3.2.3 Minimum Standard 3: Water Quality

- The WQ must be treated by at least one of the structural BMPs listed in Chapter Five at each location where a discharge of stormwater will occur.
- Minimum average pollutant removal efficiencies: 85% removal of total suspended solids (TSS), 60% removal of pathogens, 30% removal of total phosphorus (TP) for discharges to freshwater systems, and 30% removal of total nitrogen (TN) for discharges to saltwater or tidal systems.
- Excludes LID credits allowed under Section 4.6
Acceptable BMPs

- 5.2 Wet Vegetated Treatment Systems (WVTS)
- 5.3 Stormwater Infiltration Practices
- 5.4 Permeable Paving
- 5.5 Filtering Systems
- 5.6 Green Roofs
- 5.7 Open Channel Systems

Minimum Design Criteria

- Required Elements and Design Guidance
  - If required elements can’t be met, select a different BMP
- Six Categories
  - Feasibility
  - Conveyance
  - Pretreatment
  - Treatment
  - Landscaping
  - Maintenance

Wet Vegetated Treatment Systems

- Designed to stay wet!
- Vegetation: key component
- Some restrictions near coldwater streams
Surface WVTS in Cloverleaf

Typical Location for highway BMPs: A WVTS within the R/W
**Infiltration**

- Soil testing required
- Separation to SHGT and bedrock
- Restrictions in fill

**Permeable Paving**

- Two main categories
Considerations for Permeable Pavements for Linear Projects

- **Pros:**
  - Reduced salt/sand usage;
  - Water quality/recharge benefits;
  - Safety? (less ice? less water spray?);
  - Maintenance? (less potential for frost heave)

- **Cons:**
  - Uncertain long-term performance;
  - Maintenance frequency (sweeping-resurfacing);
  - Contractor/plant capabilities;
  - Initial capital cost.
Recent Example-Maine Mall Road

- 1st application of PP on high volume road in Northeast;
- Approx 1.5 acres of Imp. cover converted (1,000’ +/-)

Filtering Practices

- Sand/organic filters
- Bioretention areas/Tree filters

Sand Filters
Bioretention

Bioretention Planting Soil and Mulch

- Loamy Sand to a Sandy Loam
  - 85-88% sand
  - 8-12% silt
  - 0-2% clay
- Well-aged graded compost (25% of soil mix)
- Layer of well-aged, shredded hardwood mulch (aged 6 months, if possible)
LID for Linear Transportation Projects:
RI SW Manual
Open Channels

Highway Dry Swale with Check Dams in Median

Dry Swale
Swales/Bios Combinations & Applications

Practices Approved for Other Criteria

- Pretreatment Practices
  - Chapter 6
    - Grass Channel
    - Filter Strips
    - Sediment Forebay
    - Deep Sump Catch Basins
    - Proprietary Devices

- Storage Practices
  - Chapter 7
    - Stormwater Basins
    - Underground Storage Devices

II. Selecting the Most Effective and Appropriate Stormwater Practices

LID for Linear Transportation Projects:
RI SW Manual
Five Selection Factors to Consider

1. Land Use
2. Physical Feasibility
3. Watershed
4. Stormwater Management Capability
5. Community and Environmental

#1. Land Use

The land use of the contributing drainage area influences the stormwater strategy:
- Rural areas
- Residential sites
- Roads/highways
- Commercial sites
- LUHPLs
- Urban sites (e.g., redevelopment)

Linear Bioretention
Retrofit Application

# 2. Physical Feasibility

Some Practices Cannot Be Used Because of Site Constraints:
- Soils
- Groundwater
- Drainage Area
- Minimum Surface Area
- Slope Restriction
- Head

Wet Swale
- Used when water table is close to surface
#3. Watershed Factors

Different Receiving Water Management Objectives Shape Stormwater Strategies:
- Groundwater (Aquifer protection)
- Freshwater Streams and Rivers
- Other Freshwaters (Ponds/Lakes/Wetlands)
- Coastal Waters (shellfish/beach areas)

