IS YOUR ROAD A BMP?

Presented by

David C. Nyman, P.E.
Comprehensive Environmental Inc.
Application of Low Impact Development/Integrated Site Design to Roadways:

Goal of the design approach is to:

- First...Significantly minimize or reduce runoff/pollutants
- Then... treat the remaining runoff.
Integrated Site Design for roadways, involves

- Minimizing effective impervious cover (EIC):
  - Directly reducing/minimizing pavement
  - Maximizing infiltration
  - Maximizing vegetative uptake

- Managing pollutants close to their source
Roadways consist of
- Paved surfaces
- Graded side slopes
- Drainage conveyance systems
- Managed rights-of-way

Develop a design approach to integrate runoff reduction and pollutant attenuation functions into these features.
Other Option:
• Pervious pavement

PAVEMENT
BMP Illustrated:
• Open Graded Friction Course (Limited Access Roadway Only)

EMBANKMENT
BMP Illustrated:
• Media Filter Drain
Other Options:
• Pavement
• Disconnection
• Vegetated Filter Strip
• Compost Amended Vegetated Filter Strip
• Embankment Media Filter (steep slopes)

COUNTRY DRAINAGE
BMP Illustrated:
• Micro-pool Filter
Other Options:
• Dry Water Quality Swale
• Wet Water Quality Swale
• Grassed Swale

REMAINING R.O.W.
BMP Illustrated:
• Forested Canopy Credit (within 100 feet of pavement)
Roads as BMPs
Urban Streets

- Canopy Tree Credit (within prescribed distance to pavement)
- Pavement
- Existing Catch Basin Retrofitted to Drain to Off-Line Leaching Structure
- Porous Pavement Sidewalk
Roads as BMPs
Parking and Service Facilities

- Canopy Tree Credit (within prescribed distance to pavement)
- Landscape Island Depressed Below Pavement Grade to Provide for Bioretention Cell
- Parking Spaces Constructed of Porous Pavers (or Porous Asphalt)
- Slope transition strip toward paver to prevent snow flow from catching edge of pavers (POROUS PAVER SURFACING)

Conventional Pavement
Break in Curb
Peastone Daphrame
Bioretention Cell
Slope transition strip toward paver to prevent snow flow from catching edge of pavers

POROUS PAVER SURFACING
Consider roadway elements as potential BMPs:

- Pavement stormwater practices
- Embankment stormwater practices
- Conveyance stormwater practices
- Roadway landscape stormwater practices
Pavement Options: Pervious Pavements
Pavement Options: Pervious Pavements

Source: Maine DOT
Pavement Options: Pervious Pavements

Maine Mall Road, South Portland, ME

~16750 AADT within Project Limits

Source: Maine DOT
Pavement Options: Open Graded Friction Course (OGFC)

Conventional Pavement

Open Graded Friction Course

### OGFC Pollutant Reduction Relative to Conventional Pavements

<table>
<thead>
<tr>
<th>Study</th>
<th>Pollutant (Relative % Reduction)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TSS</td>
</tr>
<tr>
<td>Berbee, et.al., 1999</td>
<td>91</td>
</tr>
<tr>
<td>Pagotto, et.al., 2000</td>
<td>90</td>
</tr>
<tr>
<td>Barrett, et.al., 2005</td>
<td>93</td>
</tr>
<tr>
<td>Barrett &amp; Shaw, 2006</td>
<td>91</td>
</tr>
<tr>
<td>Barrett, et.al., 2006</td>
<td>94</td>
</tr>
<tr>
<td>Stannard, et.al., 2008</td>
<td>88-92</td>
</tr>
<tr>
<td>Eck, et.al., 2011</td>
<td>91-96</td>
</tr>
</tbody>
</table>

Eck, et.al., 2011 also shows relative reduction does not deteriorate over time.
Embarkment Options: Compost Amended Vegetated Filter Strips (CAVFS)

2/3 loamy sand and 1/3 compost

Adapted from Washington Department of Transportation
### Embankment Options: Compost Amended Vegetated Filter Strips (CAVFS)

