Cohasset Rain Garden Project

LID in Practice – Retrofit Project

MA Water Resources Research Conference
Fifth Annual Conference, April 8, 2008

- John K. McNabb, Jr.
  Cohasset Board of Water Commissioners
  339 King Street, Cohasset, MA 02025
  (781) 383-0057
  johnmcnabb@comcast.net
  www.cohassetwater.org

- Mark S. Bartlett, PE, CPESC, TURP
  President, Norfolk Ram Group LLC
  One Roberts Road, Plymouth, MA 02360
  (508) 747-7900, ext 131
  mbartlett@norfolkram.com
  www.norfolkram.com
Cohasset Water Department LID Retrofit Project
Presentation Outline

- Background and Purpose of Project – McNabb
- LID Concepts (brief) – Bartlett
- Project Design and Construction – Bartlett
- Maintenance Issues – Bartlett
- Questions

Cohasset Water Supply
Lily Pond, Cohasset, MA
Cohasset Water Department LID Retrofit Project

Acknowledgements

$400,000+ Project Funded by:

- s. 319 Grant from MA DEP/US EPA
  - 60% - Grant
  - 40% - Minimum Match (Cohasset Water Commission)
- MA Clean Water State Revolving Fund
  - Used to fund construction.

Assistance from:
Community Garden Club of Cohasset
MA Department of Environmental Protection
US Environmental Protection Agency
Greenscapes Program through NSRWA
Cohasset Water Supply

Eutrophication

- **Surface Water Supply Protection Plan**
  (Norfolk Ram, June 2002)
- **Limnology and Water’s Edge Study**
  (ENSR, December 2002)

Reduced Loading of Nutrients (and Organic Pollutants) to Lily Pond will improve water quality
Stormwater BMP Implementation Project

Problems & Solutions

Why Lower Nutrient Loading?

- Reduces production of organics, which...
- Improve taste & odor
- Reduce THM production trihalomethanes form when treated water is chlorinated (disinfection)
Problems to Address

- Have TTHM issue, taste & odor issue
- Major water quality issue in Lily Pond is eutrophication; excessive nutrient loading
- Eutrophication Contributes to TTHM problem, high TOC & DOC in Pond water
- Pond also filling in; high TOC increases cost of treatment, more strain on plant
- While upgrading our 30 year old Treatment Plant, installing MIEX pretreatment system, also looking to watershed for remedies
Watershed Solutions - Land use patterns gave us two strategies:
(1) In Basin 1, which is mostly undeveloped, buy land
(2) In Basin 2, heavily developed, retrofit the landscape w/ Raingardens
Low Impact Development (LID)
A more sustainable land development approach

- Based on an environmentally sensitive site planning process;
- A stormwater management strategy to mimic natural hydrology.
STORMWATER PROBLEMS DEVELOP OVER MANY YEARS

ALTERATION OF LOCAL HYDROLOGIC CYCLE
LID Development
Conservation
Minimization
Soil Management
Open Drainage
Rain Gardens
Disconnected
Decentralized
Distributed
Multi-functional

Low Impact Development
Low Impact Development Concepts

Conventional End-of-Pipe BMPs for Stormwater Runoff Treatment

Bioretention (just one LID tool)

Bioretention Systems for Stormwater Runoff Treatment

Recharged to ground water or collected by storm sewers
Cohasset LID Retrofit Project

**Watershed Solution**

LID Retrofit - Bioretention (Rain Gardens) for stormwater control / treatment

**Where?**

- Residential land use & street runoff
- Three (3) developed areas contribute significant share of nutrients and other pollutants
  - Peppermint Brook sub-basin
  - State Highway, Route 3A
  - Pond Street / King Street area
Study Areas 1, 2, and 3

Peppermint Brook sub-basin

State Highway, Route 3A

Pond Street / King Street area

Cohasset Stormwater LID Project

1000 0 1000 2000 3000 Feet

Hydrography
Watershed Boundary
Town-Owned Land
Cohasset Conservation Trust
Study Area Boundary
Cohasset LID Retrofit Project

