Briefing on:

Greening Grey Infrastructure: A Lightweight Alternative to Upgrade the District’s Water Supply Facilities

Briefing for:

Excellence in Environmental Engineering and Science Conference

April 23, 2015
Overview

- Background
- Project Goals, Locations, and GI Practices
- Green Roof Design and Construction
- Pre- and Post-Construction Monitoring
- Maintenance
- Green Jobs
- Education and Outreach
- DC Clean Rivers Project Green Infrastructure Next Steps
DC WATER AND DC CLEAN RIVERS PROJECT

Green Roof at Fort Reno Reservoir
Background: What is DC Water?

- Independent Authority formed in 1996
- Formerly Water and Sewer Utility Administration (WASUA) under Dept. of Public Utilities
- Services Provided
  - Water Distribution
  - Wastewater Collection and Treatment
  - Stormwater Collection and Conveyance
- Largest advanced wastewater treatment plant in the world – 370 mgd capacity
- Serves 2 million people
  - District of Columbia
  - Parts of Maryland & Virginia
Background: Separate and Combined Sewer Systems

100% of suburbs
67% of D.C.

0% of suburbs
33% of D.C.
Background: Where are Combined Sewers Located?

- 1/3 area is combined (12,478 acres)
- 53 CSO outfalls
  - 15 to Anacostia
  - 10 to Potomac
  - 28 to Rock Creek
- Three receiving waters
  - Anacostia River
  - Potomac River
  - Rock Creek
Background: DC Clean Rivers Project Development

1998 - LTCP Started
2002 - Final LTCP
2003 - LTCP Meets WOS (EPA/DC)
2005 - Consent Decree Signed
2007 - New Nitrogen limits require changing LTCP
2011 - DC Water begins evaluating GI for Potomac and Rock Creek

2014 - DC Water proposes changing LTCP to include Green Infrastructure

Public Participation

LTCP implementation
Total Nitrogen implementation

DC Clean Rivers Project
Background: DC Clean Rivers Project Scope and Timeline

DC CLEAN RIVERS PROJECT AND NITROGEN REMOVAL PROGRAMS

- DC Clean Rivers Project: $2.6 Billion
- Nitrogen Removal: $950 Million
- Total > $3.5 Billion
- 20 yr implementation (2005 – 2025)
- 96% reduction in CSOs & flood relief in Northeast Boundary
- Approx 1 million lbs/yr nitrogen reduction predicted

Legend:
- Red: Anacostia River Tunnel System
- Yellow: Potomac River Tunnel
- Blue: Piney Branch Tunnel
- Purple: Pumping Station Rehabilitation
- Orange: Known Flood Area

DC Clean Rivers Project Scope:
- Luzon Valley (Separated)
- Separated or Diversion Work Completed
- Green Infrastructure at DC Water Facilities
- Combined Sewer Area
- East Side Pumping Station
- White House
- US Capitol
- Potomac Pumping Station
- Main and O Street Pumping Stations
- Separate CSO 006
- Poplar Point CSO 006
- Enhanced Clarification Treatment and Nitrogen Removal at Blue Plains

-known flood area

LEGEND
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Background: Progress to Date Controlling CSOs

CSO Overflow (mg/avg year)

- Anacostia River: 2142
- Potomac River: 1063
- Rock Creek: 54
- Total System: 3254

Legend:
- 1996
- 2013
- LTCP Completed (DC Water Formed)
FORT RENO RESERVOIR GREEN ROOF
‘Low Impact Development Retrofit at DC Water Facilities’ Project

- Project required by Consent Decree
- Low Impact Development (LID)/Green Infrastructure (GI) at three DC Water Sites
  - Multiple GI practices designed to manage 1.2"
    - Green Roofs
    - Pervious Pavement
    - Bioretention

<table>
<thead>
<tr>
<th>Practice</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>BIORETENTION</strong></td>
<td>Captures surface runoff in a shallow, vegetated depression underlain with a permeable soil medium.</td>
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<td><strong>GREEN ROOF</strong></td>
<td>Intercepts rainfall via a growing medium and vegetation on a roof.</td>
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<tr>
<td><strong>PERVIOUS PAVEMENT</strong></td>
<td>Permits percolation of surface runoff through a permeable media (concrete, asphalt, or pavers) into a gravel subgrade.</td>
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Project Sites

- Fort Reno Reservoir
  - 8,400 sf Pervious Pavement
  - 42,400 sf Green Roof
- East Side Pumping Station
  - 6,570 sf Green Roof
- Anacostia Water Pumping Station
  - 1,000 sf Pervious Pavement
  - 1,500 sf Bioretention
Fort Reno Reservoir Site
Existing Conditions

- ACCESS ROAD
- TURF
- ABANDONED PUMP HOUSE
- MULCHING AREA
- ONGOING CONSTRUCTION AREA
- RESERVOIR
- PARKING AREA
- TRAILER OFFICE
- OFFICE
- TANK #1
- TANK #2

View of Parking Area, Office, and Trailer Office
West End of Reservoir from Northwest Corner
Fort Reno Reservoir Existing Conditions

