



# Draft Rhode Island Stormwater Design and Installation Standards Manual



## Summary

The May 2009 Public Review Draft version of the RI Stormwater Design and Installation Standards Manual consists of approximately 165 pages of technical information and guidance to assist property owners, developers, engineers, consultants, contractors, municipal staff and others in planning, designing and implementing effective stormwater best management practices for the development and redevelopment of properties in Rhode Island. It is divided into 7 chapters, and includes an extensive glossary of terms, 7 pages of references, and 11 technical appendices. The contents of the chapters and appendices are as follows:

**Chapter 1: Introduction** - describes the purpose, applicability, and general organization of the manual, including steps in how to use the manual.

**Chapter 2: Why Stormwater Matters** - describes stormwater runoff and its impact on watershed hydrology, water quality, runoff volumes, and ecology.

**Chapter 3: Stormwater Management Standards and Performance Criteria** - presents the 12 minimum standards and performance criteria for stormwater management in the State of Rhode Island.

**Chapter 4: Low Impact Development (LID) Site Planning and Design Strategies** – describes a three-step LID site planning and design process that must be used to comply with minimum performance Standard No. 1.

**Chapter 5: Structural Stormwater Treatment Practices for Meeting Water Quality Criteria** - outlines the four groups of acceptable structural best management practices (BMPs) that can be used to meet the water quality criteria and presents specific design criteria and guidelines for their design. The four groups of structural BMPs include (1) Wet Vegetated Treatment Systems (WVTS), (2) Infiltration Practices, (3) Filtering Systems, and (4) Open Channel Practices.

**Chapter 6: Pretreatment Practices** – presents the suite of stormwater management pretreatment practices that can be used to improve water quality and enhance the effective design life of practices by consolidating sedimentation location.

**Chapter 7: Storage Practices for Stormwater Quantity Control** – presents “storage” practices (e.g., dry detention ponds) that can be used to provide stormwater detention.

**Glossary of Terms** - defines terms used in the manual.

**References** - lists references used in the manual; these references provide additional guidance on a number of recommended stormwater management practices and related topics.

**Appendices** - the technical appendices include supplemental information on the design, construction, and maintenance of structural stormwater management practices.

**Appendix A: Stormwater Management Plan Checklist** - outlines the components that must

be included in an applicant's stormwater management plan (included herein).

**Appendix B: Landscaping Guidelines and Planting List** - provides general background on how to establish more functional landscapes within stormwater BMPs, provides guidance for all acceptable treatment BMPs, and provides a plant list of native species.

**Appendix C: Retrofitting Existing Development for Stormwater Management** – describes techniques for retrofitting existing developed sites to improve or enhance the water quality mitigation functions of the sites.

**Appendix D: Site Specific Design Examples** provides LID site planning and BMP design examples to help designers and plan reviewers better understand the new criteria in this Manual. The examples demonstrate design procedures and performance criteria that should be considered when siting and designing stormwater BMPs.

**Appendix E: Maintenance Plans** - includes guidance on creating an appropriate maintenance plan and example checklists that can be incorporated in the plan.

**Appendix F: BMP Construction Specifications** - contains material specifications for constructing wet vegetated treatment practices, infiltration practices, filters, bioretention areas, and open channels.

**Appendix G: Pollution Prevention and Source Controls** – provides guidance on preventative source controls for solid waste containment, roads and parking areas, hazardous materials containment, septic system management, and lawn, garden, and landscape management.

**Appendix H: Assorted Design Tools** - provides additional information to help BMP designers, including sections on approved testing requirements (e.g., soils testing for infiltration) and miscellaneous design details.

**Appendix I: Rhode Island River and Stream Order** - includes a list and map of the rivers and streams in Rhode Island that are 4th-order or larger.

**Appendix J: Technology Assessment Protocol (TAP) for Innovative and Emerging Technologies** - describes testing and reporting procedures to evaluate the effectiveness of emerging stormwater treatment technologies and existing BMPs.

**Appendix K: Hydrologic & Hydraulic Modeling Guidance** - includes DEM recommended content and procedures on the performance of hydrological and hydraulic modeling analyses.

