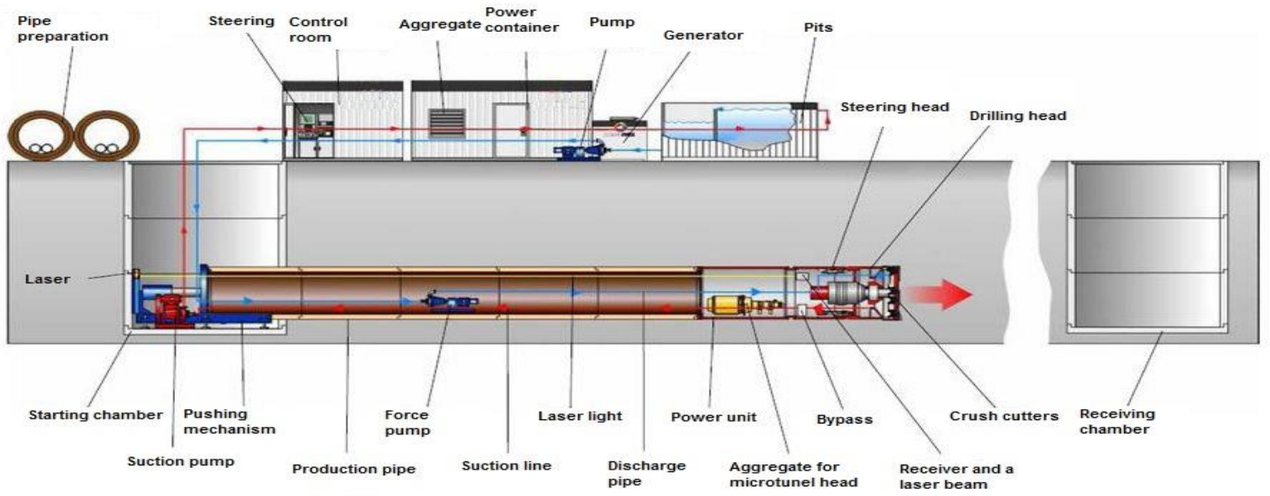
| No. | Bid Item | Quantity | Unit |
|---|---|---|---|
| 1 | Mobilization | 1 | LS |
| 2 | Field Office | 1 | LS |
| 3 | Construction Layout Stakes | 1 | LS |
| 4 | Maintenance of Traffic | 1 | LS |
| 5 | Monitoring Systems, Pre & Post Construction Inspection and Third Party Claims and Preconstruction Video | 1 | LS |
| 6 | 2.5" Asphalt Planing & Resurfacing, Location "A" | 11,000 | SY |
| 7 | 2.5" Asphalt Planing & Resurfacing, Location "B" | 11,600 | SY |
| 8 | Partial Depth Pavement Patching | 2,750 | SY |
| 9 | Trenchless Installation of 48" RCP Relief Sewer | 5,200 | LF |
| 10 | 12" VCP, C-700, ES Sewer, As Directed | 200 | LF |
| 11 | 6" VCP Service Connection, As Directed | 200 | LF |
| 12 | Construction of MH-M1 Shaft and Manhole | 1 | LS |
| 13 | Construction of all Launch or Receiving Shafts and Corresponding Manholes to accommodate the Bidder's Means and Methods. (Similar to MH-M2, MH-M4, MH-E1, MH-E7 and MH-E11) | 1 | LS |
| 14 | Construction of all Precast Manholes on Tunneled Pipe to accommodate the Bidder's Means and Methods. (Similar to MH-M3, MH-E2, MH-E3, MH-E4, MH-E5, MH-E6, MH-E8, MH-E9, MH-E10) | 1 | LS |
| 15 | Relief Connection from Existing System to Relief Sewer (MH-M2A, MH-E1A/EIB, MH-M5, MH-E2A, MH-E3A, MH-E4A, MH-E5A, MH-E6A, MH-E7A, MH-E8A, MH-E9A, MH-E10A, MH-E11A) | 13 | EA |
| 16 | Relief Connection from Existing System to Relief Sewer (MH-M3) | 1 | LS |
| 17 | 10" Waterline Relocation | 500 | LF |
| 18 | 12" Waterline Relocation | 150 | LF |
| 19 | 16" Waterline Relocation | 100 | LF |
| 20 | 10" Waterline Valve | 4 | EA |
| 21 | 12" Waterline Valve | 2 | EA |
| 22 | 16" Waterline Valve | 1 | EA |
| 23 | Reconnect Water Service (1" and Smaller) | 6 | EA |
| 24 | Replace Waterline Service (1" and Smaller) | 6 | EA |
| 25 | Relocate 72" Storm | 1 | LS |
| 26 | Work Involving Contaminated Soil or Water, As Directed | 1 | ALLOW |
| 27 | Utility Allowance | 1 | ALLOW |

