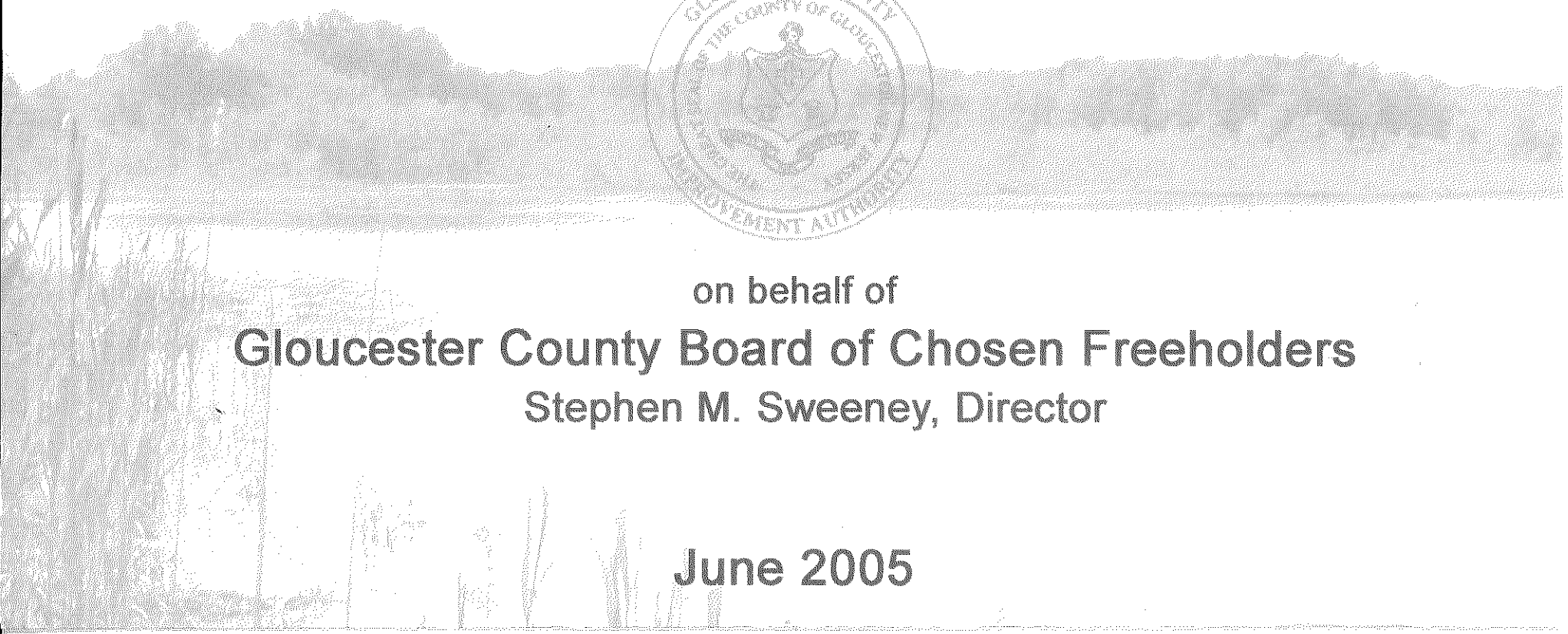
Gloucester County Highway Department Stormwater Management Program

prepared for

Gloucester County Improvement Authority



on behalf of

Gloucester County Board of Chosen Freeholders

Stephen M. Sweeney, Director

June 2005

General Permit

Highway Agency Stormwater General Permit
(NJ0141887)
Major Modification
Effective Date of Permit Modification: September 1, 2005

PART I
NARRATIVE REQUIREMENTS:

A. Authorization Under this Permit

1. Permit Area

a. This permit applies to all areas of the State of New Jersey.

2. Eligibility

a. This permit may authorize all new and existing stormwater discharges to surface water and groundwater from small municipal separate storm sewer systems (MS4s) at highways or other thoroughfares owned or operated by a Highway Agency (Highway Agency) under N.J.A.C. 7:14A-25.2(a)3 except as provided in A.5 below.

b. A "Highway Agency" is a county, State, interstate, or Federal agency that operates a small MS4 at a highway or other thoroughfare (including a maintenance or service facility or rest area for such a thoroughfare). For purposes of N.J.A.C. 7:14A-25 and this permit, a "highway or other thoroughfare" does not include:

i. Any thoroughfare confined to the grounds of a single building, or of two or more buildings that are not a "public complex" pursuant to N.J.A.C. 7:14A-25.2(a)2 (unless that building(s) is a maintenance or service facility for a highway or other thoroughfare not confined to such grounds);

ii. Any thoroughfare confined to the grounds of a "public complex" (each such thoroughfare is instead part of the "public complex"); or

iii. Any thoroughfare (other than the Palisades Interstate Parkway) confined to an officially designated park, forest, recreational area, natural area, wildlife management area, or set aside for water supply protection.

c. On a case-by-case basis, the Department may use this permit to authorize new and existing stormwater discharges to surface water and groundwater from municipal separate storm sewers owned or operated by a county, State, interstate, or Federal agency at a thoroughfare identified under b.iii above, or by an agency (other than a county, State, interstate, or Federal agency) at a thoroughfare not identified under b.i or b.ii above. As used in this permit, the term "Highway Agency" includes such agencies, and the term "small MS4" includes such municipal separate storm sewers, pursuant to this provision of this permit. This provision does not apply to:

i. Any municipal separate storm sewer that is owned or operated by a municipality that is assigned to Tier A under N.J.A.C. 7:14A-25.3(a)1; or

ii. Any municipal separate storm sewer that is owned or operated by a municipality that is assigned to Tier B under N.J.A.C. 7:14A-25.3(a)2, unless the stormwater discharge from that sewer is identified under N.J.A.C. 7:14A-25.2(a)4 (special designations) but the Department does not determine that such identification warrants assignment of the municipality to Tier A under N.J.A.C. 7:14A-25.3(a)1v.

d. After the Effective Date of Permit Authorization (EDPA), the permit authorizes the following new and existing non-stormwater discharges from small MS4s owned or operated by Highway Agencies:

i. Water line flushing and discharges from potable water sources

ii. Uncontaminated ground water (e.g., infiltration, crawl space or basement sump pumps, foundation or footing drains, rising ground waters)

iii. Air conditioning condensate (excluding contact and non-contact cooling water)

iv. Irrigation water (including landscape and lawn watering runoff)

v. Flows from springs, riparian habitats and wetlands, water reservoir discharges and diverted stream flows

vi. Residential car washing water, and residential swimming pool discharges

vii. Sidewalk, driveway and street wash water

viii. Flows from fire fighting activities including the washing of fire fighting vehicles

ix. Vehicle and equipment washwater from maintenance yard operations pursuant to Part I, Section F.8.e of the permit

x. Flows from rinsing of the following equipment with clean water:

- Beach maintenance equipment immediately following their use for their intended purposes; and
- Equipment used in the application of salt and de-icing materials immediately following salt and de-icing material applications. Prior to rinsing with clean water, all residual salt and de-icing materials must be removed from equipment and vehicles to the maximum extent practicable using dry cleaning methods (e.g., shoveling and sweeping). Recovered materials are to be returned to storage for reuse or properly discarded.

Rinsing of equipment in the above situations is limited to exterior, undercarriage, and exposed parts and does not apply to engines or other enclosed machinery.

e. If any of the discharges listed in 2.d above are identified by the Highway Agency as a significant contributor of pollutants to or from the MS4, the Highway Agency must address the discharge as an illicit connection or as an improper disposal of waste as specified in Part I, Section F of this permit.

3. Authorization

a. In order to obtain authorization under this permit (except for automatic renewal of authorization under A.4 below) a complete Request for Authorization (RFA) shall be submitted in accordance with the requirements of this permit. Upon review of the RFA, the Department may, in accordance with N.J.A.C. 7:14A-6.13, either:

i. Issue notification of authorization under this permit, in which case, authorization is deemed effective the first day of the following month of the date of the notification of authorization;

ii. Deny authorization under this permit and require submittal of an application for an individual permit; or

iii. Deny authorization under this permit and require submittal of an RFA for another general permit.

b. For discharges from a small MS4 authorized by this permit, the Highway Agency is exempt from N.J.A.C. 7:14A-6.2(a)2. This exemption means that the discharge of any pollutant not specifically regulated in the NJPDES permit or listed and quantified in the NJPDES application or RFA shall not constitute a violation of the permit.

c. Authorization under this permit shall cease to be effective under N.J.A.C. 7:14A-6.13(f), (h), (j) and (o), where applicable.

4. Automatic Renewal of Authorization

a. Authorization under this permit will be automatically renewed when this general permit is reissued as provided by N.J.A.C. 7:14A-6.13(d)9 and 25.4(a)3 so long as the discharge authorized under the general permit continues to be eligible. The Department shall issue a notice of renewed authorization to the Highway Agency.

b. If the Highway Agency is aware of any information in the most recently submitted RFA that is no longer true, accurate, and/or complete, the Highway Agency shall provide the correct information to the Department within 90 days of the effective renewal authorization notice.

5. Stormwater Discharges Not Authorized

a. This permit does not authorize "stormwater discharge associated with industrial activity" as defined in N.J.A.C. 7:14A-1.2. Types of facilities that a Highway Agency may operate and that are considered to be engaging in "industrial activity" include but are not limited to certain landfills and recycling facilities, certain transportation facilities (including certain local passenger transit and air transportation facilities), certain facilities handling domestic sewage or sewage sludge, steam electric power generating facilities, and construction activity that disturbs five acres or more (see N.J.A.C. 7:14A-1.2 for the full definition of "stormwater discharge associated with industrial activity"). Any Highway Agency that operates an industrial facility with such a discharge must submit a separate request for authorization (RFA) or individual permit

application for that discharge. An RFA submitted for the Highway Agency Stormwater General Permit does not qualify as an RFA for such a discharge.

i. Deadlines to apply for a NJPDES permit for "stormwater discharge associated with industrial activity" are set forth in N.J.A.C. 7:14A-24.4(a)1. If such a discharge is from a facility (other than an airport, powerplant, or uncontrolled sanitary landfill) that is owned or operated by a Highway Agency with a population of less than 100,000, the Highway Agency shall submit the RFA or individual permit application by March 3, 2004. If such a discharge is from any other industrial facility, N.J.A.C. 7:14A-24.4(a)1 specifies earlier deadlines to apply.

b. This permit does not authorize "stormwater discharge associated with small construction activity" as defined in N.J.A.C. 7:14A-1.2. In general, this is the discharge to surface water of stormwater from construction activity that disturbs at least one but less than five acres (see N.J.A.C. 7:14A-1.2 for the full definition). Any Highway Agency that operates a construction site with such a discharge must submit a separate RFA or individual permit application for that discharge. An RFA submitted for the Highway Agency Stormwater General Permit does not qualify as an RFA for such a discharge.

c. This permit does not authorize any stormwater discharge that is authorized under another NJPDES permit. A Highway Agency does not have to implement measures contained in this NJPDES permit for stormwater discharges at facilities owned or operated by that Highway Agency that are regulated under a separate NJPDES stormwater permit authorizing those discharges.

d. This permit does not authorize stormwater discharges from projects or activities that conflict with an adopted areawide or Statewide WQM plan.

B. Requests for Authorization Requirements

1. Deadline for Requesting Authorization for an Existing Discharge

a. An RFA for the existing discharges from the small MS4 owned or operated by a Highway Agency must be submitted to the Department on or before March 3, 2004, except as provided below.

i. The Department may, in its discretion, accept an RFA submitted after the foregoing deadline; however, the Highway Agency may still be held liable for violating the deadline to apply in accordance with N.J.A.C. 7:14A-25.4 and for discharging pollutants without a valid NJPDES permit in accordance with N.J.A.C. 7:14A-2.1(d).

2. Deadline for Requesting Authorization for a New Discharge

a. An RFA for discharges from a new small MS4 owned or operated by a Highway Agency must be submitted to the Department at least ninety (90) days prior to the operation of the new MS4 system.

i. A Highway Agency that already has authorization to discharge from a small MS4 under the Highway Agency Stormwater General Permit does not need to submit an additional RFA for the expansion of an existing small MS4.

ii. A new small MS4 is a small MS4 that did not exist on March 3, 2004 and results in a new discharge to surface or ground waters of the State.

3. Requesting Authorization

a. A separate RFA shall be submitted by each Highway Agency applying for authorization under this permit.

i. A single RFA may be submitted for the stormwater discharge from an entire small MS4 owned and operated by a Highway Agency, or the Highway Agency may divide the small MS4 into smaller regions and submit a separate RFA for each of these smaller regions.

ii. The Department may choose to issue single or multiple authorizations under this permit to a Highway Agency regardless of whether the Highway Agency submitted a single or multiple RFAs.

4. Contents of the Request for Authorization

a. A completed RFA shall include all of the following information regarding the Highway Agency and shall be completed using the Department's RFA form:

i. The name of the Highway Agency that operates the small MS4, and the address of the main Highway Agency office (or other appropriate office if the RFA is for a smaller region).

ii. The name and mailing address of the Stormwater Program Coordinator of the Highway Agency who will submit any reports or certifications required by the permit and to whom the Department shall send all correspondence concerning the permit.

iii. A certification acknowledging the best management practices and measurable goals specified in the permit.

iv. A list of the locations of any maintenance facilities, service areas, or rest stops on property owned or operated by the Highway Agency.

v. If the RFA is for a smaller region, a map identifying the region.

vi. A list of other NJPDES Stormwater Permits held by the Highway Agency.

vii. Additional information may be required by the Department to be included as part of the RFA if the Department determines that such additional information (including other data, reports, specifications, plans, permits, or other information) is reasonably necessary to determine whether to authorize the discharge under this permit.

5. Where to Submit

a. A completed and signed RFA shall be submitted to the Department at the address specified on the Department's RFA form.

C. Definitions

1. The following definitions apply to this permit.

a. "Catch Basin" means a cistern, vault, chamber or well that is usually built along a street as part of the storm sewer system.

b. "EDPA" means Effective Date of Permit Authorization.

c. "Illicit connection" means any physical or non-physical connection that discharges the following to a municipal separate storm sewer system, unless that discharge is authorized under a NJPDES permit other than the NJPDES permit for discharges from that system (non-physical connections may include, but are not limited to, leaks, flows, or overflows into the municipal separate storm sewer system):

i. Domestic sewage;

ii. Non-contact cooling water, process wastewater, or other industrial waste (other than stormwater); or

iii. Any category of non-stormwater discharges that a Highway Agency for the MS4 identifies as a source or significant contributor of pollutants pursuant to 40 C.F.R. 122.34(b)(3)(iii).

d. "MS4" means a municipal separate storm sewer system.

e. "Municipal separate storm sewer" means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains):

i. Owned or operated by the United States, an interstate agency, a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe organization, or a designated and approved management agency under section 208 of the CWA that discharges to surface water or groundwater;

ii. Designed and used for collecting or conveying stormwater;

iii. Which is not a combined sewer;

iv. Which is not part of a POTW; and

v. Which is not either of the following:

- A separate storm sewer(s) that is at an industrial facility, and that collects or conveys stormwater discharges associated with industrial activity that occurs at that facility; or

- A separate storm sewer(s) that is at a construction site, and that collects or conveys stormwater discharges associated with small construction activity that occurs at that site.

f. "Small municipal separate storm sewer system" or "small MS4" means all municipal separate storm sewers (other than "large" or "medium" municipal separate storm sewer systems as defined in N.J.A.C. 7:14A-1.2) that are:

i. Owned or operated by municipalities described under N.J.A.C. 7:14A-25.1(b);

ii. Owned or operated by county, State, interstate, or Federal agencies, and located at public complexes as described under N.J.A.C. 7:14A-25.2(a)2;

iii. Owned or operated by county, State, interstate, or Federal agencies, and located at highways and other thoroughfares as described under N.J.A.C. 7:14A-25.2(a)3; or

iv. Owned or operated by county, State, interstate, Federal or other agencies, and receive special designation under N.J.A.C. 7:14A-25.2(a)4.

g. "Solid and floatable materials" means sediment, debris, trash, and other floating, suspended, or settleable solids.

h. "Stormwater" means water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, is captured by separate storm sewers or other sewerage or drainage facilities, or is conveyed by snow removal equipment.

D. Special Conditions

1. Sharing of Responsibilities

a. A Highway Agency may rely on another governmental, private, or nonprofit entity (for example, a watershed association) to satisfy the Highway Agency's NJPDES permit obligations to implement one or more control measures (or components(s) thereof) pursuant to N.J.A.C. 7:14A-25.7(a) if:

i. The other entity, in fact, implements the measure(s), or component(s) thereof;

ii. The particular measure(s), or component(s) thereof, is at least as stringent as the corresponding NJPDES permit requirement;

iii. The other entity agrees in writing (or is required by law) to implement the measure(s), or component(s) thereof, on the Highway Agency's behalf. The Highway Agency is responsible for compliance with this permit if the other entity fails to implement the measure(s), or component(s) thereof. In the annual reports the Highway Agency must submit under Part I, Section H.3, the Highway Agency shall specify that it is relying on another entity to satisfy some of the Highway Agency's NJPDES permit obligations.

iv. If the Highway Agency is relying on another entity regulated under the NJPDES permit program to satisfy all of that Highway Agency's NJPDES permit obligations, including that Highway Agency's obligation to file these annual reports, the Highway Agency shall notify the Department of this reliance in writing, and shall also note this reliance in the Highway Agency's SPPP.

E. Stormwater Program and Stormwater Pollution Prevention Plan

1. Stormwater Program

a. Highway Agencies are required to develop, implement, and enforce a stormwater program. This program shall be designed to reduce the discharge of pollutants from the

Highway Agency's small MS4 to the maximum extent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the Federal Act and the State Act by including the Statewide Basic Requirements (SBRs) set forth in Part I, Section F and any Additional Measures (AMs) required under Part I, Section G below. At the Highway Agency's discretion, the stormwater program may also include Optional Measures (OMs) also in accordance with Part I, Section G below.

2. Stormwater Pollution Prevention Plan (SPPP)

a. A Highway Agency shall prepare and implement a written Stormwater Pollution Prevention Plan (SPPP) that describes the Highway Agency's stormwater program and serves as the mechanism for the implementation of the Statewide Basic Requirements. The SPPP must address stormwater quality issues related to new development, redevelopment and existing development at the Highway Agency's small MS4. The SPPP shall be prepared and implemented in accordance with the deadlines specified in Part I, Section H. The SPPP shall include, at a minimum, all of the information and items identified in Attachment A.

i. The SPPP shall be signed, dated and retained by the Stormwater Program Coordinator of the Highway Agency.

b. For any projects or activities which the Highway Agency contracts out to private contractors after the EDPA, the awarded contract must require the contractor to conduct projects or activities in a manner that complies with the Highway Agency's SPPP and this permit's conditions. The Highway Agency is responsible for any violations of this permit resulting from a contractor's noncompliance.

c. SPPPs may be amended so long as they continue to meet the requirements of this permit. Any amended SPPPs shall be signed, dated, implemented, retained, and otherwise treated in the same manner as the original SPPP. The Highway Agency shall retain each previous SPPP for a period of at least five years from the date of that previous SPPP. This period may be extended by written request of the Department at any time.

F. Statewide Basic Requirements (SBRs)

1. Stormwater quality issues related to new development, redevelopment and existing development at the Highway Agency's small MS4 are to be addressed through the implementation of the following Statewide Basic Requirements (SBRs). The permit specifies the BMPs that will be implemented for those SBRs. These SBRs and related BMPs are to be detailed in the Highway Agency's SPPP.

a. Additional information is provided and each of the SBRs and related BMPs are described in more detail in the Department's Highway Agency Stormwater Permit Guidance Document.

2. Public Notice

a. Minimum Standard - Highway Agencies shall comply with applicable State and local public notice requirements when providing for public participation in the development and implementation of the Highway Agency's stormwater program.

b. Measurable Goal - Highway Agencies shall certify annually that all applicable State and local public notice requirements were followed.

c. Implementation – Upon the effective date of permit authorization (EDPA).

3. Post-Construction Stormwater Management in New Development and Redevelopment

a. Minimum Standard - To prevent or minimize water quality impacts, the Highway Agency shall develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment projects on property owned or operated by the Highway Agency that disturb one acre or more, including projects less than one acre that are part of a larger common plan of development or sale, that discharge into the Highway Agency's small MS4. The Highway Agency shall in its post-construction program:

i. Comply with the applicable design and performance standards established under N.J.A.C. 7:8 for major development, unless:

- Those standards do not apply because of a variance or exemption granted under N.J.A.C. 7:8; or
- Alternative standards are applicable under an areawide or Statewide Water Quality Management Plan adopted in accordance with N.J.A.C. 7:15.

ii. Ensure adequate long-term operation and maintenance of BMPs.

iii. Comply with standards set forth in Attachment C of the permit to control passage of solid and floatable materials through storm drain inlets.

iv. Projects that do not require any Department permits (the term "permit", in this case, shall include transition area waivers under the Freshwater Wetlands Protection Act) under the Flood Hazard Area Control Act (N.J.S.A. 58:16A-50 et seq.), Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et seq.), Coastal Area Facility Review Act (N.J.S.A.:19-1 et seq.), or Waterfront and Harbor Facilities Act (N.J.S.A. 12:5-3) are not considered "new development or redevelopment projects" if construction began prior to the implementation deadline for this SBR, or if the projects went to bid or had right-of-way authorization prior to the date on which the permittee received authorization under this permit.

b. Measurable Goal – Highway Agencies shall certify annually that they have developed, implemented, and are actively enforcing a program to address stormwater runoff from new development and redevelopment projects in accordance with the minimum standard.

c. Implementation

i. Upon the effective date of permit authorization, Highway Agencies shall ensure adequate long-term operation and maintenance of BMPs on property owned or operated by the Highway Agency.

ii. Within 12 months from the effective date of permit authorization, Highway Agencies shall:

- Comply with the standards set forth in Attachment C of the permit to control passage of solid and floatable materials through storm drainage inlets for storm drain inlets the Highway Agency installs within the Highway Agency's small MS4.
- Adopt and implement applicable design and performance standards established under N.J.A.C. 7:8 for major development at the Highway Agency pursuant to 3.a.i. above.

4. Local Public Education

a. Local Public Education Program

i. Minimum Standard –The Local Public Education Program shall describe how the Highway Agency will distribute educational information to appropriate users and employees of the Highway Agency to satisfy this minimum standard. The following SBR topics shall be included in the Local Public Education Program: Storm Drain Labeling, Pet Waste Control, Improper Waste Disposal Control and Wildlife Feeding Control.

To satisfy the requirement to distribute educational material, Highway Agencies shall provide information material in any form (e.g., calendars, brochures, signs, sheets, booklets) by locating this material at rest areas and service areas located along the Highway Agency's small MS4.

ii. Measurable Goal - Highway Agencies shall certify annually that they have met the Local Public Education Program minimum standard.

iii. Implementation - Within 12 months from the effective date of permit authorization, Highway Agencies shall comply with the Local Public Education Program minimum standard.

b. Storm Drain Inlet Labeling

i. Minimum Standard - Highway Agencies shall establish a storm drain inlet labeling program and label all storm drain inlets located at rest areas, service areas, maintenance facilities, and storm drain inlets along streets with sidewalks within the Highway Agency's small MS4. The program shall establish a schedule for labeling, develop a long term maintenance plan, and when possible, coordinate efforts with watershed groups and volunteer organizations.

ii. Measurable Goal - Highway Agencies shall certify annually that a storm drain inlet labeling program has been developed or is being implemented, and shall identify the number of storm drain inlets labeled within the year.

iii. Implementation - Within 12 months from the effective date of permit authorization, Highway Agencies shall develop a labeling program for the storm drain inlets identified in the minimum standard. Highway Agencies must either:

- Label a minimum of 50% of the storm drain inlets within 36 months from the EDPA; and label all remaining storm drain inlets on or before 60 months from EDPA; or

- Divide the Highway Agency's small MS4 into two sectors for the purposes of storm drain inlet labeling and include a map of the two sectors in the SPPP. Label the storm drain inlets in one sector within 36 months from the EDPA; and label all remaining storm drain inlets on or before 60 months from EDPA.

5. Improper Disposal of Waste

a. Pet Waste Control

i. Minimum Standard - Highway Agencies shall, to the extent allowable under law, adopt and enforce an appropriate regulatory mechanism that requires pet owners or their keepers to immediately and properly dispose of their pet's solid waste deposited at rest areas and service areas within the Highway Agency's small MS4.

ii. Measurable Goal - Highway Agencies shall certify annually that they have met the Pet Waste Control minimum standard.

iii. Implementation - Within 18 months from the effective date of permit authorization, Highway Agencies shall have fully implemented the Pet Waste Control minimum standard.

b. Litter Pick Up Program

i. Minimum Standard - Highway Agencies shall develop and implement a litter pick up program that includes roadside clean up of trash and debris and regular collection of refuse from litter receptacles owned and operated by the Highway Agency including those located at rest areas and service areas. Highway Agencies shall maintain records of roadside clean ups and estimates of the total amount of trash and debris collected.

ii. Measurable Goal - Highway Agencies shall certify annually that they have met the Litter Pick Up Program Control minimum standard and shall report dates of roadside clean ups and estimates of trash and debris collected.

iii. Implementation - Within 12 months from the effective date of permit authorization, Highway Agencies shall have developed and begin implementing the Litter Pick Up Program minimum standard.

c. Improper Waste Disposal Control

i. Minimum Standard - Highway Agencies shall, to the extent allowable under law, adopt and enforce an appropriate regulatory mechanism prohibiting the Highway Agency and its employees from the improper spilling, dumping, or disposal of materials other than stormwater into the Highway Agency's small MS4 (excluding those authorized in Part I, Section A.2.d). If the Highway Agency observes anyone else engaging in the improper spilling, dumping, or disposal of materials other than stormwater, the Highway Agency shall report the incident to the Department's Action Hotline (877-927-6337).

ii. Measurable Goal - Highway Agencies shall certify annually that they have met the Improper Waste Disposal Control minimum standard.

iii. Implementation - Within 18 months from the effective date of permit authorization, Highway Agencies shall have fully implemented the Improper Waste Disposal Control minimum standard.

d. Wildlife Feeding Control

i. Minimum Standard - Highway Agencies shall, to the extent allowable under law, adopt and enforce an appropriate regulatory mechanism that prohibits the feeding on any property owned or operated by the Highway Agency of any wildlife (excluding confined animals, for example, wildlife confined in zoos, parks, or rehabilitation centers or unconfined wildlife at environmental education centersor feral cats as part of an approved Trap-Neuter-Release (TNR) program.)

ii. Measurable Goal - Highway Agencies shall certify annually that they have met the Wildlife Feeding Control minimum standard.

iii. Implementation - Within 18 months from the effective date of permit authorization, Highway Agencies shall have fully implemented the Wildlife Feeding Control minimum standard.

6. Illicit Connection Elimination and MS4 Outfall Pipe Mapping

a. Minimum Standard

i. Storm Sewer Outfall Pipe Mapping – Highway Agencies must develop a map showing the location of the end of all MS4 outfall pipes that are operated by the Highway Agency, and that discharge from the Highway Agency's small MS4 into a surface water body (e.g., a lake, ocean, or stream including an intermittent stream). This map shall also show the location (and name, where known to the Highway Agency) of all surface water bodies receiving discharges from those outfall pipes. Each outfall pipe mapped shall be given an individual alphanumeric identifier, which shall be noted on the map. The outfall pipes shall be mapped on either a tax map prepared in accordance with Title 18, Chapter 23A of the New Jersey Administrative Code or on another map drawn to equal or larger (more detailed) scale. The Highway Agency shall submit a copy of its outfall pipe map to the Department upon request.

ii. Prohibiting Illicit Connections - Each Highway Agency shall, to the extent allowable under law, effectively prohibit through an appropriate regulatory mechanism, illicit connections to the Highway Agency's small MS4, and implement appropriate enforcement procedures and actions.

iii. Illicit Connection Elimination Program - Each Highway Agency must develop and implement a program to detect and eliminate their illicit connections into the Highway Agency's small MS4. The program, at minimum, must include an initial physical inspection of all its outfall pipes. All outfall pipes that are found to have dry weather flow are to be further investigated.

The inspections of outfall pipes and investigations of dry weather flows are to be conducted in accordance with the procedures for detecting, investigating, and eliminating illicit connections contained in Attachment B of the permit. Results of the inspections of outfall pipes and dry weather flows are to be recorded on

the Department's Illicit Connection Inspection Report form contained in the Department's "Highway Agency General Permit Guidance Document". Inspection reports for dry weather flows discovered as a result of initial physical inspections or as part of the ongoing program must be submitted to the Department with the annual certification. If the dry weather flow is intermittent, the Highway Agency must perform, at minimum, three (3) additional investigations in an attempt to locate the illicit connection. If an illicit connection cannot be located or is found to emanate from an entity other than the Highway Agency then the Highway Agency must submit to the Department a written explanation detailing the results of the investigation. If the illicit connection is found to be from another public entity, the Highway Agency shall also notify that entity. All illicit connections found that result from the Highway Agency's own illicit connections must be eliminated within six (6) months of the discovery.

After the completion of the initial physical inspection of all outfall pipes, Highway Agencies must maintain an ongoing program to detect and eliminate illicit connections. The ongoing program will respond to complaints and reports of illicit connections, including complaints and reports from operating entities of interconnected small MS4s, and continue to investigate dry weather flows discovered during routine inspections and maintenance of the small MS4.

b. Measurable Goal

i. Highway Agencies shall certify annually that an outfall pipe map has been completed or is being prepared in accordance with permit conditions and shall report the number of outfall pipes mapped within the year being reported and the total number of outfall pipes mapped to date.

ii. Highway Agencies shall submit an annual certification to the Department certifying that an appropriate regulatory mechanism is in place prohibiting illicit connections and is being actively enforced.

iii. Highway Agencies shall certify annually that an illicit connection elimination program has been developed in accordance with permit conditions to detect and eliminate illicit connections into the Highway Agencies' small MS4. Annual certifications shall also include the number of outfalls physically inspected, the number of outfalls found to have dry weather flow, the number of illicit connections found and the number of illicit connections eliminated. Copies of inspection reports shall be submitted with the annual certification for those outfalls found to have dry weather flow.

c. Implementation

i. Storm Sewer Outfall Pipe Mapping – Highway Agencies shall divide the Highway Agency's small MS4 into two (2) sectors for the purposes of outfall mapping. A diagram of the Highway Agency showing the two (2) sectors shall be part of the Highway Agency's SPPP. Highway Agencies shall map the location of the end of small MS4 outfall pipes in one sector 36 months from the

EDPA; and map the location of the end of all small MS4 outfall pipes on or before 60 months from the EDPA.

ii. Prohibiting Illicit Connections - Within 18 months from the effective date of permit authorization, Highway Agencies shall effectively prohibit through an appropriate regulatory mechanism, illicit connections in accordance with the minimum standard.

iii. Illicit Connection Elimination Program - Within 18 months from the effective date of permit authorization, Highway Agencies shall have developed and begun implementing a program to detect and eliminate illicit connections in accordance with the minimum standard. Highway Agencies shall perform an initial physical inspection of all outfall pipes using the Department's Illicit Connection Inspection Report form within 60 months from the EDPA.

7. Solids and Floatable Controls

a. Street Sweeping

i. Minimum Standard –

(For County Agencies Only) County Highway Agencies shall sweep, at a minimum of once per month (weather and street conditions permitting) all streets (including roads or highways) that meet all of the following criteria:
- the street is owned or operated by the County Agency;
- the street is curbed and has storm drains;
- the street has a posted speed limit of 35 mph or less;
- the street is not an entrance or exit ramp; and
- the street is in a predominantly commercial area.

Highway Agencies other than County Highway Agencies shall sweep at a minimum of once per quarter (weather and street conditions permitting) all streets (including roads or higways) that meet all of the following criteria:
- the street is owned or operated by the Highway Agency;
- the street is curbed and has storm drains;
- the street has a posted speed limit of 35 mph or less;
- the street is not an entrance or exit ramp; and
- the street is in a predominantly commercial area.

All remaining streets (including roads or highways) that they own or operate shall be swept at a minimum of once every 2 years.

ii. Measurable Goal - Highway Agencies shall certify annually that they have met the Street Sweeping minimum standard. Highway Agencies must maintain records including the date and areas swept, number of miles of streets swept and the total amount of materials collected. Information shall be reported to the Department in the annual report and certification.

iii. Implementation - Within 12 months of effective date of permit authorization Highway Agencies shall have developed and begun implementing a street sweeping program that meets the minimum standard above.

b. Storm Drain Inlets

i. Minimum Standard - Retrofitting of existing storm drain inlets to meet the standard contained in Attachment C of the permit is required where such inlets are in direct contact with repaving, repairing (excluding repair of individual potholes), reconstruction or alterations of facilities owned or operated by the Highway Agency. For exemptions to this standard, refer to "Exemptions" in Attachment C.

ii. Measurable Goal – Highway Agencies shall certify annually that such storm drain inlets have been retrofitted to meet the minimum standard contained in Attachment C, unless otherwise exempted.

iii. Implementation - Within 12 months of effective date of permit authorization and thereafter, Highway Agencies shall retrofit all such storm drain inlets in accordance with the Storm Drain Inlets minimum standard.

c. Stormwater Facility Maintenance

i. Minimum Standard - Highway Agencies shall develop and implement a stormwater facility maintenance program for cleaning and maintenance of all stormwater facilities operated by the Highway Agency. Stormwater facilities include, but are not limited to: catch basins, detention basins, filter strips, riparian buffers, infiltration trenches, sand filters, constructed wetlands, wet ponds, bioretention systems, low flow bypasses, and stormwater conveyances. The stormwater facility maintenance must be performed as required to ensure the proper function and operation of the stormwater facility. Highway Agencies shall also clean all catch basins operated by the Highway Agency annually to remove accumulated sediment, trash and debris. If the Highway Agency is unable to clean all catch basins annually, the Highway Agency must provide, as part of their SPPP, a justification and detailed schedule for less frequent cleaning.

ii. Measurable Goal - Highway Agencies shall certify annually that all stormwater facilities are properly functioning and that all catch basins have been cleaned in accordance with the minimum standard. If stormwater facilities were found not to be functioning properly and repairs were not made, a schedule for such repairs shall be included in the annual report and certification. Highway Agencies shall also maintain records of inspections, maintenance and repairs that were performed which shall be reported in the annual report and certification.

iii. Implementation - Within 12 months from the effective date of permit authorization, Highway Agencies shall have developed and begun implementing a stormwater facility maintenance program in accordance with the minimum standard.

d. Road Erosion Control Maintenance

i. Minimum Standard - Highway Agencies shall develop a roadside erosion control maintenance program to identify and repair erosion along streets (including roads or highways) operated by the Highway Agency. Highway Agencies are also required to regularly inspect and maintain the stability of

shoulders, embankments, ditches and soils along these streets to ensure that they are not eroding and contributing to sedimentation of receiving waters. Repairs shall be made in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey, N.J.A.C. 2:90-1 (or N.J.A.C. 16:25A where NJDOT is the Highway Agency).

ii. Measurable Goal - Highway Agencies shall certify annually that they have developed and are implementing a Roadside Erosion Control Maintenance program. The certification shall also indicate the locations of all problem areas corrected and any maintenance done during that year. The dates of all inspections and employee training sessions shall also be reported in the annual report and certification.

iii. Implementation - Within 18 months from the effective date of permit authorization, Highway Agencies shall have developed and begun implementing a roadside erosion control maintenance program in accordance with the minimum standard.

e. Outfall Pipe Stream Scouring Remediation

i. Minimum Standard - Highway Agencies shall develop and implement a stormwater outfall pipe scouring detection, remediation and maintenance program to detect and control localized stream and stream bank scouring in the vicinity of outfall pipes operated by the Highway Agency. This program shall identify all areas where localized stream and bank scouring occurs as a result of stormwater discharges from the Highway Agency's MS4. These areas shall then be prioritized and repairs shall be scheduled and completed. Repairs shall be made in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90-1 (e.g., Conduit Outlet Protection 12-1), or N.J.A.C. 16:25A where NJDOT is the Highway Agency.

ii. Measurable Goal - Highway Agencies shall certify annually that they have met the Outfall Pipe Stream Scouring Remediation minimum standard. In addition, the Highway Agency shall list the location of outfall scouring identified, the dates control measures are to begin, and the dates any control measures were completed.

iii. Implementation - Within 18 months of the effective date of permit authorization, Highway Agencies shall have developed and begun implementing an outfall pipe stream scouring detection, remediation and maintenance program. This program shall identify and prioritize all stormwater outfall pipes needing repairs, and then schedule and complete the repairs.

f. Roadside Vegetation Management

i. Minimum Standard - Highway agencies must develop a Roadside Vegetation Management Program that limits the application of herbicides and restricts the methods by which mulch is applied. Highway Agencies shall only apply herbicides in a 2 foot radius around structures where it is not practical to mow (such as around guardrails, signposts, telephone poles, etc.). If mulch is applied, it shall be stabilized in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey N.J.A.C. 2:90-1 (or N.J.A.C. 16:25A

where NJDOT is the Highway Agency) to prevent it from being washed away with stormwater into the waters of the State.

ii. Measurable Goal – Highway Agencies shall certify annually that they have met the Roadside Vegetation Management minimum standard.

iii. Implementation - Within 12 months of the effective date of permit authorization, Highway Agencies shall have developed and begun implementing the Roadside Vegetation Management minimum standard.

8. Maintenance Yard Operations (including Maintenance Activities at Service Areas, and Ancillary Operations)

a. De-icing Material Storage

i. Minimum Standard - Highway Agencies must construct a permanent structure (a permanent building or permanent structure that is anchored to a permanent foundation with a impermeable floor, and that is completely roofed and walled) for the storage of salt, and other de-icing materials, if applicable. Once completed, Highway Agencies shall perform regular maintenance and inspections of the permanent structure. Seasonal tarping shall be used as an interim BMP until the permanent structure is completed. Sand may be stored outside and uncovered if a 50-foot setback is maintained from storm sewer inlets, ditches or other stormwater conveyance channels, and surface water bodies.

ii. Measurable Goal - Highway Agencies shall certify annually that they have met the De-icing Material Storage minimum standard.

iii. Implementation - Within 12 months from the effective date of permit authorization, Highway Agencies shall implement the interim seasonal tarping BMP. Within 12 months of the effective date of permit authorization, Highway Agencies will comply with the 50-foot buffer requirement for the outside storage of sand. Within 36 months from the effective date of permit authorization Highway Agencies shall store all salt and de-icing materials in a permanent structure.

b. Fueling Operations

i. Minimum Standard - Highway Agencies must develop and implement standard operating procedures for vehicle fueling, and receiving of bulk fuel deliveries at maintenance yard operations. The standard operating procedures shall incorporate the required practices listed in Attachment D.

ii. Measurable Goal - Highway Agencies must certify annually that there is a vehicle fueling and bulk receiving standard operating procedures in place.

iii. Implementation - Within 12 months of the effective date of permit authorization, Highway Agencies shall have developed and begun implementing the required standard operating procedures for fueling operations.

c. Vehicle Maintenance

i. Minimum Standard - Highway Agencies shall develop and implement a standard operating procedure (SOP) for vehicle maintenance and repair activities that occur at maintenance yard operations, if applicable. The SOP shall include the required practices listed in Attachment D. The SOP shall include regular inspections of all maintenance areas and activities.

ii. Measurable Goal - Highway Agencies must certify annually that there is a vehicle maintenance standard operating procedure in place and that regular inspections and maintenance are being performed.

iii. Implementation - Within 12 months of the effective date of permit authorization, Highway Agencies shall have developed and begun implementing the required standard operating procedures for Vehicle Maintenance.

d. Good Housekeeping Practices

i. Minimum Standard - Highway Agencies must implement good housekeeping procedures for all materials or machinery listed in the Inventory Requirements for Maintenance Yard Operations prepared in accordance with Attachment D. These good housekeeping procedures include, but are not limited to, the required practices listed in Attachment D at maintenance yard operations (including maintenance activities at Service Areas, and ancillary operations).

ii. Measurable Goal - Highway Agencies must certify annually that they have met the Good Housekeeping Practices minimum standard.

iii. Implementation - Within 12 months of the effective date of permit authorization, Highway Agencies shall have developed and begun implementing the required standard operating procedures for Good Housekeeping Practices.

e. Equipment and Vehicle Washing

i. Minimum Standard - Highway Agencies must eliminate the unpermitted discharge of equipment and vehicle wash wastewater to the waters of the State from maintenance yard operations by either installing a vehicle wash reclaim system, capturing and hauling the wastewater for proper disposal, connecting to sanitary sewer (where applicable and approved by local authorities), ceasing the activity and/or applying for and obtaining a separate NJPDES permit.

ii. Measurable Goal - After implementation, Highway Agencies must certify annually that there is no unpermitted discharge from vehicle and equipment washing activities at their maintenance yard operations and describe the BMP option implemented at each of the locations where vehicle and equipment washing activities occur.

iii. Implementation – This permit authorizes existing discharges of equipment and vehicle wash water from maintenance yard operations until February 28, 2009. On or before February 28, 2009 Highway Agencies shall have a BMP option implemented and shall have no unpermitted discharge of equipment and vehicle wash wastewater to the waters of the State.

9. Employee Training

a. Minimum Standard - Highway Agencies shall develop and conduct an annual employee training program for appropriate employees and appropriate topics. At a minimum, annual employee training will include the following topics:

i. Waste Disposal Education –Training shall include how to respond to inquires regarding proper waste disposal.

ii. Control Measures – Training shall include an overview of the Pet Waste Control, Improper Waste Disposal Control, Wildlife Feeding Control, Illicit Connection Prohibition and Wildlife Feeding Control measures, their requirements, enforcement policy, and hazards associated with improper waste disposal.

iii. Roadside Vegetation Management – Training shall include herbicide and mulch application requirements.

iv. Illicit Connection Elimination and Outfall Pipe Mapping – Training shall include information regarding the hazards associated with illicit connections and details of the program including investigation techniques, physical observations, field sampling, and mapping procedures.

v. Street Sweeping – Training shall include sweeping schedules and record keeping requirements.

vi. Stormwater Facility Maintenance - Training shall include catch basin cleaning schedules and record keeping requirements.

vii. Road Erosion Control and Outfall Pipe Stream Scouring Remediation – Training shall include identifying road erosion and outfall pipe scouring and repairs.

viii. Maintenance Yard Operations (including Ancillary Operations) – Training shall include de-icing material storage, fueling, vehicle maintenance, equipment/vehicle washing and good housekeeping SOPs, if applicable.

ix. Construction Activity / Post-Construction Stormwater Management in New Development and Redevelopment – Training shall include information regarding the requirement to obtain a NJPDES construction activity stormwater permit (see Part I, Section A.5.a and A.5.b of this permit) and requirements for Post-Construction Stormwater Management in New Development and Redevelopment (See Part I, Section F.3 of this permit).

b. Measurable Goal - Highway Agencies must certify annually the date of the annual employee training.

c. Implementation – Training shall begin 12 months from the effective date of permit authorization.

10. Construction Site Stormwater Runoff Control

a. Pursuant to N.J.A.C. 7:14A-25.6(b)2 and 25.7(b), the Department is responsible for developing, implementing, and enforcing a NJPDES permit program to reduce pollutants in stormwater runoff to small MS4s from construction activities. The Highway Agency is not required to include this SBR in its stormwater program or discuss this SBR in its SPPP.

G. Additional Measures and Optional Measures

1. Additional Measures

a. Additional Measures (AMs) are non-numeric or numeric effluent limitations that are expressly required to be included in the stormwater program by an adopted areawide or Statewide Water Quality Management Plan (WQM plan). AMs may modify or be in addition to SBRs. AMs may be required by a TMDL approved or established by USEPA, a regional stormwater management plan, or other elements of adopted areawide or Statewide WQM plans.

b. The Department will provide written notice of the adoption of an AM to each Highway Agency whose stormwater program will be affected, and will list each adopted AM in the permit by making a minor modification to the permit. The AMs, other than numeric effluent limitations, will specify the BMPs that must be implemented and the measurable goals for each BMP. The AMs will also specify time periods for implementation.

2. Optional Measures

a. At the Highway Agency's discretion, the stormwater program may also include Optional Measures (OMs), which are BMPs that are not implemented for SBRs or AMs but that prevent or reduce the pollution of the waters of the State.

H. Deadlines and Certifications

1. Stormwater Pollution Prevention Plan

a. Within twelve (12) months from the effective date of permit authorization, the Highway Agency shall prepare an SPPP.

b. The SPPP shall include, at a minimum, all of the information and items identified in Attachment A. The SPPP shall be signed, dated, and retained by the Highway Agency.

2. Statewide Basic Requirements

a. Each SBR contained in Part I, Section F of the permit has a specific implementation schedule based on the effective date of permit authorization. Each SBR shall be implemented in accordance with that schedule. Highway Agencies shall certify in the Annual Report and Certification the status of the implementation of each SBR and the date implementation was completed, as appropriate.

i. The Department may grant a six-month extension to the deadlines contained in an implementation schedule for any of the SBRs if the Highway Agency submits a written request for such extension, at least 30 days prior to the deadline, establishing to the Department's satisfaction that the Federal, State and local permits and approvals necessary for the construction of best management

practices could not with due diligence be obtained within the time period set forth in Section F above. The written request shall be submitted to:

NJDEP
Division of Water Quality
Bureau of Nonpoint Pollution Control
Municipal Stormwater Regulation Program
P.O. Box 029
Trenton, NJ 08625-0029

3. Annual Report and Certification

a. Highway Agencies shall complete an Annual Report (on a form provided by the Department) summarizing the status of compliance with this permit including measurable goals and the status of the implementation of each SBR and BMP contained in Part I, Section F of the permit. This report shall include a certification that the Highway Agency is in compliance with its stormwater program, SPPP and this permit, except for any incidents of noncompliance. Any incidents of noncompliance with permit conditions shall be identified in the Annual Report and Certification. A copy of each Annual Report and Certification shall be kept at a central location and shall be made available to the Department for inspection.

i. If there are incidents of noncompliance, the report shall identify the steps being taken to remedy the noncompliance and to prevent such incidents from recurring.

ii. The Annual Report and Certification shall be signed and dated by the Highway Agency, and shall be maintained for a period of at least five years. This period may be extended by written request of the Department at any time.

b. The Annual Report and Certification shall be submitted to the Department pursuant to the following submittal schedule:

i. Submit an Annual Report and Certification: on or before July 1, 2005 and every 12 months thereafter.

I. Standard Conditions

1. The following general conditions are incorporated by reference. The Highway Agency is required to comply with the regulations, which were in effect as of March 3, 2004.

a. General Permits N.J.A.C. 7:14A-6.13
b. Penalties for Violations N.J.A.C. 7:14-8.1 et seq.
c. Incorporation by Reference N.J.A.C. 7:14A-2.3
d. Toxic Pollutants N.J.A.C. 7:14A-6.2(a)4i
e. Duty to Comply N.J.A.C. 7:14A-6.2(a)1 & 4
f. Duty to Mitigate N.J.A.C. 7:14A-6.2(a)5 & 11
g. Inspection and Entry N.J.A.C. 7:14A-2.11(e)
h. Enforcement Action N.J.A.C. 7:14A-2.9
i. Duty to Reapply N.J.A.C. 7:14A-4.2(e)3
j. Signatory Requirements for Applications and Reports N.J.A.C. 7:14A-4.9
k. Effect of Permit/Other Laws N.J.A.C. 7:14A-6.2(a)6 & 7 & 2.9(c)
l. Severability N.J.A.C. 7:14A-2.2

m. Administrative Continuation of Permits N.J.A.C. 7:14A-2.8
n. Permit Actions N.J.A.C. 7:14A-2.7(c)
o. Reopener Clause N.J.A.C. 7:14A-6.2(a)10, 16.4(b) & 25.7(b)
p. Permit Duration and Renewal N.J.A.C. 7:14A-2.7(a) & (b)
q. Consolidation of Permit Process N.J.A.C. 7:14A-15.5
r. Confidentiality N.J.A.C. 7:14A-18.2 & 2.11(g)
s. Fee Schedule N.J.A.C. 7:14A-3.1
t. UIC Corrective Action N.J.A.C. 7:14A-8.4
u. Additional Conditions Applicable to UIC Permits N.J.A.C. 7:14A-8.9
v. UIC Operating Criteria N.J.A.C. 7:14A-8.16

2. Operation And Maintenance

a. Need to Halt or Reduce not a Defense N.J.A.C. 7:14A-2.9(b)
b. Proper Operation and Maintenance N.J.A.C. 7:14A-6.12

3. Monitoring And Records

a. Monitoring N.J.A.C. 7:14A-6.5
b. Recordkeeping N.J.A.C. 7:14A-6.6
c. Signatory Requirements for Monitoring Reports N.J.A.C. 7:14A-6.9

4. Reporting Requirements

a. Planned Changes N.J.A.C. 7:14A-6.7
b. Reporting of Monitoring Results N.J.A.C. 7:14A-6.8
c. Noncompliance Reporting N.J.A.C. 7:14A-6.10 & 6.8(h)
d. Hotline/Two Hour & Twenty-four Hour Reporting N.J.A.C. 7:14A-6.10(c) & (d)
e. Written Reporting N.J.A.C. 7:14A-6.10(e) &(f) & 6.8(h)
f. Duty to Provide Information N.J.A.C. 7:14A-2.11, 6.2(a)14 & 18.1
g. Compliance Schedules N.J.A.C. 7:14A-6.4
h. Transfer N.J.A.C. 7:14A-6.2(a)8 & 16.2

5. Copies of the NJPDES rules may be purchased by contacting West Group, St. Paul, Minnesota, 1-800-808-WEST.

J. Additional Conditions

1. Agency and Public Review

a. The Highway Agency shall make the SPPP available upon request to an authorized representative of the Department and to the owner of and operating entity for any municipal separate storm sewer system that receives discharges from the Highway Agency's small MS4.

b. Upon review by an authorized representative, the Department may notify the Highway Agency at any time that the SPPP does not meet one or more of the minimum requirements. Within 30 days after receiving such notification (unless otherwise specified by the Department), the SPPP shall be amended to adequately address all deficiencies, and written certification of such amendments shall be submitted to the Department.

c. Highway Agencies shall make records required by this permit, including its SPPP, available to the public at reasonable times during regular business hours (see N.J.A.C. 7:14A-18 for confidentiality provisions).

2. Other Laws

a. In accordance with N.J.A.C. 7:14A-6.2(a)7, this permit does not authorize any infringement of State or local law or regulations, including, but not limited to the Pinelands rules (N.J.A.C. 7:50), N.J.A.C. 7:1E (Department rules entitled "Discharges of Petroleum and other Hazardous Substances"), the New Jersey Register of Historic Places Rules (N.J.A.C. 7:4), and all other Department rules. No discharge of hazardous substances (as defined in N.J.A.C. 7:1E-1.6) resulting from an onsite spill shall be deemed to be "pursuant to and in compliance with [this] permit" within the meaning of the Spill Compensation and Control Act at N.J.S.A. 58:10-23.11c.

3. Operations and Maintenance Manual

a. In accordance with N.J.A.C. 7:14A-6.12(c), for a discharge authorized by this permit, the Highway Agency is exempt from the requirement to prepare an operations and maintenance manual.

Attachment A
CONTENTS OF THE STORMWATER POLLUTION PREVENTION PLAN

A. SPPP Team

1. The Stormwater Pollution Prevention Plan (SPPP) shall identify the person or persons responsible for implementing or coordinating the SPPP activities (including, at the Highway Agency's discretion, OMs).

B. Description of Required Best Management Practices

1. The SPPP shall identify and discuss each Statewide Basic Requirement (SBR) and best management practice (BMP) required by the Highway Agency Stormwater General Permit.

2. The SPPP shall identify and discuss each Additional Measure (AM), if any, required by the Highway Agency Stormwater General Permit.

3. The SPPP shall identify and discuss any Optional Measures (OMs) the Highway Agency chooses to include in its stormwater program.

4. For each SBR, AM, or OM included in the Highway Agency's stormwater program, the SPPP shall:

a. Describe the method of implementation;

b. Include detailed record keeping, as appropriate or as required;

c. Include an implementation schedule consistent with permit requirements, including interim milestones;

d. Include any special diagrams required by the permit (i.e., Storm Drain Inlet Labeling and Illicit Connection Elimination and MS4 Outfall Pipe Mapping);

e. Sharing responsibilities (If the Highway Agency wants to share responsibilities for implementing one or more control measures (other than OMs) with one or more other entities pursuant to N.J.A.C. 7:14A-25.7(a), the SPPP must describe which measure(s) the Highway Agency will implement, and identify the entity(ies) that will implement the other measure(s));

f. Maintenance schedules, as appropriate; and

g. Inspection schedules, as appropriate.

C. Identifying Areas Served by Combined Sewer

1. Highway Agencies that want to exclude any "combined sewer area" from the stormwater program must include a map showing the boundaries of the combined sewer area. A "combined sewer area" is an area that is excluded because all stormwater from that area (and operated by the Highway Agency) is discharged to combined (or sanitary) sewer systems.

Attachment B
PROCEDURES FOR DETECTING, INVESTIGATING, AND ELIMINATING ILLICIT CONNECTIONS

Detection

An illicit connection for the purposes of this permit, is any physical or non-physical connection that discharges domestic sewage, non-contact cooling water, process wastewater, or other industrial waste (other than stormwater) to the Highway Agency's small MS4, unless that discharge is authorized under a NJPDES permit other than this Highway Agency Stormwater General Permit (non-physical connections may include, but are not limited to, leaks, flows, or overflows into the municipal separate storm sewer system). An illicit connection is also any category of non-stormwater discharges that a Highway Agency identifies as a source or significant contributor of pollutants pursuant to 40 C.F.R. 122.34(b)(3)(iii).

MS4 outfall pipes, for the most part, should not be discharging during substantial dry periods (72 hours after a rain event). Such flow is frequently referred to as "dry weather flow", which may be the result of an illicit connection. All dry weather flows are generally non-stormwater discharges, however not all dry weather flows are illicit connections. Some non-stormwater flows result from the improper disposal of waste (e.g., radiator flushing, engine degreasing, improper disposal of oil) and some may be the result of allowable discharges such as residential car washing, irrigation runoff, permitted (NJPDES) discharges and natural waters (e.g., spring water and groundwater infiltration). By using the Department's Illicit Connection Inspection Report form and making physical observations, a Highway Agency will compile information that will help determine if the dry weather flow is an illicit connection and the most likely source of the illicit connection. After making these physical observations, additional chemical field testing will enable a Highway Agency to further narrow the potential sources of the illicit connection.

The first physical observation is to observe if there is a dry weather flow. Some dry weather discharges are continuously flowing and some are intermittent. Observations will allow the Highway Agency to establish with reasonable certainty if there is an intermittent flow. If there are indications of intermittent flows (staining, odors, deterioration of outfall structure) follow-up investigations are required (see Investigation section). An estimate of the flow rate of the discharge shall also be noted (flow rate can be estimated by various methods, including timing how long it takes to fill a container of a known size). Additional physical observations and measurements shall be made for odor, color, turbidity, floatable matter, temperature, deposits and stains, vegetation and algal growth, and condition of outfall structure (see Illicit Connection Inspection Report form). Information compiled from physical observations and field monitoring should be used to help identify potential sources. These observations are very important since they are the simplest method of identifying grossly contaminated dry weather flows. If physical observations alone are sufficient to warrant further investigation, then field testing is not required.

If a dry weather flow exists and after making all physical observations (unless physical observations are enough to warrant further investigation), the Highway Agency shall field test for surfactants (detergents). If these flows contain surfactants in excess of the detection limit, Highway Agencies shall field test for ammonia (as N) and potassium to help distinguish sanitary wastewater sources from other non-stormwater flows that contain detergents. Non-stormwater discharges that are absent of surfactants shall be tested for fluoride to help distinguish potable from

non-potable sources. Highway Agencies should refer to the "Highway Agency Stormwater General Permit Guidance Manual" for assistance and interpretation of field testing results.

All of the tests for the tracing of illicit connections may be performed in the field by employees of the Highway Agency or may be contracted out. Lab certification for those parameters is **not** required, however all person(s) responsible for calibrating, maintaining, and taking field samples shall be trained in the use of the equipment and appropriate field testing protocol.

Investigation

Any storm sewer outfall pipe found during the initial inspection or on any subsequent inspection to have a non-stormwater discharge or indications of an intermittent non-stormwater discharge requires further investigation by the Highway Agency to identify and locate the specific source. Non-stormwater discharges suspected of being sanitary sewage and/or significantly contaminated shall be prioritized and investigated first. Investigations of non-stormwater discharges suspected of being cooling water, washwater, or natural flows may be delayed until after all suspected sanitary sewage and/or significantly contaminated discharges have been investigated, eliminated and/or resolved.

Dry weather flows believed to be an immediate threat to human health or the environment shall be reported immediately to the Department's Action Hotline at 1-877-WARNDEP (1-877-927-6337).

Physical observations and field testing can help narrow the identification of potential sources of a non-stormwater discharge. However it is unlikely that either will pinpoint the exact source. Therefore, Highway Agencies will need to perform investigations "upstream" to identify illicit connections to systems with identified problem outfalls.

All non-stormwater discharges, whether continuous or intermittent must be investigated by the Highway Agency. All investigations must be resolved. If the source is found to be a non-stormwater discharge authorized under Part I, Section A.2.d of the permit, no further action is required. If a non-stormwater discharge is found but no source is able to be located within six (6) months of beginning the investigation, then the Highway Agency shall submit to the Department a Closeout Investigation form to close out the investigation. The Highway Agency must document that a good faith effort was made to find the source of the dry weather discharge and document each phase of the investigation. If the observed discharge is intermittent the Highway Agency must document, in the Illicit Connection Inspection Report form, that a minimum three (3) separate investigations were made to observe the discharge when it is flowing. If these attempts are unsuccessful, the Highway Agency shall submit to the Department the Closeout Investigation form noted above. However, since this is an ongoing program, the Highway Agency should periodically recheck these suspected intermittent discharges.

Elimination

Non-stormwater discharges traced to their source and found to be the Highway Agency's own illicit connections shall be eliminated within six (6) months of their discovery. The Highway Agency may apply for a NJPDES permit for the discharge, but the discharge shall be ceased until a valid NJPDES permit has been issued by the Department. Highway Agencies are required to verify that the illicit discharge was eliminated within the specified timeframe and ensure that

measures taken to eliminate the discharge are permanent and are not done in such a manner that would allow easy reconnection to the MS4.

If an illicit connection cannot be located or is found to emanate from an entity other than the Highway Agency then the Highway Agency must submit to the Department a written explanation detailing the results of the investigation. If the illicit connection is found to be from another public entity, the Highway Agency shall also notify that entity.

Attachment C
DESIGN STANDARD - STORM DRAIN INLETS

This standard applies to storm drainage inlets installed as part of new development and redevelopment projects that disturb one acre or more. In addition, retrofitting of existing storm drainage inlets to this standard is required where such inlets are in direct contact with repaving, repairing (excluding repair of individual potholes), reconstruction or alterations of facilities owned or operated by the Highway Agency. For exemptions to this standard see "Exemptions" below.

Grates in Pavement or Other Ground Surfaces

Design engineers shall use either of the following grates whenever they use a grate in pavement or another ground surface to collect stormwater from that surface into a storm drain or surface water body under that grate:

1. The New Jersey Department of Transportation (NJDOT) bicycle safe grate, which is described in Chapter 2.4 of the NJDOT Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines (April 1996).

2. A different grate, if each individual clear space in that grate has an area of no more than seven (7.0) square inches, or is no greater than 0.5 inches across the smallest dimension.

   (In regard to whether the different grate must also be bicycle safe, the Residential Site Improvement Standards include requirements for bicycle-safe grates.)

Examples of grates subject to this standard include grates in grate inlets, the grate portion (non-curb-opening portion) of combination inlets, grates on storm sewer manholes, ditch grates, trench grates, and grates of spacer bars in slotted drains. Examples of ground surfaces include surfaces of roads (including bridges), driveways, parking areas, bikeways, plazas, sidewalks, lawns, fields, open channels, and stormwater basin floors.

Curb-Opening Inlets (Including Curb-Opening Inlets in Combination Inlets)

Whenever design engineers use a curb-opening inlet, the clear space in that curb opening (or each individual clear space, if the curb opening has two or more clear spaces) shall have an area of no more than seven (7.0) square inches, or be no greater than two (2.0) inches across the smallest dimension.

Exemptions

Retrofitting Exemptions

1. Repaving, repairing, reconstruction or alterations projects that began construction prior to March 3, 2004, and projects that were awarded bid prior to March 3, 2004, are exempted from the storm drain inlet design standard.
2. Existing curb-opening inlets do not need to be retrofitted to meet the design standard if each individual clear space in the curb opening has an area of no more than nine (9.0) square inches.

Hydraulic Performance Exemptions

1. New Development and Redevelopment Projects - Where the review agency determines that this standard would cause inadequate hydraulic performance that could not practicably be overcome by using additional or larger storm drainage inlets that meet these standards.
2. Retrofitting of existing storm drain inlets - Where the review agency determines that this standard would cause inadequate hydraulic performance.

Alternative Device Exemptions

1. Where flows from the water quality design storm as specified in N.J.A.C. 7:8 are conveyed through any device (e.g., end of pipe netting facility, manufactured treatment device, or a catch basin hood) that is designed, at a minimum, to prevent delivery of all solid and floatable materials that could not pass through one of the following:

    a. A rectangular space four and five-eighths inches long and one and one-half inches wide (this option does not apply for outfall netting facilities); or

    b. A bar screen having a bar spacing of 0.5 inches.

2. Where flows are conveyed through a trash rack that has parallel bars with one-inch (1") spacing between the bars, to the elevation of the water quality design storm as specified in N.J.A.C. 7:8.

Note - The preceding exemptions do not authorize any infringement of requirements in the Residential Site Improvement Standards for bicycle-safe grates in new residential development (N.J.A.C. 5:21-4.18(b)2 and 7.4(a)).

Historic Places Exemption

Where the Department determines, pursuant to the New Jersey Register of Historic Places Rules at N.J.A.C. 7:4-7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.

Attachment D
REQUIRED PRACTICES FOR FUELING OPERATIONS, VEHICLE MAINTENANCE, AND GOOD HOUSEKEEPING SBRs

A. The following BMPs must be implemented at maintenance yards, including maintenance activities at Service Areas and ancillary operations (for example, impound yards, solid waste transfer stations, mobile fueling), where applicable, that are operated by the Highway Agency:

1. Inventory Requirements for Maintenance Yard Operations (including Service Areas, and Ancillary Operations)

a. Highway Agencies shall include for maintenance yard operations an inventory that includes the following:

i. A list to be made part of the SPPP of general categories of all materials or machinery located at the maintenance yard, which could be a source of pollutants in a stormwater discharge. The materials in question include, but are not limited to: raw materials; intermediate products; final products; waste materials; by-products; machinery and fuels; and lubricants, solvents, and detergents that are related to the maintenance yard operations or ancillary operations. Materials or machinery that are not exposed to stormwater or that are not located at the maintenance yard or related to its operations do not need to be included.

2. Fueling

a. No topping off vehicles, mobile fuel tanks, and storage tanks. Drip pans must be used under all hose and pipe connections and other leak-prone areas during bulk transfer of fuels.

b. During bulk transfer block storm sewer inlets, or contain tank with temporary berms or temporary absorbent booms during the transfer process. If temporary berms are being used instead of blocking the storm sewer inlets, all hose connection points associated with the transfer of fuel must be within the temporary berms during the loading/unloading of bulk fuels. A trained employee must always be present to supervise during bulk fuel transfer.

c. Clearly post, in a prominent area of the facility, instructions for safe operation of fueling equipment, and appropriate contact information for the person(s) responsible for spill response.

d. Any equipment, tanks, pumps, piping and fuel dispensing equipment found to be leaking or in disrepair must immediately be repaired or replaced.

3. Vehicle Maintenance

a. Perform all vehicle and equipment maintenance at an indoor location with a paved floor whenever possible. For projects that must be performed outdoors that last more than one day, portable tents or covers must be placed over the equipment being serviced when not being worked on, and drip pans must be used.

4. General Good Housekeeping

a. Properly mark or label all containers. Labels must be kept clean and visible. All containers must be kept in good condition and tightly closed when not in use. When practical, containers must be stored indoors. If indoor storage is not practical, containers may be stored outside as long as they are covered and placed on spill platforms. An area that is graded and/or bermed that prevents run-through of stormwater may be used in place of spill platforms. Outdoor storage locations must be regularly maintained.

b. Conduct cleanups of any spills or liquids or dry materials immediately after discovery. Clean all maintenance areas with dry cleaning methods only. Spills shall be cleaned up with a dry, absorbent material (i.e., kitty litter, sawdust, etc.) and the rest of the area is to be swept. Collected waste is to be disposed of properly. Clean-up materials, spill kits and drip pans must be kept near any liquid transfer areas, protected from rainfall.

5. Good Housekeeping Practices for Salt and De-icing Material Handling

a. The SPPP for De-icing Material Storage shall include the following required practices to ensure that Maintenance Yard Operations prevent or minimize the exposure of salt and de-icing materials to stormwater runoff from storage, loading and unloading areas and activities:

i. Prevent and/or minimize the spillage of salt and de-icing materials during loading and unloading activities.

ii. At the completion of loading and unloading activities, spilled salt and de-icing materials shall be removed using dry cleaning methods and either reused or properly discarded.

iii. Sweeping by hand or mechanical means of storage and loading/unloading areas shall be done on a regular basis. More frequent sweeping is required following loading/unloading activities. Sweeping shall also be conducted immediately following, as practicable, loading/unloading activities.

iv. Tracking of materials from storage and loading/unloading areas shall be minimized.

v. Minimize the distance salt and de-icing materials are transported during loading/unloading activities.

b. Interim Seasonal Tarping - All Highway Agencies must tarp all de-icing materials until a permanent structure is built. Interim storage measures must include, but are not limited to the following:

i. Tarping materials that are not actively being used.

ii. The storage of de-icing materials (salt and de-icing products) outside is limited to October 15th through April 30th. All salt and de-icing materials must be removed from the site prior to May 1st and may not be stored outside again until October 15th.

iii. The implementing of a regular inspection, sweeping and housekeeping program to ensure that the material is maintained and stored in a proper manner.

6. Inspections

a. Inspections of all Municipal Maintenance Yard Operations shall be conducted regularly.

b. Discharge of Stormwater from Secondary Containment

i. The discharge pipe/outfall from a secondary containment area must have a valve and the valve must remain closed at all times except as described below. A Highway Agency may discharge stormwater that accumulated in the secondary containment area if a visual inspection is performed to ensure that the contents of aboveground storage tank have not come in contact with the stormwater to be discharged. Visual inspections are only effective when dealing with materials that can be observed, like petroleum. If the contents of the tank are not visible in stormwater, the Highway Agency must rely on previous tank inspections to determine with some degree of certainty that the tank has not leaked. If the Highway Agency cannot make a determination with reasonable certainty that the stormwater in the secondary containment area is uncontaminated by the contents of the tank, then the stormwater should be hauled for proper disposal.

Permit Authorization

c: Bill Fleming
FAX 767-0272

State of New Jersey

James E. McGreevey
Governor

Department of Environmental Protection

Bradley M. Campbell
Commissioner

Bureau of Nonpoint Pollution Control
Division of Water Quality
P.O. Box 029
Trenton, N.J. 08625-0029
Tel: 609-633-7021, 292-0407
FAX: 609-984-2147
www.state.nj.us/dep/dwq/nonpoint.htm

May 6, 2004

Jerry K. Lovell
Gloucester County DPW
1200 N Delsea Drive
Clayton, New Jersey 08312

Re: R12 -Highway Agency Stormwater General Permit
NJPDES: NJG0155373 / PI ID #: 228000
Gloucester County DPW

Dear Jerry K. Lovell:

Enclosed please find your Highway Agency's Authorization to Discharge (Authorization) under the New Jersey Pollutant Discharge Elimination System (NJPDES) Highway Agency Stormwater General Permit NJ0141887 (Highway Permit), and a copy of the final permit. The "Effective Date" on the enclosed Authorization, 05/01/2004, is your Highway Agency's "Effective Date of Permit Authorization" (EDPA) under this final permit. The implementation schedules contained in the final permit are based on your Highway Agency's EDPA.

A unique NJPDES permit number NJG0155373 has been assigned for your Highway Agency's authorization under the Highway Permit. In any future correspondence or inquiries, please use or refer to that NJPDES permit number.

The enclosed final permit includes some technical corrections and changes to the advance copy that the Department of Environmental Protection (Department) mailed to your Highway Agency in late January. Please replace the advance copy with the official final permit contained in this mailing. Also enclosed with this mailing is a summary of these technical corrections and changes.

A compact disk (CD) that contains guidance for the Highway Permit will be mailed to you under separate cover. The guidance will have blank and completed example Stormwater Pollution Prevention Plan (SPPP) forms to assist your Highway Agency in preparing its SPPP. The CD will also contain other guidance including courtesy copies of the amended NJPDES Stormwater rules (N.J.A.C. 7:14A) and Stormwater Management rules (N.J.A.C.7:8), model regulatory mechanisms, the New Jersey Stormwater Best Management Practices Manual, and additional educational materials supplied by the Department's Division of Watershed Management.

If any information about your Highway Agency in this letter or the enclosed Authorization (i.e., mailing address, Highway Agency Stormwater Program Coordinator, etc.) is incorrect or has changed or changes in the future, please contact the Bureau of Nonpoint Pollution Control for an Administrative Update Form.

001
07/01/05 FRI 15:34 FAX
07/01/2005 15:49

The Department appreciates your efforts toward accomplishing the goal of providing cleaner water for our State and looks forward to working together with you in the future. If you have any questions please contact Matthew Klewin at the Bureau of Nonpoint Pollution Control at (609) 633-7021, or (609) 292-0407.

Sincerely,

Barry Chalofsky, P.P., Chief
Bureau of Nonpoint Pollution Control

Enclosures: (3)
Authorization to Discharge
NJPDES General Permit No. NJ0141887
Summary of technical corrections and changes

C: (w/AUTHORIZATION Form): NJDEP Water Compliance and Enforcement Region Office
Debbie Esposti, BPM

Summary of Technical Corrections and Changes to Advance Copy of Final Highway Agency Stormwater General Permit

Part I, Section E.2.a: In the first sentence, deleted ", *in accordance with Part I, Section H.1,*".

Part I, Section F.6.a.i: In the next to last sentence, changed "The outfalls shall be mapped ... " to "The outfall *pipes* shall be mapped ..." In the last sentence, changed "The Highway Agency shall submit a copy of this map ... " to "The Highway Agency shall submit a copy of *its outfall pipe* map ... "

Part I, Section J.2.a: Inserted "*the New Jersey Register of Historic Places Rules (N.J.A.C. 7:4),*" before "and all other Department rules."

Attachment B, Procedures for Detecting, Investigating, and Eliminating Illicit Connections, Investigation: In the last paragraph, changed "Illicit Connection Report form" to "Illicit Connection *Inspection* Report form."

Attachment C, Design Standard - Storm Drain Inlets, Exemptions: Added the following exemption:

"Historic Places Exemption"

"*Where the Department determines, pursuant to the New Jersey Register of Historic Places Rules at N.J.A.C. 7:4-7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.*"

Attachment D, Required Practices For Fueling Operations, Vehicle Maintenance, and Good Housekeeping SBRs, Section A.2.c: Changed to read: "*Clearly post, in a prominent area of the facility, instructions for safe operation of fueling equipment, and appropriate contact information for the person(s) responsible for spill response.*"

SPPP & Map

NJPDES Highway Agency Stormwater General Permit

Stormwater Pollution Prevention Team Members

Number of team members may vary.

