Presented by

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GOALS:

Efficient and cost effective maintenance of storm water BMPs by DPWs

Simple and consistent BMP design

Ensure continued effectiveness of BMPs
Why We Need Storm Water BMPs
How Development Changes the Cycle

Before
Most precipitation is absorbed by vegetation, evaporates, or infiltrates through the ground.

After
Vegetative absorption and ground infiltration is reduced; surface runoff is increased.
Why Do We **Need** Storm Water BMPs?

Prevent and Mitigate Storm Water Impacts

- Quality
- Quantity
- Recharge
Storm Water Quality

Basin – Swale – Rain Garden
- Typically Treat 1” of Rainfall from Impervious Areas
- Water Quality Volume
- Avoid Mixing of Additional Storm Water
Hydrodynamic Separator

- Typically Treat 1” of Rainfall from Impervious Areas
- Water Quality Flow
- Avoid Mixing of Additional Storm Water
Storm Water Quantity

Detention – Retention

• Typically Reduce Proposed Peak Flows to Existing Peak Flows

(2 through 100 year storm events)
## Storm Water Recharge

### Function of Proposed Impervious Area

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>0.4 inches</td>
<td>0.6 inches</td>
</tr>
<tr>
<td>B</td>
<td>0.25 inches</td>
<td>0.35 inches</td>
</tr>
<tr>
<td>C</td>
<td>0.10 inches</td>
<td>0.25 inches</td>
</tr>
<tr>
<td>D</td>
<td>0 inches</td>
<td>0.1 inches</td>
</tr>
</tbody>
</table>
Typical Types of BMPs
Typical Types of BMPs

Wide Variety
- Catch Basins
- Hydrodynamic Separators
- Forebays
- Basins
- Rain Gardens
- Swales
- Infiltration Systems
- Filters
- Permeable Pavements
Why They Become Ineffective
Why Do BMPs Stop Working?

Lack of MAINTENANCE!
Some causes are:

• Access…
  – Physical
  – Legal
Why Do BMPs Stop Working?

Design...
Why Do BMPs Stop Working?

Cost...
Why Do BMPs Stop Working?

Site Constraints…

• Requires specialized tools / training
• Overly time consuming

Result: deferred maintenance
Why Do BMPs Stop Working?

Construction Practices...
Case Study I
Why Do BMPs Stop Working?

CASE STUDY I

Sedimentation and Erosion Control
Why Do BMPs Stop Working?

CASE STUDY I

Sedimentation and Erosion Control Construction - Summer 2005
Why Do BMPs Stop Working?

CASE STUDY I

Sedimentation and Erosion Control
Why Do BMPs Stop Working?

CASE STUDY I

Sedimentation and Erosion Control
Why Do BMPs Stop Working?

CASE STUDY I

Sedimentation and Erosion Control
Case Study II
Why Do BMPs Stop Working?

CASE STUDY II

Construction & Access
Why Do BMPs Stop Working?

CASE STUDY II

Construction & Access
Why Do BMPs Stop Working?

CASE STUDY II

Construction & Access
Why Do BMPs Stop Working?

CASE STUDY II

Construction & Access

2007 – Initial Review

2012 – Retrofit Complete
CASE STUDY III
Why Do BMPs *Stop Working*?

**CASE STUDY III**

**No Maintenance**

Constructed – Approximately 1996
Why Do BMPs Stop Working?

CASE STUDY III

No Maintenance
Why Do BMPs Stop Working?

CASE STUDY III

No Maintenance
Why Do BMPs Stop Working?

CASE STUDY III

No Maintenance
Why Do BMPs **Stop Working?**

CASE STUDY III

**No Maintenance**
Downstream results
Development and Construction of BMPs
DESIGN

Minimum standards and performance criteria for storm water provided by local or state regulations.
Local Review and Approval
- Town / City Engineer Review
- Peer Review
- Local Board/Commission Review
- Public Works?

How BMPs are Developed & Constructed
How BMPs are Developed & Constructed

Consider Owners Ability to Maintain the BMP
• Equipment
• Manpower
• Knowledge & Skill

Specify the Correct BMP for the Ability of the DPW
How BMPs are Developed & Constructed

Majority of Construction done by Developer / Contractor

DPW may have little to no control over construction

- Proper E&S Control and Plan
- Inspection Parameters
- DO NOT USE DURING CONSTRUCTION
Strategies to Reduce Maintenance Costs
Design Strategies to Reduce Maintenance Costs

Typical Maintenance Requirements:

- Sediment Removal
- Light Oils
- Mowing
- Erosion Repair
- Compaction
Suggestions for Typical Practices
Design Strategies to **Reduce Maintenance Costs**

**Forebays**

*First Means of Collecting Sediment*

- Limit Riprap
- Provide Easy Access
- Concrete Bottom
- Size for Sediment Load
Design Strategies to Reduce Maintenance Costs

