Analysis of the Implementation of City-Wide Green Infrastructure Solutions to Address CSOs

Case Studies:
New York City, Philadelphia, Cleveland

NJEWA Annual Conference
Atlantic City, NJ
May 7, 2018
Presentation Outline

• Background on Regulations
• Overview of GI Programs and Long Term Control Plans (LTCPs)
  • New York City
  • Philadelphia
  • Cleveland (NEORSD)
• Examples of Common GI Technologies
• Status Updates on LTCPs
• Lessons Learned
• Questions
Regulations

Background on city regulations
## Consent Decree Requirements by City

<table>
<thead>
<tr>
<th>City</th>
<th>Time Frame</th>
<th>Goal</th>
<th>Methods Utilized</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York City</td>
<td>New York</td>
<td>20 Years</td>
<td>Reduce CSO discharge through</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>green and grey infrastructure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Green and grey infrastructure</td>
</tr>
<tr>
<td>Philadelphia</td>
<td>Pennsylvania</td>
<td>25 Years</td>
<td>Reduce stormwater pollution</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>entering the waterways by</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>85%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mostly green infrastructure</td>
</tr>
<tr>
<td>Northeast Ohio Regional</td>
<td></td>
<td>25 Years</td>
<td>Limit overflows from 80</td>
</tr>
<tr>
<td>Ohio Regional Sewer District</td>
<td></td>
<td></td>
<td>per year to 4 per year</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>resulting in 98% capture</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mostly grey infrastructure</td>
</tr>
</tbody>
</table>
GI Programs and Long Term Control Plans

New York City, Philadelphia and Cleveland
Regulated Agency: NYC Department of Environmental Protection

Population: > 8 million citizens

Infrastructure: 14 wastewater treatment plants

Collection System: 60% Combined, 40% Separated

GI Program and LTCPs:
City-wide GI Program and 11 LTCPs utilizing green and grey infrastructure
NYC Green Infrastructure Program

2010
NYC Green Infrastructure Plan was published. Consent Order began in 2012 and extends through 2030

$410 Million
Total investment of GI between 2010 and March 2017

1.67 BG/yr
Target CSO volume reduction per based on Performance Metric Report

78,749 Acres
Total Impervious Area Citywide

$1 Billion
Budgeted between 2017-2027

4,000 Constructed
Total number of assets that have been constructed since the start of the program
NYC’s Long Term Control Plans – Grey Infrastructure Improvements

1. Bronx River
   - $185M grey – sewer modifications
   
2. Hutchinson River
   - $167M grey – disinfection, floatables and outfall

Hydraulic Relief

3. Alley Creek
   - $12M grey - disinfection

4. Flushing Creek
   - $18M grey – disinfection

Disinfection

5. Flushing Bay
   - $1,616M 25 MG CSO storage tunnel

6. Newtown Creek
   - $1,422M 39 MG CSO storage tunnel and PS expansion

Tunnels

7. Gowanus Canal
   - $932M 2 CSO storage tanks

9. Westchester Creek
   - $124M already implemented in grey infrastructure

10. Jamaica Bay
    - LTCP not yet approved

11. East River/Open Waters
    - LTCP not yet approved

9. Westchester Creek
   - $124M already implemented in grey infrastructure

8. Coney Island
   - $197M already implemented in grey infrastructure
Philadelphia

Regulated Agency: Philadelphia Water Department

Population: > 1.5 million citizens

Infrastructure: 3 wastewater treatment plants

Collection System: 60% Combined, 40% Separated

Long Term Control Plan:
- Green stormwater infrastructure
- Stream corridor restoration and preservation
- Wet weather treatment plant upgrades
“eliminate the pollutants that otherwise would be removed by the capture of 85% by volume of the combined sewage collected in the Combined Sewer System during precipitation events”
Philadelphia Green City Clean Waters Program

25
Year plan

85%
Of CSS
Eliminate the pollutants that otherwise would be removed by the capture of 85% by volume of the combined sewage collected in the Combined Sewer System during precipitation events

$2.4 Billion
Total investment after 25-year period

$2.4 Billion
Wet weather treatment plant upgrades

$1.67 Billion
Dedicated to Green Stormwater Infrastructure

$1.67 Billion
Adaptive management which can be directed towards either green or gray infrastructure

$345 Million
$420 Million

5/7/2018
Mott MacDonald | NJWEA Conference
## Stream Corridor Restoration and Preservation

Restoring Living Resources and…

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Commitment</th>
<th>Public Education and Volunteer Programs</th>
<th>Municipal Measures</th>
<th>Sewer Evaluation, cleaning, relining and rehab</th>
<th>Monitor and Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tookany/Tacony-Frankford</td>
<td>$3.12M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobbs Creek Watershed</td>
<td>$2.92M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delaware Direct Watershed</td>
<td>$33.65M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tidal Schuylkill</td>
<td>$33.65M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Wet Weather Upgrades to WWTPs