The following is an excerpt from Appendix A of the manual and includes the basic minimum information that would need to be submitted to DEM for an application of approval to comply with the 12 minimum standards listed in Chapter Three of the manual:

## **CHECKLIST FOR STORMWATER MANAGEMENT PLAN PREPARATION AND REVIEW**

### **General Information**

- Applicant name, mailing address, and telephone number

- Contact information for Engineering firm and Rhode Island Registered P.E. responsible for site plans and stormwater management plan
- Common address and legal description of project site
- Vicinity map
- Existing zoning and land use at the project site
- Proposed land use– indicate if land use meets definition of a “Land Use with Higher Potential Pollutant Loads” (“LUHPPL”; see Manual Table 3-2)
- General Project Narrative
- Project type (new development or redevelopment)

### **Existing and Proposed Mapping and Plans**

Existing and proposed mapping and plans (scale not greater than 1” = 40’) with North arrow that illustrate at a minimum:

- Existing topography (2-foot contours required)
- Existing and proposed subwatershed delineations and drainage flow paths, mapped according to the DEM *Guidance for Preparation of Subwatershed Maps*. Subwatershed area boundaries need to be complete; include off-site areas in both mapping and analyses, as applicable.
- Perennial and intermittent streams, in addition to areas subject to storm flowage
- Mapping of predominant soils from USDA soil surveys, especially hydric soil groups as well as location of site-specific borings and/or test pits (on subwatershed maps only – not site plans)
- Boundaries of existing predominant vegetation and proposed limits of clearing
- Location and field-verified boundaries of resource protection areas such as freshwater and coastal wetlands, lakes, ponds, coastal shoreline features and required setbacks (e.g., buffers, water supply wells, septic systems)
- Location of floodplain and, if applicable, floodway limits and relationship of site to upstream and downstream properties and drainages
- Location of existing and proposed roads, buildings, and other structures including limits of disturbance
- Existing and proposed utilities (e.g., water, sewer, gas, electric) and easements
- Location of existing and proposed conveyance systems such as grass channels, swales, and storm drains
- Location and dimensions of channel modifications, such as bridge or culvert crossings
- Location, size, and limits of proposed LID planning and site design techniques (type of practice, depth, area). LID techniques should be labeled clearly on the plan and a key should be provided that corresponds to a tabular description.

- Location, size, and limits of disturbance of proposed stormwater treatment practices (type of practice, depth, area). Stormwater treatment practices (BMPs) should be labeled with numbers that correspond to the table in Section A.1.5.
- Soils information from test pits or borings at the location of proposed stormwater management facilities, including but not limited to soil descriptions, depth to seasonal high groundwater, depth to bedrock, and estimated hydraulic conductivity. Soils information will be based on site test pits or borings logged by a Rhode Island PE or certified Class IV Soil Evaluator.
- 8.5 x 11 inch copy of site plan for public notice

## Minimum Stormwater Management Standards

### Minimum Standard 1: LID Site Planning and Design Strategies

Document specific LID site planning and design strategies and associated methods that were employed for the project. If a particular method was not used, justification must be provided along with a description of proposed alternatives.

LID Strategies and Associated Methods	Method incorporated? (check one)			If no or N/A, you must document why the method is not feasible or not applicable at your site and include a description of proposed alternatives.
	Yes	No	N/A <sup>1</sup>	
<b><u>Avoid the Impacts</u></b>				
Preservation of Undisturbed Areas				
Preservation of Buffers and Floodplains				
Reduction of Clearing and Grading				
Locating Sites in Less Sensitive Areas				
Compact Development				
Work with the Natural Landscape Conditions, Hydrology, and Soils				
<b><u>Reduce the Impacts</u></b>				
Reduction of Roadway Area				
Reduction of Sidewalk Area				
Reduction of Driveway Area				
Reduction of Cul-de-Sac Area				
Reduction of Building Footprint				
Reduction of Parking Lot Area				
<b><u>Manage the Impacts</u></b>				
Disconnecting Impervious Area				
Mitigation of Runoff				
Stream Restoration				
Reforestation				

<sup>1</sup> N/A refers to "not applicable." If N/A is marked, applicants must describe why a certain method is not applicable at their site. For example, preserving wetland buffers may be not applicable for sites that are not located within buffers to any jurisdictional wetlands.