Completed by: Larry Haynes, Sr.
Title: Public Works Director
Highway Agency Name: Gloucester County Highway Division
NJPDES #: NJG 0141887
PIID #: 228439
Effective Date of Permit Authorization (EDPA): May 1, 2004
Date form Complete: May 1, 2005
Date of most recent update: April 28, 2006

Stormwater Program Coordinator: Larry Haynes, Sr.
Title: Public Works Director
Office Phone #: 856-307-6412
Emergency Phone #: 856-277-2493

Public Notice Coordinator: George Strachan
Title: GCIA Assistant t. Administrator
Office Phone #: 856-423-0200 x152
Emergency Phone #: same

Post-Construction Stormwater Management Coordinator: Chuck Romick
Title: County Planner
Office Phone #: 856-307-6650
Emergency Phone #: same

Local Public Education Coordinator: George Strachan
Title: same
Office Phone #: same
Emergency Phone #: same

Regulatory Mechanism Coordinator: George Strachan
Title: same
Office Phone #: same
Emergency Phone #: same

Physical Operations Coordinator: Larry Haynes, Sr.
Title: Public Works Director
Office Phone #: 856-307-6412
Emergency Phone #: 856-277-2493

Employee Training Coordinator: Larry Haynes, Sr.
Title: Public Works Director
Office Phone #: same
Emergency Phone #: same

Other:
Title:
Office Phone #:
Emergency Phone #:

SPPP Form 2 - Public Notice

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: George Strachan.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Briefly outline the principal ways in which you comply with applicable State and local public notice requirements when providing for public participation in the development and implementation of your stormwater program.

Meetings that require public notice under the Open Public Meetings Act (Sunshine Law, NJSA 10:4-6 et seq.) will be advertised in a manner that complies with the requirements of the Act. Gloucester County provides budget notice in a mannner that complies with the requirements of the Local Budget Law (NJSA 40A:4-1 et seq.). All resolutions that provide a penalty or fine will be noticed in accordance with the requirements of NJSA 40:24-3.

SPPP Form 3 – New Development and Redevelopment Program

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Chuck Romick

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Describe in general terms your post-construction stormwater management in new development and redevelopment program (post-construction program), and how it complies with the Highway Permit minimum standard. This description must address how adequate long term operation and maintenance of BMPs will be ensured; compliance with the standard in Attachment C of the permit (new storm drain inlet design standard); adoption and implementation of applicable design and performance standards established under N.J.A.C. 7:8 for major development; and use of the Post-Construction Program Design Checklist for Individual Projects. Attach additional pages as necessary.

The Gloucester County Highway Division will design (sometimes with the consultant support) and maintain all projects which are new development and redevelopment projects described in the Highway Agency Permit in accordance with the permit requirements for such projects. The County's Annual Reports will list these projects. On _____ the Gloucester County Board of Freeholders passed Resolution No. _____, which incorporates the provisions listed below.

(1) Adopts and incorporates by reference the applicable design and performance standards and maintenance requirements established under NJAC 7:8 for major development including the storm drain inlet design standard in Attachment C of the NJPDES Highway Agency General Permit

(2) Requires that all such projects be designed to comply with these standards.

(3) Requires that the NJPDES Highway Agency General Permit's "Post-Construction Program Design Checklist for Individual Projects" be completed before each project's construction is approved.

The Gloucester County Engineer, Highway Division and Planning Department have discusses the stormwater design and performance standards in order to encourage consistency and coordination among the County's stormwater management activities.

Gloucester County uses storm drain inlets and grates that comply with Attachment C for all new construction. All repaving and reconstruction projects incorporate the retrofitting of inlets and grates to comply with Attachment C, unless adequate hydraulic performance can not be achieved.

Since the EDPA, Gloucester County has not constructed a highway project considered major development or redevelopment that must comply with the requirements of the NJPDES Highway Agency Stormwater General Permit. The County will ensure adequate long term operation and maintenance of BMPs for all such future projects by preparing a Project Maintenance Plan in accordance with N.J.A.C. 7:8-5.8, where applicable, and through funding of the maintenance program to ensure proper function and operation of the County Highway Division's regulated stormwater facilities.

SPPP Form 4 - Local Public Education Program

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: George Strachan r

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Local Public Education Program

Describe your Local Public Education Program. Be specific on how you will distribute your educational information.

The Gloucester County Highway Division does not own or operate any service areas within the County's highway system. The County does not provide rest or picnic areas along county roadways or at scenic locations and does not maintain any litter or trash receptacles.

The County of Gloucester is distributing the NJDEP stormwater brochure as a part of its countywide newsletter.

SPPP Form 5 – Storm Drain Inlet Labeling

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Storm Drain Inlet Labeling

Describe your storm drain inlet labeling program, including your labeling schedule, the details of your long-term maintenance plan, and plans on coordinating with watershed groups or other volunteer organizations.

Because of safety concerns, Gloucester County will utilize Highway Division employees to accomplish inlet labeling. All new curb box inlets are purchased with the inlet label information stamped on the casting by the foundry.

All storm drain inlets located at maintenance facilities and along county highways with sidewalks will be labeled in accordance with the NJPDES Highway Agency Stormwater General Permit. Gloucester County's roadways have been divided into 2 sectors and inlets in 50% of these sectors will be labeled within 3 years (by May 2007) of the EDPA. The remaining sector will be labeled within 5 years (by May 2009) of the EDPA. (See sectors on attached county roadway map.)

The county, through the GCIA, has purchased fish shaped, 4-inch by 12-inch, Scotchlane labels, white with blue text that read, "No Dumping—Drains to Stream" for use by the Highway Division.

The curb box inlet labels will be periodically inspected and maintained as needed by Gloucester County Highway Division employees.

SPPP Form 6 – MS4 Outfall Pipe Mapping

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Explain how you will prepare your map (include its type and scale, and the schedule for the mapping process). Who will prepare your map (e.g., employees, a consultant, etc.)?

Gloucester County, through the GCIA, has begun mapping outfall pipes associated with the County Highway Division's stormwater system. Gloucester County is utilizing an alphanumeric identifier for each outfall. The system was proposed by the DVRPC for outfalls in the tri-county region. The name and location of the surface water body is included. The County will use its GIS for mapping, managing and storing the outfall information and has used GPS dataloggers for collecting field data for each outfall. The data will also be available for the DVRPC outfall GIS-database.

The SCS and Rowan University have collected outfall data for a portion of the Maurice River, Raccoon Creek, and Mantua Creek basins in Gloucester County and this information has also been utilized. Gloucester County's roadways have been divided into sectors and outfalls in 50% of these sectors will be mapped within 3 years (by May 2007) of the EDPA. Outfalls within the remaining sectors will be mapped within 5 years (by May 2009) of the EDPA. (See sectors on attached county roadway map.)

Gloucester County is evaluating production of the outfall maps using GIS and the NJDEP's 2002 aerial photos as a base map.

During the outfall pipe mapping, outfall pipes are inspected for evidence of illicit connections and for outfall pipe related stream scouring. This information will also be entered into the outfall GIS, along with digital pictures of the outfall and stream conditions. (See below for the illicit connection program)

SPPP Form 7 – Illicit Connection Elimination Program

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Describe your Illicit Connection Elimination Program, and explain how you plan on responding to complaints and/or reports of illicit connections (e.g., hotlines, etc.). Attach additional pages as necessary.

Gloucester County, through the GCIA outfall mapping, is identifying potential illicit connections. The Illicit Connection Inspection Report Form or a similar spreadsheet or database will be used to record the collected information. This information will be used to complete the Annual Report and to update Form 8.

Outfall pipes found to have dry weather flow or intermittent non-stormwater flow will be tested following the NJDEP's illicit connection testing protocol. If the test results are positive, efforts will be made to identify the location and source of the illicit connection. Illicit connections associated with the County will be eliminated within 6 months of their discovery. Illicit connections from other public or private sources will be reported to the source and to the appropriate County or local health department for enforcement. A written explanation of all illicit connection investigations and their outcome will be prepared and sent to the NJDEP. Illicit connections from private sources will be reported to the NJDEP. If the illicit connection posees an immediate threat, the NJDEP hotline will be contacted and separate writtten notification will be sent to the NJDEP.

SPPP Form 8 – Illicit Connection Records

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Prior to July 1, 2006

Note: *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*

Total number of inspections performed this year? _____

Number of outfalls found to have a dry weather flow? _____

Number of outfalls found to have an illicit connection? _____

How many of the Highway Agency's own illicit connections were eliminated? _____

Of the Highway Agency's own illicit connections found, how many remain? _____

How many illicit connections found to emanate from another entity were reported to NJDEP? ___

July 1, 2006 – June 30, 2007

Note: *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*

Total number of inspections performed this year? _____

Number of outfalls found to have a dry weather flow? _____

Number of outfalls found to have an illicit connection? _____

How many of the Highway Agency's own illicit connections were eliminated? _____

Of the Highway Agency's own illicit connections found, how many remain?_____

How many illicit connections found to emanate from another entity were reported to NJDEP? ____

July 1, 2007 – June 30, 2008

Note: *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*

Total number of inspections performed this year? _____

Number of outfalls found to have a dry weather flow? _____

Number of outfalls found to have an illicit connection? _____

How many of the Highway Agency's own illicit connections were eliminated? _____

Of the Highway Agency's own illicit connections found, how many remain?_____

How many illicit connections found to emanate from another entity were reported to NJDEP? ____

July 1, 2008 – June 30, 2009 ***Note:*** *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*
Total number of inspections performed this year? _____
Number of outfalls found to have a dry weather flow? _____
Number of outfalls found to have an illicit connection? _____
How many of the Highway Agency's own illicit connections were eliminated? _____
Of the Highway Agency's own illicit connections found, how many remain? _____
How many illicit connections found to emanate from another entity were reported to NJDEP? ____

SPPP Form 9 – Litter Pick Up Program

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Please describe your litter pick up program. Be sure to include the refuse collection schedule and detail how rest area, service area, and roadside clean ups will be implemented.
(NOTE: Attach a litter pick up log containing the following information: dates of roadside clean ups and estimates of the total amount of trash and debris collected.)

There are no rest areas, picnic areas, or other roadside areas or receptacles owned or maintained by the Gloucester County Highway Division. The County Highway Division does routinely inspect county roadway rights-of way for litter and debris during routine maintenance operations. The county Highway Division also responds to calls from residents or motorists concerning debris in the rights-of way. Highway Division trucks are dispatched to cleanup and remove litter and debris along county roadways.

The Gloucester County Improvement Authority maintains an Adopt-a Highway program providing bags for litter and the county picks up the bags for disposal. The County Improvement Authority also conducts cleanup days, using volunteer groups (scouts) and keeps track of the amount of waste cleaned up.

SPPP Form 10 – Regulatory Mechanisms

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

For each regulatory mechanism, give the date of adoption. If not yet adopted, explain the development status: There are no rest areas or service areas in the county highway system.

Pet Waste _____

(NOTE: If the Highway Agency is not developing a pet waste regulatory mechanism because the Agency does not operate any rest areas or service areas for the Agency facilities subject to this permit, provide that explanation above.)

Improper Disposal of Waste _____

Wildlife Feeding _____

Illicit Connections _____

What is the nature of these regulatory mechanisms and how will they be enforced?

If your position is that the Highway Agency has no legal authority to adopt and/or enforce a mechanism to regulate pet waste disposal or wildlife feeding by the general public on Highway Agency property, attach a statement from your attorney supporting this position.

The Gloucester County Highway Division has no legal authority to adopt or enforce a mechanism to regulate pet waste and other waste disposal or wildlife feeding by the general public on Highway Division property (roads). A statement supporting this position from the County Counsel will be attached. Illicit connections are controlled through the operation and maintenance of the highway system and the illicit connection elimination program that will be conducted in conjunction with the highway system outfall mapping. If necessary, local municipal codes, ordinances and enforcement procedures will be utilized to enforce the elimination of any illicit connections.

SPPP Form 11 – Storm Drain Inlets (Retrofitting)

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

What type of storm drain inlet design will generally be used for retrofitting?

Repaving, repairing, reconstruction or alteration project name (attach additional pages as necessary)	Projected start date	Start date	Date of completion	# of storm drain inlets	# of storm drains with exemptions

Are you claiming any alternate device exemptions or historic place exemptions for any of the above projects? Please explain.

See attached list.

SPPP Form 12 – Street Sweeping and Road Erosion Control Maintenance

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Street Sweeping

Please describe the street sweeping schedule that you will maintain.
(NOTE: Attach a street sweeping log containing the following information: date and area swept, # of miles swept and the total amount of materials collected.)

The Gloucester County Highway Division has identified roads that require monthly street sweeping under the permit (commercial areas with speed limits less than 35mph with curbs and storm drains) has implemented a monthly street sweeping program. Gloucester County will maintain its existing street sweeping schedule for other county roads.

Road Erosion Control Maintenance

Describe your Road Erosion Control Maintenance Program, including how you will perform inspections and frequency. A list of all sites of roadside erosion and the repair technique(s) you will be using for each site should be attached to this form.
(NOTE: Attach a road erosion control maintenance log containing the following information: location, repairs, date)

Gloucester County will utilize existing road department emplyees to identify existing roadside erosion and perform inspections. Erosion sites will be repaired in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey. Maintenance personnel will keep an inspection log including a list of repairs and the dates that the repairs were completed. The list will be included in the Annual Report and Certification.

SPPP Form 13 – Stormwater Facility Maintenance

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Please describe your annual catch basin cleaning program and schedule. Attach additional pages as necessary.

The Gloucester County Highway Division inspects, and if necessary cleans, catch basins at least once per year in accordance with the permit standards. Catch basins found to be in disrepair are identified and maintenance is scheduled.

Material (debris) removed from catch basins is disposed in accordance with the NJDEP Division of Solid and Hazardous Waste standards. Material is hauled to the GCIA landfill for disposal. Solid wastes will be tested in accordance with the landfills requirements.

Please describe your stormwater facility maintenance program for cleaning and maintenance of all stormwater facilities operated by the Highway Agency. Attach additional pages as necessary.

(NOTE: Attach a maintenance log containing information on any repairs/maintenance performed on stormwater facilities to ensure their proper function and operation.)

The Gloucester County Highway Division is developing and implementing a stormwater facilitiy maintenance program that ensures proper operation of the highway division's stormwater facilities. These include inlets, catch basins, pipes, swales, ponds and seperators. These facilities are regularly inspected and major repairs included in the capital program. Routine maintenance and repairs are performed by the Highway Division staff on a routine basis.

Further, the Highway Division is aware of stormwater facilities that require increased levels of maintenace in order to avoid blockages and flooding. These locations are more frequently inspected and maintained.

SPPP Form 14 - Roadside Vegetation Management

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Describe your roadside vegetation management program to limit the application of herbicides and mulch. Attach additional pages as necessary.

The Gloucester County Highway Division does not use herbicides and will not apply them outside the prescribed two-foot radius of any structure for which it is impractical to mow around. Should workers use herbicides, they will be trained in the NJPDES permit requirements and in proper application methods.

In addition, low maintenance plantings (wildflowers and other vegetation types) will be used along county highways where mowing is difficult or impossible (steep slopes, naturally wet areas, highway shoulders etc.)

SPPP Form 15 - Outfall Pipe Stream Scouring Remediation

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Describe your stormwater outfall pipe scouring detection, remediation and maintenance program to detect and control active, localized stream and stream bank scouring. Attach additional pages as necessary.

(NOTE: Attach a prioritized list of sites observed to have scouring, date of anticipated repair, method of repair and date of completion.)

The Gloucester County Highway Division, through the GCIA, has developed and implemented a stormwater outfall pipe stream scouring detection, remediation and maintenance program to control localized stream and stream bank scouring in the vicinity of the highway system outfall pipes. The initial inspection of stream scour will be conducted with the outfall pipe mapping activities, and scour information will be included in the GIS, following the protocol developed by the DVRPC. Priorities for repair of scour will be established based on these initital inspections and a schedule developed for the repairs, including state and federal permits. Repairs that do not require state or federal permits will be accomplished first. The design of repairs will be in accordance with the Standards of Soil Erosion and Sediment Control in New Jersey.

SPPP Form 16 – De-icing Material Storage

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

De-icing Material Storage

Describe how you currently store your highway agency's de-icing materials, and describe your inspection schedule. If your current storage practices do not meet the de-icing material storage SBR describe your construction schedule and your seasonal tarping interim measures. If you plan on sharing a storage structure, please include its location, as well as a complete list of all concerned public entities. If you store sand outdoors, describe how it meets the minimum standard.

The Gloucester County Highway Division currently stores deicing materials in a covered strorage shed at the Clayton facility. Seasonal "tarping" will be used as an interim measure at the Swedesboro and Mantua facilities until a permanent storage structure is in place.

SPPP Form 17 – Standard Operating Procedures

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

BMP	Date SOP went into effect	Describe your inspection schedule
Fueling Operations (including the required practices listed in Attachment D of the permit)	July 1, 2005	Inspections monthly
Vehicle Maintenance (including the required practices listed in Attachment D of the permit)	July 1, 2005	Inspections monthly
Good Housekeeping Practices (including the required practices listed in Attachment D of the permit) **Attach inventory list required by Attachment D of the permit**	July 1, 2005	Inspections monthly

SPPP Form 18 – Employee Training

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Ralph Brownlee

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Describe your employee training program. For each required topic, list the employees that will receive training on that topic, and the date the training will be held. Attach additional pages as necessary.

The Gloucester County Highway Division employee training will be conducted in groups including those employees that are involved or affected by each of the permit compliance issues. The County proposes the following groupings and schedule for training.

(1) **Waste Disposal Control** - If any County controls are adopted, training to be discussed inconjunction with Form 10- Regualtory Mechanisms and an explanation of appropriate training inserted here.

(2) **Stormwater Facility Maintenance** - This training will involve the stormwater permit requirements for county owned stormwater facilities and the maintenace yard. NJPDES permit compliance requirements including periodic inspections, record keeping and rehabilitation will be addressed. The training will cover catch basin cleaning, debris disposal, problematic portions of the stormwater system, and the maintenace yard operating procedures.

(3) **Outfalls** - This training will involve outfall pipe mapping, illicit connection elimination, and outfall related stream scour. The training will involve only those employees involved with these portions of the NJPDES highway agency stormwater general permit compliance and may include a consultant. The GIS, GPS and data acquisition requirements will be discussed and include training for field evaluation of pipe, flow and stream bank conditions.

(4) **Roadsides and Repaving** - This training will involve roadside vegetation management, roadside erosion and Adopt-A-Highway. The training will involve only those emoployees involved with roadside maintenance and repaving. The new inlet requirements, inlet retrofitting requirements, and inlet labeling requirements will also be addressed as part of this training.

(5) **New Construction and Redevelopment** - Stormwater requirements for design engineering including the new stormwater regulations, BMPs and the BMP maintenace requirements will be discussed at this training session. Appropriate representative from the engineering, Highway Division, and the planning departments will be in attendance.

Stormwater Pollution Prevention Plan

NJPDES Highway Agency Stormwater General Permit

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Signature _____ **Date** April 28, 2006

Print or Type Name and Title Larry Haynes, Sr., Stormwater Program Coordinator

NJPDES Highway Agency Stormwater General Permit

Stormwater Pollution Prevention Team Members

Number of team members may vary.

Completed by: Larry Haynes, Sr.
Title: Public Works Director
Highway Agency Name: Gloucester County Highway Division
NJPDES #: NJG 0141887
PIID #: 228439
Effective Date of Permit Authorization (EDPA): May 1, 2004
Date form Complete: May 1, 2005
Date of most recent update: April 28, 2006

Stormwater Program Coordinator: Larry Haynes, Sr.
Title: Public Works Director
Office Phone #: 856-307-6412
Emergency Phone #: 856-277-2493

Public Notice Coordinator: George Strachan
Title: GCIA Assistant t. Administrator
Office Phone #: 856-423-0200 x152
Emergency Phone #: same

Post-Construction Stormwater Management Coordinator: Chuck Romick
Title: County Planner
Office Phone #: 856-307-6650
Emergency Phone #: same

Local Public Education Coordinator: George Strachan
Title: same
Office Phone #: same
Emergency Phone #: same

Regulatory Mechanism Coordinator: George Strachan
Title: same
Office Phone #: same
Emergency Phone #: same

Physical Operations Coordinator: Larry Haynes, Sr.
Title: Public Works Director
Office Phone #: 856-307-6412
Emergency Phone #: 856-277-2493

Employee Training Coordinator: Larry Haynes, Sr.
Title: Public Works Director
Office Phone #: same
Emergency Phone #: same

Other:
Title:
Office Phone #:
Emergency Phone #:

SPPP Form 2 - Public Notice

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: George Strachan.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Briefly outline the principal ways in which you comply with applicable State and local public notice requirements when providing for public participation in the development and implementation of your stormwater program.

Meetings that require public notice under the Open Public Meetings Act (Sunshine Law, NJSA 10:4-6 et seq.) will be advertised in a manner that complies with the requirements of the Act. Gloucester County provides budget notice in a mannner that complies with the requirements of the Local Budget Law (NJSA 40A:4-1 et seq.). All resolutions that provide a penalty or fine will be noticed in accordance with the requirements of NJSA 40:24-3.

SPPP Form 3 – New Development and Redevelopment Program

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Chuck Romick

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Describe in general terms your post-construction stormwater management in new development and redevelopment program (post-construction program), and how it complies with the Highway Permit minimum standard. This description must address how adequate long term operation and maintenance of BMPs will be ensured; compliance with the standard in Attachment C of the permit (new storm drain inlet design standard); adoption and implementation of applicable design and performance standards established under N.J.A.C. 7:8 for major development; and use of the Post-Construction Program Design Checklist for Individual Projects. Attach additional pages as necessary.

The Gloucester County Highway Division will design (sometimes with the consultant support) and maintain all projects which are new development and redevelopment projects described in the Highway Agency Permit in accordance with the permit requirements for such projects. The County's Annual Reports will list these projects. On _____ the Gloucester County Board of Freeholders passed Resolution No. _____, which incorporates the provisions listed below.

(1) Adopts and incorporates by reference the applicable design and performance standards and maintenance requirements established under NJAC 7:8 for major development including the storm drain inlet design standard in Attachment C of the NJPDES Highway Agency General Permit

(2) Requires that all such projects be designed to comply with these standards.

(3) Requires that the NJPDES Highway Agency General Permit's "Post-Construction Program Design Checklist for Individual Projects" be completed before each project's construction is approved.

The Gloucester County Engineer, Highway Division and Planning Department have discusses the stormwater design and performance standards in order to encourage consistency and coordination among the County's stormwater management activities.

Gloucester County uses storm drain inlets and grates that comply with Attachment C for all new construction. All repaving and reconstruction projects incorporate the retrofitting of inlets and grates to comply with Attachment C, unless adequate hydraulic performance can not be achieved.

Since the EDPA, Gloucester County has not constructed a highway project considered major development or redevelopment that must comply with the requirements of the NJPDES Highway Agency Stormwater General Permit. The County will ensure adequate long term operation and maintenance of BMPs for all such future projects by preparing a Project Maintenance Plan in accordance with N.J.A.C. 7:8-5.8, where applicable, and through funding of the maintenance program to ensure proper function and operation of the County Highway Division's regulated stormwater facilities.

SPPP Form 4 - Local Public Education Program

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: George Strachan r

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Local Public Education Program

Describe your Local Public Education Program. Be specific on how you will distribute your educational information.

The Gloucester County Highway Division does not own or operate any service areas within the County's highway system. The County does not provide rest or picnic areas along county roadways or at scenic locations and does not maintain any litter or trash receptacles.

The County of Gloucester is distributing the NJDEP stormwater brochure as a part of its countywide newsletter.

SPPP Form 5 – Storm Drain Inlet Labeling

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Storm Drain Inlet Labeling

Describe your storm drain inlet labeling program, including your labeling schedule, the details of your long-term maintenance plan, and plans on coordinating with watershed groups or other volunteer organizations.

Because of safety concerns, Gloucester County will utilize Highway Division employees to accomplish inlet labeling. All new curb box inlets are purchased with the inlet label information stamped on the casting by the foundry.

All storm drain inlets located at maintenance facilities and along county highways with sidewalks will be labeled in accordance with the NJPDES Highway Agency Stormwater General Permit. Gloucester County's roadways have been divided into 2 sectors and inlets in 50% of these sectors will be labeled within 3 years (by May 2007) of the EDPA. The remaining sector will be labeled within 5 years (by May 2009) of the EDPA. (See sectors on attached county roadway map.)

The county, through the GCIA, has purchased fish shaped, 4-inch by 12-inch, Scotchlane labels, white with blue text that read, "No Dumping---Drains to Stream" for use by the Highway Division.

The curb box inlet labels will be periodically inspected and maintained as needed by Gloucester County Highway Division employees.

SPPP Form 6 – MS4 Outfall Pipe Mapping

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Explain how you will prepare your map (include its type and scale, and the schedule for the mapping process). Who will prepare your map (e.g., employees, a consultant, etc.)?

Gloucester County, through the GCIA, has begun mapping outfall pipes associated with the County Highway Division's stormwater system. Gloucester County is utilizing an alphanumeric identifier for each outfall. The system was proposed by the DVRPC for outfalls in the tri-county region. The name and location of the surface water body is included. The County will use its GIS for mapping, managing and storing the outfall information and has used GPS dataloggers for collecting field data for each outfall. The data will also be available for the DVRPC outfall GIS-database.

The SCS and Rowan University have collected outfall data for a portion of the Maurice River, Raccoon Creek, and Mantua Creek basins in Gloucester County and this information has also been utilized. Gloucester County's roadways have been divided into sectors and outfalls in 50% of these sectors will be mapped within 3 years (by May 2007) of the EDPA. Outfalls within the remaining sectors will be mapped within 5 years (by May 2009) of the EDPA. (See sectors on attached county roadway map.)

Gloucester County is evaluating production of the outfall maps using GIS and the NJDEP's 2002 aerial photos as a base map.

During the outfall pipe mapping, outfall pipes are inspected for evidence of illicit connections and for outfall pipe related stream scouring. This information will also be entered into the outfall GIS, along with digital pictures of the outfall and stream conditions. (See below for the illicit connection program)

SPPP Form 7 – Illicit Connection Elimination Program

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Describe your Illicit Connection Elimination Program, and explain how you plan on responding to complaints and/or reports of illicit connections (e.g., hotlines, etc.). Attach additional pages as necessary.

Gloucester County, through the GCIA outfall mapping, is identifying potential illicit connections. The Illicit Connection Inspection Report Form or a similar spreadsheet or database will be used to record the collected information. This information will be used to complete the Annual Report and to update Form 8.

Outfall pipes found to have dry weather flow or intermittent non-stormwater flow will be tested following the NJDEP's illicit connection testing protocol. If the test results are positive, efforts will be made to identify the location and source of the illicit connection. Illicit connections associated with the County will be eliminated within 6 months of their discovery. Illicit connections from other public or private sources will be reported to the source and to the appropriate County or local health department for enforcement. A written explanation of all illicit connection investigations and their outcome will be prepared and sent to the NJDEP. Illicit connections from private sources will be reported to the NJDEP. If the illicit connection posees an immediate threat, the NJDEP hotline will be contacted and separate writtten notification will be sent to the NJDEP.

SPPP Form 8 – Illicit Connection Records

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Prior to July 1, 2006

Note: *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*

Total number of inspections performed this year? _____

Number of outfalls found to have a dry weather flow? _____

Number of outfalls found to have an illicit connection? _____

How many of the Highway Agency's own illicit connections were eliminated? _____

Of the Highway Agency's own illicit connections found, how many remain? _____

How many illicit connections found to emanate from another entity were reported to NJDEP? ___

July 1, 2006 – June 30, 2007

Note: *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*

Total number of inspections performed this year? _____

Number of outfalls found to have a dry weather flow? _____

Number of outfalls found to have an illicit connection? _____

How many of the Highway Agency's own illicit connections were eliminated? _____

Of the Highway Agency's own illicit connections found, how many remain?_____

How many illicit connections found to emanate from another entity were reported to NJDEP? ____

July 1, 2007 – June 30, 2008

Note: *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*

Total number of inspections performed this year? _____

Number of outfalls found to have a dry weather flow? _____

Number of outfalls found to have an illicit connection? _____

How many of the Highway Agency's own illicit connections were eliminated? _____

Of the Highway Agency's own illicit connections found, how many remain?_____

How many illicit connections found to emanate from another entity were reported to NJDEP? ____

July 1, 2008 – June 30, 2009 ***Note:*** *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*
Total number of inspections performed this year? _____
Number of outfalls found to have a dry weather flow? _____
Number of outfalls found to have an illicit connection? _____
How many of the Highway Agency's own illicit connections were eliminated? _____
Of the Highway Agency's own illicit connections found, how many remain? _____
How many illicit connections found to emanate from another entity were reported to NJDEP? ____

SPPP Form 9 – Litter Pick Up Program

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Please describe your litter pick up program. Be sure to include the refuse collection schedule and detail how rest area, service area, and roadside clean ups will be implemented.
(NOTE: Attach a litter pick up log containing the following information: dates of roadside clean ups and estimates of the total amount of trash and debris collected.)

There are no rest areas, picnic areas, or other roadside areas or receptacles owned or maintained by the Gloucester County Highway Division. The County Highway Division does routinely inspect county roadway rights-of way for litter and debris during routine maintenance operations. The county Highway Division also responds to calls from residents or motorists concerning debris in the rights-of way. Highway Division trucks are dispatched to cleanup and remove litter and debris along county roadways.

The Gloucester County Improvement Authority maintains an Adopt-a Highway program providing bags for litter and the county picks up the bags for disposal. The County Improvement Authority also conducts cleanup days, using volunteer groups (scouts) and keeps track of the amount of waste cleaned up.

SPPP Form 10 – Regulatory Mechanisms

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

For each regulatory mechanism, give the date of adoption. If not yet adopted, explain the development status: There are no rest areas or service areas in the county highway system.

Pet Waste _____

(NOTE: If the Highway Agency is not developing a pet waste regulatory mechanism because the Agency does not operate any rest areas or service areas for the Agency facilities subject to this permit, provide that explanation above.)

Improper Disposal of Waste _____

Wildlife Feeding _____

Illicit Connections _____

What is the nature of these regulatory mechanisms and how will they be enforced?

If your position is that the Highway Agency has no legal authority to adopt and/or enforce a mechanism to regulate pet waste disposal or wildlife feeding by the general public on Highway Agency property, attach a statement from your attorney supporting this position.

The Gloucester County Highway Division has no legal authority to adopt or enforce a mechanism to regulate pet waste and other waste disposal or wildlife feeding by the general public on Highway Division property (roads). A statement supporting this position from the County Counsel will be attached. Illicit connections are controlled through the operation and maintenance of the highway system and the illicit connection elimination program that will be conducted in conjunction with the highway system outfall mapping. If necessary, local municipal codes, ordinances and enforcement procedures will be utilized to enforce the elimination of any illicit connections.

SPPP Form 11 – Storm Drain Inlets (Retrofitting)

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

What type of storm drain inlet design will generally be used for retrofitting?

Repaving, repairing, reconstruction or alteration project name (attach additional pages as necessary)	Projected start date	Start date	Date of completion	# of storm drain inlets	# of storm drains with exemptions

Are you claiming any alternate device exemptions or historic place exemptions for any of the above projects? Please explain.

See attached list.

SPPP Form 12 – Street Sweeping and Road Erosion Control Maintenance

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Street Sweeping

Please describe the street sweeping schedule that you will maintain.
(NOTE: Attach a street sweeping log containing the following information: date and area swept, # of miles swept and the total amount of materials collected.)

The Gloucester County Highway Division has identified roads that require monthly street sweeping under the permit (commercial areas with speed limits less than 35mph with curbs and storm drains) has implemented a monthly street sweeping program. Gloucester County will maintain its existing street sweeping schedule for other county roads.

Road Erosion Control Maintenance

Describe your Road Erosion Control Maintenance Program, including how you will perform inspections and frequency. A list of all sites of roadside erosion and the repair technique(s) you will be using for each site should be attached to this form.
(NOTE: Attach a road erosion control maintenance log containing the following information: location, repairs, date)

Gloucester County will utilize existing road department emplyees to identify existing roadside erosion and perform inspections. Erosion sites will be repaired in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey. Maintenance personnel will keep an inspection log including a list of repairs and the dates that the repairs were completed. The list will be included in the Annual Report and Certification.

SPPP Form 13 – Stormwater Facility Maintenance

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Please describe your annual catch basin cleaning program and schedule. Attach additional pages as necessary.

The Gloucester County Highway Division inspects, and if necessary cleans, catch basins at least once per year in accordance with the permit standards. Catch basins found to be in disrepair are identified and maintenance is scheduled.

Material (debris) removed from catch basins is disposed in accordance with the NJDEP Division of Solid and Hazardous Waste standards. Material is hauled to the GCIA landfill for disposal. Solid wastes will be tested in accordance with the landfills requirements.

Please describe your stormwater facility maintenance program for cleaning and maintenance of all stormwater facilities operated by the Highway Agency. Attach additional pages as necessary.

(NOTE: Attach a maintenance log containing information on any repairs/maintenance performed on stormwater facilities to ensure their proper function and operation.)

The Gloucester County Highway Division is developing and implementing a stormwater facilitiy maintenance program that ensures proper operation of the highway division's stormwater facilities. These include inlets, catch basins, pipes, swales, ponds and seperators. These facilities are regularly inspected and major repairs included in the capital program. Routine maintenance and repairs are performed by the Highway Division staff on a routine basis.

Further, the Highway Division is aware of stormwater facilities that require increased levels of maintenace in order to avoid blockages and flooding. These locations are more frequently inspected and maintained.

SPPP Form 14 - Roadside Vegetation Management

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Describe your roadside vegetation management program to limit the application of herbicides and mulch. Attach additional pages as necessary.

The Gloucester County Highway Division does not use herbicides and will not apply them outside the prescribed two-foot radius of any structure for which it is impractical to mow around. Should workers use herbicides, they will be trained in the NJPDES permit requirements and in proper application methods.

In addition, low maintenance plantings (wildflowers and other vegetation types) will be used along county highways where mowing is difficult or impossible (steep slopes, naturally wet areas, highway shoulders etc.)

SPPP Form 15 - Outfall Pipe Stream Scouring Remediation

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Describe your stormwater outfall pipe scouring detection, remediation and maintenance program to detect and control active, localized stream and stream bank scouring. Attach additional pages as necessary.

(NOTE: Attach a prioritized list of sites observed to have scouring, date of anticipated repair, method of repair and date of completion.)

The Gloucester County Highway Division, through the GCIA, has developed and implemented a stormwater outfall pipe stream scouring detection, remediation and maintenance program to control localized stream and stream bank scouring in the vicinity of the highway system outfall pipes. The initial inspection of stream scour will be conducted with the outfall pipe mapping activities, and scour information will be included in the GIS, following the protocol developed by the DVRPC. Priorities for repair of scour will be established based on these initital inspections and a schedule developed for the repairs, including state and federal permits. Repairs that do not require state or federal permits will be accomplished first. The design of repairs will be in accordance with the Standards of Soil Erosion and Sediment Control in New Jersey.

SPPP Form 16 – De-icing Material Storage

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

De-icing Material Storage

Describe how you currently store your highway agency's de-icing materials, and describe your inspection schedule. If your current storage practices do not meet the de-icing material storage SBR describe your construction schedule and your seasonal tarping interim measures. If you plan on sharing a storage structure, please include its location, as well as a complete list of all concerned public entities. If you store sand outdoors, describe how it meets the minimum standard.

The Gloucester County Highway Division currently stores deicing materials in a covered strorage shed at the Clayton facility. Seasonal "tarping" will be used as an interim measure at the Swedesboro and Mantua facilities until a permanent storage structure is in place.

SPPP Form 17 – Standard Operating Procedures

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

BMP	Date SOP went into effect	Describe your inspection schedule
Fueling Operations (including the required practices listed in Attachment D of the permit)	July 1, 2005	Inspections monthly
Vehicle Maintenance (including the required practices listed in Attachment D of the permit)	July 1, 2005	Inspections monthly
Good Housekeeping Practices (including the required practices listed in Attachment D of the permit) **Attach inventory list required by Attachment D of the permit**	July 1, 2005	Inspections monthly

SPPP Form 18 – Employee Training

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

Team Member/Title: Ralph Brownlee

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Describe your employee training program. For each required topic, list the employees that will receive training on that topic, and the date the training will be held. Attach additional pages as necessary.

The Gloucester County Highway Division employee training will be conducted in groups including those employees that are involved or affected by each of the permit compliance issues. The County proposes the following groupings and schedule for training.

(1) **Waste Disposal Control** - If any County controls are adopted, training to be discussed inconjunction with Form 10- Regualtory Mechanisms and an explanation of appropriate training inserted here.

(2) **Stormwater Facility Maintenance** - This training will involve the stormwater permit requirements for county owned stormwater facilities and the maintenace yard. NJPDES permit compliance requirements including periodic inspections, record keeping and rehabilitation will be addressed. The training will cover catch basin cleaning, debris disposal, problematic portions of the stormwater system, and the maintenace yard operating procedures.

(3) **Outfalls** - This training will involve outfall pipe mapping, illicit connection elimination, and outfall related stream scour. The training will involve only those employees involved with these portions of the NJPDES highway agency stormwater general permit compliance and may include a consultant. The GIS, GPS and data acquisition requirements will be discussed and include training for field evaluation of pipe, flow and stream bank conditions.

(4) **Roadsides and Repaving** - This training will involve roadside vegetation management, roadside erosion and Adopt-A-Highway. The training will involve only those emoployees involved with roadside maintenance and repaving. The new inlet requirements, inlet retrofitting requirements, and inlet labeling requirements will also be addressed as part of this training.

(5) **New Construction and Redevelopment** - Stormwater requirements for design engineering including the new stormwater regulations, BMPs and the BMP maintenace requirements will be discussed at this training session. Appropriate representative from the engineering, Highway Division, and the planning departments will be in attendance.

Stormwater Pollution Prevention Plan

NJPDES Highway Agency Stormwater General Permit

Highway Agency Name: Gloucester County

NJPDES # : NJG 0141887 PI ID #: 228439

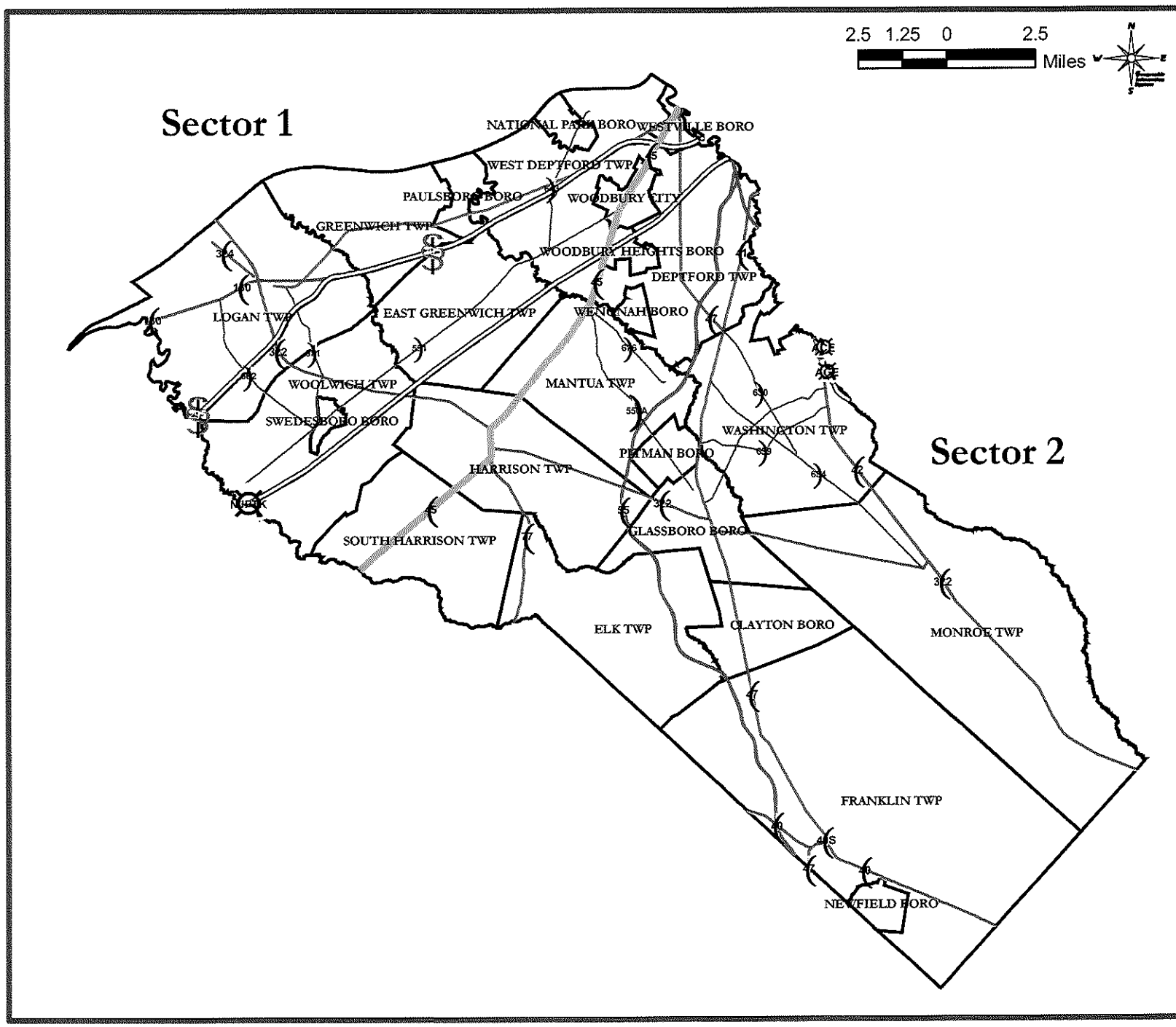
Team Member/Title: Larry Haynes, Sr.

Effective Date of Permit Authorization (EDPA): May 1, 2004

Date of Completion: May 1, 2005 Date of most recent update: April 28, 2006

Signature _____ **Date** April 28, 2006

Print or Type Name and Title Larry Haynes, Sr., Stormwater Program Coordinator



Gloucester County Highway Divison

Figure No. 1

SECTOR MAP

Legend

- Municipal Boundary
- Sector Lines for Inlets and Outfalls

Roads (as mapped by NJDOT)

Type

- Interstate
- Toll Road
- US Highway
- State Highway
- County Route

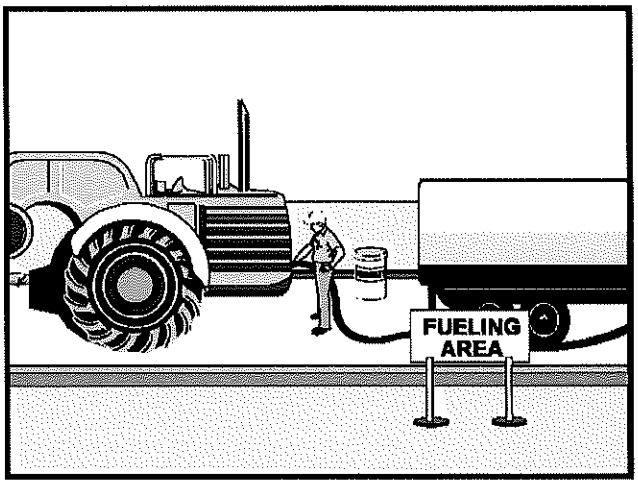
Gloucester County Improvement Authority
Freeholder Director
Stephen M. Sweeney, Liaison

Gloucester County, New Jersey, USA
Dated: 07/28/05 Drawn By: SEB

Note:
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Operating Procedures

Gloucester County Highway Division
Standard Operating Procedures
Vehicle and Equipment Fueling



Gloucester County Highway Division Maintenance Yards with Fueling Operations

Clayton, Mantua and Swedesboro Yards

Introduction and Purpose

Vehicle and equipment fueling procedures and practices are designed to minimize pollution of surface or ground waters. Understanding the procedures for delivering fuel into vehicles, mobile fuel tanks, and storage tanks is critical for this purpose. Safety is always the priority.

Scope

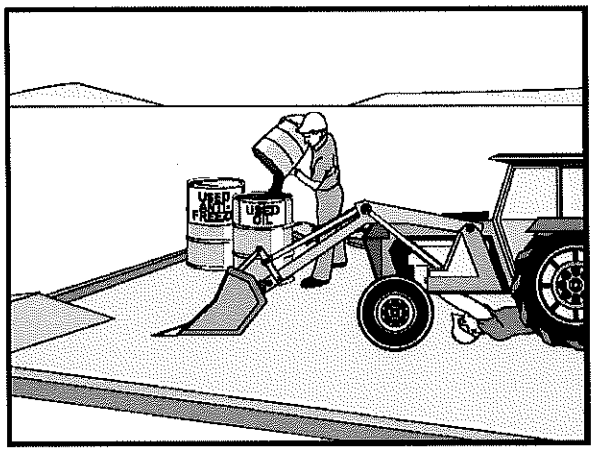
These procedures are to be implemented at all maintenance yards with fueling, including mobile fueling operations.

Standards and Specifications (for vehicle and equipment fueling)

- Shut the engine off
- Ensure that the fuel is the proper type of fuel.
- Absorbent spill clean-up materials and spill kits shall be available in fueling areas and on mobile fueling vehicles and shall be disposed of properly after use.
- Nozzles used in vehicle and equipment fueling shall be equipped with an automatic shut-off to prevent overfill.
- Fuel tanks shall not be "topped off."
- Mobile fueling shall be minimized. Whenever practical, vehicles and equipment shall be transported to the designated fueling area in the maintenance yard.
- Clearly post, in a prominent area of the facility, instructions for safe operation of fueling equipment, and appropriate contact information for the person(s) responsible for spill response.

Standards and Specifications (for bulk fueling)	• Drip pans or absorbent pads shall be used under all hose and pipe connections and other leak-prone areas during bulk fueling. • Block storm sewer inlets, or contain tank trucks used for bulk transfer, with temporary berms or temporary absorbent booms during the transfer process. If temporary berms are being used instead of blocking the storm sewer inlets, all hose connection points associated with the transfer of fuel must be within the temporary berms during the loading/unloading of bulk fuels. • Protect fueling areas with berms and/or dikes to prevent run-on, runoff, and to contain spills. • A trained employee must always be present to supervise during bulk transfer.
Spill Response	• Conduct cleanups of any fuel spills immediately after discovery. • Uncontained spills are to be cleaned using dry cleaning methods only. Spills shall be cleaned up with a dry, absorbent material (e.g., kitty litter, sawdust, etc.) and absorbent materials shall be swept up. • Collected waste is to be disposed of properly. • Contact a Gloucester County Highway Division Supervisor or Emergency Number (856) 307-6410.
Maintenance and Inspection	• Fueling areas and storage tanks shall be inspected monthly. • Keep an ample supply of spill cleanup material on the site. • Any equipment, tanks, pumps, piping and fuel dispensing equipment found to be leaking or in disrepair must be repaired or replaced immediately.

Gloucester County Highway Division
Standard Operating Procedures
Vehicle Maintenance



Gloucester County Highway Division Maintenance Yards BMP Objectives

-Waste Management
-Spill Prevention, Containment and Countermeasures
-Pollution Control

Introduction and Purpose

This SOP contains the basic practices of vehicle maintenance to be implemented at all maintenance yards including maintenance activities at ancillary operations for the Gloucester County Highway Division. The purpose of this SOP is to provide a set of guidelines for the Highway Division vehicle maintenance yards including maintenance activities at ancillary operations.

Scope

This SOP applies to all maintenance yards including maintenance activities at ancillary operations within the Gloucester County Highway Division.

Standards and Specifications

- Conduct vehicle maintenance operation only in designated areas.
- Whenever possible, perform all vehicle and equipment maintenance at an indoor location with a paved floor.
- Always use drip pans.
- Absorbent spill clean-up materials shall be available in maintenance areas and shall be disposed of properly after use.
- Maintenance areas shall be protected from stormwater run-on and runoff, and shall be located at least 50 from feet downstream drainage facilities and watercourses.
- Use portable tents or construct a roofing-device over long-term maintenance areas and for projects that must be performed outdoors.

- Do not dump or dispose oils, grease, fluids, and lubricants onto the ground.
- Do not dump or dispose batteries, used oils, antifreeze and other toxic fluids into a storm drain or watercourse.
- Do not bury tires.
- Collect waste fluids in properly labeled containers and dispose properly.

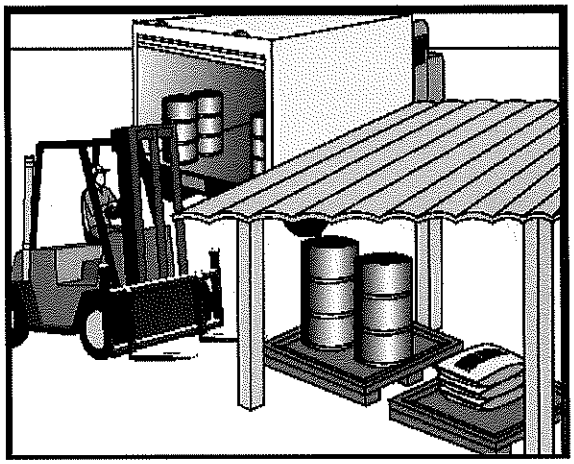
Spill Response and Reporting

- Provide spill containment dikes or secondary containment around stored oils and other fluid storage drum(s).
- Conduct cleanups of any fuel spills immediately after discovery.
- Spills are to be cleaned using dry cleaning methods only. Spills shall be cleaned up with a dry, absorbent material (e.g., kitty litter, sawdust, etc.) and the rest of the area is to be swept.
- Collected waste is to be disposed of properly.
- Contact a Gloucester County Highway Division Supervisor or Emergency Number (856) 307-6410.

Maintenance and Inspection

- Periodically check for leaks and damaged equipment and make repairs as necessary.

Gloucester County Highway Division
Standard Operating Procedures
Good Housekeeping



Gloucester County Highway Division
Good Housekeeping
Goals

-Proper Recycling
-Proper Waste Disposal
-Pollution Prevention

Introduction and Purpose

This SOP contains the basic practices of good housekeeping to be implemented at maintenance yards including maintenance activities at ancillary operations for the Gloucester Highway Division. The purpose of this SOP is to provide a set of guidelines for the employees of Gloucester County Highway Division for Good Housekeeping Practices at their maintenance yards including maintenance yards at ancillary operations.

Scope

This SOP applies to all maintenance yards including maintenance activities at ancillary operations in Gloucester County.

Standards and Specifications (General)

- All containers should be properly labeled and marked, and the labels must remain clean and visible.
- All containers must be kept in good condition and tightly closed when not in use.
- When practical, chemicals, fluids and supplies should be kept indoors.
- If containers are stored outside, they must be covered and placed on spill platforms.
- Keep storage areas clean and well organized.
- Spill kits and drip pans must be kept near any liquid transfer areas, protected from rainfall.
- Absorbent spill clean-up materials must be available in maintenance areas and shall be disposed of properly after use.
- Place trash, dirt and other debris in the dumpster.
- Collect waste fluids in properly labeled containers and dispose of them properly.
- Establish and maintain a recycling program by disposing papers, cans, bottles and trash in designated bins.

Standards and Specifications (Salt and De-icing Material Handling)

- During loading and unloading of salt and de-icing materials, prevent and/or minimize spills. If salt or de-icing materials are spilled, remove the materials using dry cleaning methods. All collected materials shall be either reused or properly discarded.
- Sweeping should be conducted once a week to get rid of dirt and other debris. Sweeping should also be conducted immediately following loading/unloading activities, when practical.
- Minimize the tracking of materials from storage and loading/unloading areas.
- Minimize the distance that salt and de-icing materials are transported during loading/unloading activities.
- Any materials that are stored outside must be tarped when not actively being used.
- If interim seasonal tarping is being implemented, de-icing materials may be stored outdoors only between October 15th through April 30th.

Spill Response and Reporting

- Conduct clean up of any spill(s) immediately after discovery.
- Spills are to be cleaned using dry cleaning methods only.
- Contact a Gloucester County Highway Division Supervisor or Emergency Number (856) 307-6410.

Maintenance and Inspection

- Periodically check for leaks and damaged equipment and make repairs as necessary.
- Perform monthly inspections of all (indoor and outdoor if applicable) storage locations.

Maintenance Yard
Inventory

Record Keeping Logs

Illicit Connection Inspection Report Form

Municipality Information

Municipality: _____ County _____

NJPDES # :_____ PI ID #: _____

Team Member: _____

Date _____Effective Date of Permit Authorization (EDPA): _____

Outfall #: _____ Location: _____

Receiving Waterbody: _____

1. Is there a dry weather flow? Y ( ) N ( )
2. If "YES", what is the outfall flow estimate? _____ gpm
   (flow sample should be kept for further testing, and this form will need to be submitted with the Annual Report and Certification)
3. Are there any indications of an intermittent flow? Y ( ) N ( )
4. If you answered "**NO**" to BOTH question #1 and #3, there is probably not an illicit connection and you can skip to question #7.
   (NOTE: This form **does not** need to be submitted to the Department, but should be kept with your SPPP.)

   If you answered "**YES**" to either question, please continue on to question #5.
   (NOTE: This form will need to be submitted to the Department with the Annual Report and Certification.)

5. **PHYSICAL OBSERVATIONS**:

(a) **ODOR**: none sewage sulfide oil gas rancid/sour other: _____

(b) **COLOR**: none yellow brown green red gray other: _____

(c) **TURBIDITY**: none cloudy opaque

(d) **FLOATABLES**: none petroleum sheen sewage other: _____

(e) **DEPOSITS/STAINS**: none sediment oily other: _____

(f) **VEGETATION CONDITIONS**: normal excessive growth inhibited growth

(g) **DAMAGE TO OUTFALL STRUCTURES**:

IDENTIFY STRUCTURE: _____

DAMAGE: none concrete spalling/cracking peeling paint
metal corrosion other damage _____

6. **ANALYSES OF OUTFALL FLOW SAMPLE:**
   * field calibrate instruments in accordance with manufacturer's instructions prior to testing.

(a) **DETERGENTS**: _____ mg/L

(if sample is greater than 0.06 mg/L, the sample is contaminated with detergents [which may be from sanitary wastewater or other sources]. Further testing is required and this outfall should be given the highest priority.)

(if the sample is not greater than 0.06 mg/L and it does not show physical characteristics of sanitary wastewater [e.g., odor, floatables, and/or color] it is unlikely that it is from sanitary wastewater sources, yet there may still be an illicit connection of industrial wastewater, rinse water, backwash or cooling water. Skip to question #6c.).)

(b) **AMMONIA (as N) TO POTASSIUM RATIO:** _____

(if the Ammonia to Potassium Ratio is greater than 0.6:1, then it is likely that the pollutant is sanitary sewage)

(if the Ammonia to Potassium Ratio is less than or equal to 0.06:1, then the pollutant is from another washwater source.)

(c) **FLUORIDE:** _____ mg/L

(if the fluoride levels are between 1.0 and 2.5 mg/L, then the flow is most likely from fluoride treated potable water.)

(if the sample tests below a detection limit of 0.1 mg/L for fluoride, it is likely to be from groundwater infiltration, springs or streams. In some cases, however, it is possible that the discharge could originate from an onsite well used for industrial cooling water which will test non-detect for both detergents and fluoride. To differentiate between these cooling water discharges and ground water infiltration, you will have to rely on temperature.)

(d) **TEMPERATURE:** _____ °F

(if the temperature of the sample is over 70°F, it is most likely cooling water)

(if the temperature of the sample is under 70°F, it is most likely from ground water infiltration)

7. Is there a suspected illicit connection? Y ( ) N ( )

   If "**YES**", what is the suspected source? _____

   If "**NO**", skip to signature block on the bottom of this form.

8. Has the investigation of suspected illicit connection been completed? Y ( ) N ( )

   If "**YES**", proceed to question #9.

   If "**NO**", skip to signature block on the bottom of this form.

9. Was the source of the illicit connection found? Y ( ) N ( )

   If "**YES**", identify the source: _____

   What plan of action will follow to eliminate the illicit connection? _____

   _____

   _____

   _____

   _____

   _____

   Resolution: _____

   _____

   _____

   _____

   _____

   If "NO", complete the Closeout Investigation Form and attach it to this Illicit Connection Inspection Report Form.

Inspector's Name:	_____
Title:	_____
Signature:	_____
Date:	_____

If there is a dry weather flow or evidence of an intermittent flow, be sure to include this form with your Annual Report and Certification.

If there is not a dry weather flow or evidence of an intermittent flow, this form should be retained with your SPPP.

Closeout Investigation Form

Municipality Information

Municipality: _____ County _____

NJPDES # : **NJG** _____ PI ID #: _____

Team Member / Title: _____

Outfall #: _____ Location: _____

Receiving Waterbody: _____

Basis for Submittal:

( ) A non-stormwater discharge was found, but no source was located within six months.

( ) An intermittent non-stormwater discharge was observed, and three unsuccessful investigations were conducted to investigate the discharge while it was flowing.

Describe each phase of your investigation, including dates. Attach additional pages as necessary: _____

Inspector's Name: _____

Title: _____

Signature: _____

Date: _____

Complete and attach this form to the appropriate Illicit Connection Inspection Report Form and submit with the annual certification.

Road Erosion Control Maintenance Log

Erosion Site	Date Identified	Repair Technique	Date Completed

Street Sweeping Log

Area Swept	Date	Miles Swept	Amount of Materials Collected

Outfall Pipe Stream Scouring Log

Site Number	Description of Scour Problem	Date Identified	Method of Repair	Date of Anticipated Repair	Date Completed

Storm Drain Inlet Labeling Log

Site	Date Labeled	Label Type	Comments

Storm Drain Inlet Retrofitting Log

Project Name	Projected Start Date	Start Date	Date Completed	Inlets (#)	Exemptions

Annual Reports

Annual Report and Certification
Highway Agency Stormwater General Permit

Highway Agency Name: Gloucester County

NJPDES # :NJG 0155373 PI ID #: 228000

Team Member: Jerry Lovell

Date July 1, 2005 Effective Date of Permit Authorization (EDPA): May 1, 2004

Stormwater Pollution Prevention Plan

Have you prepared a Stormwater Pollution Prevention Plan that describes your Stormwater Program?
Y (X) N ( )

Does the SPPP include all of the information and items required by the permit (including Attachment A)?
Y (X) N ( )

Is the SPPP signed and dated? Y (X) N ( ) Date SPPP signed: May 1, 2005

Is the SPPP retained by your Stormwater Program Coordinator? Y (X) N ( )

Was the SPPP amended since the last annual report? Y ( ) N (X)

If so, in general terms, what was amended? _____

_____

_____

_____

_____

_____

Public Notice

Are you complying with applicable State and local public notice requirements when providing for public participation in the development and implementation of your stormwater program?
Y (X) N ( )

Annual Report and Certification

Highway Agency Stormwater General Permit

Highway Agency Name: Gloucester County

NJPDES # :NJG 0155373 PI ID #: 228000

Team Member: Jerry Lovell

Date July 1, 2005 Effective Date of Permit Authorization (EDPA): May 1, 2004

Post-Construction Stormwater Management in New Development and Redevelopment

Are you ensuring adequate long-term operation and maintenance of BMPs on property that you own or operate? Y (X) N ( )

For storm drain inlets that you install, are you complying with the standard set forth in Attachment C of the permit to control passage of solid and floatable materials? Y (X) N ( )

For major development on property that you own or operate, have you adopted applicable design and performance standards established under N.J.A.C. 7:8 pursuant to Part I, Section F.3.a.i of the permit? Y (X) N ( ) Resolution under review by County solicitor

Name and type of written document(s) through which you adopted and require compliance with these standards (for example, resolution, ordinance, regulations, order, or memorandum issued by your governing body, ranking elected official, principal executive officer, or duly authorized official; changes to your policy and/or procedures manual, design manual, and/or stormwater manual):

Using BMP Manual and the Highway Agency Project Checklist. Also, a resolution is under review for adoption by the County.

Date you adopted these standards: June 1, 2005

Status of this document(s) (if these standards not yet adopted): _____

For new development or redevelopment projects that are not grandfathered (i.e., not exempted under N.J.A.C. 7:8-1.6(b)), does the document(s) require completion of the Post-Construction Program Design Checklist for Individual Projects before you approve the project's construction? Y (X) N ( )

For major development on property that you own or operate, are you implementing these standards pursuant to Part I, Section F.3.a.i of the permit? Y (X) N ( )

Date when your adopted standards are in effect: June 1, 2005

Provide the following information for each new development or redevelopment project that is regulated by the Highway Permit, and not exempted under N.J.A.C. 7:8-1.6(b). After a project is listed in an annual report as completely constructed, do not include that project in subsequent annual reports.

Project Name Municipality/County[1]	Description (e.g., new alignment, widening, etc.)	Acres of Disturbance[2]	Acres of Add'l Imperv. Surface[2]	LURP Permit Required? (Y, P, N)[3]	Design Checklist for Individual Projects Completed? (Y/N)	Waiver Claimed Under N.J.A.C. 7:8-5.2(e)? (Y/N)	Approved for Construction? (Y/N)	Construction Completed? (Y/N)

[1]Omit county if the Highway Agency is a county, or operates in only one New Jersey county

[2]Add "(est.)" after number of acres, if number of acres is estimated, approximate, or preliminary

[3]"LURP Permit Required" means that an NJDEP Land Use Regulation Program permit (stream encroachment permit; freshwater wetlands permit or transition area waiver; CAFRA, coastal wetlands, or waterfront development permit) has been or must be secured for the project.

Y = entire project requires a LURP Permit P = part of the project requires a LURP Permit N = none of the project requires a LURP Permit

Annual Report and Certification

Highway Agency Stormwater General Permit

Highway Agency Name: Gloucester County

NJPDES # :NJG 0155373 PI ID #: 228000

Team Member: Jerry Lovell

Date July 1, 2005 Effective Date of Permit Authorization (EDPA): May 1, 2004

Local Education Program

Local Public Education Program

Have you developed a Local Public Education Program? Y (X) N ( )

Date development of program completed: June 1, 2005

Are you providing educational materials at rest areas and service areas along your MS4?

Y ( ) N ( ) N/A – no service or rest areas. Materials made available at the County Public Works building and library and will eventually be on the web.

Storm Drain Inlet Labeling

Have you established a storm drain inlet labeling program? Y (X) N ( )

Have you divided your highway agency into two sectors for the purpose of storm drain inlet labeling?

Y (X) N ( )

If "yes," circle number of sectors labeled to date: 0 1 2

If "no," please check approximate percentage of storm drain inlets labeled to date:

25% 50% 75% 100% other (specify) _____% N/A at this time

Have you developed a long term maintenance plan for the storm drain inlet labels? Y (X) N ( )

Are you implementing your long-term maintenance plan? Y ( ) N ( ) N/A at this time

Annual Report and Certification

Highway Agency Stormwater General Permit

Highway Agency Name: Gloucester County

NJPDES # :NJG 0155373 PI ID #: 228000

Team Member: Jerry Lovell

Date July 1, 2005 Effective Date of Permit Authorization (EDPA): May 1, 2004

Improper Disposal of Waste

Have you adopted and are you enforcing a:

Improper Disposal of Waste Regulatory Mechanism Y ( ) N (X) Date adopted: _____

Illicit Connection Regulatory Mechanism Y ( ) N (X) Date adopted: _____

Status of these regulatory mechanisms (if not adopted):
Under review by County Solicitor

Method(s) of enforcement (e.g., agency personnel disciplinary actions, fines, warnings, additional signs, etc.): N/A at this time

Do you operate any rest areas and/or service areas along your MS4? Y ( ) N (X)

If "yes," have you adopted and are you enforcing a:

Pet Waste Regulatory Mechanism Y ( ) N (X) Date adopted: _____

Wildlife Feeding Regulatory Mechanism Y ( ) N (X) Date adopted: _____

Status of these regulatory mechanisms (if not adopted): N/A – no rest/service areas

Method(s) of enforcement (e.g., fines, warnings, agency personnel disciplinary actions, additional signs, etc.): _____

Litter Pick Up Program

Have you developed a litter pick up program? Y ( ) N (X)

Roadside Clean Up Dates	Estimated Amount of Materials Collected
Adopt a Highway By Improvement Authority	N/A at this time - development underway

Annual Report and Certification

Highway Agency Stormwater General Permit

Highway Agency Name: Gloucester County

NJPDES # :NJG 0155373 PI ID #: 228000

Team Member: Jerry Lovell

Date July 1, 2005 Effective Date of Permit Authorization (EDPA): May 1, 2004

Illicit Connection Elimination and MS4 Outfall Pipe Mapping

Outfall Pipe Mapping

Number of sectors with MS4 outfall pipes mapped to date (please circle): 0 1 2

Date first sector completed: N/A at this time Date second sector completed: N/A at this time

Illicit Connection Elimination Program

Have you developed an Illicit Connection Elimination program? Y (X) N ( )

Date development of program completed: Program development underway

Have you begun the initial physical inspection of all outfall pipes using the NJDEP Illicit Connection Inspection Report form? Y ( ) N (X)

Number of outfalls physically inspected since July 1st of previous year: _____

Number of outfalls found to have dry weather flows during that period: _____

Number of outfalls found to have an illicit connection during that period: _____

Number of Highway Agency's own illicit connections found during that period: _____

Number of such illicit connections eliminated during that period: _____

Number of illicit connections found during that period to emanate from another entity: _____

Number of such illicit connections reported to the NJDEP during that period: _____

(For any outfalls found to have a dry weather flows, a copy of the inspection report shall be submitted with this Annual Report and Certification.)

Provide the following information for each outfall found to have an illicit connection since July 1st of previous year.

Outfall Identifier	Source of Illicit Connection (including whether source is from Highway Agency or another entity)	Date Eliminated, or Reported to NJDEP (indicate which)

Annual Report and Certification

Highway Agency Stormwater General Permit

Highway Agency Name: Gloucester County

NJPDES # :NJG 0155373PI ID #: 228000

Team Member: Jerry Lovell

Date July 1, 2005 Effective Date of Permit Authorization (EDPA): May 1, 2004

Street Sweeping Program

Have you developed a Street Sweeping Program? Y(X) N ( ) Program development underway

Were all required streets swept? Y ( ) N ( ) N/A at this time

Did you sweep more than the required streets? Y (X) N ( )

What was the total number of miles swept? _____ miles. N/A at this time

Please list the total amount of materials collected for each month since July 1st of previous year :

July _____

August _____

September _____

October _____

November _____

December _____

January _____

February _____

March _____

April _____

May _____

June _____

If street sweeping was not completed for any of these months, please explain: _____

_____

_____

_____

_____

_____

_____

_____

Annual Report and Certification

Highway Agency Stormwater General Permit

Highway Agency Name: Gloucester County

NJPDES # :NJG 0155373 PI ID #: 228000

Team Member: Jerry Lovell

Date July 1, 2005 Effective Date of Permit Authorization (EDPA): May 1, 2004

Storm Drain Inlet Retrofitting

Were all storm drain inlets in direct contact with repaving, repairing, reconstruction or alterations retrofitted or replaced to meet the standard? Y (X) N ( )

Attach a sheet indicating areas where there were repaving, repairing, reconstruction, or alteration projects.

Attach a list of storm drain inlets that were exempted as a part of these projects.

Outfall Pipe Stream Scouring Remediation

Have you developed an Outfall Pipe Stream Scouring Remediation Program? Y ( ) N (X)
Date development of program completed: N/A at this time - development underway

Program Status

Location of Outfall Pipe (including alphanumeric identifier)	Repair Start Date	Repair Complete Date

Annual Report and Certification

Highway Agency Stormwater General Permit

Highway Agency Name: Gloucester County

NJPDES # :NJG 0155373 PI ID #: 228000

Team Member: Jerry Lovell

Date July 1, 2005 Effective Date of Permit Authorization (EDPA): May 1, 2004

Stormwater Facility Maintenance

Have you developed a Stormwater Facility Maintenance Program? Y (X) N ( )

Date development of program completed: _____ Program development underway

Catch Basins:

Total number of catch basins that you operate:_____

Were all catch basins inspected and/or cleaned? Y ( ) N ( ) N/A at this time

Total number of catch basins cleaned: _____

Amount of materials removed from catch basins, if available: _____ tons / cubic yards

(circle one)

Other Stormwater Facilities:

Were all stormwater facilities (e.g., detention basins, filter strips, riparian buffers, infiltration trenches, sand filters, constructed wetlands, wet basins, bioretention systems, low flow bypasses, and stormwater conveyances) that you operate inspected? Y ( ) N ( ) N/A at this time

Were any found to be in need of cleaning or repair in order to function properly? Y ( ) N (X)

Was the cleaning performed? Y ( ) N (X) Were repairs made? Y ( ) N (X)

Describe repair(s) or schedule for repair(s). Attach additional pages as necessary. _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Annual Report and Certification

Highway Agency Stormwater General Permit

Highway Agency Name:_ Gloucester County

NJPDES # :NJG0155373 PI ID #: 228000

Team Member: Jerry Lovell

Date July 1, 2005 Effective Date of Permit Authorization (EDPA): May 1, 2004

Road Erosion Control Maintenance

Have you developed a Roadside Erosion Control Program? Y (X) N ( )

Date development of program completed: June 1, 2005

Were any areas of road erosion identified? Y ( ) N (X)

Attach a sheet identifying the dates of inspections, locations of road erosion and whether repairs have been made.

Roadside Vegetation Management

Have you developed a Roadside Vegetation Management Program? Y (X) N ( )

Date development of program completed: June 1, 2005

De-icing Material and Sand Storage

Are you currently using an existing permanent structure for de-icing material storage?
Y (X) N ( ) N/A ( ) Permanent at Clayton, but seasonal at Mantua and Swedesboro

If a permanent structure is not yet built, is seasonal tarping being used? Y (X) N ( ) N/A ( )

If you answered N/A to the above questions, please explain: _____

_____

_____

If sand is being stored outside, is it set back 50 feet from storm sewer inlets, ditches or other stormwater conveyance channels, and surface water bodies? Y (X) N ( ) N/A ( )

Fueling Operations

Are you implementing Standard Operating Procedures for vehicle fueling and receiving of bulk fuel deliveries at maintenance yard operations? Y (X) N ( ) Date SOP in effect: June 1, 2005

Vehicle Maintenance

Are you implementing Standard Operating Procedures for vehicle maintenance and repair activities at maintenance yard operations? Y (X) N ( ) Date SOP in effect: June 1, 2005

Good Housekeeping Practices

Are you implementing Good Housekeeping Practices for all materials or machinery listed in the Inventory Requirements for Maintenance Yard Operations (including maintenance activities and ancillary operations)? Y (X) N ( ) Date practices are in effect: June 1, 2005

Employee Training

Did you conduct an annual employee training program for appropriate employees on appropriate topics?
Y ( ) N (X) N/A at this time-development underway

Attach a sheet identifying the date(s) of the training programs.

Annual Report and Certification

Highway Agency Stormwater General Permit

Highway Agency Name: Gloucester County

NJPDES # :NJG 0155373 PI ID #: 228000

Date July 1, 2005Effective Date of Permit Authorization (EDPA): May 1, 2004

Sharing of Responsibilities

For each of the following, indicate if you are relying on another entity to satisfy all or part of any permit requirements. For those you checked "yes," please give additional information on the appropriate Annual Report and Certification form.