Summary of Project Goals / Benefits

1. Reduce Nutrient Loading
2. Reduce Other Pollution
   • Suspended solids, organic pollutants, oils
3. Help Prevent Catastrophic Contamination
4. Public Education / Demonstration Project
Cohasset LID Retrofit Project

Estimated Quantities of Pollutant Removal

- Expect to reduce nutrient loadings from treated areas by 50% or more.
  - Reduce nitrogen loading by 658 kg/yr
  - Reduce phosphorus loading by 22 kg/yr
  - Nutrient removals typical of LID controls being implemented
  - Reduce TSS, organic pollutants, oils by 80% or more

- Improve inflow concentrations from Peppermint Brook to be similar to those measured in Brass Kettle Brook (relatively undeveloped basin)
  - Peppermint Brook Total P avg. ~ 0.05 mg/l
  - Brass Kettle Brook Total P avg. ~ 0.02 mg/l
  - Lily Pond Total P ~ 0.03 to 0.06+
Cohasset LID Retrofit Project

Project Implementation

1. 2005: Demonstration Rain Garden (at Pond)
2. 2005-06: 6 LID BMPs
3. By Spring ’07: 15 LID BMPs
4. By Spring ’08: 31 other locations (13 to go)
Bioretention
Treatment, Retention, Infiltration, Landscaping

- Excavation filled with engineered soil mix
- Herbaceous perennials, shrubs, trees
- Ponded water infiltrates within 72 hours
- Overflow outlet and optional underdrain
Demonstration Rain garden at Lily Pond

Site prior to excavation

- Designed to intercept flows from parking lot
- Public outreach tool to educate community
- Demonstrate a mix of plant types and ages
Excavation
Underdrain & Cleanout
Graded Filter
Bioretention Soil Mixing

- 50% Coarse Sand
- 25% Topsoil
- 25% Shredded Hardwood Bark Mulch

Stir well and serve.
Placement of Bioretention Soil Mix
Bioretention Cell Design

Developed Four Rain Garden Prototypes
Coyle & Caron LLC
Landscape Architecture, Scituate, MA

Plant Selection Criteria **Aesthetic** Considerations:

- **Neighborhood style** – architecture and landscapes.
- **Front yard visibility**.
- **Color**.
Plant Selection Criteria **Environmental** Considerations:

**Variable Soil Moisture:**
- Long periods of drought.
- Short periods of inundation.

**Variable Exposure to Light:**
- Full sun.
- Deep shade.

**Cold hardiness.**

**Harsh Road Edge Conditions:**
- Snow plowing and snow stockpiling.
- Salt tolerance.

**Native Plants.**

**Biodiversity.**
Bioretention Cell Design

- Review Site conditions, determine ideal Cell size
- Review Soil conditions (use Infiltration or Underdrain?)
- Develop Hydrographs for Tributary Areas
- Set allowable ponding height
- **Model runoff through Cell** — based on porosity (infiltration rate) and Cell Volume - Verify that Cell has enough capacity
Stormwater Treatment

Criteria for Storm Events

Boston Logan Rainfall Record 1920 - 1999
Cumulative Rainfall Depth Percentage
Bioretention Cell Design

- Compile Historical Rainfall Data (gathered from local Rain Gauge)
- Analyze data: rainfall depth for 90% of area rainfall events

