Innovative Urban Stormwater Management

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Stormwater Management Has Evolved

- Management techniques
- Drivers
- Public perception
Where has this led us?

- The public expects more
  - They are well informed and engaged
  - They are viewed as customers

- We (as professionals) are challenged to provide more
  - Holistic solutions (multi beneficial)
  - Integrated planning (inter agency & department)
  - Public & stakeholder engagement
  - Prioritization tools and transparent framework
  - Optimize budget and resources
  - Change management / adaptive management
  - Innovative approaches

Buzz words or Key Elements of Success?
St. Peters, MO
Implementing Comprehensive Urban Stormwater Management
St. Peters, MO

• The community
  – 28 Miles West of St. Louis
  – Population of 57,000
  – MS4 Community

• The program
  – Spending ~$3M annually
  – Combination of public and private ownership
  – Easements placed over all retrofits
  – 100% maintained by City

• The Elements of Success
  – Improvements & retrofits based on prioritized master plan (but room for adaptation)
  – Built trust among the public
  – City progressed through a mixture of locations (public & private)
  – Balanced public engagement
Typical Existing Detention Basins

Concrete low flow channels

Existing Outfall

Concrete reinforced banks
Typical Existing Detention Basins (recently constructed)

Existing Outfall

Concrete low flow channels
Post Construction (1st yr)
Post Construction (2\textsuperscript{nd} yr)
Typical Existing Detention Basins

Concrete low flow channels

Existing Outfall
Post Construction
Key Elements of Success – Basin Retrofits

✓ Holistic Solutions
  – Clear design objectives
    • Water quality
    • Flood mitigation
    • Aesthetics
  – Flexibility in design
    • Highly interactive design process with staff
    • Transparency of challenges

✓ Public Engagement
  – Proactively educate & engage residents
  – Identify the leaders & interested parties
  – Set limits & expectations
Channel stabilization & corridor restoration
Existing Condition
Post Construction
Calwood Channel
Understanding the history for:
Engineers & Public

2/1990

3/1996

3/2002
Post Construction (< 1yr)
Created Tailored Poster Boards for “trouble” sites & lots

Conceptual Lot Drainage Improvements (Aug, 2013)

- Tie downspouts to drain inlet and drain pipe
- Drain pipe outfall can be miter drain at slope (above) or pop-up drain at edge of channel buffer (below)
- Channel bank would be stabilized with stone boulder toe protection with native buffer
Key Elements of Success – Stream Channels

- **Public Engagement**
  - Listen: Identify concerns (perceived or real)
  - Manage expectations
    - What is a “natural system”
    - Tree removal, plantings, & armoring
    - Construction process

- **Integrated planning (inter-department coordination)**
  - Engineering, construction, & maintenance teams
  - Facilitated by city (not consultant)

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Stormwater Management – Planning, Design, & Implementation

- 356 Acre urban watershed
- Complete re-envisioning of solutions
  - Leveraged existing assets
  - Floodplain enhancement
  - Tunnel repair
  - Storm sewer improvements
  - Channel restoration
  - Basin modifications
Elements of Success – Planning, Design, & Implementation

- Adaptive Management
  - Openness to new ideas, approaches, & solutions
  - Adaptability of strategic plan
  - Ownership of process by City staff

- Innovative approaches
  - Leverage technology

- Optimize budget & resources
  - Alternative analysis (50,000+ alternatives)

Traditional vs Optimized
City purchased land for Stormwater Park
Pre Construction
Post Construction <1yr
Resiliency Audits, Planning, and Response

• **Purpose:**
  – Enhance resiliency through response planning
  – Identify potential flood risk and flood vulnerabilities
  – Leveraged technology for advanced warning system: Real-time estimates of flooding risk

• **Result:**
  – Empowers owners & heightens overall community awareness

Superstorm Sandy business recovery program managed by NYC EDC
Assessing Exterior Vulnerabilities

Superstorm Sandy High Water Mark
Data-Driven Reports & Recommendations

- Location Specific Resiliency Assessments
  - Engage, inform, & empower owners
- Data Collection via. Web-Based Forms
- Auto Generated Reports
  - Modeling Results & Expected Risk
  - Identified Vulnerabilities
  - Recommendations & Fact Sheets

Floodproofing Fact Sheets
Flood Resiliency Dashboards - Response
Resiliency Dashboards

Forecasted Flood Inundation & System Statuses

Forecasted Site Inundation Depth
“UNKNOWN” status indicates data is unavailable or forecasted precipitation and tide are below modeled thresholds.

Current Flood Advisory System Statuses
“OFFLINE” indicates that one or more data streams have been offline in the past 48 hours which might impact computation of site-specific flood information.

Color-coded locations by estimated flood inundation depth
Color-coded locations by estimated flood risk

Radar

How Much Rain is in the Forecast?
This chart shows the expected probability and quantity of rainfall in the next 48 hours (source: weather.gov).
Elements of Success

✓ Innovative Approaches
  – Openness of NYC to leverage technology & new approach

✓ Public & Stakeholder Engagement
  – Willingness to engage stakeholders in innovative pilot

✓ Optimize Budget & Resources
  – Resiliency through response planning
  – Empowerment of residents

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Distributed BMPs
The case for lot level BMPs

Metropolitan Water Reclamation District of Greater Chicago
Phase II Pilot Study

Geosyntec consultants
Study Area

- 17 square miles
- 44,053 structures (excludes garages)
- Chronic urban flooding
  - Basement backups
  - Surface flooding
Looking for Solutions

• Balance **system engineering** & **outcome engineering**:
  • System – target level of performance of network (the system)
  • Outcome – focuses on desired outcome (protect homes)

• Flooding solutions balance:
  • Conveyance
  • Volume
  • Structural flood protection

• Ensure the question being asked is framed properly
These are a few follow on questions that should be answered before jumping to the question of how to implement lot level BMPs.

- What level of performance can be expected from BMPs?
- How to quantify performance? How well does it work?
- Does it matter where GI or distributed BMPs are placed?
- Is there a critical mass or threshold of implementation that is needed?
- How can the best location and type of BMP be determined?
- How to compare Green vs Gray vs other solutions?

The Big Question: Will BMPs Work?
Results & Findings

• Explicit modeling of GI in combined sewer model is achievable
  • Provides like-to-like comparison of green and gray
  • Avoids “proxy” modeling of GI
  • Demonstrated integral dependence of green & gray performance

• Optimization protocol demonstrated unique distribution of GI performance
  • Intelligent distribution results in significant implementation cost reduction
Integration of GI with Regional Gray – 100 yr

Maximum GI
Opportunistic Implementation

Optimized GI
Implementation Based on Performance

Structures removed:
42,300

Structures removed:
43,300
Elements Leading to Success

✓ Innovative Approaches
  – Openness of MWRDGC to leverage technology
✓ Prioritization Tools & Transparent Framework
  – Ownership & engagement of MWRDGC staff
✓ Optimize Budget & Resources
  – Robust alternative analysis
✓ Integrated Planning
  – MWRDGC & City collaboration

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Richard Fisher (MWRDGC) Presented Overview at Prior MPC Meeting

Moving Forward:
- Evaluate master planning needs throughout county
- Develop adaptive approach, centered on managing local stormwater issues with multiple-disciplined teams
- Leverage and build upon work of others
- Develop a repeatable process
- Create actionable plans

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Questions?

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