Statewide Basic Requirement	Relying on another entity? "yes"	"no"
Public Notice		X
Comply with applicable design and performance standards for major development (post-construction)		X
Long term operation and maintenance of BMPs (post-construction)		X
Storm drain inlet design standard (post-construction)		X
Local Public Education Program	X	
Storm Drain Inlet Labeling Program	X	
Pet waste regulatory mechanism		N/A
Litter pick up program	X	
Improper disposal of waste regulatory mechanism		N/A
Wildlife feeding regulatory mechanism	X	
Outfall pipe mapping		N/A
Illicit connection regulatory mechanism		N/A
Illicit connection elimination program	X	
Street sweeping		X
Storm drain inlet retrofitting		X
Stormwater facility maintenance		X
Road erosion control		X
Outfall pipe stream scouring		X
Roadside vegetation management		X
De-icing and sand storage	X	
Fueling operations		X
Vehicle maintenance		X
Good housekeeping		X
Employee Training	X	

Annual Report and Certification

Highway Agency Stormwater General Permit

Highway Agency Name: Gloucester County

NJPDES # :NJG 0155373PI ID #: 228000

Team Member: Jerry Lovell

Date July 1, 2005_Effective Date of Permit Authorization (EDPA): May 1, 2004

Incidents of Noncompliance

For any incidents of noncompliance, identify the steps being taken to remedy the noncompliance and to prevent such incidents from recurring.

1. Litter pickup program is under development and will be underway within the next few months.
2. Street sweeping program development underway – record keeping getting started.
3. Outfall pipe stream scour, illicit connection and outfall mapping to begin late summer or fall 2005.
4. Stormwater facility maintenance program under development –County does not have any existing BMPs.
5. Road erosion control program underway – record keeping getting started.
6. Inventory of maintenance yards will be prepared by fall 2005.

Annual Report and Certification

Highway Agency Stormwater General Permit

Highway Agency Name: GloucesterCounty

NJPDES # :NJG 0155373 PI ID #: 228000

Date July 1, 2005 Effective Date of Permit Authorization (EDPA): May 1, 2004

Annual Certification

"I certify under penalty of law that this Annual Report and Certification and all attached documents were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate this information. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering this information, the information in this Annual Report and Certification and all attached documents is, to the best of my knowledge and belief, true, accurate and complete.

"I certify that the Highway Agency is in compliance with its stormwater program, Stormwater Pollution Prevention Plan (SPPP) and the NJPDES Highway Agency Stormwater General Permit No. NJ0141887 except for any incidents of noncompliance which are identified herein. For any incidents of noncompliance, the Annual Report identifies the steps being taken to remedy the noncompliance and to prevent such incidents from recurring.

"I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information."

Signature _____ **Date** _____

Print or Type Name: Jerry K Lovell

Print or Type Title County Engineer

WHO MUST SIGN?

Either a principal executive officer or a ranking elected official; or duly authorized representative.

A principal executive officer or ranking elected official may assign his or her signatory authority for this Certification to a duly authorized representative, which is a named individual or a title of a position having overall responsibility for the operation of stormwater facilities or environmental matters, by submitting a letter to the Bureau of Permit Management stating said authority and naming the individual or position. The duly authorized representative is the Stormwater Program Coordinator only if the Coordinator has overall responsibility for the operation of stormwater facilities or environmental matters.

CAPITOL COUNTY

POLICY AND PROCEDURE No. ____ (DRAFT)

SUBJECT: Illicit Connections to Storm Sewers at County Highways

Effective Date: _____, 200_

Approved By: _____

Note: In the Highway Permit, the requirement to prohibit illicit connections is limited to MS4s at certain highways and other thoroughfares. However, a county or other Highway Agency may choose to prohibit illicit connections to all MS4s operated by the Highway Agency, including those located at county operated Public Complexes and other county operated facilities. Also, if an agency obtains both the Highway Permit and the Public Complex Permit, the agency could adopt a single policy and procedure to meet requirements in both permits.

I. Purpose

A policy and procedure to prohibit illicit connections by Capitol County to the municipal separate storm sewer system at county highways, so as to protect public health, safety and welfare, and to prescribe penalties for the failure to comply. This policy and procedure does not apply to any illicit connection which emanates from an entity other than Capitol County.

II. Definitions

For the purpose of this policy and procedure, the following terms, phrases, words, and their derivations shall have the meanings stated herein unless their use for the purpose of this policy and procedure clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "sh
directory. The definitions below are the same as or based on corresponding or related definitions in the New Jersey Pollutant Discharge Elimination System (NJPDES) rules at N.J.A.C. 7:14A-1.2.

a. Coun₩ highway – any highway or o₩er thoroughfare operated by Capitol County (including a maintenance facility or rest area for such a thoroughfare). For purposes of this policy and procedur₦ a "highway or o₩₦ ₩oroughlar₦" does not include:

1. Any thoroughfare confined to the grounds of one or more buildings; or
2. Any thoroughfare confined to a park or recreational area operated by Capitol County.

(Note: This draft definition omits highway service areas because Capitol County does not operate or plan to operate any highway service areas.)

b. Domestic sewage - waste and wastewater from humans or household operations.

c.

to the municipal separate storm sewer
that discharge is authorized under a

separate storm sewer s stem.

d.

e.
conv

collecting and conve ing stormwater.

ghway agencies that operate combined
"
ems that are designed to carry sanitary sewage at all times and to collect and transport stormwater

f.

g. to reduce temperature for the purpose

water ma howev or biocides to control fouling of equipment such as heat ex

h.
comes into direct contact with or results from the production or use of an raw

Process wastewater includes, but is not limited to, leachate and cooling water other than non-contact cooling water.

i. StorP water – water resulting froP precipitation (including rain and snow) that runs off the land's surface, is transP itted to the subsurface, is captured by separate storm sewers or other sewerage or drainage facilities, or is conveyed by snow removal equipment.

III. Prohibited Conduct

scharge or cause to be discharged, through an illicit connection to

CAPITOL COUNTY

POLICY AND PROCEDURE No. ____ (DRAFT)

SUBJECT: Improper Disposal of Waste Into Storm Sewers at County Highways

Effective Date: _____, 200_

Approved By: _____

Note: In the Highway Permit, the requirement to prohibit improper disposal of waste is limited to MS4s at certain highways and other thoroughfares. However, a county or other Highway Agency may choose to prohibit improper disposal of waste to all MS4s operated by the Highway Agency, including those located at county operated Public Complexes and other county operated facilities. Also, if an agency obtains both the Highway Permit and the Public Complex Permit, the agency could adopt a single policy and procedure to meet requirements in both permits.

I. Purpose

A policy and procedure to prohibit the spilling, dumping, or disposal, by Capitol County and its employees, of materials other than stormwater to the municipal separate storm sewer system (MS4) at county highways, so as to protect public health, safety and welfare, and to prescribe penalties for the failure to comply.

II. Definitions

For the purpose of this policy and procedure, the following terms, phrases, words, and their derivations shall have the meanings stated herein unless their use for the purpose of this policy and procedure clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shDl" is DwDys directory.

a. CounWhighwDy – Dhy highwDy or oWer thoroughfare operated by Capitol County (including a maintenance facility or rest area for such a thoroughfare). For purposes of this policy and procedurH D"highwDy or oWH WoroughIDH' does not include:
   1. Any thoroughfare confined to the gr
      or recreational area operated by Capitol County.

(Note: This draft definition omits highway service areas because Capitol County does not operate or plan to operate any highway service areas.)

b. Municipal separate storm sewer system (MS

owned or operated by Capitol County or other public body,

ghway agencies that operate combined

ems that are designed to carry sanitary sewage at all times and to collect and transport stormwater

c.

III. Prohibited Conduct

a.
municipal separate storm sewer sy

b.

IV. Exceptions to Prohibition

a.
b.

c.

e.

i.

1. Beach maintenance equipment immediately following their use for their intended purposes; and
2. Equipment used in the application of salt and de-icing materials immediately following salt and de-icing material applications. Prior to rinsing with clean water, all residual salt and de-icing materials must be removed from equipment and vehicles to the maximum extent practicable using dry cleaning methods (e.g., shoveling and sweeping). Recovered materials are to be returned to storage for reuse or properly discarded.

Rinsing of equipment in the above situations is limited to exterior, undercarriage, and exposed parts and does not apply to engines or other enclosed machinery.

V. Penalties

Any Capitol County officer or employee who continues to be in violation of the provisions of this policy and procedure, after being duly notified, shall be subject to removal, suspension, demotion, or other disciplinary action.

Draft Resolution - Pet Waste at Highway Rest Areas

Resolution # [ ] - Pet Waste at Highway Rest Areas

Notes:

1. *If Capitol County were governed under the Optional County Charter Act, 1.J.S.A. 40:41A-1 et seq., this "reso@tion" wou@ instead be an "ordinance" (see 1.J.S.A. 40:41A-27 and –101).*

2. *This draft resolution omits highway service areas because Capitol County does not operate or plan to operate any highway service areas.*

3. *equire ent is li ited to rest areas and service areas at certain highways hoose to regulate pet waste disposal property located at county operated P operated facilities. Also, if Capitol and the P tol County could adopt a single Pet aste resolution to eet req*

S T O . Purpose:
A resolution to establish requirements for the proper disposal of pet solid waste deposited at highway rest areas operated by Capitol County, so as to protect public health, safety and welfare, and to prescribe penalties for failure to comply.

S T O . Definitions:
For the purpose of this resolution, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

a. Highway rest area – any rest area, including any picnic area or scenic overlook, for a highway or other thoroughfare operated by Capitol County. For purposes of this resolution, a "highway or other thoroughfare" does not include:
   1. Any thoroughfare confined to the grounds of one or more buildings; or
   2. Any thoroughfare confined to a park or recreational area operated by Capitol County.
b. Immediate – shall mean that the pet solid waste is removed at once, without delay.
c. Owner/Keeper – any person who shall possess, maintain, house or harbor any pet or otherwise have custody of any pet, whether or not the owner of such pet.

d. Person – any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to County jurisdiction.
e. Pet - a domesticated animal (other than a disability assistance animal) kept for amusement or companionship.
f. Pet solid waste – waste matter expelled from the bowels of the pet; excrement.
g. Proper disposal – placement in a designated waste receptacle, or other suitable container, and discarded in a refuse container which is regularly emptied by the county or some other refuse collector; or disposal into a system designed to convey domestic sewage for proper treatment and disposal.

SECTION III. Requirement for Disposal:
All pet owners and keepers are required to immediately and properly dispose of their pet's solid waste deposited at highway rest areas operated by Capitol County.

SECTION IV. Exemptions:
Any owner or keeper who requires the use of a disability assistance animal shall be exempt from the provisions of this section while such animal is being used for that purpose.

SECTION V. Enforcement:
The provisions of this resolution shall be enforceable by any local or State police officer.

SECTION VI. Violations and Penalty:
Any person(s) convicted by a court of competent jurisdiction of violating this resolution shall be subject to a fine not to exceed **[insert amount]**.

SECTION VII. Severability:
Each section, subsection, sentence, clause and phrase of this resolution is declared to be an independent section, subsection, sentence, clause and phrase, and the finding or holding of any such portion of this resolution to be unconstitutional, void, or ineffective for any cause, or reason, shall not affect any other portion of this resolution.

SECTION VIII. Effective date:
This resolution shall be in full force and effect from and after its adoption and any publication as may be required by law.

ALL OF WHICH IS ADOPTED this _____ day of ____, 200_, by the Board of Chosen Freeholders of Capitol County.

Draft Resolution - Wildlife Feeding on Highway Property

Resolution # [ ] - Wildlife Feeding on Highway Property

Notes:

1. *If Capitol County were governed under the Optional County Charter Act, 1.J.S.A. 40:41A-1 et seq., this "resoQtion" wouQ instead be an "ordinance"*

at certain highways and other thoroughf

e wildlife feeding on any property
gency, including property located at
county operated facilities. Also,

A resolution to prohibit the feeding of unconfined wildlife, on any property owned or operated by Capitol County for county highways, so as to protect public health, safety and welfare, and to prescribe penalties for failure to comply.

SECTION II. Definitions:
For the purpose of this resolution, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

a. County highway– any highway or other thoroughfare operated by Capitol County (including a maintenance facility or rest area for such a thoroughfare). For purposes of this resolution, a "highway or other thoroughfare" does not include:
1. Any thoroughfare confined to the grounds of one or more buildings; or
2. Any thoroughfare confined to a park or recreational area operated by Capitol County.

(Note: This draft definition omits highway service areas because Capitol County does not operate or plan to operate any highway service areas.)

b. Feed – to give, place, expose, deposit, distribute or scatter any edible material with the intention of feeding, attracting or enticing wildlife. Feeding does not include baiting in the legal taking of fish and/or game.

c. Person – any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to county jurisdiction.
d. Wildlife – all animals that are neither human nor domesticated.

SECTION III. Prohibited Conduct:

a. No person shall feed, on any property owned or operated by Capitol County for a county highway, any wildlife, excluding confined wildlife (for example, wildlife confined in zoos, parks or rehabilitation centers, or unconfined wildlife at environmental education centers).

SECTION IV. Enforcement:

a. The provisions of this resolution shall be enforceable by any local or State police officer.
b. Any person found to be in violation of this resolution shall be ordered to cease the feeding immediately.

SECTION V. Violations and Penalties:

Any person(s) who is found to be in violation of the provisions of this resolution shall be subject to a fine not to exceed **[insert amount]**.

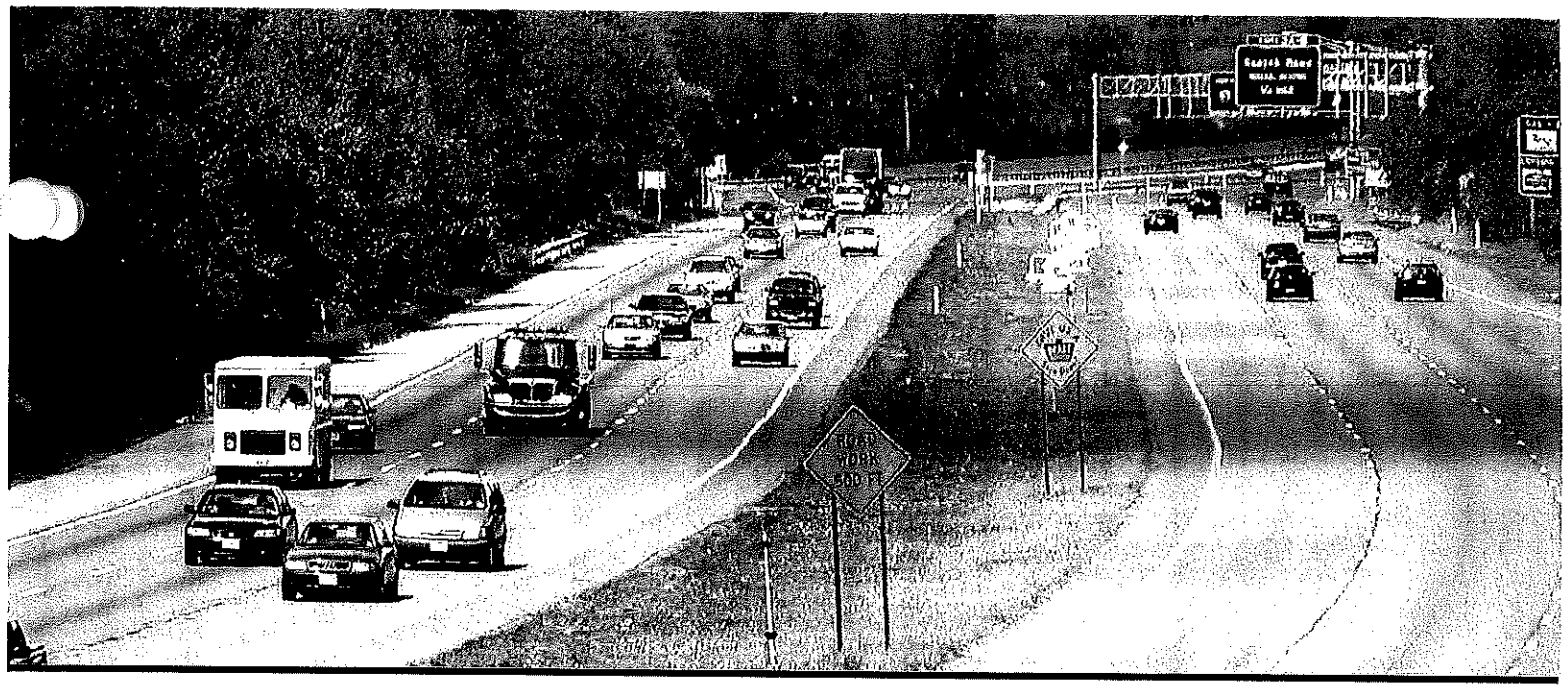
SECTION VI. Severability:

Each section, subsection, sentence, clause and phrase of this resolution is declared to be an independent section, subsection, sentence, clause and phrase, and the finding or holding of any such portion of this resolution to be unconstitutional, void, or ineffective for any cause, or reason, shall not affect any other portion of this resolution.

SECTION VII. Effective date:

This resolution shall be in full force and effect from and after its adoption and any publication as may be required by law.

ALL OF WHICH IS ADOPTED this _____ day of ____, 200_, by the Board of Chosen Freeholders of Capitol County.



Highway Agency

Stormwater Guidance Document

NJPDES General Permit No NJ0141887



New Jersey Department of Environmental Protection
Division of Water Quality
Municipal Stormwater Regulation Program

Highway Agency Stormwater Guidance Document

August 2004



State of New Jersey
Governor James E. McGreevey

New Jersey Department of Environmental Protection
Commissioner Bradley M. Campbell

Municipal Stormwater Regulation Program
Bureau of Nonpoint Pollution Control
Division of Water Quality

Acknowledgements

Barry Chalofsky, P.P., Chief
Bureau of Nonpoint Pollution Control
Division of Water Quality

Municipal Stormwater Regulation Team

The following members of the Department of Environmental Protection Municipal Stormwater Regulation Team, over the last three years, developed the Municipal Stormwater Regulation Program, including amendments to the New Jersey Pollutant Discharge Elimination System Stormwater rules (N.J.A.C. 7:14A), the municipal stormwater general permits, and guidance documents and supporting materials:

Bruce Friedman
William Minervini
Kimberly Maxwell
Janet Jessel
Fred Bowers
Cindy Davis
Matthew Klewin
Tosin Sekoni
Tara Wood
JulieAnn Zoleta

GIS Work and Mapping – Linda Coles

Additional Acknowledgements

The following employees of the Department of Environmental Protection have contributed in the preparation of this guidance document:

Sandra Blick
Kerry Kirk-Pflugh
Elizabeth Semple
John Laurita

Municipal Stormwater Advisory Group

The following members of the Municipal Stormwater Advisory Group assisted in the development of the Municipal Stormwater Regulation Programs:

Joseph Doyle, NJ Planning Officials
James DeMuro/Frank Scarantino,
NJ Association of Municipal Engineers/ NJ Association of Professional Engineers
Abigail Fair, Association of NJ Environmental Commissions
Andras Fekete, NJ Department of Transportation
Robert Simicsak, Township of Woodbridge
John Winterstella, NJ State League of Municipalities
Nancy Wittenberg, NJ Builders Association
Ray Zabihach, NJ Association of Counties

The program also included input from the New Jersey Department of Transportation's New Jersey Quality Initiative Group, with representatives of most of the State's transportation-related agencies and associations, and from the Best Management Practices Subcommittee composed of representatives from various municipal, county and state public works agencies.

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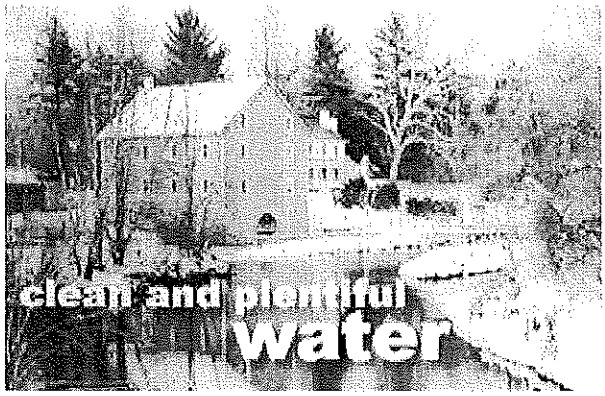
Chapter 1 - Introduction

BACKGROUND

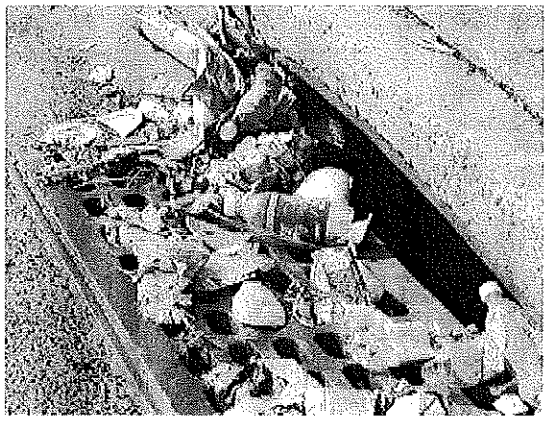


The Municipal Stormwater Regulation Program is part of the Clean and Plentiful Water initiative.

As result of the U. S. Environmental Protection Agency's (USEPA) Phase II rules published in December 1999, the New Jersey Department of Environmental Protection (Department) has developed the Municipal Stormwater Regulation Program. This program addresses pollutants entering our waters from certain storm drainage systems owned or operated by local, county, State, interstate, or federal government agencies. USEPA regulations refer to these systems as "municipal separate storm sewer systems" (MS4s). As a result of USEPA's new Phase II rules, the Department's Municipal Stormwater Regulation Program has issued New Jersey Pollutant Discharge Elimination System (NJPDES) permits to highway agencies, as well as public complexes, and municipalities throughout the state. Public complexes include certain large public colleges, prisons, hospital complexes and military bases. Highway Agencies include county, state, interstate, or federal government agencies that operate highways and other thoroughfares such as each of the 21 counties, the New Jersey Department of Transportation, the Port Authority of N.Y. and N.J., the New Jersey Turnpike Authority, and the South Jersey Transportation Authority. The Department's revised NJPDES stormwater rules were signed on January 5, 2004 by Commissioner Bradley Campbell, and appear in the February 2, 2004 edition of the New Jersey Register at 36 N.J.R. 813(a).

WHY IS THIS HAPPENING?

It is widely understood that stormwater/nonpoint sources are the largest remaining major source of pollutants in our waters. It is estimated that up to 60 percent of our existing water pollution problems are attributable to stormwater/nonpoint pollution. The quality of our surface and ground waters is directly related to the health of our ecosystems and the quality of our lives. Opportunities to engage in boating, swimming and fishing are diminished if water quality is impaired. Impaired water quality impacts shellfish production, tourism at beaches and coastal communities, and increases drinking water treatment costs.



"Floatables," like the trash seen here, contribute to stormwater/nonpoint pollution.

Stormwater/nonpoint pollution can often be linked to our daily activities and lifestyles. The way we plan communities, build shopping centers, commute, and maintain lawns all impact stormwater quality. Many times people do not know or understand that there are alternatives. For example, homeowners can have a green lawn without massive doses of fertilizers and pesticides, pet owners should deposit pet waste in the trash or in the toilet

and not leave it at the curb. Often there is a lack of public awareness. People are unaware that storm drains often discharge directly to water bodies. When people allow motor oil, trash, and their pet's waste to enter the storm sewer in their street, they don't realize that it may end up in the lake down the block or many miles away. Individually these acts may seem insignificant, but the cumulative impacts of these activities contribute to stormwater/nonpoint source pollution and reduce water quality.

USEPA and the State of New Jersey realize the critical importance of substantially reducing stormwater/nonpoint pollution entering into the waters of the state. The Municipal Stormwater Regulation Program attempts to do just that, through the implementation of Statewide Basic Requirements (SBRs) and Best Management Practices (BMPs) including public education, contained in the NJPDES Stormwater General Permits.

PROGRAM AND PERMIT DEVELOPMENT

The Department developed the Municipal Stormwater Regulation Program with input from members of the regulated community, affected governmental agencies, and the public. The Department established an advisory group that included representatives from the New Jersey Department of Transportation, municipalities and groups such as the New Jersey State League of Municipalities, New Jersey County Planners Association and the Association of New Jersey Environmental Commissions. A Best Management Practice subcommittee was also formed to assist in the development of practical best management practices for the general permits. This subcommittee included representatives of municipal and county public works departments, and the New Jersey Department of Transportation and other Highway Agencies.

PERMITS AND PERMIT REQUIREMENTS

The Department has issued four general permits to implement the Municipal Stormwater Regulation Program: the Highway Agency Stormwater General Permit (Highway Permit); the Public Complex Stormwater General Permit (Public Complex Permit); the Tier A Municipal Stormwater General Permit (Tier A Permit); and the Tier B Municipal Stormwater General Permit (Tier B Permit).



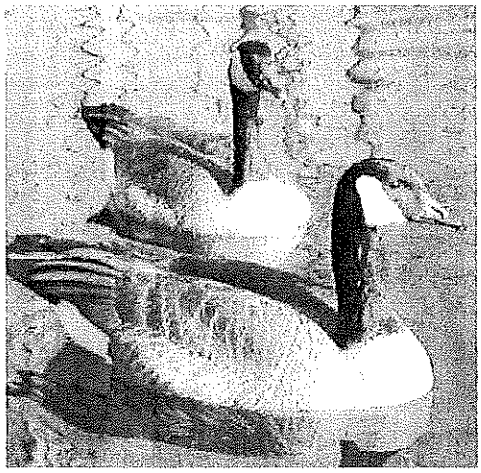
Highway Agencies must comply with applicable design and performance standards in N.J.A.C. 7:8 for their own "new development and redevelopment projects".

The permits address stormwater quality issues related to new development, redevelopment and existing development by requiring the development of a stormwater program and implementation of specific permit requirements referred to as Statewide Basic Requirements (SBRs). SBRs may also require the permittee to implement related best management practices (BMPs). All SBRs and related BMPs contain minimum standards, measurable goals, and implementation schedules. New development and redevelopment is addressed, in part, by requiring Highway Agencies, municipalities, and Public Complexes to comply with applicable design and performance standards established under N.J.A.C. 7:8 for certain projects. Existing development is addressed through broad topics including Local Public Education, and (for the Tier A, Public

Complex and Highway Permits) Improper Disposal of Waste, Solids and Floatable Controls, Maintenance Yard Operations and Employee Training.

The Highway Permit, Public Complex Permit, Tier A Permit, and Tier B Permit, may require the implementation of Additional Measures (AMs). AMs are measures (non-numeric or numeric effluent limitations) that may modify or be in addition to the SBRs required by the permits, and whose inclusion in a stormwater program may be required by a Water Quality Management Plan (WQM plan). AMs may be required by Total Maximum Daily Loads (TMDLs) approved or established by USEPA, regional stormwater management plans, or other elements of WQM plans. (See Chapter 10 for more details.)

The permits also allow for the inclusion of Optional Measures (in the Tier B Permit they are referred to as "Other Measures"). These are BMPs that are not specifically required by the permit but are recommended as ways to further enhance a stormwater program and improve water quality.



Wildlife management, an Optional Measure, may include geese population control techniques.

PURPOSE OF THIS GUIDANCE DOCUMENT

The purpose of this Guidance Document is to assist the Highway Agency in understanding what is required under the Phase II Municipal Stormwater Regulation Program, and how to comply with the Highway Permit.

The Guidance Document includes various chapters, many of which are solely dedicated to discussing specific permit requirements. These permit requirements are either Statewide Basic Requirements (SBRs) or related Best Management Practices (BMPs). Each specific permit requirement, whether it be a SBR or BMP, is broken down into three section headings: **"What is required?," "What does this mean?"** and **"Want to know more?"** These section headings are intended to make understanding and implementing the permit language easier.

"What is required?" is language taken **directly** from the permit, and follows the same convention as in the permit: **minimum standard, measurable goal,** and **implementation schedule.** The minimum standard is one or more minimum actions that must be taken to comply with the requirements of the permit. The measurable goal is the mechanism for reporting to the Department your progress in meeting the minimum standard and is usually accomplished through the submittal of the Annual Report and Certification. The implementation schedule sets the deadlines for permit compliance.

"What does this mean?" explains the SBR or BMP minimum standard in an easier to understand format.

"Want to know more?" covers other information that may be of interest to your Highway Agency, but is not necessary to know in order to comply with the permit. This section discusses why each BMP is important and what environmental benefits may result from their implementation. The Department may also make recommendations in "Want to know more?" that may be beneficial in implementing your program, but are not required by the permit.

Chapter 2 - Stormwater Pollution Prevention Plan and Example Forms

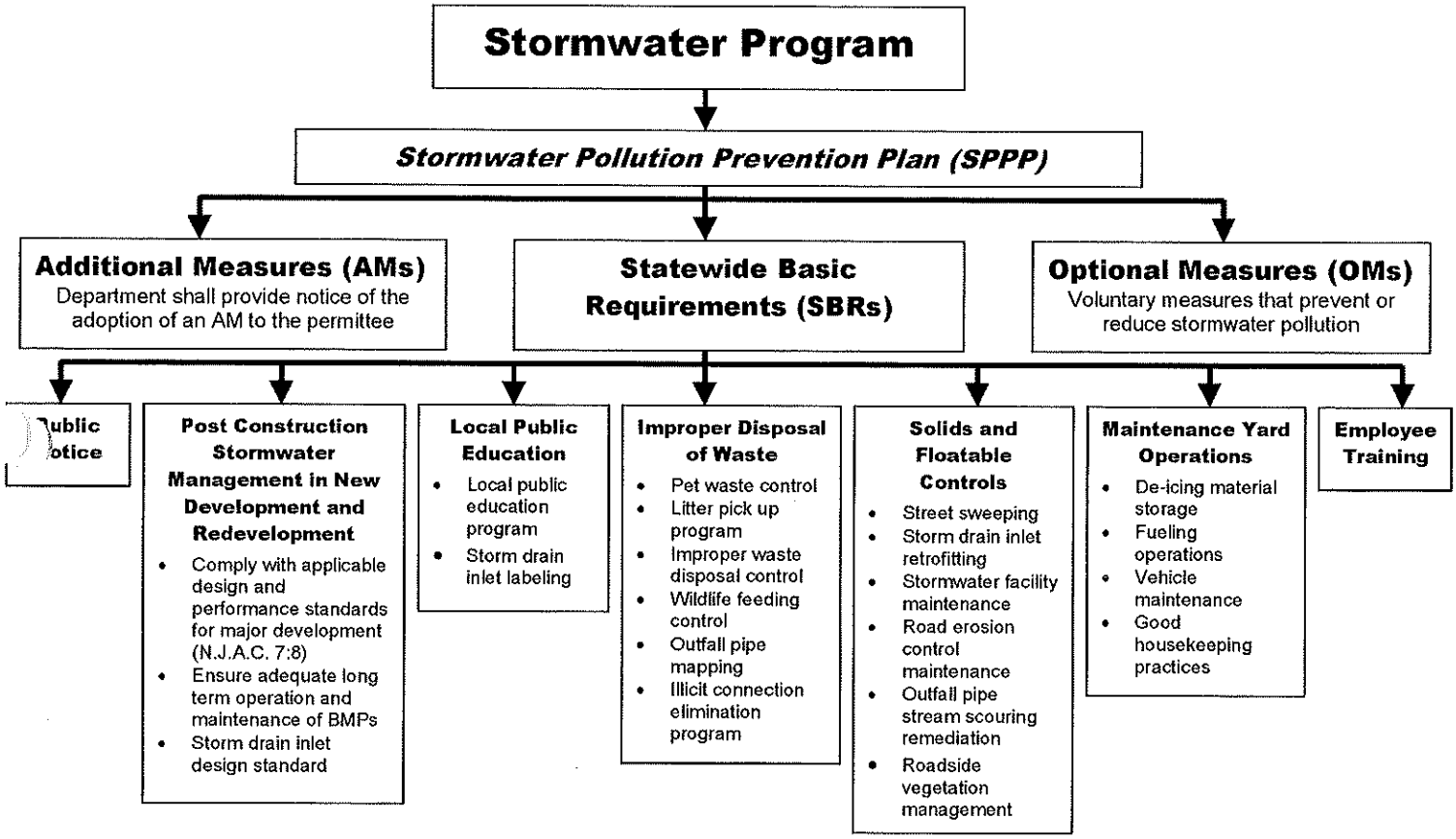
The Highway Permit requires that each Highway Agency develop, implement, and enforce a stormwater program. The stormwater program is described in the Highway Agency's ***written*** Stormwater Pollution Prevention Plan (SPPP). In simpler terms, the SPPP describes how your Highway Agency will implement each permit requirement and it provides a place for record keeping, documenting when you met the permit requirements. The purpose of this Chapter is to assist you in completing your SPPP. In addition, at the end of this chapter are the example regulatory mechanisms discussed in **Chapter 6 - Improper Disposal of Waste.**

The chart on the next page (Figure 1) shows how the stormwater program, SPPP, Statewide Basic Requirements (SBRs) and other permit requirements (Additional Measures and Optional Measures) all relate to one another. This chart gives a simple representation of what may seem to be a complicated program. The Department has tried to reduce the amount of paperwork, and make forms easy to complete. Your Highway Agency should be able to quickly complete its SPPP on its own, leaving more time and money for implementing the actual SBRs and best management practices (BMPs).

Completed example forms are contained in this Chapter. Blank forms are provided in Chapter 12 of this guidance manual. Electronic copies of the blank forms are also being provided on a compact disk or may be downloaded from our website at www.state.nj.us/dep/dwq/municstw.html. The forms on the CD and on our website are Adobe Acrobat PDF files and Microsoft Word files. The word files have a fill in feature that allows you to easily complete and update the forms. If the Highway Agency has a full version of Adobe Acrobat, the PDF files can be saved and updated. Highway Agencies do not have to use the Department's forms and may develop their own forms. However, it is important that the SPPP fully describe your Highway Agency's stormwater program, **including items required by Attachment A of the permit** and specifics on implementation and record keeping.

When completing your SPPP, it is important to include as much detailed information about your Highway Agency's stormwater program as possible. In addition, it is important to keep up with the record keeping requirements. The Department only included some forms for record keeping (e.g., Illicit Connection Records). In many instances, it is more efficient to use database software (e.g., Microsoft Excel or Access) for this purpose, which allows easy updates. After each update, the updated spreadsheet should be printed out and attached to your SPPP. Highway Agencies should handle all record keeping requirements in a similar fashion. It is also acceptable to keep handwritten records.

The more detailed information you include, the easier it will be to complete the Annual Report and Certification that must be submitted each year, ensure permit compliance, and work through personnel changes within the Highway Agency. A well-written and detailed SPPP will also make the annual inspections conducted by the Department's Water Compliance and Enforcement Offices easier for both the Department and the Highway Agency.


Stormwater Program
Stormwater Pollution Prevention Plan (SPPP)
Additional Measures (AMs)
Department shall provide notice of the adoption of an AM to the permittee
Statewide Basic Requirements (SBRs)
Optional Measures (OMs)
Voluntary measures that prevent or reduce stormwater pollution
ublic otice
Post Construction Stormwater Management in New Development and Redevelopment
Comply with applicable design and performance standards for major development (N.J.A.C. 7:8)
Ensure adequate long term operation and maintenance of BMPs
Storm drain inlet design standard
Local Public Education
Local public education program
Storm drain inlet labeling
Improper Disposal of Waste
Pet waste control
Litter pick up program
Improper waste disposal control
Wildlife feeding control
Outfall pipe mapping
Illicit connection elimination program
Solids and Floatable Controls
Street sweeping
Storm drain inlet retrofitting
Stormwater facility maintenance
Road erosion control maintenance
Outfall pipe stream scouring remediation
Roadside vegetation management
Maintenance Yard Operations
De-icing material storage
Fueling operations
Vehicle maintenance
Good housekeeping practices
Employee Training

Highway Agencies are not required to submit the SPPP to the Department. The Department will review the completed SPPP as part of regular compliance assistance inspections, so your Stormwater Program Coordinator should have access to the document at all times. In addition, the SPPP should be available for use by employees it may affect. It may be a good idea to have copies made for each member of the Stormwater Pollution Prevention Team with one person responsible for making updates or compiling record keeping data. You must also make the SPPP available to the public at reasonable times during regular business hours.

The SPPP is a dynamic document that is never "completed." It should not be filed away in a drawer. The SPPP needs to be continually updated and revised as people, tasks, and best management practices change. Each year, when you complete your Annual Report and Certification, is the perfect time to evaluate your stormwater program, SPPP, and make appropriate changes, revisions, and updates.

Stormwater Pollution Prevention Plan Forms

FORM 1 – STORMWATER POLLUTION PREVENTION TEAM

This team is made up of the individuals responsible for overseeing the implementation of the various permit requirements. These individuals should be selected for their knowledge in the subject area or as a result of their current responsibilities within the Highway Agency. It is not possible for one individual within the Highway Agency to implement a successful stormwater program. Due to the wide range of tasks required, a variety of personnel must be involved in planning and implementing the stormwater program. They could include the Highway Agency attorney, engineers, code enforcement officers, maintenance yard manager, employee training coordinator, and members of local environmental organizations. Your team members are not limited to only Highway Agency personnel. They could include local volunteers, members of the local watershed association or environmental groups and educational professionals.

It is recommended that the team meet on a regular basis to coordinate activities and discuss permit compliance issues. An individual needs to be named the Stormwater Program Coordinator (this coordinator was identified in the Request for Authorization previously submitted to the Department). This individual will be the primary contact for the Department and will be contacted when the Department schedules an inspection.

FORM 2 – PUBLIC NOTICE

Highway Agencies must comply with applicable State and local public notice requirements when providing for public participation in the development and implementation of the Highway Agency's stormwater program. Highway Agencies should use this form to summarize notice procedures.

FORM 3 – NEW DEVELOPMENT AND REDEVELOPMENT PROGRAM

This form is used to describe your overall post-construction stormwater management in new development and redevelopment program. This includes how your Highway Agency will, among other things, ensure that all major development and redevelopment undertaken by the Highway Agency complies with the applicable aspects of the Stormwater Management Rules at N.J.A.C. 7:8, ensure adequate long-term operation and maintenance of BMPs, and implement the new storm drain inlet design standard required by the permit.

FORM 4 – LOCAL PUBLIC EDUCATION PROGRAM

On this form, your Highway Agency will describe how it intends to provide informational material, in any form, to appropriate users and employees of the Highway Agency to satisfy the requirement set forth in the permit. The Department's Division of Watershed Management's Outreach and Education Bureau and/or local watershed groups can be of assistance in putting together educational materials. Their phone numbers are in the Important Names, Addresses and Contacts chapter (Chapter 14) of this guidance document.

FORM 5 - STORM DRAIN INLET LABELING

This form is provided to describe how you will label storm drain inlets in accordance with the minimum standard (see permit or Chapter 5 of this guidance document for details). You should include specific information including your schedule, the type of label you will use (e.g., stencils, buttons, etc.), the contents of the label (e.g., logos, graphics, etc.), and whether you will be soliciting help from watershed groups or volunteer organizations or if your employees will perform the labeling. It is strongly encouraged, however, that the labeling be done with volunteers as part of a larger environmental education outreach program. The description of your Storm Drain Inlet Labeling Program should also include long-term maintenance plans. Highway Agencies should track the progress of the storm drain inlet labeling to ensure that they meet the implementation schedule contained in the permit and so that they can report their progress in the Annual Report and Certification.

FORM 6 – MS4 OUTFALL PIPE MAPPING

Use this form to describe how you will prepare your outfall pipe map. Include the type of map you will use to identify your outfalls (e.g., a tax map or a different map drawn to an equal or more detailed scale). Also, identify who will prepare your map (e.g., employees, a consultant, etc.)

FORM 7 – ILLICIT CONNECTION ELIMINATION PROGRAM

Use this form to describe your Highway Agency's ongoing program for detecting and eliminating illicit connections, including how you will perform your initial inspections, and how you will respond to complaints and/or reports of illicit connections (e.g., hotlines, etc.).

FORM 8 – ILLICIT CONNECTION RECORDS

Use this page to keep track of the number of inspections you conduct annually, the number of dry weather flows and illicit connections you find, how many illicit connections you have eliminated or reported that year, and how many still remain.

NOTE: Results from illicit connection inspections should be recorded on the Department's Illicit Connection Inspection Report form (provided in Chapter 12 of this guidance manual). If a dry weather flow is found, the inspection report form for that outfall pipe must be included in your annual certification.

FORM 9 – LITTER PICK UP PROGRAM

On this form you should describe your Highway Agency's Litter Pick Up Program. A refuse collection schedule will need to be included as well as details on how rest areas, service areas, and roadside cleanups will be conducted. Records of roadside cleanups and estimates of the total amount of trash and debris collected must be attached to this form.

FORM 10 – IMPROPER DISPOSAL OF WASTE – REGULATORY MECHANISMS

Highway Agencies should use this form to list the dates that the regulatory mechanisms required by the permit (e.g., pet waste, wildlife feeding, etc.) are adopted or revised to meet the minimum standard in the permit. At the bottom of this form is a section where the Highway Agency should discuss how they will enforce these regulatory mechanisms, once adopted.

FORM 11 – SOLIDS AND FLOATABLE CONTROL – STORM DRAIN INLETS (RETROFITTING)

You should use this form to keep track of storm drain inlet retrofitting in your Highway Agency. For each repaving, repairing, reconstruction or alteration project, you should include the name of the project, the projected start date of the project, its actual start date, and the date the project was/will be completed. The number of storm drain inlets that will be affected by the project should be listed here, along with the number of storm drains with hydraulic or other exemptions. The bottom of the form provides you with a space to explain if you have any alternative devices and/or if you are planning on having any installed in the future. You should include any locations, and what types of alternative devices you have or will use.

FORM 12 – STREET SWEEPING & ROAD EROSION CONTROL

On the top portion of this form you should describe the street sweeping schedule you will maintain. You should also attach a street sweeping log that contains the date(s) and area(s) swept, the number of miles swept and the total amount of materials collected.

The bottom portion of this form should be used to describe your Road Erosion Control Maintenance Program, including how you will perform inspections, and the frequency of these inspections. A log containing the locations of road erosion, the repairs that were/will be made to fix the erosion, and the date of the repairs should be attached to your SPPP.

FORM 13 – STORMWATER FACILITY MAINTENANCE

This form asks for two separate things. On the top of the form you should describe your annual catch basin cleaning program and schedule.

The bottom portion of the form should be used to describe the stormwater facility cleaning and maintenance program you will implement to ensure that the facilities are properly functioning and operating. (If you are unsure of the different types of stormwater facilities you may have, there are examples in the permit, and in Chapter 7 of this guidance document.) A maintenance log containing information on any repairs/maintenance performed on stormwater facilities should be attached to your SPPP.

SPPP FORM 14 - ROADSIDE VEGETATION MANAGEMENT

This form should be used to describe what steps will be taken to modify your current roadside vegetation management program to fit the requirements of the permit. It should describe in detail what provisions will be made to limit the usage of herbicide and mulch when doing landscaping work along your roads.

FORM 15 – OUTFALL PIPE STREAM SCOURING REMEDIATION

This form should be used to describe your stormwater outfall pipe stream scouring program and how you will detect and control active, localized stream and stream bank scouring around your stormwater outfall pipes. A prioritized list of all sites found to have such scouring should be attached to this form, and should include the anticipated date of the repair, the method of repair you will use, and the date the repair is completed.

FORM 16 – DE-ICING MATERIAL STORAGE

This form should be used to describe how you currently store your de-icing materials. If you do not currently meet the permit's requirements, explain here the steps you will take to meet these requirements. Include construction schedules and interim tarping procedures. If you will be sharing a storage structure, include the location of this structure and a list of all concerned public entities. Finally, if you store sand outdoors, describe how your sand storage sites meet the requirements of the permit.

FORM 17 – STANDARD OPERATING PROCEDURES

For each of the BMPs (Fueling Operations BMP, Vehicle Maintenance BMP, and the Good Housekeeping BMP), indicate the date you developed and implemented required SOPs and attach a copy of each of the SOPs.

FORM 18 – EMPLOYEE TRAINING

Use this form to give details on the required employee training program. A list or table should be attached to this form indicating the required topic name, the employees that will receive training on that topic, and the date the training will be held.

NJPDES Highway Agency Stormwater General Permit

Stormwater Pollution Prevention Team Members

Number of team members may vary.

Completed by: *Eric Johnson*
Title: *Environmental Manager – Operations, Capitol County Road Department*
Highway Agency Name: *Capitol County*
NJPDES #:NJG *0007788*
PIID #: *123456*
Effective Date of Permit Authorization (EDPA):*April 1, 2004*
Date form complete: *January 1, 2005*
Date of most recent update:

Stormwater Program Coordinator: *Eric Johnson*
Title: *Environmental Manager – Operations, Capitol County Road Department*
Office Phone #: *609-555-1234*
Emergency Phone #: *609-555-2345*

Public Notice Coordinator: *Bernadette Jones*
Title: *Capitol County Counsel*
Office Phone #: *609-555-3456*
Emergency Phone #: *609-555-4567*

Post-Construction Stormwater Management Coordinator: *Peter Reimer*
Title: *Principal Engineer, Capitol County Road Department*
Office Phone #: *609-555-5678*
Emergency Phone #: *609-555-6789*

Local Public Education Coordinator: *Jennifer Robinson*
Title: *Education Director, Bluefish River Watershed Association*
Office Phone #: *609-555-7890*
Emergency Phone #: *609-555-1122*

Regulatory Mechanism Coordinator: *Bernadette Jones*
Title: *Capitol County Counsel*
Office Phone #: *609-555-3456*
Emergency Phone #: *609-555-4567*

Physical Operations Coordinator: *Jack Carr*
Title: *Capitol County Road Department Director*
Office Phone #: *609-555-2233*
Emergency Phone #: *609-555-3344*

Employee Training Coordinator: *Vera Wood*
Title: *Employee Training Coordinator*
Office Phone #: *609-555-4455*
Emergency Phone #: *609-555-5566*

Other: *Albert Fazekas*
Title: *Maintenance Yard Manager, Capitol County Road Department*
Office Phone #: *609-555-6677*
Emergency Phone #: *609-555-7788*

SPPP Form 2 - Public Notice

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Bernadette Jones/Capitol County Counsel*

Effective Date of Permit Authorization (EDPA): *April 1, 2004*

Date of Completion: *February 3, 2005* Date of most recent update:

Briefly outline the principal ways in which you comply with applicable State and local public notice requirements when providing for public participation in the development and implementation of your stormwater program.

For any meetings where public notice is required under the Open Public Meetings Act ("Sunshine Law," N.J.S.A. 10:4-6 et seq.), Capitol County provides public notice in a manner that complies with the requirements of that Act. Also, in regard to the county budget, Capitol County provides public notice in a manner that complies with the requirements of the Local Budget Law, N.J.S.A. 40A:4-1 et seq. For resolutions of the Capitol County Board of Chosen Freeholders that provide a penalty for violation thereof, Capitol County provides public notice in a manner that complies with the requirements of N.J.S.A. 40:24-3.

SPPP Form 3 – New Development and Redevelopment Program

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Peter Reimer/Principal Engineer, Capitol County Road Department*

Effective Date of Permit Authorization (EDPA): *April 1, 2004*

Date of Completion: *March 7, 2005* Date of most recent update:

Describe in general terms your post-construction stormwater management in new development and redevelopment program (post-construction program), and how it complies with the Highway Permit minimum standard. This description must address how adequate long term operation and maintenance of BMPs will be ensured; compliance with the standard in Attachment C of the permit (new storm drain inlet design standard); adoption and implementation of applicable design and performance standards established under N.J.A.C. 7:8 for major development; and use of the Post-Construction Program Design Checklist for Individual Projects. Attach additional pages as necessary.

The Capitol County Road Department (Road Department) will design (sometimes with consultant support) and maintain all projects which are "new development and redevelopment projects" described in the Highway Permit in accordance with the permit requirements for such projects. The County's Annual Reports will list these projects, including the construction in 2006 of a new maintenance yard for our highway system in the southern portion of the county. On March 1, 2005, the Capitol County Board of Chosen Freeholders passed Resolution No. 10-2005, which:

(1) Adopts (and incorporates by reference) for such projects the applicable design and performance standards (including maintenance requirements) established under N.J.A.C. 7:8 for major development, and the storm drain inlet design standard in Attachment C;

(2) Requires that all such projects be designed to comply with these design and performance standards and this storm drain inlet design standard; and

(3) Requires that the Highway Permit's Post-Construction Program Design Checklist for Individual Projects be completed before each project's construction is approved.

The Road Department intends to consider the applicable design and performance standards as early as possible in the project planning and design process. In addition, Capitol County intends to authorize a contract to the Adobe Engineering and Consulting Group which will help the Road Department update its project design and management software to incorporate the new standards and procedures. The Road Department is also continuing to discuss stormwater issues with others in County government, such as the Capitol County Planning Board, that have stormwater management responsibilities. These discussions are intended to encourage consistency and coordination among county stormwater management activities, and may result in some future revisions to the County's post-construction program.

We expect that for most projects, we will comply with the storm drain inlet design standard in Attachment C either by conveying flows through a trash rack as described in the "Alternative Device Exemptions," or (for flows not conveyed through such a trash rack), by installing the NJDOT bicycle safe grate and (if needed) a curb opening with a clear space no bigger than two inches across the smallest dimension. The storm drain inlets will also be engineered to ensure adequate hydraulic performance (for retrofitting of existing storm drain inlets see Form 11).

Since the EDPA, Capitol County has not constructed any projects regulated by the Highway Permit as new development and redevelopment projects. When the County constructs such a project, the County will ensure adequate long-term operation and maintenance of BMPs for that project by preparing (through the Road Department) a project maintenance plan in accordance with N.J.A.C. 7:8-5.8 where applicable, and by requiring and funding the Road Department's implementation of that plan. For BMPs at stormwater facilities, maintenance of these BMPs will also be an integral part of the stormwater facility maintenance program that we are developing to ensure proper function and operation of all County stormwater facilities regulated by the Highway Permit.

SPPP Form 4 - Local Public Education Program

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Jennifer Robinson/Education Director, Bluefish River Watershed Association*

Effective Date of Permit Authorization (EDPA):*April 1, 2004*

Date of Completion: *January 6, 2005* Date of most recent update:

Local Public Education Program

Describe your Local Public Education Program. Be specific on how you will distribute your educational information.

Capitol County does not own or operate any service areas along the County highway system. The county does provide five rest areas (picnic areas) along rural county roadways with tables at scenic locations. The county has determined that the most efficient way to provide for public education on required topics at these locations is to post appropriate signs. The five picnic areas will each have "No Feeding of Wildlife" signs. All five locations may be used for pet walking and will have "Clean Up Pet Waste" signs and pet waste stations supplied with clean-up bags and trash receptacles. All picnic areas have litter receptacles and "No Littering" signs will be posted near these receptacles. In addition, the county operates two maintenance garages. Signs will be posted at those locations warning about improper disposal of waste.

SPPP Form 5 – Storm Drain Inlet Labeling

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Jennifer Robinson/Education Director, Bluefish River Watershed Association*

Effective Date of Permit Authorization (EDPA):*April 1, 2004*

Date of Completion: *January 6, 2005* Date of most recent update:

Storm Drain Inlet Labeling

Describe your storm drain inlet labeling program, including your labeling schedule, the details of your long-term maintenance plan, and plans on coordinating with watershed groups or other volunteer organizations.

Capitol County is relying on volunteers from the Bluefish River Watershed Association to share the responsibility of storm drain inlet labeling, but realizes that the ultimate responsibility for completion of this requirement falls upon the County to complete and maintain labeling. Please see agreement letter dated December 5, 2004.

The attached map shows Capitol County has been divided into 2 sectors. The first sector is located in the area above Bluefish River and the second sector is below Bluefish River. All storm drain inlets at our 5 picnic areas, maintenance yards, and storm drain inlets along streets with sidewalks will be labeled. Capitol County is aware that the permit requires all service area storm drain inlets to be labeled, however, the county does not operate any service areas.

Jennifer Robinson, Education Director for the Bluefish River Watershed Association, will organize volunteers to label all storm drain inlets on low speed/low risk roads and within our 5 picnic areas. Bluefish River Watershed Association will be coordinating educational information and events to coincide with the volunteer labeling. Volunteers will use stencils stating "Do Not Dump...Drains to Waterway".

Due to safety concerns, high speed/high risk roadways will be labeled by Capitol County Road Department personnel. Employees will also label storm drains located within our maintenance yards. The county will use purchased plastic labels affixed with adhesive. These labels will state "Do Not Dump...Drains to Waterway". These labels are being used to reduce maintenance.

As storm drain inlets are replaced, the new inlets will have a stamped message from the foundry.

The first sector will be labeled by April 2007 and the second sector will be labeled by April 2009.

All storm drain inlet labels will be inspected periodically and maintained as needed by Capitol County Road Department employees.

SPPP Form 6 – MS4 Outfall Pipe Mapping

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Eric Johnson/Environmental Manager- Operations, Capitol County Road Department*

Effective Date of Permit Authorization (EDPA): *April 1, 2004*

Date of Completion: *January 13, 2005* Date of most recent update:

Explain how you will prepare your map (include its type and scale, and the schedule for the mapping process). Who will prepare your map (e.g., employees, a consultant, etc.)?

Capitol County Road Department employees will map, on tax maps, the location of the end of all of the road department's outfall pipes, an alphanumeric identifier for the outfall pipe and the name and location of the surface water body(ies) receiving a discharge from the outfall pipe. In accordance with the Highway Agency permit, Capitol County Road Department employees will map the end of the outfall pipes by dividing the Capitol County Road Department into two sectors. The first sector, which is comprised of the section of Capitol County above Bluefish River, shall be mapped within the allotted 36 months (that is by April 2007), with the section below Bluefish River being mapped within the remainder of the allotted 60 months (that is by April 2009). (See attached map.)

Capitol County has both rural and urban areas, therefore the scale of the tax maps vary pursuant to the Tax Map regulations at N.J.A.C. 7:18-23A. Capitol County Road Department employees will also use GPS to locate the end of outfall pipes and will provide a separate list of outfall identifier numbers and GPS coordinates. During outfall pipe mapping, county road employees will also inspect outfall pipes for illicit connections and outfall pipe stream scouring.

SPPP Form 7 – Illicit Connection Elimination Program

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Eric Johnson/Environmental Manager - Operations, Capitol County Road Department*

Effective Date of Permit Authorization (EDPA):*April 1, 2004*

Date of Completion: *January 13, 2005* Date of most recent update:

Describe your Illicit Connection Elimination Program, and explain how you plan on responding to complaints and/or reports of illicit connections (e.g., hotlines, etc.). Attach additional pages as necessary.

Capitol County Road Department employees will conduct an initial physical inspection of all of our outfall pipes during the mapping process. We will be using the Illicit Connection Inspection Report form provided by the NJDEP to record the collected information. Outfall pipes found to have a dry weather flow or intermittent non-stormwater flow will be rechecked in cooperation with the Capitol County Health Department to locate the illicit connection. If we are able to locate the illicit connection and find that it is from the County's own activities, it will be eliminated within six months. If, after the appropriate amount of inspection, we are unable to locate the source of the illicit connection it will be noted on the Closeout Investigation Form. For illicit connections from a public source (e.g., a neighboring municipality), notification will be provided to the source and a written explanation sent to the NJDEP detailing the results of the investigation. Capitol County will only alert the NJDEP of illicit connections found to be from a private entity. If the illicit connection poses an immediate threat, employees have been instructed to call the NJDEP hotline. Separate written notification of such action will also be sent to the NJDEP.

Capitol County had previously established a hotline for the use of reporting spills and illegal dumping into the county MS4. The hotline will now be made available for reporting illicit connections.

SPPP Form 8 – Illicit Connection Records

Highway Agency Information	
	Highway Agency Name: *Capitol County*
	NJPDES # : NJG *0007788* PI ID #: *123456*
	Team Member/Title: *Eric Johnson/Environmental Manager - Operations, Capitol County Road Department*
	Effective Date of Permit Authorization (EDPA): *April 1, 2004*
	Date of Completion: *January 13, 2005* Date of most recent update:

Prior to July 1, 2006 ***Note:*** *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*
Total number of inspections performed this year? *Program implementation will begin by October 2005*
Number of outfalls found to have a dry weather flow? *N/A*
Number of outfalls found to have an illicit connection? *N/A*
How many of the Highway Agency's own illicit connections were eliminated? *N/A*
Of the Highway Agency's own illicit connections found, how many remain? *N/A*
How many illicit connections found to emanate from another entity were reported to NJDEP? *N/A*

July 1, 2006 – June 30, 2007 ***Note:*** *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*
Total number of inspections performed this year?
Number of outfalls found to have a dry weather flow?
Number of outfalls found to have an illicit connection?
How many of the Highway Agency's own illicit connections were eliminated?
Of the Highway Agency's own illicit connections found, how many remain?
How many illicit connections found to emanate from another entity were reported to NJDEP?

July 1, 2007 – June 30, 2008 ***Note:*** *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*
Total number of inspections performed this year?
Number of outfalls found to have a dry weather flow?
Number of outfalls found to have an illicit connection?
How many of the Highway Agency's own illicit connections were eliminated?
Of the Highway Agency's own illicit connections found, how many remain?
How many illicit connections found to emanate from another entity were reported to NJDEP?

July 1, 2008 – June 30, 2009 ***Note:*** *Attach a copy of each illicit connection report form for outfalls found to have a dry weather flow.*
Total number of inspections performed this year?
Number of outfalls found to have a dry weather flow?
Number of outfalls found to have an illicit connection?
How many of the Highway Agency's own illicit connections were eliminated?
Of the Highway Agency's own illicit connections found, how many remain?
How many illicit connections found to emanate from another entity were reported to NJDEP?

SPPP Form 9 – Litter Pick Up Program

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Eric Johnson/ Environmental Manager - Operations, Capitol County Road Department*

Effective Date of Permit Authorization (EDPA):*April 1, 2004*

Date of Completion: *February 23, 2005* Date of most recent update:

Please describe your litter pick up program. Be sure to include the refuse collection schedule and detail how rest area, service area, and roadside clean ups will be implemented.
(NOTE: Attach a litter pick up log containing the following information: dates of roadside clean ups and estimates of the total amount of trash and debris collected.)

Capitol County will continue to utilize our Adopt-A-Highway volunteers for the roadside clean-ups. At the current time the volunteers do their clean ups once a month, weather permitting. Bags of trash set at the roadside after these clean ups are then collected by Capitol County Road Department employees the following Tuesday. Capitol County Road Department will conduct monthly roadside litter pickups on county roads that are not part of the "Adopt-A-Highway" program. Capitol County is investigating the feasibility of using a County prisoner detail for litter pick-up.

Trash from the 5 picnic areas along Capitol County roads is collected twice a week, on Tuesdays and Thursdays, by Capitol County Road Department employees. Extra trash receptacles will be placed at each of the picnic areas. County Road Department employees are also going to set up trash bag dispensers, one at each picnic area, so people will have bags in which to collect litter from their cars, instead of throwing it onto the picnic area parking lot.

Capitol County does not operate any service areas.

SPPP Form 10 – Regulatory Mechanisms

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Bernadette Jones/Capitol County Counsel; Damon Gibbs, Director of Human Resources; & Eric Johnson, Environmental Manager- Operations, Capitol County Road Department*

Effective Date of Permit Authorization (EDPA): *April 1, 2004*

Date of Completion: *March 7, 2005* Date of most recent update:

For each regulatory mechanism, give the date of adoption. If not yet adopted, explain the development status:

Pet Waste: *draft under review by County Board of Chosen Freeholders*
(NOTE: If the Highway Agency is not developing a pet waste regulatory mechanism because the Agency does not operate any rest areas or service areas for the Agency facilities subject to this permit, provide that explanation above.)

Improper Waste Disposal: *draft under review by County Board of Chosen Freeholders*

Wildlife Feeding: *draft under review by County Board of Chosen Freeholders*

Illicit Connections: *draft under review by County Board of Chosen Freeholders*

What is the nature of these regulatory mechanisms and how will they be enforced?

The regulatory mechanisms for pet waste and wildlife feeding, which will regulate the conduct of the general public on certain County property, will consist of resolutions, passed by the Capitol County Board of Chosen Freeholders, that prescribe penalties and are enforceable under N.J.S.A. 40:24-2 et seq. Draft resolutions prepared by our County Counsel are under review by that Board. These resolutions will be enforceable by any local or State police officer.

The regulatory mechanisms for improper waste disposal and illicit connections, which will regulate the conduct of the County government and its employees rather than the general public, will consist of written "Policies and Procedures" adopted under a resolution passed by the Capitol County Board of Chosen Freeholders. Draft policies and procedures prepared by our Road Department and Human Resource Department are under review by that Board. Such policies and procedures will be enforceable through removal, suspension, demotion, or other County personnel disciplinary actions.

The adopted versions of all four regulatory mechanisms will be effective by October 1, 2005.

If your position is that the Highway Agency has no legal authority to adopt and/or enforce a mechanism to regulate pet waste disposal or wildlife feeding by the general public on Highway Agency property, attach a statement from your attorney supporting this position.

Not applicable.

SPPP Form 11 – Storm Drain Inlets (Retrofitting)

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: 123456

Team Member/Title: *Jack Carr/ Capitol County Road Department Director*

Effective Date of Permit Authorization (EDPA):*April 1, 2004*

Date of Completion: *January 11, 2005* Date of most recent update:

What type of storm drain inlet design will generally be used for retrofitting?

For most projects Capitol County will use the NJDOT bicycle safe grate style and (if needed) a curb opening with a clear space no bigger than two inches across the smallest dimension.

Repaving, repairing, reconstruction or alteration project name (attach additional pages as necessary)	Projected start date	Start date	Date of completion	# of storm drain inlets	# of storm drains with exemptions
Section 45 Repaving Project	*August 23, 2005*	-	-	*6*	*2*
Haines Road Reconstruction Project	*September 13, 2005*	-	-	*3*	*1*

Are you claiming any alternate device exemptions or historic place exemptions for any of the above projects? Please explain.

Capitol County will claim neither of the exemptions for the projects listed above. However, for certain other projects that may be initiated several years from now, the County is conducting a feasibility study to determine if it would be cost effective to install a trash netting device at the stormwater outfall pipe structures instead of retrofitting dozens of storm drain inlets. The County should make a decision by Spring 2006.

SPPP Form 12 – Street Sweeping and Road Erosion Control Maintenance

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Jack Carr/ Capitol County Road Department Director*

Effective Date of Permit Authorization (EDPA):*April 1, 2004*

Date of Completion: *January 11, 2005* Date of most recent update:

Street Sweeping

Please describe the street sweeping schedule that you will maintain.
(NOTE: Attach a street sweeping log containing the following information: date and area swept, # of miles swept and the total amount of materials collected.)

Capitol County has determined which of its roads require monthly sweeping under the Highway Permit, and will implement a monthly street sweeping program of those roads beginning in April 2005. For all other county roads, Capitol County intends to maintain its existing street sweeping schedule of sweeping once a year.

(See Form 13 for the road department's proper handling and disposal of debris program.)

Road Erosion Control Maintenance

Describe your Road Erosion Control Maintenance Program, including inspection schedules. A list of all sites of roadside erosion and the repair technique(s) you will be using for each site should be attached to this form.
(NOTE: Attach a road erosion control maintenance log containing the following information: location, repairs, date)

Capitol County will utilize Capitol County Road Department employees to identify existing roadside erosion, performing road erosion inspections twice a year. After eroding sites are identified, they will be prioritized, and then repaired in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey. All maintenance personnel will maintain an inspection log that will include a list of all repairs and dates repairs were completed. Individual lists will be compiled by Eric Johnson/Environmental Manager – Operations Capitol County Road Department, and included in the Annual Report and Recertification. This program of inspections and repairs will begin in October 2005.

SPPP Form 13 – Stormwater Facility Maintenance

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Jack Carr/Capitol County Road Department Director*

Effective Date of Permit Authorization (EDPA): *April 1, 2005*

Date of Completion: *November 18, 2004* Date of most recent update:

Please describe your annual catch basin cleaning program and schedule. Attach additional pages as necessary.

Capitol County will maintain its yearly catch basin cleaning schedule in compliance with the minimum standard set forth in the Highway Permit. If, at the time of inspection, no sediment, trash or debris is observed in the catch basin, then that catch basin will not be cleaned. All catch basins will be inspected yearly, even if they were found to be clean the previous year. At the time of cleaning, the catch basins will also be inspected for proper function. Maintenance will be scheduled for those catch basins that are in disrepair. The program is scheduled to begin April 2005.

Road clean up materials will remain staged on concrete pads for the appropriate staging time, as per the standards set in guidance provided by the NJDEP Division of Solid and Hazardous Waste. Once a month waste will be hauled to the Capitol County landfill for disposal. Permission has been granted by the Capitol County Sewage Authority to discharge water from catch basin cleaning into their sanitary sewers. Waste will be tested once a year for hazardous materials.

Litter will be sorted from clean up materials for recycling.

Please describe your stormwater facility maintenance program for cleaning and maintenance of all stormwater facilities operated by the Highway Agency. Attach additional pages as necessary.
(NOTE: Attach a maintenance log containing information on any repairs/maintenance performed on stormwater facilities to ensure their proper function and operation.)

Capitol County will develop and implement a stormwater facility maintenance program that ensures proper function and operation of all highway system stormwater facilities operated by the county. We have identified a number of stormwater facilities within the highway system, including: catch basins, storm sewer pipes, storm drains, swales, an infiltration basin, and an oil/water separator at the northern maintenance yard. The identified stormwater facilities will be regularly inspected, on an annual basis, and repairs will be prioritized.

Flooding commonly occurs along Admiral Byrd Boulevard and inspections have revealed that a section of storm sewer leading to Bluefish River is blocked with debris. Due to public safety issues caused by the flooding of the roadway, this maintenance and repair is scheduled to be completed as soon as possible.

SPPP Form 14 - Roadside Vegetation Management

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Jack Carr/Capitol County Road Department Director*

Effective Date of Permit Authorization (EDPA):*April 1, 2004*

Date of Completion: *January 11, 2005* Date of most recent update:

Describe your roadside vegetation management program to limit the application of herbicides and mulch. Attach additional pages as necessary.

In accordance with the Highway Permit, Capitol County will no longer apply herbicides outside the prescribed two-foot radius of any structure for which it is impractical to mow around. Albert Fazekas, Maintenance Yard Manager, is looking into replacing the existing brand of herbicide with one that poses less of a water pollution risk (though this would not remove the restriction on herbicide use and application). The requirements of the permit have also prompted maintenance yard workers to look into planting low maintenance, native wild flowers along the roadsides in hopes of improving aesthetics and reducing the amount of labor that would go into taking care of plants along the roadside, including the mowing of "wet" areas and areas with steep slopes.

We hope to extend our volunteer Adopt-A-Highway program to include an Adopt-A-Highway Landscaping program where volunteers would "adopt" a section of highway for an amount of time (e.g., two years) and maintain the vegetation along that stretch of road. Tasks would include pulling weeds, planting flowers, and possibly even mowing the grass.

In regard to applying mulch and herbicides, designated workers who perform roadside vegetation management will be trained on the specifications of the permit and how to properly apply these products.
(See SPPP Form 18)

SPPP Form 15 - Outfall Pipe Stream Scouring Remediation

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Jack Carr/Capitol County Road Department Director*

Effective Date of Permit Authorization (EDPA): *April 1, 2004*

Date of Completion: *January 11, 2005* Date of most recent update:

Describe your stormwater outfall pipe scouring detection, remediation and maintenance program to detect and control active, localized stream and stream bank scouring. Attach additional pages as necessary.

(NOTE: Attach a prioritized list of sites observed to have scouring, date of anticipated repair, method of repair and date of completion.)

Capitol County will develop and implement a stormwater outfall pipe stream scouring detection, remediation, and maintenance program to detect and control localized stream and stream bank scouring in the vicinity of the highway system outfall pipes operated by the County. We will coordinate the initial steps of this effort with the mapping and inspections of outfall pipes and prioritize the outfall pipes found to have scouring in the order in which they will need to be repaired. To help in prioritizing the outfall pipes, we will photograph the scouring found at each outfall site. A schedule will be established for repairs, beginning with the outfall pipes most in need of remediation or those with easy access. In addition, repairs that do not need any NJDEP permits or other local, State, or Federal permits may be done first. All repairs will be made in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey.

SPPP Form 16 – De-icing Material Storage

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Jack Carr/Capitol County Road Department Director*

Effective Date of Permit Authorization (EDPA):*April 1, 2004*

Date of Completion: *December 9, 2004* Date of most recent update:

De-icing Material Storage

Describe how you currently store your highway agency's de-icing materials, and describe your inspection schedule. If your current storage practices do not meet the de-icing material storage SBR describe your construction schedule and your seasonal tarping interim measures. If you plan on sharing a storage structure, please include its location, as well as a complete list of all concerned public entities. If you store sand outdoors, describe how it meets the minimum standard.

Capitol County currently stores its de-icing material in stockpiles at its northern maintenance yard. Capitol County will implement the interim seasonal tarping procedures at this site until a permanent structure is built. From October 15th through April 30th we will inspect each tarp weekly to ensure that it is covering the salt pile. Inspections for spilled salt will be completed after loading and unloading activities.

Capitol County will begin site selection for a single storage structure to store de-icing materials. The following tentative schedule is set for the construction:

Site Selection.....12/04
Site Design.....3/05
Bid Construction Contract.....6/05
Apply for Required Permits.....9/05
Begin Construction.....3/06
Complete Construction.....9/06

A seven-month buffer is built into the tentative schedule for potential delays in bidding of the project, procuring permits or delays due to weather. However, the storage structure should be complete within 36 months of EDPA (4/07).

SPPP Form 17 – Standard Operating Procedures

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

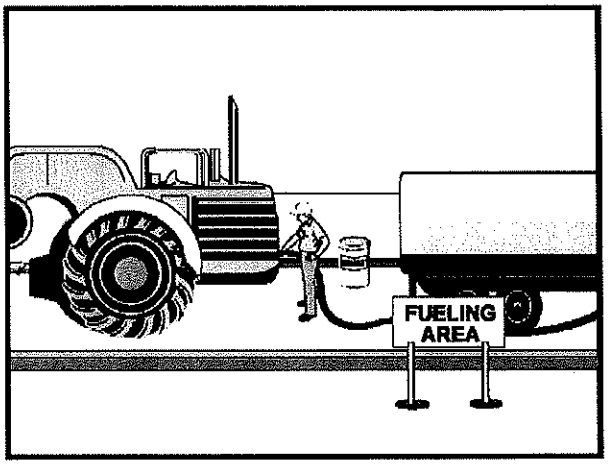
Team Member/Title: *Jack Carr/Capitol County Road Department Director*

Effective Date of Permit Authorization (EDPA): *April 1, 2004*

Date of Completion: *December 9, 2004* Date of most recent update:

BMP	Date SOP went into effect	Describe your inspection schedule
Fueling Operations (including the required practices listed in Attachment D of the permit)	*September 14, 2004*	*A list of fueling locations within our maintenance yards has been compiled and attached to this form. These locations will be inspected once a month.*
Vehicle Maintenance (including the required practices listed in Attachment D of the permit)	*September 14, 2004*	*Monthly inspections will be held at vehicle maintenance sites to ensure that the SOP is being met.*
Good Housekeeping Practices (including the required practices listed in Attachment D of the permit) **Attach inventory list required by Attachment D of the permit**	*August 30, 2004*	*Inspections will be conducted on a monthly basis to ensure that good housekeeping practices are in effect.*

Capitol County Road Department
Standard Operating Procedures
Vehicle and Equipment Fueling



Capitol County Road Department Maintenance Yards with Fueling Operations

Kings Court Maintenance Yard

Introduction and Purpose

Vehicle and equipment fueling procedures and practices are designed to minimize pollution of surface or ground waters. Understanding the procedures for delivering fuel into vehicles, mobile fuel tanks, and storage tanks is critical for this purpose. Safety is always the priority.