**Minimum Standard 2: Groundwater Recharge**

Demonstrate that groundwater recharge criteria for the site have been met. Include:

- The required recharge volume (Rev) in acre-feet (See Manual Section 3.3.2)
- LID Stormwater Credit to be applied to recharge requirement, if applicable, with the following calculations (See Manual Section 4.6.1):
  - the recharge area (Rea) in acres for the site
  - the site impervious area draining to QPAs
  - the new recharge volume (Rev) requirement
- Specific BMPs that will be used to meet the recharge requirement. *Note: Only BMPs listed in Manual Table 3-5, List of BMPs Acceptable for Recharge may be used to meet the recharge requirement.*

**Minimum Standard 3: Water Quality**

Demonstrate that the water quality criteria for the site have been met. Include:

- Required water quality volume in acre-feet or ft<sup>3</sup> (see Manual Section 3.3.3).
- LID Stormwater Credit to be applied to water quality requirement, if applicable, with the following calculations (see Manual Section 4.6.1):
  - the new impervious area (in acres) for the site
  - the new water quality volume requirement (WQv) in acre-feet
- Specific BMPs that will be used to meet water quality volume requirement. *Note: Only BMPs listed in Manual Table 3-6, Acceptable BMPs for Water Quality Treatment may be used to meet the water quality requirement.*
- Specify any additional pollutant-specific requirements and/or pollutant removal efficiencies applicable to the site as the result of SAMP, TMDL, or other watershed-specific requirements.

**Minimum Standard 4: Conveyance and Natural Channel Protection**

Demonstrate that the conveyance and natural channel protection criteria for the site have been met. Include:

- Justification for channel protection criterion waiver, if applicable (see Manual Section 3.3.4).
- Required channel protection volume (see Manual Section 3.3.4).
- Specific BMPs that will be used to meet the channel protection requirement. Hydrologic and hydraulic site evaluation as described in Manual Section 3.3.4 should be included in Checklist for each channel protection BMP.

**Minimum Standard 5: Overbank Flood Protection**

Demonstrate that the overbank flood protection criteria for the site have been met. Include:

- Justification for overbank flood protection criterion waiver, if applicable (see Manual Section 3.3.5).
- Pre and post-development peak discharge rates.
- Specific BMPs that will be used to meet the overbank flood protection requirement. Hydrologic and hydraulic site evaluation as described in Manual Section 3.3.4 should be included in Checklist for each overbank flood protection BMP.

**Minimum Standard 6: Redevelopment Projects**

Demonstrate that criteria for redevelopment projects have been met, if applicable. Include:

- Description of site that meets redevelopment definition.
- Approved off-site location within watershed where stormwater management requirements will be met, if applicable (see Manual Section 3.2.6).

**Minimum Standard 7: Pollution Prevention**

Demonstrate that the project meets the criteria for pollution prevention. Include:

- Stormwater pollution prevention plan

**Minimum Standard 8: LUHPPLs** (“Land Uses with Higher Potential Pollutant Loads”)

Demonstrate that the project meets the criteria for LUHPPLs, if applicable. Include:

- Description of any land use activities considered stormwater LUHPPL (see Manual Table 3-2).
- Specific BMPs listed in Checklist Section A.1.5 that receive stormwater from LUHPPL drainage areas. These BMP types must be listed in Manual Table 3-3, “Acceptable BMPs for Use at LUHPPLs.”
- Additional BMPs, if any, that meet RIPDES MSGP requirements.

**Minimum Standard 9: Illicit Discharges**

Demonstrate that there are no illicit discharges to the stormwater management system.

**Minimum Standard 10: Construction Erosion and Sedimentation Control**

Demonstrate that erosion and sedimentation control (ESC) practices will be used during the construction phase and land disturbing activities. Include:

- Description of temporary sediment trapping and conveyance practices, including sizing calculations and method of temporary and permanent stabilization (see Manual Section 3.2.9 and *the Rhode Island Soil Erosion and Sediment Control Handbook*).
- Description of sequence of construction. Activities should be phased to avoid compacting soil during construction, particularly in the location of infiltrating stormwater practices and qualifying pervious areas for stormwater credits.
- Location of construction staging and material stockpiling areas.

**Minimum Standard 11: Stormwater Management System Operation and Maintenance**

Provide a stormwater management system maintenance plan that at a minimum includes:

- Name, address, and phone number of responsible parties for maintenance
- Description of annual maintenance tasks
- Description of applicable easements
- Description of funding source
- Minimum vegetative cover requirements
- Access and safety issues

## LID Stormwater Credit

Description of stormwater credit, if applicable. Label Qualifying Pervious Areas (QPAs) on the site map, and document that all stormwater credit requirements listed in Manual Section 4.6 are met for the site. For each QPA, note the impervious area (in acres) that drains to it, and place a check in the appropriate box to demonstrate that it meets the following criteria:

