



# MODEL STORMWATER STANDARDS FOR COASTAL WATERSHED COMMUNITIES

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## SOUTHEAST WATERSHED ALLIANCE

### ***DRAFT Model Stormwater Standards for Coastal Watershed Communities*** ***Revised November 28, 2012***

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## SECTION 1. INTRODUCTION AND NEED FOR CONSISTENT STANDARDS

The mission of the Southeast Watershed Alliance (SWA) is to establish a regional framework for New Hampshire coastal watershed communities, regional planning commissions, state and federal regulators, and other stakeholders to collaborate on implementation measures to improve and protect the quality and quantity of water resources, and more effectively address the challenges of meeting clean water standards. Currently there is a lack of well-defined, enforceable stormwater performance standards for coastal watershed communities.

The SWA has launched a stormwater initiative that will provide minimum, consistent, and effective model stormwater management standards for coastal communities. As part of their initiative, SWA will encourage the adoption of the model stormwater management standards to provide a consistent level of stormwater management and water quality protection within the 42 communities in NH's coastal watershed.

This initiative will develop minimum stormwater performance standards which will be drafted through collaboration between technical experts, professional planners and the SWA membership. These standards will encourage the use of Low Impact Development (LID) strategies, will build upon innovative stormwater standards recently adopted by several coastal watershed communities, and will be consistent with EPA Region 1 and NHDES guidelines.

To evaluate the effectiveness of these model standards and other water quality and/or stormwater standards that have been or will be adopted by coastal watershed communities, further analyses will be needed to calculate nutrient and other pollutant load reductions achieved over time. Future load reductions can then be modeled with the calculation of expected impervious cover reductions and associated pollutant load reductions based on implementation of best management and innovative practices, land use, and projected growth and redevelopment rates in the region. These efforts will ensure that measures taken by municipalities to disconnect impervious cover (IC) and curb pollutant loads to receiving waters – from both redevelopment and new development - have defensible and accountable methods for counting reductions that can be attributed to their efforts.

## SECTION 2. PURPOSE AND GOALS

The purpose of these standards in New Hampshire's Coastal Watershed is to:

- Control non-point source pollution from future development.
- Mitigate and reduce non-point source and stormwater pollution from existing development.
- Manage the quality and quantity of surface water and groundwater resources.

The primary goals for the implementation of these standards in New Hampshire's Coastal Watershed are to:

1. Provide a cost effective way of managing stormwater infrastructure and water resources for the maximum benefit.

2. Manage ecosystem services that humans rely on and sustain them into the future.
3. Consider projected changes in climate (temperature, flooding, precipitation, storm events) in the design, siting and implementation of stormwater infrastructure and other investments
4. Make use of technological advances in data collection and analysis to enable regulators, researchers, resource managers and municipalities to track changes in pollutant loading and sources, water quality trends, land use changes, and the cause and effect relationships between them. This will allow for implementation of adaptive management strategies.
5. Coordinate tracking and accounting methodologies to ensure municipalities receive credit for existing pollutant reduction strategies and future reductions or preventative strategies that demonstrate compliance with federal and state requirements and permits.

***NOTE: Before adoption of these or other stormwater management standards, it is strongly recommended that the municipality complete a review of existing zoning ordinances and land development regulations (i.e. requirements for stormwater management, erosion and sediment control, parking lots, landscaping and other related site development elements) to identify amendments to such ordinances and regulations for consistency and compatibility with the SWA model stormwater management standards, and federal and state requirements. The references below provide examples of methods used for review of municipal regulatory standards relating to land development practices as permitted through local zoning and regulations.***

**Example 1.** The *Piscataqua Region Environmental Planning Assessment (PREPA, 2010)* includes a watershed wide review of Municipal Regulations and Conservation Strategies relating to protection of water quality and water resources (including stormwater management, erosion/sediment control, wetlands, buffers, drinking water, floodplain management, and impervious surface limits). The document is available at [http://www.prep.unh.edu/resources/pubs\\_by\\_date.htm](http://www.prep.unh.edu/resources/pubs_by_date.htm) (scroll down the page to the 2010 publications). PREP created a worksheet which was used to collect data from coastal watershed communities. Note: The worksheet is appended as a separate document.

**Example 2.** The Acton Wakefield Watersheds Alliance (AWWA) recently prepared a community-based plan in cooperation with the towns, lake associations and other local stakeholders in New Hampshire and Maine. The *Salmon Falls Headwater Lakes Watershed Management Plan (WMP)* includes a Municipal Ordinance Review as an appendix to the plan, which outlines a review methodology that could be tailored to address stormwater management. These documents are available at <http://www.awwatersheds.org/programs/watershed-plans/68-watershed-plan-unveiled>.

**Example 3.** The Center for Watershed Protection (Ellicott City, MD) prepared a worksheet as a companion document to their publication *Better Site Design: A Handbook for Changing Development Rules in Your Community*. This worksheet - *Codes and Ordinance Worksheet (1998)* - uses the 22 principles for implementing water quality protections through better site design development and provides a self-assessment. The document is available at [http://awsps.org/docman-test/cat\\_view/64-manuals-and-plans/82-stormwater-management-manuals-plans-and-guidance.html](http://awsps.org/docman-test/cat_view/64-manuals-and-plans/82-stormwater-management-manuals-plans-and-guidance.html). ***Additional references from the Center are provided in Appendix B to assist communities with stormwater evaluation and planning for watershed resource protection.***

## SECTION 3. MODEL STORMWATER STANDARDS AND MUNICIPAL APPROACHES FOR ADOPTION

This section is organized in several parts: Introduction; Detailed instructions for each of the three suggested Regulatory Approaches A, B and C including specific language and criteria necessary to implement them; and the Seven Critical Core Elements (recommended minimum Performance Standards for Stormwater Management).

### INTRODUCTION

#### Implementation Options

Stormwater management standards are most commonly implemented by municipalities through zoning or regulations. The following parts of this section detail three methods of adoption: **Approach A** as part of a zoning ordinance; **Approach B** as part of Site Plan and/or Subdivision Regulations; and **Approach C** a dual approach as part of zoning and regulations. All three approaches provide consistent oversight and implementation of stormwater standards by the Planning Board through zoning with a Conditional Use Permit process and as part of Site Plan Review Regulations and Subdivision Regulations.

#### Challenges and Benefits of Regulatory Approaches

Implementing stormwater standards through zoning and land use regulations have unique challenges and benefits.