Scope

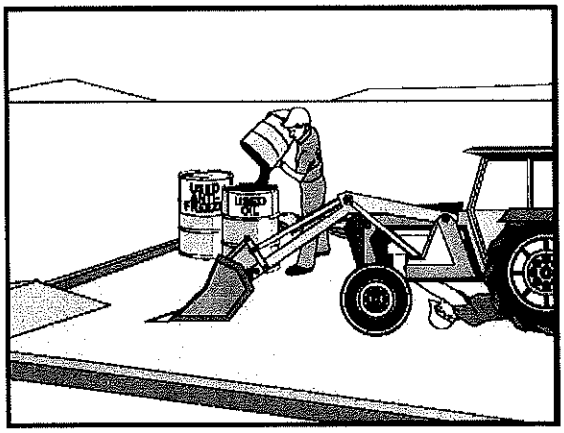
These procedures are to be implemented at all maintenance yards with fueling, including mobile fueling operations.

Standards and Specifications (for vehicle and equipment fueling)

- Shut the engine off
- Ensure that the fuel is the proper type of fuel.
- Absorbent spill clean-up materials and spill kits shall be available in fueling areas and on mobile fueling vehicles and shall be disposed of properly after use.
- Nozzles used in vehicle and equipment fueling shall be equipped with an automatic shut-off to prevent overfill.
- Fuel tanks shall not be "topped off."
- Mobile fueling shall be minimized. Whenever practical, vehicles and equipment shall be transported to the designated fueling area in the maintenance yard.
- Clearly post, in a prominent area of the facility, instructions for safe operation of fueling equipment, and appropriate contact information for the person(s) responsible for spill response.

Standards and Specifications (for bulk fueling)	• Drip pans or absorbent pads shall be used under all hose and pipe connections and other leak-prone areas during bulk fueling. • Block storm sewer inlets, or contain tank trucks used for bulk transfer, with temporary berms or temporary absorbent booms during the transfer process. If temporary berms are being used instead of blocking the storm sewer inlets, all hose connection points associated with the transfer of fuel must be within the temporary berms during the loading/unloading of bulk fuels. • Protect fueling areas with berms and/or dikes to prevent run-on, runoff, and to contain spills. • A trained employee must always be present to supervise during bulk transfer.
Spill Response	• Conduct cleanups of any fuel spills immediately after discovery. • Uncontained spills are to be cleaned using dry cleaning methods only. Spills shall be cleaned up with a dry, absorbent material (e.g., kitty litter, sawdust, etc.) and absorbent materials shall be swept up. • Collected waste is to be disposed of properly. • Contact the Capitol County Division of Environmental Health Services at 555-8989.
Maintenance and Inspection	• Fueling areas and storage tanks shall be inspected monthly. • Keep an ample supply of spill cleanup material on the site. • Any equipment, tanks, pumps, piping and fuel dispensing equipment found to be leaking or in disrepair must be repaired or replaced immediately.

Capitol County Road Department
Standard Operating Procedure
Vehicle Maintenance



Capitol County Road Department Maintenance Yards BMP Objectives

-Waste Management
-Spill Prevention, Containment and Countermeasures
-Pollution Control

Introduction and Purpose

This SOP contains the basic practices of vehicle maintenance to be implemented at all maintenance yards including maintenance activities at ancillary operations for the Capitol County Road Department. The purpose of this SOP is to provide a set of guidelines for the Capitol County Road Department vehicle maintenance yards including maintenance activities at ancillary operations.

Scope

This SOP applies to all maintenance yards including maintenance activities at ancillary operations within the Capitol County Road Department.

Standards and Specifications

- Conduct vehicle maintenance operation only in designated areas.
- Whenever possible, perform all vehicle and equipment maintenance at an indoor location with a paved floor.
- Always use drip pans.
- Absorbent spill clean-up materials shall be available in maintenance areas and shall be disposed of properly after use.
- Maintenance areas shall be protected from stormwater run-on and runoff, and shall be located at least 50 from feet downstream drainage facilities and watercourses.
- Use portable tents or construct a roofing-device over long-term maintenance areas and for projects that must be performed outdoors.

- Do not dump or dispose oils, grease, fluids, and lubricants onto the ground.
- Do not dump or dispose batteries, used oils, antifreeze and other toxic fluids into a storm drain or watercourse.
- Do not bury tires.
- Collect waste fluids in properly labeled containers and dispose properly.

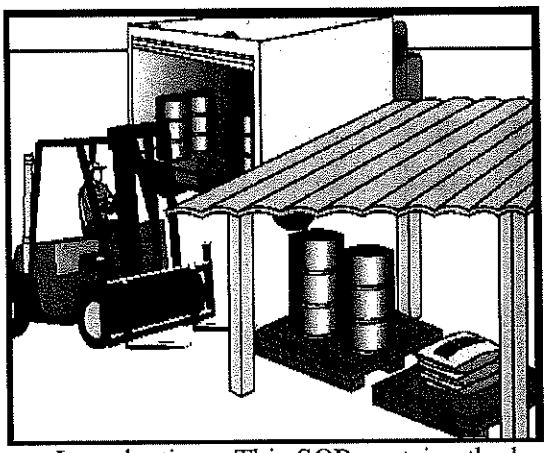
Spill Response and Reporting

- Provide spill containment dikes or secondary containment around stored oils and other fluid storage drum(s).
- Conduct cleanups of any fuel spills immediately after discovery.
- Spills are to be cleaned using dry cleaning methods only. Spills shall be cleaned up with a dry, absorbent material (e.g., kitty litter, sawdust, etc.) and the rest of the area is to be swept.
- Collected waste is to be disposed of properly.
- Contact the Capitol County Division of Environmental Health Services at 555-8989.

Maintenance and Inspection

- Periodically check for leaks and damaged equipment and make repairs as necessary.

Capitol County Road Department
Standard Operating Procedure
Good Housekeeping



Capitol County Road Department Good Housekeeping Goals

-Proper Recycling
-Proper Waste Disposal
-Pollution Prevention

Introduction and Purpose

This SOP contains the basic practices of good housekeeping to be implemented at maintenance yards including maintenance activities at ancillary operations for the Capitol County Road Department. The purpose of this SOP is to provide a set of guidelines for the employees of Capitol County Road Department for Good Housekeeping Practices at their maintenance yards including maintenance yards at ancillary operations.

Scope

This SOP applies to all maintenance yards including maintenance activities at ancillary operations in Capitol County Road Department.

Standards and Specifications (General)

- All containers should be properly labeled and marked, and the labels must remain clean and visible.
- All containers must be kept in good condition and tightly closed when not in use.
- When practical, chemicals, fluids and supplies should be kept indoors.
- If containers are stored outside, they must be covered and placed on spill platforms.
- Keep storage areas clean and well organized.
- Spill kits and drip pans must be kept near any liquid transfer areas, protected from rainfall.
- Absorbent spill clean-up materials must be available in maintenance areas and shall be disposed of properly after use.
- Place trash, dirt and other debris in the dumpster.
- Collect waste fluids in properly labeled containers and dispose of them properly.
- Establish and maintain a recycling program by disposing papers, cans, bottles and trash in designated bins.

Standards and Specifications (Salt and De-icing Material Handling)	• During loading and unloading of salt and de-icing materials, prevent and/or minimize spills. If salt or de-icing materials are spilled, remove the materials using dry cleaning methods. All collected materials shall be either reused or properly discarded. • Sweeping should be conducted once a week to get rid of dirt and other debris. Sweeping should also be conducted immediately following loading/unloading activities, when practical. • Minimize the tracking of materials from storage and loading/unloading areas. • Minimize the distance that salt and de-icing materials are transported during loading/unloading activities. • Any materials that are stored outside must be tarped when not actively being used. • If interim seasonal tarping is being implemented, de-icing materials may be stored outdoors only between October 15th through April 30th.
Spill Response and Reporting	• Conduct clean up of any spill(s) immediately after discovery. • Spills are to be cleaned using dry cleaning methods only. • Contact the Capitol County Division of Environmental Health Services at 555-8989.
Maintenance and Inspection	• Periodically check for leaks and damaged equipment and make repairs as necessary. • Perform monthly inspections of all (indoor and outdoor if applicable) storage locations.

SPPP Form 18 – Employee Training

Highway Agency Information

Highway Agency Name: *Capitol County*

NJPDES # :NJG *0007788* PI ID #: *123456*

Team Member/Title: *Vera Wood / Employee Training Coordinator*

Effective Date of Permit Authorization (EDPA):*April 1, 2004*

Date of Completion: *November 30, 2004* Date of most recent update:

Describe your employee training program. For each required topic, list the employees that will receive training on that topic, and the date the training will be held. Attach additional pages as necessary.

For our employee training program, we will group the required topics together based upon similarities in context. Any questions should be directed to the Employee Training Coordinator, Vera Wood, who can be reached at 609-555-4455. Although it was recommended that computer training be used, all training will occur in a seminar type fashion, with all sessions being held on the premises of the Capitol County Business Offices.

Waste Disposal Education which includes overviews of Pet Waste Control, Improper Waste Disposal Control, Wildlife Feeding Control, and Illicit Connection Prohibition will be conducted on April 20, 2005 by both Eric Johnson, Stormwater Program Coordinator, and Bernadette Jones, Counsel for Capitol County. Bernadette will be on hand to discuss the regulatory mechanisms associated with topics that will be covered. Appropriate legal personnel and employees of the road department will be required to attend.

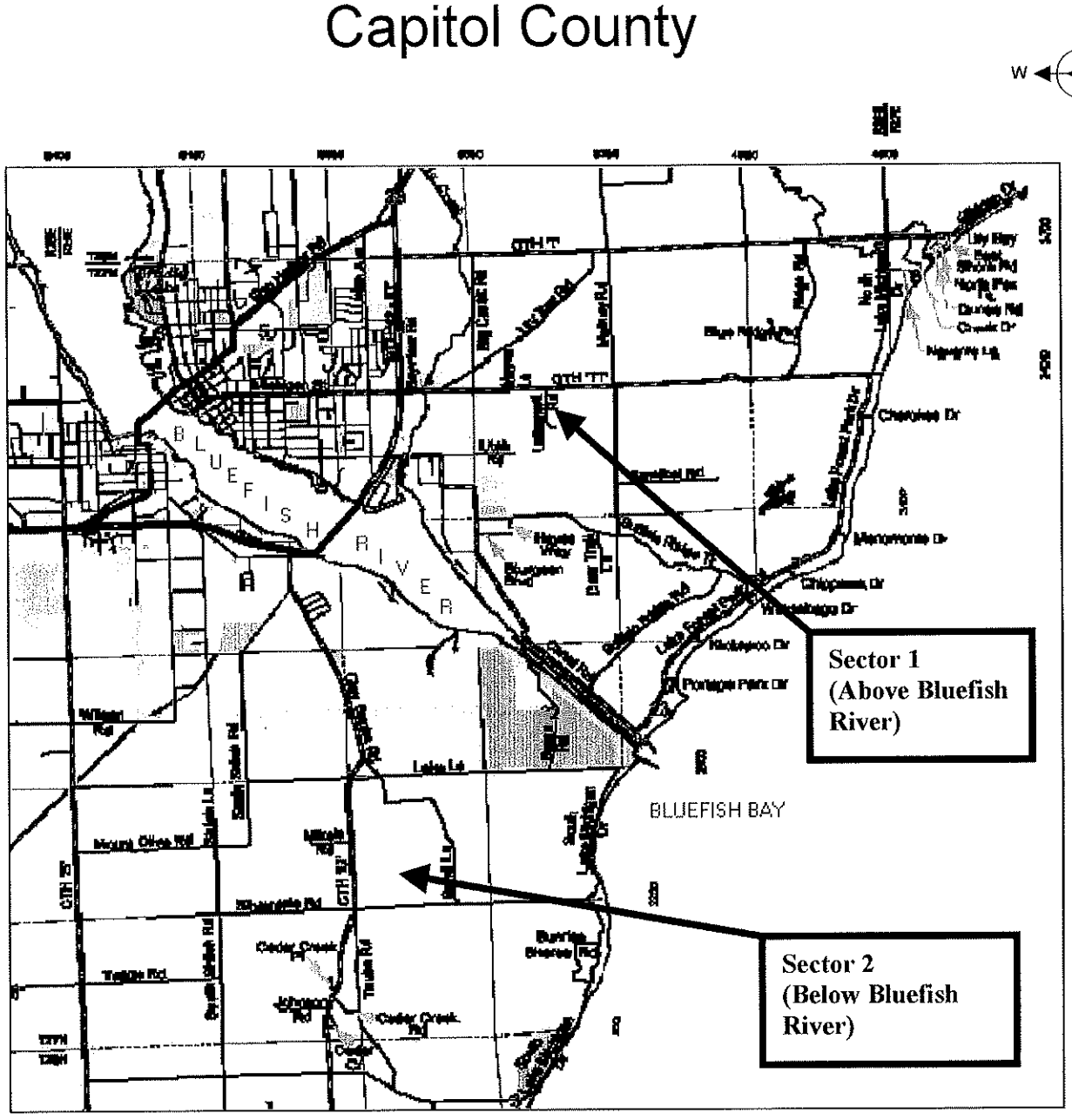
Roadside Vegetation Management, Street Sweeping, Stormwater Facility Maintenance, and Maintenance Yard Operations will be grouped into one training session that will more than likely be scheduled on May 11, 2005 as an all day event. Eric Johnson and Jack Carr, Physical Operations Coordinator, will be in charge of developing and conducting this seminar. Maintenance Yard and Highway Maintenance employees will be required to attend.

Illicit Connection Elimination and Outfall Pipe Mapping, as well as Road Erosion Control and Outfall Pipe Stream Scouring Remediation, will be covered as an all day training session on April 28, 2005 with Jack Carr and Peter Reimer, Post-Construction Stormwater Management Coordinator. We are in the process of developing a team specifically for dealing with illicit connections and outfall pipe mapping. Just those designated to this team will be required to attend this event.

Lastly, Construction Activity/Post-Construction Stormwater Management in New Development and Redevelopment will be covered by Peter Reimer on May 4, 2005 for highway engineering and maintenance personnel.

Dates for annual training programs after 2005 are yet to be determined.

Capitol County



Storm Drain Inlet Labeling
MS4 Outfall Pipe Mapping

Draft Resolution - Pet Waste at Highway Rest Areas

Resolution # [ ] - Pet Waste at Highway Rest Areas

Notes:

1. *If Capitol County were governed under the Optional County Charter Act, N.J.S.A. 40:41A-1 et seq., this "resolution" would instead be an "ordinance" (see N.J.S.A. 40:41A-27 and –101).*

2. *This draft resolution omits highway service areas because Capitol County does not operate or plan to operate any highway service areas.*

3. *In the Highway Permit, the pet waste requirement is limited to rest areas and service areas at certain highways and other thoroughfares. However, a county or other Highway Agency may choose to regulate pet waste disposal on any property owned or operated by the Highway Agency, including property located at county operated Public Complexes and other county operated facilities. Also, if Capitol County obtains both the Highway Permit and the Public Complex Permit, Capitol County could adopt a single Pet Waste resolution to meet requirements in both permits.*

SECTION I. Purpose:
A resolution to establish requirements for the proper disposal of pet solid waste deposited at highway rest areas operated by Capitol County, so as to protect public health, safety and welfare, and to prescribe penalties for failure to comply.

SECTION II. Definitions:
For the purpose of this resolution, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

a. Highway rest area – any rest area, including any picnic area or scenic overlook, for a highway or other thoroughfare operated by Capitol County. For purposes of this resolution, a "highway or other thoroughfare" does not include:
   1. Any thoroughfare confined to the grounds of one or more buildings; or
   2. Any thoroughfare confined to a park or recreational area operated by Capitol County.

b. Immediate – shall mean that the pet solid waste is removed at once, without delay.

c. Owner/Keeper – any person who shall possess, maintain, house or harbor any pet or otherwise have custody of any pet, whether or not the owner of such pet.

d. Person – any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to County jurisdiction.
e. Pet - a domesticated animal (other than a disability assistance animal) kept for amusement or companionship.
f. Pet solid waste – waste matter expelled from the bowels of the pet; excrement.
g. Proper disposal – placement in a designated waste receptacle, or other suitable container, and discarded in a refuse container which is regularly emptied by the county or some other refuse collector; or disposal into a system designed to convey domestic sewage for proper treatment and disposal.

SECTION III. Requirement for Disposal:
All pet owners and keepers are required to immediately and properly dispose of their pet's solid waste deposited at highway rest areas operated by Capitol County.

SECTION IV. Exemptions:
Any owner or keeper who requires the use of a disability assistance animal shall be exempt from the provisions of this section while such animal is being used for that purpose.

SECTION V. Enforcement:
The provisions of this resolution shall be enforceable by any local or State police officer.

SECTION VI. Violations and Penalty:
Any person(s) convicted by a court of competent jurisdiction of violating this resolution shall be subject to a fine not to exceed **[insert amount]**.

SECTION VII. Severability:
Each section, subsection, sentence, clause and phrase of this resolution is declared to be an independent section, subsection, sentence, clause and phrase, and the finding or holding of any such portion of this resolution to be unconstitutional, void, or ineffective for any cause, or reason, shall not affect any other portion of this resolution.

SECTION VIII. Effective date:
This resolution shall be in full force and effect from and after its adoption and any publication as may be required by law.

ALL OF WHICH IS ADOPTED this _____ day of ____, 200_, by the Board of Chosen Freeholders of Capitol County.

CAPITOL COUNTY

POLICY AND PROCEDURE No. ____ (DRAFT)

SUBJECT: Improper Disposal of Waste Into Storm Sewers at County Highways

Effective Date: _____, 200_

Approved By: _____

Note: In the Highway Permit, the requirement to prohibit improper disposal of waste is limited to MS4s at certain highways and other thoroughfares. However, a county or other Highway Agency may choose to prohibit improper disposal of waste to all MS4s operated by the Highway Agency, including those located at county operated Public Complexes and other county operated facilities. Also, if an agency obtains both the Highway Permit and the Public Complex Permit, the agency could adopt a single policy and procedure to meet requirements in both permits.

I. Purpose

A policy and procedure to prohibit the spilling, dumping, or disposal, by Capitol County and its employees, of materials other than stormwater to the municipal separate storm sewer system (MS4) at county highways, so as to protect public health, safety and welfare, and to prescribe penalties for the failure to comply.

II. Definitions

For the purpose of this policy and procedure, the following terms, phrases, words, and their derivations shall have the meanings stated herein unless their use for the purpose of this policy and procedure clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

a. County highway – any highway or other thoroughfare operated by Capitol County (including a maintenance facility or rest area for such a thoroughfare). For purposes of this policy and procedure, a "highway or other thoroughfare" does not include:
   1. Any thoroughfare confined to the grounds of one or more buildings; or
   2. Any thoroughfare confined to a park or recreational area operated by Capitol County.

(Note: This draft definition omits highway service areas because Capitol County does not operate or plan to operate any highway service areas.)

b. Municipal separate storm sewer system (MS4)– a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains) that is owned or operated by Capitol County or other public body, and is designed and used for collecting and conveying stormwater.

(Note: For counties or other highway agencies that operate combined sewer systems, add the following: "MS4s do not include combined sewer systems, which are sewer systems that are designed to carry sanitary sewage at all times and to collect and transport stormwater from streets and other sources.")

c. Stormwater – water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, is captured by separate storm sewers or other sewerage or drainage facilities, or is conveyed by snow removal equipment.

III. Prohibited Conduct

Capitol County and its employees are prohibited from:

a. spilling, dumping, or disposing of materials other than stormwater to the municipal separate storm sewer system located at county highways.

b. spilling, dumping, or disposing of materials other than stormwater in such a manner as to cause the discharge of pollutants to the municipal separate storm sewer system located at county highways.

IV. Exceptions to Prohibition

a. Water line flushing and discharges from potable water sources
b. Uncontaminated ground water (e.g., infiltration, crawl space or basement sump pumps, foundation or footing drains, rising ground waters)
c. Air conditioning condensate (excluding contact and non-contact cooling water)
d. Irrigation water (including landscape and lawn watering runoff)
e. Flows from springs, riparian habitats and wetlands, water reservoir discharges and diverted stream flows
f. Residential car washing water, and residential swimming pool discharges
g. Sidewalk, driveway and street wash water
h. Flows from fire fighting activities
i. Flows from rinsing of the following equipment with clean water:

1. Beach maintenance equipment immediately following their use for their intended purposes; and
2. Equipment used in the application of salt and de-icing materials immediately following salt and de-icing material applications. Prior to rinsing with clean water, all residual salt and de-icing materials must be removed from equipment and vehicles to the maximum extent practicable using dry cleaning methods (e.g., shoveling and sweeping). Recovered materials are to be returned to storage for reuse or properly discarded.

Rinsing of equipment in the above situations is limited to exterior, undercarriage, and exposed parts and does not apply to engines or other enclosed machinery.

V. Penalties

Any Capitol County officer or employee who continues to be in violation of the provisions of this policy and procedure, after being duly notified, shall be subject to removal, suspension, demotion, or other disciplinary action.

Draft Resolution - Wildlife Feeding on Highway Property

Resolution # [ ] - Wildlife Feeding on Highway Property

Notes:

1. *If Capitol County were governed under the Optional County Charter Act, N.J.S.A. 40:41A-1 et seq., this "resolution" would instead be an "ordinance" (see N.J.S.A. 40:41A-27 and –101).*

2. *In the Highway Permit, the wildlife feeding requirement is limited to property at certain highways and other thoroughfares. However, a county or other Highway Agency may choose to regulate wildlife feeding on any property owned or operated by the Highway Agency, including property located at county operated Public Complexes and other county operated facilities. Also, if Capitol County obtains both the Highway Permit and the Public Complex Permit, Capitol County could adopt a single Wildlife Feeding resolution to meet requirements in both permits.*

SECTION I. Purpose:
A resolution to prohibit the feeding of unconfined wildlife, on any property owned or operated by Capitol County for county highways, so as to protect public health, safety and welfare, and to prescribe penalties for failure to comply.

SECTION II. Definitions:
For the purpose of this resolution, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

a. County highway– any highway or other thoroughfare operated by Capitol County (including a maintenance facility or rest area for such a thoroughfare). For purposes of this resolution, a "highway or other thoroughfare" does not include:
1. Any thoroughfare confined to the grounds of one or more buildings; or
2. Any thoroughfare confined to a park or recreational area operated by Capitol County.

(Note: This draft definition omits highway service areas because Capitol County does not operate or plan to operate any highway service areas.)

b. Feed – to give, place, expose, deposit, distribute or scatter any edible material with the intention of feeding, attracting or enticing wildlife. Feeding does not include baiting in the legal taking of fish and/or game.

c. Person – any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to county jurisdiction.
d. Wildlife – all animals that are neither human nor domesticated.

SECTION III. Prohibited Conduct:
a. No person shall feed, on any property owned or operated by Capitol County for a county highway, any wildlife, excluding confined wildlife (for example, wildlife confined in zoos, parks or rehabilitation centers, or unconfined wildlife at environmental education centers).

SECTION IV. Enforcement:
a. The provisions of this resolution shall be enforceable by any local or State police officer.
b. Any person found to be in violation of this resolution shall be ordered to cease the feeding immediately.

SECTION V. Violations and Penalties:
Any person(s) who is found to be in violation of the provisions of this resolution shall be subject to a fine not to exceed **[insert amount]**.

SECTION VI. Severability:
Each section, subsection, sentence, clause and phrase of this resolution is declared to be an independent section, subsection, sentence, clause and phrase, and the finding or holding of any such portion of this resolution to be unconstitutional, void, or ineffective for any cause, or reason, shall not affect any other portion of this resolution.

SECTION VII. Effective date:
This resolution shall be in full force and effect from and after its adoption and any publication as may be required by law.

ALL OF WHICH IS ADOPTED this _____ day of ____, 200_, by the Board of Chosen Freeholders of Capitol County.

CAPITOL COUNTY

POLICY AND PROCEDURE No. ____ (DRAFT)

SUBJECT: Illicit Connections to Storm Sewers at County Highways

Effective Date: _____, 200_

Approved By: _____

Note: In the Highway Permit, the requirement to prohibit illicit connections is limited to MS4s at certain highways and other thoroughfares. However, a county or other Highway Agency may choose to prohibit illicit connections to all MS4s operated by the Highway Agency, including those located at county operated Public Complexes and other county operated facilities. Also, if an agency obtains both the Highway Permit and the Public Complex Permit, the agency could adopt a single policy and procedure to meet requirements in both permits.

I. Purpose

A policy and procedure to prohibit illicit connections by Capitol County to the municipal separate storm sewer system at county highways, so as to protect public health, safety and welfare, and to prescribe penalties for the failure to comply. This policy and procedure does not apply to any illicit connection which emanates from an entity other than Capitol County.

II. Definitions

For the purpose of this policy and procedure, the following terms, phrases, words, and their derivations shall have the meanings stated herein unless their use for the purpose of this policy and procedure clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory. The definitions below are the same as or based on corresponding or related definitions in the New Jersey Pollutant Discharge Elimination System (NJPDES) rules at N.J.A.C. 7:14A-1.2.

a. County highway – any highway or other thoroughfare operated by Capitol County (including a maintenance facility or rest area for such a thoroughfare). For purposes of this policy and procedure, a "highway or other thoroughfare" does not include:

1. Any thoroughfare confined to the grounds of one or more buildings; or
2. Any thoroughfare confined to a park or recreational area operated by Capitol County.

(Note: This draft definition omits highway service areas because Capitol County does not operate or plan to operate any highway service areas.)

b. Domestic sewage - waste and wastewater from humans or household operations.

c. Illicit connection – any physical or non-physical connection that discharges domestic sewage, non-contact cooling water, process wastewater, or other industrial waste (other than stormwater) to the municipal separate storm sewer system operated by Capitol County, unless that discharge is authorized under a NJPDES permit other than the Highway Agency Municipal Stormwater General Permit (NJPDES Permit Number NJ0141887). Non-physical connections may include, but are not limited to, leaks, flows, or overflows into the municipal separate storm sewer system.

d. Industrial waste - non-domestic waste, including, but not limited to, those pollutants regulated under Section 307(a), (b), or (c) of the Federal Clean Water Act (33 U.S.C. §1317(a), (b), or (c)).

e. Municipal separate storm sewer system (MS4)– a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains) that is owned or operated by Capitol County or other public body, and is designed and used for collecting and conveying stormwater.

(Note: For counties or other highway agencies that operate combined sewer systems, add the following: "MS4s do not include combined sewer systems, which are sewer systems that are designed to carry sanitary sewage at all times and to collect and transport stormwater from streets and other sources.")

f. NJPDES permit – a permit issued by the New Jersey Department of Environmental Protection to implement the New Jersey Pollutant Discharge Elimination System (NJPDES) rules at N.J.A.C. 7:14A.

g. Non-contact cooling water - water used to reduce temperature for the purpose of cooling. Such waters do not come into direct contact with any raw material, intermediate product (other than heat) or finished product. Non-contact cooling water may however contain algaecides, or biocides to control fouling of equipment such as heat exchangers, and/or corrosion inhibitors.

h. Process wastewater - any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product.

Process wastewater includes, but is not limited to, leachate and cooling water other than non-contact cooling water.

i. Stormwater – water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, is captured by separate storm sewers or other sewerage or drainage facilities, or is conveyed by snow removal equipment.

III. Prohibited Conduct

Capitol County and its employees shall not discharge or cause to be discharged, through an illicit connection to the municipal separate storm sewer system located at county highways, any domestic sewage, non-contact cooling water, process wastewater, or other industrial waste (other than stormwater).

IV. Penalties

Any Capitol County officer or employee who continues to be in violation of the provisions of this policy and procedure, after being duly notified, shall be subject to removal, suspension, demotion, or other disciplinary action.

Chapter 3 - Public Notice

The Public Notice Statewide Basic Requirement (SBR) requires compliance with all applicable State and local public notice requirements.

WHAT IS REQUIRED?

Minimum Standard

Highway Agencies shall comply with applicable State and local public notice requirements when providing for public participation in the development and implementation of the Highway Agency's stormwater program.

Measurable Goal

Highway Agencies shall certify annually that all applicable State and local public notice requirements were followed.

Implementation Schedule

Upon the effective date of permit authorization (EDPA).

WHAT DOES THIS MEAN?

This SBR means that the Highway Agency must comply with any applicable State and local public notice requirements when a public involvement/participation program is being implemented in regard to the Highway Agency's stormwater program. The permit requires the Highway Agency to comply with requirements for public notice that are already in effect under law. An example would be the public notice requirements in the Open Public Meetings Act ("Sunshine Law," N.J.S.A. 10:4-6 et seq.).

Chapter 4 - Post-Construction Stormwater Management in New Development and Redevelopment

The Post-Construction Stormwater Management in New Development and Redevelopment SBR requires the Highway Agency to develop, implement, and enforce a program that addresses stormwater runoff from certain new development and redevelopment projects that are on property owned or operated by the Highway Agency, and that discharge into the MS4 at the Highway Agency's highways or other thoroughfares.

WHAT IS REQUIRED?

Minimum Standard

To prevent or minimize water quality impacts, the Highway Agency shall develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment projects on property owned or operated by the Highway Agency that disturb one acre or more, including projects less than one acre that are part of a larger common plan of development or sale, that discharge into the Highway Agency's small MS4. The Highway Agency shall in its post-construction program:

i. Comply with the applicable design and performance standards established under N.J.A.C. 7:8 for major development, unless:

   - Those standards do not apply because of a variance or exemption granted under N.J.A.C. 7:8; or

   - Alternative standards are applicable under an areawide or Statewide Water Quality Management Plan adopted in accordance with N.J.A.C. 7:15.

ii. Ensure adequate long-term operation and maintenance of BMPs.

iii. Comply with standards set forth in Attachment C of the permit to control passage of solid and floatable materials through storm drain inlets.

iv. Projects that do not require any Department permits (the term "permit", in this case, shall include transition area waivers under the Freshwater Wetlands Protection Act) under the Flood Hazard Area Control Act (N.J.S.A. 58:16A-50 et seq.), Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et seq.), Coastal Area Facility Review Act (N.J.S.A. 13:9-1 et seq.), or Waterfront and Harbor Facilities Act (N.J.S.A. 12:5-3) are not considered "new development or redevelopment projects" if construction began prior to the implementation deadline for this SBR, or if the projects went to bid or had right-of-way authorization prior to the date on which the permittee received authorization under this permit.

Measurable Goal

Highway Agencies shall certify annually that they have developed, implemented, and are actively enforcing a program to address stormwater runoff from new development and redevelopment projects in accordance with the minimum standard.

Implementation Schedule

i. Upon the effective date of permit authorization, Highway Agencies shall ensure adequate long-term operation and maintenance of BMPs on property owned or operated by the Highway Agency.

ii. Within 12 months from the effective date of permit authorization, Highway Agencies shall:

- Comply with the standards set forth in Attachment C of the permit to control passage of solid and floatable materials through storm drainage inlets for storm drain inlets the Highway Agency installs within the Highway Agency's small MS4.
- Adopt and implement applicable design and performance standards established under N.J.A.C. 7:8 for major development at the Highway Agency pursuant to item i. of the minimum standard.

WHAT DOES THIS MEAN?

To prevent or minimize pollution of surface waters and groundwater by stormwater runoff from certain new development and redevelopment projects, Highway Agencies must develop, implement, and enforce a "post-construction program" to control post-construction stormwater runoff from these projects.



New development and redevelopment projects subject to the stormwater management rule may need to consider groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements.

The projects addressed under this SBR are new development and redevelopment projects (such as new or enlarged roadways or road maintenance or service facilities), on property owned or operated by the Highway Agency, that:

1. disturb one acre or more (including projects less than one acre that are part of a larger common plan of development or sale); and

2. discharge stormwater into the small MS4 at the highways or other thoroughfares owned or operated by the Highway Agency.

(**Note** - This SBR does not require Highway Agencies to control post-construction stormwater runoff from new development and redevelopment on private or public property not owned or operated by the Highway Agency, even though such runoff is discharged into the Highway Agency's small MS4. Nor does this SBR

require Highway Agencies to control post-construction stormwater runoff from new development and redevelopment on Highway Agency property if such runoff is not discharged into the small MS4 at the Highway Agency's highways or other thoroughfares.)

For the purpose of this SBR the following terms are defined as:

"Disturbance" means the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation.

"Impervious surface" means a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water. Impervious surfaces include areas such as roadways, paved parking lots and concrete sidewalks.

"Redevelopment" refers to alterations that change the "footprint" of a roadway or other site or building in such a way that results in the disturbance of one acre or more of land. The term is not intended to include such activities as exterior remodeling, which would not be expected to cause adverse stormwater quality impacts and offer no new opportunity for stormwater controls. The Department does not consider pavement resurfacing projects that do not disturb the underlying or surrounding soil, remove surrounding vegetation, or increase the area of impervious surface to be "redevelopment projects."

"Common plan of development or sale" means a contiguous area where multiple separate and distinct development or redevelopment activities have occurred, are occurring, or are proposed to occur under one plan. The "plan" in a "common plan of development or sale" is broadly defined as any announcement or piece of documentation (including, but not limited to, a sign, public notice or hearing, advertisement, drawing, permit application) or physical demarcation (including, but not limited to, boundary signs, lot stakes, surveyor markings).

To develop, implement, and enforce this post-construction program, the Highway Agency must meet requirements concerned with:

- The Department's **Stormwater Management rules (N.J.A.C. 7:8)**, which establish stormwater management design and performance standards for new development and redevelopment, and which are implemented through the Department's Land Use Regulation Program as well as the Highway Permit
- **Long-term operation and maintenance of BMPs**
- **Storm drain inlets**

Overview of the Stormwater Management Rules

On February 2, 2004, the Department's new Stormwater Management rules were published in the New Jersey Register and became effective (36 N.J.R. 670(a) and 781(a)). This is the first major update of these rules since their adoption in 1983, and includes fundamental changes in how systems and structures for managing stormwater runoff in New Jersey are planned, designed and implemented.

The new Stormwater Management rules provide a framework and incentives for managing runoff and resolving nonpoint source impairment on a drainage area basis for new development and redevelopment and existing developed areas, and establish a hierarchy for implementation of stormwater management measures with initial reliance on low impact site design techniques to maintain natural vegetation and drainage before incorporating structural BMPs. These new rules also establish new runoff control performance standards for groundwater recharge, water quality and

water quantity; establish special area protection measures (buffers) for pristine and exceptional value ("Category One") waters; provide regulatory consistency among local and State regulatory agencies; and provide safety standards for stormwater management basins.



Special water resource protection areas are established along all waters designated "Category One".

Highway Agency officials involved with highway development or redevelopment decisions, along with their consultants, need to become familiar with the new requirements in these rules; the guidance contained in the New Jersey Stormwater Best Management Practices Manual; and effective nonstructural stormwater management techniques, such as maintaining natural drainage paths and vegetation, and minimizing increases in impervious cover, that will preserve and protect water resources for the future.

A courtesy copy of these rules, answers to "**Frequently Asked Questions**," and the **New Jersey Stormwater Best Management Practices Manual** are available at www.njstormwater.org.

Questions or submissions regarding the **Stormwater Management rules** should be directed to the Division of Watershed Management, New Jersey Department of Environmental Protection, P.O. Box 418, Trenton, New Jersey 08625.

The new Stormwater Management rules have six subchapters as follows:

Subchapter 1. General Provisions

Subchapter 2. General Requirements for Stormwater Management Planning

Subchapter 3. Regional Stormwater Management Planning

Subchapter 4. Municipal Stormwater Management Planning

Subchapter 5. Design and Performance Standards for Stormwater Management Measures

Subchapter 6. Safety Standards for Stormwater Management Basins

Highway Agencies are directly affected by subchapters 1, 5, and 6 of these new rules, and may also be directly affected by subchapters 2 and/or 3 if a regional stormwater management planning area includes all or part of the highway or other thoroughfare, or if the Highway Agency (for example, a county) conducts stormwater management planning on its own initiative under these new rules. Several provisions of subchapter 5 are discussed further below.

In addition, the Department amended (effective February 2, 2004) the stormwater management provisions of the following rules in order to coordinate with and cross-reference the new Stormwater Management rules: the Freshwater Wetlands Protection Act Rules at N.J.A.C. 7:7A; the Coastal Zone Management Rules at N.J.A.C. 7:7E; the Flood Hazard Area Control Act rules at

N.J.A.C. 7:13; the Water Quality Management Planning rules at N.J.A.C. 7:15; and the Dam Safety Standards at N.J.A.C. 7:20. These amendments affect Highway Agency projects that need stream encroachment permits or certain other Department permits.

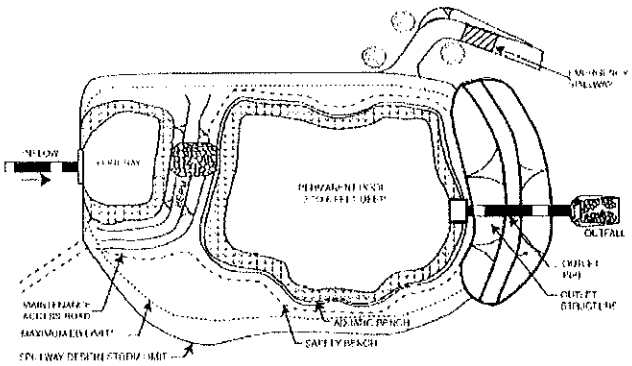
Major Development

"Major development" is one of the most important terms in these new rules and this SBR. The design and performance standards in subchapter 5 apply to "major development" only. The "major development" regulated under this SBR is limited to development and redevelopment projects that disturb one or more acres of land. However, some other "major development" that does not disturb one or more acres of land, but that increases impervious surface by one-quarter acre or more, is subject to these new rules through (i) permits issued to Highway Agencies under the Department's Land Use Regulation Program (LURP), which includes stream encroachment permits; freshwater wetlands permits and transition area waivers; and CAFRA, coastal wetlands, and waterfront development permits; and (ii) the Department's Dam Safety Standards permit-by-rule for Class IV dams (if the Highway Agency designs or constructs a Class IV dam(s) for stormwater management purposes).

(**Note:** Under N.J.A.C. 7:8-1.6 ("Applicability to Major Development"), major development which has received certain Department LURP permits prior to February 2, 2004 is **not** required to comply with the new Stormwater Management rules, but instead shall be subject to the stormwater management requirements in effect on February 1, 2004. In addition, under item iv. of the minimum standard, Highway Agency projects that do not require Department LURP permits are **not** considered "new development or redevelopment projects" if (1) construction began prior to 12 months after the date on which the Highway Agency received authorization under the Highway Permit, or (2) if the projects went to bid or had right-of-way authorization prior to that authorization date.)

Design and Performance Standards for Major Development

As part of its post-construction program, the Highway Agency must adopt and implement the applicable design and performance standards for major development established under N.J.A.C. 7:8, unless those standards do not apply because of a variance or exemption granted under N.J.A.C. 7:8, or unless alternative standards under a Water Quality Management Plan (WQM Plan) are applicable. (If such alternative standards are applicable, the Highway Agency must adopt and implement them.)



Wet Ponds may be used in some instances to meet runoff quality standards contained in N.J.A.C. 7:8-5.5.

As noted in the Department's Annual Report and Certification form for this SBR (see Chapter 13), the Highway Agency must adopt the design and performance standards by means of a written Highway Agency document(s). Such a document could be, for example, a resolution, ordinance, regulation, order, or memorandum issued by the Highway Agency's governing body, ranking elected official, principal executive officer, or

duly authorized official, or a change to the Highway Agency's policy and/or procedures manual, design manual, and/or stormwater manual. The Highway Agency must provide the name and type of this document(s) in its Annual Report.

The Highway Agency should use a document(s) appropriate for that agency's institutional structure and procedures. The document(s) must either include a copy of the design and performance standards, or incorporate those standards by reference. If the Highway Agency already has its own procedures manual, design manual, and/or stormwater manual for project planning and design, the Highway Agency should update that manual(s) to mention expressly those standards, the Highway Permit, and the standards set forth in Attachment C of the Highway Permit to control passage of solid and floatable materials through storm drainage inlets.

For each new development or redevelopment project that is regulated by the Highway Permit (and not exempted under N.J.A.C. 7:8-1.6(b)), the Highway Agency must list the project in the Annual Report and Certification form for this SBR, and complete the Post-Construction Program Design Checklist for Individual Projects (see Chapter 13) before the Highway Agency approves the project's construction. To the extent that compliance of the project with the applicable design and performance standards is addressed through the Department's Land Use Regulation Program, the final determination as to whether the project complies with those standards is made by the Department through that Program.

In the new Stormwater Management Rules, subchapter 5 establishes design and performance standards for "stormwater management measures" for "major development" intended to minimize the adverse impact of stormwater runoff on water quality and water quantity and loss of groundwater recharge in receiving water bodies.

"Stormwater management measure" is defined in these rules as "any structural or nonstructural strategy, practice, technology, process, program, or other method intended to control or reduce stormwater runoff and associated pollutants, or to induce or control the infiltration or groundwater recharge of stormwater or to eliminate illicit or illegal nonstormwater discharges into stormwater conveyances."

The standards specified in subchapter 5 do not apply to major development if alternative design and performance standards that are at least as protective as would be achieved through subchapter 5 when considered on a regional stormwater management area basis are applicable under a regional stormwater management plan adopted in accordance with N.J.A.C. 7:8 or a WQM plan adopted in accordance with N.J.A.C. 7:15.

Subchapter 5 consists of the following sections:

7:8-5.1 Scope

7:8-5.2 Stormwater management measures for major development

7:8-5.3 Nonstructural stormwater management strategies

7:8-5.4 Erosion control, groundwater recharge and runoff quantity standards

7:8-5.5 Stormwater runoff quality standards

7:8-5.6 Calculation of stormwater runoff and groundwater recharge

7:8-5.7 Standards for structural stormwater management measures

7:8-5.8 Maintenance requirements

7:8-5.9 Sources for technical guidance

Some of the most important new design and performance standards in subchapter 5 include:

- The requirements in N.J.A.C. 7:8-5.2 and 5.3 to incorporate the following **nonstructural stormwater management strategies** into the design:
    - Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss;
    - Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces;
    - Maximize the protection of natural drainage features and vegetation;
    - Minimize the decrease in the "time of concentration" from pre-construction to post-construction. "Time of Concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the drainage area to the point of interest within a watershed;
    - Minimize land disturbance including clearing and grading;
    - Minimize soil compaction;
    - Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides;
    - Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas; and
    - Provide other source controls to prevent or minimize the use or exposure of pollutants at the site in order to prevent or minimize the release of those pollutants into stormwater runoff (see N.J.A.C. 7:8-5.3(b)9 and the New Jersey Stormwater Best Management Practices Manual for examples).
- The requirement in N.J.A.C. 7:8-5.2 to avoid adverse impacts of concentrated flow on habitat for **threatened and endangered species** as documented in the Natural Heritage Database established under N.J.S.A. 13:1B-15.147 through 15.150, particularly *Helonias bullata* (swamp pink) and/or *Clemmys muhlnebergi* (bog turtle).
- The provisions in N.J.A.C. 7:8-5.2 that **exempt** certain utility line and public pedestrian access projects from the groundwater recharge and stormwater runoff quantity and quality requirements at N.J.A.C.



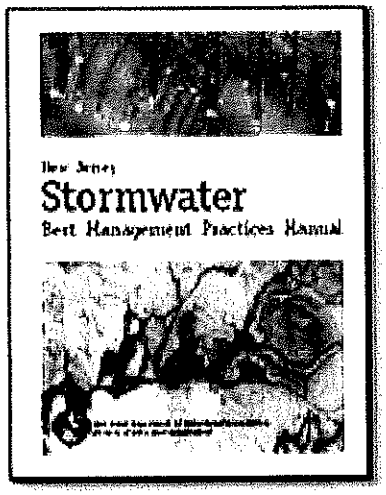
Nonstructural stormwater management strategies include breaking up or disconnecting impervious surfaces.

7:8-5.4 and 5.5, and that allow a **waiver from strict compliance** with those requirements to be obtained for the enlargement (widening) of an existing public roadway or railroad or the construction or enlargement of a public pedestrian access.

- The standard in N.J.A.C. 7:8-5.4 to encourage and control **infiltration and groundwater recharge**, including requirements that the design engineer (except in certain specified circumstances) either:
    - Demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures maintain 100 percent of the average annual pre-construction groundwater recharge volume for the site; **or**
    - Demonstrate through hydrologic and hydraulic analysis that the increase of stormwater runoff volume from pre-construction to post-construction for the two-year storm is infiltrated.
- The standard in N.J.A.C. 7:8-5.4 to control **stormwater runoff quantity impacts**.
    - This standard provides the design engineer with various alternatives, such as, for example, designing stormwater management measures so that the post-construction peak runoff rates for the two, 10 and 100-year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates.
- The **"Stormwater runoff quality standards"** in N.J.A.C. 7:8-5.5, including:
    - The requirement (if at least an additional one-quarter acre of impervious surface is being proposed) that stormwater management measures be designed to reduce the post-construction load of **total suspended solids** (TSS) in stormwater runoff generated from the water quality design storm by 80 percent of the anticipated load from the developed site, expressed as an annual average. Table 2 in N.J.A.C. 7:8-5.5 presents the presumed TSS removal rates for certain BMPs designed in accordance with the New Jersey Stormwater Best Management Practices Manual.
    - The requirement that stormwater management measures be designed to reduce, to the maximum extent feasible, the post-construction **nutrient** load of the anticipated load from the developed site in stormwater runoff generated from the water quality design storm.
    - The requirement that the applicant preserve and maintain **300-foot "special water resource protection areas"** along all waters designated "Category One" in the Department's Surface Water Quality Standards at N.J.A.C. 7:9B, and along perennial or intermittent streams that drain into or upstream of the Category One waters as shown on the U.S. Geological Survey (USGS) Quadrangle Maps or in the County Soil Surveys, within the associated hydrologic unit code 14 (HUC14) drainage. All encroachments within such areas shall be subject to review and approval by the Department.
- The **maintenance requirements** in N.J.A.C. 7:8-5.8 (see the discussion below under "Maintenance Requirements - Stormwater Management Rules").

The requirement in the Highway Permit to "comply with the applicable design and performance standards established under N.J.A.C. 7:8" pertains to **all** applicable design and performance standards established under the Stormwater Management rules, not just to the "Stormwater runoff

quality standards" in N.J.A.C. 7:8-5.5. Problems such as human-induced base-flow reduction (due to reduced recharge) and exacerbation of flooding and erosion also present water quality problems because they alter the chemical, physical, or biological integrity of the waters of the State, or otherwise contribute to water pollution.



Technical and maintenance guidance for stormwater management measures can be found in the New Jersey Stormwater Best Management Practices Manual (BMP Manual) and other documents listed in N.J.A.C 7:8-5.9. The BMP Manual was developed by the New Jersey Department of Environmental Protection, in coordination with the New Jersey Department of Agriculture, the New Jersey Department of Community Affairs, the New Jersey Department of Transportation, municipal engineers, county engineers, consulting firms, contractors, and environmental organizations. A copy of the BMP manual can be found on the Department's Stormwater Web site at http://www.njstormwater.org. The BMP manual is also on the CD of guidance material provided by the Department to Highway Agencies and from Maps and Publications, Department of Environmental Protection, 428 East State Street, P.O. Box 420, Trenton, New Jersey, 08625; telephone (609) 777-1038.

The Highway Agency should consider the design and performance standards in subchapter 5 as early as possible in the project planning and design process (including any project scope development or feasibility assessment). Projects should be designed with stormwater issues and nonstructural stormwater management strategies addressed as a primary consideration early in that process, instead of as a secondary concern or afterthought. Early consideration may protect Highway Agencies from additional time and expense associated with redesign, or from spending unnecessary time and resources on developing flawed project concepts that do not comply with the Highway Permit. Also, if the project requires but does not yet have an environmental assessment (EA) or environmental impact statement (EIS) under Executive Order No. 215 of 1989 or the National Environmental Policy Act, the relationship of the project to these standards and this SBR should be discussed in the EA or EIS prepared for the project.

To encourage coordination of a county Highway Agency's post-construction program with other county stormwater management activities (including review of municipal stormwater management plans and ordinances, and of certain subdivisions and site plans), the Department encourages county Highway Agency personnel who have significant responsibility for this SBR to communicate, throughout the development and implementation of this post-construction program, with other county government personnel who have stormwater management responsibilities (county planning agency personnel, for example, in counties with separate road departments and planning agencies).

Under N.J.A.C. 7:8-2.5, counties and other agencies that conduct stormwater management planning under the new Stormwater Management rules may petition the Department at the Division of Watershed Management address provided above for an exemption to the requirements of those rules by submitting documentation to demonstrate that, if granted, the exemption will not result in an increase in flood damage, water pollution, including threats to the biological integrity, or constitute a threat to the public safety. **The stormwater pollution prevention plan (SPPP)**

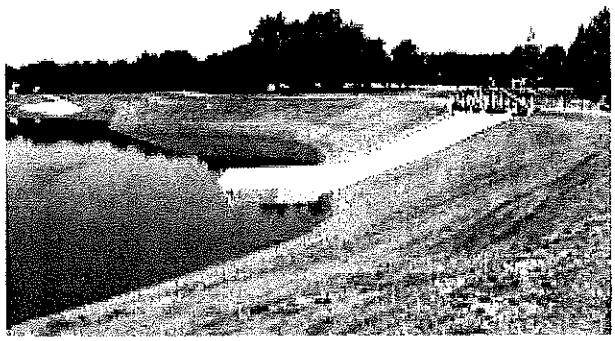
required by Part I, Section E of the Highway Permit is not a "stormwater management plan" under those rules.

Training

The Department has provided and will continue to provide training to Highway Agency officials on implementation of the new Stormwater Management rules. Training on the updated stormwater rule performance standards has occurred and will continue to occur by request from the Department directly and through the Rutgers Office of Continuing Education. Information on training opportunities will be made available on the Department's stormwater Web site at www.njstormwater.org and on the Rutgers Office of Continuing Education Web site at http://aesop.rutgers.edu/~ocpe/. Please call Rutgers at (732) 932-9271 and request that you be put on the mailing list to receive notice of upcoming training opportunities.

Operation and Maintenance of BMPs

As a part of the post-construction program, the Highway Agency must ensure adequate long-term operation and maintenance of BMPs. This means that for any BMP that is installed in order to comply with the requirements of the Highway Agency's post-construction program, the Highway Agency must ensure adequate long-term operation as well as preventative and corrective maintenance (including replacement). The Highway Agency may perform the operation and maintenance itself, or may make arrangements with other entities to perform the operation and maintenance.



Proper long term operation and maintenance of BMPs ensures that they continue to perform as intended.

As discussed above, the Highway Agency must also adopt and implement applicable design and performance standards established under N.J.A.C. 7:8 for major development at the Highway Agency pursuant to item i. of the minimum standard above. These standards include the maintenance requirements in N.J.A.C. 7:8-5.8 (see the discussion below under "Maintenance Requirements - Stormwater Management Rules"). These standards are also implemented through permits issued to Highway Agencies under the Department's Land Use Regulation Program.

Note also that under the "Stormwater Facility Maintenance" component of the Solids and Floatable Controls SBR (discussed in Chapter 8 below), the Highway Agency must develop and implement a stormwater facility maintenance program for cleaning and maintenance of **all** stormwater facilities operated by the Highway Agency, including existing stormwater facilities not affected by the post-construction program. The operation and maintenance component of the post-construction program should be integrated as soon as possible with the development and implementation of that stormwater facility maintenance program.

Maintenance Requirements - Stormwater Management Rules

Among the most important design and performance standards in N.J.A.C. 7:8-5 are the maintenance requirements in N.J.A.C. 7:8-5.8. Discussed below are provisions in those requirements that are generally important to Highway Agencies:

1. The design engineer shall prepare a maintenance plan for the stormwater management measures incorporated into the design of a major development.
2. The maintenance plan shall contain:
   - Specific preventative maintenance tasks and schedules
   - Cost estimates, including estimated cost of sediment, debris, or trash removal
   - The name, address, and telephone number of the person or persons responsible for preventative and corrective maintenance (including replacement).

     Maintenance guidelines for stormwater management measures are available in the New Jersey Stormwater Best Management Practices Manual (BMP Manual). If the maintenance plan identifies a person other than the developer (for example, a public agency or homeowners' association) as having the responsibility for maintenance, the plan shall include documentation of such person's agreement to assume this responsibility, or of the developer's obligation to dedicate a stormwater management facility to such person under an applicable ordinance or regulation.

     (**Note:** In the context of the Highway Permit, the "developer" is generally if not always the Highway Agency itself. A "person other than the developer" might be, for example, a municipality.)

   - N.J.A.C. 7:8-5.8 does not specifically assign the responsibility for maintenance of stormwater management measures to Highway Agencies or other entities. Instead, the rule simply requires that the entity responsible for maintenance be specified. The decision whether and to whom a Highway Agency assigns responsibility is a site-specific one based on the particular facts and circumstances involved. A Highway Agency may choose to assume responsibility for maintenance, but it is not obligated to do so under this rule. The Highway Agency is responsible under N.J.A.C. 7:8-5.8 for indicating the person or entity responsible for maintenance.

     The selection of BMPs, and the maintenance needs associated with the BMPs, should take into account the ability of the Highway Agency or other future users to maintain the proposed stormwater facility. Guidance on the maintenance of specific BMPs is provided in the BMP Manual.

     (**Note:** Under the "Stormwater Facility Maintenance" component of the Solids and Floatable Controls SBR discussed in Chapter 8 below, the Highway Agency must develop and implement a program for cleaning and maintenance of **all** stormwater facilities operated by the Highway Agency. The Highway Agency may not rely on another entity to perform such cleaning and maintenance unless Part I, Section D of the Highway Permit ("Sharing of Responsibilities") is satisfied.)
3. If the person responsible for maintenance identified under **(2)** above is not a public agency, the maintenance plan and any future revisions based on **(6)** below shall be recorded upon the deed

of record for each property on which the maintenance described in the maintenance plan must be undertaken.

4. Preventative and corrective maintenance shall be performed to maintain the function of the stormwater management measure, including repairs or replacement to the structure; removal of sediment, debris, or trash; restoration of eroded areas; snow and ice removal; fence repair or replacement; restoration of vegetation; and repair or replacement of nonvegetated linings.

5. The person responsible for maintenance identified under **(2)** above shall maintain a detailed log of all preventative and corrective maintenance for the structural stormwater management measures incorporated into the design of the development, including a record of all inspections and copies of all maintenance-related work orders.

    - The maintenance plan and any revisions, as well as the maintenance record, must be maintained for the life of the stormwater management measures on the site. Maintenance logs for the most recent three years, as well as the maintenance plan and any revisions should remain available for review by public entities with jurisdiction over the activities on the site. If members of the public wish to review the maintenance plan or record, they should contact the Highway Agency.

      The Department is not requiring a specific format for the maintenance plan or the maintenance logs. Sample maintenance forms are available in the NJDEP Division of Water Resources "Ocean County Demonstration Study Stormwater Facilities Maintenance Manual," dated June 1989, and updated samples may be available in the future.

6. The person responsible for maintenance identified under **(2)** above shall evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan (and, if applicable, the deed) as needed.

    - The Department recognizes that maintenance for each major development will vary depending on the stormwater management measures implemented within the development, and has provided guidance for maintenance measures in the BMP Manual, including the type and frequency of maintenance. The effective implementation of the maintenance is based on the implementation of the approved maintenance plan. The frequency of maintenance is to be documented on maintenance logs that are required for the stormwater management measures under **(5)** above.

7. The person responsible for maintenance identified under **(2)** above shall retain and make available, upon request by any public entity with administrative, health, environmental or safety authority over the site, the maintenance plan and the documentation required by **(5)** and **(6)** above.

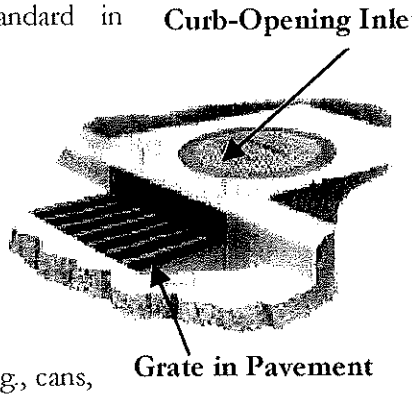
(**Note:** In addition, under Part I, Section J.1 of the Highway Permit, Highway Agencies shall make records required by the Highway Permit, including records of inspections, maintenance, and repairs required by the "Stormwater Facility Maintenance" component of the Solids and Floatable Controls SBR discussed in Chapter 8 below, available to the public at reasonable times during regular business hours (see N.J.A.C. 7:14A-18 for confidentiality provisions). Highway Agencies that are subject to New Jersey's Open Public Records Act must also comply with that Act.)

The need for a maintenance plan, and implementation of that plan, cannot be overemphasized. The lack of maintenance is one of the major reasons for the failure of structural BMPs to provide the level of treatment for which they were designed. Basic maintenance procedures are contained in the

BMP Manual. Unique or innovative maintenance procedures for those measures that are not specified in the BMP Manual may also be used.

Storm Drain Inlets (New Development and Redevelopment)

For new development and redevelopment projects subject to this SBR, Highway Agencies must comply with the design standard in Attachment C of the Highway Permit to control passage of solid and floatable materials through storm drain inlets. This design standard is addressed in the Annual Report and Certification form for this SBR, and in the Post-Construction Program Design Checklist for Individual Projects (see Chapter 13).



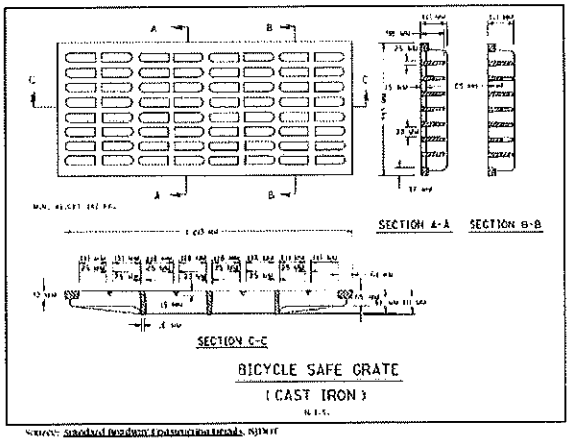
There are separate design standards for grates in pavement or other ground surfaces, and for curb-opening inlets. Each standard is described below. These standards help prevent certain solids and floatables (e.g., cans, plastic bottles, wrappers, and other litter) from reaching the surface waters of the State.

Grates in Pavement or other Ground Surfaces

The standard applies to grates that are used in pavement or another ground surface to collect stormwater into a storm drain or surface water body under the grate.

- Examples of storm drain inlet grates subject to this standard include grates in grate inlets, the grate portion (non-curb-opening portion) of combination inlets, grates on storm sewer manholes, ditch grates, trench grates, and grates of spacer bars in slotted drains. Examples of ground surfaces include surfaces of roads (including bridges), driveways, parking areas, bikeways, plazas, sidewalks, lawns, fields, open channels, and stormwater basin floors.

NJDOT "Bicycle Safe" Grate



Many grate designs meet the standard. The first option (especially for storm drain inlets along roads) is simply to use the New Jersey Department of Transportation (NJDOT) bicycle safe grate. This grate is described in Chapter 2.4 of the NJDOT Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines, which is available at: http://www.state.nj.us/transportation/publicat/bike_guidelines.htm.

The other option is to use a different grate, as long as each "clear space" in the grate (each individual opening) is:

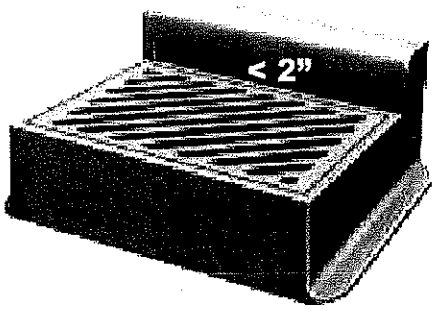
- No bigger than seven (7.0) square inches; or
- No bigger than 0.5 inches (½ inch) across the smallest dimension (length or width).

Curb-Opening Inlets (Including Curb-Opening Inlets in Combination Inlets)

If the storm drain inlet has a curb opening, the clear space in that curb opening (or each individual clear space, if the curb opening has two or more clear spaces) must be:

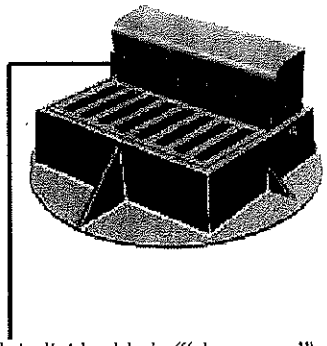
- No bigger than two (2.0) inches across the smallest dimension (length or width) - many curb-opening inlets installed in recent years meet this criterion; or
- No bigger than seven (7.0) square inches

Option 1 (Example)



A curb-opening with a "clear space" no bigger than 2" across the smallest dimension

Option 2 (Example)



Each individual hole ("clear space") in the curb-opening is no bigger than 7 square inches

Exemptions

The requirements of this standard do not apply whenever any of the following exemptions listed in Attachment C are applicable:

- A "Hydraulic Performance Exemption" where the review agency (generally, the Highway Agency itself) determines that this standard would cause inadequate hydraulic performance that could not practicably be overcome by using additional or larger storm drain inlets that meet this standard.
- Either of two "Alternative Device Exemptions":
  - The first of these exemptions is where flows from the "water quality design storm" as specified in N.J.A.C. 7:8 are conveyed through any device or combination of devices (e.g., end of pipe netting facility, manufactured treatment device, or a catch basin hood) that is designed, at a minimum, to prevent the passage of all solid and floatable materials that could not fit through one of the following:
    1. A rectangular space that is four and five-eighths ($4^5/_8$) inches long and one and one-half (1½) inches wide (this option does not apply for outfall netting facilities); or
    2. A bar screen that has a ½ inch (0.5 inches) opening between each bar.

- The second of these exemptions is where flows are conveyed through a trash rack that has parallel bars with one-inch (1.0 inch) spacing between the bars, to the elevation of the "water quality design storm" as specified in N.J.A.C. 7:8.

  One of the requirements in the new Stormwater Management rules at N.J.A.C. 7:8-5.7(a)2 is that "trash racks shall be installed at the intake to the outlet structure as appropriate, and shall have parallel bars with one-inch spacing between the bars to the elevation of the water quality design storm." **This second "Alternative Device Exemption" will therefore be applicable to many new development and redevelopment projects.**

  In the new Stormwater Management Rules, the "water quality design storm" is specified at N.J.A.C. 7:8-5.5(a).

- A "Historic Places Exemption" where the Department determines, pursuant to the New Jersey Register of Historic Places Rules at N.J.A.C. 7:4-7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.

WANT TO KNOW MORE?

Stormwater runoff from lands modified by urbanization or highways can harm surface water and groundwater resources by changing natural hydrologic patterns, accelerating stream flows, destroying aquatic habitat, and elevating pollutant concentrations and loadings. These adverse environmental impacts can be more effectively prevented or minimized for new development and redevelopment projects (as required in this SBR) than for existing developed areas.

For a brief description of the hydrologic cycle and how development affects the cycle, see the "Stormwater Discussion" in the Department's Sample Municipal Stormwater Management Plan (Appendix C of the New Jersey Stormwater Best Management Practices Manual). For more detailed description of the adverse impacts that unmanaged land development can have on groundwater recharge and stormwater runoff quality and quantity both at and downstream of a development site, see Chapter 1, "Impacts of Development on Runoff," of the New Jersey Stormwater Best Management Practices Manual. That Chapter also reviews the fundamental physical, chemical, and biological aspects of the rainfall-runoff process and how they can be altered by development. In doing so, that Chapter demonstrates the need for the new Stormwater Management Rules at N.J.A.C. 7:8, which have been developed to directly address these adverse impacts. In addition, that Chapter seeks to increase understanding of these physical, chemical, and biological processes in order to improve the design of structural and non-structural measures mandated by the Rules' groundwater recharge, stormwater quality, and stormwater quantity requirements.

In regard to the design of storm drain inlets, every piece of solid or floatable material that is caught before it enters or leaves a storm drainage system will benefit the environment. Minimizing the size of spaces in storm drain inlet grates and curb openings will trap certain solid and floatable materials before they reach our waterways. However, these spaces must also be large enough to provide adequate hydraulic performance.

Several resources providing information related to this SBR were identified in the pages above. For convenience, some of these resources are also listed below:

- A courtesy copy of the new Stormwater Management Rules (N.J.A.C. 7:8), and answers to "Frequently Asked Questions" about those rules, are available at www.njstormwater.org.

- The New Jersey Stormwater Best Management Practices Manual is available at www.njstormwater.org and from Maps and Publications, Department of Environmental Protection, 428 East State Street, P.O. Box 420, Trenton, New Jersey, 08625; telephone (609) 777-1038. This Manual is also on the CD of guidance material provided by the Department to Highway Agencies.

Chapter 5 - Local Public Education

This Statewide Basic Requirement (SBR) requires Highway Agencies to educate appropriate users and employees on the impact of certain of their activities on stormwater quality. Topics include things such as properly disposing of pet wastes, used motor oil, and, if applicable, not feeding wildlife. The Division of Watershed Management, Office of Outreach and Education offers numerous materials and programs that can assist Highway Agencies in developing and implementing a Local Public Education program. Information on these programs and educational materials can be found on the Department's Division of Watershed Management website at www.state.nj.us/dep/watershedmgt. The Department will also provide supplemental educational information on a compact disk supplied to each Highway Agency that can be used to expand the Local Public Education Program.

Local Public Education Program

WHAT IS REQUIRED?

Minimum Standard

The Local Public Education Program shall describe how the Highway Agency will distribute educational information to appropriate users and employees of the Highway Agency to satisfy this minimum standard. The following SBR topics shall be included in the Local Public Education Program: Storm Drain Labeling, Pet Waste Control, Improper Waste Disposal Control and Wildlife Feeding Control.

To satisfy the requirement to distribute educational material, Highway Agencies shall provide informational material in any form (e.g., calendars, brochures, signs, sheets, booklets) by locating this material at rest areas and service areas located along the Highway Agency's small MS4.



Providing a "Pet Area", pet waste clean –up bags, and signs would satisfy the requirement to distribute educational material on Pet Waste Control at rest areas and service areas.

Measurable Goal

Highway Agencies shall certify annually that they have met the Local Public Education Program minimum standard.

Implementation Schedule

Within 12 months from the effective date of permit authorization, Highway Agencies shall comply with the Local Public Education Program minimum standard.

WHAT DOES THIS MEAN?

Highway Agencies shall make available to appropriate users and employees information in any form (e.g., calendars, brochures, signs, sheets, booklets) containing the SBRs required by the permit at rest

stops and service areas. For example, your Highway Agency could post signs at rest areas that state, "Do Not Feed Wildlife" and "Pick Up After Your Pet."

WANT TO KNOW MORE?

It is estimated that up to 60% of our existing water pollution problems are attributable to **stormwater/nonpoint pollution**. This pollution can often be linked to our daily activities and lifestyles - things like walking pets, washing cars, changing motor oil, fertilizing the lawn, and littering. When it rains, pollutants from these activities can be washed into storm drains and eventually flow into New Jersey's surface and ground waters. These pollutants can contaminate our drinking water, as well as degrade aquatic populations and habitats and beaches.

The **improper disposal of hazardous wastes** can impact stormwater, ground water and surface water quality. Many of the products used for the operation, repair, and maintenance of motor vehicles contain chemicals that are harmful to people and the environment. These can include things like antifreeze, motor oil, paint, solvents, battery acid and lead, engine cleaner, rust preventative, and degreasers. These products may contain petroleum hydrocarbons and other toxic, flammable, or corrosive chemical components, all of which may be introduced into the environment if not properly disposed. When such wastes are deliberately or inadvertently discharged into the storm drain (e.g., dumping of used motor oil, flushing of radiator coolant) they can have a significant impact on stormwater quality. Disposing these wastes directly onto the ground can impact ground water quality and disposing of them into a septic system can impact ground water quality and destroy helpful bacteria in the septic system. When hazardous wastes are discharged into the sewer system they may destroy bacteria used for treatment at the sewage treatment plant (STPs). In addition, STPs are not designed to treat hazardous wastes, which pass through the plant, and are consequently discharged to surface water.

For additional information regarding pet waste and wildlife feeding see Chapter 6 of this guidance document.

Storm Drain Inlet Labeling

WHAT IS REQUIRED?

Minimum Standard

Highway Agencies shall establish a storm drain inlet labeling program and label all storm drain inlets located at rest areas, service areas, maintenance facilities, and storm drain inlets along streets with sidewalks within the Highway Agency's small MS4. The program shall establish a schedule for labeling, develop a long term maintenance plan, and when possible, coordinate efforts with watershed groups and volunteer organizations.



Examples of appropriate storm drain inlet labels

Measurable Goal

Highway Agencies shall certify annually that a storm drain inlet labeling program has been developed or is being implemented, and shall identify the number of storm drain inlets labeled within the year.

Implementation Schedule

Within 12 months from the effective date of permit authorization, Highway Agencies shall develop a labeling program for the storm drain inlets identified in the minimum standard. Highway Agencies must either:

- Label a minimum of 50% of the storm drain inlets within 36 months from the EDPA; and label all remaining storm drain inlets on or before 60 months from EDPA; or
- Divide the Highway Agency's small MS4 into two sectors for the purposes of storm drain inlet labeling and include a map of the two sectors in the SPPP. Label the storm drain inlets in one sector within 36 months from the EDPA; and label all remaining storm drain inlets on or before 60 months from EDPA.

WHAT DOES THIS MEAN?

The storm drain inlet labeling program, generally undertaken by local volunteer groups in cooperation with the Highway Agency, involves labeling storm drain inlets with a cautionary message about dumping pollutants. The Highway Agency is responsible for placing a label with such a message on or adjacent to all of the storm drain inlets that are located at rest areas, service areas, maintenance facilities, and storm drain inlets along streets with sidewalks operated by the Highway Agency. The message may be a short phrase such as "The Drain is Just for Rain," "Drains to [Local Waterbody]," "No Dumping. Drains to River," "You Dump it, You Drink it. No Waste Here." or it may be a graphic such as a fish. Although a stand-alone graphic is permissible, the Department strongly recommends that a short phrase accompany the graphic. These labels serve as a reminder to individuals that the storm sewer system connects to local surface and/or ground water bodies and that pollutants that enter via this pathway will ultimately end up in those water bodies.

WANT TO KNOW MORE?

Users and employees of the Highway Agency may not be aware that water in storm sewers is not treated at sewage treatment plants before it reaches its ultimate destination. Additionally, some individuals view storm sewers as trash receptacles for general trash, used oil from their automobiles, paint from home-improvement projects, leftover herbicides, and various other pollutants. The storm drain inlet-labeling program provides an opportunity to educate the public about the connection between storm sewers and local water bodies.

Public participation, through volunteer groups such as environmental organizations, or school groups, is beneficial to the program and shall be used when possible. For safety reasons, the Department recommends that volunteers only label inlets in low traffic/low speed limit areas. An alternative could be for the Highway Agency to perform the labeling work, although this lacks the public participation element which lends itself to education. Another option is to have the work overseen by the Highway Agency but carried out by volunteers to ensure adherence to permit and safety requirements.

Most people, when informed that the storm sewer discharges to the surface or ground water, will not use the storm sewer as a trash can. Education, especially of young children, continues to pay benefits into the future. The storm drain inlet label stimulates interest in the subject matter of stormwater quality and nonpoint pollution control. Once there is that interest, the rest of the message is easier to convey. Surveys continue to show that the environment, and especially water quality, is a top concern of New Jersey residents. The storm drain inlet labeling program addresses those residents' concerns, shows an effort to improve water quality, and starts the education process that will last a lifetime. For more information on how to plan and implement a Storm Drain Inlet labeling program, go to the Department's website (Division of Watershed Management) at www.state.nj.us/dep/watershedmgt. The Division of Watershed Management has produced a manual that will assist you in planning your storm drain inlet labeling program.