Cohasset Area Daily Rainfall Data
subsurface investigations

Check soil types, permeability, depth to bedrock

- Report excerpt – for the 33 Borings in project areas

<table>
<thead>
<tr>
<th>Drainage Areas</th>
<th>Location</th>
<th>Date</th>
<th>Soil From 0 ft. to 4 ft. Depth</th>
<th>Soil From 4 ft. to 8 ft. Depth</th>
<th>Groundwater (Yes/No)</th>
<th>Refusal Depth (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA-1</td>
<td>69 Old Pasture Rd</td>
<td>9/22/04</td>
<td>Topsoil/ Gravelly Sand</td>
<td>Wet Glacial Till</td>
<td>Yes - 6.5-7.0 ft.</td>
<td>N/A</td>
</tr>
<tr>
<td>DA-2</td>
<td>64 Old Pasture Rd</td>
<td>9/22/04</td>
<td>Topsoil/ Gravelly Sand</td>
<td>Wet Glacial Till</td>
<td>Yes -4.5 ft.</td>
<td>N/A</td>
</tr>
<tr>
<td>DA-4</td>
<td>48 Old Pasture Rd</td>
<td>9/22/04</td>
<td>Topsoil/ Gravelly Sand</td>
<td>Dry Sand</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>DA-9</td>
<td>Evergreen &amp; Old Pasture</td>
<td>9/22/04</td>
<td>Topsoil/ Gravelly Sand</td>
<td>Damp Sand</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>DA-5</td>
<td>33 Old Pasture</td>
<td>9/22/04</td>
<td>Wet- Very Gravelly Sand</td>
<td>Wet Gravelly Sand</td>
<td>Yes 5.5 ft.</td>
<td>N/A</td>
</tr>
<tr>
<td>DA-12 + 14</td>
<td>25 Old Pasture</td>
<td>9/22/04</td>
<td>Topsoil/ Coarse Sand</td>
<td>Dry Gravelly Sand</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>DA-13</td>
<td>4 Evergreen</td>
<td>9/22/04</td>
<td>Dry Sand</td>
<td>Wet Sand</td>
<td>Yes 5.5 ft.</td>
<td>N/A</td>
</tr>
<tr>
<td>DA-10</td>
<td>End of Evergreen</td>
<td>9/22/04</td>
<td>Dry Gravelly Sand</td>
<td>Sand and Gravel/ Glacial Till</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>DA-18</td>
<td>20 Old Pasture</td>
<td>9/22/04</td>
<td>Damp Sand w/ little till</td>
<td>Dry Sand</td>
<td>No</td>
<td>6.5</td>
</tr>
</tbody>
</table>
Bioretention Cell Design – Hydrologic Design

- Identify possible Bioretention locations & define tributary drainage
- Calculate Impervious and Pervious Areas
- Model the Tributary Area for the 90% Occurrence Storm
### Bioretention Cell Design Example

Assumed infiltration rate of 6 in/hour was used for the soil medium

<table>
<thead>
<tr>
<th>Length (ft)</th>
<th>Width (ft)</th>
<th>Infiltration Rate</th>
<th>Depth (ft)</th>
<th>Ponding Height (ft)</th>
<th>Porosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>8</td>
<td>0.50</td>
<td>3</td>
<td>0.50</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Critical Times: \( t=0, t=6 \)

<table>
<thead>
<tr>
<th>( t )</th>
<th>( q_i )</th>
<th>( \Delta V_i )</th>
<th>( \Sigma V_i )</th>
<th>( \Delta V_s )</th>
<th>( \Sigma V_s )</th>
<th>( \Sigma Q_o )</th>
<th>( \Sigma V_i - \Sigma V_o )</th>
<th>( \Sigma V_s - (\Sigma V_i - \Sigma V_o) )</th>
<th>Adequate Storage Capacity (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>48.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>48.00</td>
</tr>
<tr>
<td>0.5</td>
<td>0.02</td>
<td>36</td>
<td>36</td>
<td>10.56</td>
<td>58.56</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>36</td>
</tr>
<tr>
<td>1</td>
<td>0.01</td>
<td>18</td>
<td>54</td>
<td>10.56</td>
<td>69.12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>54</td>
</tr>
<tr>
<td>1.5</td>
<td>0.01</td>
<td>18</td>
<td>72</td>
<td>10.56</td>
<td>79.68</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>72</td>
</tr>
<tr>
<td>2</td>
<td>0.01</td>
<td>18</td>
<td>90</td>
<td>10.56</td>
<td>90.24</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>90</td>
</tr>
<tr>
<td>2.5</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>100.80</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10.80</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>111.36</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21.36</td>
</tr>
<tr>
<td>3.5</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>121.92</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>31.92</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>132.48</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>42.48</td>
</tr>
<tr>
<td>4.5</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>143.04</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>53.04</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>153.60</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>63.60</td>
</tr>
<tr>
<td>5.5</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>164.16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>74.16</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>174.72</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>84.72</td>
</tr>
<tr>
<td>6.5</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>185.28</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>95.28</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>194.84</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>105.64</td>
</tr>
<tr>
<td>7.5</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>204.40</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>116.04</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>213.96</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>126.56</td>
</tr>
<tr>
<td>8.5</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>223.52</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>137.52</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>233.08</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>148.08</td>
</tr>
<tr>
<td>9.5</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>243.64</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>158.64</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>253.20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>169.20</td>
</tr>
<tr>
<td>10.5</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>263.76</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>179.76</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>273.32</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>190.32</td>
</tr>
<tr>
<td>11.5</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>283.88</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>200.88</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>10.56</td>
<td>294.44</td>
<td>0</td>
<td>0</td>
<td>-36.72</td>
<td>211.44</td>
</tr>
</tbody>
</table>
Cohasset Retrofit Project