#### CAVS Pollutant Removal

<table>
<thead>
<tr>
<th>Study</th>
<th>Pollutant</th>
<th>TSS</th>
<th>Total P</th>
<th>Total Cu</th>
<th>Total Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSDOT, 2005 (% Removal, conc.)</td>
<td></td>
<td>84</td>
<td>-17</td>
<td>79</td>
<td>67</td>
</tr>
<tr>
<td>Herrara, 2007 (% Removal, conc.)</td>
<td></td>
<td>94</td>
<td>77-84</td>
<td>80-84</td>
<td>87-90</td>
</tr>
<tr>
<td>Herrara, 2007 (% Load Reduction)</td>
<td></td>
<td>98-99</td>
<td>96-99</td>
<td>96-100</td>
<td>97-100</td>
</tr>
</tbody>
</table>
Embankment Options: Media Filter Drain (MFD)

Ecology Mix:
- crushed stone aggregate
- perlite
- dolomite
- gypsum

Adapted from Washington Department of Transportation
### Embankment Options: Media Filter Drain (MFD)

#### Media Filter Drain Pollutant Removal

<table>
<thead>
<tr>
<th>Study</th>
<th>TSS</th>
<th>Total P</th>
<th>Total N</th>
<th>Total Cu</th>
<th>Total Pb</th>
<th>Total Zn</th>
<th>Turbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSDOT, 2005</td>
<td>95</td>
<td>84</td>
<td></td>
<td>82</td>
<td></td>
<td></td>
<td>89</td>
</tr>
<tr>
<td>Wright Water Eng’rs, et.al., 2011</td>
<td></td>
<td></td>
<td></td>
<td>57</td>
<td>67-85</td>
<td>59-83</td>
<td></td>
</tr>
<tr>
<td>Geosyntec, et.al., 2010</td>
<td>47</td>
<td>42</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geosyntec, et. al., 2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80</td>
</tr>
</tbody>
</table>
Accessible, maintainable systems based on use of natural materials

Linear conveyance systems that provide treatment; examples:
- Water Quality Swales
- Linear Bioretention Swales
- Variations: think outside the box:
  VTrans Micro-Pool Filter
Conveyance System Options:
Micro-Pool Filter

Source: Vermont Agency of Transportation
## Conveyance System Options: Micro-Pool Filter

### Estimated Micro-Pool Pollutant Removal

<table>
<thead>
<tr>
<th>Source</th>
<th>Pollutant (% Removal)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TSS</td>
</tr>
<tr>
<td>MassDEP, 2008 Data for Sand Filters</td>
<td>80</td>
</tr>
</tbody>
</table>

Plus: Channel Protection 
Enhanced treatment by settling pools, vegetated filter layer
Landscape Management Options: Pavement Disconnection

Adapted from Maryland Stormwater Design Manual
Landscape Options: “Micro” treatment systems

Scale BMPs to fit the design context; example:

Micro-Bioretenion Cell

Adapted from Maryland Stormwater Design Manual
Landscape Options: Trees in the Roadway Landscape

Trees as BMPs
- Urban street trees (individual trees)
- Wooded landscape
In Central Massachusetts, a 12-inch Red Maple...

- Intercepts 1353 gallons of water per year;
- Equals 3.8 inches of runoff reduction over the area of the tree’s canopy
- Significant “Runoff Reduction” potential

National Tree Benefit Calculator
https://www.arborday.org/calculator/index.cfm
In addition to interception/evaporation, trees reduce runoff by:

- Uptake and transpiration from the ground
- Enhancing infiltration into the ground
- Roots binding soil, preventing erosion and associated accelerated runoff

Source: Tree City USA Bulletin No. 55
Arbor Day Foundation
Landscape Options: Trees in the Roadway Landscape

Use trees for runoff reduction:

- Introduction, restoration, or preservation of individual canopy trees
- Preservation/restoration of forested landscape
- Incentives for implementation of these measures
Landscape Options: Credits for Trees

- City of Philadelphia, PA stormwater program:
  - Water Quality Volume reduction for individual trees
  - Existing tree preservation (canopy within 20 feet)
  - New tree installation (canopy within 10 feet)
  - Must comply with specified standards

- Pennsylvania (State) Stormwater BMP Manual
  - Individual tree credits
  - Forested area credits (within 100 feet)

- Portland, OR
  - Comparable practices to Philadelphia
Landscape Options: Trees in the Roadway Landscape
Landscape Options: Trees in the Roadway Landscape

Is Your Road a BMP?

- Tree Canopy Preservation?
- Enhanced Conveyance System?
- Pavement Disconnection?
- Media Filter Drain?

Questions?

dnyman@ceiengineers.com