Swales & Basins

- Limit Riprap
- Provide Access to Bottom of Basin and to Outlet
- Proper Side Slope
- Proper Bottom Width
- Proper Berm Width
- Design of Sand / Loam Mix
- Design of Underdrain
- Removal of Invasive Plants
- Aesthetics
Design Strategies to Reduce Maintenance Costs

Hydrodynamic Separators

- Depth
- Access Covers
- Confined Space Issues
- Internal Mechanics may block ability to maintain or may break
- Alternate means of maintenance if equipment is unavailable
Design Strategies to **Reduce Maintenance Costs**

**Rain Gardens**

- Plantings
- Mulch
- Aesthetics - Free Maintenance?
Design Strategies to Reduce Maintenance Costs

Separation of Public and Private Watersheds

- Employ LID
Costs Associated with Maintenance
## Costs Associated with Maintenance

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Designed with no input from DPW (maintained once in 10 years)</th>
<th>Designed with DPW in mind (maintained yearly)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair Lawn</td>
<td>4 hours</td>
<td>N/A</td>
</tr>
<tr>
<td>Construct Access into Basin</td>
<td>2 hour</td>
<td>N/A</td>
</tr>
<tr>
<td>Remove Trees &amp; Brush</td>
<td>8 hours</td>
<td>N/A</td>
</tr>
<tr>
<td>Mowing</td>
<td>2 hours</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Remove Sediment</td>
<td>4 hours</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Loam, Seed, E &amp; S</td>
<td>4 hours</td>
<td>N/A</td>
</tr>
</tbody>
</table>
## Costs Associated with Maintenance

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</tr>
</thead>
<tbody>
<tr>
<td>Typical Cost Savings over 10 years (manhours only)</td>
<td>2 employees for 24 hours</td>
<td>2 employees for 45 minutes each year</td>
</tr>
<tr>
<td></td>
<td>48 manhours</td>
<td>15 manhours</td>
</tr>
</tbody>
</table>

70% Reduction in Man Power
Design Ordinance
• Structural Conveyance
  Catch Basins, Manholes, Pipe, etc.
• Pretreatment (10 to 25% WQV) for Swales / Basins
  Forebays, Hydrodynamic Separators, Grass Swales, etc.
• Primary Treatment Practices
  Swales, Basins, etc.
• Maintenance Access
  Min. 12’ wide, Max. 15% slope
• Special Provisions
  Infiltration, Inspection
• Details
Concrete Forebay Bottom Detail

- Wood float or broom finish
- 2 #5 continuous top & bottom lap 24”
- Provide corner bars
- 1’-0” min. rolled 3/4”Ø crushed stone under entire slab
- #4 @ 12” each way
- 3”
- 6” concrete slab on grade
- Compacted granular fill
Typical Basin Cross Section Detail

Typical Basin Cross Section
Basin Berm Detail

- Impermeable embankment material (see note)
- 4" topsoil or riprap armoring as required by 25 yr storm velocity
- Stormwater basin
- Varieties
- 12" min.
- Remove topsoil
- 8' min.
- 3 min.
- Existing grade
Gravel Access Way Detail

NOTES:
1. MAINTENANCE ACCESS WAYS SHALL BE A MINIMUM OF 12’ WIDE & SHALL HAVE A MAXIMUM SLOPE OF 15% AND A MAXIMUM CROSS SLOPE OF 4%.
2. ACCESS WAYS SHALL BE PROVIDED TO ALL MAJOR SYSTEM COMPONENTS.
Retrofitting Existing BMPs
Retrofit of Existing Practices

• Ensure no downstream harm
  – Flooding & Erosion
• Preserve WQV
• Ensure easy & cost effective maintenance
CASE STUDY I

Town Hall Swale
CASE STUDY I

Town Hall Swale

Retrofit of Existing Practices
CASE STUDY I

Town Hall Swale
TIPS FOR SUCCESSFUL CONSTRUCTION
Tips for Successful BMP Installation

- Implement Design Ordinance
- Proper Design, Coordination and Review
- Proper Construction
  - Install BMP after upgradient watershed is stabilized
  - Ensure proper E & S
  - Inspections
  - Maintenance by Contractor Prior to Acceptance of Ownership
  - Training
  - Preparation and Filing of As Built Plan
ADDITIONAL CASE STUDIES
CASE STUDY I

Public Works Facility
CASE STUDY I

Public Works Facility

- Improper Install and E&S over Winter
CASE STUDY I

Public Works Facility

- Restoration of Basin
CASE STUDY I

Public Works Facility
CASE STUDY I

Public Works Facility
CASE STUDY II

Rain Garden
CASE STUDY II

Rain Garden
CASE STUDY II

Rain Garden
CASE STUDY III

Town Owned Swale
CASE STUDY III

Town Owned Swale
CASE STUDY III

Town Owned Swale
CASE STUDY III

Town Owned Swale
Questions?

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