Four Phase Project Results

- Demonstration Rain Garden at Lily Pond
  - $7,500 and 300 Square Feet : $25/Sq. Foot

- Thirty six (36) rain gardens to date
  - 29 in residential area & 7 along Rt.3A
  - Spring ’08: 13 to be completed

- Also, a 5000 gal oil/water separator / spill containment at Rt.3A intersection

- Most with underdrain connections to catch basins

- Bid under MGL Ch. 30
  - Bid prices vary from $65 to $90/Sq. Foot
Example Sites from BMP 06-01

- Daylilly
- Sweet Fern
- W. Amethyst Medallion Daylilly
Rt.3A
Bioretention
Cell
Yes, even Mass Highway was agreeable !!
5,000 Gallon Oil / Water BMP Tank at Rt.3A intersection (Mass Hwy site)
Rain Garden Maintenance

- Remove litter, debris and sediment.
- Replace mulch. (Do not use dyed mulches).
- Inspect vegetation and remove damaged limbs and replace diseased plant.
- No fertilizers.
- Use native or non-invasive species.
- Inspect spring and fall.

<table>
<thead>
<tr>
<th>Task</th>
<th>Cost per location per Year</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring Cleanup</td>
<td>$190</td>
<td>clean / rake, weed, trim, remove / replace dead plants***, add new mulch</td>
</tr>
<tr>
<td>Periodic Checks throughout the growing season</td>
<td>$90</td>
<td>rake, trim, adjust mulch, etc.</td>
</tr>
<tr>
<td>Total</td>
<td>$280</td>
<td>each rain garden location</td>
</tr>
</tbody>
</table>
## Benefits - Improved Stormwater Quality

### BMP Removal Rates

<table>
<thead>
<tr>
<th>Treatment Unit</th>
<th>Total suspended solids removal (percent)</th>
<th>Nitrate - nitrogen removal (percent)</th>
<th>Total zinc removal (percent)</th>
<th>Total petroleum hydrocarbons - diesel removal (percent)</th>
<th>Average peak flow reduction (percent)</th>
<th>Average lag time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water quality unit&lt;sup&gt;A&lt;/sup&gt;</td>
<td>66</td>
<td>0</td>
<td>74</td>
<td>47</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Water quality unit and subsurface infiltration unit&lt;sup&gt;A&lt;/sup&gt;</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>100</td>
<td>83</td>
<td>364</td>
</tr>
<tr>
<td>Surface sand filter</td>
<td>49</td>
<td>6</td>
<td>81</td>
<td>100</td>
<td>60</td>
<td>220</td>
</tr>
<tr>
<td>Retention pond</td>
<td>81</td>
<td>64</td>
<td>92</td>
<td>61</td>
<td>85</td>
<td>554</td>
</tr>
<tr>
<td><strong>Bioretention unit</strong></td>
<td>97</td>
<td>44</td>
<td>100</td>
<td>100</td>
<td>85</td>
<td>615</td>
</tr>
<tr>
<td>Hydrodynamic separator and filtration chamber&lt;sup&gt;A&lt;/sup&gt;</td>
<td>66</td>
<td>10</td>
<td>61</td>
<td>42</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Hydrodynamic separators&lt;sup&gt;A&lt;/sup&gt;</td>
<td>29-41</td>
<td>0-37</td>
<td>26-42</td>
<td>26-53</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td><strong>Gravel wetland</strong></td>
<td>100</td>
<td>99</td>
<td>100</td>
<td>100</td>
<td>85</td>
<td>336</td>
</tr>
<tr>
<td>Stone swale</td>
<td>52</td>
<td>0</td>
<td>66</td>
<td>33</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Source: April 2006 Civil Engineering, Reference: UNH Stormwater Center  
<sup>A</sup> Indicates manufactured device*
Phosphorous Removal