- Built: 1926-28
- 5.8 million gallon covered drinking water reservoir serves District of Columbia
- Access hatches throughout
- Historic ventilation houses at each end
- Roof:
  - Approximately 1-acre
  - Repairs and upgrades to reservoir and roof in 1997
  - Internal and external inspection in 2010
  - 8-inch thick concrete slab with 2-way reinforcing
  - Built-up roof

**EXISTING RESERVOIR ROOF:**

- Roofing material
- Lightweight concrete
- Foam board Insulation
- Concrete slab roof
- Reservoir wall

**Existing Reservoir Roof**
Fort Reno Reservoir Green Roof Structural Assessment

- Structural analysis indicated no structural deficiencies
- Existing roofing material loading = 30 psf
- Concrete and Rebar Sampling Program:
  - Three 6-inch concrete cores
  - Reinforcing steel from wall sample

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<tr>
<th>Item</th>
<th>Assumed</th>
<th>Actual</th>
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<tr>
<td>Compressive Strength of Concrete</td>
<td>2,500 psi</td>
<td>6,120 – 7,360 psi</td>
</tr>
<tr>
<td>Yield Strength of Steel (billet or axle)</td>
<td>33 ksi</td>
<td>72 ksi</td>
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- Available loading of 50 psf for the complete green roof system was determined (used assumed values)
- Additional snow load of 30 psf
- Staging of materials prohibited on roof
# Fort Reno Reservoir Green Roof Design Considerations

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<thead>
<tr>
<th>Design Consideration</th>
<th>Concern</th>
<th>Solution</th>
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<tr>
<td><strong>Structural Loading</strong></td>
<td>• Integrity of the existing concrete slab (potential for leakage)</td>
<td>• Structural integrity assessed</td>
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<tr>
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<td>• Compressive strength of concrete roof slab</td>
<td>• Concrete and steel testing performed to ensure structural roof capacity</td>
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<tr>
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<td>• Tensile strength of the structural steel reinforcing in the roof slab</td>
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<td><strong>Safety of Drinking Water Supply</strong></td>
<td>• Protection of the potable water stored within the reservoir</td>
<td>• Green roof designed with three waterproofing layers</td>
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<td>• Perception of constructing a green roof over a potable water reservoir</td>
<td>• Leak detection system designed as part of green roof system</td>
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<td>• Presence of contaminants in the concrete and built-up roofing system</td>
<td>• Environmental sampling performed on existing roof material</td>
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<td>• Reservoir removed from service during construction</td>
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Fort Reno Reservoir Green Roof Design and Construction

- 42,500 square feet
- Extensive: 4 to 6-inch depth
- “Mounding” design
- Planted with sedums, succulents, grasses and perennials
- Access hatches and ventilation houses not impacted
- Paver paths provided for accessibility and maintenance

Green Roof Plantings
- 4”-6” Soil Media
- Capillary fabric and drainage aggregate
- Root barrier
- Mounding insulation
- Thermoplastic Waterproofing Membrane
- Continuous Leak Detection
- Mod-Bit membrane
- Tapered insulation and protection board
- Vapor barrier
- Concrete slab roof
- Reservoir wall

Demo of Existing Waterproofing
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Fort Reno Reservoir Green Roof Design and Construction

Planting Plan by Zones Based on Mounding Insulation Heights

Sedum Adjacent to Paver Walkway

Perennials in Bloom During Summer 2014
Pre- and Post-Construction Monitoring

- Pre-Construction Monitoring
  - Rain gages and flow meters installed to document pre-construction runoff

- Post-Construction Monitoring (underway)
  - Rain gages and flow meters in place to document post-construction runoff
  - Monitoring to date indicates 90% reduction in runoff volume compared to pre-construction
Post-Construction Maintenance

- Contractor performing post-construction maintenance for five years at all facilities
- Green roof maintenance includes:
  - Weeding
  - Annual soil media tests (with fertilization as required)
  - Supplemental plantings (as required)
    - 90% coverage required by end of third growing season
  - Inspecting roof drains, pavers, other roof components, etc.
  - Pest management (as required)
  - Irrigation (temporary during plant establishment)
Green Jobs

- 2014 Green Roof Maintenance Pilot Program
  - Green Roof Focus
  - Program began in summer 2014
  - Recruited 10 underemployed candidates from soft skills training programs (Sasha Bruce Youthwork, Jubilee Jobs, and AFL-CIO)
  - 4 in-class technical sessions led by DCG and UDC
  - 4 in-field sessions: DC Water Fort Reno Reservoir green roof and in-field “job shadowing” with Furbish and Capital Greenroofs
  - Online trainee database accessible to local green roof installation and maintenance companies at training completion (forthcoming)

For additional Information visit:
http://www.dcwater.com/giatdcwater
and http://dcgreenworks.org/programs/green-job-training/
Outreach and Education

- Advance STEM outreach and education opportunities with schools:
  - Alice Deal Middle School Collaboration
  - Earth Echo Hangout
  - Site tours with students

Video Launching Green Infrastructure Design Challenge

Alice Deal Middle School Students

Wilson High School Tour at Fort Reno Reservoir
DC Clean Rivers Project: Green Infrastructure Next Steps

$60 M of Green Infrastructure in Piney Branch

$30 M of Green Infrastructure in CSO 027, 028 and 029

Separate CSO 025 and 026 ($10 M)
Questions?

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Fort Reno Green Roof  
Ribbon Cutting Ceremony