Chapter 6 - Improper Disposal of Waste

The Improper Disposal of Waste Statewide Basic Requirement (SBR) focuses on the proper disposal of wastes such as pet waste and litter. When they are disposed of improperly, they become a significant source of stormwater pollution. The Best Management Practices (BMPs) discussed below, when implemented together, may significantly reduce the addition of nutrients, disease causing microorganisms (pathogens), solids and other pollutants to receiving waters in a cost-effective manner.

Most of the BMPs found in this section require the adoption and enforcement of a regulatory mechanism, to the extent allowable under law. The appropriate type of regulatory mechanism (for example a resolution, ordinance, or regulation) and enforcement method (for example, fines, employee disciplinary action) will depend on the Highway Agency's enabling legislation and institutional structure and procedures, and on whether the mechanism regulates the conduct of the general public or just the Highway Agency itself. Example regulatory mechanisms for each BMP can be found in **Chapter 2 - Stormwater Pollution Prevention Plans and Example Forms**. These example regulatory mechanisms are to assist in developing your own regulatory mechanisms, and are based on enabling legislation for most New Jersey counties. A Highway Agency may change the example regulatory mechanisms to fit their individual needs, but should ensure that their change doesn't prevent the regulatory mechanism from meeting the permit minimum standard. If your Highway Agency already has a regulatory mechanism in place that meets the requirements of the permit, a new or modified regulatory mechanism is not required. However, if the regulatory mechanism does not meet the minimum standard of the permit, then the regulatory mechanism has to be modified accordingly. Your legal counsel should review all regulatory mechanisms.

Pet Waste

WHAT IS REQUIRED?

Minimum Standard

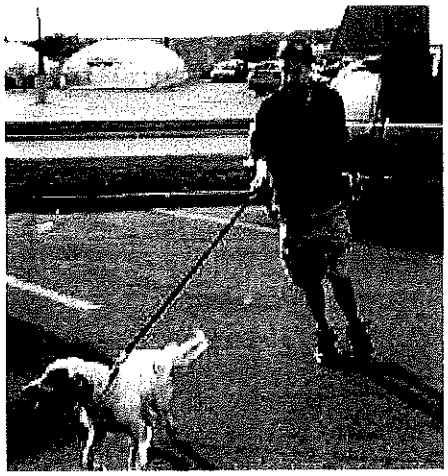
Highway Agencies shall, to the extent allowable under law, adopt and enforce an appropriate regulatory mechanism that requires pet owners or their keepers to immediately and properly dispose of their pet's solid waste deposited at rest areas and service areas within the Highway Agency's small MS4.

Measurable Goal

Highway Agencies shall certify annually that they have met the Pet Waste Control minimum standard.

Implementation Schedule

Within 18 months from the effective date of permit authorization, Highway Agencies shall have fully implemented the Pet Waste Control minimum standard.



Pet owners must properly dispose of their pet's solid waste at all highway rest areas and service areas.

WHAT DOES THIS MEAN?

Highway Agencies must to the extent allowable under law, adopt and enforce a regulatory mechanism to ensure that pet owners and keepers (walkers or pet sitters) immediately and properly dispose of their pet's solid waste deposited at highway rest areas and service areas within the Highway Agency's small MS4. This means that someone walking a pet needs to immediately pick up after the pet and properly dispose of the solid waste. Regulatory mechanisms and the threat of fines are often not enough to make people clean up after their pets. Therefore it is important, as per the Local Public Education Program, to educate the public about the regulatory mechanism.

WANT TO KNOW MORE?

Pet waste can be a significant source of organic pollutants and pathogens. When pet waste is left along sidewalks, streets, rest areas and service areas and is not properly disposed of, it can be carried into storm drains by rain during storm events. Most storm drains are not connected to sewage treatment plants, but drain directly to local water bodies. By controlling pet waste, pollutant loading entering these surface waters is reduced. Such pollutants include oxygen demanding substances, nitrogen and phosphorous, and pathogens. Pet waste uses up oxygen in the decay process, which in turn can harm aquatic animals and degrade overall water quality. Nitrogen and phosphorous are nutrients that can overstimulate weed and algal growth in slow moving water bodies and coastal waters. Pathogens in pet waste include protozoa, parasites and bacteria. It is estimated that about 95 percent of the fecal coliform in urban stormwater are of non-human origin. A Seattle study showed that leaking sewer lines were initially suspected but "animals, particularly household pets, were the culprits." In addition, "it has been estimated that for watersheds of up to 20 square miles draining to small coastal bay, 2-3 days of droppings from a population of about 100 dogs would contribute enough bacteria and nutrients to temporarily close a bay to swimming and shellfishing." [1, 2, 3] As a result of the impact of animal waste on water quality, regulatory mechanisms requiring pet owners and keepers to immediately clean up after their pets, makes simple environmental sense.

Recommendations

To make your pet waste regulatory mechanism more effective, the following recommendations are provided by the Department. These recommendations may be beneficial but are not required by the permit.

- Provide pet waste stations with pet waste removal bags, and dedicated trash cans for pet waste at rest areas and service areas operated by the Highway Agency.
- Place educational posters about pet waste at rest areas and service areas, in addition to the required educational material.

References

1. Alderserio, K.D. Wait and M. Sobsey. 1996. Detection and characterization of male-specific RNA coliphages in a New York City reservoir to distinguish between human and non-human sources of contamination. In *Proceedings of a Symposium on New York City Water Supply Studies,* ed. Mcdonnell et al. TPS-96-2. American Resources Association. Herndon, VA.
2. Trial, W. et al. 1993. Bacterial source tracking: studies in an urban Seattle watershed. *Puget Sound Notes* 30:1-3.
3. USEPA. 1993. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Litter Pick Up Program

WHAT IS REQUIRED?



Litter along our highways ends up as litter on our beaches.

Minimum Standard

Highway Agencies shall develop and implement a litter pick up program that includes roadside clean up of trash and debris and regular collection of refuse from litter receptacles owned and operated by the Highway Agency including those located at rest areas and service areas. Highway Agencies shall maintain records of roadside clean ups and estimates of the total amount of trash and debris collected.

Measurable Goal

Highway Agencies shall certify annually that they have met the Litter Pick Up Program Control minimum standard and shall report dates of roadside clean ups and estimates of trash and debris collected.

Implementation Schedule

Within 12 months from the effective date of permit authorization, Highway Agencies shall have developed and begin implementing the Litter Pick Up Program minimum standard.

WHAT DOES THIS MEAN?

Highway Agencies must develop and implement a Litter Pick Up Program that will reduce the discharge of materials such as fast food wrappers, soda cans and bottles, and other trash into MS4s. Your Highway Agency is responsible for the clean up of roadside litter and also collecting trash from litter receptacles owned and operated by the Highway Agency, including those at rest areas and service areas. Record keeping requirements of the litter pick up program, including estimates of the total amount of trash and debris collected, must be kept and included in an annual report form submitted to the Department.

Instituting a new program such as this is a heavy undertaking and may be coordinated with agencies outside of the Highway Agency. Organizing the effort with volunteer groups or perhaps even the Department of Corrections may help in starting the program. The Division of Programs and Community Services within the Department of Corrections operates the Community Labor Assistance Program, which can be reached at 609-984-7414.

WANT TO KNOW MORE?

Litter is a significant pollutant, especially in urban areas and heavily traveled roadways where large volumes of trash are generated by travelers who throw trash out of their car windows. "Litter", as defined in the State Litter Statute (N.J.S.A. 13:1E-215), "means any used or unconsumed substance or waste material which has been discarded, whether made of aluminum, glass, plastic, rubber, paper, or other natural or synthetic material, or any combination thereof, including, but not limited to, any bottle, jar, or any top, cap or detachable tab of any bottle, jar or can, any unlighted cigarette,



Birds can easily become stuck in discarded plastic 6-pack rings. Photo: Bill Burton

cigar, match or any flaming or glowing material or any garbage, trash, refuse, debris, rubbish, grass clippings, or other lawn or garden waste, newspapers, magazines, glass, metal, plastic or paper containers or other packaging or construction material..."

Currently there are many established means to reduce the potential costs of litter pick up along the highways. Eligible Highway Agencies should take advantage of any monies available through the Clean Communities Act. Through the Clean Communities Act monies are available to counties for litter pick up and educational materials on litter control. Many Highway Agencies also have an "Adopt a Highway" program where volunteers pick up litter along their roads and highways. However the "Adopt a Highway " program does not ensure that the litter on these highways will be picked up on a consistent basis, so the Highway Agencies must monitor these roads to ensure that the litter along these roads and highways is picked up on a regular basis. Highway Agencies that have service areas and rest stops face unique problems. Unlike other areas within the Highway Agency, these locations have the greatest concentration of pedestrian traffic. Rest stops and service areas also vary in the potential for the amount of litter that is present. Service areas and rest stops with fast food restaurants, gas stations, or heavily used picnic areas will have an even greater amount of litter than rest stops without the concentrated amenities. Usually, in service areas and rest stops volunteer groups cannot be used for litter pick up, and the work has to be completed with the maintenance staff of the Highway Agencies.

Littering can significantly impact receiving waters. Litter, such as fast food wrappers, soda cans and bottles, and other trash, if not properly disposed, could eventually end up in our lakes, streams, and oceans. When litter reaches these surface water bodies it can have a negative impact on marine and other wildlife. For example, birds can easily become stuck in plastic 6-pack rings, marine mammals and sea turtles often choke on plastic bags that they mistake for jellyfish, and many sharks have been found with aluminum cans in their digestive systems.

Litter is a serious problem in many states, especially in a state as densely populated and heavily traveled as New Jersey. It is the Department's duty to promote and encourage a clean and safe environment for future generations. Litter not only poses a threat to public health and safety, but also plays a large role in a highway's aesthetic appearance. By fully utilizing this program, your Highway Agency will not only reduce the amount of litter along highways, in rest stops and service areas, but will also reduce the amount of solids and floatables in stormwater facilities and reduce the amount of trash to collect during street sweeping operations.

Recommendations

The following recommendations are provided by the Department to help make your stormwater program more successful, but are not required by the permit.

- Incorporate more trash and recycling receptacles at places where trash is likely to accumulate, such as the parking lots and entrances/exits of rest area and service area buildings.
- Put additional signs along areas with heavy litter, such as service areas and rest stops.

- Encourage travelers to use supplied trash cans and recycling receptacles (which should come equipped with tight fitting lids).
- Provide rest areas and service areas with cigarette butt receptacles to be placed in areas where people congregate to smoke.
- Supply car litter bags.

Improper Disposal of Waste

WHAT IS REQUIRED?



A single quart of motor oil can pollute 250,000 gallons of drinking water.

Minimum Standard

Highway Agencies shall, to the extent allowable under law, adopt and enforce an appropriate regulatory mechanism prohibiting the Highway Agency and its employees from the improper spilling, dumping, or disposal of materials other than stormwater into the Highway Agency's small MS4 (excluding those authorized in Part I, Section A.2.d). If the Highway Agency observes anyone else engaging in the improper spilling, dumping, or disposal of materials other than stormwater, the Highway Agency shall report the incident to the Department's Action Hotline (877-927-6337).

Measurable Goal

Highway Agencies shall certify annually that they have met the Improper Waste Disposal Control minimum standard.

Implementation

Within 18 months from the effective date of permit authorization, Highway Agencies shall have fully implemented the Improper Waste Disposal Control minimum standard.

WHAT DOES THIS MEAN?

This BMP requires the Highway Agency, through a regulatory mechanism, to prohibit the Highway Agency and its employees from spilling, dumping, or disposal of materials other than stormwater into the municipal separate storm sewer system (MS4) at the highway. This includes materials like automotive fluids, used motor oil, paints and solvents that can directly impact receiving water bodies. The BMP also requires the Highway Agency to actively enforce the regulatory mechanism, which includes taking appropriate action when someone is found violating the regulatory mechanism. The Highway Agency must report anyone else engaging in improper spilling, dumping, or disposal of materials other than stormwater to the Department's Action Hotline (877-927-6337).

This permit does allow the following new and existing nonstormwater discharges from the MS4:

- water line flushing and discharges from potable water sources;
- uncontaminated ground water (e.g., infiltration, crawl spaces or basement sump pumps, foundation or footing drains, rising ground waters);

- air conditioning condensate (excluding contact and non-contact cooling water);
- irrigation water (including landscape and lawn watering runoff);
- flows from springs, riparian habitats and wetlands, water reservoir discharges and diverted stream flows;
- residential car washing water, and residential swimming pool discharges;
- sidewalk, driveway and street wash water;
- flows from fire fighting activities;
- Flows from rinsing of the following equipment with clean water:
  - Beach maintenance equipment immediately following their use for their intended purposes; and
  - Equipment used in the application of salt and de-icing materials immediately following salt and de-icing material applications. Prior to rinsing with clean water, all residual salt and de-icing materials must be removed from equipment and vehicles to the maximum extent practicable using dry cleaning methods (e.g., shoveling and sweeping). Recovered materials are to be returned to storage for reuse or properly discarded.

  Rinsing of equipment in the above situations is limited to exterior, undercarriage, and exposed parts and does not apply to engines or other enclosed machinery.

WANT TO KNOW MORE?

The improper disposal of pollutants can have a negative effect on surface and ground water quality. Failure to properly dispose of materials like automotive fluids, motor oil, lawn and garden supplies, cleaning supplies, paints and solvents, can have a direct impact on receiving waterbody quality. Each year nearly 180 million gallons of used oil is disposed of improperly. It is estimated that a single quart of motor oil can pollute 250,000 gallons of drinking water.

Uninformed users and employees may dump hazardous materials onto streets, sidewalks, roadways, onto the ground, or down storm sewers, unintentionally causing the pollutants to enter surface and/or ground waters. Most illegal disposal occurs because people are unaware that it causes an environmental problem or that it is actually illegal. A smaller percentage of these occurrences are deliberate acts. The proper disposal of these wastes may be as simple as disposing of it with other trash. However, a better option may be to recycle or reuse these materials. Motor oil, oil filters, and automotive batteries are just a few examples of hazardous materials that can be recycled and reused. The threat they pose to the environment, as well as human health, can be greatly reduced when these materials are recycled and reused instead of being dumped down storm sewers or onto the ground.

For more information on the improper disposal of wastes please see the Local Public Education BMP, "Want to know more?" section in Chapter 5 of this guidance manual.

Recommendations

The following recommendations may be beneficial but are not required.

- Establish a hotline for reporting the improper disposal of waste. A hotline or dedicated telephone number makes it easier to report illegal disposal

- Appropriate personnel (operators, police, fire, ER) should have emergency phone numbers such as the County Office of Emergency Management and the NJDEP Action Hotline (1-877-927-6337)

Wildlife Feeding

WHAT IS REQUIRED?

Minimum Standard

Highway Agencies shall, to the extent allowable under law, adopt and enforce an appropriate regulatory mechanism that prohibits the feeding on any property owned or operated by the Highway Agency of any wildlife (excluding confined animals, for example, wildlife confined in zoos, parks, or rehabilitation centers or unconfined wildlife at environmental education centers).

Measurable Goal

Highway Agencies shall certify annually that they have met the Wildlife Feeding Control minimum standard.

Implementation Schedule

Within 18 months from the effective date of permit authorization, Highway Agencies shall have fully implemented the Wildlife Feeding Control minimum standard.

WHAT DOES THIS MEAN?

Highway Agencies must to the extent allowable under law adopt and enforce a wildlife feeding regulatory mechanism to prohibit the feeding of unconfined wildlife on property owned or operated by the Highway Agency for its highways. This prohibition helps prevent nutrients, organic pollutants, and pathogens associated with wildlife fecal matter from entering local water bodies, as well as preventing overgrazing, which can lead to erosion. It is important to note that while most people understand "wildlife" to mean waterfowl, "wildlife" also includes other wild animals, such as bears, deer and pigeons. The Highway Agency may allow baiting of wildlife for the purposes of hunting and fishing if done in accordance with New Jersey Fish and Game regulations.

WANT TO KNOW MORE?

Many people enjoy feeding waterfowl and other wildlife. For them, it provides an escape from their everyday life and work, it gives them a sense of pleasure and fulfillment to help the animals, and it brings the wildlife closer so that their children can see them. What these people don't realize is that they are actually harming the very animals they are trying to help. Feeding wildlife can actually do more harm than good to both the animal and its habitat, and can also be harmful to people. Artificial feeding can, for example, result in poor nutrition, delayed migration, spread of disease, overcrowding, unnatural behavior, water pollution, and aggressive behavior.

Feeding attracts wildlife in unnatural numbers, beyond natural food and water supplies, and frequently in numbers beyond which people will tolerate. This overcrowding often results in over-grazing which can lead to erosion, which can result in excess amounts of sediment getting into our waters. These areas can quickly become unsanitary and unusable to people, and a breeding ground for wildlife disease. While these diseases are generally not transmissible in wild settings, they thrive in overcrowded and unsanitary conditions where the wildlife is eating in the same place where they defecate. Many beach closings have also been attributed to geese and other birds. When an excessive

number of birds congregate near a beach or waterway, their fecal matter can sometimes overload the normal capacity of a beach to absorb natural wastes, thus degrading the water quality and requiring the area to be closed to the public. In addition to this, where birds congregate to feed, E-coli counts can swell to levels that make the water unsuitable for swimming.

Excess nutrients in ponds and other waterways caused by unnatural numbers of waterfowl and other wildlife droppings can result in water-quality problems such as summer algal blooms. These problems are directly related to a loss of habitat and wildlife, including fish kills, as well as odor nuisances, taste and odor in drinking water, and an interference with various forms of recreation (e.g., fishing, swimming, boating, etc.).

There are many other options and alternatives to feeding wildlife. If everyone stops feeding wildlife, the wildlife will not disappear. Families can still visit sites to enjoy viewing the animals. Children can still be encouraged to learn about wildlife and their natural habitats. Additionally, some zoos offer feeding of captive wildlife (petting zoos).

Illicit Connection Program/Outfall Pipe Mapping

WHAT IS REQUIRED?

Minimum Standards

Storm Sewer Outfall Pipe Mapping – Highway Agencies must develop a map showing the location of the end of all MS4 outfall pipes that are operated by the Highway Agency, and that discharge from the Highway Agency's small MS4 into a surface water body (e.g., a lake, ocean, or stream including an intermittent stream). This map shall also show the location (and name, where known to the Highway Agency) of all surface water bodies receiving discharges from those outfall pipes. Each outfall pipe mapped shall be given an individual alphanumeric identifier, which shall be noted on the map. The outfall pipes shall be mapped on either a tax map prepared in accordance with Title 18, Chapter 23A of the New Jersey Administrative Code or on another map drawn to equal or larger (more detailed) scale. The Highway Agency shall submit a copy of its outfall pipe map to the Department upon request.

Regulatory Mechanism Prohibiting Illicit Connections - Each Highway Agency shall, to the extent allowable under law, effectively prohibit through an appropriate regulatory mechanism, illicit connections to the Highway Agency's small MS4, and implement appropriate enforcement procedures and actions.

Illicit Connection Elimination Program - Each Highway Agency must develop and implement a program to detect and eliminate their illicit connections into the Highway Agency's small MS4. The program, at minimum, must include an initial physical inspection of all its outfall pipes. All outfall pipes that are found to have dry weather flow are to be further investigated.

The inspections of outfall pipes and investigations of dry weather flows are to be conducted in accordance with the procedures for detecting, investigating, and eliminating illicit connections contained in Attachment B of the permit. Results of the inspections of outfall pipes and dry weather flows are to be recorded on the Department's Illicit Connection Inspection Report form contained in the Department's "Highway Agency General Permit Guidance Document". Inspection reports for dry weather flows discovered as a result of initial physical inspections or as part of the ongoing program must be submitted to the Department with the annual certification. If the dry weather flow is intermittent, the Highway Agency must perform, at minimum, three (3) additional

investigations in an attempt to locate the illicit connection. If an illicit connection cannot be located or is found to emanate from an entity other than the Highway Agency then the Highway Agency must submit to the Department a written explanation detailing the results of the investigation. If the illicit connection is found to be from another public entity, the Highway Agency shall also notify that entity. All illicit connections found that result from the Highway Agency's own illicit connections must be eliminated within six (6) months of the discovery.

After the completion of the initial physical inspection of all outfall pipes, Highway Agencies must maintain an ongoing program to detect and eliminate illicit connections. The ongoing program will respond to complaints and reports of illicit connections, including complaints and reports from operating entities of interconnected small MS4s, and continue to investigate dry weather flows discovered during routine inspections and maintenance of the small MS4.

Measurable Goal

Highway Agencies shall certify annually that an outfall pipe map has been completed or is being prepared in accordance with permit conditions and shall report the number of outfall pipes mapped within the year being reported and the total number of outfall pipes mapped to date.

Highway Agencies shall submit an annual certification to the Department certifying that an appropriate regulatory mechanism is in place prohibiting illicit connections and is being actively enforced.

Highway Agencies shall certify annually that an illicit connection elimination program has been developed in accordance with permit conditions to detect and eliminate illicit connections into the Highway Agencies' small MS4. Annual certifications shall also include the number of outfalls physically inspected, the number of outfalls found to have dry weather flow, the number of illicit connections found and the number of illicit connections eliminated. Copies of inspection reports shall be submitted with the annual certification for those outfalls found to have dry weather flow.

Implementation Schedule

Storm Sewer Outfall Pipe Mapping – Highway Agencies shall divide the Highway Agency's small MS4 into two (2) sectors for the purposes of outfall mapping. A diagram of the Highway Agency showing the two (2) sectors shall be part of the Highway Agency's SPPP. Highway Agencies shall map the location of the end of small MS4 outfall pipes in one sector 36 months from the EDPA; and map the location of the end of all small MS4 outfall pipes on or before 60 months from the EDPA.

Regulatory Mechanism Prohibiting Illicit Connections - Within 18 months from the effective date of permit authorization, Highway Agencies shall effectively prohibit through an appropriate regulatory mechanism, illicit connections in accordance with the minimum standard.

Illicit Connection Elimination Program - Within 18 months from the effective date of permit authorization, Highway Agencies shall have developed and begun implementing a program to detect and eliminate illicit connections in accordance with the minimum standard. Highway Agencies shall perform an initial physical inspection of all outfall pipes using the Department's Illicit Connection Inspection Report form within 60 months from the EDPA.

WHAT DOES THIS MEAN?

Highway Agencies are required to develop and maintain an ongoing program to detect and eliminate illicit connections. The first step in this program is to develop an outfall pipe map, showing the

location of the end of all MS4 outfall pipes that are operated by the Highway Agency and that discharge to surface water. If any outfalls are found to have a dry weather flow, they must be further investigated. If they are found to have an illicit connection, the illicit connection must be eliminated (or reported to the Department if the illicit connection is found to emanate from an entity other than the Highway Agency). A regulatory mechanism prohibiting illicit connections shall be adopted and enforced. Finally an annual report shall be submitted to the Department certifying that the map is being prepared, or has been completed, according to the schedule set in the permit, that the illicit connection elimination program has been developed and is being implemented, and that the regulatory mechanism prohibiting illicit connections is in place and is being enforced. Additionally, the Highway Agency is required to fill out an Illicit Connection Inspection Report Form for each outfall inspected. For outfalls that are found to have dry weather flows, these forms must be submitted to the Department with the annual report. A copy of this form can be found in Chapter 12 of this document.

(**Important Note:** The Highway Agency is not required to map its entire municipal separate storm sewer system, just the ends of the outfall pipes. In addition, the Highway Agency is not required to map outfall pipes that are operated by another entity (e.g., NJDOT or other State agency, county, another Highway Agency, municipality, private entity, etc.).

WANT TO KNOW MORE?

An "illicit connection," as described in Attachment B in the permit, means any physical or non-physical connection that discharges the following to the Highway Agency's small MS4, unless that discharge is authorized under a New Jersey Pollutant Discharge Elimination System (NJPDES) permit other than the Highway Permit (non-physical connections may include, but are not limited to, leaks, flows, or overflows into the municipal separate storm sewer system):

- Domestic sewage
- Non-contact cooling water, process wastewater, or other industrial waste (other than stormwater); or
- Any category of non-stormwater discharges that the Highway Agencies identifies as a source or significant contributor of pollutants pursuant to 40 C.F.R. 122.34(b)(3)(iii).

Illicit connections of non-stormwater discharges have been shown to contribute substantial levels of contaminants to surface water bodies. These illicit connections may originate from sources such as improperly connected sanitary sewage lines, industrial flows and from leaking or overflowing sanitary sewer lines and pumping stations. The first step in implementing an illicit connection elimination program is to identify and map stormwater outfall pipes.

It is widely felt that any in-roads made in eliminating the large number of inappropriate entries into storm sewer systems will further enhance conventional pollution control programs. Secondary treatment of sanitary sewage is standard throughout the country, yet these efforts in upgrading treatment are undercut by untreated sanitary wastes being discharged via illicit connections from our MS4 systems.

Types of pollutants discharged via illicit connections vary widely and can originate from a myriad of sources. Illicit discharges may include; sanitary sewage, cooling water, industrial flows, and wash water and can contribute pollutants such as pathogens, nutrients, metals, petroleum hydrocarbons, detergents, chlorine, organics and heat. All of these pollutants can cause an adverse effect on receiving waters and contribute substantial levels of contaminants.



Highway Agencies must perform a visual inspection of each outfall pipe operated by the Highway Agency. Dry weather flows must be investigated further.

Procedures for Detecting, Investigating, and Eliminating Illicit Connections

Requirements for these procedures can be found in Attachment B of the permit. This section may include some of these requirements, but also includes recommendations provided by the Department that are not required by the permit.

Detection

MS4 outfall pipes, for the most part, should not be discharging during substantial dry periods (72 hours after a rain event). Such flow is frequently referred to as "dry weather flow," which may be the result of an illicit connection. All dry weather flows are non-stormwater discharges, however not all dry weather flows are illicit connections. Some non-stormwater flows result from the improper disposal of waste (e.g., radiator flushing, engine degreasing, improper disposal of oil) and some may be the result of allowable discharges such as residential car washing, irrigation runoff, permitted (NJPDES) discharges and natural waters (spring water and groundwater infiltration). By using the Department's Illicit Connection Inspection Report form[1] and making physical observations, a Highway Agency will compile information that will help determine if the dry weather flow is an illicit connection and the most likely source of the illicit connection. After making these physical observations, additional chemical field-testing will enable a Highway Agency to further narrow the potential source(s) of the illicit connection.

The first physical observation is to observe if there is a dry weather flow. Some dry weather discharges are continuously flowing and some are intermittent. Observations will allow the Highway Agency to establish with reasonable certainty if there is an intermittent flow. If there are indications of intermittent flows (staining, odors and deterioration of outfall structure) follow-up investigations are required (see Investigation section). An estimate of the flow rate of the discharge should also be noted (e.g., flow rate can sometimes be estimated by timing how long it takes to fill a container of a known size). Additional physical observations and measurements should be made for odor, color, turbidity, floatable matter, temperature, deposits and stains, vegetation and algal growth and condition of outfall structure (see Illicit Connection Inspection Report form).

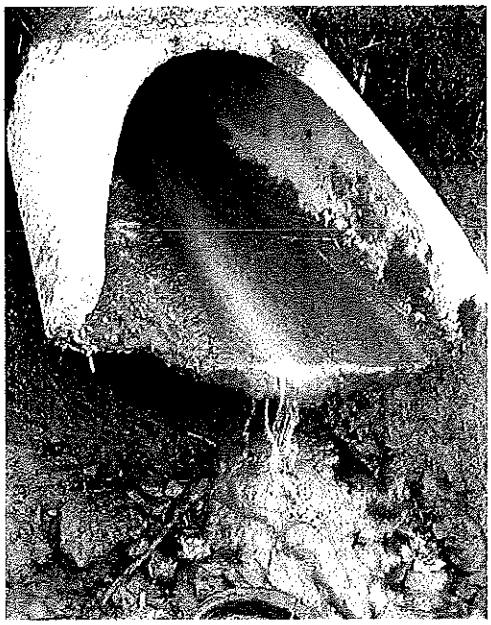
[1] A copy of this form can be found in Chapter 12 of this document

If a dry weather flow exists, and after making all physical observations, the flow should be tested for detergents (surfactants as methylene blue active substances – (MBAS)). Results of monitoring for detergents, using a testing procedure with a detection limit of 0.06 mg/L, can accurately distinguish between discharges that are contaminated by sanitary wastewater and those that are not. Dry weather flows that contain detergents in excess of the detection limit require further investigation and should be given the highest priority. Dry weather flows that do not test positive for detergents and do not show physical characteristics of sanitary wastewater (odor, floatables, and/or color) are unlikely to be from sanitary wastewater sources, yet they may still be illicit connections of industrial wastewater, rinse water, backwash, or cooling water.

Non-stormwater discharges that are detergent-free, and therefore not sanitary, should be tested for fluoride. Fluoride concentration is a reliable indicator of whether the non-stormwater flow is from a potable or non-potable water source. Fluoride treated potable waters usually have concentrations of total fluoride in the range of 1.0 to 2.5 mg/L. Non-stormwater discharges that test below the detection limit for fluoride (0.13 mg/L using a Hach Colorimeter DR/850) are likely to be groundwater infiltration, springs or streams. In some instances a Highway Agency may find a non-stormwater discharge that originates from an on-site well used for industrial cooling water which will test non-detect for both detergents and fluoride. Highway Agencies will have to rely on temperature to differentiate between these cooling water discharges and ground water infiltration and other natural flows. Fluoride testing won't be able to pinpoint the source of the illicit connection, but is a helpful tool in further narrowing the search.

The ratio of ammonia (as N) to potassium can be used to help distinguish a sanitary wastewater source from a washwater source. Detergents will be present in both sanitary sewage and washwater. Generally the ammonia/potassium ratio of sanitary sewage will be greater than 0.60. Non-stormwater flows with an ammonia/potassium ratio less than 0.60 are likely to be a washwater source.

All of the tests recommended for the tracing of illicit connections may be performed in the field by employees of the Highway Agency or may be contracted out. Lab certification for those parameters is **not** required. It is advised that the person taking the field sample be familiar and trained in appropriate field testing protocol and be familiar with the equipment to be used. Analysis for detergents (MBAS), fluoride, ammonia, and potassium may be conducted by using a field spectrophotometer produced by various lab instrument manufacturers. The spectrophotometers are accurate, easy to use with limited training and are designed to be used in the field. Figure 2 illustrates the recommended steps to use when identifying an illicit connection.



Physical observations for turbidity, staining, odor, and color can help determine the source of an illicit discharge.

Investigation

Any storm sewer outfall pipe found during the initial inspection, or on any subsequent inspection to have a non-stormwater discharge, or indications of an intermittent non-stormwater discharge, requires further investigation by the Highway Agency to identify and locate the specific source. Non-stormwater discharges suspected of being sanitary sewage and/or significantly contaminated should be prioritized and investigated first. Dry weather flows believed to be an immediate threat to human health or the environment shall be reported immediately to the NJDEP Action Hotline at 1-877-WARNDEP (1-877-927-6337). Investigations of non-stormwater discharges suspected of being cooling water, washwater, or natural flows may be delayed until after all suspected sanitary sewage and/or significantly contaminated discharges have been investigated, eliminated and/or resolved.

Information compiled from physical observations and field monitoring should be used to help identify potential sources. These observations are very important since they are the simplest method of identifying grossly contaminated dry weather flows (see Figure - 3).

The use of field testing further narrows the potential sources of the non-stormwater discharge. However it is unlikely that either the physical observations or the field testing alone will pinpoint the exact source of the dry weather discharge. As a result, Highway Agencies will need to perform investigations "upstream" (but not outside Highway Agency property) to identify potential illicit connections to systems with identified problem outfalls.

Common approaches to identifying potential sources of illicit connections include drainage system surveys (field testing at upstream manholes, visual inspections, video/televised, smoke and dye testing), and industrial and commercial site assessments.

A drainage system survey may require that a Highway Agency similarly inspect each storm sewer line that connects into the main storm drain trunk line much like the initial inspections performed on each outfall pipe. Physical observations and additional field testing will help locate the dry weather flow as you trace the source moving further and further up the storm sewer pipe. Depending on the size and complexity of the storm drain system, it may be possible to isolate smaller portions of the system for more intensive investigations including smoke tests, dye testing and televised inspections. Information may be compiled from industrial and commercial facilities on Highway Agency property by distributing or performing industrial inventories. Through inspections or facility self-inspections it may be possible to locate illicit connections at likely sources such as floor drains, wash bays, and cooling water systems.

Facilities may not be aware that these connections are illicit and may find these connections while completing the questionnaire and correct them on their own. Information from these surveys may also allow Highway Agencies to eliminate certain industries as potential sources during an investigation.

All non-stormwater discharges, whether continuous or intermittent, must be investigated by the Highway Agency. All investigations must be resolved. If the source is found to be a non-stormwater discharge authorized under Part I Section A.2.d of the permit then no further action is required. If a non-stormwater discharge is found but no source is located within six (6) months of beginning the investigation, then the Highway Agency shall submit an Closeout Investigation Form to the address(es) listed on the form. The Highway Agency must document that a good faith effort was made to find the source of the dry weather discharge and document each phase of the investigation. If the observed discharge is intermittent the Highway Agency must make and document a minimum of three (3) separate attempts to investigate the discharge when it is flowing.

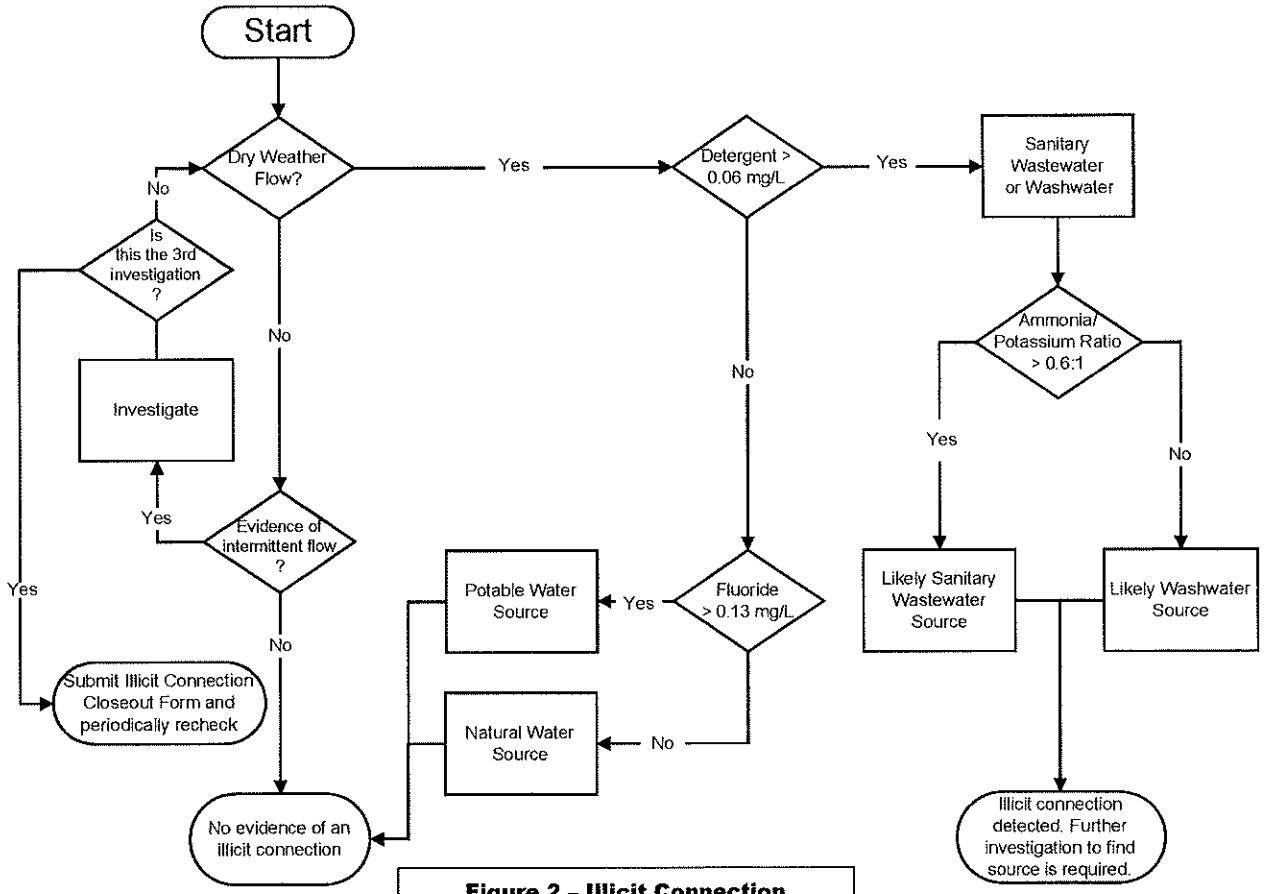


Figure 2 – Illicit Connection Investigation Flow Chart

Interpretations of Physical Observations and Likely Associated Sources

Odor	*Sewage:* smell associated with stale/septic sanitary wastewater. *Sulfur ("rotten eggs"):* industries that discharge sulfide compounds or organics (meat packers, canneries, dairies, etc.). *Oil and gas:* petroleum refineries or many facilities associated with vehicle maintenance or petroleum product storage. *Rancid-sour:* food preparation facilities (restaurants, hotels, etc.).
Color	Important indicator of inappropriate industrial sources. Industrial dry weather discharges may be of any color, but dark colors, such as brown, gray, or black, are most common. *Yellow:* chemical plants, textile and tanning plants. *Brown:* meat packers, printing plants, metal works, stone and concrete, fertilizers, and petroleum refining facilities. *Red:* meat packers. *Gray:* dairies, sewage.
Turbidity	Often affected by the degree of gross contamination. Dry weather industrial flows with moderate turbidity can be cloudy, while highly turbid flows can be opaque. High turbidity is often a characteristic of undiluted dry weather industrial discharges. *Cloudy:* sanitary wastewater, concrete or stone operations, fertilizer facilities, and automotive dealers. *Opaque:* food processors, lumber mills, metal operations, pigment plants.
Floatable Matter	A contaminated flow may contain floating solids or liquids directly related to industrial or sanitary wastewater pollution. Floatables of industrial origin may include animal fats, spoiled foods, solvents, sawdust, foams, packing materials, or fuel. Floatables in sanitary wastewater include fecal matter, toilet paper, sanitary napkins and condoms.
Deposits and Stains	Deposits and stains on outfall structures may be evidence of intermittent non-stormwater discharges. Deposits and stains include coatings, residues or fragments of materials. Grayish- black deposits that contain animal flesh or hair may be from leather tanneries. White crystalline powder is usually due to nitrogenous fertilizer wastes. Excessive sediment deposits may be attributed to construction site erosion. Sources of oily residues may include petroleum refineries, storage facilities, and/or vehicle service facilities.
Vegetation	Vegetation surrounding an outfall may show the effects of industrial pollutants. Decaying organic materials coming from food processors may cause increased vegetation growth. Other toxic materials from industrial discharges may decrease or kill vegetation. Non-stormwater discharges that contain excessive nutrients from concentrated animal feeding activities may also kill vegetation.
Damage to Outfall Structures	Cracking, deterioration, and scouring of concrete or peeling of paint at an outfall pipe may be caused by severely contaminated industrial discharges that are extremely acidic or basic. Primary metal industries may discharge highly acidic batch dumps. Food processors with discharges that become "septic" produce hydrogen sulfide gas, which quickly deteriorates metal surfaces.
Temperature	Both sanitary wastewater and cooling water may substantially increase the outfall discharge temperature. Elevated temperature measurements in discharges that test negative for detergents are likely to be cooling water discharges. Sources of cooling water discharges would be industrial facilities in the drainage area.

Figure - 3

If these attempts are unsuccessful, the Highway Agency shall submit the **Closeout Investigation Form** with the Annual Report and Certification (see Chapter 12). However, since this is an ongoing program, Highway Agencies should periodically recheck these suspected intermittent discharges.

Elimination

Non-stormwater discharges traced to their source and found to be the Highway Agency's own illicit connections shall be eliminated within six (6) months of their discovery. The Highway Agency may apply for a NJPDES permit for the discharge, but the discharge shall be ceased until a valid NJPDES permit has been issued by the Department. Highway Agencies are required to verify that the illicit discharge was eliminated within the specified timeframe and ensure that measures taken to eliminate the discharge are permanent and are not done in such a manner that would allow easy reconnection to the MS4.

If an illicit connection cannot be located or is found to emanate from an entity other than the Highway Agency then the Highway Agency must submit to the Department a written explanation detailing the results of the investigation. If the illicit connection is found to be from another public entity, the Highway Agency shall also notify that entity.

Mapping and Illicit Connection Program Recommendations

The following recommendations may be beneficial but are not required by the permit.

- To help reduce costs, when mapping your outfall pipes, look for signs of outfall pipe stream scouring (see Outfall Pipe Stream Scouring Remediation BMP in Chapter 8 of this guidance document), and complete your Illicit Connection Report form. This will ensure that you do not have to make multiple visits to the same outfall pipes.
- Map your entire MS4 system in addition to the required maps. An accurate map of the entire storm sewer system will aid in the investigation and elimination of illicit connections and allow for better stormwater facilities management and better planning of new development.
- Use the most accurate methods feasible for locating the end of the outfall pipe including Global Positioning System technology.
- Aerial, infrared and thermal photography may be helpful in identifying suspect discharges.
- Conduct routine dye testing of industries and commercial establishments that have a greater probability of illicit connections (automobile-related businesses, restaurants).

References:

USEPA, Investigation of Inappropriate Pollutant Entries into Storm Drainage Systems, January 1993.

USEPA, National Menu of Best Management Practices for Storm Water Phase II, last modified May 31, 2001.

Pitt, Robert, Illicit Discharge and Elimination, Presentation at the USEPA *National Storm Water Coordinator's Meeting*, Orlando, 2001.

Chapter 7 - Solids and Floatable Control

Solids and Floatable Control focuses on using preventative measures to help reduce the amounts of solids and floatable materials which may enter or result from the MS4s. "Solid and floatable materials" means sediment, debris, trash, and other floating, suspended, or settleable solids. The permit targets the reduction of solids and floatables since they are one of the most visible pollutants that impact our receiving waters. Many solids on streets come from pavement, tire and vehicle equipment wear, and often contain heavy metals and petroleum hydrocarbons. Solids are also produced by erosion along roads and in the vicinity of stormwater outfall pipes. These solids contribute to siltation of waterways and make streambeds unsuitable for many species reproduction. Solids and floatables create nuisances such as odors and toxic/corrosive gases. Solids and floatables are also aesthetically unappealing, making water look dirty, turbid and cloudy.

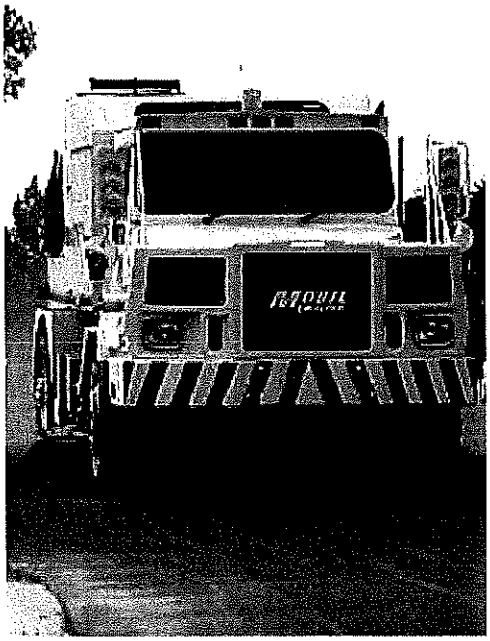
Street Sweeping

WHAT IS REQUIRED?

Minimum Standard

(For County Agencies Only) County Highway Agencies shall sweep all rest areas, service areas, maintenance yards, and all county owned or operated curbed streets (including roads or highways) with storm drains that have a posted speed limit of 35 mph or less (excluding all entrance and exit ramps) in predominantly commercial areas at a minimum of once per month, weather and street surface conditions permitting.

Highway Agencies other than County Highway Agencies shall sweep all rest areas, service areas, maintenance yards, and all curbed streets (including roads or highways) that they own or operate with storm drains that have a posted speed limit of 35 mph or less (excluding all entrance and exit ramps), in predominantly commercial areas, at a minimum of once per quarter, weather and street surface conditions permitting. All remaining streets (including roads or highways) that they own or operate shall be swept at a minimum of once every 2 years.



Street sweeping removes solids and floatables from the roadside before they are discharged from the storm drain system.

Measurable Goal

Highway Agencies shall certify annually that they have met the Street Sweeping minimum standard. Highway Agencies must maintain records including the date and areas swept, number of miles of streets swept and the total amount of materials collected. Information shall be reported to the Department in the annual report and certification.

Implementation Schedule

Within 12 months of effective date of permit authorization Highway Agencies shall have developed

and begun implementing a street sweeping program that meets the minimum standard above.

WHAT DOES THIS MEAN?

What streets need to be swept?

The only streets (including roads and highways) that need to be swept monthly or quarterly are streets that meet **all** of the following criteria:

- the street is owned or operated by the Highway Agency;
- the street is curbed and has storm drains;
- the street has a posted speed limit of 35 mph or less;
- the street is not an entrance or exit ramp; and
- the street is in a predominately commercial area.

(Highway Agencies other than County Highway Agencies must sweep all of their remaining streets once every two years)

Highway Agencies are required to sweep these streets (weather and street surface conditions permitting) and maintain appropriate record keeping, which will allow the completion of the annual report and certification. The Department has primarily targeted those streets that potentially have the most pollutants (e.g., those in predominately commercial areas). Predominantly commercial generally means those areas with businesses involving the sale of goods or services, for example a central business district. Areas that are primarily residential, industrial or agricultural are not predominately commercial and therefore are not required to be swept monthly, if you are a County Highway Agency, or quarterly if you are a Highway Agency other than a County Highway Agency. However, the Department encourages all Highway Agencies to maintain existing street sweeping and try to sweep all of their streets once per year.

WANT TO KNOW MORE?

Street sweeping removes silt, trash, total suspended solids (TSS), hydrocarbons, excessive nutrients such as phosphorous and nitrogen, and other chemicals from the roadside before they are discharged from the storm drain system. Studies have revealed that the vast majority of toxic and conventional pollutants found in stormwater are associated with automobile maintenance and use. Studies have identified gasoline combustion, brake fluid, transmission oil, antifreeze, grease, undercoating and tire and brake lining wear as the chief contributors. Since little can be done to prevent the pollutants from depositing on street surfaces, attention must be focused on removing the accumulated materials. A regular street-sweeping program will help to clean and maintain the attractiveness of communities and enhance business viability and residential values.

It is also important to note there is a relationship between regular sweeping and maintenance of catch basins and other stormwater facilities. A regular sweeping program will reduce the amount of material accumulating in such facilities, reducing the need for frequent cleaning. More information on catch basin and stormwater facility maintenance can be found in this Chapter of the guidance document.

For information on how to properly dispose of materials collected during street sweeping and catch basin cleaning see: http://www.state.nj.us/dep/dshw/rrtp/sweeping.htm.

For information on the beneficial use program see:
http://www.state.nj.us/dep/dshw/rrtp/bud.htm.

Recommendations

The following are recommendations that may be beneficial but are not required by the permit.

- Higher efficiency street sweepers should be considered when purchasing new equipment (e.g., regenerative air and vacuum filter street sweepers).
- By sharing staff and equipment, Highway Agencies may benefit by saving money and resources.
- Parking should be regulated on predominately commercial streets to facilitate sweeper access.

Storm Drain Inlet Retrofitting

WHAT IS REQUIRED?

Minimum Standard

Retrofitting of existing storm drain inlets to meet the standard contained in Attachment C of the permit is required where such inlets are in direct contact with repaving, repairing (excluding repair of individual potholes), reconstruction or alterations of facilities owned or operated by the Highway Agency. For exemptions to this standard, refer to "Exemptions" in Attachment C.

Measurable Goal

Highway Agencies shall certify annually that such storm drain inlets have been retrofitted to meet the minimum standard contained in Attachment C, unless otherwise exempted.

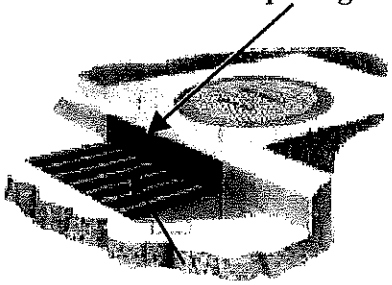
Implementation Schedule

Within 12 months of effective date of permit authorization and thereafter, Highway Agencies shall retrofit all such storm drain inlets in accordance with the Storm Drain Inlets minimum standard.

WHAT DOES THIS MEAN?

Any time your Highway Agency does any repaving, repairing, reconstruction or alterations of facilities owned or operated by the Highway Agency, storm drain inlets in direct contact with the repaving, repairing, reconstruction or alterations must be retrofitted or replaced to meet the standard contained in Attachment C of the permit. Facilities include all roads, parking lots, and any other areas that the Highway Agency owns or operates that have storm drain inlets. Repairing does not include the filling of individual potholes.

There are separate design standards for grates in pavement or other ground surfaces, and for curb-opening inlets. Each standard is described below. These standards help prevent certain solids and floatables (e.g., cans, plastic bottles, wrappers, and other litter) from reaching the surface waters of the State.



It is important to note that Attachment C of the permit also contains a number of exemptions to the storm drain inlet retrofitting requirement. The exemptions include:

- grandfathering of projects that began construction or were awarded bid prior to March 3, 2004;
- hydraulic performance exemption when the Highway Agency determines that the standard would cause inadequate hydraulic performance (flooding);
- historic places exemption for situations where action to meet this standard constitutes an encroachment or will damage or destroy a New Jersey Register listed historic property;
- alternative device exemption where flows are already conveyed through a device that meets certain standards to prevent the delivery of solids and floatable materials;
- an exemption for **existing** curb-opening inlets if each individual clear space in the curb opening is no larger than 9 square inches.

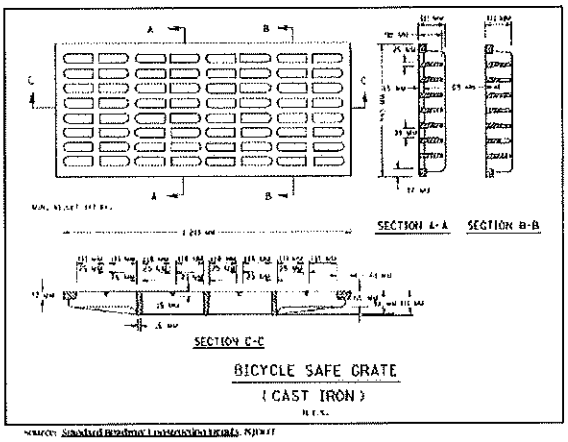
Attachment C of the permit and guidance provided below should be consulted for the actual standard for grates and curb-opening inlets and specific exemption language.

Grates In Pavement or Other Ground Surfaces

The standard applies to grates that are used in pavement or another ground surface to collect stormwater into a storm drain or surface water body under the grate.

Examples of storm drain inlet grates subject to this standard include grates in grate inlets, the grate portion (non-curb-opening portion) of combination inlets, grates on storm sewer manholes, ditch grates, trench grates, and grates of spacer bars in slotted drains. Examples of ground surfaces include surfaces of roads (including bridges), driveways, parking areas, bikeways, plazas, sidewalks, lawns, fields, open channels, and stormwater basin floors.

NJDOT "Bicycle Safe" Grate



Many grate designs meet the standard. The first option (especially for storm drain inlets along roads) is to use the New Jersey Department of Transportation (NJDOT) bicycle safe grate. This grate is described in Chapter 2.4 of the NJDOT Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines, which is available at: http://www.state.nj.us/transportation/publicat/bike_guidelines.htm.

The other option is to use a different grate, as long as each "clear space" in the grate (each individual opening) is:

- No bigger than seven (7.0) square inches; **or**
- No bigger than 0.5 inches (½ inch) across the smallest dimension (length or width).

Curb-Opening Inlets (including Curb-Opening Inlets in Combination Inlets)

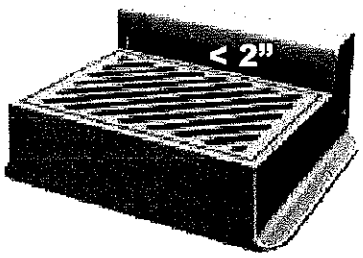
If the storm drain inlet has a curb opening, the clear space(s) in that curb opening(s) (or each individual clear space, if the curb opening has two or more clear spaces) must be:

- No bigger than two (2.0) inches across the smallest dimension (length or width) - many curb-opening inlets installed in recent years meet this criterion;

  or

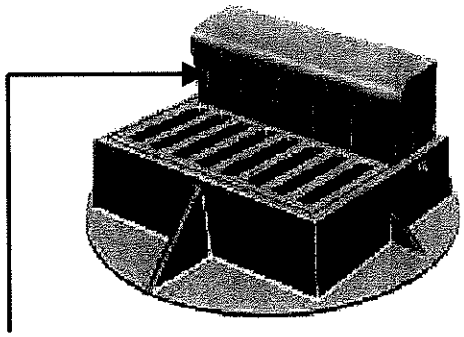
- No bigger than seven (7.0) square inches

Option 1 (Example)



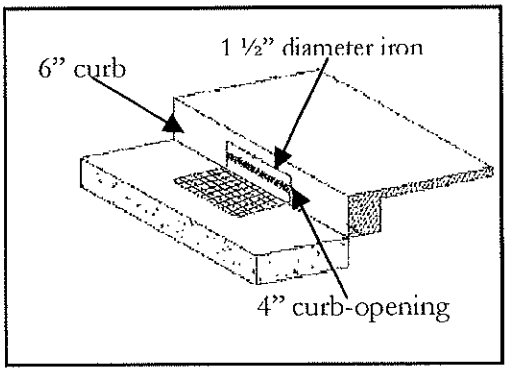
A curb-opening with a "clear space" no bigger than 2" across the smallest dimension

Option 2 (Example)



Each individual hole ("clear space") in the curb-opening is no bigger than 7 square inches

Retrofitting Discussion



After retrofit w/ 1 ½" diameter rod, each clear space of the curb-opening is 1 ¼" across the smallest dimension.

Highway Agencies which are undertaking a repaving, repairing, reconstruction or alteration project that will require the retrofitting of storm drain inlets pursuant to this section of the permit, have 2 choices: a) replace the hood piece, or b) retrofit the curb-opening inlet to meet the new design standard. (In most situations the grate will need to be replaced since there is no practical way to retrofit a grate to meet the standard.) Replacing the gutter inlet or hood piece may be the easiest solution. The Department has worked with a number of foundries to ensure a style is manufactured that meets the new design standard. A lower cost option would be to retrofit the curb-opening inlet by dividing the existing opening into 2 or more smaller openings (each no bigger than two (2.0) inches across the smallest dimension) with a bar, rod, or flat iron. This bar or flat iron needs to be permanently affixed to the casting by attaching to the existing bolt pattern on the hood piece or by some other

method. This retrofitting technique has successfully been done, and can be seen, in many NJ locations. Replacing the grate with a grate that extends to the back of the curb opening is another option.

Exemptions

For purposes of this SBR, the requirements of this standard do not apply whenever any of the following exemptions listed in Attachment C are applicable:

- A **"Hydraulic Performance Exemption"** where the Highway Agency or other review agency determines that this standard would cause inadequate hydraulic performance.
- Either of two **"Alternative Device Exemptions"**:
  - The first of these exemptions is where flows from the "water quality design storm" as specified in N.J.A.C. 7:8 are conveyed through any device or combination of devices (e.g., end of pipe netting facility, manufactured treatment device, or a catch basin hood) that is designed, at a minimum, to prevent the passage of all solid and floatable materials that could not fit through one of the following:
    1. A rectangular space that is four and five-eighths ($4^5/_8$) inches long and one and one-half (1½) inches wide (this option does not apply for outfall netting facilities); or
    2. A bar screen that has a ½ inch (0.5 inches) opening between each bar.
  - The second of these exemptions is where flows are conveyed through a trash rack that has parallel bars with one-inch (1.0 inch) spacing between the bars, to the elevation of the "water quality design storm" as specified in N.J.A.C. 7:8.

    One of the requirements in the new Stormwater Management Rules at N.J.A.C. 7:8-5.7(a)2 is that "trash racks shall be installed at the intake to the outlet structure as appropriate, and shall have parallel bars with one-inch spacing between the bars to the elevation of the water quality design storm" [emphasis added].

    In the new Stormwater Management Rules, the "water quality design storm" is specified at N.J.A.C. 7:8-5.5(a).
- A **"Historic Places Exemption"** where the Department determines, pursuant to the New Jersey Register of Historic Places Rules at N.J.A.C. 7:4-7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.

WANT TO KNOW MORE?

Several studies have been conducted to determine what materials are most often discharged to storm sewers. Some of the most commonly found materials were polystyrene pieces, pieces of paper, candy and food wrappers, plastic bag fragments, and metal foil, with the biggest offender being plastic products. The useful qualities of plastic (it is cheap and plentiful) make it a tremendous pollution problem. Plastic needs ultraviolet light to decompose, taking hundreds of years to decay. In the meantime plastic continues to accumulate in our waterways, causing the deaths of many mammals, fish, birds and reptiles each year.

Every piece of solid or floatable material that is caught before it enters or leaves a storm drainage system will benefit the environment. Minimizing the size of spaces in storm drain inlet grates and curb openings will trap certain solid and floatable materials before they reach our waterways. However, these spaces must also be large enough to provide adequate hydraulic performance.

Recommendations

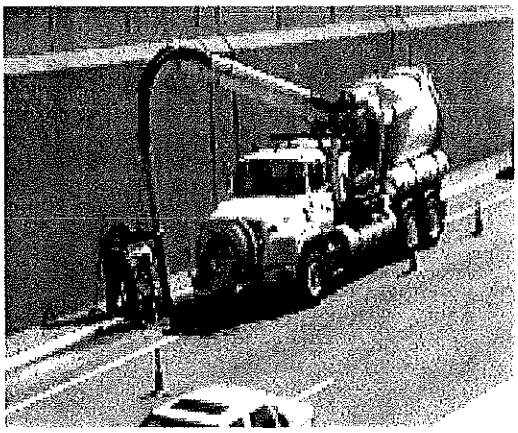
The following recommendations may be beneficial but are not required by the permit.

- Retrofit existing storm drain inlets to meet the standard contained in Attachment C earlier than required by the permit (rather than waiting until repaving or other projects).
- Increase street sweeping (above the minimum standard) to reduce clogging of storm drain inlets.
- Use additional devices to remove solid and floatable materials including trash racks, mesh nets, bar screens and trash booms.

Stormwater Facility Maintenance

WHAT IS REQUIRED?

Minimum Standard



As sweeping increases and storm drain inlets are retrofitted, amounts of material removed during catch basin cleaning should decrease.

Highway Agencies shall develop and implement a stormwater facility maintenance program for cleaning and maintenance of all stormwater facilities operated by the Highway Agency. Stormwater facilities include, but are not limited to: catch basins, detention basins, filter strips, riparian buffers, infiltration trenches, sand filters, constructed wetlands, wet ponds, bioretention systems, low flow bypasses, and stormwater conveyances. The stormwater facility maintenance must be performed as required to ensure the proper function and operation of the stormwater facility. Highway Agencies shall also clean all catch basins operated by the Highway Agency annually to remove accumulated sediment, trash and debris. If the Highway Agency is unable to clean all catch basins annually, the Highway Agency must provide, as part of their SPPP, a justification and detailed schedule for less frequent cleaning.

Measurable Goal

Highway Agencies shall certify annually that all stormwater facilities are properly functioning and that all catch basins have been cleaned in accordance with the minimum standard. If stormwater facilities were found not to be functioning properly and repairs were not made, a schedule for such repairs shall be included in the annual report and certification. Highway Agencies shall also maintain records of inspections, maintenance and repairs that were performed which shall be reported in the annual report and certification.

Implementation Schedule

Within 12 months from the effective date of permit authorization, Highway Agencies shall have developed and begun implementing a stormwater facility maintenance program in accordance with

the minimum standard.

WHAT DOES THIS MEAN?

This BMP requires that the Highway Agency maintain all stormwater facilities owned and operated by the Highway Agency to ensure that they are properly functioning. The BMP also requires the annual inspection and cleaning of all catch basins owned or operated by the Highway Agency. A catch basin is a cistern, vault, chamber or well that is usually associated with a storm drain inlet along a street, with the capability to trap debris and some sediments before they travel further into the MS4. Typically, a catch basin has a sump at its base. If the Highway Agency is unable to clean all catch basins annually, the Highway Agency must provide, as part of their SPPP, a justification and detailed schedule for less frequent cleaning. If, during the inspection of the catch basin, no sediment, trash or debris are observed, then the catch basin does not have to be cleaned that year.

This stormwater facility maintenance BMP does not include **private or public stormwater facilities** that discharge into the Highway Agency's MS4 but are not operated by the Highway Agency. Proper maintenance, including preventative maintenance, of stormwater facilities ensures they operate as designed. Stormwater facilities vary due to the environmental effect desired, from simple conveyance to designed wetland ecosystems that mimic nature. Many stormwater facilities like wet ponds, filter strips, and manmade wetlands provide pollutant removal. Additional stormwater facilities like infiltration basins, infiltration trenches and porous paving are designed to recharge groundwater. All must be maintained to operate at the designed efficiency.

Information on proper maintenance of many stormwater facilities is found in the New Jersey Stormwater Best Management Practices Manual as amended.

- For information on the proper handling and disposal of the debris collected during catch basin cleaning, see http://www.state.nj.us/dep/dshw/rrtp/sweeping.htm.

  (**Note**: In accordance with this guidance, at a minimum, all potentially contaminated road cleanup material must be staged on an impervious surface and covered with a waterproof material (i.e., tarpaulin or 10-mil plastic sheeting). The containment must be maintained for the duration of the staging period to prevent contaminant volatilization, runoff, leaching, or fugitive dust emissions. See above guidance for specifics.)

- For information on the beneficial reuse program see: http://www.state.nj.us/dep/dshw/rrtp/bud.htm.

WANT TO KNOW MORE?

Recommendations

Listed below are recommendations, not required by the permit, to help maintain stormwater facilities.

- Increase catch basin inspection and cleaning in problem areas (e.g., prone to flooding).
- Perform maintenance inspections after major storm events.
- Increase street sweeping (above the minimum standard) to decrease the amount of materials entering the catch basins and other stormwater facilities.
- Coordinate the timing of catch basin cleaning with the local mosquito control agency where possible.

Road Erosion Control

WHAT IS REQUIRED?

Minimum Standard

Highway Agencies shall develop a roadside erosion control maintenance program to identify and repair erosion along streets (including roads or highways) operated by the Highway Agency. Highway Agencies are also required to regularly inspect and maintain the stability of shoulders, embankments, ditches and soils along these streets to ensure that they are not eroding and contributing to sedimentation of receiving waters. Repairs shall be made in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey, N.J.A.C. 2:90-1 (or N.J.A.C. 16:25A where NJDOT is the Highway Agency).

Measurable Goal

Highway Agencies shall certify annually that they have developed and are implementing a Roadside Erosion Control Maintenance program. The certification shall also indicate the locations of all problem areas corrected and any maintenance done during that year. The dates of all inspections and employee training sessions shall also be reported in the annual report and certification.

Implementation Schedule

Within 18 months from the effective date of permit authorization, Highway Agencies shall have developed and begun implementing a roadside erosion control maintenance program in accordance with the minimum standard.

WHAT DOES THIS MEAN?

Highway Agencies must develop a program to detect and repair erosion along the streets (including roads and highways) operated by the Highway Agency, and to regularly inspect and maintain the stability of shoulders, embankments, ditches and soils along these streets to ensure that they are not eroding and contributing to sedimentation of receiving waters. This requirement for road erosion control is limited to streets, shoulders, embankments, ditches and soils for which the Highway Agency has, alone or along with other persons, primary management and operational decision-making authority. In some instances, these areas may not include the entire Highway Agency owned right-of-way. Any repairs are to be made in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey (N.J.A.C. 2:90-1), or with the NJDOT Soil Erosion and Sediment Control Standards at N.J.A.C. 16:25A where NJDOT is the Highway Agency.

It is important to note that this is an ongoing program and that all erosion along these streets operated by the Highway Agency does not need to be repaired in any specific timeframe. Highway Agencies however, must be able to show that there is an effective program in place and that repairs are being made. The Department does not expect that where existing erosion is widespread, all repairs will be completed during the initial five-year term of the permit. Rather, the Department expects the Highway Agency to show an ongoing, good faith effort to accomplish such repairs (including a prioritized schedule of the repairs).

WANT TO KNOW MORE?

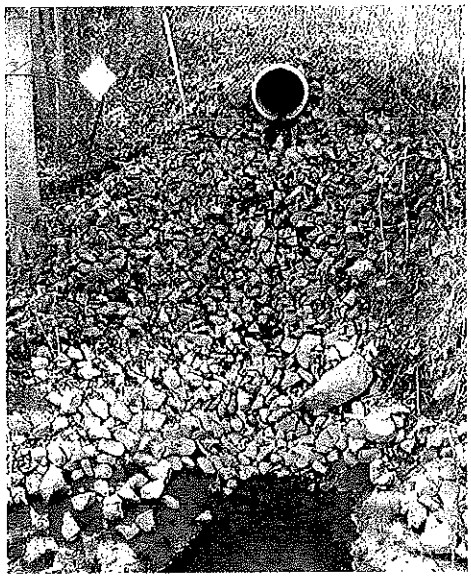
New Jersey has approximately 35,600 miles of roads and more highways, per square mile, than any other state. Erosion along these streets, highways, and other roads contributes suspended solids, sediment and other materials to storm sewer systems and waterways.

Vegetative cover (including the root system) plays an important role in preventing erosion by: shielding the soil surface from the impact of falling rain drops and flowing water, reducing the velocity of runoff; maintaining the soil's capacity to absorb water; and holding soil particles in place. In addition, vegetative cover may also be effective at removing heavy metals from runoff. However, utilizing vegetation to control erosion may require frequent monitoring, especially in the early stages when new vegetation is being established. Standards for vegetative cover, as well as other stabilization practices are found in the Standards for Soil Erosion and Sediment Control in New Jersey. A copy of these standards can be obtained from your Local Soil Conservation District (see Chapter 14 of this guidance document for a complete listing). Standards for vegetative cover and other stabilization practices are also found in the NJDOT Soil Erosion and Sediment Control Standards.

Sedimentation or deposition of material eroded by runoff from roads and roadsides may have significant impacts on water quality, and when not maintained, roadside erosion can significantly contribute to the pollution of stormwater runoff. Sedimentation not only causes an increase of costs for ditch, culvert and catch basin cleaning, it is also the single largest contributor of pollution to our nation's waters. Sedimentation can lead to a decrease in water carrying and storage capacities of streams and reservoirs, as well as destroy fish and other aquatic habitats. For example, sedimentation can fill the pores between gravel and cobble stream bottoms, greatly decreasing the spawning areas for many fish species (including native trout) and the habitat for macroinvertebrates, which serve as food for many fish species.

Outfall Pipe Stream Scouring Remediation

WHAT IS REQUIRED?



A scour hole is caused by excessive velocity of the discharge. Riprap may help dissipate the flow, reducing damage to the stream bank.

Minimum Standard

Highway Agencies shall develop and implement a stormwater outfall pipe scouring detection, remediation and maintenance program to detect and control localized stream and stream bank scouring in the vicinity of outfall pipes operated by the Highway Agency. This program shall identify all areas where localized stream and bank scouring occurs as a result of stormwater discharges from the Highway Agency's MS4. These areas shall then be prioritized and repairs shall be scheduled and completed. Repairs shall be made in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90-1 (e.g., Conduit Outlet Protection 12-1), or N.J.A.C. 16:25A where NJDOT is the Highway Agency.

Measurable Goal

Highway Agencies shall certify annually that they have met the Outfall Pipe Stream Scouring Remediation minimum standard. In addition, the Highway Agency shall list the location of outfall scouring identified, the dates control measures are to begin, and the dates any control measures were completed.

Implementation Schedule

Within 18 months of the effective date of permit authorization, Highway Agencies shall have developed and begun implementing an outfall pipe stream scouring detection, remediation and maintenance program. This program shall identify and prioritize all stormwater outfall pipes needing repairs, and then schedule and complete the repairs.

WHAT DOES THIS MEAN?

Highway Agencies must develop a program to detect and control any active localized stream and stream bank scouring located on property operated by the Highway Agency in the vicinity of outfall pipes operated by the Highway Agency. The program does not apply to outfall pipes that discharge into the ocean or into any other waterways that are not "streams." For purposes of this SBR, a "stream" may be perennial or intermittent, may be tidal or non-tidal, and may be called, for example, a "river," "brook," "creek," "run," "branch," 'kill," or "ditch," or may have no name. Any areas that are found to be eroding must be prioritized based on the extent of erosion, and repairs must be scheduled and completed. All repairs shall be made using methods found in the Standards for Soil Erosion and Sediment Control in New Jersey (N.J.A.C. 2:90-1) or the NJDOT Soil Erosion and Sediment Control Standards (N.J.A.C. 16:25A) where NJDOT is the Highway Agency.

Where existing active localized stream and stream bank scouring is widespread, the Department does not expect that this program will result in the repair of all such scouring in the initial five-year permit term. Rather, the Department expects this program to include an ongoing, good faith effort to accomplish such repair, which may not be completed during the initial permit term. The Department also notes that this program applies to locations where there is active scouring, but not to locations where scouring occurred in the past, but has now ceased.

Repairing scouring may be problematic due to access restriction and/or Department permitting requirements. The Department's Land Use Regulation Program (www.nj.gov/dep/landuse) may require wetlands, stream encroachment or coastal permits prior to any repairs or remediation. Access and the need for permits/approvals may be considered when a permittee prioritizes and schedules repairs. The Department is attempting to streamline the process for getting wetlands and stream encroachment permits needed to repair localized stream and stream bank scouring and is aware that substantial time may be required to obtain these permits, which is one of the reasons why the Highway Permit does not specify deadlines for completing repairs. Prioritizing outfall repairs in areas that allow easy access and don't require permits may be appropriate.

WANT TO KNOW MORE?

Outfall pipe stream scouring is the localized scouring of the stream bank or bottom caused by the discharge from the outfall pipe. This type of erosion to the stream bed and stream banks can cause sedimentation in the waterways. While sedimentation is a natural process, the accelerated accumulation of sediments in aquatic ecosystems leads to a decline in surface water quality and biodiversity. For more information on the harmful environmental impacts caused by sedimentation, please see the "Want to know more" section of the Road Erosion Control Maintenance BMP in this Chapter of the guidance document.

Scouring occurs when the velocity of stormwater leaving an outfall pipe erodes the stream bottom or the stream bank. To prevent scouring from occurring, the exit velocity of the water from the outfall pipes must be dissipated and/or reduced. Stream bank stabilization is needed when vegetative stabilization practices are not practical and where the stream banks are subject to heavy

erosion. One way to prevent scouring from occurring is to reduce the quantity of stormwater that reaches eroding outfall(s) by infiltrating the stormwater before it reaches the outfall. For more information on how to do this, see the New Jersey Stormwater Best Management Practices Manual as amended.

Another solution to stream and stream bank scouring is to implement one or more of the engineering standards approved by the State Soil Conservation Committee. A copy of these standards can be obtained from your Local Soil Conservation District (see Chapter 14 of this guidance document for a complete listing). The NJDOT Soil Erosion and Sediment and Control Standards are available at: http://www.state.nj.us/transportation/

Recommendations

The following recommendation may be beneficial but is not required by the permit.

