The Success of Inflow and Infiltration Removal in the City of Roosevelt Park

Peter Brink, P.E.
Introduction
Overview of Project

- Reconstruction of Main Road in Roosevelt Park
- New Storm Sewer
- Groundwater Removal System
- How the City is saving money!!
Summary of Construction Costs

- Road/Watermain/Storm Sewer Cost: $2.3M
- Groundwater System Cost: $1.5M
- Total: $3.8M

- But the city is saving $220,000 per year!!
Characteristics

- One square mile
- Population today = 3,800
- Households today = 1,700
- Primarily bedroom community
- Some commercial and industrial
Early Advertising
Historical Notes

• Became a city in 1946

• Residents complained about flooding, high water, and lack of street lights

• Proposals to fix water issues failed under two previous votes
Study Phase
The Challenges

• Streets in Poor Condition
• Lack of Storm Water System in Many Areas
• Hydrogeology – Shallow Groundwater
• Direct Connection of Underdrains to Sanitary Sewer
• Groundwater Pumping Stations
• Residential Sump Pumps

• Several previous studies going back to 1960’s
Streets
Street Condition Ratings
Roosevelt Road Prior to Project
Stormwater System
Existing Storm Water System

- Several City Streets have no storm sewer
- Poorly draining subgrade
- Premature pavement failure
- Significant input to high groundwater
- Existing storm sewer carrying continuous flow from groundwater pump stations
Roosevelt Park Stormwater System
Poor Drainage
Hydrogeology
Hydrogeology

- Shallow groundwater above clay layer
- Significant rise in groundwater levels after rain event
- Caused problems with water in homes
- Addressed with groundwater pump stations and connections to sanitary sewer
Cross Section Locations
Roosevelt and Seminole

Henry and Broadway

SECTION B
Existing Underdrains and Groundwater Pumping Systems
Existing Groundwater Flow to Sanitary and Storm Sewer

- Much of City sanitary constructed with underdrains
- Direct connections in several manholes
- Underdrains also connected to four Pump Stations
- Basement sump pumps
Plan of Groundwater Pump Station
Existing Groundwater Pump Stations

- Originally Designed to Pump 100 to 200 gpm each
- Capacity of underdrains/pumps dropped over time
- Routinely required pump replacement
- No redundancy
- Continuous use of electricity
- Systems were near end of useful life
Groundwater Entering Sanitary
Groundwater Entering Sanitary
Improvement Options
Review of Options

• Problem studied since at least 1960

• P&N June 2014 Report reviewed following options:
  • Additional Storm Sewers
  • Rehabilitate Existing Groundwater Pump Stations
  • Construct New Groundwater Pump Stations
  • Construct Gravity Groundwater Removal System
  • Construct Infiltration Trenches
  • Upsize Underdrain System to Sanitary
Outlet Options

- Main storm water trunk outlet too high for gravity
- Existing storm discharge is to a flashy stream with downstream flooding issues
- Other City storm outlets too high for discharge by gravity
- Considered discharge to deeper aquifer for groundwater
- Lincoln Drain in Norton Shores low enough for gravity discharge
OPTION 1 – REHABILITATE EXISTING PUMP STATIONS

ADVANTAGES

• Reduce Flow to Sanitary Sewer, $ Savings
• Lower Groundwater Levels at Basements
• Could Install New Pumping Equipment Only

DISADVANTAGES

• Old Manhole Structures and Old Underdrains
• Limited by Depth of Existing Structures
• Use of Capacity in Storm System
• Long Term Maintenance/Electric Costs

COST ~ $1,300,000
OPTION 2 – NEW PUMP STATIONS

ADVANTAGES

• Reduce Flow to Sanitary Sewer, $ Savings
• Lower Groundwater Levels at Basements
• Provide Better Groundwater Removal than PS Rehabilitation
• New Manhole Structures

DISADVANTAGES

• Will Use Capacity in Storm System
• Long Term Maintenance/Electrical Costs

COST ~ $1,700,000
OPTION 1 and 2 – REHABILITATE OR REPLACE EXISTING PUMP STATIONS
OPTION 3 – GRAVITY GROUNDWATER DISCHARGE PIPE