(“pre-testing” completed at 11 outfall sites
“post-testing” is underway at ~20 sites)

“Phosphorous removal appears to increase linearly with depth and reach a maximum of approximately 80% by about 2 to 3 feet depth. The likely mechanism for removal of phosphorous is its sorption onto aluminum, iron and clay minerals in the soil.” (low impact development center)

**Reported Phosphorous Removal**

- 63% to 85%
- 70% to 85%
- 76%

**Article / Source**

Cohasset Retrofit Project – Questions?
BACKUP SLIDES W/ ADDITIONAL DETAILS
### Operations & Maintenance

- **The key to long-term performance and effectiveness of BMPs**
- **Record keeping and consistency of Inspections necessary**
- **Cost Experience:**
  - About $300 per year per rain garden

---

#### Table 4-1
**RainGarden Maintenance Schedule**

<table>
<thead>
<tr>
<th>Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Visually inspect and repair in the Spring and Fall. In the event of erosion, stabilize erosion path with 3/4-inch crushed stone.</td>
</tr>
<tr>
<td>• Remove accumulated sediment, debris, and litter</td>
</tr>
<tr>
<td>• Check the soil pH every other Spring. Apply appropriate product to adjust pH, as required. The recommended soil pH levels should range from be between 5.0 and 6.0 for the raingardens.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mulch</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Re-mulch any void areas by hand, as needed.</td>
</tr>
<tr>
<td>• Every Spring, add a fresh mulch layer.</td>
</tr>
<tr>
<td>• Every 3rd year, remove and replace mulch.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Once a month, during the growing season visually inspect vegetation for disease and pest problems.</td>
</tr>
<tr>
<td>• Every Spring and Fall, remove and replace all dead and diseased vegetation.</td>
</tr>
<tr>
<td>• Weed, as needed.</td>
</tr>
<tr>
<td>• Prune excess growth and dead branches every Spring.</td>
</tr>
<tr>
<td>• During periods of drought, inspect for signs of stress (unrevived wilting, yellow, spotted or brown leaves, loss of leaves, etc.). Water in the early morning as needed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Asphalt Inlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Every Spring and Fall, inspect asphalt inlet. Remove accumulated sediment, fallen leaves and debris.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Annually, after a heavy rainstorm, inspect RainGardens for signs of ponding and to make sure water dissipates after a period of 4 to 6 hours.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Underdrain Inspection Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Visually inspect each underdrain pipe cleanout to observe signs of clogging and/or broken pipe.</td>
</tr>
</tbody>
</table>
Typical Inspection Form

<table>
<thead>
<tr>
<th>Facility Number:</th>
<th>Date:</th>
<th>Time:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather:</td>
<td>Inspector(s):</td>
<td></td>
</tr>
<tr>
<td>Date of Last Rainfall:</td>
<td>Amount:</td>
<td>Inches</td>
</tr>
<tr>
<td>Street Location:</td>
<td>GPS Coordinates:</td>
<td></td>
</tr>
</tbody>
</table>

**Scoring Breakdown:**

- N/A = Not Applicable
- 1 = Monitor (potential for future problem exists)
- 2 = Routine Maintenance Required
- 3 = Immediate Repair Necessary

---

### 1. Outlet
- Broken: N/A, N/H, 0, 1, 2, 3
- Clogging: N/A, N/H, 0, 1, 2, 3
- Submerged Outlet Pipe: N/A, N/H, 0, 1, 2, 3

### 2. Bioretention Soil Mix
- Sediment Accumulation > 1": No, Yes
- Ponding more than 24 hours after rain: No, Yes
- Soil pH: N/A, N/H, 0, 1, 2, 3
- Sediment Accumulation in soil bed: N/A, N/H, 0, 1, 2, 3
- Oil or chemical accumulation in soil bed: N/A, N/H, 0, 1, 2, 3
- Other: N/A, N/H, 0, 1, 2, 3