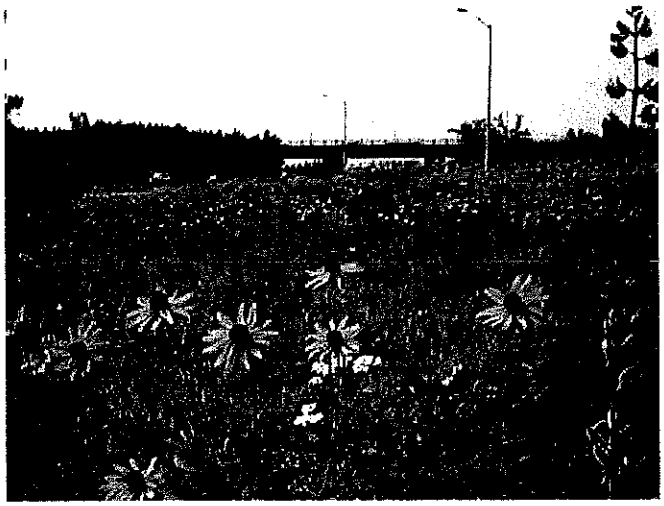
- To help reduce costs, when mapping your outfall pipes, look for signs of outfall pipe stream scouring (see Illicit Connection Program/Outfall Pipe Mapping in Chapter 6). This will ensure that you do not have to make multiple visits to the same outfall pipes.

Roadside Vegetation Management

WHAT IS REQUIRED?

Minimum Standard

Highway Agencies must develop a Roadside Vegetation Management Program that limits the application of herbicides and restricts the methods by which mulch is applied. Highway Agencies shall only apply herbicides in a 2 foot radius around structures where it is not practical to mow (such as around guardrails, signposts, telephone poles, etc.). If mulch is applied, it shall be stabilized in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey N.J.A.C. 2:90-1 (or N.J.A.C. 16:25A where NJDOT is the Highway Agency) to prevent it from being washed away with stormwater into the waters of the State.



Your Highway Agency may consider planting native wildflowers, as they need less care and aesthetically pleasing.

Measurable Goal

Highway Agencies shall certify annually that they have met the Roadside Vegetation Management minimum standard.

Implementation Schedule

Within 12 months of the effective date of permit authorization, Highway Agencies shall have developed and begun implementing the Roadside Vegetation Management minimum standard.

WHAT DOES THIS MEAN?

All Highway Agencies are required to develop a Roadside Vegetation Management program to limit the usage of herbicides and prevent them from being washed away with stormwater to the surface waters of the State. Herbicides may only be used to control vegetation in areas where physical means of controlling grass growth and other plant life, such as mowing, may be restricted due to spatial limitations. In such instances, as in around guardrails, signposts, and telephone poles, herbicides may only be applied in a two (2) foot radius around the structure. Mulch, when applied, must be stabilized in accordance with the Standards for Soil Erosion and_Sediment Control in New Jersey N.J.A.C. 2:90-1 (or N.J.A.C. 16:25A where NJDOT is the Highway Agency), to prevent it from being washed away with stormwater.

WANT TO KNOW MORE?

Herbicides, although intended to be useful, are often over-applied and thus become detrimental to vegetation and surrounding water bodies. Many herbicides are water soluble, meaning that they will stay for a short time at the place of application before being washed away with the first significant rainfall through highway ditches and into local waterways. Although the effect of small doses of herbicides on water bodies is unknown, when large quantities of herbicide end up in streams, lakes, rivers, and the ocean, chemicals kill or hinder the growth of native flora and fauna. The long-term drawbacks of herbicides are also known to include soil depletion and land based environmental damage.

Landscapers have a propensity to use mulch for their projects, as it adds aesthetic value to properties. Practically it conserves moisture that replenishes neighboring vegetation and it also helps to hinder weed growth. However, the major problem with using mulch on highway land is its tendency to be easily moved. The fact that mulch is shredded or in small chunks makes it easily displaced during rain or snow events. These small pieces can then be transported to storm drains and ultimately to local waterways.

Recommendations

The following recommendations may be beneficial but are not required.

- Use organic plant growth regulators instead of herbicides around guardrails, signposts, and telephone poles to maintain bare ground.
- Plant low maintenance vegetation that grows slowly and will require less upkeep.
- Use wildflowers instead of grasses. They are aesthetically pleasing and need less care by Highway Agency employees.
- Institute a Adopt-a-Highway Landscape program where volunteer groups adopt a section of highway, of any size, and agree to maintain it for a period of two years or more. Maintenance includes planting, pulling weeds, and mowing roadside grassy areas.

Chapter 8 - Maintenance Yard Operations

This Chapter focuses on eliminating and/or minimizing the amounts of pollutants entering the waters of the State from maintenance yard operations, including maintenance activities at service areas and ancillary operations. Ancillary Operations may include Highway Agency owned or operated impoundment lots, recycling centers, solid waste transfer stations, mobile fueling stations, etc. The concept behind these BMPs is to stress ways of improving stormwater quality through the implementation of pollution prevention and source reduction techniques. Many of the BMPs in this Chapter require the development of standard operating procedures (SOPs). **At a minimum, these SOPs must include the items listed in Attachment D of the permit.**

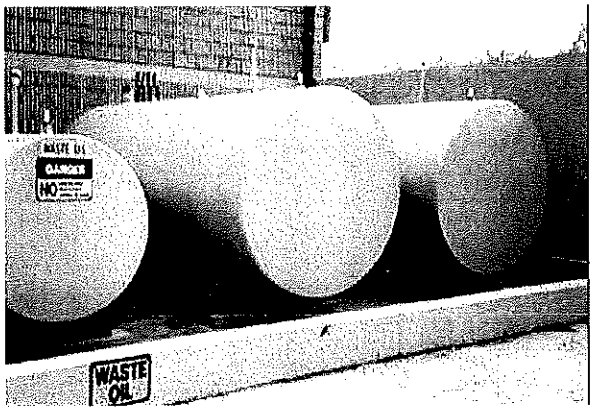
Inspections

Inspections are an important part of your maintenance yard operations. The entire maintenance yard needs to be inspected regularly, and these inspections should be documented as a part of your Stormwater Pollution Prevention Plan (SPPP).

- Inspections of all Maintenance Yard Operations shall be conducted regularly.

Discharge of Stormwater from Secondary Containment

Many maintenance yards have secondary containment for things such as aboveground fueling tanks and waste oil storage. These containment areas can accumulate water during storm events. This permit authorizes the discharge of clean stormwater from secondary containment, under the following conditions:



The Highway Permit authorizes the discharge of stormwater that accumulates in a secondary containment area if certain precautions are taken.

- The discharge pipe/outfall from a secondary containment area must have a valve and the valve must remain closed at all times except as described below. A Highway Agency may discharge stormwater that accumulated in the secondary containment area if a visual inspection is performed to ensure that the contents of aboveground storage tank have not come in contact with the stormwater to be discharged. Visual inspections are only effective when dealing with materials that can be observed, like petroleum. If the contents of the tank are not visible in stormwater, the Highway Agency must rely on previous tank inspections to determine with some degree of certainty that the tank has not leaked. If the Highway Agency cannot make a determination with reasonable certainty that the stormwater in the secondary containment area is uncontaminated by the contents of the tank, then the stormwater shall be hauled for proper disposal.

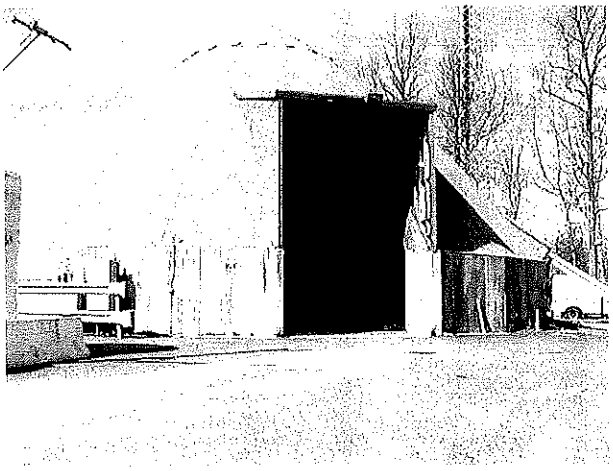
  (**NOTE:** If the stormwater from secondary containment is hauled, the Department recommends that copies of all hauling receipts be kept on site.)

De-icing and Sand Storage

WHAT IS REQUIRED?

Minimum Standard

Highway Agencies must construct a permanent structure (a permanent building or permanent structure that is anchored to a permanent foundation with a impermeable floor, and that is completely roofed and walled) for the storage of salt, and other de-icing materials, if applicable. Once completed, Highway Agencies shall perform regular maintenance and inspections of the permanent structure. Seasonal tarping shall be used as an interim BMP until the permanent structure is completed. Sand may be stored outside and uncovered if a 50-foot setback is maintained from storm sewer inlets, ditches or other stormwater conveyance channels, and surface water bodies.



An acorn storage shed is an example of a "permanent structure."

Measurable Goal

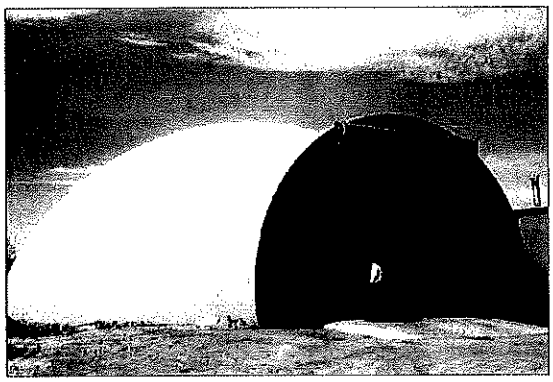
Highway Agencies shall certify annually that they have met the De-icing Material Storage minimum standard.

Implementation Schedule

Within 12 months from the effective date of permit authorization, Highway Agencies shall implement the interim seasonal tarping BMP. Within 12 months of the effective date of permit authorization, Highway Agencies will comply with the 50-foot buffer requirement for the outside storage of sand. Within 36 months from the effective date of permit authorization Highway Agencies shall store all salt and de-icing materials in a permanent structure.

WHAT DOES THIS MEAN?

When salt and other de-icing materials are stored outside and uncovered, they can easily dissolve and be transported by stormwater. To prevent de-icing materials, including sand/salt mixtures, from coming into contact with stormwater Highway Agencies must construct indoor storage. This permanent structure for the storage of salt and other de-icing materials must be a permanent building or permanent structure that is anchored to a permanent foundation with a impermeable floor, and that is completely roofed and walled. An example would be an acorn structure, a monolithic dome (shotcrete dome), a shed or



Monolithic, or shotcrete dome

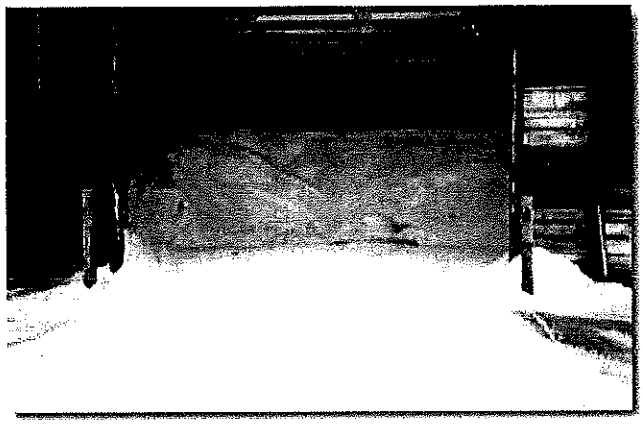


This three sided storage structure does not comply with the permit minimum standard.

building. The permanent structure may have an open entryway for equipment access for loading and unloading. The structure can not be a three sided building. Highway Agencies have 36 months from the effective date of permit authorization to construct such a structure. Until this structure is built, all de-icing materials may be stored outdoors between October 15 and April 30 as long as they are tarped when not in use (see Interim Seasonal Tarping below). Additionally, sand may be permanently stored outdoors and uncovered, as long as a 50-foot setback is maintained from any storm sewer inlets, ditches or other stormwater conveyance channels, and surface water bodies. For sand stored in three-sided uncovered bins, the 50-foot setback is measured from the open side of the bin. It is important to note that if the sand is covered the 50-foot setback is not required.

Good Housekeeping Practices for Salt and De-Icing Material Handling (as required by Attachment D of the permit)

The SPPP for De-icing Material Storage shall include the following required practices to ensure that Maintenance Yard Operations prevent or minimize the exposure of salt and de-icing materials to stormwater runoff from storage, loading and unloading areas and activities:



The Highway Agency should be implementing good housekeeping procedures to prevent and minimize spillage of salt and de-icing materials during loading and unloading activities.

- Prevent and/or minimize the spillage of salt and de-icing materials during loading and unloading activities.
- At the completion of loading and unloading activities, spilled salt and de-icing materials shall be removed using dry cleaning methods and either reused or properly discarded.
- Sweeping by hand or mechanical means of storage and loading/unloading areas shall be done on a regular basis. More frequent sweeping is required following loading/unloading activities. Sweeping shall also be conducted immediately following, as practicable, loading/unloading activities.
- Tracking of materials from storage and loading/unloading areas shall be minimized.
- Minimize the distance salt and de-icing materials are transported during loading/unloading activities.

Interim Seasonal Tarping - All Highway Agencies must tarp all de-icing materials until a permanent structure is built. Interim storage measures must include, but are not limited to the following:

- Tarping materials that are not actively being used.
- The storage of de-icing materials (salt and de-icing products) outside is limited to October 15 through April 30. All salt and de-icing materials must be removed from the site prior to May 1 and may not be stored outside again until October 15.
- The implementing of a regular inspection, sweeping and housekeeping program to ensure that the material is maintained and stored in a proper manner.

WANT TO KNOW MORE?

The application of salt and sand on roads to improve conditions in winter weather has been a popular practice since the 1930s. Sand is widely used in colder climates where temperatures drop below 0° F. In New Jersey, where the climate is warmer, salt is primarily used to reduce ice bonding to road surfaces. The Department understands that during the winter, the application of sand and salt is a public safety issue that outweighs the possible environmental impacts of the application. However, the proper storage and handling of these materials is something within our control. In addition during winter weather, salt and de-icing materials are spread over large areas. However, at storage facilities the discharges are concentrated and year round. The Department's goal is to ensure that these materials are properly handled, stored or covered, so that they are not transported by stormwater and discharged to surface and ground waters of the State.

Improper salt and sand storage may result in stormwater runoff containing high amounts of sodium and solids. Sodium chloride (road salt) is an effective de-icer but can be highly corrosive to stormwater facilities. Smaller waterways like small streams, rivers and ponds are at a higher risk to increases in salinity, which can threaten species that have lowered immune responses. Additionally, sodium chloride washed off roadways can eventually reach drinking water sources where even small traces can affect people with hypertension. Requiring indoor storage of salt and de-icing materials is an effective pollution prevention technique that helps to eliminate pollutant loadings to surface and groundwaters.

Recommendations

The following recommendations are not required by the permit, but should be taken into account when siting a new permanent structure:

- Locate the site at least 200 hundred feet away from nearby streams, wells, reservoirs and groundwater sources.
- Do not build your structure in designated well head protection areas.
- Ensure that the top elevation of the pad for the permanent structure, as well as the access way, is higher than the 100-year storm level.
- Control site drainage by diverting stormwater away from storage areas (e.g., by installing curbing, temporary berms, etc.).
- Place wind barriers at strategic areas where shipments of salt and sand are being loaded. This can help to reduce the possibility of windblown particles entering nearby areas.

- When constructing a de-icing material storage structure, include a paved, impermeable access way.
- Highway Agencies are encouraged to work together with neighboring highway agencies (such as NJ Turnpike Authority, South Jersey Transportation Authority, NJDOT), municipalities and/or public complexes to construct joint use de-icing material storage facilities.

Fueling Operations

WHAT IS REQUIRED?

Minimum Standard

Highway Agencies must develop and implement standard operating procedures for vehicle fueling, and receiving of bulk fuel deliveries at maintenance yard operations. The standard operating procedures shall incorporate the required practices listed in Attachment D.

Measurable Goal

Highway Agencies must certify annually that there is a vehicle fueling and bulk receiving standard operating procedures in place.

Implementation Schedule

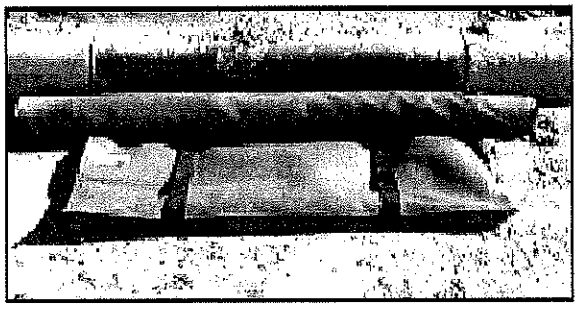
Within 12 months of the effective date of permit authorization, Highway Agencies shall have developed and begun implementing the required standard operating procedures for fueling operations.

WHAT DOES THIS MEAN?

When applicable, the minimum standard requires Highway Agencies to develop SOPs for vehicle fueling and receiving of bulk fuel. The SOP shall, at minimum, include, the following:

Fueling (as required by Attachment D of the permit)

- No topping off vehicles, mobile fuel tanks, and storage tanks. Drip pans must be used under all hose and pipe connections and other leak-prone areas **during** bulk transfer of fuels.
- During bulk transfer, block storm sewer inlets, or contain tank trucks used for bulk transfer, with temporary berms or temporary absorbent booms during the transfer process. If temporary berms are being used instead of blocking the storm sewer inlets, all hose connection points associated with the transfer of fuel must be within the temporary berms during the loading/unloading of bulk fuels. A trained employee must always be present to supervise during bulk fuel transfer.



Storm drain inlets blocked during bulk fuel transfer.

- Clearly post, in a prominent area of the facility, instructions for safe operation of fueling equipment, and appropriate contact information for the person(s) responsible for spill response.

- Any equipment, tanks, pumps, piping and fuel dispensing equipment found to be leaking or in disrepair must immediately be repaired or replaced.

(NOTE - All repairs and replacement of such equipment, pumps, piping, and fuel dispensing equipment should be made in accordance with any applicable local, State, or federal regulations and/or requirements.)

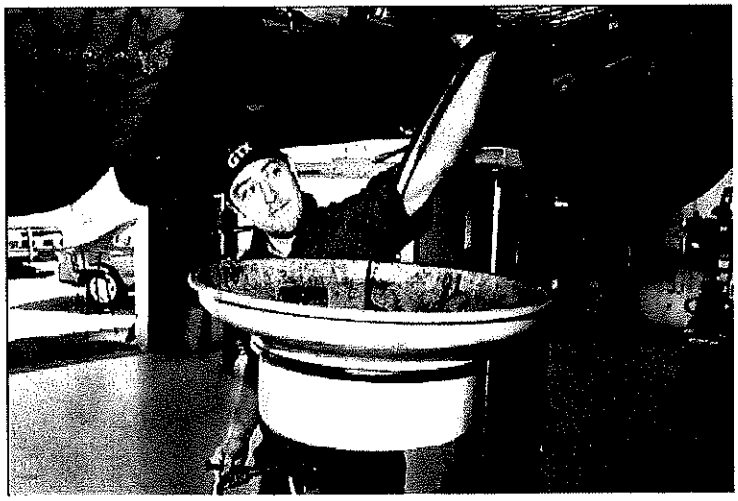
Recommendations

The following recommendations may be beneficial but are not required.

- Use only pumps, hoses and containers that have been approved for fuel use.
- When installing new tanks consider aboveground storage tanks rather than underground storage tanks.
- Designated transfer areas should be paved with concrete and be designed with containment.
- When practical, vehicle fueling should be done at designated fueling areas rather than on location (mobile fueling) where employees are less equipped to handle spills.
- Fueling stations can be regional or shared with other Highway Agencies or other public agencies to help to reduce costs of operation and upgrading.
- Ensure that all underground storage tanks are maintained in accordance with the New Jersey Underground Storage of Hazardous Substances Act (N.J.S.A. 58:10A-21 et seq.) and the Department's Underground Storage Tanks rules at N.J.A.C. 7:14B, if applicable.

Vehicle Maintenance

WHAT IS REQUIRED?



Vehicle maintenance should be performed indoors whenever possible.

Minimum Standard

Highway Agencies shall develop and implement a standard operating procedure (SOP) for vehicle maintenance and repair activities that occur at maintenance yard operations, if applicable. The SOP shall include the required practices listed in Attachment D. The SOP shall include regular inspections of all maintenance areas and activities.

Measurable Goal

Highway Agencies must certify annually that there is a vehicle maintenance standard operating procedure in place and that regular inspections and maintenance are being performed.

Implementation Schedule

Within 12 months of the effective date of permit authorization, Highway Agencies shall have developed and begun implementing the required standard operating procedures for Vehicle Maintenance.

WHAT DOES THIS MEAN?

Highway Agencies are required to develop and implement vehicle maintenance SOPs to eliminate and/or minimize the amount of pollutants entering surface and ground water from vehicle maintenance activities. **The SOP shall, at minimum, include the following:**

Vehicle Maintenance (as required by Attachment D of the permit)

Perform all vehicle and equipment maintenance at an indoor location with a paved floor whenever possible. For projects that must be performed outdoors that last more than one day, portable tents or covers must be placed over the equipment being serviced when not being worked on, and drip pans must be used.

If maintenance is being performed outdoors on exposed equipment (such as engine blocks, lawn equipment, and tractors) and won't be completed in one day, the exposed machinery, should be covered with a tarp or portable tent when not being worked on. If the machinery is not exposed (hood of vehicle can be closed, tractor engine cover replaced), then no tarp is required. Drip pans are required if equipment that is being serviced could possibly leak oil, hydraulic fluids or other fluids, and will be left outside for a time period greater than one day.

Important Note - Floor drains within maintenance garages, if connected to the MS4, are illicit connections and must be eliminated in accordance with the Highway Agency's Illicit Connection Elimination Program (see Chapter 6 of this guidance document). All other discharges from floor drains within maintenance garages to surface or ground waters of the State require a separate NJPDES permit in accordance with N.J.A.C. 7:14A. Any such discharge must be ceased until a final effective NJPDES permit is issued by the State. The Department recommends, however, that all floor drains in maintenance garages be permanently sealed, and that all discharges to "motor vehicle waste disposal wells" be closed in accordance with N.J.A.C. 7:14A-8.4. If you have any questions or concerns about a floor drain or about "motor vehicle waste disposal wells," contact the Department's Bureau of Nonpoint Pollution Control at (609) 633-7021.

Good Housekeeping Practices

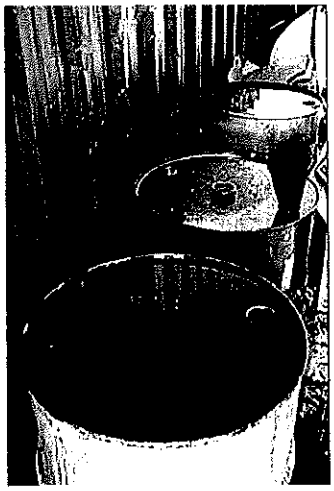
WHAT IS REQUIRED?

Minimum Standard

Highway Agencies must implement good housekeeping procedures for all materials or machinery listed in the Inventory Requirements for Maintenance Yard Operations prepared in accordance with Attachment D. These good housekeeping procedures include, but not limited to, the required practices listed in Attachment D at all maintenance yard operations (including maintenance operations at ancillary operations).

Measurable Goal

Highway Agencies must certify annually that they have met the Good Housekeeping Practices minimum standard.



Good housekeeping includes proper storage of materials like waste oil.

Implementation Schedule

Within 12 months of the effective date of permit authorization, Highway Agencies shall have developed and begun implementing the required standard operating procedures for Good Housekeeping.

WHAT DOES THIS MEAN?

The intent of this program is to help maintain a clean and orderly work place. Highway Agencies are required to do this by maintaining up-to-date inventories, conducting regular inspections and educating all employees about good housekeeping practices. Requirements and recommendations include basic housekeeping practices such as eliminating or minimizing exposure of materials to stormwater, maintaining a clean and orderly work environment, cleaning up any spills as soon as they are discovered, properly disposing of any hazardous materials, etc. Some examples of how to do this might include keeping oil, oil filters, hydraulic and transmission fluids, greases, cleaning solutions, antifreeze, coolants and batteries indoors or covered and on a spill platform.

Inventory Requirements for Maintenance Yard Operations (including Service Areas and Ancillary Operations)

In accordance with Attachment D of the permit, Highway Agencies shall include for maintenance yard operations an inventory that includes the following:

- A list to be made part of the SPPP of general categories of all materials or machinery located at the maintenance yard, which could be a source of pollutants in a stormwater discharge. The materials in question include, but are not limited to: raw materials; intermediate products; final products; waste materials; by-products; machinery and fuels; and lubricants, solvents, and detergents that are related to the maintenance yard operations or ancillary operations. Materials or machinery that are not exposed to stormwater or that are not located at the maintenance yard or related to its operations do not need to be included.

In addition to the Inventory Requirements for Maintenance Yard Operations, **the Good Housekeeping SOP shall also include the following:**

Good Housekeeping (as required by Attachment D of the permit)

- Properly mark or label all containers. Labels must be kept clean and visible. All containers must be kept in good condition and tightly closed when not in use. When practical, containers must be stored indoors. If indoor storage is not practical, containers may be stored outside as long as they are covered and placed on spill platforms. An area that is graded and/or bermed that prevents run-through of stormwater may be used in place of spill platforms. Outdoor storage locations must be regularly maintained.

- Conduct cleanups of any spills or liquids or dry materials immediately after discovery. Clean all maintenance areas with dry cleaning methods only. Spills shall be cleaned up with a dry, absorbent material (e.g., kitty litter, sawdust, etc.) and the rest of the area is to be swept.

Collected waste is to be disposed of properly. Clean-up materials, spill kits and drip pans must be kept near any liquid transfer areas, protected from rainfall.

Important Note: Discharges of hazardous substances shall be reported to the NJDEP Action Hotline at 1-877-WARN-DEP (1-877-927-6337) in accordance with N.J.A.C. 7:1E-5.3 (a copy of the rule may be found at: http://www.nj.gov/dep/rpp/brp/download.htm). Additional information on discharges of hazardous substances and notification requirements may be found at: http://www.state.nj.us/dep/enforcement/relprev/dpcc/document/dcrgid.htm.

Recommendations

The following recommendations may be beneficial to your program but are not required by the permit.

- Dispose of stockpiles of scrap you will never use.
- Switch to non-toxic chemicals whenever possible.
- Equipment should be kept clean of excessive build-up of oil and grease, and all equipment should be checked regularly for drips or leaks.
- Batteries should be stored indoors, and any leaking, cracked or broken batteries should be handled in accordance with applicable federal and/or State rules and regulations.
- Check incoming vehicles and equipment for leaks (including delivery trucks and employee and subcontractor vehicles). Do not allow leaking vehicles or equipment on site.

WANT TO KNOW MORE?

Fueling, Vehicle Maintenance, and Good Housekeeping

When stormwater is exposed to pollutants associated with maintenance and fueling activities it becomes polluted with toxic or other deleterious materials (e.g., petroleum hydrocarbons, heavy metals and organics). Many times this stormwater contamination is a result of human errors, such as topping off fuel tanks, not being attentive during loading and unloading procedures, improper cleanup after a spill occurs, and improperly storing materials associated with maintenance activities (e.g., fertilizers, pesticides, waste oil, waste solvents, scrap materials, and material stock piles). The fueling, maintenance and good housekeeping SOPs, if properly implemented, help eliminate or minimize stormwater contamination from these activities.

Fueling and maintenance activities can contribute to local stormwater pollution when not managed properly. Petroleum hydrocarbons, found in diesel fuel, waste oils and lubricants, can be harmful to aquatic life. Hydrocarbons that have a lighter density can float on the surface of the water harming waterfowl, while dense hydrocarbons sink to the bottom and accumulate in the sediment, affecting bottom feeders and other organisms. Heavy metals, which are found in fuel and may leach from scrap materials and batteries, tend to have a cumulative effect on the food chain since they can accumulate in the tissues, becoming more and more potent as they are passed up the food chain. In addition, heavy metals have been shown to cause several detrimental effects on various species of shellfish, including inhibited feeding behavior, delayed shell growth, depression of cardiovascular function and respiration and a suppression of growth or death of eggs, embryos or larvae. Organic compounds, like BTEX found in gasoline, and other organic compounds found in solvents are known mutagens, teratogens, and carcinogens.

When good housekeeping practices are not implemented, hazardous materials are potentially exposed to stormwater. Once that happens the only effective way to remove the pollutants is by providing costly treatment. Stormwater is difficult at best to treat due to inherent problems like variability of rainfall and its intensity. If maintenance yards are large, storage of stormwater for treatment requires the construction of large lined basins. Instead, it is far more cost effective to implement BMPs designed at eliminating or minimizing contact between stormwater and source materials. Properly implemented Good Housekeeping SOPs do just that and prevent the need for costly end of pipe treatment systems.

Equipment and Vehicle Washing

Equipment and vehicle washing is not authorized under the Highway Permit (except for washwater from rinsing of certain de-icing and beach maintenance vehicles and equipment as authorized in Part I, Section A.2.d.) The discharge of equipment and vehicle washwater from maintenance yards to the surface and ground waters of the State may be unlawful under the Water Pollution Control Act unless a separate NJPDES permit is obtained for such discharge.

Chapter 9 - Employee Training

Employee training is one of the most important aspects of the permit. All of the time and effort undertaken to develop a stormwater program and to write a SPPP is wasted if employees aren't properly trained and clearly understand what is expected of them. Sometimes it is difficult to change how people do things. Stressing employee training and not dismissing it as an afterthought shows employees that your Highway Agency is serious about its stormwater program and protecting the environment.

WHAT IS REQUIRED?

Minimum Standard

Highway Agencies shall develop and conduct an annual employee training program for **appropriate employees and appropriate topics**. At a minimum, annual employee training will include the following topics:

i. **Waste Disposal Education** –Training shall include how to respond to inquires regarding proper waste disposal.

ii. **Control Measures** – Training shall include an overview of the Pet Waste Control, Improper Waste Disposal Control, Wildlife Feeding Control, and Illicit Connection Prohibition measures, their requirements, enforcement policy, and hazards associated with improper waste disposal.

iii. **Roadside Vegetation Management** – Training shall include herbicide and mulch application requirements.

iv. **Illicit Connection Elimination and Outfall Pipe Mapping** – Training shall include information regarding the hazards associated with illicit connections and details of the program including investigation techniques, physical observations, field sampling, and mapping procedures.

v. **Street Sweeping** – Training shall include sweeping schedules and record keeping requirements.

vi. **Stormwater Facility Maintenance** - Training shall include catch basin cleaning schedules and record keeping requirements.

vii. **Road Erosion Control and Outfall Pipe Stream Scouring Remediation** – Training shall include identifying road erosion and outfall pipe scouring and repairs.

viii. **Maintenance Yard Operations (including Ancillary Operations)** – Training shall include de-icing material storage, fueling, vehicle maintenance, equipment/vehicle washing and good housekeeping SOPs, if applicable.

ix. **Construction Activity / Post-Construction Stormwater Management in New Development and Redevelopment** – Training shall include information regarding the requirement to obtain a NJPDES construction activity stormwater permit (see Part I, Section A.5.a and A.5.b of this permit) and requirements for Post-Construction Stormwater Management in New Development and Redevelopment (See Part I, Section F.3 of this permit).

Measurable Goal

Highway Agencies must certify annually the date of the annual employee training.

Implementation Schedule

Training shall begin 12 months from the effective date of permit authorization.

WHAT DOES THIS MEAN?

Employee training is intended to increase employee awareness of the stormwater program and its importance, as well as their role in its implementation. It is believed that if the employees understand what is required of them and why it is being required, they will be more likely to comply with the conditions of the permit. Employees must be trained about the various topics listed above, but the education program need not be limited to those topics. All employees should be involved in the training program, but the permit requires training only on those particular topics that are relevant to their job descriptions. For example, maintenance yard personnel shall be trained on the maintenance yard SOPs, but they don't need to be trained on local public education.

Overall, this training program is very important to the success of the Stormwater Pollution Prevention Plan required by this permit. Since the goal of this training is to stress the importance of the permit and the required practices, the training should encourage employees to take an active and environmentally responsible role in implementing the stormwater program.

WANT TO KNOW MORE?

In many ways, education and training may be considered the most important aspect of this program. It is widely recognized that education is the key to providing people with the knowledge, awareness, attitudes and values that will help them play their part in sustaining the environment, not only while they are at work but also throughout life. This SBR specifically targets the employees that work for Highway Agencies.

Employee training has two purposes. The first is to familiarize the workers with the permit requirements, and what specifically will be required of them. The second is to give the employees an overview of the stormwater program, why it is being done, and why their participation is important. As mentioned above, if the employees do not understand what is required of them and why it is required then they will not do it. As philosopher Baba Dium said, "We only conserve what we love, we only love what we understand, we only understand what we know and we only know what we are taught."

Chapter 10 - Additional Measures

Additional Measures (AMs) are measures (non-numeric or numeric effluent limitations) that are expressly required to be included in the stormwater program by an areawide or Statewide Water Quality Management Plan (WQM plan). AMs may modify or be in addition to SBRs.

Additional Measures may be required by a Total Maximum Daily Load (TMDL) approved or established by the US Environmental Protection Agency, a regional stormwater management plan, or other elements of adopted areawide or Statewide WQM plans. If a Highway Agency has to implement an AM as a result of such a WQM plan, the Department will provide written notice of the AM to that Highway Agency. The Department will also list each required AM in the permit through minor modifications to the permit. The AMs, other than numeric effluent limitations, will specify the measures that must be implemented, the measurable goals and an implementation schedule for each BMP.

A Water Quality Management Plan is a plan that is prepared pursuant to Sections 208 and 303 of the Federal Act and the Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq., including the Statewide, areawide, and county WQM plans. Department rules governing WQM plans are found at N.J.A.C. 7:15.

The Total Maximum Daily Load is the sum of individual wasteload allocations for point sources, load allocations for nonpoint sources of pollution, other sources such as tributaries or adjacent segments, and allocations to reserve or margin of safety for an individual pollutant.

More information on Water Quality Management Plans, and the most recent updates concerning Total Maximum Daily Loads can be found at the following website:
http://www.nj.gov/dep/watershedmgt/programs.htm

Regional stormwater management planning is a water resource management strategy that identifies and develops solutions to problems that can be managed most effectively on a regional basis. The product of this planning process, the regional stormwater management plan, spans the boundaries of individual Highway Agencies, properties, neighborhoods, and even county borders. A plan may address an existing water quantity issue, such as localized flooding; an existing water quality issue, such as excess pollutant loading; or issues of water quantity and quality that may be generated by future development. Regional stormwater planning creates a combination of regulations and actions tailored to the specific needs of a drainage area, but it does not reduce environmental protection. Rather, it allows regulations more flexibility to match the concerns, conditions, and features of regions that are connected by a common drainage area. More information on regional stormwater management plans can be found in subchapter 3 of the Stormwater Management rules (N.J.A.C. 7:8) and in Chapter 3 of the New Jersey Stormwater Best Management Practices Manual.

(http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm).

As of the date this Highway Permit guidance document was issued, no AMs have been adopted.

Chapter 11 - Optional Measures

At the Highway Agency's discretion, the stormwater program may also include Optional Measures (OMs), which are Best Management Practices (BMPs) that are not implemented as Statewide Basic Requirements or Additional Measures but that prevent or reduce the pollution of the waters of the State. These OMs are voluntary BMPs that may further enhance a Highway Agency's stormwater program and may target a specific pollutant of concern or problem affecting the Highway Agency. The SPPP should include any OM that the Highway Agency plans on implementing, along with an implementation schedule. If a Highway Agency does not implement an OM identified in their SPPP, the Highway Agency will not be considered to be in violation of the permit.

Suggested Optional Measures include:

- Wildlife Management;
- Fertilizer and Pesticide Management;
- Retrofit of Existing Stormwater Management Measures;
- Road De-icing, and;
- Planting of Native Vegetation in Existing Landscapes.

Highway Agencies are not limited to those topics and may develop an OM on their own if they feel it will help to reduce or prevent the pollution of the waters of the State. Whenever an OM is implemented it should be reviewed periodically to check its effectiveness. If the desired results are not being accomplished the OM should either be improved, modified or abandoned.

Wildlife Management

The Canada goose (*Branta canadensis*) is probably the most commonly recognized bird in New Jersey, and with good reason. New Jersey currently has about 85,000 geese, which places us with the highest density of Canada geese in the United States: 12 geese per square kilometer.

However, this wasn't always the case. In 1967, one subspecies, the Aleutian Canada goose, was listed as endangered by the U.S. Fish and Wildlife Service. This was primarily due to the introduction of a non-native arctic fox species to their nesting island, which became predatory on the defenseless geese. This introduction led to a population decline to approximately 800 geese. The Canada goose population was declining so rapidly that state and federal biologists resorted to importing thousands of mating pairs of geese from the Midwest in the 1960's to ensure their survival in the Mid-Atlantic States. Under the cover of the 1916 Migratory Bird Treaty (which prohibited spring shooting, limited the shooting season, and put a quota system on bag limits) and the federal wildlife agency, the geese began to thrive.

Today, Canada geese populations are broken down into two distinct groups: the migratory population and the resident population. Currently, the migratory population is below management objectives, and thus is still strictly protected by the U.S. Fish and Wildlife Service and the 1916 Migratory Bird Treaty. The resident population, however, continues to grow at an alarming rate. If nothing is done to control the resident geese in the Atlantic flyway, their population is estimated to exceed 1.6 million by 2012.

This Optional Measure addresses the concerns raised by the ever increasing Canada goose population in New Jersey, and the impacts they have on our environment.

Canada geese are grazers, their diet consisting mainly of grasses and other green vegetation. They tend to be attracted to urban sites with short lawns, and they will almost always choose fertilized lawns over unfertilized lawns. For these reasons geese are often found congregating on rest areas and service areas.

Canada geese nest in the spring and nesting sites are usually surrounded by, or very close to, water. Water provides the geese with access to food, drink and an escape from predators. Nesting females also tend to use the same nesting site year after year, which makes it difficult to remove them once they breed in an area. In addition to this, once a year the geese begin a complete molt of their flight feathers. During this period the geese will be unable to fly, thus making it necessary for them to be in areas near water with a close food source.

These characteristics of the Canada goose, in addition to their increasing populations, often conflict with human interests, necessitating some form of management. Depending on the severity of the problem, non-lethal or lethal methods may be chosen. The management control methods listed below are only recommendations and may be implemented as needed. However, using two or more of the following techniques will provide better results than relying on just one method.

Non-Lethal Control Measures

Barriers

Barriers can be effective in small areas where the geese tend to walk from their feeding source to the water. A low fence or other barrier, such as high vegetation, that prevents the geese from easily moving from grassy areas to the water may be all that is needed to solve the problem. Fencing works best during their summer molt when the birds cannot fly into the water. The barriers can either be permanent or temporary.

Overhead Wire Grids

Overhead wire grids are typically made out of polypropylene lines and placed over a body of water, which is usually supported by fiberglass rod posts that are evenly spaced around the perimeter. A two-strand perimeter fence should also surround the area to deny entry to the pond from the sides. The overhead wire grid prevents the geese from landing in the water by reducing the long take-off and landing zones needed by the Canada geese.

Scare Decoys

Scare decoys, such as the Dead Canadian Goose, will discourage geese from nesting or feeding near a body of water. This method is typically most effective where the problem area is small in size.

Repellants

Repellants are substances that can be sprayed on the lawn to deter the geese by making the grass taste bad to them. Biodegradable deterrents using human-safe food flavoring derived from grapes (methyl anthranilate) can be sprayed on an area and will last about 14 days per application. Other deterrents contain an ultraviolet repellant to visually deter the birds. Before this method is used, however, local regulations must be checked to ensure use near ponds or wetlands.

Sound Deterrents

Sound deterrents must be in place early in the season to be effective. Sound deterrents can be as simple as banging on ordinary pots and pans, or as complex as pistol-launched pyrotechnics, firecrackers, or liquid propane gas cannons. To be most effective the sound deterrents should go off under the birds as they come in to land. Sound deterrents are the best option for large-scale geese problems, but may not be suitable for residential or public areas. Additionally, a permit to discharge a firearm may be required.

Visual Deterrents

Visual deterrents include items such as balloons, streamers, flags and scarecrows. Large red, white, yellow, or mylar balloons have proven to be most effective. They should be filled with helium and tethered on a monofiliment line to scare the geese. To increase the balloons' effectiveness, large eyespots can be drawn on. Any visual deterrent used should be moved periodically to make sure that the geese don't become accustomed to them

Hazing

Hazing the geese includes chasing the geese from any area where they are not welcome. People or livestock herding dogs that are trained to chase geese can be used to haze the geese, however special permits may be required to use dogs to haze geese. This can be an effective method of control in areas where noise and appearance are important considerations.

Education

Educating the public is a very important part of goose management. Many times people attract large number of geese to an area by feeding them. By feeding the geese, they are only encouraged to stay in the area. (Many people also don't realize that bread is not a nutritional food source for geese and can actually harm them.) In addition to adopting and implementing the wildlife feeding regulatory mechanism and educating the public about not feeding the geese, people should also be made aware of the ideal habitat of the Canada goose, and what they can do to make their property less attractive to the geese. Since geese typically like to live near ponds, access to these ponds should be limited. In the springtime, the ponds can be fenced off, or high vegetation can be allowed to grow around the pond. If the pond has an aerator, it should be turned off in the wintertime to allow the pond to freeze over. Also, old goose nests or goose nest platforms should be removed (no permit is required to remove these).

Lethal Control Measures

Hunting

The most effective, but controversial, method of population control of the Canada geese is to allow a hunting season for them. Several states, including New Jersey, currently have a hunting season for Canada geese. There are presently three hunting seasons for Canada geese in New Jersey: the regular Canada goose season, September season and winter season, with bag limits ranging from two to five geese. More information can be found on this topic by visiting the New Jersey Fish and Wildlife webpage (www.njfishandwildlife.com), or the NJDEP webpage (www.state.nj.us/dep/fgw).

Egg Addling, Oiling, or Replacing

One means of population control for the Canada goose is to ensure that they don't produce offspring. The easiest way to accomplish this is to alter their eggs so that they are no longer viable. There are several ways that this can be done, however, it should be kept in mind that if a goose

cannot find its egg, or realizes that it has been tampered with, it will simply find a new nest and lay more eggs. Additionally, all of these methods can be very time consuming and dangerous. The nest must be watched for times when the geese are not nearby so that they do not see their eggs being tampered with. If the geese do see someone near their nest, they may become aggressive.

Egg addling means that the eggs are shaken to mix up the contents, or a small hole is poked in the shell so that the inside can be stirred up. Both of these methods will destroy the egg, making sure it does not hatch.

Egg oiling involves rubbing a thin layer of oil on the outside of the entire shell. This prevents the egg from "breathing" and suffocates it.

Replacing the real eggs with wooden or other artificial eggs may also be effective. Remember, if the eggs are simply removed, the geese will just lay more. If the eggs are replaced with artificial eggs, though, the geese will continue to incubate them as if they were real.

Although the resident population of the Canada goose continues to grow at an alarming rate, and continue to claim more and more recreational areas as their own, this is not the major complaint. The major complaint is not attributed to what they take from these areas, but rather what they leave behind. The average Canada goose produces two to four pounds of droppings a day. These droppings can contain salmonella bacteria that persist (in wet droppings) for up to one month.

Substances that are derived from goose droppings can cause water quality problems, including noxious algal blooms, beach closings, and the spread of fowl related diseases.

When geese droppings are allowed to enter the water, the nutrient level increases. This can lead to excessive plant and algal growth, which is directly related to a loss of habitat and wildlife including fish kills and eutrophication. Eutrophication can permanently change the character of a lake by increasing the organic content, eventually converting it into marsh and land areas.

Many beach closings have also been attributed to geese. When an excessive number of geese congregate near a beach or waterway, their fecal matter can sometimes overload the normal capacity of a beach to absorb natural wastes, thus degrading the water quality and requiring the area to close to the public.

Finally, geese can be responsible for the spread of some fowl related diseases. Among these are viral, bacterial and parasitic diseases, to which only waterfowl are susceptible.

The costs associated with implementing this optional measure can be highly variable, depending on the method(s) chosen, and the frequency they must be repeated. Additionally, some of the options are more time consuming or require special permits, which may add to the pre-existing cost of the actual control measure.

While it is difficult to quantify the benefits an area will receive through managing goose populations, it is reasonable to assume that any reduction in their population will have a positive effect on the environment. The amount of benefits received will depend on the severity of the problem in the first place, the method(s) chosen to control the goose populations, and how frequently the control methods are repeated.

More information on this topic can be found at:

http://www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/Goosedraft.pdf
http://www.fw.umn.edu/research/goose/html/default.html
http://www.wildlifedamagecontrol.com/canadageese.htm

http://www.pacd.org/resources/lake_notes/geese02.htm
http://www.birdcontrolsupplies.com/bobbesg.htm
http://www.wnrmag.com/stories/1998/dec98/geese.htm

Fertilizer and Pesticide Management Program

The Department recommends that Highway Agencies adopt, as an Optional Measure, a fertilizer and pesticide management program that restrict their use of such chemicals. This is especially important in highways located near lakes, rivers or bays.

Fertilizer management

A fertilizer management program may include the following restrictions:

- Require soil samples to be tested to determine which nutrients, if any, are necessary before any fertilizers are applied.
- Allow nitrogen-based fertilizers only in slow-release formulas.
- Forbid the use of phosphorous-based fertilizers unless soil testing demonstrates a need for it.
- Prohibit the use of fertilizer within 25 feet of any lake, stream, drain, river, wetland, or natural waterway.
- Require that fertilizers be watered within 24 hours of application.
- Prohibit fertilizer applications when heavy rainfall is anticipated.
- Ban the application of fertilizers before April 15 and after November 15, when there is a risk that frost will prevent the nutrients from being absorbed into the soil.
- Require applicators to take precautions against applying fertilizers to impervious surfaces, such as driveways and sidewalks, where the nutrients will simply wash away into storm sewers or nearby waterways with the next rainfall.

Pesticide management

A pesticide management program should at a minimum conform with the Pesticide Control Code (N.J.A.C. 7:30). This program may, for example, address the following issues:

- The proper storage of pesticides (N.J.A.C. 7:30–1.9, 9.4)
- Pesticide application/use and safety equipment (N.J.A.C. 7:30–2.2, 2.3, 9.3, 9.7, 10.3)
- The proper methods of disposal of pesticides, their containers, and equipment that holds or has held a pesticide (N.J.A.C. 7:30–9.6, 11.2, 11.3)
- Accidental pesticide misapplications, spills, and emergency containment (N.J.A.C. 7:30–9.14, 9.15, 11.1)

Retrofit of Existing Stormwater Management Measures

For more information on this topic please see Chapter 8 of the New Jersey Stormwater Best Management Practices Manual at:

http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

Road De-icing

Road de-icing is a common practice during and after winter storms. Essentially it consists of applying salt (NaCl), or other types of de-icing materials, to lower the freezing temperature of the precipitation. Lowering the freezing temperature of the snow and ice causes it to melt quicker, and allows motorists to travel roadways safely. Excessive use of de-icers can be environmentally detrimental due to increasing sediment loads and soluble materials entering surface and ground water. The excessive use of de-icers may adversely affect roadside vegetation, pollute waterways and/or groundwater, as well as adversely affect aquatic life or cause corrosion.

However, the use of road salt is a public safety issue as well as a water quality issue. The short-term need for clear, safe winter roadways outweighs the environmental impacts. None of the recommendations here are to be construed as advocating the reduction of de-icing efforts to the point of jeopardizing public safety. Rather, most are simple techniques that can be easily integrated into existing de-icing practices that can reduce the impact on surface and ground water quality.

Road salts were identified in the early 1970's as a pollutant source after high levels of sodium, calcium and chloride were found in public water supply wells. Aside from contaminating potable surface and ground water, high levels of sodium chloride can kill roadside vegetation, impair aquatic ecosystems and corrode infrastructure such as bridges, roads and stormwater management devices.

Application of typical de-icers and alternative de-icers should be considered when formulating a de-icing policy. New, safer alternatives are being developed that may lesson our dependence on traditional de-icers. Alternative de-icing materials and techniques should be considered whenever possible.

Application of De-icing Materials

In general, the Department promotes the smart use of salt and other de-icing materials. This concept encourages Highway Agencies to consider a wide range of options when formulating a management policy on the application of de-icing materials. These de-icing policies should take into consideration storm characteristics, roadway conditions, road characteristics, the type and availability of equipment, and availability and need of alternative de-icing materials (other than NaCl). Reduced application rates and alternative de-icing practices should be incorporated in environmentally sensitive areas, areas that drain to surface drinking water sources (reservoirs), and groundwater recharge areas (e.g., ground water supply wells, and wellhead protection areas). Reduced application rates may also be considered on secondary roads or on other roads rarely traveled.

One of the most effective means in preventing over-application is the use of calibrated spreaders, which ensure delivering de-icing materials at the predetermined optimal application rate. Automated controls on spreaders are recommended to ensure a consistent and correct application. The spreader should be calibrated prior to a snow storm event and periodically during the snow season, regardless

of whether or not automatic or manual controls are used. A regular schedule of maintenance for snow removing equipment (including salt spreaders) should be incorporated into a snow management policy. Poor maintenance of the snow removal equipment is often responsible for excessive salt use. Guidelines for the calibration of spreaders and determination of application rates are given in the EPA document *Manual for De-icing Chemicals: Application Practices.*

De-icing is recommended for snowfalls of less than two inches and for road surfaces with packed snow already on the road surfaces. A management policy of de-icing of roadways should consider factors such as length and duration of the snowfall and initial conditions of the roadway which will be salted. The salting of road surfaces after the snow has accumulated will only result in the applied rock salt being removed with the snow when plowed.

De-icing Materials and Alternative De-icing Materials

In most instances winter de-icing materials consist of rock salt (NaCl) or a combination of rock salt and sand. The effectiveness of this mixture is significantly reduced at temperatures below 25 degrees Fahrenheit. As a result, it is not practical to increase the amount of rock salt when spreading below 25 degrees Fahrenheit. At temperatures lower than 25 degrees Fahrenheit, rock salt can be applied with calcium chloride (CaCl), which increases the effectiveness of the deicer at temperatures down to -25 degrees Fahrenheit.

Various mixtures of sodium chloride, calcium chloride and sand can be used depending on the sensitivity of the area. The State of Connecticut recommends a 7:2 sand pre-mix be used in sensitive areas. Pre-mix is 3.5 parts sodium chloride and 1 part calcium chloride by weight. Use of higher ratios of calcium salts is recommended environmentally since calcium poses fewer problems than sodium.

New de-icing materials are periodically developed which are more environmentally friendly and can be used in sensitive areas or as an alternative to traditional de-icers. In some instances, the costs of these new materials are prohibitive on a large-scale basis but they could be used in smaller target areas.

One of the best alternatives to de-icing materials is sand. Sand has no de-icing properties but when used as a mix with rock salt, can be helpful in areas where increased traction is needed and where a reduction of rock salt is desired. Ash and cinders are another low tech alternative to calcium chloride. While using sand, gravel, ash and cinders reduce the amount of sodium, they have their own environmental problems, specifically, causing sedimentation and increasing suspended solids in receiving waters.

NOTE: The New Jersey Department of Environmental Protection does not promote the use of any specific product discussed below.

Calcium Chloride: Has a lower freezing point than rock salt. Absorbs moisture readily and stays on the pavement longer than rock salt. Used in "wetting" of roadways prior to snowfall.

Calcium Magnesium Acetate: Less effective, better environmentally.

Magnesium Chloride: Basically as effective as calcium chloride in adhering to the road surface and has comparable freezing temperature.

Potassium Acetate: Does not have the chloride residual problems associated with other de-icers. Does not cause corrosion and has a low environmental impact.

Potassium Chloride: Is similar in performance and cost to calcium chloride and magnesium chloride. Has a similar chloride residual problem.

Urea: Less corrosive than rock salt and has little to no effect on roadside vegetation.

Reduction of the Application of De-icing Materials

Remote sensors along roadways can be used to determine which parts of roadways have ice on them. Some sensors can detect ice as thin as 0.005 inches. Using this technology will enable the effective delivery of de-icing material to sections of roadway that need it most rather than spreading on the entire roadway.

The state of Vermont has used a strategy that employs an application curve for efficient salting. Application rates vary with temperature. The study "Smart Salting: A Winter Maintenance Strategy" is available from the Vermont Agency of Transportation.

Structural controls are another way to reduce over-application of de-icing materials. Snow fences are used to keep snow from being blown into drifts. Studies show that fences minimize costs associated with snow clearing, reduce the formation of compacted snow, and reduce the need for chemicals. Mechanical snow removal costs approximately 100 times more than trapping snow with fences.

Planting of Native Vegetation in Existing Landscapes

For new development and redevelopment projects the Stormwater Management rules require low maintenance landscaping that encourages the retention and planting of native vegetation, and that minimizes the use of lawns, fertilizers and pesticides. The Department is recommending that as an Optional Measure Highway Agencies incorporate these same concepts into their own existing developed areas and open space. Planting native (or well-adapted) trees and shrubs in a watershed will help restore a healthy stream environment. Plantings help to improve local water quality by preventing erosion, slowing stormwater runoff, and provide food and shelter for wildlife. The NJ Watershed Ambassadors can help organize and implement volunteer plantings. Information on the NJ Watershed Ambassadors program may be found at http://www.nj.gov/dep/watershedmgt/ambassadors_index.htm. For more information on landscaping and native species please see Chapter 7 of the New Jersey Stormwater Best Management Practices Manual.

(http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm)

Chapter 12 – Annual Report and Certification, and Blank Forms

This Chapter contains all blank forms required by the permit including:

- Annual Report and Certification form;
- Stormwater Pollution Prevention Plan forms;
- Illicit Connection Inspection Report form (see Chapter 6); and
- Closeout Investigation form (see Chapter 6).

These forms are meant to aid the Highway Agency by making the process of complying with your permit, completing the SPPP, conducting inspections, and reporting to the Department easier. Electronic copies of the blank forms are on the CD provided to you by the Department and may also be downloaded at www.state.nj.us/dep/dwq/municstw.html. The forms are available as both a PDF file, which allows the form to be completed on the computer, or as an MS Word fill in form document. If the Highway Agency has a full version of Adobe Acrobat, the PDF files can be saved and updated. If you are using an Adobe Acrobat Reader, you will be able to complete the forms, but not save the completed forms for future use.

Each Highway Agency should use the blank Stormwater Pollution Prevention Plan forms or create their own forms, provided that all the required information is included, when completing its SPPP (see Chapter 2 of this guidance document for more information on your SPPP). When completing your SPPP, it's important to include detailed information about your Highway Agency's stormwater program. The more information your SPPP contains, the more beneficial it will be to you and the Department. The Highway Permit does not require Highway Agencies to submit the SPPP to the Department, however, the Department will review the completed SPPP as part of regular compliance assistance inspections. In addition, the SPPP should be kept on site for use by members of the Stormwater Pollution Prevention Team and other employees it may affect.

The SPPP should be an evolving document and should not be filed away upon completion. The SPPP needs to be continually updated and revised as people, tasks, and best management practices change. Each year you will be required to submit an **Annual Report and Certification**. This is the perfect time to evaluate your stormwater program and SPPP and make appropriate changes, revisions and updates.

Annual Report and Certification

Highway Agencies shall complete an Annual Report (on a form provided by the Department below) summarizing the status of compliance with this permit including measurable goals and the status of the implementation of each SBR contained in Part I, Section H of the permit. This report shall include a certification that the Highway Agency is in compliance with its stormwater program, SPPP and this permit, except for any incidents of noncompliance. Any incidents of noncompliance with permit conditions shall be identified in the Annual Report and Certification. A copy of each Annual Report and Certification shall be kept at a central location and shall be made available to the Department for inspection.

- If there are incidents of noncompliance, the report shall identify the steps being taken to remedy the noncompliance and to prevent such incidents from recurring.

- The Annual Report and Certification shall be signed and dated by the Highway Agency, and shall be maintained for a period of at least five years. This period may be extended by written request of the Department at any time.

The Annual Report and Certification shall be submitted to the Department pursuant to the following submittal schedule:

- Submit an Annual Report and Certification: **on or before July 1, 2005 and every 12 months thereafter.**

Annual Report and Certification Form

Stormwater Pollution Prevention Plan Forms

Illicit Connection Inspection Report Form

Closeout Investigation Form

Chapter 13 - Industrial and Construction Activity Operated by the Highway Agency

Provisions within the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 temporarily exempted certain discharges from the need to obtain an industrial stormwater discharge permit under the Federal Clean Water Act. The exempted discharges included those associated with Phase I industrial activities at facilities owned or operated by Highway Agencies with populations of less than 100,000 (with the exception of powerplants, airports, and uncontrolled sanitary landfills). This "ISTEA" exemption was later extended by U.S. Environmental Protection Agency and Department regulations. The Department's Phase II Rule further extended the deadline to apply for a permit for these previously exempted industrial activities to **March 3, 2004**.

It is important to note that the Highway Permit **does not** authorize the discharge of stormwater associated with industrial activity and that **a Highway Agency must apply for a separate NJPDES permit if the Highway Agency operates those types of facilities.** Types of facilities that a Highway Agency may operate and that are considered to be engaging in "industrial activity" include but are not limited to:

- certain landfills and recycling facilities;
- certain transportation facilities (including certain local passenger transit and air transportation facilities);
- certain facilities handling domestic sewage or sewage sludge (including certain Sewage Treatment Plants);
- steam electric power generating facilities; and
- construction activity that disturbs five acres or more

(See N.J.A.C. 7:14A-1.2 for the full definition of "stormwater discharge associated with industrial activity.")

A Highway Agency must apply for a separate NJPDES permit if it operates any of these activities regardless of the size of the population of the Highway Agency in which they are located.

In addition, the Highway Permit **does not** authorize "stormwater discharge associated with small construction activity" as defined in N.J.A.C. 7:14A-1.2. In general, this is the discharge to surface water of stormwater from construction activity that disturbs at least one but less than five acres. Any Highway Agency that operates a construction site with such a discharge must apply for a separate NJPDES permit for that discharge. In most cases, this permit is the Department's Construction Activity Stormwater General Permit (NJ0088323) obtained through the Soil Conservation District (or through NJDOT where NJDOT is the Highway Agency). This general permit is also used for construction activity that disturbs five acres or more.

Chapter 14 - Important Names, Addresses and Contacts

Listed below are names, addresses and contacts that may be helpful to the Highway Agency when preparing and implementing its stormwater program.

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION CONTACT INFORMATION

Bureau of Nonpoint Pollution Control

Division of Water Quality
PO Box 029
Trenton, New Jersey 08625-0029
Tele: (609) 633-7021

Home of the Municipal Stormwater Regulation Program (MSRP), which implements the Phase II Rules, issues permit authorizations under the MSRP, and provides outreach and compliance assistance. Also issues NJPDES permits for industrial stormwater discharges and discharges to ground water.

Division of Watershed Management

PO Box 418
Trenton, New Jersey 08625-0418
(609) 984-0058

For assistance with the Stormwater Management rules:

- **Bureau of Northern Planning**
  Ken Klipstein, Bureau Chief
  (609) 633-3812
- **Bureau of Southern Planning**
  Steve Jacobus or Bob Mancini
  (609) 984-6888

For assistance with **technical questions** regarding the Stormwater Management rules:

- Sandra Blick, Supervising Environmental Specialist
  Division of Watershed Managementat:
  (609) 633-1441

For assistance with education and outreach:

- **Bureau of Outreach and Education**
  Kerry Kirk Pflugh, Section Chief
  (609) 292-2113

For other sites related to watershed management (e.g., watershed associations) see: http://www.nj.gov/dep/watershedmgt/links.htm

Bureau of Permit Management
Division of Water Quality
PO Box 029
Trenton, New Jersey 08625-0029
(609) 984-4428

Reviews and processes requests for authorization (RFAs) under the Municipal Stormwater General Permits. RFA, permit fee and billing questions should be submitted to this bureau.

New Jersey Environmental Infrastructure Trust

PO Box 440
Trenton, NJ 08625
(609) 219-8600

Provides low-cost financing for the capital equipment purchase and construction components of environmental infrastructure projects (including stormwater projects) that enhance and protect ground and surface water resources, ensure the safety of drinking water supplies, and make possible responsible and sustainable economic development. Administers the Municipal and County Stormwater Grant program.

Land Use Regulation, Compliance and Enforcement

PO Box 439
Trenton, New Jersey 08625-0439
(609) 292-0060

Reviews applications for permits to build or develop on environmentally sensitive land such as freshwater wetlands, coastal areas and floodplains.

Solid Waste Regulation

PO Box 414
Trenton, NJ 08625-0414
(609) 984-5950

Responsible for the effective management of solid and hazardous wastes and recyclable materials, such as street sweeping and catch basin cleaning debris.

Bureau of Point Source Permitting

Issues permits for nonstormwater discharges to surface water including process wastewater, noncontact cooling water, or domestic sewage discharges.

Region 1
Serving northern and western parts of the State, plus Monmouth and Ocean Counties
(609) 633-3869

Region 2
Serving southern and central parts of the State
(609) 292-4860

Regional NJDEP Water Compliance and Enforcement Offices

Conducts compliance evaluation inspections of NJPDES permitted facilities.

Northern (& Metro)
1259 Route 46 East
Parsippany, New Jersey 07054-4191
(973) 299-7592
Fax: (973) 299-7719
(serves Bergen, Essex, Hudson, Hunterdon, Morris, Passaic, Somerset, Sussex & Warren Counties)

Central
Horizon Center
PO Box 407
Robbinsville, New Jersey 08625-0407
(609) 584-4201
Fax: (609) 584-4220
(serves Mercer, Middlesex, Monmouth, Ocean & Union Counties)

Southern
One Port Center
2 Riverside Drive
Camden, New Jersey 08102
(856) 614-3655
Fax: (856) 614-3608
(serves Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester & Salem Counties)

NJ Geological Survey

29 Arctic Parkway
P.O. Box 427
Trenton, NJ 08625
(609) 292-1185
http://www.state.nj.us/dep/njgs/

The NJ Geological Survey is a public service and research agency within the NJ Department of Environmental Protection. Founded in 1835, the NJGS has evolved from a mineral resources and topographic mapping agency to a modern environmental organization that collects and provides geoscience information to government, consultants, industry, environmental groups, and the public.

CONTACT INFORMATION FOR OTHER GOVERNMENT / PUBLIC AGENCIES

New Jersey Department of Transportation

Administrative Offices
1035 Parkway Avenue
Trenton, NJ 08625
http://www.state.nj.us/transportation/

State Soil Conservation Committee

New Jersey Department of Agriculture
CN330
Trenton, NJ 08625
http://www.state.nj.us/agriculture/rural/natrsrc.htm

(see last page of this Chapter for a list of soil conservation districts and their phone numbers)

U.S. Geological Survey

1-888-ASK-USGS (1-888-275-8747).
http://www.usgs.gov/

U.S. Environmental Protection Agency

Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.

Washington, DC 20460
(202) 272-0167
http://www.epa.gov/

CONTACT INFORMATION FOR OTHER GROUPS AND ORGANIZATIONS

Watershed Associations

Contact the Department's Division of Watershed Management for contact information for your local Watershed Association (http://www.nj.gov/dep/watershedmgt/links.htm)

New Jersey State League of Municipalities

407 West State Street
Trenton, NJ 08618
(609) 695-3481
http://www.njslom.org/

New Jersey Association of Counties

150 West State Street
Trenton, NJ 08608
609-394-3467
http://www.njac.org/

Association of New Jersey Environmental Commissions (ANJEC)

PO Box 157
Mendham, NJ 07945
Phone: (973) 539-7547
(609) 278-5088

ANJEC is a statewide non-profit organization that assists the efforts of environmental commissions, local officials, interested citizens, private organizations and government agencies. ANJEC protects natural resources through smart growth and State Plan implementation, preserves open space, protects water resources and cares for the urban environment. ANJEC is active in the Coalition for Affordable Housing and the Environment and the Highlands Coalition. They also work to protect the special resources of the Pinelands and the Delaware Bayshore.

New Jersey Quality Initiative

The NJ Department of Transportation's New Jersey Quality Initiative Group includes representatives of most of the State" transportation-related agencies and associations.
http://www.state.nj.us/njqi/HTMLindex.html

Clean Ocean Action

P.O. Box 505, Highlands, New Jersey 07732-0505
Tele: (732) 872-0111

and

PO Box 1098,
Wildwood, New Jersey 08260

Tele: (609) 729-9262

Clean Ocean Action's south Jersey office is also the home of the new environmental education center, the Institute for Coastal Education. The Wildwood Office organizes activities, programs, and citizen action events for the Cape May & Atlantic Counties area.

Clean Ocean Action's goal is to improve the degraded marine water quality off the New Jersey/New York coast, by identifying and attacking the sources of pollution by using research, public education, and citizen action to convince public officials to enact and enforce measures which will clean up and protect the ocean.

BULLETINS, DOCUMENTS, MANUALS, ETC.

Stormwater Pollution Prevention Plan Electronic Worksheets

Contact the Bureau of Nonpoint Pollution Control, or visit www.njstormwater.org

Information concerning industrial stormwater permitting (for ISTEA or other facilities)

Contact the Bureau of Nonpoint Pollution Control

New Jersey Stormwater Best Management Practices Manual as amended

Contact the Division of Watershed Management, or visit www.njstormwater.org

NJPDES Rules (N.J.A.C. 7:14A) and the New Jersey Register

Official versions are available from:
West Group, Attn: COP
620 Opperman Drive
PO Box 64833
St. Paul, MN 55164-9742
To order call (800) 328-9352

Cost $77 (NJPDES Rules), $169. (New Jersey Register)

Unofficial version of the NJPDES rules are on the Division of Water Quality website at: www.njstormwater.org.

Code of Federal Regulations and Federal Register

Available from: State, university, law, and some county libraries. Also available at http://www.gpoaccess.gov/

Standards for Soil Erosion and Sediment Control in New Jersey

Available from: State Soil Conservation Committee (SSCC) or your local SCD

NJDOT Soil Erosion and Sediment and Control Standards

http://www.state.nj.us/transportation/

Local Soil Conservation Districts

BERGEN
327 Ridgewood Avenue
Paramus, NJ 07652
201-261-4407
201-261-7573 (fax)
973-538-1552*

BURLINGTON
Tiffany Square, Suite 100
2615 Route 38 - RD 2
Mount Holly, NJ 08060
609-267-7410
609-267-3347 (fax)
609- 267-0811*
burlsoil@bellatlantic.net

CAMDEN
403 Commerce Lane, Suite 1
W. Berlin, NJ 08091
856-767-6299
856-767-1676 (fax)
856-267-0811*
ccscd@jersey.net

CAPE-ATLANTIC
Atlantic County Office Building
6260 Old Harding Highway
Mays Landing, NJ 08330
609-625-3144
609-625-7360 (fax)
609-205-1225*
capeatlantic@erols.com
www.capeatlantic.org/

CUMBERLAND
PO Box 144, Route 77
Deerfield, NJ 08313
856-451-2422
856-451-1358 (fax)
856-205-1225
http://cumberland-soil.deeweb.com
csc123@jnlk.com

FREEHOLD
(Monmouth & Middlesex)
211 Freehold Road
Manalapan, NJ 07726
732-446-2300
732-446-9140 (fax)
732-462-1079*
http://www.freeholdscd.org/
fscd@webspan.net

GLOUCESTER
301 Hollydell Dr.
Sewell, NJ 08080
856-589-5250
856-256-0488 (fax)
856-769-2790*
http://www.gloucesterscd.org/
victor-devasto@nj.nacdnet.org

HUDSON, ESSEX & PASSAIC
15 Bloomfield Avenue
North Caldwell 07006
973-364-0786
973-364-0784 (fax)
973-538-1552*
hepscd@bellatlantic.net

HUNTERDON
Community Services Annex
8 Gauntt Place
Flemington, NJ 08822
908-788-1397
908-788-0795 (fax)
908-782-3915*

MERCER
508 Hughes Drive
Hamilton Square, NJ 08690
609-586-9603
609-586-1117 (fax)
732-462-1079*
http://www.mercerscd.org/home.htm
mercersoil@aol.com

MORRIS
Court House, PO Box 900
Morristown 07960
560 W. Hanover Avenue,
Morris Township, NJ
973-285-2953
973-285-8345 (fax)
973-538-1552*
mcscd@ibm.net

OCEAN
714 Lacey Road
Forked River, NJ 08731
609-971-7002
609-971-3391 (fax)
609-267-0811*
www.ocscd.org/index.htm
info@ocscd.org

SALEM
PO Box 168
Deerfield, NJ 08313
856-769-1124
856-451-1358 (fax)
856-769-2790*
http://cumberland-soil.deeweb.com

SOMERSET-UNION
Somerset County 4-H Center
308 Milltown Road
Bridgewater, NJ 08807
908-526-2701
908-526-7017 (fax)
908-782-3915*
tlurlow@co.somerset.nj.us

SUSSEX
186 Halsey Rd, Suite 2
Newton, NJ 07860
973-579-5074
973-579-7846 (fax)
908-852-5450*
http://www.nacdnet.org/resources/NJ.htm

WARREN
224 Stiger Street
Hackettstown, NJ 07840
908-852-2579
908-852-2284 (fax)
908-852-5450*
wcscd@bellatlantic.net

State Soil Conservation Committee
New Jersey Department of Agriculture
CN 330, Trenton, NJ 08625
609-292-5540
609-633-7229 (fax)
www.state.nj.us/agriculture/rural/natrsrc.htm
james.sadley@ag.state.nj.us

Inlet Labeling Guidelines

Storm Drain Labeling Guidelines for New Jersey

Prepared by
New Jersey Department of Environmental Protection
Division of Watershed Management
PO Box 418
Trenton, NJ 08625
609-984-0058

March 2004

Storm Drain Labeling Guidelines for New Jersey

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Acknowledgements

This guide is compilation of several guides and other materials that are already in existence. Many thanks to the following organizations:

Partnership for the Delaware Estuary
Whippany River Watershed Partnership
United States Environmental Protection Agency

Storm Drain Labeling Guidelines for New Jersey

Why Label Storm Drains?

Storm drain labeling is a great way to make people in your community more aware of nonpoint source pollution and polluted runoff. Nonpoint Source Pollution, or people pollution, is a contamination of our ground water, waterways, and ocean that results from everyday activities such as fertilizing the lawn, walking pets, changing motor oil and littering. With each rainfall, pollutants generated by these activities are washed into storm drains that flow into our waterways and ocean. Polluted runoff is stormwater contaminated by nonpoint source pollution. It harms local waterways, which we rely on for recreation and drinking water.

Residents may not be aware that most storm drains empty directly into local waterways, without treatment. Some individuals may view storm drains as trash receptacles for trash, used motor oil, leftover paint, pet waste or other pollutants. Storm drain labeling serves as an educational tool to remind people about the connection between storm drains and local waterbodies.

By labeling storm drains we can make everyone more aware of the nonpoint source pollution and polluted runoff. This is one step in educating people so that they can change their attitudes and behaviors that contribute to the problem.

Storm drain inlet labeling is also a requirement of New Jersey's new municipal stormwater permitting program. All Tier A municipalities are required to establish a storm drain inlet labeling program and label all storm drain inlets that are along municipal streets with sidewalks, and all storm drains within plazas, parking areas, or maintenance yards operated by the municipality. This program establishes a schedule for labeling, develops a long term maintenance plan and when possible coordinates the efforts with watershed groups and volunteer organizations. On an annual basis, these Tier A municipalities must identify the number of storm drains labeled. For more information on this program, visit www.njstormwater.org or call 609-633-7021.

A key factor in the success of a storm drain labeling program is visibility. Publicity in the local media about the event and volunteer participation in the event greatly increases the value of the labeling program as an educational tool. Municipalities are not required to use volunteers or seek media attention, but these activities do greatly improve the overall value of the program. Municipalities may opt to label the storm drains themselves or organize the storm drain labeling activities of local volunteers.

Types of Labeling

There are two types of storm drain labeling that can be done, stenciling with paint or gluing storm drain markers. Stenciling involves using a stencil and paint to label the drain. This type of marking has been used since early 1990s. The paint generally lasts up to 2 years, depending on weather and traffic conditions. Marking involves gluing a purchased marker to the storm drain. This method may last up to 10 years.