	QPA 1	QPA 2	QPA 3	QPA 4
<b>Impervious Area Draining to QPA (acres)</b>				
<b>QPA Criteria</b>	<b>Criterion Met?</b>			
QPA infiltration area is at least 10ft from building foundation.				
Contributing impervious area does not exceed 1,000 ft <sup>2</sup> .				
Length of QPA in feet is equal to or greater than the contributing rooftop area in ft <sup>2</sup> divided by 13.3. The maximum contributing flow path from non-rooftop impervious areas is 75ft.				
QPA does not overlap any other QPA.				
Lot is greater than 6,000 ft <sup>2</sup> .				
The slope of the QPA is less than or equal to 5.0%.				
Disconnected downspouts draining to QPA are at least 10 feet away from the nearest impervious surface.				
Runoff from rooftops without gutters / downspouts that drains to QPA flows away from the structure as low-velocity sheet flow.				
QPA is located on Hydrologic Soil Group (HSG) A or B soils.				
Depth to groundwater within QPA is 18 inches or greater (has been confirmed by evaluation by RI PE or a RI-certified Class IV Soil Evaluator).				
Runoff is directed over soft shoulders, through curb cuts or level spreaders to QPA.				
Measures are employed at discharge point to prevent erosion and promote sheet flow.				
The flow path through the QPA complies with the setback requirements for structural infiltration BMPs.				
Rooftop runoff draining to QPA from LUHPPLs does not commingle with runoff from any paved surface or areas that may generate higher pollutant loads				
Construction vehicles shall not be allowed to drive over the QPA during construction. If the area becomes compacted, soil must be amended, tilled and revegetated once construction is complete				
Inspection and maintenance of the QPA is included in the site Operation and Maintenance Plan (Minimum Standard 11).				
The QPA is owned or controlled by the property owner				
There is no history of groundwater seepage and / or basement flooding on the property				

## Best Management Practices

Provide detailed information for all structural stormwater best management practices (BMPs) to be implemented. *Note: If a BMP cannot meet the required design criteria in Manual Chapters Five, Six, and Seven, a different BMP should be considered.*

Fill in the following table to document which proposed practices meet which requirement(s). Number each BMP and label them accordingly on the site map:

BMP No.	Type of BMP	Check the function provided by the BMP				
		Pretreatment	Re <sub>v</sub>	WQ <sub>v</sub>	CP <sub>v</sub>	Q <sub>p</sub>

In addition, for all structural components of stormwater system (e.g., storm drains, open channels, swales, stormwater BMPs, etc.) provide the following, if applicable:

- Hydrologic and hydraulic analysis, including:
  - Study design/analysis points. The existing and proposed condition analyses need to compare the same overall area; thus, common study points are needed for both existing and proposed conditions.
  - Existing condition analysis for subwatershed boundaries, curve numbers, time of concentrations, runoff rates, volumes, velocities, and water surface elevations showing methodologies used and supporting calculations
  - Proposed condition analysis for subwatershed boundaries, curve numbers, time of concentrations, runoff rates, volumes, velocities, water surface elevations, and routing showing the methodologies used and supporting calculations
  - Downstream Analysis, where required (see Manual Section 3.3.6)
  - Final sizing calculations for structural stormwater BMPs including, contributing drainage area, storage, and outlet configuration

- Stage-discharge or outlet rating curves and inflow and outflow hydrographs for storage facilities (e.g., detention, retention, or infiltration facilities)
- Dam breach analysis, where necessary, for earthen embankments over six (6) feet in height, or a capacity of 15 acre-feet or more, or that is a significant or high hazard dam

□ Subwatershed Drainage Area Maps prepared in accordance with DEM's *Guidance for Preparation of Subwatershed Maps*.

□ Representative cross-section and profile drawings, notes and details of structural stormwater management practices and conveyances (i.e., storm drains, open channels, swales, etc.), which include:

- Locations, cross sections, and profiles of all streams and drainage swales and their method of stabilization
- Existing and proposed structural elevations (e.g., invert of pipes, manholes, etc.)
- Design water surface elevations
- Structural details of outlet structures, embankments, spillways, stilling basins, grade control structures, conveyance channels, etc.
- Logs of borings and/or test pit investigations along with supporting geotechnical report

□ Landscaping plans for structural stormwater BMPs, including:

- Species, size, planting methods, and maintenance requirements of proposed landscaping

□ Structural calculations, where necessary

□ Applicable construction specifications

□ Identification of all anticipated applicable local and State permits

□ Identification of all anticipated legal agreements (e.g., off-site easements, deed restrictions, and covenants)