- Site Plan Review Regulations and Subdivision Regulations can be adopted by a Planning Board through the public hearing process. However, Planning Board support for stormwater regulations can shift due to changes in membership that can occur from year to year as members are replaced or added through the electoral process or as appointed by the Board of Selectmen or Council.
- Zoning amendments require vote by the municipality's governing body (ballot by majority of legal voters) or legislative body (council form of government). Once adopted, zoning standards typically remain in place unless the Planning Board, elected officials or the majority of the voting membership of the municipality move to repeal or amend them by offering a warrant article or resolution to affect change.

## **Option A. Zoning Ordinance Approach**

### ***Introduction***

Stormwater standards can be adopted as part of a zoning ordinance and may apply to a geographically limited area as an overlay district or uniformly throughout a municipality. Zoning amendments are approved by a city or town council or the legislative body of a municipality (residents through vote on a warrant article).

### **Here Begins Text to Incorporate into a Zoning Ordinance**

1. Applicability of Stormwater Management Standards.

**Note: Use the following language for an Overlay District.**

The Stormwater Management Overlay District shall be comprised of *[insert here a description of the geographic extent of the stormwater management overlay district]*. The following stormwater standards shall apply to all land within the district boundaries. Redevelopment of existing developed sites shall also be subject to the standards described herein.

**Note: Use the following language for standards that apply to all lands in the municipality.**

The Stormwater Management Standards shall apply to all lands within the municipal boundaries. Redevelopment of existing developed sites shall also be subject to the standards described herein.

***Insert Critical Core Elements A through G here.***

2. An applicant may request relief from the requirements of the overlay district through the Conditional Use Permit process. All such requests to diverge from any requirement or standard shall be accompanied by a narrative description of and justification for the requested relief, a site plan showing the proposed standard(s) and required standard(s). Relief from the requirements of the overlay district may be granted through issuance of a Conditional Use Permit issued by the Planning Board.
3. A Conditional Use Permit is a decision that would permit relief from or reduction in a specific requirement or standard of the overlay district but that is otherwise generally consistent with its goals, purpose and provisions. The Planning Board shall have the authority to grant or deny a request for a Conditional Use Permit pursuant to the provisions of RSA 674:16 and RSA 674:21.
4. The grant or denial of a Conditional Use Permit by the Planning Board may be appealed to the Superior Court, as provided for in RSA 677:15. [Explanatory Note: A Planning Board decision on a Conditional Use Permit request cannot be appealed to the Zoning Board of Adjustment (RSA 676:5 III).]
5. A Conditional Use Permit, for relief from the requirements of this section, may be granted by the Planning Board after proper public notice and public hearing provided the Planning Board finds that the applicant's request complies with standards 5.a, 5.b or 5.c below.
  - a. Improves a specific aspect of public health or safety; **or**
  - b. Provides an increased level of ecosystem services, environmental or natural resource protection; **or**
  - c. Provides a measureable public benefit (such as public open space or public amenity).

## **Option B. Site Plan Review and/or Subdivision Regulations Approach**

### **Introduction**

Stormwater standards can be adopted as part of land development regulations which apply uniformly throughout a municipality for different types of development. Standards would apply to commercial, industrial and multi-family housing under Site Plan Review Regulations, and commercial and residential subdivision under Subdivision Regulations. Amendments to land development regulations are approved by the Planning Board at a properly noticed public hearing.

### **HERE BEGINS TEXT TO INCORPORATE INTO SITE PLAN REVIEW REGULATIONS**

#### **Provisions and Standards for Post-Construction Stormwater Management**

1. The provisions and standards of this section are implemented for the purpose of:
  - Managing stormwater runoff to protect water quality and quantity.
  - Causing no increase in contribution of a pollutant for which a water body is impaired.
  - Treating all new runoff discharged to a municipal drainage system, surface water body or wetland.
  - Causing no discharge of runoff to an adjacent property in excess of runoff discharged in the existing developed or undeveloped condition.
2. All development subject to these regulations shall comply with the requirements of the following Critical Core Elements.

*Insert Critical Core Elements A through G here.*

### **HERE BEGINS TEXT TO INCORPORATE INTO SUBDIVISION REGULATIONS**

#### **Provisions and Standards for Post-Construction Stormwater Management**

1. These provisions and standards shall apply to all development activities including but not limited to construction of roads, drainage infrastructure, utilities and other structures or development that support the subdivision.
2. **[Option 1]** Development on residential lots shall be exempt from these provisions and standards. **[Option 2]** Development on residential lots shall incorporate best management practices from the *NHDES Homeowners Guide to Stormwater Management (2011, as amended)* to manage and treat runoff to the maximum extent practicable.

***NOTE: Municipalities will decide whether to apply these stormwater standards to development on residential lots. If the standards are applied, recommend referencing the NHDES Homeowners Guide to Stormwater Management (2011, as amended) for technical specifications and implementation of best management practices for stormwater management.***

3. The provisions and standards of this section are implemented for the purpose of:
  - Managing stormwater runoff to protect water quality and quantity.
  - Causing no increase in contribution of a pollutant for which a water body is impaired.
  - Treating all new runoff discharged to a municipal drainage system, surface water body or wetland.
  - Resulting in no discharge of runoff to an adjacent property in excess of runoff discharged in the existing developed or undeveloped condition.

*Insert Critical Core Elements A through G here.*

## **Option C. Zoning Ordinance and Regulations Approach**

### **Here Begins Text to Incorporate into a Zoning Ordinance**

1. Applicability of Stormwater Management Standards.
  - a. **Note: Use the following language for an Overlay District.**  
The Stormwater Management Overlay District shall be comprised of *[insert here a description of the geographic extent of the stormwater management overlay district]*. The following stormwater standards shall apply to all land within the district boundaries. Existing development shall be subject to these standards as described herein.
  - b. **Note: Use the following language for standards that apply to all lands in the municipality.**  
The Stormwater Management Standards shall apply to all lands within its boundaries. Existing development shall be subject to these standards as described herein.
2. An applicant may request relief from the requirements of the overlay district through the Conditional Use Permit process. All such requests to diverge from any requirement or standard shall be accompanied by a narrative description of and justification for the requested relief, a site plan showing the proposed standard(s) and required standard(s). Relief from the requirements of the overlay district may be granted through issuance of a Conditional Use Permit issued by the Planning Board.
3. A Conditional Use Permit is a decision that would permit relief from or reduction in a specific requirement or standard of the overlay district but that is otherwise generally consistent with its goals, purpose and provisions. The Planning Board shall have the authority to grant or deny a request for a Conditional Use Permit pursuant to the provisions of RSA 674:16 and RSA 674:21.
4. The grant or denial of a Conditional Use Permit by the Planning Board may be appealed to the Superior Court, as provided for in RSA 677:15. [Note: A Planning Board decision on a Conditional Use Permit request cannot be appealed to the Zoning Board of Adjustment (RSA 676:5 III).]
5. A Conditional Use Permit, for relief from the requirements of the overlay district, may be granted by the planning board after proper public notice and public hearing provided the planning board finds that the applicant's request complies with standards 5.a, 5.b or 5.c below.
  - a. Improves a specific aspect of public health; **or**
  - b. Provides an increased level of ecosystem services, environmental or natural resource protection; **or**
  - c. Provides a measureable public benefit (such as increased public space, open space or public amenities).

