Underground Stormwater Detention and Rainwater Harvesting System for Northbrook Park District

Brett Holmes, P.E., CPSWQ
• Recognized by Storm Water Solutions Magazine as a Top Project Winner for 2017.

• Won the Illinois Section ASCE Outstanding Civil Engineering Achievement under $10 Million, ACEC-Illinois Engineering Excellence, and Friends of the Chicago River – Green Ribbon.
Topics to be discussed

• Northbrook stormwater history

• Project overview

• Site constraints and stormwater detention design considerations

• Opportunities to incorporate green infrastructure

• Importance of collaborations, negotiations, and public outreach

• Utilization of technology to maximize project benefits
Wescott Park Stormwater Management Project

Owner: Village of Northbrook and Northbrook Park District

Engineering Firm: Baxter & Woodman

General Contractor: V3 Companies of Illinois

Location: Wescott Park, located at 1820 Western Avenue, Northbrook, Illinois

Design Features: Stormwater Storage and Rainwater Harvesting
Village of Northbrook

- Cook County, IL
- Population: 33,170
- 13 Square Miles
- 25 Miles NW of Chicago
# Master Stormwater Management Plan

<table>
<thead>
<tr>
<th>Version</th>
<th>Details</th>
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</table>
| 1<sup>st</sup> Edition | - Created in response to 1982 and 1987 flood events  
                        | - Approved in 1993                                                     |
| 1996 and 2002 Updates | - Included updated costs  
                        | - Reflected completed projects                                        |
| 2011 Update      | - Addendums added in 2012 & 2015  
                        | - In total, 31 potential projects included                            |
Wescott Park Stormwater Detention

Proposed Detention Location

Wescott Park

Wescott Elementary School
Flooding Issues
Study Phase

Ten homes flood in 25-year storm event
Conclusions

Proposed Sewer Route

Proposed Detention Location
Proposed Conditions

25-year flood protection for all homes
Design and Time Restraints

School and Park District Coordination

- Agreement between Village and Park District
- Defined:
  - Construction limits
  - Project schedule
  - Responsibilities
- Irrigation system to be provided
Project Funding

• MWRDGC applied for funding to Cover Incremental Cost of Rainwater Harvesting System
• Intergovernmental Agreement
Design Phase

- Began fall of 2014
- Estimated cost: $10.3M

Main Components

- 23 ac-ft underground detention
- 42-inch diameter storm sewer
- High capacity inlets
- Restrictor
- Irrigation system for ballfield
Underground Detention Design

Design Considerations

• Height and footprint dictated by site constraints
• Minimum HS-20 loading
• 8-month construction window
• Expected service life and product warranty
• Cost
## Underground System Comparison

<table>
<thead>
<tr>
<th>Underground System</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>StormTrap DoubleTrap</td>
<td>• Modular, precast concrete system</td>
</tr>
<tr>
<td></td>
<td>• 93% efficient storage</td>
</tr>
<tr>
<td>Corrugated Metal Pipe</td>
<td>• Storage in circular CMP and void space of backfill</td>
</tr>
<tr>
<td></td>
<td>• 86% efficient storage</td>
</tr>
<tr>
<td></td>
<td>• Durability concerns</td>
</tr>
<tr>
<td>Chamber With Reinforced Stone Piers and Walls</td>
<td>• Structurally supported by reinforced stone aggregate</td>
</tr>
<tr>
<td></td>
<td>• 64% efficient storage</td>
</tr>
<tr>
<td>Cast-in-Place Concrete</td>
<td>• Efficient storage</td>
</tr>
<tr>
<td></td>
<td>• Requires structural design</td>
</tr>
<tr>
<td></td>
<td>• Longer construction time</td>
</tr>
<tr>
<td>Plastic/Resin Systems</td>
<td>• Modular</td>
</tr>
<tr>
<td></td>
<td>• Height limitations</td>
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</tbody>
</table>
StormTrap DoubleTrap System

• Modular, precast concrete system
• 2’-2” to 15’-0” in height
• Innovative design which facilitates quick and efficient installations and minimizes the detention footprint
• Does not rely on void space storage
• 50-year warranty
Pre-Construction Rendering
Rainwater Harvesting System

- Village authorized B&W to move forward with design in August 2015

- Concept:
  
  Use detained water for irrigation

  Automatically drain StormTrap in advance of large storms

  - Storage in StormTrap
  - Pump from StormTrap
  - Irrigation
Illinois Department of Public Health

Requirements for Conditional Approval

• NSF 350 Standards
• Monthly testing for E. coli for one year
• Limited irrigation hours
• Requirements for spigot

<table>
<thead>
<tr>
<th>NSF 350 STANDARD</th>
<th>MAX</th>
<th>AVG</th>
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<tbody>
<tr>
<td>Turbidity</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>TSS</td>
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<td>10</td>
</tr>
<tr>
<td>CBOD</td>
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<td>10</td>
</tr>
<tr>
<td>E. coli</td>
<td>200</td>
<td>2.2</td>
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<tr>
<td>Odor</td>
<td></td>
<td>Non-Offensive</td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td>6.0 – 9.0</td>
</tr>
</tbody>
</table>
Stormwater Management System

- Pre-Treatment Sedimentation
- Storage in StormTrap
- Pump from StormTrap
- UV Sanitization System
- Irrigation
Storage Configuration – Option 1

Pros
- No StormTrap modifications
- Drains by gravity

Cons
- Watertight seal required over large area
- Gate/valve required
Storage Configuration – Option 2

**Pros**
- Reduced footprint of watertight seal
- Drains by gravity

**Cons**
- Gate/valve required
- Tailwater impacts
Storage Configuration – Option 3

**Pros**
- Least expensive option
- Additional volume provided
- Failure condition not critical

**Cons**
- Does not drain by gravity
System Design and Functionality

- StormTrap DoubleTrap divided into two sub sections
- 11’- 4’’ height in sump area, 10’- 0’’ in remainder of structure
- Modular units placed on stone foundation
- Number of pieces: 1,722
- Total water stored: 23.7 acre feet
System Design and Functionality
System Design and Functionality
System Design and Functionality
System Design and Functionality – Roof Inflow
System Design and Functionality – Watertight Seal

• System sealant type - joint

• Joints are sealed with Xypex Patch’n Plug hydraulic cement compound

• Sealed joints were tested following construction
UV Sanitization System

- Additional pre-filtration
- UV radiation kills bacteria and pathogens
- Minimal contact time required
- Non-chemical
- No odor
System Controls and Automation

- Automated control system
- Utilizes online weather forecast data
- Pumps stored water to the downstream sewer system in advance of large storms
- Onsite touch screen controls
- Web interface to monitor system remotely
Construction Progress
Construction Progress
Construction Progress
Construction Progress
Construction Progress
Construction Progress
Construction Progress
Wescott Park Time-Lapse
Questions?

Thank you

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