### 3. Underdrain
- Broken: N/A, N/H, 0, 1, 2, 3
- Clogging: N/A, N/H, 0, 1, 2, 3

### 4. Plants
- Disease/Pest Problems: N/A, N/H, 0, 1, 2, 3
- Weeds: N/A, N/H, 0, 1, 2, 3
- Excess growth and/or dead branches: N/A, N/H, 0, 1, 2, 3

### 5. Asphalt Inlet
- Accumulated Sediment: N/A, N/H, 0, 1, 2, 3

### 6. Mulch
- Overall Condition: N/A, N/H, 0, 1, 2, 3

### 7. Erosion
- Soil and/or debris erosion: N/A, N/H, 0, 1, 2, 3

**Overall Condition of Facility**

Total number of concerns receiving a:
- (1) - Need Monitoring
- (2) - Routine Repair
- (3) - Immediate Repair Needed

**Inspector's Summary:**
Benefits - Improved Hydrology

Discharge Comparison

Time, April 6, 2001

Discharge, cfs/acre

LID Q
Conv. Q
Prototypes - White Rain Garden

Clethra alnifolia
Clethra alnifolia 'Hummingbird'
Cornus sericea
Cornus sericea 'Elegantissima'
Deutzia gracilis
Hydrangea arborescens 'Annabelle'
Ilex glabra 'Densa'
Ilex verticillata 'Winterred'
Itea virginica 'Henry's Garnet'
Liatris spicata 'Floristan White'
Sambucus canadensis
Viburnum trilobum 'Compactum'

Summersweet
Compact Summersweet
Redtwig Dogwood
Variegated Red Twig Dogwood
Slender Deutzia
Annabelle Hydrangea
Dense Inkberry
Winterberry
Henry's Garnet Virginia Sweetspire
White Gayfeather
American Elder
Compact Cranberrybush
Cohasset BMP Implementation Project
Rain Garden Prototypes
Coyle & Caron LLC
Landscape Architecture, Scituate, MA

Prototypes - Pink Rain Garden

Callicarpa americana
Clethra alnifolia 'Ruby Spice'
Cornus sericea
Cornus sericea 'Elegantissima'
Deutzia sp. 'Strawberry Fields'
Ilex glabra 'Densa'
Liatris spicata 'Kobold'
Liatris spicata 'Floristan Violet'
Rhododendron viscosum
Rhododendron vaseyii

American Beautyberry
Pink Summersweet
Redtwig Dogwood
Variegated Red Twig Dogwood
Strawberry Fields Deutzia
Dense Inkberry
Kobold Gayfeather
Purple Gayfeather
Swamp Azalea
Pinkshell Azalea
Cohasset BMP Implementation Project
Rain Garden Prototypes
Coyle & Caron LLC
Landscape Architecture, Scituate, MA

Prototypes - Green & White Rain Garden

Cornus sericea 'Kelseyi'
Deutzia gracilis 'Nikko'
Echinacea purpurea 'White Swan'
Hydrangea arborescens 'Annabelle'
Liatris spicata 'Floristan White'
Rhus aromatica 'Gro Low'
Salix purpurea 'Nana'
Salvia sylvestris 'Snowhill'

Compact Kelsey Dogwood
Compact Nikko Deutzia
White Coneflower
Annabelle Hydrangea
White Gayfeather
Grow Low Fragrant Sumac
Dw.Purpleosier Willow
Snowhill Sage
Prototypes - Lily Rain Garden

- Achillea sp. 'Moonshine'
- Comptonia peregrina
- Hemerocallis sp. 'Indian Giver'
- Hemerocallis 'Rosy Returns'
- Hemerocallis 'Stella de Oro'
- Hemerocallis sp. 'Woodside Amethyst'
- Liatris spicata 'Floristan Violet'
- Liatris spicata 'Kobold'
- Moonshine Yarrow
- Sweet Fern
- Indian Giver Medallion Daylily
- Rosy Returns Dw. Daylily
- Stella de'Oro Daylily
- W. Amethyst Medallion Daylily
- Purple Gayfeather
- Kobold Gayfeather