***NOTE: Proceed by incorporating the Critical Core Elements A through G into Site Plan Review Regulations and/or Subdivision Regulations using language from Option B (see previous section)***



## SECTION 4: THE CRITICAL CORE ELEMENTS - PERFORMANCE STANDARDS FOR STORMWATER MANAGEMENT

### Seven Critical Core Elements of Stormwater Management

Stormwater management requirements in either a zoning ordinance and/or land development regulation should include *seven critical core elements* as a component toward implementation of an adaptive water resources management strategy. These *seven critical core elements* of stormwater management are:

<b>Element A</b>	<b><i>Applicability Standards</i></b>
<b>Element B</b>	<b><i>Minimum Thresholds for Applicability</i></b>
<b>Element C</b>	<b><i>Best Management Practices</i></b>
<b>Element D</b>	<b><i>Applicability for Redevelopment</i></b>
<b>Element E</b>	<b><i>Stormwater Management Plan Approval and Recordation</i></b>
<b>Element F</b>	<b><i>Maintenance Criteria</i></b>
<b>Element G</b>	<b><i>Inspection of Infrastructure</i></b>

Elements A through G are described on pages 7-12 of this document.

#### ELEMENT A. APPLICABILITY STANDARDS

***NOTE: These applicability requirements address directly methods to reduce pollutant load burden for the municipality, particularly those municipalities subject to EPA MS4 permit requirements.***

1. These standards apply to all projects subject to ***[insert one of the following – the Zoning Article containing the stormwater standards, or Site Plan Review Regulations and/or Subdivision Regulations pertaining to stormwater management.]*** At the discretion of the Planning Board, qualifying applications may be required to include a post-construction stormwater management plan prepared by a NH licensed engineer. [NOTE: If not already part of the regulations, a description and submission requirements for a post-construction stormwater management plan should be added.]
2. All projects under review by the Planning Board of such magnitude as to require a stormwater permit from EPA Construction General Permit (CGP) program or NH Department of Environmental Services (NHDES) Alteration of Terrain (AOT) program shall comply with the standards of EPA and/or NHDES permits and this section, whereas the stricter standards shall apply.,
3. ***[OPTIONAL]*** Activities permitted by federal and state laws governing agriculture, forestry, silviculture and horticulture are subject to the standards and practices described in Elements C and D pertaining to water quality criteria and discharge of stormwater to adjacent properties, public or private drainage infrastructure, surface water bodies and wetlands.

## ELEMENT B. MINIMUM THRESHOLDS FOR APPLICABILITY

**NOTE:** A minimum threshold condition is a measure of the amount of total disturbance for a new development or redevelopment project whereby the full stormwater standards would apply to all applications subject to zoning, Site Plan Review Regulations and Subdivision Regulations. *The threshold can be established to include projects qualifying under NHDES Alteration of Terrain permit and/or capture smaller projects that do not meet the threshold for the NHDES Alteration of Terrain permit.* Disturbance is defined as any permanent alteration of the land surface or removal of vegetation or trees associated with a development activity (excluding routine landscaping and yard maintenance, gardening, commercial excavation operations, or removal of trees, stumps and invasive vegetation). Note – a lower threshold is encouraged for certain sensitive areas such as habitat, drinking water and groundwater protection, and proximity to impaired waters.

1. Minimum Thresholds for Applicability: These stormwater management standards apply to all projects requiring Planning Board review and approval under the *[insert reference to applicable zoning article or regulation here]*. . For smaller projects that disturb less than ***[insert standard here]*** square feet an applicant may request a waiver of the full standards providing minimum protections and management are implemented. For the purpose of these standards, disturbance is defined as any alteration of the land surface or permanent removal of vegetation or trees associated with a development activity (refer to the definition of disturbance in the Glossary of Terms).

**NOTE FOR #1 and #2.** The suggested minimum threshold for small projects eligible for a waiver may be revised up or down to reflect municipal priorities or at the discretion of the Planning Board depending upon the location and type of development, to protect critical sensitive resources or presence of an existing water body impairment. In recently adopted stormwater ordinances and/or regulations, municipalities have established thresholds for applicability ranging from 5,000 to 20,000 square feet. However, applicability thresholds should be low enough to ensure a high level of confidence that the development activity will have negligible impacts on water quality and natural hydrologic processes.

2. Waiver Option for Small Development Projects: At the request of an applicant, the Planning Board may grant a waiver to any or all stormwater standards for projects that: disturb less than ***[insert maximum area here]*** square feet; create less than ***[insert maximum area here]*** square feet of new impervious surface; and do not disturb land within 100 feet of a surface water body or wetland.

***[NOTE: In #2 above, the Planning Board may determine the distance criteria from surface waters and/or wetlands based upon site conditions such as slope, soil type and subsurface materials or identification of an impaired water body within the contributing drainage area of the project.]***

3. Conditions for Granting of Waivers: In order for the Planning Board to issue a waiver, the applicant must demonstrate and board must find the application meets the minimum criteria listed below and, if granted, will be considered conditions of approval.
  - a. Runoff from **NEW** impervious surfaces shall be directed to a filtration and/or infiltration device or properly discharged to a naturally occurring or fully replanted and vegetated area with slopes of 15 percent or less and with adequate controls to prevent soil erosion and concentrated flow.

- b. Impervious surfaces for parking areas and roads shall be minimized to the extent possible (including minimum parking requirements for proposed uses and minimum road widths).
- c. Runoff generated from **NEW** impervious surfaces shall be retained on the development site and property and mimic natural hydrologic processes to the maximum extent possible, or it is determined that the biological and chemical properties of the receiving waters will not be degraded by or its hydrology will benefit from discharge of stormwater runoff from the development site.
- d. Compliance with standards 3.a-3.d above will be determined by the Planning Board on a case by case basis as site conditions and constraints will differ greatly between various redevelopment proposals.