ADVANTAGES

• Reduce Flow To Sanitary Sewer, $ Savings
• Lower Groundwater Levels at Basements
• No Electrical Cost, Minimal Maintenance
• Can Combine Install With Road Construction to Save $
• Impact a Much Larger Area than Pump Stations Alone

DISADVANTAGES

• Requires Installation in Norton Shores
• Requires Review Of Downstream Capacity

COST ~ $1,500,000
OPTION 3 – GRAVITY GROUNDWATER DISCHARGE PIPE
OPTION 4 – GROUNDWATER DRAIN TRENCHES

ADVANTAGES

• Reduce Flow to Sanitary Sewer, $ Savings
• Lower Groundwater Levels at Basements
• No Electrical Cost, Minimal Maintenance

DISADVANTAGES

• Transport Piping From West Side of City
• Installing Stone Under Roads Could Cause Settling

HIGHEST COST ~ $2,300,000
# SUMMARY OF OPTION COSTS

<table>
<thead>
<tr>
<th>OPTION</th>
<th>APPROXIMATE COST</th>
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<tbody>
<tr>
<td>1 – EX PUMP STATIONS</td>
<td>$1,300,000</td>
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<tr>
<td>2 – NEW PUMP STATIONS</td>
<td>$1,700,000</td>
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<tr>
<td>3 – GRAVITY GROUNDWATER PIPE</td>
<td>$1,500,000</td>
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<tr>
<td>4 – GROUNDWATER DRAIN TRENCHES</td>
<td>$2,300,000</td>
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Solutions
Solutions Implemented

- Storm System in Roosevelt Road
- Gravity Groundwater Drain
- Decommission Groundwater Pump Stations
- Master Plan for Future Storm System Improvements
Gravity Groundwater Drain

- Directional Drill 2,300 feet of 16-inch HDPE
- Open Cut install of 3,700 feet of 15-inch PVC
- 9,000 feet of 4, 6, and 8-inch underdrain
- Connection to 3 of 4 groundwater pump stations
- Connection to existing underdrain at 2 additional locations
Slotted 4-inch Schedule 40 PVC
Slotted 6-inch PVC
16-inch HDPE
15-inch PVC
Groundwater System with Connections to Existing Drains
Groundwater System
Groundwater System Goals

- Remove approximately 100 to 200 gpm being pumped by existing pump stations
- Remove 200 to 800 gpm being discharged to sanitary sewer by existing underdrains
- Lower groundwater table to reduce volume from basement sumps
Design Considerations

- Capacity of groundwater system of 500 to 800 gpm
- Area of influence large enough to impact all of City
- Underdrain slot size vs. native soil grain size
HDD Underdrain Installation

• Several of the branches installed by HDD
• Contractor was able to install by pulling or pushing 4-inch slotted PVC
• Completed with biodegradable drilling fluid
• Development completed by jetting
Groundwater System Results

• Significant decline in measured groundwater levels

• Groundwater flows observed at outfall of system match expectations

• Substantial decrease in Sanitary Sewer flow and cost
Roosevelt Park
Wastewater Flow and Groundwater Levels

Groundwater Levels and Wastewater Flow
Reduced Sanitary Flow

- Projected sanitary flow based on population = 325,000 to 400,000 gpd
- Sanitary flows before project ranged from 350,000 to 2,000,000 gpd
- Groundwater system lowered water levels and allowed connections to sanitary system to be plugged
Reduced Sanitary Flow

- Sanitary flows since have typically ranged from 325,000 to 550,000 gpd
- 200,000 to 400,000 gpd returned to stream instead of being pumped 17 miles to WWTP
- Approximately 110,000,000 gallons diverted from wastewater system from January 2017 through May 2018
Roosevelt Park 2018 Wastewater Flow vs. 2011 - 2015 Average
With Cumulative savings since 1/1/17
Roosevelt Park Sanitary Flows vs Muskegon McGraft Flow
The Road is Printing Money!!

- Savings of $220,000 in 2017 vs. average of ‘11 –’15
- Savings of $110,000 in 2018 through May 30
- Projected to provide simple payback for groundwater removal portion of project in approximately 7 years
Conclusions

• The main road through Roosevelt Park received a major upgrade

• Storm water system in Roosevelt Road reduces ponding and infiltration

• Groundwater system is removing clean groundwater that was entering sanitary and storm system

• City of Roosevelt Park is saving over $200,000 per year in reduced sanitary costs
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