Northeast, Southeast and Southwest WWPTs

### Northeast
- Vortex Swirl Concentrator
- Conventional Clarifiers
- Chemically Enhanced Primary Treatment with Conventional Clarifiers
- Ballasted Flocculation

### Southeast
- Vortex Swirl Concentrator
- Conventional Clarifiers
- Chemically Enhanced Primary Treatment with Conventional Clarifiers
- CEPT with Plate Settlers
- Ballasted Flocculation

### Southwest
- Vortex Swirl Concentrator
- Conventional Clarifiers
- Chemically Enhanced Primary Treatment with Conventional Clarifiers
- Ballasted Flocculation
Regulated Agency: Northeast Ohio Regional Sewer District

Population: >1.4 million citizens in Cleveland and 61 suburban communities

Infrastructure: 3 wastewater treatment plants

Collection System: 23% Combined, 77% Separated

Long Term Control Plan: Grey infrastructure utilized and only minimum required green infrastructure implemented
NEORSD – Project Clean Lake

25
Year plan
Reduce total volume of raw sewage discharges from 4.5 billion gallons to 494 million gallons annually

$42
Million
6 program areas to implement green infrastructure technologies

98%
Capture of CSO
Wet weather flows will be captured and treated

3
WWTPs
Increasing capacity at all three wastewater treatment plants

$3
Billion
Total 25-year investment for green and gray improvements

7
Storage Tunnels
Construction of 7 tunnels ranging from 2-5 miles in length up to 300 feet underground

5/7/2018
Cleveland Consent Decree: $3B
CSO – 25 Year Capital Improvement Plan

- Tunnels
- Sewer Improvements
- Green Infrastructure
- WWTP Improvements
- Pump Stations
- Storage Tanks
- Other
Green Infrastructure Programs
GI Technologies Used
Common Types
GI Technologies Philadelphia

GREEN ROOFS

STORMWATER WETLAND
Common Types

GI Technologies Philadelphia/NYC

- Porous / Permeable Pavement
- Stormwater Green Streets / Bumpouts
- Right-of-Way Bioswales / Rain Gardens
- Rain Barrels / Cisterns (Philadelphia Only)
Common Types

GI Technologies Cleveland

INFILTRATION BASINS

DETENTION BASINS

PERMEABLE PAVERS
Status Update
NEW YORK CITY

Status Update

• 3,841 GI systems constructed or in construction between 2010 and 2016, thousands more in planning and design
• Based on 1.5% GI implementation rate, 507 MG/yr of CSO volume reduction
• Planned $1 billion investment over the next 10 years
Philadelphia, Pennsylvania

Status Update 2016

• Installed 837.7 “greened acres”
• Reduction of over 1.5 billion gallons of CSOs
• 441 green infrastructure sites
Status Update

Cleveland, Ohio

1 tunnel Complete
3 tunnels in Construction
1 tunnel commencing design in 2018
25 total control measures
4 control measures complete
11 CMs to achieve full operation in next 4 years
Over 2 BG in CSO reduction

9 Projects (2013-2019)
5 Projects completed
4 Projects in construction
Estimated capital costs of $60M
5.7 MG in additional CSO control

Grey Infrastructure
Green Infrastructure

CM 24 Completed
+2 BG CSO reduction in next 4 years

CM 1: Increase Easterly WWTP Secondary Treatment Capacity Completed
CM 6: Euclid Creek/Dugway Storage Tunnel System
  - Dugway West Relief Sewer 110 MG CSO Control
  - Euclid Creek Tunnel/TDPS: 365 MG of CSO Control (delayed to 2018)
CM 18: Mary Street PS Completed
CM 10: Stones Levee PS Completed
Lessons Learned
Lessons Learned

1. There is a need for BOTH green and grey technologies

2. Some cities find green infrastructure to be more cost effective while others find grey to be more cost effective

3. Grey infrastructure allows for the management more stormwater during larger wet-weather events; green infrastructure good for small and long duration storms

4. Green infrastructure allows for increased public awareness between agencies and rate payers and other environmental benefits
Green Infrastructure is trending

Chicago

St. Louis

Seattle

Atlanta

Milwaukee

Los Angeles

New York City

Philadelphia
Green Infrastructure Lessons Learned

- Use of vegetation & natural features to assure water supplies and manage stormwater
- 85% of storms <1-inch in rainfall volume
- 80% of pollutant mass is transported in the first quarter inch of runoff
- GI is less effective during flash flood events compared to long duration storms
- Dispersed management approach
- Most effective higher in watershed
- Community benefits & visibility
- Long term maintenance plan required
- Public Relations
Success: Combination of Green and gray

- GI technologies are good for smaller rain events <1 inch in depth
- GI technologies will have minimal effects on large scale flood events
- Gray infrastructure will be more cost effective in storing large volumes of stormwater
Thank you!

Kathryn DePippo, PE, ENV SP
Project Engineer
E Kathryn.depippo@mottmac.com
T 212.532.3078