#### **ELEMENT C. BEST MANAGEMENT PRACTICES**

1. Performance Specifications: All proposed stormwater practices and measures shall be installed and maintained in accordance with manufacturers' specifications and performance specifications in the NH Stormwater Management Manual Volume 2 (December 2008 or current revision) a copy of which is available from the NHDES website at [www.des.nh.gov/organization/divisions/water/stormwater/manual.htm](http://www.des.nh.gov/organization/divisions/water/stormwater/manual.htm).
2. Water Quality Protection: All aspects of the application shall be designed to protect the quality of surface waters and groundwater of the *[Insert name of municipality here]* as follows:
  - a. No person shall locate, store, discharge, or permit the discharge of any treated, untreated, or inadequately treated liquid, gaseous, or solid materials of such nature, quantity, noxiousness, toxicity, or temperature that may run off, seep, percolate, or wash into surface water or groundwater so as to contaminate, pollute, harm, impair or contribute to an impairment of such waters.
  - b. All storage facilities for fuel, chemicals, chemical or industrial wastes, and biodegradable raw materials shall meet the regulations of the New Hampshire Department of Environmental Services (NHDES) including but not limited to those involving Underground Storage Tanks, Above Ground Storage Tanks, hazardous Waste and Best Management Practices for Groundwater Protection (Env-Wa 401).
3. Stormwater Management for New Development: All proposed stormwater management and treatment systems shall meet the following performance standards.
  - a. Existing surface waters, including lakes, ponds, rivers, perennial and intermittent streams (natural or channelized), and wetlands (including vernal pools) shall be protected by the minimum buffer setback distances (as specified in the Zoning and Regulations). Stormwater and erosion and sediment control BMPs shall be located outside the specified buffer zone unless otherwise approved by the Planning Board. Alternatives to stream and wetland crossings that eliminate or minimize environmental impacts shall be considered whenever possible. When necessary, as determined by the Planning Board or their representative, stream and wetland crossings shall comply with state recommended design standards to minimize impacts to flow and enhance animal passage (see the University of New Hampshire Stream Crossing Guidelines (May 2009, as amended) available from the UNH Environmental Research Group website at [http://www.unh.edu/erg/stream\\_restoration/nh\\_stream\\_crossing\\_guidelines\\_unh\\_web\\_rev\\_2.pdf](http://www.unh.edu/erg/stream_restoration/nh_stream_crossing_guidelines_unh_web_rev_2.pdf))

- b. Low Impact Development (LID) site planning and design strategies must be used to the maximum extent practicable (MEP) in order to reduce the generation of the stormwater runoff volume for both new development and redevelopment projects (see Element D for redevelopment standards). An applicant must document in writing why LID strategies are not appropriate if not used to manage stormwater.
- c. All stormwater treatment areas shall be planted with native plantings appropriate for the site conditions: grasses, shrubs and/or other native plants in sufficient numbers and density to prevent soil erosion and to achieve the water quality treatment requirements of this section.
- d. All areas that receive rainfall runoff must be designed to drain within a maximum of 72 hours for vector control.
- e. Salt storage areas shall be covered and loading/offloading areas shall be designed and maintained in accordance with NH DES published guidance such that no untreated discharge to receiving waters results. Snow storage areas shall be located in accordance with NH DES published guidance such that no direct untreated discharges to receiving waters are possible from the storage site. Runoff from snow and salt storage areas shall enter treatment areas as specified above before being discharged to receiving waters or allowed to infiltrate into the groundwater. See NHDES published guidance fact sheets on road salt and water quality, and snow disposal at <http://des.nh.gov/organization/commissioner/pip/factsheets/wmb/index.htm>.
- f. Runoff shall be directed into recessed vegetated and landscape areas designed for treatment and/or filtration to the MEP to minimize Effective Impervious Cover (EIC) and reduce the need for irrigation systems.
- g. All newly generated stormwater, whether from new development or expansion of existing development (redevelopment), shall be treated on the development site. Runoff shall not be discharged from the development site to municipal drainage systems, privately owned drainage systems (whether enclosed or open drainage). Runoff shall not be discharged to surface water bodies or wetlands in excess of volumes discharged under existing conditions (developed condition or undeveloped condition).
- h. A development plan shall include provisions to retain stormwater on the site by using the natural flow patterns of the site. Runoff from impervious surfaces shall be treated to achieve 80% removal of Total Suspended Solids and at least 50% removal of both total nitrogen and total phosphorus using appropriate treatment measures, as specified in the NH Stormwater Manual. Volumes 1 and 2, December 2008 as amended (refer to Volume 2, page 6, Table 2.1 Summary of Design Criteria, Water Quality Volume for treatment criteria) or other equivalent means. Where practical, the use of natural, vegetated filtration and/or infiltration BMPs or subsurface gravel wetlands for water quality treatment is preferred given its relatively high nitrogen removal efficiency. Note: The Anti-Degradation provisions of the State Water Quality Standards require that runoff from new development shall not lower water quality or contribute to existing water body impairments.

***NOTE: An alternative approach to requiring specific pollutant removal rates for treatment of runoff can be to restrict selection of BMP's to those that achieve a specified minimum removal rate or greater.***

3. Stormwater Management for New Development (continued)

- i. Measures shall be taken to control the post-development peak rate runoff so that it does not exceed pre-development runoff for the 2-year, 10-year and 25-year, 24-hour storm events. Similar measures shall be taken to control the post-development runoff volume to infiltrate the groundwater recharge volume  $GR_v$  according to the following ratios of Hydrologic Soil Group (HSG) type versus infiltration rate multiplier: HSG-A: 1.0; HSG-B: 0.75; HSG-C: 0.4; HSG-D: 0.15. For sites where infiltration is limited or not practicable, the applicant must demonstrate that the project will not create or contribute to water quality impairment. Infiltration structures shall be in locations with the highest permeability on the site.
- j. The physical, biological and chemical integrity of the receiving waters shall not be degraded by the stormwater runoff from the development site.
- k. The design of the stormwater drainage system shall provide for the disposal of stormwater without flooding or functional impairment to streets, adjacent properties, downstream properties, soils, or vegetation.
- l. The design of the stormwater management systems shall take into account upstream and upgradient runoff that flows onto, over, or through the site to be developed or re-developed, and provide for this contribution of runoff.
- m. Appropriate erosion and sediment control measures shall be installed prior to any soil disturbance, the area of disturbance shall be kept to a minimum, and any sediment in runoff shall be retained within the project area. Wetland areas and surface waters shall be protected from sediment. Disturbed soil areas shall be either temporarily or permanently stabilized consistent with the NHDES Stormwater Manual Volume 3 guidelines. In areas where final grading has not occurred, temporary stabilization measures should be in place within 7 days for exposed soil areas within 100 feet of a surface water body or wetland and no more than fourteen (14) days for all other areas. Permanent stabilization should be in place no more than 3 days following the completion of final grading of exposed soil areas.
- n. All temporary control measures shall be removed after final site stabilization. Trapped sediment and other disturbed soil areas resulting from the removal of temporary measures shall be permanently stabilized prior to removal of temporary control measures.
- o. Every effort shall be made to use pervious parking surfaces as an alternative to impervious asphalt or concrete for general and overflow parking areas. Pervious pavement shall be appropriately sited and designed for traffic and vehicle loading conditions.
- p. Whenever practicable, native site vegetation shall be retained, protected, or supplemented. Any stripping of vegetation shall be done in a manner that minimizes soil erosion.