# Construction

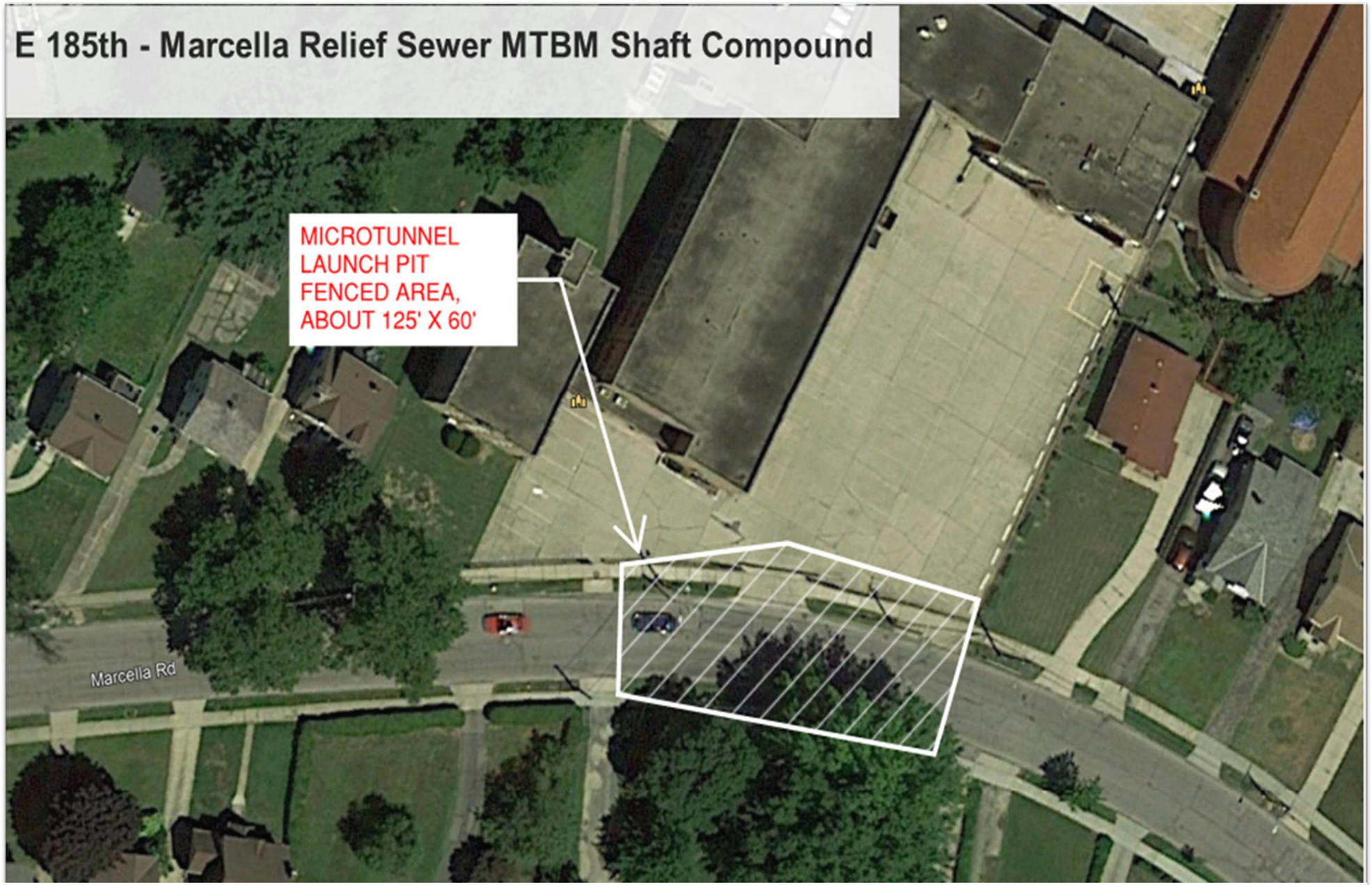
## Lessons Learned/Design Considerations

- Utility Relocations need to occur early (natural gas, water, and overhead lines)
- Determine land acquisition early (Microtunnel easements more attractive)
- Allowances are key for unseen conditions
  - Boulders/cobbles
  - Voids
  - Water-table
  - Older Utilities
- Full-time Inspector
- Progress for tunneling generally 50’ per shift
  - Sped up by City granting a variance from the noise ordinance
- Large areas need for launch shaft work zones (100’x50’)
- Keeping the public & business owners informed
- Post-construction monitoring for model verification





# Construction Photos




1ST LAUNCH PIT IN MIDDLE OF MARCELLA RD. NEARBY SCHOOL & PARKING LOT

# Construction Photos



1ST LAUNCH PIT NEAR THE MIDDLE OF MARCELLA RD. NEARBY SCHOOL & PARKING LOT

Google Earth

# Construction Photos




1ST LAUNCH PIT NEAR THE MIDDLE OF MARCELLA RD. NEARBY SCHOOL & PARKING LOT

# Construction Photos




SLURRY PROCESSING EQUIPMENT AT 1ST LAUNCH PIT NEAR THE MIDDLE OF MARCELLA RD.

# Construction Photos




LAUNCH PIT NEAR THE MARCELLA & E 185TH INTERSECTION. RECEIVING PIT TO THE WEST

Google Earth

# Q&A