#4. Stormwater Management Capability

No single practice achieves all stormwater management objectives. A combination of practices is often needed to provide desired level of:
- Groundwater recharge
- Water quality treatment
- Channel protection
- Flood control
- Ability to treat LUHPPs
Other community and environmental impacts should be considered when selecting BMPs:

- Ease of maintenance
- Affordability
- Community acceptance/aesthetics
- Safety
- Habitat

Important when higher removals are required (see list in Section 3.2.3). Table H-3/H-4 compares removal efficiencies for:

- Total Suspended Solids
- Total Phosphorus
- Total Nitrogen
- Bacteria

ESC Practices

1. Sediment Barriers
2. Diversions & Conveyances
3. Settling Devices
4. Stabilization
5. Inlet Protection
6. Outlet Protection
### Typical ESC Practices for Roads

1. Inlet protection
2. Sediment barriers/perimeter control
3. Outlet protection
4. Traffic management
5. Check dams in roadside ditches
6. Slope stabilization
7. Stockpile management/designated storage

### How could you apply ESC practices on this project?

- Flow in ditch
- Inlet protection
- Sediment barriers/perimeter control
- Outlet protection
- Traffic management
- Check dams in roadside ditches
- Slope stabilization
- Stockpile management/designated storage

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**LID for Linear Transportation Projects:**
**RI SW Manual**

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**Acceptable BMPs for Water Quality**

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**8/25/2011**
1. Sediment Barriers

Objective: Keep sediment from leaving site

- Natural area protection
- Silt fence
- Stable construction entrance
- Alternative “fencing”
- Turbidity curtains

Perimeter Controls

Perimeter Controls
2. Diversions & Conveyances

Objective: Convey “clean” and “dirty” runoff safely around or through site

- Earth berms
- Diversion swales
- Vegetated/lined waterways
- Check dams

Must convey 10-yr storm

3. Settling Devices

Objective: Temporarily pond runoff to let sediment settle out before discharging off site

- Sediment trap
- Sediment basin

Must retain 1-inch runoff

- Small depression
- Simpler outlet structure
- Larger excavation
- Can be permanent
- More infrastructure

4. Stabilization Practices

Objective: Protect bare soils and slopes from eroding

- Vegetation/mulch/soil
- Surface roughening
- Erosion control blankets
- Pipe slope drains
5. Inlet Protection

Objective: Keep sediment out of inlets, but still let water in

- Fabric
- Block & rock
- Wattles
- Inserts

6. Outlet Protection

Objective: Prevent erosion at point of discharge by slowing and spreading flow

- Rock outlet
- Level spreader

Minimum Standard 11: Stormwater Management System Operation and Maintenance

The stormwater management system must have an operation and maintenance plan that shall at a minimum include:

- Stormwater management system(s) owners;
- The party(ies) responsible for operation and maintenance;
- The routine and non-routine maintenance tasks and a schedule;
- A plan that shows the location of all stormwater BMPs and discharge points;
- A description and delineation of public safety features;
- An estimated budget; and
- The funding source.
There are two key components to adequately maintaining stormwater management infrastructure:

- Periodic and scheduled inspections, and
- Maintenance scheduling and performance
  - Routine
  - Non-routine

Typical Maintenance Elements

- Sediment removal or containment
- Sediment disposal
- Erosion and gully repair
- Trash and debris cleanout
- Structural and mechanical systems
- Vegetation pruning and replacement
- System repair and replacement

APPENDIX E: GUIDANCE FOR DEVELOPING OPERATION AND MAINTENANCE PLANS

An essential component of a successful stormwater system is the ongoing operation and maintenance of the various components of the stormwater drainage, control, and conveyance systems. Failure to provide effective maintenance can reduce the hydraulic capacity and the pollutant removal efficiency of stormwater practices.
Maintenance Burden is a function of the type of facility as well as the design and implementation:

- WVTS: Medium to Easy
- Infiltration*: Medium to Difficult
- Filters: Medium to Difficult
- Green Roofs: Medium
- Open Channels: Medium to Easy

*Except drywells - Easy

Questions?