## ELEMENT D. APPLICABILITY FOR REDEVELOPMENT

**NOTE:** Criteria for redevelopment are critical to the effectiveness of any non-point source pollution management strategy. Redevelopment criteria must balance the economic incentives of utilizing and updating existing commercial property while at the time impose reasonable measures to improve water quality conditions for new development. Adopting redevelopment criteria is much like concepts applicable to electrical code enforcement which requires redevelopment projects to improve standards prior to issuance of an occupancy permit.

Redevelopment criteria should hold property owners accountable and at minimum require them to evaluate “hot spots and worst offender” situations (i.e. locations where stormwater is not managed properly or contributes high levels of pollutants to receiving waters or wetlands) on a site to target for treatment of “existing conditions” and require a narrative and/or explanation describing why retrofit of these areas is not possible. [Encourage use of watershed plans and NHDES Geomorphic Assessment reports to identify existing “hot spots” for deficient SWM and areas of active erosion; this information is geographically limited to areas within the river and tributary floodplain and valley].

**NOTE:** Because redevelopment may present a wide range of constraints and limitations, an evaluation of options may be proposed to work in conjunction with broader state watershed goals and local initiatives. Stormwater requirements for redevelopment may vary based upon the existing impervious surface cover on the site, the available space for new stormwater BMPs, and the sensitivity of nearby water bodies and wetlands. In order to determine the stormwater requirements for redevelopment projects, the percentage of the site covered by existing impervious areas must be calculated. For redevelopment projects on sites having less than 40% existing impervious surface coverage, it is generally considered that adequate space exists to apply the same stormwater management requirements as those required for new development projects. For sites that have greater than 40% impervious surface cover, it is recognized that the available space for BMPs will be limited and thus, greater flexibility in meeting the stormwater management standards will be needed so as to not prevent redevelopment. For these redevelopment sites, the applicant may be permitted to meet stormwater management requirements either on-site or at an approved off-site location, within the same watershed

### 1. Redevelopment Criteria:

- a. In order to determine the stormwater requirements for redevelopment projects, the percentage of the site covered by existing impervious areas must be calculated. Stormwater requirements for redevelopment will vary based upon the amount of site surface area that is covered by existing impervious surfaces.
- b. For sites meeting the definition of a redevelopment project and having less than 40% existing impervious surface coverage, the stormwater management requirements will be the same as other new development projects with the important distinction that the applicant can meet those requirements either on-site or at an approved off-site location. The applicant must satisfactorily demonstrate that impervious area reduction, LID strategies and BMPs have been implemented on-site to the maximum extent practicable.
- c. For sites meeting the definition of a redevelopment project and having more than 40% existing impervious surface coverage, stormwater shall be managed for water quality in accordance with one or more of the following techniques, listed in order of preference:

- i. Implement measures onsite that result in disconnection or treatment of at least 30% of the existing impervious cover as well as 50% of the additional proposed impervious surfaces and pavement areas through the application of filtration media; or
- ii. Implement other LID techniques onsite to the maximum extent practicable to provide treatment for at least 50% of the entire site area.

**NOTE: THE FOLLOWING STANDARDS FOR OFF-SITE MITIGATION ARE OPTIONAL.** An off-site mitigation option offers flexibility for redevelopment of existing developed sites and a way to implement water quality improvements in locations where little or no stormwater management exists currently (retrofit). This option is also particularly effective for implementing retrofit projects in **sensitive areas and high pollutant load areas that might otherwise not be addressed.**

## 2. Off-Site Mitigation:

- a. In cases where the applicant demonstrates, to the satisfaction of the planning board, that on-site treatment has been implemented to the maximum extent possible or is not feasible, off-site mitigation will be an acceptable alternative if implemented within the same subwatershed, within the project's drainage area or within the drainage area of the receiving water body. To comply with local watershed objectives the mitigation site would be preferably situated in the same subwatershed as the development and impact/benefit the same receiving water.
- b. Off-site mitigation shall be equivalent to no less than the total area of impervious cover NOT treated on-site.
- c. An approved off-site location must be identified, the specific management measures identified, and an implementation schedule developed in accordance with planning board review. The applicant must also demonstrate that there is no downstream drainage or flooding impacts as a result of not providing on-site management for large storm events.

**NOTE: Refer to Appendix A for guidance on implementation of an off-site stormwater mitigation program, including options for developing targeted approaches that address local impairments and water quality issues.**

### *Optional: Other Incentives*

For MS4 communities, the draft NPDES permit references "increased discharges to impaired waters must provide additional BMPs or enhanced control of an existing discharge". If this requirement becomes part of the new MS4 permit, any increase to "existing discharges" will need to be addressed as part of all redevelopment applications. This can be done by retrofitting existing controls or treating all new stormwater contributions.

## **ELEMENT E. STORMWATER MANAGEMENT PLAN APPROVAL AND RECORDATION**

1. Plan Approval and Review. The Planning Board shall approve the Stormwater Management Plan if it complies with the requirements of these regulations and other requirements as provided by law. At the discretion of the Planning Board, a technical review by a third party may be required of any stormwater management and erosion control plan prepared under these regulations. The technical review shall be performed by a qualified professional consultant, as determined by the Planning Board, and the expense of which shall be the full responsibility of the applicant.

2. Recordation of Approved Stormwater Management Plan. After final Planning Board approval, and established as a condition of such approval, the owner of record of the property shall record at the Registry of Deeds documentation sufficient to provide notice to all persons that may acquire any property subject to the requirements of and responsibilities described in the approved stormwater management plan (see RSA 477:3-a). The notice shall comply with the applicable requirements for recording contained in RSA 477 and 478.

**ELEMENT F. OPERATIONS AND MAINTENANCE CRITERIA**

Stormwater management and sediment and erosion control plans shall be incorporated as part of any approved site plan or subdivision plan. The owner of record of the property shall record a Notice of Decision of these plans at the Registry of Deeds. The Notice of Decision shall be attached to the property deed and apply to all persons that may acquire any property subject to the approved stormwater management and sediment control plans. The Notice of Decision shall reference the requirements for maintenance pursuant to the stormwater management and erosion and sediment control plans as approved by the Planning Board.