In determining which type of labeling to use, consider the cost of materials and how long they will last. Stenciling costs less initially and lasts a shorter time than markers which costs more initially but last longer. Another consideration is the educational value of the actual labeling process for the participants and residents. Since stenciling is done more frequently, it provides a more frequent reminder about polluted runoff.

How to Label Storm Drains

Below we have outlined the various tasks necessary to conduct a successful labeling event. At each event there are unique circumstances that come up and must be addressed by the organizers. A coordinator should be designated to oversee the event.

Preparation before the Event

1. Form an organizing committee and designate tasks.

2. Determine whether or not you will use stencils or markers. Determine what your stencils or markers will say and whether or not you want to include a graphic such as a fish, turtle, heron or crab. Some suggested messages are: "NO DUMPING – DRAINS TO RIVER, "ONLY RAIN DOWN THE STORM DRAIN," and "DUMP NO WASTE – DRAINS LOCAL WATERWAY." These messages can be customized to include the names of local waterbodies. In addition, you may wish to print the message in other languages depending on the community. Spanish is included as a standard on some markers.

3. Determine whether you will be purchasing materials or looking for donations. Include time to manufacture the markers or stencils in your timeline.

4. Identify your targeted area for labeling. Survey the area to locate the storm drains and determine how many there are. This information will determine how many labels you will need to buy and how many people will be involved in the event.

5. Select a date and a rain date for the event. Select the time and meeting location for the event.
    a. Find out if there are any other events planned for that time period that might conflict or compliment your labeling event. A litter clean-up by the local environmental commission or flower planting by the garden club would compliment your labeling.

b. The pavement or storm drain structure must be over 50 degrees for marking so that the adhesives will work properly. The surface must be dry for either stencils or markers.

6. Obtain written permission from your county or municipality to conduct the labeling. Call your county or municipality to find out the appropriate person or department to obtain permission from, usually the public works, highway or sewage authority. Ask them for a map of storm drains that you have permission to label.

7. In order to involve more volunteers, call various groups in your school and neighborhood to find out if they would be interested in participating. Consider involving your local AmeriCorps New Jersey Watershed Ambassador (See Resources Available at NJDEP section).

8. Prepare a promotional flyer to distribute to potential volunteers. You may want to invite friends, family, school clubs, youth groups, community organizations and neighbors. It may be beneficial to call these groups and/or make a presentation at one of their meetings.

9. Request support from local businesses to provide refreshments either before or after the event. Local businesses may also wish to contribute stenciling supplies (garbage bags, paint, brushes, gloves, etc.).

10. Invite community leaders including elected officials to participate in the event.

11. Acquire or prepare an informational flier to hand out during the event. Many materials are available for no or low cost from government agencies such as the NJ Department of Environmental Protection, local environmental groups or watershed associations (See Resource Section at the back of this booklet).

12. Prepare a press alert at least two weeks prior to the event and send it to the local media. Follow-up by calling the reporters and editors before the event.

13. Survey the area before the event to familiarize yourself with it. Note any safety concerns.

Week before the event

14. Make sure all materials are on hand. Prepare packets of supplies and information for each of your teams. Include a map of their area to label. Prepare sign-in sheets, name tags, and copies.

15. Make follow-up phone calls to confirm volunteers. Advise them of who to call in case of inclement weather. Make sure they know the time and location for the event.

16. Confirm refreshments if you are providing them.

17. Make follow up phone calls to the news media and local officials.

Day of the Event

1. Plan to arrive early to allow time to set-up before volunteers arrive.

2. Register volunteers. Allow about 30 minutes for registration and refreshments.

3. Give an overview of the day and why their work is important.

4. Divide volunteers into teams. Assign a team leader. Teams should be composed of 4 to 6 people. Make sure they have enough supplies for the area they will cover. Go over safety considerations.

5. Give volunteers a lesson on how to label the storm drain.

6. Send teams out to different areas, making sure that each team is clear on what area they are to stencil. Give them a specific time to return.

7. Take photographs of the event in order to document it and/or use them in a post-event press release.

8. When they return, collect leftover supplies. Dispose of any collected trash and recyclables properly.

9. Ask volunteers for feedback on the event. Provide refreshments if appropriate.

Follow-up after the Event

1. Send thank you letters to volunteers, businesses, supporters and any others that assisted you in the project.

2. Send a post-event press release to the local media. Include photographs of the actual event. Be sure to mention volunteer groups, sponsors and community leaders that were involved in the event.

3. Put together a summary of the event and provide it to your municipality.

Labeling Tips

All surfaces must be dry for either stenciling or marking.

Remember while working in or near the street, there is inherent risk. Be very cautious of passing cars, especially if you are working with children. Consider wearing brightly-colored safety vests, using traffic cones to protect your team and assigning a team member to serve as look-out for traffic.

Storm Drain Stenciling Tips

Supplies you will need:

- **Stencils**
- **Latex paint**
- **Foam brushes**
- **Safety Vests**
- **Educational flyers**
- **Gloves***
- **Paint stirrer**
- **Wire brushes or brooms**
- **Dustpans**
- **Newspapers or rags**
- **Trash bags**

Remember:

- A little paint goes a long way!! Using too much blurs the stencil image.
- Try to stencil in area where cars will not be driving directly on the paint. This greatly shortens the life of the paint.

How to stencil:

- Use a wire brush or broom to clear away any loose debris from the spot where the stencil will be placed. Pull weeds if necessary. Put debris in garbage bags and dispose of it properly. Keep recyclables separate and recycle any items that can be recycled.
- Designate one team member as the safety person to look out for vehicles.
- Have two team members hold down the stencil firmly on the street in front of or behind the storm drain. A third team member can gently sponge or brush paint onto the stencil. You do not need to soak the brush. The less paint you use the more control you will have in painting a clearly legible message. When using the foam brush, press straight up and down on the street to apply the paint. Wiping side to side will cause the paint to get trapped under the stencil blurring the message. All three of these team members should wear gloves.
- Once painting is completed, lift the stencil straight up to prevent smearing.
- While some team members are stenciling, others may hand out educational flyers to people passing by or to nearby businesses in the vicinity of the stenciled areas.

Please note that many people have allergic reactions to latex gloves. Check with your team members before distributing them if you use latex gloves.

Storm Drain Marking Tips

Supplies you will need:

- **Markers**
- **Adhesive**
- **Safety Vests**
- **Educational flyers**
- **Gloves***
- **Wire brushes or brooms**
- **Dustpans**
- **Newspapers or rags**
- **Trash bags**

Remember:

- Try to place the marker in area where cars will not be driving directly on it. This can greatly shorten the life of the marker.
- Surface temperatures must be over 50 degrees for most of the adhesives used to seal properly.

How to apply a marker:

- Use a wire brush or broom to clear away any loose debris from the spot where the stencil will be placed. Pull weeds if necessary. Put debris in garbage bags and dispose of it properly. Keep recyclables separate and recycle any items that can be recycled.
- Designate one team member as the safety person to look out for vehicles.
- Have two team members apply the adhesive in a spiral pattern on the back of the marker. Be sure to wear gloves.
- Apply the marker to the cleaned area. Press down hard to insure a proper seal with the adhesive under the entire surface of the marker.
- While some team members are applying markers, others may hand out educational flyers to people passing by or to nearby businesses in the vicinity of the stenciled areas.

Please note that many people have allergic reactions to latex gloves. Check with your team members before distributing them if you use latex gloves

Storm drain markers are available from two sources:
This information does not constitute an endorsement by the NJDEP of either of these manufacturers.

ACP International
1010 Oakmead
Arlington, Texas 76011
817-640-0992
www.acpinternational.com

das Manufacturing
3610 Cinnamon Trace Drive
Valrico, Florida 33594
800-549-6024
www.dasmanufacturing.com

For storm drain stencils, you may purchase stencil materials locally and create your own OR purchase pre-cut or custom stencils from:

Earthwater Stencils
Rochester, Washington
(360) 956-3774
www.earthwater-stencils.com

In addition, check with watershed association and environmental groups listed in the Additional Resources Section. They may have customized labels or markers for your watershed.

NonPoint Source Pollution Tips

Information in this section can be used in preparation of an educational flyer to distribute while labeling. Check with your local watershed association or environmental group listed in the Additional Resources Section for local educational materials.

Nonpoint Source Pollution is the contamination of our ground water, waterways, and ocean that results from everyday activities such as fertilizing the lawn, walking pets, changing motor oil and littering. With each rainfall, pollutants generated by these activities are washed into storm drains that flow into our waterways and ocean. They also can soak into the ground contaminating the ground water below.

Each one of us, whether we know it or not, contributes to nonpoint source pollution through our daily activities. As a result, nonpoint source pollution is the BIGGEST threat to many of our ponds, creeks, lakes, wells, streams, rivers and bays, our ground water and the ocean.

The collective impact of nonpoint source pollution threatens aquatic and marine life, recreational water activities, the fishing industry, tourism and our precious drinking water resources. Ultimately, the cost becomes the burden of every New Jersey resident.

But there's good news - in our everyday activities we can stop nonpoint source pollution and keep our environment clean. Simple changes in YOUR daily lifestyle can make a tremendous difference in the quality of New Jersey's water resources. Here are just a few ways you can reduce nonpoint source pollution.

LITTER: Place litter, including cigarette butts and fast food containers, in trash receptacles. Never throw litter in streets or down storm drains. Recycle as much as possible.

FERTILIZERS: Fertilizers contain nitrates and phosphates that, in abundance, cause blooms of algae that can lead to fish kills. Avoid the overuse of fertilizers and do not apply them before a heavy rainfall.

PESTICIDES: Many household products made to exterminate pests also are toxic to humans, animals, aquatic organisms and plants. Use alternatives whenever possible. If you do use a pesticide, follow the label directions carefully.

HOUSEHOLD HAZARDOUS PRODUCTS: Many common household products (paint thinners, moth balls, drain and oven cleaners, to name a few) contain toxic ingredients. When improperly used or discarded, these products are a threat to public health and the environment. Do not discard with the regular household trash. Use natural and less toxic alternatives whenever possible. Contact your County Solid Waste Management Office for information regarding household hazardous waste collection in your area.

MOTOR OIL: Used motor oil contains toxic chemicals that are harmful to animals, humans and fish. Do not dump used motor oil down storm drains or on the ground. Recycle all used motor oil by taking it to a local public or private recycling center.

CAR WASHING: Wash your car only when necessary. Consider using a commercial car wash that recycles its wash water. Like fertilizers, many car detergents contain phosphate. If you wash your car at home, use a non-phosphate detergent.

PET WASTE: Animal wastes contain bacteria and viruses that can contaminate shellfish and cause the closing of bathing beaches. Pet owners should use newspaper, bags or scoopers to pick up after pets and dispose of wastes in the garbage or toilet.

SEPTIC SYSTEMS: An improperly working septic system can contaminate ground water and create public health problems. Avoid adding unnecessary grease, household hazardous products and solids to your septic system. Inspect your tank annually and pump it out every three to five years depending on its use.

BOAT DISCHARGES: Dumping boat sewage overboard introduces bacteria and viruses into the water. Boat owners should always use marine sanitation devices and pump-out facilities at marinas.

As you can see, these suggestions are simple and easy to apply to your daily lifestyle. Making your commitment to change at least one habit can result in benefits that will be shared by all of us and add to the health and beauty of New Jersey's water resources.

Resources Available at NJDEP

These resources are available through the NJDEP Division of Watershed Management and are provided for low or no cost. Please call 609-292-2113 or visit www.nj.gov/dep/watershedmgt

The New Jersey Watershed Ambassadors Program

The New Jersey Watershed Ambassadors Program is a community-oriented AmeriCorps environmental program designed to raise awareness about water issues in New Jersey. Through this program, AmeriCorps members are placed across the state to serve their local communities. Watershed Ambassadors monitor the rivers of New Jersey through River Assessment and Biological Assessment volunteer monitoring protocols. Watershed Ambassadors also make interactive presentations to community organizations and schools. They also organize and participate in stewardship projects such as storm drain stenciling, litter clean-ups and restoration projects.

Project WET (Water Education for Teachers)

Project WET is a nationally renowned program that offers teachers a better understanding about the world's water resources through hands-on, multi-disciplinary lessons. Project WET is the only program that teaches about the importance and value of water in our every day life with formal and non-formal educators while offering specialized programs about New Jersey's water resources and watersheds. NJ Project WET is a well-rounded program that focuses on water supply, water quality, water conservation, watershed management, land use planning and wetlands. Project WET provides educators with accurate insight into critical water issues while offering a large selection of creative teaching strategies.

In addition to workshops, NJ Project WET reaches another 5,000 students annually and an estimated 12,000 parents, volunteers, educators and administrators through its Water Festival Grant Program. A Water Festival is a one-day celebration of water with a focus on a school's watershed. Students participate in a series of learning stations that examine water use over time, water's role in shaping our country, what a watershed is, how water is cleaned and used again, how a molecule travels through the water cycle and much more. The festivals involve the community and attract positive media attention that reaches thousands of people across the state.

NJ Project WET offers a unique learning opportunity for high school students and teachers through its Watershed Stewards Program. This program focuses on a weekend leadership workshop for a high school team of four or five students. They are provided instruction and training in watershed topics and team-building experiences that prepare them to focus on a watershed service project that will address an environmental concern. Each Watershed Steward Team must work with three community organizations and solicit another 20 volunteers to assist with the project. Participants receive a small grant to conduct a Watershed Steward Project.

Harbor Watershed / Urban Fishing Program

The goal of the Urban Fishing Program is to educate young students living in the Newark

Bay Complex about the hazards of eating contaminated fish and help them to discover the beauty of the great natural resource. Students who participate in the program sample recreational opportunities that the bay has to offer while learning how to be responsible citizens within the estuary. The students experience four days of intense yet enjoyable instruction related to the Newark Bay Complex. Throughout the four days students are given hands-on experiences such as fishing, water monitoring, eco-cruising and community clean-ups which will endure with them over a lifetime. The program also includes a storm drain marking program that can help municipalities fulfill their stormwater permitting requirements.

Clean Water Raingers Program
This program offers educators a number of teaching materials for their students as well as background information on watersheds and nonpoint source pollution. Educators who participate in the Clean Waters Raingers Program are provided with free booklets and associated materials for their elementary school age students. The *Clean Water Raingers Coloring Book, How to be a Clean Water Rainger Booklet* and the *Clean Water Raingers stickers* are also popular giveaways at family oriented events and festivals. These publications are also available online on the Department's environmental education web page.

Volunteer Monitoring Program - Watershed Watch
The Division has begun to implement a Volunteer Monitoring Program over the last several years. Volunteers are being encouraged to assess their local waterways using visual surveys or benthic macroinvertebrate studies. The Watershed Watch Network, comprised of volunteer monitors from across the state, works with the Department to better coordinate and improve the data collected by volunteers.

Publications
The DWM produces a number of stormwater related publications that are available for free distribution to municipalities, watershed associations, environmental groups or other organizations. These include *What's A Watershed?* Brochure, *New Jersey's Watersheds* Poster, and *Watershed Focus* Newsletter.

Additional Resources

There are many government agencies, environmental groups, and watershed association that have resources to help you. They can help you organize an event, provide volunteers, or provide educational resources. Please contact organizations in your area.

New Jersey Department of Environmental Protection
Division of Watershed Management
PO Box 418
Trenton, NJ 08625-0418
609-292-2113
www.nj.gov/dep/watershedmgt

Alliance for a Living Ocean
2007 Long Beach Boulevard
North Beach Haven, NJ 08008
609-492-0222
livingoceanalo@comcast.net
http://www.livingocean.org/index.html

Clean Ocean Action
18 Hartshorn Drive
PO Box 505
Highlands, NJ 07732
732-872-0111
sandyhook@cleanoceanaction.org
http://www.cleanoceanaction.org/

Great Swamp Watershed Association
PO Box 300
New Vernon, NJ 07976
973-966-1900
everything@greatswamp.org
http://www.greatswamp.org

Jacques Cousteau National Estuarine Research Reserve
Jacques Cousteau Coastal Education Center
130 Great Bay Boulevard
Tuckerton, NJ 08087
609-812-0649
weiss@imcs.rutgers.edu
http://www.jcnerr.org/
Lisa Weiss

Monmouth Coastal Watersheds Partnership
c/o Monmouth County Planning Board
One East Main Street
Freehold, NJ 07728
732-431-7460
Turner Shell
http://www.visitmonmouth.com/area12/

North Jersey Resource Conservation and Development Council
54 Old Highway 22
Clinton, NJ
908-735-0733
chall@northjerseyrcd.org
http://www.northjerseyrcd.org/
Christine Hall

Partnership for the Delaware Estuary
1009 Philadelphia Pike
Wilmington, DE 19809
1-800-445-4935
partners@udel.edu
www.delawareestuary.org

Passaic River Coalition
246 Madisonville Road
Basking Ridge, N.J. 07920
908-766-7550
prcwater@aol.com
http://www.passaicriver.org/
Ella Filippone

Pequannock River Coalition
PO Box 392
Newfoundland, NJ 07435
973-492-3212
pequannockguy@aol.com
Ross Kushner

Pohatcong Creek Watershed Association
256 Creek Road
Phillipsburg, NJ 08865
(908) 213-1550
www.pcwa.org
Dawn Areia

Pompeston Creek Watershed Association

551 New Albany Road
Moorestown, NJ 08057
(856) 235-9204
dlord@aol.com
Debbie Lord

Rockaway River Watershed Cabinet
c/o Morris 2000
2 Ridgedale Avenue
Cedar Knolls, NJ 07927
973-984-2000

South Branch Watershed Association
Lechner House, Echo Hill
Environmental Area, 51 Lilac Drive
Flemington , NJ 08822
908-782-0422
sbwa@eclipse.net
http://www.sbwa.org

Stony Brook Millstone Watershed Association
31 Titus Mill Road
Pennington, NJ 08534
609-737-3735
creed@thewatershed.org
www.thewatershed.org

Sussex County Municipal Utilities Authorities
34 Route 94 South
Lafayette, NJ 07848
973-579-6998
scmua@nac.net
http://www.wallkillriver.org/
Nathaniel Sajdak

Ten Towns Great Swamp Watershed Management Committee
c/o Morris 2000
2 Ridgedale Avenue
Cedar Knolls, NJ 07927
973-984-2000
http://www.tentowns.org

Watershed Management Area 3 Public Advisory Committee
holzapfeg@waynetownship.com
George Hozapfel

Watershed Management Area 4 Public Advisory Committee
Ellen Gruber
mandegruber@hotmail.com

Watershed Management Area 5 Public Advisory Committee
Bergen County Department of Health Services
327 East Ridgewood Avenue
Paramus, NJ 07652
201-634-2600
avernick@aol.com or tdecandia@co.bergen.nj.us
Anthony Vernick or Anthony DeCandia

Watershed Management Area 19 Public Advisory Committee
Burlington County Office of Land Use Planning
P. O. Box 600
Mt. Holly, NJ 08060
Gina Berg

Wreck Pond Watershed Association
809 Central Avenue
Spring Lake Heights, NJ 07762
732-449-8764
wreckpond@hotmail.com

Clean Communities Program

Sandy Huber, Executive Director
Clean Communities Council
479 West State Street
Trenton, NJ 08618
609-989-5900
info@njclean.org
http://www.njclean.org/

The Clean Communities Council works with the state departments of Environmental Protection and Treasury to oversee the implementation of litter abatement programs in 556 municipalities and 21 counties. The Council provides a clearinghouse for information about litter abatement, forums for the free exchange of ideas, and a voice for its constituents.

The Council also will ask towns and counties to report how Clean Communities grant money is spent—the number of cleanups held, number of volunteers who participated, the amount and type of litter and recyclables picked up, and the number and type of educational programs offered to schools and community groups. This information will be compiled in the Annual Report to the Governor and Legislature

Storm drain labeling is one of the allowable costs under this entitlement program. If you are planning a storm drain labelling event, please contact your local Clean Communities Coordinator to see if funding is available.

Useful websites

In addition, there are many valuable websites that can give you background information on nonpoint source pollution, polluted runoff, watershed and storm drain marking. They are listed below.

NJ Department of Environmental Protection
www.nj.gov/dep
features information on the Department's clean water initiatives, educational materials and regulatory programs

United States Environmental Protection Agency
www.epa.gov/owow/nps/
features basic information at the national level on nonpoint source pollution

The Watershed Institute
www.thewatershedinstitue.org
features information about watershed associations from across the state

Watershed Partnership for New Jersey
www.wpnj.org
features information on watershed educational resource in New Jersey

Inlet Retrofit Guidelines

Attachment C
DESIGN STANDARD - STORM DRAIN INLETS

This standard applies to storm drainage inlets installed as part of new development and redevelopment projects that disturb one acre or more. In addition, retrofitting of existing storm drainage inlets to this standard is required where such inlets are in direct contact with repaving, repairing (excluding repair of individual potholes), reconstruction or alterations of facilities owned or operated by the Highway Agency. For exemptions to this standard see "Exemptions" below.

Grates in Pavement or Other Ground Surfaces

Design engineers shall use either of the following grates whenever they use a grate in pavement or another ground surface to collect stormwater from that surface into a storm drain or surface water body under that grate:

1. The New Jersey Department of Transportation (NJDOT) bicycle safe grate, which is described in Chapter 2.4 of the NJDOT Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines (April 1996).

2. A different grate, if each individual clear space in that grate has an area of no more than seven (7.0) square inches, or is no greater than 0.5 inches across the smallest dimension.

   (In regard to whether the different grate must also be bicycle safe, the Residential Site Improvement Standards include requirements for bicycle-safe grates.)

Examples of grates subject to this standard include grates in grate inlets, the grate portion (non-curb-opening portion) of combination inlets, grates on storm sewer manholes, ditch grates, trench grates, and grates of spacer bars in slotted drains. Examples of ground surfaces include surfaces of roads (including bridges), driveways, parking areas, bikeways, plazas, sidewalks, lawns, fields, open channels, and stormwater basin floors.

Curb-Opening Inlets (Including Curb-Opening Inlets in Combination Inlets)

Whenever design engineers use a curb-opening inlet, the clear space in that curb opening (or each individual clear space, if the curb opening has two or more clear spaces) shall have an area of no more than seven (7.0) square inches, or be no greater than two (2.0) inches across the smallest dimension.

Exemptions

Retrofitting Exemptions

1. Repaving, repairing, reconstruction or alterations projects that began construction prior to March 3, 2004, and projects that were awarded bid prior to March 3, 2004, are exempted from the storm drain inlet design standard.
2. Existing curb-opening inlets do not need to be retrofitted to meet the design standard if each individual clear space in the curb opening has an area of no more than nine (9.0) square inches.

Hydraulic Performance Exemptions

1. New Development and Redevelopment Projects - Where the review agency determines that this standard would cause inadequate hydraulic performance that could not practicably be overcome by using additional or larger storm drainage inlets that meet these standards.
2. Retrofitting of existing storm drain inlets - Where the review agency determines that this standard would cause inadequate hydraulic performance.

Alternative Device Exemptions

1. Where flows from the water quality design storm as specified in N.J.A.C. 7:8 are conveyed through any device (e.g., end of pipe netting facility, manufactured treatment device, or a catch basin hood) that is designed, at a minimum, to prevent delivery of all solid and floatable materials that could not pass through one of the following:

    a. A rectangular space four and five-eighths inches long and one and one-half inches wide (this option does not apply for outfall netting facilities); or

    b. A bar screen having a bar spacing of 0.5 inches.

2. Where flows are conveyed through a trash rack that has parallel bars with one-inch (1") spacing between the bars, to the elevation of the water quality design storm as specified in N.J.A.C. 7:8.

Note - The preceding exemptions do not authorize any infringement of requirements in the Residential Site Improvement Standards for bicycle-safe grates in new residential development (N.J.A.C. 5:21-4.18(b)2 and 7.4(a)).

Historic Places Exemption

Where the Department determines, pursuant to the New Jersey Register of Historic Places Rules at N.J.A.C. 7:4-7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.

For information on the beneficial use program see:
http://www.state.nj.us/dep/dshw/rrtp/bud.htm.

Recommendations

The following are recommendations that may be beneficial but are not required by the permit.

- Higher efficiency street sweepers should be considered when purchasing new equipment (e.g., regenerative air and vacuum filter street sweepers).
- By sharing staff and equipment, Highway Agencies may benefit by saving money and resources.
- Parking should be regulated on predominately commercial streets to facilitate sweeper access.

Storm Drain Inlet Retrofitting

WHAT IS REQUIRED?

Minimum Standard

Retrofitting of existing storm drain inlets to meet the standard contained in Attachment C of the permit is required where such inlets are in direct contact with repaving, repairing (excluding repair of individual potholes), reconstruction or alterations of facilities owned or operated by the Highway Agency. For exemptions to this standard, refer to "Exemptions" in Attachment C.

Measurable Goal

Highway Agencies shall certify annually that such storm drain inlets have been retrofitted to meet the minimum standard contained in Attachment C, unless otherwise exempted.

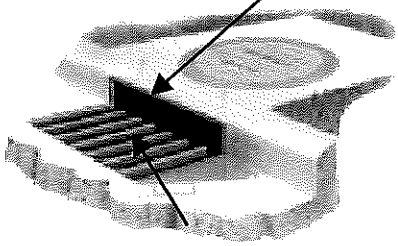
Implementation Schedule

Within 12 months of effective date of permit authorization and thereafter, Highway Agencies shall retrofit all such storm drain inlets in accordance with the Storm Drain Inlets minimum standard.

WHAT DOES THIS MEAN?

Any time your Highway Agency does any repaving, repairing, reconstruction or alterations of facilities owned or operated by the Highway Agency, storm drain inlets in direct contact with the repaving, repairing, reconstruction or alterations must be retrofitted or replaced to meet the standard contained in Attachment C of the permit. Facilities include all roads, parking lots, and any other areas that the Highway Agency owns or operates that have storm drain inlets. Repairing does not include the filling of individual potholes.

There are separate design standards for grates in pavement or other ground surfaces, and for curb-opening inlets. Each standard is described below. These standards help prevent certain solids and floatables (e.g., cans, plastic bottles, wrappers, and other litter) from reaching the surface waters of the State.



It is important to note that Attachment C of the permit also contains a number of exemptions to the storm drain inlet retrofitting requirement. The exemptions include:

- grandfathering of projects that began construction or were awarded bid prior to March 3, 2004;
- hydraulic performance exemption when the Highway Agency determines that the standard would cause inadequate hydraulic performance (flooding);
- historic places exemption for situations where action to meet this standard constitutes an encroachment or will damage or destroy a New Jersey Register listed historic property;
- alternative device exemption where flows are already conveyed through a device that meets certain standards to prevent the delivery of solids and floatable materials;
- an exemption for **existing** curb-opening inlets if each individual clear space in the curb opening is no larger than 9 square inches.

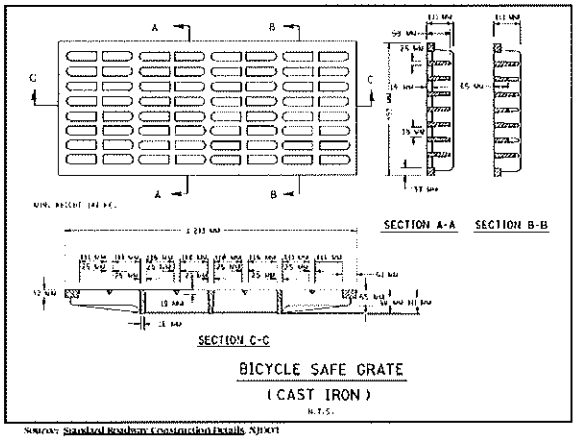
Attachment C of the permit and guidance provided below should be consulted for the actual standard for grates and curb-opening inlets and specific exemption language.

Grates In Pavement or Other Ground Surfaces

The standard applies to grates that are used in pavement or another ground surface to collect stormwater into a storm drain or surface water body under the grate.

Examples of storm drain inlet grates subject to this standard include grates in grate inlets, the grate portion (non-curb-opening portion) of combination inlets, grates on storm sewer manholes, ditch grates, trench grates, and grates of spacer bars in slotted drains. Examples of ground surfaces include surfaces of roads (including bridges), driveways, parking areas, bikeways, plazas, sidewalks, lawns, fields, open channels, and stormwater basin floors.

NJDOT "Bicycle Safe" Grate



Many grate designs meet the standard. The first option (especially for storm drain inlets along roads) is to use the New Jersey Department of Transportation (NJDOT) bicycle safe grate. This grate is described in Chapter 2.4 of the NJDOT Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines, which is available at: http://www.state.nj.us/transportation/publicat/bike_guidelines.htm.

The other option is to use a different grate, as long as each "clear space" in the grate (each individual opening) is:

- No bigger than seven (7.0) square inches; **or**
- No bigger than 0.5 inches (½ inch) across the smallest dimension (length or width).

Curb-Opening Inlets (including Curb-Opening Inlets in Combination Inlets)

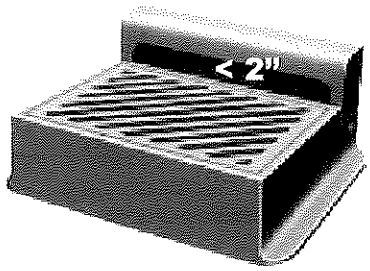
If the storm drain inlet has a curb opening, the clear space(s) in that curb opening(s) (or each individual clear space, if the curb opening has two or more clear spaces) must be:

- No bigger than two (2.0) inches across the smallest dimension (length or width) - many curb-opening inlets installed in recent years meet this criterion;

  or

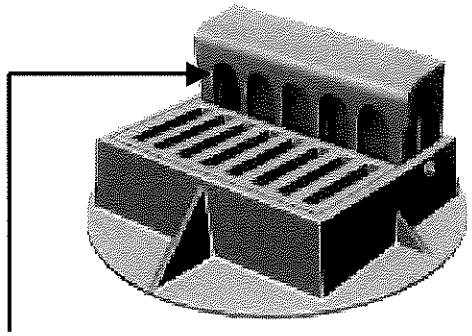
- No bigger than seven (7.0) square inches

Option 1 (Example)



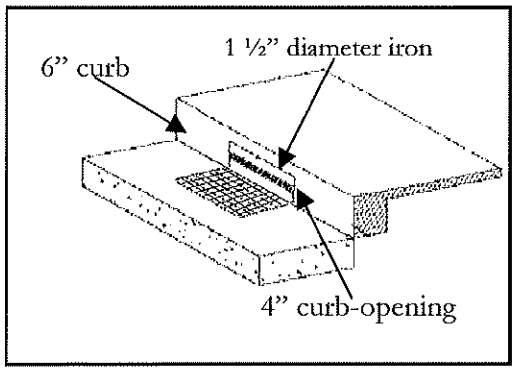
A curb-opening with a "clear space" no bigger than 2" across the smallest dimension

Option 2 (Example)



Each individual hole ("clear space") in the curb-opening is no bigger than 7 square inches

Retrofitting Discussion



After retrofit w/ 1 ½" diameter rod, each clear space of the curb-opening is 1 ¼" across the smallest dimension.

Highway Agencies which are undertaking a repaving, repairing, reconstruction or alteration project that will require the retrofitting of storm drain inlets pursuant to this section of the permit, have 2 choices: a) replace the hood piece, or b) retrofit the curb-opening inlet to meet the new design standard. (In most situations the grate will need to be replaced since there is no practical way to retrofit a grate to meet the standard.) Replacing the gutter inlet or hood piece may be the easiest solution. The Department has worked with a number of foundries to ensure a style is manufactured that meets the new design standard. A lower cost option would be to retrofit the curb-opening inlet by dividing the existing opening into 2 or more smaller openings (each no bigger than two (2.0) inches across the smallest dimension) with a bar, rod, or flat iron. This bar or flat iron needs to be permanently affixed to the casting by attaching to the existing bolt pattern on the hood piece or by some other

method. This retrofitting technique has successfully been done, and can be seen, in many NJ locations. Replacing the grate with a grate that extends to the back of the curb opening is another option.

Exemptions

For purposes of this SBR, the requirements of this standard do not apply whenever any of the following exemptions listed in Attachment C are applicable:

- A **"Hydraulic Performance Exemption"** where the Highway Agency or other review agency determines that this standard would cause inadequate hydraulic performance.
- Either of two **"Alternative Device Exemptions"**:
  - The first of these exemptions is where flows from the "water quality design storm" as specified in N.J.A.C. 7:8 are conveyed through any device or combination of devices (e.g., end of pipe netting facility, manufactured treatment device, or a catch basin hood) that is designed, at a minimum, to prevent the passage of all solid and floatable materials that could not fit through one of the following:
    1. A rectangular space that is four and five-eighths ($4^5/_8$) inches long and one and one-half (1½) inches wide (this option does not apply for outfall netting facilities); or
    2. A bar screen that has a ½ inch (0.5 inches) opening between each bar.
  - The second of these exemptions is where flows are conveyed through a trash rack that has parallel bars with one-inch (1.0 inch) spacing between the bars, to the elevation of the "water quality design storm" as specified in N.J.A.C. 7:8.

    One of the requirements in the new Stormwater Management Rules at N.J.A.C. 7:8-5.7(a)2 is that "trash racks shall be installed at the intake to the outlet structure as appropriate, and shall have parallel bars with one-inch spacing between the bars to the elevation of the water quality design storm" [emphasis added].

    In the new Stormwater Management Rules, the "water quality design storm" is specified at N.J.A.C. 7:8-5.5(a).
- A **"Historic Places Exemption"** where the Department determines, pursuant to the New Jersey Register of Historic Places Rules at N.J.A.C. 7:4-7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.

WANT TO KNOW MORE?

Several studies have been conducted to determine what materials are most often discharged to storm sewers. Some of the most commonly found materials were polystyrene pieces, pieces of paper, candy and food wrappers, plastic bag fragments, and metal foil, with the biggest offender being plastic products. The useful qualities of plastic (it is cheap and plentiful) make it a tremendous pollution problem. Plastic needs ultraviolet light to decompose, taking hundreds of years to decay. In the meantime plastic continues to accumulate in our waterways, causing the deaths of many mammals, fish, birds and reptiles each year.

Every piece of solid or floatable material that is caught before it enters or leaves a storm drainage system will benefit the environment. Minimizing the size of spaces in storm drain inlet grates and curb openings will trap certain solid and floatable materials before they reach our waterways. However, these spaces must also be large enough to provide adequate hydraulic performance.

Recommendations

The following recommendations may be beneficial but are not required by the permit.

- Retrofit existing storm drain inlets to meet the standard contained in Attachment C earlier than required by the permit (rather than waiting until repaving or other projects).
- Increase street sweeping (above the minimum standard) to reduce clogging of storm drain inlets.
- Use additional devices to remove solid and floatable materials including trash racks, mesh nets, bar screens and trash booms.

Stormwater Facility Maintenance

WHAT IS REQUIRED?

Minimum Standard



As sweeping increases and storm drain inlets are retrofitted, amounts of material removed during catch basin cleaning should decrease.

Highway Agencies shall develop and implement a stormwater facility maintenance program for cleaning and maintenance of all stormwater facilities operated by the Highway Agency. Stormwater facilities include, but are not limited to: catch basins, detention basins, filter strips, riparian buffers, infiltration trenches, sand filters, constructed wetlands, wet ponds, bioretention systems, low flow bypasses, and stormwater conveyances. The stormwater facility maintenance must be performed as required to ensure the proper function and operation of the stormwater facility. Highway Agencies shall also clean all catch basins operated by the Highway Agency annually to remove accumulated sediment, trash and debris. If the Highway Agency is unable to clean all catch basins annually, the Highway Agency must provide, as part of their SPPP, a justification and detailed schedule for less frequent cleaning.

Measurable Goal

Highway Agencies shall certify annually that all stormwater facilities are properly functioning and that all catch basins have been cleaned in accordance with the minimum standard. If stormwater facilities were found not to be functioning properly and repairs were not made, a schedule for such repairs shall be included in the annual report and certification. Highway Agencies shall also maintain records of inspections, maintenance and repairs that were performed which shall be reported in the annual report and certification.

Implementation Schedule

Within 12 months from the effective date of permit authorization, Highway Agencies shall have developed and begun implementing a stormwater facility maintenance program in accordance with

Educational Material

Solutions to Stormwater Pollution

Easy Things You Can Do Every Day To Protect Our Water

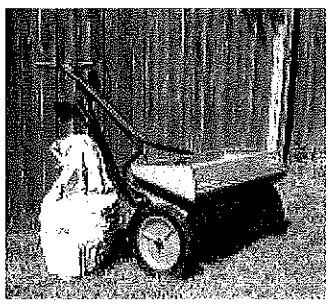
A Guide to Healthy Habits for Cleaner Water

Pollution on streets, parking lots and lawns is washed by rain into storm drains, then directly to our drinking water supplies and the ocean and lakes our children play in. Fertilizer, oil, pesticides, detergents, pet waste, grass clippings: You name it and it ends up in our water.

Stormwater pollution is one of New Jersey's greatest threats to clean and plentiful water, and that's why we're all doing something about it.

By sharing the responsibility and making small, easy changes in our daily lives, we can keep common pollutants out of stormwater. It all adds up to cleaner water, and it saves the high cost of cleaning up once it's dirty.

As part of New Jersey's initiative to keep our water clean and plentiful and to meet federal requirements, many municipalities and other public agencies including colleges and military bases must adopt ordinances or other rules prohibiting various activities that contribute to stormwater pollution. Breaking these rules can result in fines or other penalties.



As a resident, business, or other member of the New Jersey community, it is important to know these easy things you can do every day to protect our water.



Limit your use of fertilizers and pesticides

- Do a soil test to see if you need a fertilizer.
- Do not apply fertilizers if heavy rain is predicted.
- Look into alternatives for pesticides.
- Maintain a small lawn and keep the rest of your property or yard in a natural state with trees and other native vegetation that requires little or no fertilizer.
- If you use fertilizers and pesticides, follow the instructions on the label on how to correctly apply it. Make sure you properly store or discard any unused portions.

Properly use and dispose of hazardous products

- Hazardous products include some household or commercial cleaning products, lawn and garden care products, motor oil, antifreeze, and paints.
- Do not pour any hazardous products down a storm drain because storm drains are usually connected to local waterbodies and the water is not treated.

- If you have hazardous products in your home or workplace, make sure you store or dispose of them properly. Read the label for guidance.
- Use natural or less toxic alternatives when possible.
- Recycle used motor oil.
- Contact your municipality, county or facility management office for the locations of hazardous-waste disposal facilities.



Keep pollution out of storm drains

- Municipalities and many other public agencies are required to mark certain storm drain inlets with messages reminding people that storm drains are connected to local waterbodies.
- Do not let sewage or other wastes flow into a stormwater system.

Clean up after your pet

- Many municipalities and public agencies must enact and enforce local pet-waste rules.
- An example is requiring pet owners or their keepers to pick up and properly dispose of pet waste dropped on public or other people's property.
- Make sure you know your town's or agency's requirements and comply with them. It's the law. And remember to:
  - Use newspaper, bags or pooper-scoopers to pick up wastes.
  - Dispose of the wrapped pet waste in the trash or un-wrapped in a toilet.
  - Never discard pet waste in a storm drain.

Don't feed wildlife

- Do not feed wildlife, such as ducks and geese, in public areas.
- Many municipalities and other public agencies must enact and enforce a rule that prohibits wildlife feeding in these areas.



Don't litter

- Place litter in trash receptacles.
- Recycle. Recycle. Recycle.
- Participate in community cleanups.

Dispose of yard waste properly

- Keep leaves and grass out of storm drains.
- If your municipality or agency has yard waste collection rules, follow them.
- Use leaves and grass clippings as a resource for compost.
- Use a mulching mower that recycles grass clippings into the lawn.



Contact information

For more information on stormwater related topics, visit www.njstormwater.org or www.nonpointsource.org

Additional information is also available at U. S. Environmental Protection Agency Web sites www.epa.gov/npdes/stormwater or www.epa.gov/nps

New Jersey Department of Environmental Protection
Division of Water Quality
Bureau of Nonpoint Pollution Control
Municipal Stormwater Regulation Program
(609) 633-7021

April 2004

Pet Waste Pollutes Our Waters

What You Can Do To Help Protect Our Water

Clean and plentiful water is important to our families, our environment, our economy and our quality of life.

Did you know that animal waste from pets can pollute our waters? When left on the ground, pet waste is washed by rain and melting snow and ice into storm drains that carry it to our rivers, lakes, the ocean and drinking water.

Animal waste contains a high concentration of nutrients as well as bacteria and disease-causing microorganisms that can cause problems.

What you can do

Pet owners or anyone who takes your pet for walks must properly dispose of the waste by picking it up, wrapping it and either placing it in the trash or flushing it unwrapped down the toilet.

Your municipality is required to adopt and enforce local pet-waste laws. At a minimum, your community must require that pet owners or their keepers **immediately** and **properly** dispose of their pet's solid waste deposited on **any public or private property not owned or possessed by that person.** People with assistance animals such as Seeing Eye dogs are exempt.

Make sure you know what your municipality requires – and follow it.

Thank you for doing your part to keep New Jersey's waters clean.

For more information, please contact the following:

New Jersey Department of Environmental Protection
Division of Water Quality
Bureau of Nonpoint Pollution Control
Municipal Stormwater Regulation Program
(609) 633-7021

Visit www.njstormwater.org or www.nonpointsource.org

Additional information is also available at U. S. Environmental Protection Agency Web sites www.epa.gov/npdes/stormwater or www.epa.gov/nps



NJ Department of Environmental Protection
Division of Watershed Management
PO Box 418
Trenton, NJ 08625-0418
609-984-0058

WATER RESOURCE PROTECTION PRACTICES

State of New Jersey
Christine Todd Whitman, Governor
Department of Environmental Protection
Robert C. Shinn, Jr., Commissioner

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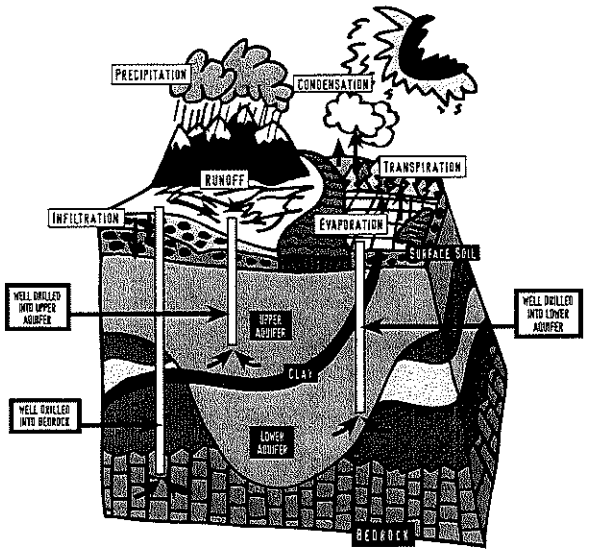
WHAT IS GROUND WATER?

Where does the water that rains on your home go? After it leaves your lawn, street or sidewalk, where is it headed? Does it wander into a wetlands? Does it puddle in your backyard? Does it zip down a sink hole? If it soaks into the ground, it becomes ground water.



A sizable amount of rainwater runoff seeps into the ground to become ground water. Ground water moves into water-filled layers of porous geologic formations called aquifers. If the aquifer is close to the surface, its ground water can flow into nearby waterways or wetlands, providing a base flow. Depending on your location, aquifers containing ground water can range from a few feet below the surface to several hundred feet underground. Aquifer recharge areas are locations where rainwater and other precipitation seeps into the earth's surface to enter an aquifer. Contrary to popular belief, aquifers are not flowing underground streams or lakes.

Ground water moves at an irregular pace, seeping from more porous soils, from shallow to deeper areas and from places where it enters the Earth's surface to where it is discharged or withdrawn. A system of more than 100 aquifers is scattered throughout New Jersey, covering 7,500 square miles.

WHY IS GROUND WATER IMPORTANT?

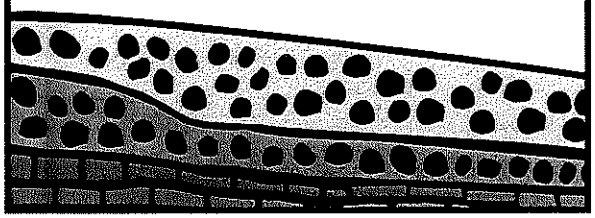
Ground water is the primary drinking water source for half of the state's population. Most of this water is obtained from individual domestic wells or public water supplies which tap into aquifers. New Jersey agriculture also depends on a steady supply of clean ground water for irrigation.

GROUND WATER COMPLICATIONS

Humans have an impact on ground water in a number of ways. One way people influence ground water is by changing where stormwater flows. By changing the contour of the land and adding impervious surfaces such as roads, parking lots and rooftops, people change how and where water goes. When it rains, the stormwater in a developed area is less able to soak into the ground because the land is now covered with roads, rooftops and parking lots. Less ground water will be recharged and more water will flow directly into streams and rivers.

Another way people affect ground water is by adding potential pollution sources. How the land above ground water is used by people, whether it is farms, houses or shopping centers, has a direct impact on ground water quality. As rain washes over a parking lot, it might pick up road salt and motor oil and carry these pollutants to a local aquifer. On a farm or suburban lawn, snow melt might soak fertilizers and pesticides into the ground.

When properly used, the amount of ground water pumped out for human purposes is less than what nature supplies to recharge the aquifer. If overused, more water is pumped out than is recharged. With less ground water in the aquifer, it becomes more difficult to use and more susceptible to pollution and salt water intrusion.

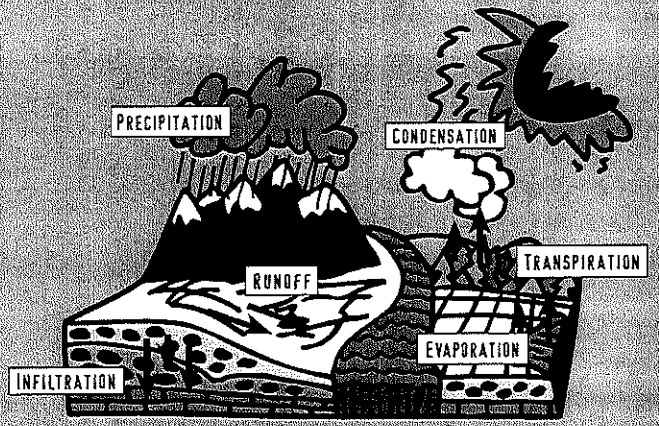


WATER CONSERVATION

Conserving water through efficient water use can help prevent pollution. Using less water reduces the runoff of agricultural pollutants pesticides and fertilizers. Diverting less water from waterways or aquifers leaves more water in streams or lakes, protecting existing ecosystems such as wetlands (which absorb certain types of pollution) and water supplies.

Water conservation can also save money by reducing pumping and treatment costs both before water reaches your home and after it leaves. Reduced water use may extend the life of existing sewage treatment facilities. It can also eliminate the need to develop a new water supply. New wells and reservoirs are expensive and time consuming to locate and build.

THE WATER CYCLE



For millions of years, water has been used. It is constantly being recycled and reused. It is important to understand how water moves through the Earth's water cycle, which is defined as the movement of water from the Earth's surface into the atmosphere and back to the Earth's surface again.

When it rains, the rainwater flows overland into waterways or is absorbed by the ground or plants. Water evaporates from land and water bodies, becoming water vapor in the atmosphere. Water is also released from trees and other plants through "transpiration." The water vapor from evaporation and transpiration forms clouds in the atmosphere which in turn provide precipitation (rain, hail, snow, sleet) to start the cycle over again. This process of water recycling, known as the water cycle, repeats itself continuously.

What is Nonpoint Source Pollution?

Nonpoint Source Pollution, or people pollution, is a contamination of our ground water, waterways, and ocean that results from everyday activities such as fertilizing the lawn, walking pets, changing motor oil and littering. With each rainfall, pollutants generated by these activities are washed into storm drains that flow into our waterways and ocean. They also can soak into the ground contaminating the ground water below.

Each one of us, whether we know it or not, contributes to nonpoint source pollution through our daily activities. As a result, nonpoint source pollution is the BIGGEST threat to many of our ponds, creeks, lakes, wells, streams, rivers and bays, our ground water and the ocean.

The collective impact of nonpoint source pollution threatens aquatic and marine life, recreational water activities, the fishing industry, tourism and our precious drinking water resources. Ultimately, the cost becomes the burden of every New Jersey resident.

But there's good news - in our everyday activities we can stop nonpoint source pollution and keep our environment clean. Simple changes in YOUR daily lifestyle can make a tremendous difference in the quality of New Jersey's water resources. Here are just a few ways you can reduce nonpoint source pollution.

LITTER: Place litter, including cigarette butts and fast food containers, in trash receptacles. Never throw litter in streets or down storm drains. Recycle as much as possible.

FERTILIZERS: Fertilizers contain nitrates and phosphates that, in abundance, cause blooms of algae that can lead to fish kills. Avoid the overuse of fertilizers and do not apply them before a heavy rainfall.

PESTICIDES: Many household products made to exterminate pests also are toxic to humans, animals, aquatic organisms and plants. Use alternatives whenever possible. If you do use a pesticide, follow the label directions carefully.

HOUSEHOLD HAZARDOUS PRODUCTS: Many common household products (paint thinners, moth balls, drain and oven cleaners, to name a few) contain toxic ingredients. When improperly used or discarded, these products are a threat to public health and the environment. Do not discard with the regular household trash. Use natural and less toxic alternatives whenever possible. Contact your County Solid Waste Management Office for information regarding household hazardous waste collection in your area.

MOTOR OIL: Used motor oil contains toxic chemicals that are harmful to animals, humans and fish. Do not dump used motor oil down storm drains or on the ground. Recycle all used motor oil by taking it to a local public or private recycling center.

CAR WASHING: Wash your car only when necessary. Consider using a commercial car wash that recycles its wash water. Like fertilizers, many car detergents contain phosphate. If you wash your car at home, use a non-phosphate detergent.

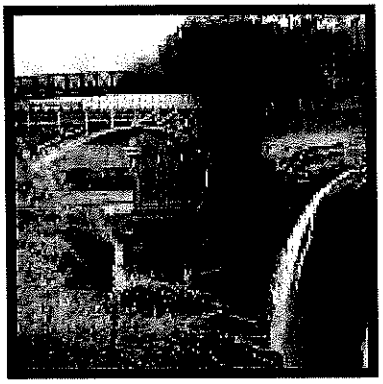
PET WASTE: Animal wastes contain bacteria and viruses that can contaminate shellfish and cause the closing of bathing beaches. Pet owners should use newspaper, bags or scoopers to pick up after pets and dispose of wastes in the garbage or toilet.

SEPTIC SYSTEMS: An improperly working septic system can contaminate ground water and create public health problems. Avoid adding unnecessary grease, household hazardous products and solids to your septic system. Inspect your tank annually and pump it out every three to five years depending on its use.

BOAT DISCHARGES: Dumping boat sewage overboard introduces bacteria and viruses into the water. Boat owners should always use marine sanitation devices and pump-out facilities at marinas.

As you can see, these suggestions are simple and easy to apply to your daily lifestyle. Making your commitment to change at least one habit can result in benefits that will be shared by all of us and add to the health and beauty of New Jersey's water resources.





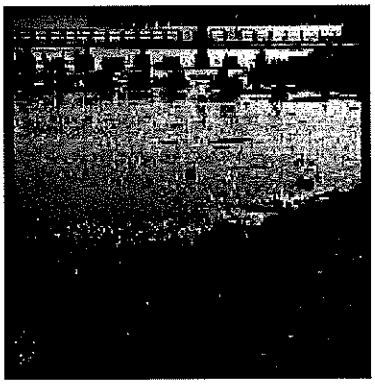
What's a watershed?

No matter where you are in New Jersey, you are in a watershed. Watersheds are everywhere ... from your front doorstep to the local park to the shopping mall to the creek down the road. Watersheds are the link between our land, our water and our communities because the quality of our water is linked to how we use the watershed surrounding it.

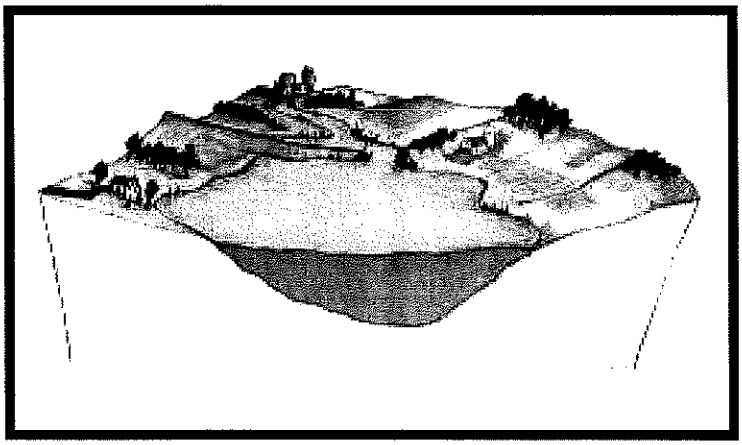
So what is a watershed?








What's a watershed?



A watershed is the area of land that drains into a body of water such as a river, lake, stream or bay. It is separated from other watersheds by high points in the area such as hills or slopes. It includes not only the waterway itself but also the entire land area that drains to it. For example, the watershed of a lake would include not only the streams entering that lake but also the land area that drains into those streams and eventually the lake. Drainage basins generally refer to large watersheds that encompass the watersheds of many smaller rivers and streams.

What's the water cycle?

For millions of years, water has been used. It is constantly being recycled and reused. It is important to understand how water moves through the Earth's water cycle, which is defined as the movement of water from the Earth's surface into the atmosphere and back to the Earth's surface again.

When it rains, the rainwater flows over land into waterways or is absorbed by the ground or plants. Water evaporates from land and water bodies becoming water vapor in the atmosphere. Water is also released from trees and other plants through "transpiration." The water vapor from evaporation and transpiration forms clouds in the atmosphere which in turn provide precipitation (rain, hail, snow, sleet) to start the cycle over again. This process of water recycling, known as the water cycle, repeats itself continuously.

What's your watershed address?

Where does the water that rains on your home go? After it leaves your lawn, street or sidewalk where is it headed? Does it flow downhill straight to a nearby stream or lake? Does it wander into a wetlands? Does it puddle in your backyard? Does it zip down a storm drain to a local creek?

That destination, whether it's a puddle, a pond, a bay or a lake, is your watershed address. It could be Duck Pond, Spring Lake, Millstone River, Barnegat Bay or Beaver Brook. Just like there are towns within counties within states, there are subwatersheds within watersheds within drainage basins. For example, the rain that falls on your driveway might flow into Lake Hopatcong, which flows into the Musconetcong River, which flows into the Delaware River. So your watershed address would be Lake Hopatcong, Musconetcong River, Delaware River even though your mail finds you through Jefferson Township, Morris County, New Jersey.

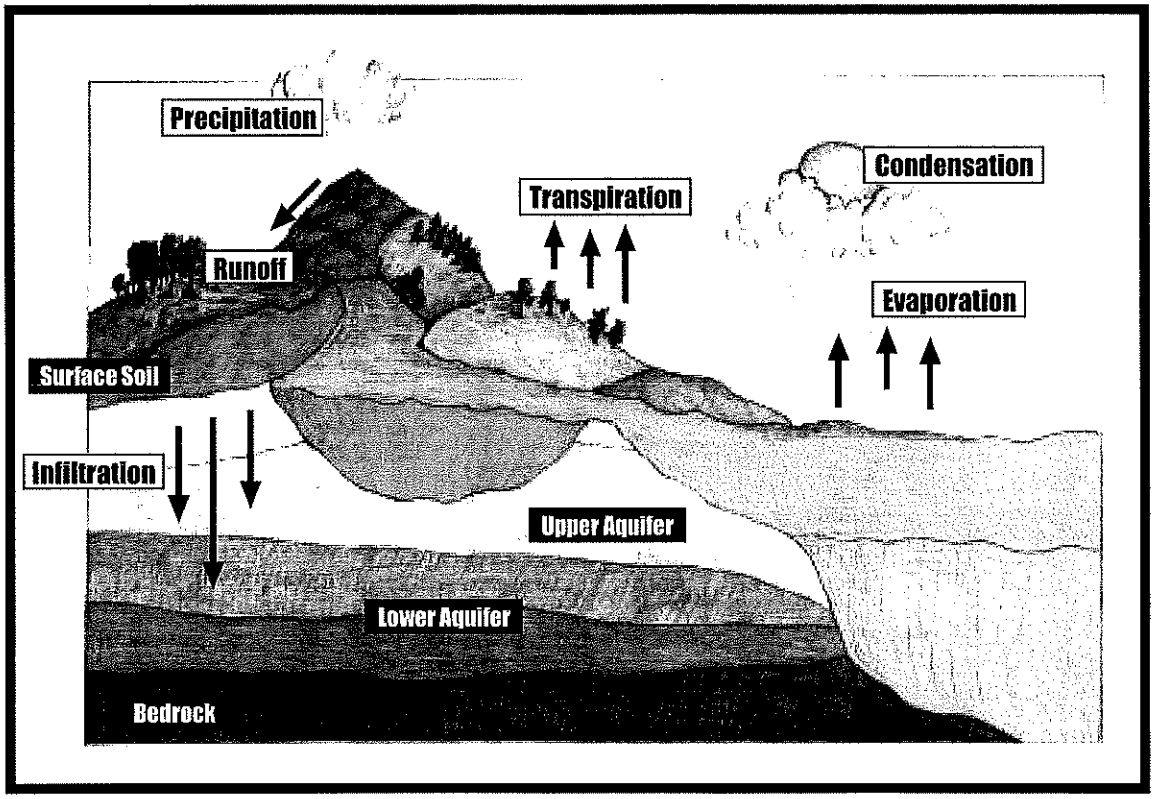


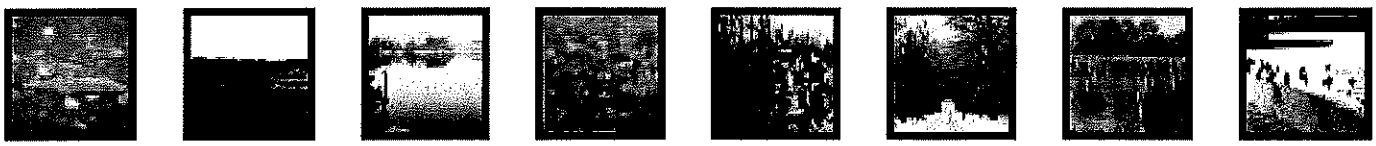
What's ground water?

A sizable amount of rainwater runoff seeps into the ground to become ground water. Ground water moves into water-filled layers of porous geological formations called aquifers. If the aquifer is close to the surface, its ground water can flow into nearby waterways or wetlands, providing a base flow. Depending on your location, aquifers containing ground water can range from a few feet below the surface to several hundred feet underground. Aquifer recharge areas are locations where rainwater and other precipitation seeps into the Earth's surface to enter an aquifer. Contrary to popular belief, aquifers are not flowing underground streams or lakes.

Ground water moves at an irregular pace, seeping from more porous soils, from shallow to deeper areas and from places where it enters the Earth's surface to where it is discharged or withdrawn. A system of more than 100 aquifers is scattered throughout New Jersey, covering 7,500 square miles.

Why is ground water important?
Ground water is the primary drinking water source for half of the state's population. Most of this water is obtained from individual domestic wells or public water supplies which tap into aquifers. New Jersey agriculture also depends on a steady supply of clean ground water for irrigation.





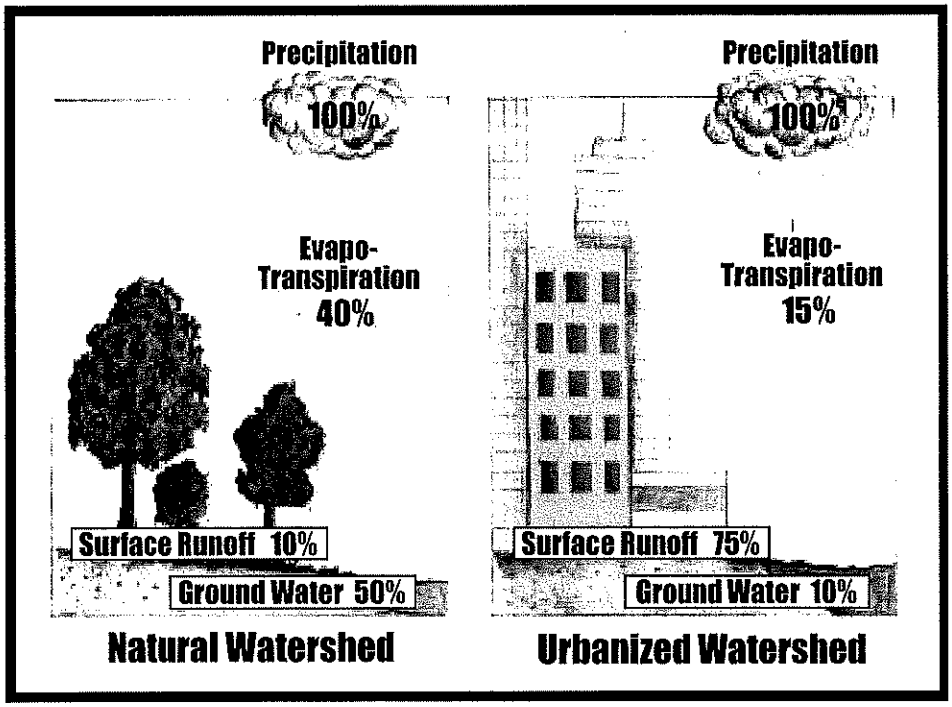
How does urbanization change a watershed?

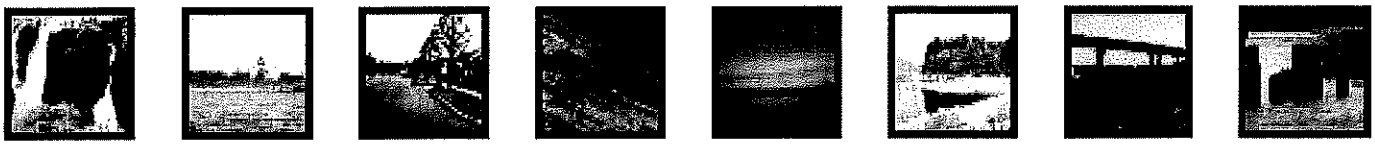
Urbanization (or development) has a great effect on local water resources. It changes how water flows in the watershed and what flows in the water. Both surface and ground water flow are changed.

As a watershed becomes developed, trees, shrubs and other plants are replaced with impervious surfaces (roads, rooftops, parking lots and other hard surfaces that do not allow stormwater to soak into the ground). Without the plants to store and slow the flow of stormwater, the rate of stormwater runoff is increased. Less stormwater soaks into the ground because the sidewalks, roads, parking lots and rooftops block this infiltration. This means a greater volume of water reaches the waterway faster and less water infiltrates to ground water. This in turn leads to more flooding after storms and reduced flow in streams and rivers during dry periods. The reduced amount of infiltrating water can lower ground water levels, which in turn can stress local waterways that depend on steadier flows of water.

In the stream, more erosion of stream banks and scouring of channels will occur due to volume increase. This in turn degrades habitat for plant and animal life that depend on clean water. Sediment from eroded stream banks clogs the gills of fish and blocks light needed for plants. The sediment settles to fill in stream channels, lakes and reservoirs. This also increases flooding and the need for dredging to clear streams or lakes for boating.

In addition to the high flows caused by urbanization, the increased runoff also contains increased contaminants. These include litter, cigarette butts and other debris from sidewalks and streets, motor oil poured into storm sewers, heavy metals from brake linings, settled air pollutants from car exhaust and pesticides and fertilizers from lawn care. These contaminants reach local waterways quickly after a storm.





What's watershed management?

The watershed management approach seeks to effectively protect our water resources by taking into account the entire watershed. Successful watershed management requires the participation and involvement of the entire community within the watershed boundaries, including industry, government, business and citizens. Since everyone may contribute to watershed problems, all should be involved in identifying both the problems and the solutions.

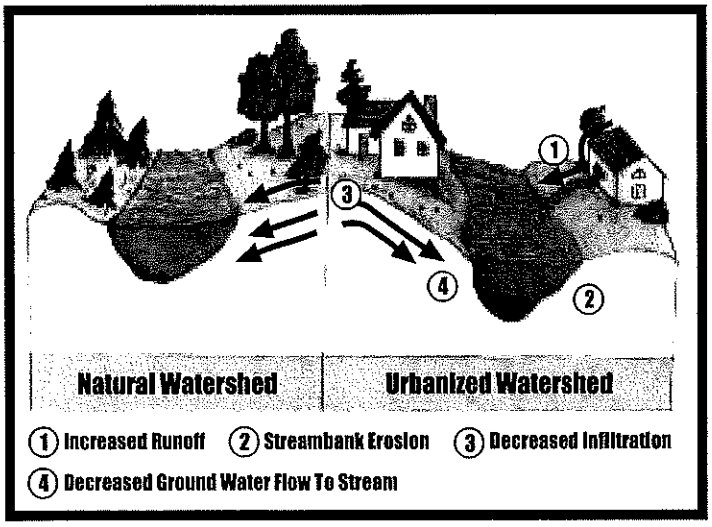
One of the first steps in watershed management is problem identification. Does the local lake choke with weeds in the summer? Are failing septic systems closing shellfish beds? Is increased runoff causing stream banks to erode?

Once the problems and their causes have been identified, practical solutions must be chosen. The watershed community must identify traditional or innovative solutions that will work in their area. These solutions can range from changes to municipal stormwater ordinances to homeowner education about lawn care to stream bank restoration projects.

Identifying which solutions are right for a particular watershed is a crucial component of the watershed management process. Different solutions work in different communities. Developed with the watershed community of industry, government, business and citizens, watershed management planning reflects the concerns and priorities of that community.

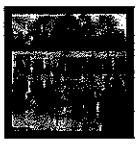
Once solutions have been identified, they must be implemented to be successful. This can be the most difficult part of the process. How can implementation be ensured? Who will carry out the plan? Is the community committed to implementing the plan? Are there resources available to do it?

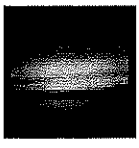
The advantage of watershed management planning is that it addresses all sources of pollution within the watershed and is developed by the community most affected by it. Nonpoint source pollution is particularly suited to this approach because it is frequently beyond the scope of traditional regulatory programs. The plan can incorporate solutions ranging from change in local land use to integrated pest management. Each plan will uniquely fit the problems and solutions of its watershed.









New Jersey's five watershed bureaus and 20 watershed management areas

Northwest Bureau
(609) 633-3812

1. Upper Delaware River
2. Walkill, Pochuck, Papakating
11. Central Delaware Tributaries

Northeast Bureau
(609) 633-1179

3. Pompton, Pequannock, Wanaque, Ramapo
4. Lower Passaic, Saddle
5. Hackensack, Pascack, Hudson
6. Upper and Mid-Passaic, Whippany, Rockaway

Raritan Bureau
(609) 633-7020

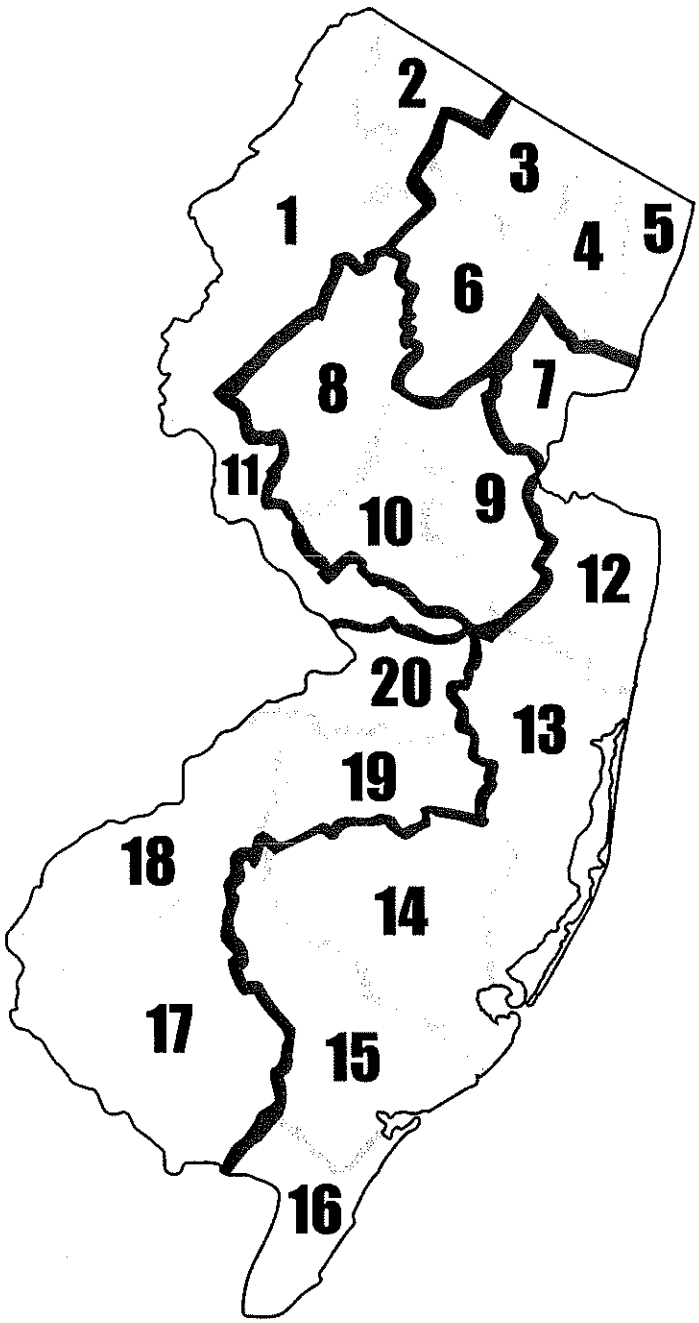
7. Elizabeth, Rahway, Woodbridge
8. North and South Branch Raritan
9. Lower Raritan, South River, Lawrence Brook
10. Millstone River

Atlantic Coastal Bureau
(609) 984-6888

12. Monmouth Watersheds
13. Barnegat Bay Watersheds
14. Mullica, Wading River
15. Great Egg Harbor, Tuckahoe
16. Cape May Watersheds

Lower Delaware Bureau
(609) 633-1441

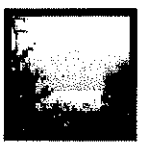
17. Maurice, Salem, Cohansey
18. Lower Delaware Tributaries
19. Rancocas Creek
20. Crosswicks Creek



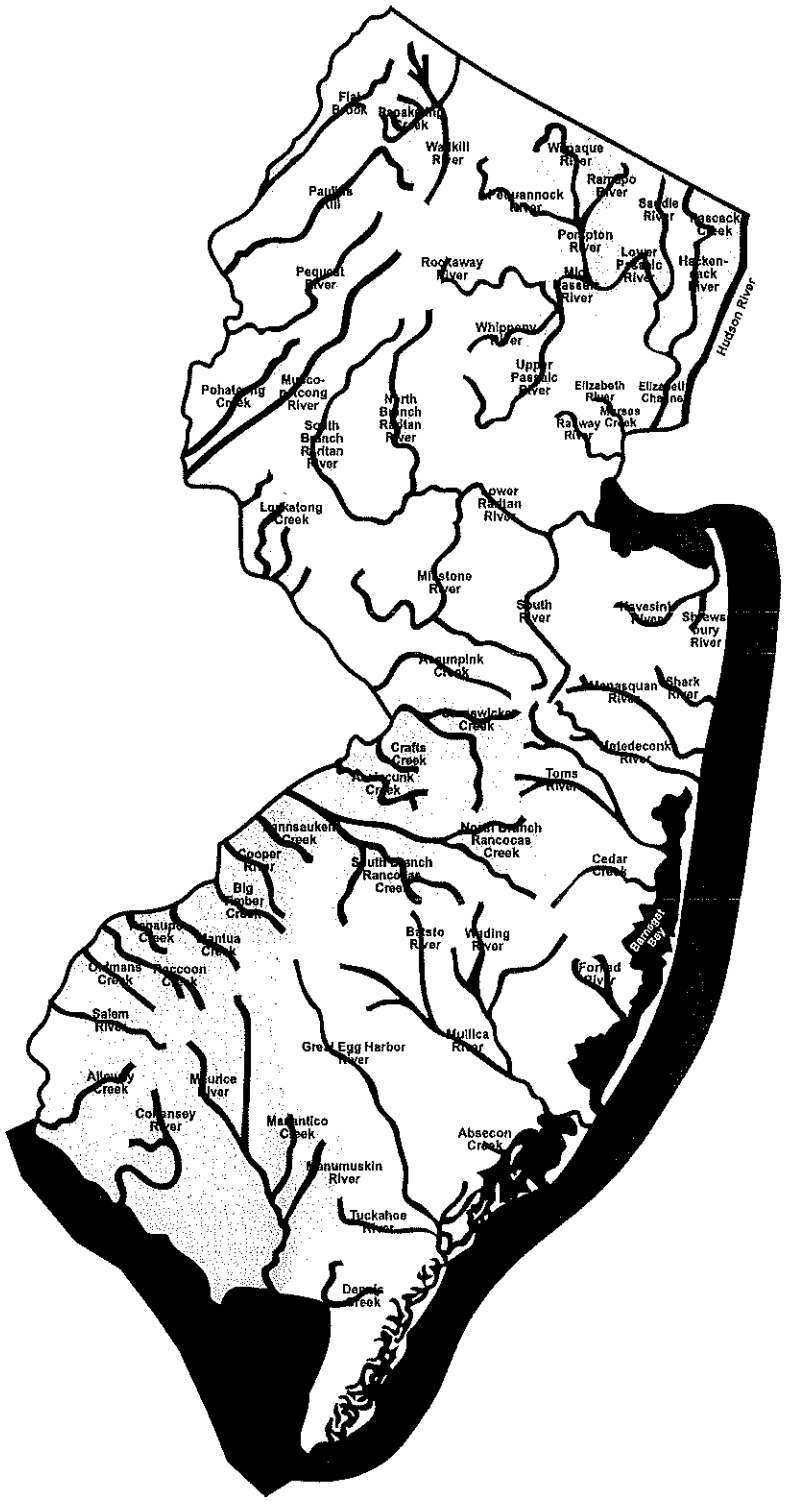






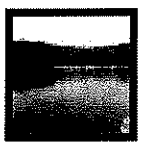
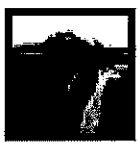



New Jersey's five watershed regions and major waterways



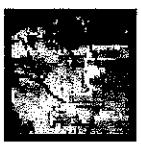
watershed regions

- ☐ Atlantic Coastal
- ☐ Lower Delaware
- ☐ Northeast
- ☐ Northwest
- ☐ Raritan







Watershed protection and nonpoint source pollution
what you can do today!