**ELEMENT G. POST-CONSTRUCTION STORMWATER INFRASTRUCTURE – INSPECTION AND RESPONSIBILITY**

Municipal staff or their designated agent shall have site access to complete routine inspections to ensure compliance with the approved stormwater management and sediment and erosion control plans. Such inspections shall be performed at a time agreed upon with the landowner. If permission to inspect is denied by the landowner, municipal staff or their designated agent shall secure an administrative inspection warrant from the district or superior court under RSA 595-B Administrative Inspection Warrants. Expenses associated with inspections shall be the responsibility of the applicant/property owner.

The applicant shall bear final responsibility for the installation, construction, inspection, and disposition of all stormwater management and erosion control measures required by the Planning Board. Site development shall not begin before the Stormwater Management Plan receives written approval by the Planning Board.

The municipality retains the right, though accepts no responsibility, to repair or maintain stormwater infrastructure if: a property is abandoned or becomes vacant; and in the event a property owner refuses to repair infrastructure that is damaged or is not functioning properly.



## SECTION 5. LEGAL BASIS IN NEW HAMPSHIRE

### Introduction

Stormwater management requirements can be addressed effectively through performance based zoning ordinances and land development regulations. Following are the NH statues which enable local regulation of stormwater as a component of zoning and land use.

RSA 674:16 – Grant of Power

RSA 674:17 – Purposes of Zoning Ordinances

RSA 674:21 - Innovative Land Use Controls

RSA 674:36 – Subdivision Regulations

RSA 674:44 – Site Plan Review Regulations

Although many larger sites are subject to NH's Alteration of Terrain permit requirements and federal EPA storm water management requirements under the federal Clean Water Act, local zoning ordinances and land development regulations provide municipalities the authority to act independently to address local problems and issues relating to water quality impacts and water resource management on a case by case basis. Often federal and state regulations apply to only the largest development projects and lack the oversight and enforcement that municipalities are ultimately responsible for.

### Zoning Ordinance

Zoning is an appropriate means for addressing stormwater for the purpose of “promoting the health, safety, or the general welfare of the community” (RSA 674:16) and “to assure proper use of natural resources” (RSA 674:17). A performance-based approach (authorized under RSA 674:21 when supported by the master plan) allows the community to specify the desired outcome or performance required by any development activity without being overly prescriptive regarding the specific techniques or approaches used. A zoning ordinance is also the appropriate means for specifying basic size and dimensional requirements of development affecting stormwater management, such as lot usage, impervious coverage, density, location of buildings, and retention of vegetative cover.

A zoning ordinance can also authorize the planning board to require a more detailed stormwater management plan for certain types of development, such as for larger developments, developments subject to subdivision and/or site plan review, or for developments near sensitive resources. Within this context, the planning board will develop site plan and subdivision regulations specifying what information is required in a plan and establishing any additional requirements necessary. Refer to the *Land Development Regulations* section below.

***Local regulation is the only form of public review for development too small to be subject to federal or state stormwater regulations.*** A local zoning ordinance ensures that all development activity complies with the stormwater management requirements, including projects not subject to state or federal regulations and individual building lots that are not subject to subdivision or site plan review. Individual lots that do not go through the subdivision or site plan review process can be subject to basic stormwater management standards through a building permit and may be enforced by a code enforcement officer.

### **Land Development Regulations**

Site Plan Review and Subdivision Regulations (RSA 674:44 and 674:36) shall incorporate standards to protect public health and safety, protect water resources, and prevent sources of pollution from entering the environment. Regulations can authorize the Planning Board to seek third party assistance as part of the review of submitted development applications and include engineering review and oversight of construction activities, particularly those involving large development sites and innovative techniques such as Low Impact Development. Regulations can specify conditions of approval laying out specific requirements and procedures for inspection of development sites during and after construction. Stormwater regulations should include the incorporation of site operations (i.e. housekeeping activities) and indicate the entity responsible to complete on-going maintenance in accordance with submitted maintenance plans for new stormwater infrastructure. Unlike zoning, regulations are under the sole jurisdiction of the Planning Board and can be amended by the Planning Board following the required public noticing and hearing procedures.

#### *Additional Authority for Regulation of Stormwater Discharge*

RSA 149-I:6 provides municipal authority to regulate stormwater, independent of land use regulations. While it is likely that creation of a stormwater utility may be necessary to adopt such regulations, further legal opinion would be helpful regarding whether such regulations could be adopted in a municipality without a utility. Regulations under this statute could address water pollution problems caused by properties that discharge stormwater to regulated MS4 systems.

### **Planning For Integrated Water Management**

NH coastal watershed communities are confronted by a challenging set of land use and environmental concerns stemming from growth and development. At the same time changes in our regional climate, particularly, annual precipitation patterns and increases in the frequency and intensity of storm events are placing increased stress on available resources and infrastructure. These pressures have resulted in increasing stormwater runoff, declines in water quality, greater flood damage to private and public property, and increased risk and vulnerability of certain populations and critical infrastructure.

While these stresses are clearly inter-related, they are complex and the management and regulatory organization in New Hampshire is not structured to encourage integrated planning (or funding) for multiple issues. There are both traditional and innovative strategies that will allow communities to prepare and adapt to environmental changes, mitigate the impacts of growth, and minimize economic, social, and environmental consequences. However, many communities lack effective, enforceable water management and stormwater performance standards that will bring about actions necessary to achieve these goals.

Planning for better stormwater management is challenging because water resources are not confined to municipal boundaries and watershed plans are not always integrated into local plans.

Many land use decisions are made on a parcel-by-parcel basis. These parcel-by-parcel decisions can have cumulative impacts on water resources, stormwater infrastructure, and municipal budgets. Planning that integrates better practices with the local development approval process should help communities and their neighbors within the watershed set the groundwork for sound policies and ultimately better stormwater management. The intent of this document is to limit the economic and environmental liabilities of the municipalities by partnering with those industries and developments that directly contribute to the problem.

## SECTION 6: GLOSSARY OF TERMS

**ADAPTIVE MANAGEMENT** – Management of resources that is a structured, iterative process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring. In this way, decision making simultaneously meets one or more resource management objectives and, either passively or actively, accrues information needed to improve future management.

**BEST MANAGEMENT PRACTICES (BMPs)** - A structural or non-structural device designed to temporarily store or treat urban stormwater runoff in order to mitigate flooding, reduce pollution and provide other amenities.

**BIORETENTION** – A water quality practice that utilizes vegetation and soils to treat urban stormwater runoff by collecting it in shallow depressions, before filtering through an engineered bioretention planting soil media.

**BUFFER** – A special type of preserved area along a watercourse or wetland where development is restricted or prohibited. Buffers protect and physically separate a resource from development. Buffers also provide stormwater control flood storage and habitat values. Wherever possible, riparian buffers should be sized to include the 100- year floodplain as well as steep banks and freshwater wetlands.

**DISTURBED AREA** – An area in which the natural vegetative soil cover has been removed or altered and, therefore, is susceptible to erosion.

**ECOSYSTEM SERVICES** - The benefits of natural systems to individuals, communities, and economies. These benefits include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth.

**EFFECTIVE IMPERVIOUS COVER (EIC)** – The total impervious surface areas less the area of disconnected impervious cover (areas where runoff is captured and infiltrated or otherwise treated).

**ENVIRONMENTAL (NATURAL RESOURCE) PROTECTION** - Policies and procedures aimed at conserving natural resources, preserving the current state of natural environments and, where possible, reversing degradation. Any activity to maintain or restore environmental quality through preventing the emission of pollutants or reducing the presence of polluting substances in environmental media, and preventing physical removal or degradation of natural resources.

**FILTRATION** – The process of physically or chemically removing pollutants from runoff. Practices that capture and store stormwater runoff and pass it through a filtering media such as sand, organic material, or the native soil for pollutant removal. Stormwater filters are primarily water quality control devices designed to remove particulate pollutants and, to a lesser degree, bacteria and nutrients.

**GROUNDWATER RECHARGE** – The process by which water that seeps into the ground, eventually replenishing groundwater aquifers and surface waters such as lakes, streams, and the oceans. This process helps maintain water flow in streams and wetlands and preserves water table levels that support drinking water supplies.

**GROUNDWATER RECHARGE VOLUME** – The post-development design recharge volume (i.e., on a storm event basis) required to minimize the loss of annual pre-development groundwater recharge. The Rev is determined as a function of annual pre-development recharge for site-specific soils or surficial materials, average annual rainfall volume, and amount of impervious cover on a site.

**IMPAIRED WATERS** – Those waterbodies not meeting water quality standards. Pursuant to Section 303(d) of the federal Clean Water Act, each state prepares a list of impaired waters (known as the 303(d) list) which is presented in the state's Integrated Water Report as Category 5 waters. Those impaired waters for which a TMDL has been approved by US EPA and is not otherwise impaired, are listed in Category 4A.

**IMPERVIOUS COVER** – Those surfaces that cannot effectively infiltrate rainfall consisting of surfaces such as building rooftops, pavement, sidewalks, driveways, compacted gravel (e.g., driveways and parking lots).

**INFILTRATION** – the process of runoff percolating into the ground (subsurface materials). Stormwater treatment practices designed to capture stormwater runoff and infiltrate it into the ground over a period of days.

**LOW IMPACT DEVELOPMENT (LID)** - Low impact development is a site planning and design strategy intended to maintain or replicate predevelopment hydrology through the use of site planning, source control, and small-scale practices integrated throughout the site to prevent, infiltrate and manage runoff as close to its source as possible. Examples of LID strategies are pervious pavement, rain gardens, green roofs, bioretention basins and swales, filtration trenches, and other functionally similar BMPs located near the runoff source.

**MAXIMUM EXTENT PRACTICABLE (MEP)** - To show that a proposed development has met a standard to the maximum extent practicable, the applicant must demonstrate the following: (1) all reasonable efforts have been made to meet the standard, (2) a complete evaluation of all possible management measures has been performed, and (3) if full compliance cannot be achieved, the highest practicable level of management is being implemented.

**MITIGATION** – Activities, strategies, policies, programs, actions that, over time, will serve to avoid, minimize, or compensate for (by treating or removing pollution sources) the impacts to or disruption of water quality and water resources.

**MS4** – Refers to the *Small Municipal Separate Storm Sewer System General Permit* - the MS4 General Permit - issued by the EPA under the Clean Water Act. MS4 applies to municipalities that contain any portion of an urbanized area as defined by the Census. It applies to stormwater conveyances owned by a State, city, town, or other public entity that discharge to 'Waters of the United States'. The MS4 Permit requires that operators of small MS4s develop a Storm Water Management Program that uses appropriate Best Management Practices (BMPs) for each of the six minimum control measures required in the MS4 permit.

**NATIVE VEGETATION AND PLANTINGS** - Plants that are indigenous to the region, adapted to the local soil and rainfall conditions, and require minimal supplemental watering, fertilizer, and pesticide application.

**POLLUTANT LOAD** – means an amount of pollutants that is introduced into a receiving waterbody measured in units of concentration or mass per time (i.e. concentration (mg/l) or mass (lbs/day)).

**REDEVELOPMENT** - Any construction, alteration, or improvement that disturbs a total of 10,000 square feet or more of existing impervious area where the existing land use is commercial, industrial, institutional, governmental, recreational, or multifamily residential. Building demolition is included as an activity defined as “redevelopment”, but building renovation is not. Similarly, removing of roadway materials down to the erodible soil surface is an activity defined as “redevelopment,” but simply resurfacing of a roadway surface is not. Pavement excavation and patching that is incidental to the primary project purpose, such as replacement of a collapsed storm drain, is not classified as redevelopment. In general, the requirements in this manual do not apply to projects or portions of projects when the total existing impervious area disturbed is less than 10,000 square feet. However, specific regulatory programs may impose additional requirements. Any creation of new impervious area over portions of the site that are currently pervious is required to comply fully with the requirements of this manual, with the exception of infill projects.

**RETENTION** – The amount of precipitation on a drainage area that does not escape as runoff. It can be expressed as the difference between total precipitation and total runoff from an area.

**TOTAL SUSPENDED SOLIDS (TSS)** – The total amount of soils particulate matter which is suspended in the water column.

**WATER QUALITY VOLUME** - The storage needed to capture and treat 90% of the average annual stormwater runoff volume. In Rhode Island, this equates to 1-inch of runoff from impervious surfaces.

**WATERSHED** – All land and water area from which runoff may run to a common (design) discharge point.

## APPENDIX A GUIDANCE ON OFF-SITE STORMWATER MITIGATION PROGRAMS

### Purpose

The goals of an off-site stormwater mitigation program are to:

- Identify areas contributing high pollutant loads to groundwater, surface water and wetlands;
- Identify developed sites with no stormwater management and those where runoff is not being treated adequately;
- Inventory sites where water quality improvements are needed;
- Prioritize retrofit projects based on projected water quality benefits and implementation cost;
- Remove pollutants from stormwater to improve water quality, comply with federal and state laws, and protect aquatic ecosystems;
- Remove excess stormwater from the public sanitary sewer system; and
- Reduce the potential for sanitary sewer backups in private residences and buildings.

Several critical steps are necessary to create a successful off-site mitigation program, including but not limited to a land use/cover and development analysis, preparation of a mitigation site inventory, review of federal and state regulatory requirements, review of municipal zoning and land development standards, and financial considerations.

### Preparing a Mitigation Site Inventory

A land use/cover and development analysis can yield information about the geographic distribution of high pollutant load areas and sources, identify sub-drainage areas and/or sites with the highest pollutant loads, and help identify locations for site specific field assessments. Another technical resource are river geomorphic assessments prepared by the NH DES as part of the NH fluvial geomorphic assessment program. These assessments document field observations of water quality impairments within the river corridors and channels including physical measurements of infrastructure, photographs and field notes of channel conditions, and recommended restoration practices. The assessments are available on the NHDES Watershed Assistance Section website at [http://des.nh.gov/organization/divisions/water/wmb/was/watershed\\_based\\_plans.htm](http://des.nh.gov/organization/divisions/water/wmb/was/watershed_based_plans.htm).

***NOTE: Refer to page 24 for technical resources from the Center for Watershed Protection about how to conduct a mitigation site inventory.***

### Minimum Criteria for Permitting Use of an Off-Site Mitigation Option

A stormwater ordinance or regulation that applies an off-site mitigation option should require that any new development or redevelopment be accompanied by practices to reduce water quality impacts associated with stormwater runoff and other types of non-point source pollution.

The off-site mitigation option should further specify that these practices must be capable of ***reducing stormwater pollutant loads from a development site to a level at least some measure below the load generated by the same site prior to development.***

### Preparing an Offset Fee (Fee-in-Lieu) Program

Municipalities may require developers to pay an offset fee to fully recover the costs of stormwater management. Estimates of the cost of stormwater management can be based on either the equivalent cost method or the stormwater retrofit method, and escalate each year based on the construction cost index. These methods are used to calculate the equivalent cost to construct a stormwater treatment

practice on the same site, whereas the second method calculates the cost to local government to construct a stormwater retrofit on another site.

Offset fees for redevelopment should reflect the cost of complying with the standards for redevelopment (refer to ELEMENT D. APPLICABILITY FOR REDEVELOPMENT for specifics). Offset fees should be equivalent to the cost of performing the required treatment (area of impervious surface based on % impervious cover) and volume management as described for redevelopment.

#### *Stormwater Retrofit Cost Method*

Another way to look at offset fees (fee-in-lieu) is to estimate the cost to a municipality to manage and treat runoff from an acre of impervious surface using a larger stormwater retrofit elsewhere in the community. This approach takes advantage of the economies of scale inherent when treating larger sites (for example sites > 5 acres). Municipalities who construct stormwater retrofits want to ensure that all their costs are recovered: base construction, design and engineering, retrofit inventories and construction management. ***Thus an inventory of mitigation sites can flag opportunities to install larger BMPs and to pool financial resources by combining mitigation requirements from several projects.***

#### *Stormwater Infrastructure Maintenance Costs*

Both the equivalent cost method and stormwater retrofit method neglect the cost to the municipality of maintaining stormwater practices installed through off-site mitigation. Several technical resources suggest that requiring an impact (offset) fee at the time of project approval can help to partially recover the future costs of maintenance.

## APPENDIX B

### ADDITIONAL RESOURCES FROM THE CENTER FOR WATERSHED PROTECTION (ELLICOTT CITY, MARYLAND)

Technical resources documents available at no cost at:

[http://www.cwp.org/documents/cat\\_view/68-urban-subwatershed-restoration-manual-series.html](http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series.html)

**Manual 3: Urban Stormwater Retrofit Practices Manual (T. Schueler, D. Hirschman, M. Novotney, J. Zielinski, 2007).** Outlines the basics of retrofits, describes the 13 unique locations where they can be found, and presents rapid methods to find, design and deliver retrofits to meet a wide range of subwatershed objectives. The manual contains updated costs for retrofit practices, updated pollutant removal data for stormwater treatment options, a design point method to estimate individual retrofit removal rates, and practical tips to support the design, permitting and construction of retrofit projects. In short, the manual provides all the resources needed to develop an effective local retrofit program.

**Manual 11: Unified Subwatershed and Site Reconnaissance: A User's Manual (T. Wright, C. Swann, K. Cappiella, T. Schueler, 2005).** Examines pollution sources and restoration potential within upland areas of urban subwatersheds. The manual provides detailed guidance on how to perform each of its four components: the Neighborhood Source Assessment, Hotspot Site Investigation, Pervious Area Assessment and the analysis of Streets and Storm Drains. Together, these rapid surveys help identify upland restoration projects and source control to consider when devising subwatershed restoration plans.

**Manual 10: Unified Stream Assessment: A User's Manual (A. Kitchell, T. Schueler, 2005).** Describes a rapid technique to locate and evaluate problems and restoration opportunities within the urban stream corridor. It describes how to perform the USA, and interpret the data collected to determine the stream corridor restoration potential for your subwatershed.

**Manual 1: An Integrated Framework to Restore Small Urban Watersheds (T. Schueler, 2005).** Introduces the basic concepts and techniques of urban watershed restoration, and sets forth the overall framework we use to evaluate subwatershed restoration potential. The manual emphasizes how past subwatershed alterations must be understood in order to set realistic expectations for future restoration. Presents a simple subwatershed classification system to define expected stream impacts and restoration potential. Defines seven broad groups of restoration practices, and describes where to look in the subwatershed to implement them. Presents a condensed summary of a planning approach to craft effective subwatershed restoration plans.

**Manual 2: Methods to Develop Restoration Plans for Small Urban Watersheds (T. Schueler, A. Kitchell, 2005).** Contains detailed guidance on how to put together an effective plan to restore urban subwatersheds. The manual outlines a practical, step-by-step approach to develop, adopt and implement a subwatershed plan in your community. Within each step, the manual describes 32 different desktop analysis, field assessment, and stakeholder involvement methods used to make critical restoration management decisions.

**Manual 4: Urban Stream Repair Practices (T. Schueler, K. Brown, 2004).** Concentrates on practices used to enhance the appearance, stability, structure, or function of urban streams. Presents three broad approaches to urban stream repair - stream cleanups, simple repairs, and more sophisticated comprehensive repair applications. Outlines how to set appropriate restoration goals, how to choose the best combination of stream repair practices to meet the goals, and how to assess stream repair potential at the subwatershed level. Finally, the manual offers practical advice to help design, permit, construct and maintain stream repair practices in a series of more than 30 profile sheets.

**Manual 8: Pollution Source Control Practices (T. Schueler, C. Swann, T. Wright, S. Sprinkle, 2005).** Presents several methods to assess subwatershed pollution sources in order to develop and target education and/or enforcement efforts that can prevent or reduce polluting behaviors and operations. Manual 8 outlines more than 100 different "carrot" and "stick" options that can be used for this purpose. The manual also presents profile sheets that describe 21 specific stewardship practices for residential neighborhoods, and 15 pollution prevention techniques for control of storm water hotspots.