One way you can protect your watershed is to reduce nonpoint source pollution. Nonpoint source pollution or "people pollution" is contamination of our watersheds, ground water, waterways and ocean that results from everyday activities such as fertilizing the lawn, walking pets, changing motor oil and littering. With each rainfall, pollutants generated by these activities are washed from the entire watershed into local waterways. They can also soak into the ground contaminating the ground water below.

But there is good news - in our everyday activities we can stop nonpoint source pollution and keep our environment clean. Simple changes in your daily lifestyle can make a tremendous difference in the quality of New Jersey's water resources. Here are a few ways that you can reduce nonpoint source pollution:

Place litter in trash receptacles. Never throw litter, including cigarette butts and fast food containers, in streets or down storm drains. Recycle as much as possible.

Avoid the overuse of fertilizers. Do not apply them before a heavy rainfall. Do a soil test to see if fertilizers are necessary. Fertilizers contain nitrates and phosphates that, in abundance, cause blooms of algae that can lead to fish kills.

Use alternative to pesticides whenever possible. If you do use a pesticide, follow the label directions carefully. Many household products made to exterminate pests are also toxic to humans, animals, aquatic organisms and plants.

Pick up after your pet. Pet owners should use newspaper, bags or scoopers to pick up after their pets and dispose of wastes in the garbage or toilet, not the storm drain. Animal wastes contain bacteria and viruses that can contaminate shellfish and cause the closing of bathing beaches. Animal waste also contains nutrients that can cause algae blooms that are unsightly and can lead to fish kills.

Do not feed ducks and geese. Feeding ducks, geese and other waterfowl causes them to concentrate in small areas resulting in concentrated animal waste, causing the same problems as pet waste.

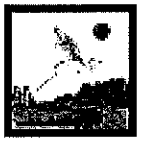
Dispose of household hazardous waste properly. Do not pour household hazardous products down any drain or toilet. Do not discard with the regular household trash. Use natural and less toxic alternatives whenever possible. Contact your County Solid Waste Management Office for information regarding household hazardous waste collection in your area. Many common household products (paint thinners, mothballs, drain and oven cleaners, to name a few) contain toxic ingredients. When improperly used or discarded, these products are a threat to public health and the environment.

Recycle all used motor oil. Do not dump used motor oil down storm drains or on the ground. Take it to a local public or private recycling center. Used motor oil contains toxic chemicals that are harmful to animals, humans and fish.

Wash your car only when necessary. Consider using a commercial car wash that recycles its wash water. Like fertilizers, many car detergents contain phosphate. If you wash your car at home, use a non-phosphate detergent.

Treat your septic system with respect. Avoid adding unnecessary grease, household hazardous products and solids to your septic system. Conserve water. Inspect your tank annually and pump it out every three to five years depending on its use. An improperly working septic system can contaminate ground water and create public health problems.

Use marine sanitation devices and pump-out facilities at marinas when boating. Observe the state's no discharge zones. Dumping boat sewage overboard introduces bacteria and viruses into the water.



For additional information please contact:
New Jersey Department of Environmental Protection · Watershed Management
P.O. Box 418 · 401 East State Street · Trenton · New Jersey · 08625-0418
609-292-2113 · www.state.nj.us/dep/watershedmgt

NJ Department of Environmental Protection
Division of Watershed Management
PO Box 418
Trenton, NJ 08625-0418
609-984-0058

WATER RESOURCE PROTECTION PRACTICES

State of New Jersey
Christine Todd Whitman, Governor
Department of Environmental Protection
Robert C. Shinn, Jr., Commissioner

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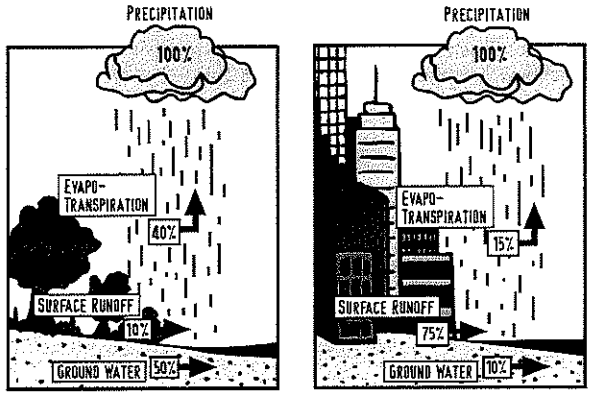
HOW DOES URBANIZATION CHANGE A WATERSHED?

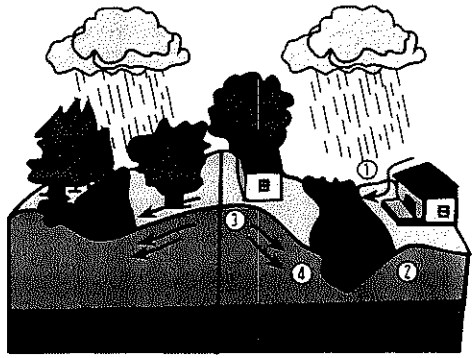
Urbanization (or development) has a great effect on local water resources. It changes how water flows in the watershed and what flows in the water. Both surface and ground water flow are changed.

As a watershed becomes developed, trees, shrubs and other plants are replaced with impervious surfaces (roads, rooftops, parking lots and other hard surfaces that do not allow stormwater to soak into the ground). Without the plants to store and slow the flow of stormwater, the rate of stormwater runoff is increased. Less stormwater is able to soak into the ground because sidewalks, roads, parking lots and rooftops block this infiltration. This means a greater volume of water reaches the waterway faster and less of that water is able to infiltrate to ground water. This in turn leads to more flooding after storms but reduced flow in streams and rivers during dry periods. The reduced amount of infiltrating water can lower ground water levels, which in turn can stress local waterways that depend on steadier flows of water.



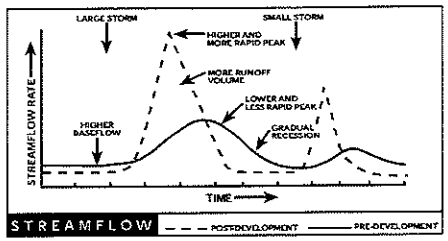
NATURAL WATERSHED URBANIZED WATERSHED

In the stream, more erosion of stream banks and scouring of channels will occur due to volume increase. This in turn degrades habitat for plant and animal life that depend on clear water. Sediment from eroded stream banks clogs the gills of fish and blocks light needed for plants. The sediment settles to fill in stream channels, lakes and reservoirs. This also increases flooding and the need for dredging to clear streams or lakes for boating.

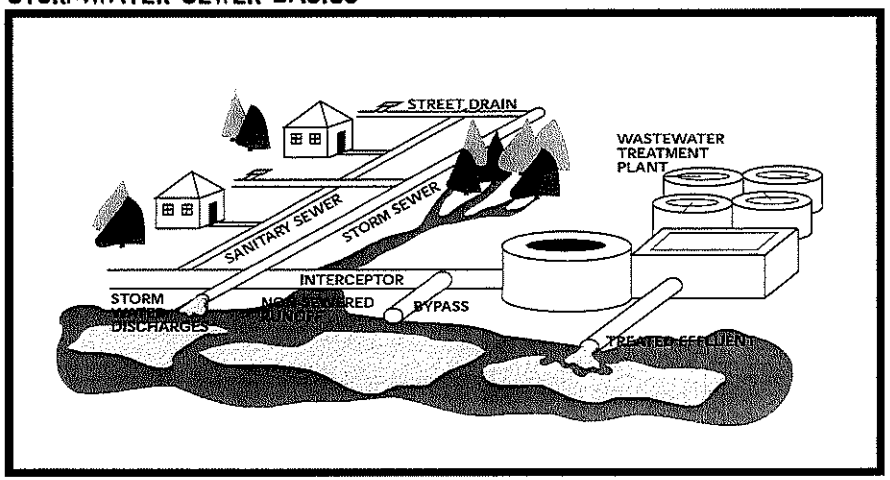


① INCREASED RUNOFF ② STREAMBANK EROSION ③ DECREASED INFILTRATION
④ DECREASED GROUND WATER FLOW TO STREAM

In addition to the high flows caused by urbanization, the increased runoff also contains increased contaminants. These include litter, cigarette butts and other debris from sidewalks and streets, motor oil poured into storm sewers, heavy metals from brake linings, settled air pollutants from car exhaust and pesticides and fertilizers from lawn care. These contaminants reach local waterways quickly after a storm.



STORMWATER SEWER BASICS



Stormwater flows into the stormwater system through a storm drain. These are frequently located along the curbs of parking lots and roadways. The grate that prevents larger objects from flowing into the storm sewer system is called a catch basin. Once below ground, the stormwater flows through pipes which lead to an outfall where the stormwater enters a stream, river or lake. In most areas of New Jersey, the stormwater sewer goes directly to local waterway without any treatment.

In some areas of the state, the outfall may lead to a stormwater management basin. These basins control the flow of stormwater and can also improve water quality, depending on how they are designed. These basins are frequently seen in newer commercial and residential areas.

In some older urban areas of the state, the stormwater and sanitary sewer systems may be combined. Here both stormwater and sewage from households and businesses travel together in the same pipes. Both stormwater and sewage are treated at sewage treatment plants except during heavy rains. During these occasions, both the stormwater and untreated sewage exceed the capacity of the treatment plant and this overflow is directed into local waterways.

PROTECTING STORMWATER SEWERS

In the first rush of water from a rainstorm, much of the debris and other pollutants that had settled on the land surface and in the stormwater sewer since the last storm will be picked up and carried into the local stream. This can significantly add to water quality problems. It is therefore important to protect the stormwater system from sources of pollution.

The following should never be dumped down storm drains, road gutters or catch basins: motor oil, pet waste, grass trimmings, leaves, debris and hazardous chemicals of any kind. Anything dumped in our stormwater collection systems will be carried into our streams.

CONTROLLING STORMWATER FLOW

Managing stormwater to reduce the impact of development on local watersheds and aquifers relies on minimizing the disruption in the natural flow – both quality and quantity of stormwater. By designing with nature, the impact of urbanization can be greatly reduced.

This can be accomplished by following these principles:

- minimizing impervious surfaces;
- maximizing natural areas or areas of dense vegetation;
- structural stormwater controls such as stormwater management basins; and
- practicing pollution prevention by avoiding contact between stormwater and pollutants.

YOU CAN MAKE A DIFFERENCE IN YOUR OWN BACKYARD

Managing stormwater in your own backyard is important. As an integral part of the watershed you live in, what you do in your backyard makes a difference. Here are some examples of what you can do at home:

1. Reduce impervious surfaces by using pavers or bricks rather than concrete for a driveway or sidewalk.
2. Divert rain from paved surfaces onto grass to permit gradual infiltration.
3. Landscape with the environment in mind. Choose the appropriate plants, shrubs and trees for the soil in your yard; don't select plants that need lots of watering (which increases surface runoff), fertilizers or pesticides.
4. Maintain your car properly so that motor oil, brake linings, exhaust and other fluids don't contribute to water pollution.
5. Keep stormwater clean. Never dump litter, motor oil, animal waste, or leaves into storm drains or catch basins.

Highway Project Checklist

Highway Agency Stormwater General Permit
Post-Construction Program
Design Checklist for Individual Projects

For each question, attach additional sheets as necessary

Highway Agency Information	
	Highway Agency:_____
	NJPDES # : NJG_____ PI ID #: _____
	Team Member: _____
	Date _____ Effective Date of Permit Authorization (EDPA):_____

1. Location of Project

a. Project Name _____

b. Highway Agency Project Number (if applicable): _____

c. Road Name(s) (if applicable): _____

d. Municipality(ies): _____

e. County(ies):_____

2. Description (type of project)

a. New alignment, widening, bridge replacement, intersection improvement, or other (describe): _____

b. Area of proposed disturbance: _____ acres (include disturbance for easements, on/off ramps, etc. that are part of the project)

c. Area of proposed additional impervious surface: _____ acres (include proposed additional impervious surface for easements, on/off ramps, etc. that are part of the project)

d. Discharges to (identify surface water body(ies)): _____

3. Related NJDEP Permits

How much (if any) of the project requires at least one NJDEP permit (stream encroachment permit; freshwater wetlands permit or transition area waiver; CAFRA, coastal wetlands, or waterfront development permit) granted under the following statutes?

	Application Number (if available)
Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.	_____
Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.	_____
Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq.	_____
Waterfront and Harbor Facilities Act, N.J.S.A. 12:5-3	_____

Answer (circle one): The entire project Part of the project None of the project

4. Compliance with NJDEP Design and Performance Standards (N.J.A.C. 7:8)

a. Nonstructural stormwater management strategies

To the maximum extent practicable, does the project meet the applicable erosion control, groundwater recharge, and stormwater runoff quantity and quality standards at N.J.A.C. 7:8-5.4 and 5.5 by incorporating nonstructural stormwater management strategies at N.J.A.C. 7:8-5.3 into the design? Y ( ) N ( )

Also see question #4.j in regard to the Low Impact Development Checklist.

b. Threatened and endangered species

ArH WH SrRjHFWs sWP wDWr ures designed to avoid adverse impacts of concentrated flow on habitat for threatened and endangered species as documented in the Natural Heritage Database established under N.J.S.A. 13:1B-15.147 through 15.150, particularly *Helonias bullata* (swamp pink) and/or *Clemmys muhlnebergi* (bog turtle)? Y ( ) N ( )

c. Exemption for certain utility line and public pedestrian access projects

How much (if any) of the project is exempt under N.J.A.C. 7:8-5.2(d) from the groundwater recharge and

circle whichever of the following are applicable:

The entire project Part of the project None of the project

Are you claiming, for the enlargement (widening) of an existing public roadway or railroad or the construction or enlargement of a public pedestrian access, a waiver under N.J.A.C. 7:8-5.2(e) from strict compliance with the groundwater recharge and stormwater runoff quantity and quality requirements at

- Circle whichever of the following are applicable:

Enlargement of existing public roadway or railroad Public pedestrian access

- Attach written documentation making the demonstration required under N.J.A.C. 7:8-5.2(e), unless "7h
  will sub
-

e. Erosion control

f. Groundwater recharge

g. Stormwater runoff quantity

h. Stormwater runoff quality

Are the project's stormwater management measures designed to prevent any increase in stormwater runoff to waters classified as FW1? Y ( ) N ( ) N/A ( ) (N/A if there is no stormwater runoff from the project to FW1 waters)

Does the project propose any encroachment within a special water resources protection area established under N.J.A.C. 7:8-5.5(h) to protect Category One waters? Y ( ) N ( ) Also see question 4.j.

If "yes," has the NJDEP approved the proposed encroachment? Y ( ) N ( ) Please explain if the NJDEP has not approved the proposed encroachment: _____

_____

_____

i. Other special circumstances

Are there special circumstances besides those noted above (e.g., alternative design and performance standards recognized under N.J.A.C. 7:8-5.1(b), and hardship waivers under N.J.A.C. 7:13-4.8) that result in one or more of the design and performance standards at N.J.A.C. 7:8-5 not being applicable to all or part of the project? Y ( ) N ( )

If "yes," describe the circumstances and identify the standard(s) that are not applicable: _____

_____

_____

_____

_____

j. Calculations and stormwater engineering report

Was stormwater runoff calculated in accordance with N.J.A.C. 7:8-5.6? Y ( ) N ( )

Attach a stormwater engineering report that includes the following information (unless the Exception below applies):

- A copy of Parts 1, 3, and 4 of the Low Impact Development Checklist (see Appendix A of the New Jersey Stormwater Best Management Practices Manual)
- A copy of a USGS topographical map(s), 7.5 minute quadrangle series, showing the project location and its HUC-14 watershed(s), and indicating any special water resources protection area(s) established under N.J.A.C. 7:8-5.5(h)
- Proof that the applicable groundwater recharge and stormwater runoff quantity and quality standards at N.J.A.C. 7:8-5.4 and 5.5 (or applicable alternative standards recognized under N.J.A.C. 7:8-5.1(b)) are met. This proof shall include complete printouts of all calculations (including detention, retention, and infiltration calculations for all basins), and shall compare existing and proposed recharge and discharge rates. The proof shall clearly explain how the attached calculations demonstrate compliance with the applicable standards. If the requirement at N.J.A.C. 7:8-5.5(a) for 80 percent TSS reduction is applicable, the proof shall detail how TSS reduction is achieved.

Exception: If "The entire project" is circled under question #3, have you submitted or will you submit the above information to the NJDEP to obtain the related NJDEP permit(s)? Y ( ) N ( )

If "yes," it is not necessary to attach a stormwater engineering report.

k. Structural stormwater management

Is the project designed to meet the applicable standards for structural stormwater management measures at N.J.A.C. 7:8-5.7? Y ( ) N ( )

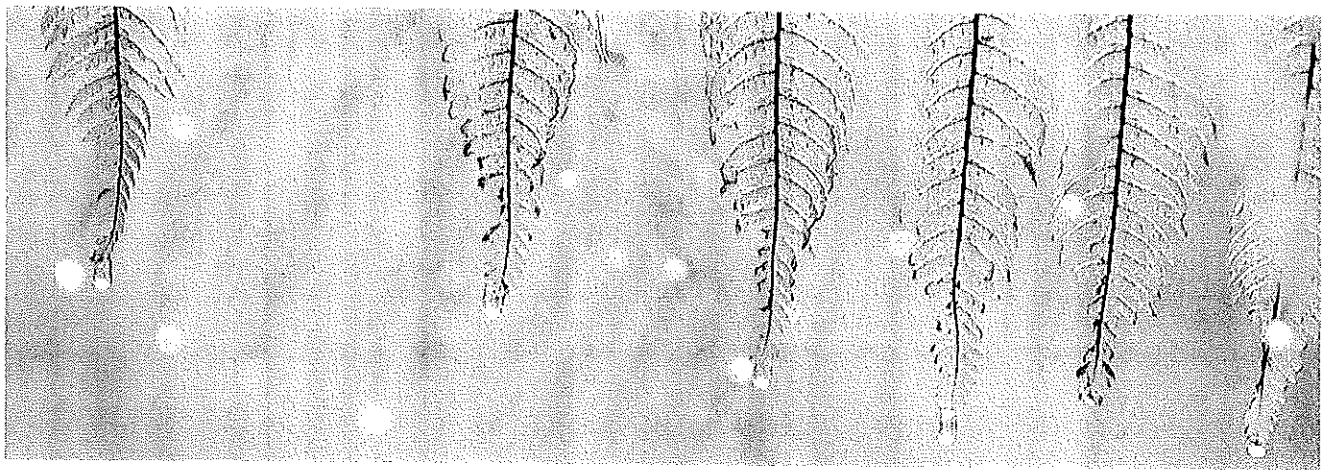
I. Maintenance

Has the design engineer prepared for the project the maintenance plan required by N.J.A.C. 7:8-5.8? Y ( ) N ( )

If "yHs," attach thH maintHhancH plan unlHss "7hHHhtirH

control passage of solid and floatable materials? Y ( ) N ( )

Attach a list of any storm drain inlets in the



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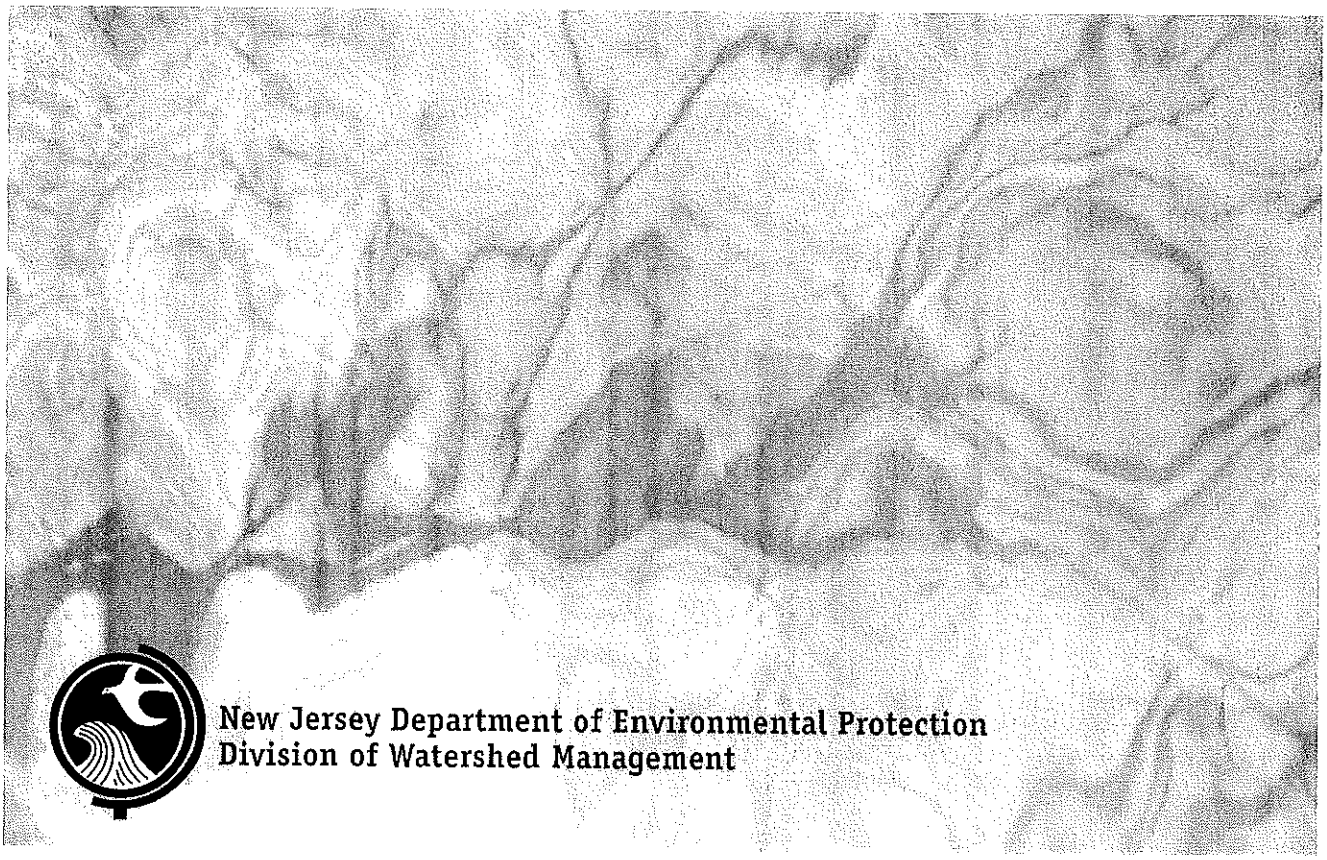

New Jersey Department of Environmental Protection
Division of Watershed Management

New Jersey Stormwater Best Management Practices Manual

April 2004

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Land Use Management

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In cooperation with

New Jersey Department of Agriculture
New Jersey Department of Community Affairs
New Jersey Department of Transportation



New Jersey Department of Environmental Protection

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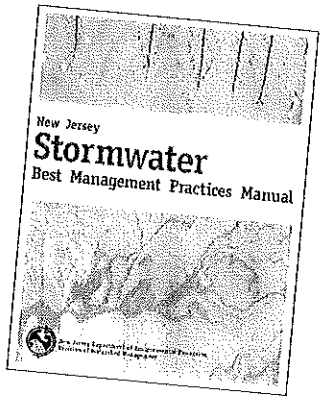
Updates and Future Versions of the Stormwater BMP Manual

Technical information regarding updates of the New Jersey Stormwater Best Management Practices Manual will be available at www.njstormwater.org
Future versions of the New Jersey Stormwater Best Management Practices Manual will reflect the technical updates found on the website.
Notices regarding future versions of the manual will be posted at this website.
Future versions of the manual are expected to occur at most once a year.

www.njstormwater.org



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Manual References

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New Jersey Stormwater Best Management Practices Manual

February 2004

CHAPTER 1

Impacts of Development on Runoff

This chapter describes the adverse impacts unmanaged land development can have on groundwater recharge and stormwater runoff quality and quantity both at and downstream of a development site. The chapter also reviews the fundamental physical, chemical, and biological aspects of the rainfall-runoff process and how they can be altered by development. In doing so, the chapter demonstrates the need for the NJDEP Stormwater Management Rules at N.J.A.C. 7:8, which have been developed to directly address these adverse impacts. In addition, the chapter seeks to increase understanding of these physical, chemical, and biological processes in order to improve the design of structural and non-structural measures mandated by the Rules' groundwater recharge, stormwater quality, and stormwater quantity requirements.

Runoff Quantity

Development can dramatically alter the hydrologic response of an area and, ultimately, an entire watershed. Prior to development, native vegetation can either directly intercept precipitation or evapotranspirate that portion that has infiltrated into the ground back into the atmosphere. Development can remove this beneficial vegetation and replace it with turf grass lawns and impervious roofs, driveways, parking lots, and roads, thereby reducing the site's pre-developed evapotranspiration and infiltration rates. In addition, clearing and grading can remove surface depressions that store rainfall. Construction activities may also compact the soil and diminish its infiltration rate, resulting in increased rates and volumes of stormwater runoff from the development site.

Impervious areas directly connected to gutters, channels, and storm sewers can transport runoff more quickly than natural, vegetated conveyances. This shortening of the transport or travel time quickens the rainfall-runoff response of the site, causing flow in downstream waterways to peak faster and higher than under natural or predeveloped site conditions. These increases can create new and aggravate existing downstream flooding and erosion problems and can increase the quantity of sediment and other pollutants in the waterways.

Filtration of runoff and removal of pollutants by natural surface and channel vegetation is eliminated by storm sewers that discharge runoff directly into waterways. Increases in impervious area can also decrease

opportunities for infiltration and reduce stream base flow and groundwater recharge. Reduced base flows and increased peak flows produce greater fluctuations between normal and storm flow rates, which can increase channel erosion and adversely impact aquatic organisms and habitats. Reduced base flows can negatively impact the hydrology of adjacent wetlands and the health of biological communities that depend on these base flows.

To address these impacts, planners, engineers, reviewers, and other participants in the design of stormwater management measures must rethink traditional approaches to both land development itself and the environmental problems it can cause. New approaches such as those described in this manual must be taken. For example, nonstructural stormwater management principles provide a prevent-minimize-mitigate approach that is preferred by the NJDEP Stormwater Management Rules. Under these Rules, nonstructural stormwater management techniques are a requirement for new land development projects. Nonstructural stormwater management measures, also known as Low Impact Development Best Management Practices (LID-BMPs), include reduction of impervious cover, maintenance of natural vegetation, and reduction of nutrient inputs. LID-BMP techniques can significantly reduce and even prevent the negative effects of land development on stormwater runoff described above. Nonstructural stormwater management practices are covered in detail in *Chapter 2: Low Impact Development Techniques.*

During heavy rainfall, many land developments increase the rate or volume of stormwater runoff, even those with well-designed LID techniques. Historically, this increased runoff was managed through state and/or local regulations that required peak runoff rates leaving a site after development to be equal to those that existed prior to development. It was believed that if the peak rate of runoff was maintained, the downstream waterways could assimilate the runoff in the same manner as before development. This control was accomplished using detention and retention basins that store and then gradually release the runoff.

However, this control methodology failed to account for the increased volume of runoff caused by land development. Watershed studies in New Jersey have demonstrated that this additional volume resulted in extended peak rates and increases in non-peak flows that increased flooding and erosion problems downstream. These same watershed studies determined that, by reducing peak post-development site runoff to rates less than pre-developed site conditions throughout the watershed, the volume of post-development runoff was redistributed and pre-development peaks were maintained or reduced throughout the watershed.

The Stormwater Management Rules incorporate these peak flow reduction requirements, which are similar to those previously published in the NJDEP Flood Hazard Area Control Act Rules and the New Jersey Department of Community Affairs (NJDCA) Residential Site Improvement Standards (RSIS).

Runoff Quality

In addition to increases in runoff volume, land development often results in the accumulation of pollutants on the land surface that runoff can mobilize and transport to streams. New impervious surfaces and cleared areas created by development can accumulate a variety of pollutants from the atmosphere, fertilizers, animal wastes, and leakage and wear from vehicles. Pollutants can include metals, suspended solids, hydrocarbons, pathogens, and nutrients. Common pollutants found in stormwater runoff are shown in Table 1-1.

In addition to increased pollutant loading, land development can adversely affect water quality and stream biota in more subtle ways. For example, stormwater falling on impervious surfaces or stored in detention or retention basins can become heated and raise the temperature of the downstream waterway, adversely affecting cold water fish species such as trout. Development can remove trees along streambanks that normally provide shading, stabilization, and leaf litter that falls into streams and becomes food for the aquatic community.

Table 1-1: Typical Stormwater Pollutants

Pollutant	Typical Concentration
Total suspended solids [a]	80 mg/l
Total phosphorus [b]	0.30 mg/l
Total nitrogen [a]	2.0 mg/l
Total organic carbon [d]	12.7 mg/l
Fecal coliform bacteria [c]	3600 MPN/100ml
E. Coli bacteria [c]	1450 MPN/100ml
Petroleum hydrocarbons [d]	3.5 mg/l
Cadmium [e]	2 ug/l
Copper [a]	10 ug/l
Lead [a]	18 ug/l
Zinc [e]	140 ug/l
Chlorides [f] (winter only)	230 mg/l
Insecticides [g]	0.1 to 2.0 ug/l
Herbicides [g]	to 5.0 ug/l

Notes

1. Data sources: [a] Schueler (1987), [b] Schueler (1995), [c] Schueler (1997), [d] Rabanal and Grizzard (1996), [e] USEPA (1983), [f] Oberts (1995), [g] Schueler (1996).
2. Concentrations represent mean or median storm concentrations measured at typical sites and may be greater during individual storms. Mean or median runoff concentrations from stormwater hotspots are higher than those shown.
3. Units: mg/l = milligrams/liter ug/l = micrograms/liter MPN = Most Probable Number

The following sections provide basic information on the most common pollutants associated with stormwater runoff from a broad range of land uses.

1. Solids/Floatables

Solids/floatables are primarily a surface water pollution concern. They are defined by the NJDEP as wastes or debris floating, suspended or otherwise contained in wastewater or waters of the state (N.J.A.C. 7:22A-1.4 et seq.). These materials include debris such as bottles, jars, cans, cardboard boxes, paper bags, newspapers, plastic containers and wrappings, condoms, hypodermic needles, leaves, and branches.

Solid/floatable materials are wastes that are inadvertently or purposefully disposed of either on land or directly into stormwater conveyances. Runoff transports this material to receiving waters where it can disperse, float, wash ashore onto beaches or embankments, or settle onto waterway bottoms. Solid/floatable material can create odors, aesthetic problems, and even toxic or corrosive gases that can emanate from bottom mud deposits.

2. Sediment

Sediment is one of the most significant pollutants created by development and transferred by its runoff. Sediments consist largely of soil materials eroded from uplands as a result of natural processes and human activities.

The greatest sediment loads are exported during the construction phase of land development. Adequate sediment and erosion control must be installed and maintained at the site to prevent the delivery of large quantities of sediment into downstream waterways and water bodies. Other pollutants such as nutrients and organic matter attached to the sediment can also be delivered. Requirements for appropriate erosion controls are available in the Standards for Soil Erosion and Sediment Control in New Jersey available from the State Soil Conservation Committee (SSCC) or local Soil Conservation Districts.

Sediment and other nonpoint source pollution from agricultural sources is also a major contributor to water quality problems in the state. Sediment from croplands clogs lakes, road ditches, canals, and culverts, particularly during and just after active tilling.

High concentrations of suspended sediment in streams and lakes cause many adverse consequences including increased turbidity, reduced light penetration, reduced prey capture for sight-feeding predators, clogged fish gills/filters, and reduced angling success. Additional impacts can result after sediment is deposited in slower moving waters. These include the smothering of benthic communities, alterations in the composition of the bottom substrate, and the rapid filling-in of small impoundments that create the need for costly dredging and reductions in the overall aesthetic value of the water resource. Sediment is also an efficient carrier of toxins and trace metals. Once deposited, pollutants in these enriched sediments can be remobilized under suitable environmental conditions and threaten benthic life.

3. Nutrients

Phosphorus and nitrogen are nutrients used by plants during photosynthesis. Phosphorus in natural waters occurs as phosphate in three classifications: orthophosphates (P04), polyphosphates (polymers of phosphoric acid), and organically bound phosphates. The most common forms of nitrogen are gaseous (N2), ammonia (NH3 or NH4), nitrite (NO2), nitrate (NO3), and nitrogen bound in organic compounds. Pollution from inorganic phosphorus (orthophosphates) and inorganic nitrogen (nitrates and ammonia) are of chief concern in New Jersey.

In general, undeveloped land produces relatively few nutrients; agricultural, residential, industrial, and commercial areas produce more nutrient loadings. In rural and residential areas, substantial amounts of nutrients originate from commercial fertilizers, manure from livestock feeding operations, or dairy farming. Fertilizer spread on lawns and farmland during the winter can contribute nutrients to runoff in the springtime. Pet wastes contribute nutrients to runoff in residential areas. Detergents and raw sanitary waste also contribute to nutrient loading.

The action of phosphates and nitrates can be quite different. Although both can be transported by groundwater, phosphorus often combines with fine soil particles and remains locked in the soil until it is either utilized by plant life or eroded away with the soil. In the latter case, the phosphorus will flow along with the soil particles as suspended sediment. Nitrates in the soil remain much more soluble. During the late winter and occasionally in midseason following exceptionally heavy rainfall, nitrates may pass below the root zone into the groundwater. This movement of nitrates into groundwater may cause a public health hazard because high nitrate concentrations in drinking water can cause infant methemoglobinemia (Blue Baby Syndrome).

Under normal conditions, phosphorus and nitrogen are not generally regarded as problem chemicals. However, in excessive amounts, phosphorus and nitrogen present a problem by over-stimulating plant growth within the aquatic environment. When excessive concentrations (especially phosphorus) pass into surface fresh waters, they can contribute to eutrophication in slower moving water bodies and to dense algal growths on substrates within flowing water systems.

The greatest risk of eutrophication is in small agricultural ponds, urban lakes, and impoundments that have retention times of two weeks or more. Under optimal growing conditions, these lake systems can experience chronic and severe eutrophic symptoms such as surface algal scums, water discoloration, strong odors, depressed oxygen levels (as the bloom decomposes), release of toxins, and reduced palatability of fishery resources. High nutrient levels also promote the growth of dense mats of green algae that attach to rocks and cobbles in shallow, unshaded headwater streams. This phenomenon is present in many residential areas with recreational water bodies bordered by extensive, improperly fertilized lawn.

Coastal waters and estuaries in New Jersey also suffer from increased incidences of phytoplankton blooms, e.g., Barnegat Bay has been the site of several algal bloom problems including brown tide. Concern exists that this problem is caused, in part, by inputs from nutrient-enriched fresh waters; however, the relationship between high nutrient levels and algal production is extremely complex and is not fully understood.

4. Pesticides

Pesticides, which include insecticides, herbicides, rodenticides, and fungicides, are among the few toxic substances deliberately introduced to the environment. These substances are used routinely for agricultural purposes and in residential and commercial property maintenance to biochemically affect specific unwanted organisms. However, these substances can produce unintended toxic effects on ecosystems and human life by contaminating soil, water, and air. Numerous acute and chronic effects on humans and other organisms are associated with pesticide exposure. Pesticides can enter an organism through inhalation, ingestion, or skin contact. They have caused decreases in aquatic populations either directly, through damage to the food chain by decreasing reproductive success, or indirectly, by reducing oxygen levels in the water through a reduction in the populations of higher plants and phytoplankton. Some pesticides, such as DDT, dieldrin, and chlordane, are no longer in use but persist in the food chain and in the human body. Other commonly used pesticides, such as malathion, are suspected carcinogens and are hazardous more through direct contact than indirect contact via the food chain.

Pesticides are carried in stormwater from application sites by becoming dissolved or suspended in runoff or by binding to particulate matter carried in runoff. These pesticides can contaminate surface or groundwater through infiltration devices or overflow. The fate and transport of pesticides are dependent on their physical and chemical properties and their chemical interactions with the environment. Processes that determine the path of pesticides in the environment are primarily photolysis (degradation in light), hydrolysis (degradation in the presence of water), and sorption reactions that are dependent on the chemical nature and solubility of the pesticide and the percentage of particulate and organic matter present in the sediment. Some pesticides, such as aldicarb, are highly soluble in water and are easily flushed into aquatic ecosystems or groundwater. Pesticides with low solubility may accumulate in sediments by adhering to particulate matter. Adsorption and absorption increase with the amount of organic matter present. These factors and the resistance to degradation of certain pesticides (expressed as the half-life) increase the persistence of these substances in the environment.

5. Metals

The permissible concentrations of metals in water are established directly by numerical criteria under the surface and groundwater quality standards and indirectly by standards under the Safe Drinking Water Act. Concentrations of metals found in water can have adverse effects upon public health as well as upon aquatic biota. Lead, arsenic, copper, cadmium, mercury, and some forms of chromium are all metals of concern.

Metals can occur naturally in soil or result from human activity. The quantities of metals leaching into water from natural sources are influenced largely by the water's pH. Acid rain and the low pH water often found in swamps may increase the solution of metals into water. Although mercury and copper have been shown to cause serious health problems, lead is of primary public health concern. It has a cumulative, toxic neurological effect and may be particularly harmful to children. One of the principal sources of lead in stormwater runoff has been the tetraethyl lead in gasoline, but pollution from this source is rapidly declining due to stringent federal controls over lead in gasoline.

6. Road Salt

Road salt, primarily composed of sodium chloride (common salt), has the potential to impair land vegetation, water quality, and aquatic ecosystems. This material is commonly used throughout the state as a low-cost substance for melting snow and ice. Road salt entering stormwater runoff generally originates from salt stockpiles or from salt application to roadways and other impervious surfaces. Precipitation falling on salted surfaces creates runoff containing dissolved salt. The increasing amount of urban and suburban development in New Jersey has resulted in increased roadways and other impervious surfaces such as parking lots, which has increased the use of road salt.

The primary problem with road salt is the contamination of ground and surface waters, which may render them unusable or require expensive treatment procedures. Increased sodium chloride concentrations in water create aesthetically displeasing drinking water and interfere with pristine manufacturing processes. High levels of sodium consumed in drinking water can elevate blood pressure and impair kidney function in susceptible individuals.

Because of salt's long residence time, salt water often tends to build up concentration in groundwater. Due to a seasonal effect, the highest levels of chloride ions appear in the summer months. This effect is attributed to the slow movement of groundwater (reacting to winter applications) and high summer evapotranspiration rates.

Excessive salt or saline input to fresh surface waters can cause significant use impairment. The input of highly concentrated saline water into fresh water lakes can retard springtime mixing. The density of the bottom layer of water increases, thereby overriding the normal thermal density gradients responsible for

vertical mixing. This saline buildup can decrease oxygen levels and cause high mortality among bottom-dwelling organisms. Increased salt loading to bays and estuaries can alter natural saline concentrations and disrupt shellfish reproduction and fish spawning. Surface water effects are dependent on the concentrations of sodium chloride entering the system, the amount of dilution, and the sensitivity of the aquatic ecosystem.

Aside from contaminating surface and groundwater, high levels of sodium chloride can kill roadside vegetation and corrode infrastructure such as bridges, roads, and stormwater management devices. In addition, some industrial operations can be impaired by an increase in the salinity of intake water.

7. Petroleum Hydrocarbons

Petroleum hydrocarbons in water are considered very harmful to natural biota. In addition, some constituents are carcinogenic and toxic to humans. No numerical criteria exist for petroleum hydrocarbons in ground or surface water quality standards. In both cases and in most waters, the basic criterion is "none noticeable."

Additional requirements for surface water prohibit hydrocarbons on aquatic substrata, along the shore in quantities detrimental to the natural biota, and where they would render waters unsuitable for their designated uses. The same standards are generally applicable to oil and grease, which, except for petroleum hydrocarbons, are not considered especially dangerous. Control efforts are mainly directed toward hydrocarbons.

Although the hydrocarbons harmful to water quality are mostly liquid at ambient temperatures, they are absorbed and adsorbed onto solid particles of sediment so rapidly that they are found mainly as particulates in runoff. Only considerable masses of oil will remain in liquid form in the larger storm drains. Petroleum hydrocarbons are also biodegradable in an aerobic environment, although at a relatively slow rate.

8. Pathogens

Pathogens (viral and bacterial) and non-pathogenic bacteria are found in the intestinal tracts of humans and other warm-blooded animals and are excreted with fecal wastes. A number of human diseases can be transmitted by runoff contaminated by fecal sources. Some well-documented bacterial agents include the *Salmonella* group responsible for typhoid fever, paratyphoid fever, and intestinal fever; the *Shigella* group causing bacillary dysentery; *Vibrio cholerae* responsible for cholera; and *Escherichia coli (E. coli)* causing gastroenteritis. In humans, gastroenteritis is the leading waterborne infectious disease in the United States. Deficient water treatment and groundwater contamination of wells are responsible for most of the outbreaks (65 percent) and cases (63 percent). The ingestion of shellfish harvested from contaminated waters can lead to disease as well.

Human fecal contamination is primarily a sewage treatment problem complicated by cross-connections or interconnections between sanitary and storm sewers, where combined sewer overflows degrade surface waters and where faulty, improperly sized, or improperly located septic systems contaminate groundwater. Animal fecal material from livestock operations, domestic pet populations, and concentrated wildlife populations contaminate surface waters via overland runoff and stormwater sewer discharges. Groundwater contamination occurs in areas with very permeable soils and/or high groundwater tables and where sinkholes, fractured rock, and well casings provide possible entry routes.

It is generally accepted that urban runoff will exceed desired bacterial limits. When considering stormwater contributions to the flow in a combined sewer system, the importance of stormwater control for bacterial water quality should be considered.

While not directly responsible for disease, fecal coliform bacteria have traditionally served as the microbiological indicators for the potential presence of waterborne pathogens. Enterococci appear to be a more accurate indicator than coliform bacteria, especially in saltwater where their resistance time and

survival rate is similar to that of pathogenic bacteria. Research is being conducted on the use of bacteriophages as viral indicators. Until regulations are revised, however, the state will continue to rely on traditional indicators (total and fecal coliforms) as well as enterococci.

Compared to other pollutants, bacteria and pathogens have relatively low residence times in the environment. Survival in surface waters varies with environmental factors such as temperature, light intensity, salinity, nutrient levels, bacteriophages and predation, absorption, sedimentation, and the presence of toxic substances.

Bacteria and viruses, when introduced to the subsurface environment, can undergo a natural die-off, be retained in the soil, or be transported to groundwater. Survival rates of both bacteria and viruses decrease with increasing temperature, decreasing soil moisture, and increasing competition with native soil microflora. Bacteria can be effectively retained in soils by the filtering action of fine particle soils with small pore size. The finer the soil grain, the greater its capability to filter out microorganisms. Adsorption, however, is the principal mechanism by which viruses are retained in the soil, and it can be a factor for retaining bacteria. Adsorption may be temporary; viruses may remain on the soil particle and be returned to subsurface flow during intense rainfall.

Groundwater is less likely to be contaminated by bacteria than surface waters. Bacteria and pathogens are generally filtered, adsorbed by soil, or dead before reaching the groundwater.

There is presently limited information that specifically addresses the survivability and transport of bacteria in stormwater runoff. The exact distances bacteria would be transported vary with soil properties, climate, and vegetation.

Parasites are an additional concern under this general category of pollutants. A number of infectious diseases are transmissible to humans via ordinary parasites. Common causes of these diseases are dog and cat parasites such as roundworms and hookworms shed in animal feces. The intimate relationships that household pets have with people, combined with the large pet population, greatly increase the potential for transmission of pathogens. This also appears to be true for bacteria and viruses, many of which have long survival times when infected pet waste is washed into receiving waters via stormwater.

Two relatively common protozoa that cause intestinal disorders in humans are also of great concern. The first is *Cryptosporidium Spp.*, which often causes diarrhea and may be accompanied by fever, abdominal pain, nausea, constipation, and/or weight loss. Most infections occur after contact with infected people. The other is *Giardia Spp.*, which causes many of the same symptoms as cryptosporidiosis. Its major reservoirs appear to be water and food contaminated by infected animals and people. A worrisome feature of these organisms is their resistance to environmental influences and disinfectants.

New Jersey Stormwater Best Management Practices Manual

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CHAPTER 2

Low Impact Development Techniques

As described in Chapter 1, land development can have severe adverse stormwater impacts, particularly if the land is converted from woods, meadow, or other natural condition to a highly disturbed area with large percentages of impervious and non-native vegetated covers. Such impacts typically include an increase in stormwater runoff volume, rate, velocity, and pollutants and a corresponding decrease in the quality of runoff and stream flow. Frequently, management of these impacts has focused on collecting and conveying the runoff from the entire site through a structural conveyance system to a centralized facility (e.g., detention basin, wet pond) where it is stored and treated prior to discharge downstream. In effect, such practices first allow the adverse runoff impacts to occur throughout the site and then provide remedial and/or restorative measures immediately prior to releasing the runoff downstream.

Since the 1960s, the range of remedial measures provided in centralized treatment facilities has increased from merely 100-year peak flow attenuation to the range of peak flow, volume, and nonpoint source pollutant controls required by New Jersey's current Stormwater Management Rules at N.J.A.C. 7:8. This has required modifications to established methods of runoff computation and the development of alternative treatment methods to be used in centralized facilities.

However, with the increasing emphasis on nonpoint source pollution and concerns over the environmental impacts of land development, it has become necessary to develop effective alternatives to the centralized conveyance and treatment strategy that has been the basis for much of the stormwater management systems and programs in the state. New strategies must be developed to minimize and even prevent adverse stormwater runoff impacts from occurring and then to provide necessary treatment closer to the origin of those impacts. Such strategies, known collectively as Low Impact Development or LID, seek to reduce and/or prevent adverse runoff impacts through sound site planning and both nonstructural and structural techniques that preserve or closely mimic the site's natural or pre-developed hydrologic response to precipitation. Rather than responding to the rainfall-runoff process like centralized structural facilities, low impact development techniques interact with the process, controlling stormwater runoff and pollutants closer to the source and providing site design measures that can significantly reduce the overall impact of land development on stormwater runoff. As such, low impact development promotes the concept of designing with nature.

Effective low impact development includes the use of both nonstructural and structural stormwater management measures that are a subset of a larger group of practices and facilities known as Best Management Practices or BMPs. As noted above, the BMPs utilized in low impact development, known as LID-BMPs, focus first on minimizing both the quantitative and qualitative changes to a site's pre-developed hydrology through nonstructural practices and then providing treatment as necessary through a network of structural facilities distributed throughout the site. In doing so, low impact development places an emphasis on nonstructural stormwater management measures, seeking to maximize their use prior to utilizing structural BMPs.

Nonstructural BMPs used in low impact development seek to reduce stormwater runoff impacts through sound site planning and design. Nonstructural LID-BMPs include such practices as minimizing site disturbance, preserving important site features, reducing and disconnecting impervious cover, flattening slopes, utilizing native vegetation, minimizing turf grass lawns, and maintaining natural drainage features and characteristics. Structural BMPs used to control and treat runoff are also considered LID-BMPs if they perform these functions close to the runoff's source. As such, they are typically smaller in size than standard structural BMPs. Structural LID-BMPs include various types of basins, filters, surfaces, and devices located on individual lots in a residential development or throughout a commercial, industrial, or institutional development site in areas not typically suited for larger, centralized structural facilities.

Finally, low impact development promotes the view of rainwater as a resource to be preserved and protected, not a nuisance to be eliminated. For example, with low impact development, roof runoff can be captured and stored in rain barrels for plant watering or other uses. Runoff can also be directed to small on-lot bioretention or infiltration basins, also known as rain gardens, to provide both runoff treatment and landscape enhancements.

Unfortunately, low impact development techniques and strategies are considered by some to be applicable only to land development sites with limited impervious cover. However, it has been clearly demonstrated that low impact development techniques can be applied to virtually any development site, regardless of impervious coverage, to produce enhanced site designs and "lower" stormwater impacts.

The use of nonstructural and structural LID-BMPs can be a significant improvement over the more centralized approach to stormwater management traditionally used in New Jersey. Even in those instances where centralized structural BMPs are still required to fully provide downstream areas with effective pollution, erosion, and flood protection, LID-BMPs can help to reduce the number and/or size of such facilities, further reducing site disturbance. And, in certain instances, it may be possible to satisfy all stormwater management requirements through the use of nonstructural LID-BMPs alone, thereby eliminating the need for any structural BMPs. In all instances, specific site and downstream conditions must be evaluated to determine the range of standard and low impact development BMPs that can be utilized at a land development site.

It is also important to note that, since low impact development typically relies on an array of nonstructural and relatively small structural BMPs distributed throughout a land development site, ownership and maintenance of the various BMPs may be similarly distributed over an array of property owners. As such, it is vital to have public understanding of and support for the various LID-BMPs officially authorized for use in a particular municipality. Such understanding and support must include an appreciation for the role that the LID-BMPs play in the site's or watershed's stormwater management program and a commitment to preserve and maintain them. Additional information regarding this issue is presented in the *Additional Considerations* section below.

The use of both nonstructural and structural BMPs in low impact development is governed by certain principles, objectives and requirements. A discussion of each of these factors is presented below, along with details of each type of LID-BMP. It should be noted that, while consideration of nonstructural stormwater management techniques at land development sites is required by the NJDEP Stormwater Management Rules at N.J.A.C. 7:8, the NJDEP believes that effective, state-wide use of such practices can be best achieved through municipal master plans and land development ordinances that mandate specific LID goals and authorize the use of specific LID-BMPs. For this reason, the Stormwater Management Rules require municipalities to review their master plans and ordinances in order to incorporate LID practices into their land development regulations to the maximum extent practicable. A detailed discussion of the NJDEP Stormwater Management Rules is presented below, along with guidelines on the development of municipal LID regulations and the selection of practical and reliable LID-BMPs.

Nonstructural Stormwater Management Strategies

As described above, effective low impact development includes the use of both nonstructural and structural stormwater management measures known as LID-BMPs. Of the two, nonstructural LID-BMPs play a particularly important role. The proposed NJDEP Stormwater Management Rules at N.J.A.C. 7:8 require in Section 5.2(a) that the design of any development that disturbs at least 1 acre of land or increases impervious surface by at least 1/4 acre must incorporate nonstructural stormwater management strategies "to the maximum extent practicable." Such a development is defined in the Rules as a "major development." As such, nonstructural LID-BMPs are to be given preference over structural BMPs. Where it is not possible to fully comply with the Stormwater Management Rules solely with nonstructural LID-BMPs, they should then be used in conjunction with LID and standard structural BMPs to meet the Rules' requirements.

More precisely, to achieve the Rules' design and performance standards, Subchapter 5 of the NJDEP Stormwater Management Rules requires the maximum practical use of the following nine nonstructural strategies at all major developments:

1. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss.
2. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces.
3. Maximize the protection of natural drainage features and vegetation.
4. Minimize the decrease in the pre-construction "time of concentration."
5. Minimize land disturbance including clearing and grading.
6. Minimize soil compaction.
7. Provide low maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers, and pesticides.
8. Provide vegetated open-channel conveyance systems discharge into and through stable vegetated areas.
9. Provide preventative source controls.

In addition, Subchapter 5 further requires an applicant seeking approval for a major development to specifically identify which and how these nine nonstructural strategies have been incorporated into the development's design. Finally, for each of those nonstructural strategies that were not able to be incorporated into the development's design due to engineering, environmental, or safety reasons, the applicant must provide a basis for this contention.

While the nonstructural stormwater management strategies listed above represent a wide range of both objectives and practices, Strategies 1 through 8 can be directly addressed through the use of specific nonstructural LID-BMPs that can be grouped into four general categories:

1. Vegetation and Landscaping;
2. Minimizing Site Disturbance;
3. Impervious Area Management; and
4. Time of Concentration Modifications.

Information on the specific nonstructural LID-BMPs included in each of these categories is presented below. A Nonstructural Stormwater Management Checklist is provided in Appendix A to assist applicants and reviewers in demonstrating that the Stormwater Management Rules' nine nonstructural stormwater management strategies have been utilized throughout the land development site to the maximum extent practicable.

Prior to utilizing any of the specific nonstructural LID-BMPs described below, applicants are urged to review the land development regulations of the municipality and/or agency from which they are seeking development approval. Despite low impact development being a relatively new aspect of stormwater management, many municipalities and agencies have already incorporated low impact development goals and strategies into their own regulations and, with the advent of the NJDEP Stormwater Management Rules, those that haven't will be required to do so. Therefore, additional nonstructural strategies and/or specific nonstructural LID-BMPs aside from those described in this chapter may have already been incorporated into a municipality's land development regulations or will be in the near future. In light of the site specific nature of LID-BMPs, these regulations may also discourage or prohibit the use of specific LID-BMPs for engineering, safety, or maintenance reasons. Consideration should also be given to having a pre-design meeting and/or site walk with pertinent regulators and technical reviewers to review local regulations and optimize the site's nonstructural stormwater management design.

Finally, engineers and site designers should recognize the importance of accurately computing existing or predeveloped runoff at a land development site. While this is an important computation at all development sites, it is particular important at those sites where nonstructural LID-BMPs will be utilized. This is because, to a large degree, these nonstructural measures will utilize and/or mimic the predeveloped site's rainfall-runoff response. As such, accurate computation of predeveloped hydrologic conditions is vital to successful LID-BMP use. It is recommended that engineers and site designers consult with regulatory entities, such as the State, municipality, or local soil conservation district, regarding predeveloped hydrologic conditions.

1. Vegetation and Landscaping

As a nonstructural LID technique, the management of existing and proposed vegetation at a land development site can significantly reduce the site's impact on downstream waterways and water bodies. As discussed in detail in Chapter 5, pervious vegetated areas reduce runoff volumes and peaks through infiltration, surface storage, and evapo-transpiration. Vegetated areas also provide a pervious surface for groundwater recharge, particularly during dormant or non-growing seasons. In addition, vegetation can remove pollutants from the runoff flowing through it through both filtration and biological uptake.

Information regarding three key nonstructural LID-BMPs that utilize vegetation and landscaping to manage stormwater runoff are presented below. A review of this information demonstrates how the features of all three are closely inter-related.

A. Preservation of Natural Areas

The preservation of existing natural vegetated areas is a nonstructural LID-BMP that must be considered throughout the design of a land development. This is especially true for areas with significant hydrologic functions such as forested areas, riparian corridors, and high groundwater or aquifer recharge capabilities. When applying for development approval from a regulatory agency or board, a plan showing natural vegetated areas on the pre-developed site, along with a narrative and photographs describing each area's vegetated and hydrologic characteristics, should be included in the application package. The narrative should also discuss the alternatives and choices made to preserve the natural vegetated areas.

In addition to identifying natural areas to be preserved at a development site, specific legal and/or procedural measures must be specified to ensure that such areas remain preserved in the future. This may include the establishment of easements or deed restrictions on specific portions of a parcel or lot that prohibit any disturbance or alteration. Other measures may not designate a particular portion of a parcel or lot but instead mandate through deed restrictions that an overall percentage of the parcel or lot must remain in natural, vegetated cover. This method allows greater flexibility but can be used only where the exact location of the preserved natural area is not critical to the success of the development's stormwater management system. In either case, the amount of natural area to be preserved must be the maximum amount feasible.

B. Native Ground Cover

Research has demonstrated that areas covered with turf grass typically generate more runoff than other types of vegetation. This is especially true when comparing grass areas with naturally wooded areas or forests. Therefore, in keeping with the goals of nonstructural LID-BMPs contained in the NJDEP Stormwater Management Rules, the amount of lawns and other grass areas at land development sites should be minimized. Instead, alternative vegetation, particularly native plants, should be used to revegetate disturbed site areas.

The use of native plants can provide a low-maintenance alternative to turf grass, resulting in lower fertilizer and water needs. The use of native ground cover, shrubs, and trees instead of turf grass can create infiltration characteristics similar to those of natural areas. These plants can also provide better habitat and create food sources for songbirds and small animals. Native landscaping can also be used to provide property screening, summer shade, and year-round landscaping interest.

In addition to revegetating site areas disturbed by construction, native plants can be used to improve or enhance the hydrologic characteristics of existing site areas. Such areas may include existing agricultural fields, developed areas, access roads, and other previously disturbed portions of the site as well as degraded natural areas. Naturally wooded areas or forests should also be restored or reestablished at land development sites wherever practical. This is also consistent with the goals of nonstructural LID-BMPs. In doing so, it is often necessary to provide stable interim vegetative cover in such restored areas.

In selecting native vegetation, consideration should be given to height, density, and other growth patterns, visual appearance, anticipated use of the planted area, and fertilizer, irrigation, and other maintenance needs. Additional information on native vegetation and landscaping is presented in Chapter 7.

C. Vegetative filters and Buffers

Both native ground cover and grass areas can provide a vegetated buffer to help filter stormwater runoff and provide locations for runoff from impervious areas to re-infiltrate. As described above, water flowing as sheet flow across a vegetated area is slowed, filtered and, depending on soil conditions, given the opportunity to re-infiltrate into the soil. Dense vegetative cover, long flow path lengths, and low surface slopes provide the most effective vegetated filters. Maximizing the use of such nonstructural LID-BMPs

helps demonstrate compliance with the nonstructural stormwater management requirements of the NJDEP Stormwater Management Rules.

Vegetative filters and buffers can be created by preserving existing vegetated areas over which runoff will flow or by planting new vegetation. Vegetative filters located immediately downstream of impervious surfaces such as roadways and parking lots can achieve pollutant removal, groundwater recharge, and runoff volume reduction. Vegetated buffers adjacent to streams, creeks, and other waterways and water bodies can also help mitigate thermal runoff impacts, provide wildlife habitat, and increase site aesthetics. Further information and detailed design procedures for vegetative filters are presented in Chapter 9.

2. Minimizing Land Disturbance

Minimizing land disturbance at a development site is a nonstructural LID-BMP that can be used during all phases of a land development project. Similar to the preservation of natural areas (see *1. Vegetation and Landscaping* above), minimizing land disturbance can help reduce post-development site runoff volumes and pollutant loads and maintain existing groundwater recharge rates and other hydrologic characteristics by preserving existing site areas. However, as a strategy, minimizing land disturbance can also be applied during a project's construction and post-construction phases.

Minimum disturbance begins during the project's planning and design phases by fitting the development into the terrain, as opposed to changing the terrain to fit the development. Also known as site fingerprinting, minimal disturbance techniques are first applied during the planning and design stages to evaluate existing site characteristics and constraints. The goal of this process is to limit clearing, grading, and other land disturbance necessary for buildings, houses, roadways, parking lots, and other proposed features and facilities. Roadway and building patterns that match the existing land forms and limit the amount of required clearing and grading should be chosen.

Site-specific conditions such as slope, soil type, drainage area, and other site conditions and constraints must be considered, including the identification of effective groundwater recharge and runoff storage areas. Wherever feasible, development should be concentrated on soils with low permeability rates to minimize the increase in runoff and to retain high permeability areas for groundwater recharge. The selection of the location of the development due to the soil type can have a significant impact on the resulting increases in runoff. Existing runoff storage areas should also be preserved to help retain the site's hydrologic character. Strict adherence to a minimum land disturbance strategy during a development's planning and design stages can also be an effective way to minimize soil compaction at those sites where there is a potential for it to occur.

In addition, the identification and evaluation of site constraints such as wetlands, Karst topography, and floodplains are critical to the effective implementation of LID designs. For example, additional analysis and provisions are applicable for development in Karst areas. It is interesting to note that the New Jersey Geological Survey's recommendations for Karst areas presented below are very similar to those for low impact development:

1. Do not concentrate flows.
2. Minimize grading.
3. Build within landscape (design around existing topography).
4. Do not alter natural drainage areas.
5. Minimize the amount of imperviousness.
6. Increased structural loads at the site can contribute to ground failures.
7. Changes to existing soil profile, including cuts, fills, and excavations, should be minimized.

Additional information on development in Karst areas can be found in Appendix A-10 of the New Jersey Department of Agriculture's Soil Erosion and Sediment Control Standards or from either the State Soil Conservation Committee (SSCC) at (609) 292-5540 or the New Jersey Geological Survey (NJGS) at (609) 292-2576. Information may also be available from the local Soil Conservation District or municipal engineer.

As noted above, land disturbance can also be minimized during a project's construction and post-construction stages. For example, during a development's construction phase, construction areas, access roads, and material and equipment storage areas can be minimized and strictly regulated. In addition, lighter-weight, rubber-tired construction equipment can be used whenever possible, with their movements limited to a few repetitive routes. Construction can also be phased to minimize the site area that will be disturbed at any given time. To help ensure compliance, such practices and requirements should be included in soil erosion and sediment control plans, construction plans, and contract documents.

Following construction, limits can be placed on the expansion of homes, buildings, driveways, parking, and other disturbed areas through deed restrictions, approving resolutions, owners' agreements, and zoning ordinances. Specific portions or percentages of a parcel or lot can be designated to remain undisturbed through deed restrictions or easements. As such, it can be seen that minimizing land disturbance should not only be one of the first nonstructural LID-BMPs applied to a land development's design, but it should also be continually reapplied throughout the life of the project.

It should also be noted that, in addition to the measures described above for minimizing soil compaction, measures can be taken to remediate a soil compaction problem. If compaction should be a problem, the Standards for Soil Erosion and Sediment Control in New Jersey recommends that, prior to topsoil and seed application, the surface of all compacted areas be scarified 6 to 12 inches.

3. Impervious Area Management

Impervious areas in a watershed have been cited in studies as an indicator of stream health. Increases in watershed imperviousness have been linked in these studies to degradation of water quality, especially in areas where the impervious surface is directly connected to a water body. Increases in impervious cover in a watershed can be directly correlated to increased runoff volumes and rates as well as waterway velocities, erosion, and flooding. Impervious areas can also accumulate nonpoint source pollutants that can significantly impact waterways when washed off by runoff.

Fortunately, comprehensive management of impervious areas at a land development site can help reduce the impervious area impacts described above. This section discusses the nonstructural LID-BMPs that can reduce the volume and peak rate of runoff from impervious surfaces by limiting their total area or disconnecting them from the site's stormwater conveyance system. Reductions in impervious area translate into more surface storage, infiltration and groundwater recharge, less stormwater runoff, and reduced storm sewer construction, maintenance, and repair costs. It is important to note that all reductions in the amount and dimensions of impervious surfaces at a land development site must also recognize safety and the level of use of the impervious surfaces.

A. Streets and Sidewalks

Street Widths: Street widths are typically based on traffic density, emergency vehicle movement, and the need for roadside parking. Street widths in residential areas are specified in Subchapter 4: Streets and Parking of the Residential Site Improvement Standards at N.J.A.C. 5:21 (RSIS). In such developments, efforts should be made to utilize the minimum pavement or cartway width consistent with the Standards. Similarly, in all other development types, the widths of all streets should be evaluated to demonstrate that the proposed width is the narrowest possible consistent with safety and traffic concerns and requirements.

Street Features: The design of certain streets or portions thereof may include features or areas that can be covered with pervious material, landscaped, and/or designed to receive runoff. For example, traffic calming measures such as circles, rotaries, medians, and islands can be vegetated or landscaped. Such features reduce the amount of impervious cover and provide an opportunity to store and possibly infiltrate runoff from adjacent impervious street surfaces. When curbs are necessary to maintain traffic safety and/or meet existing regulations, street runoff may be directed to these features through curb cuts.

Sidewalks: Sidewalk requirements within residential areas are also specified in Subchapter 4 of the RSIS and are based on the street type and development intensity. Municipal regulations often dictate the requirements for sidewalks in non-residential development to provide safe pedestrian movement. Pedestrian traffic patterns considered when determining the placement of sidewalks include the presence of schools, shopping centers, recreational facilities, handicap access, and public transportation facilities. Sidewalks can be made of pervious material, such as porous pavement or concrete, or designed to provide runoff storage and infiltration in their stone base. Where impervious material is used, sidewalks can be disconnected from the drainage system, which allows some of the runoff from them to re-infiltrate in adjacent pervious areas. Additional details regarding unconnected impervious surface is presented below.

B. Parking and Driveway Areas

Similar to street widths, the size of parking areas and driveways contributes to the total amount of impervious surface at a development site. In New Jersey, parking area and driveway requirements are typically mandated by municipal regulations and, in the case of residential areas, the RSIS. In Section 4.14, the RSIS states:

> *Alternative parking standards... shall be accepted if the applicant demonstrates these standards better reflect local conditions. Factors affecting minimum number of parking spaces include household characteristics, availability of mass transit, urban vs. suburban location, and available off-site parking resources.*

As such, the RSIS provides flexibility in selecting parking and driveway size, provided that supporting local data is available.

The RSIS further states:

> *When housing is included in a mixed-use development, a shared parking approach to the provision of parking shall be permitted.*

From the above, it can be seen that a mix of residential and nonresidential uses at a development site can share parking areas, thereby reducing the total parking area and impervious cover. The RSIS also allows a reduction in the standard 18 foot parking space length provided that room is provided for overhang by the vehicle. The overhang area can then be vegetated to further reduce (and possibly help disconnect) impervious surfaces. Non-residential developments can use these same ideas where permitted by local regulations.

At all development sites, consideration should be given to constructing some or all driveways and parking areas from pervious paving material. This is particularly true for overflow parking areas as well as driveways (and other access roadways) that are used relatively infrequently by maintenance and emergency vehicles. See below and Chapter 9 for more information on pervious paving materials. Parking can also be located underground or beneath buildings, which can help reduce the site's overall impervious coverage. Finally, parking decks can reduce overall impervious coverage by concentrating the total required parking area into a smaller footprint.

C. Pervious Paving Materials

Pervious paving materials can be used at many site locations to replace standard impervious pavement. These locations may include parking spaces, driveways, access roadways, and sidewalks. Pervious material can include pavers (interlocking concrete blocks or bricks), porous pavement (concrete or asphalt), gravel, and reinforced lawn. While brick pavers, concrete block pavers, and gravel are themselves impervious, their use can reduce impervious areas by providing gaps between individual pieces through which runoff can reach a pervious base course and/or subsoil. Turf blocks (open cells made of concrete, plastic, or composite materials that are filled with soil and planted with grass) may also be utilized to replace traditionally paved areas. Porous concrete and porous asphalt are generally considered fully pervious and may be viable options for areas that need to be fully paved. Municipal regulations must be reviewed to determine whether the use of pervious paving materials is permissible at a development site. It may also be appropriate to discuss the use of pervious paving materials with local officials and Soil Conservation Districts.

In selecting the type of pervious paving material to be used at a development site, consideration must be given to anticipated character and intensity of use of the material's surface. This will include the type, weight and size of vehicle, and the traffic rate and frequency. For example, due to their non-monolithic character, pavers, turf blocks, and gravel can achieve significant infiltration but may not be able to withstand regular traffic loads. As such, these materials may be more appropriate for overflow parking areas and emergency or maintenance access roads. Since its monolithic character is similar to standard impervious paving, porous pavement will have more general use, provided that adequate subsurface drainage is available. In all cases, consideration must be given to the effects of snow plowing and other maintenance activities. Additional information regarding pervious paving is available in Chapter 9.

D. Unconnected Impervious Areas

Unconnected impervious areas are impervious surfaces that are not directly connected to a site's drainage system. Instead, runoff from an unconnected impervious area is allowed to sheet flow from the impervious area across a downstream pervious surface, where it has the opportunity to re-infiltrate into the soil, thereby reducing the total runoff volume. An unconnected impervious surface may be on-grade (e.g., a parking lot) or above-grade (e.g., a roof). While impervious area disconnection is most applicable to low density development where pervious open space is readily available to accept impervious area runoff, opportunities to utilize unconnected impervious area can usually be found even at highly impervious development sites.

In most circumstances, impervious areas can be considered unconnected under the following conditions:

1. All runoff from the unconnected impervious area must be sheet flow.
2. Upon entering the downstream pervious area, all runoff must remain as sheet flow.
3. Flow from the impervious surface must enter the downstream pervious area as sheet flow or, in the case of roofs, from downspouts equipped with splash pads, level spreaders, or dispersion trenches that reduce flow velocity and induce sheet flow in the downstream pervious area.
4. All discharges onto the downstream pervious surfaces must be stable and nonerosive.
5. The shape, slope, and vegetated cover in the downstream pervious area must be sufficient to maintain sheet flow throughout it length. Maximum slope of the downstream pervious area is 8 percent.
6. The maximum roof area that can be drained by a single downspout is 600 square feet.

Methods to compute the resultant runoff volumes and peak runoff rates from unconnected impervious areas are presented in Chapter 5 of this manual. This includes parameters and procedures for determining the effective size of the downstream pervious area that receives the runoff from an unconnected impervious area.

Curb requirements included in the RSIS and many municipal regulations are often cited as a limiting factor in the use of unconnected impervious areas. However, residential curb requirements in the current RSIS provide flexibility to limit curbing, and also allow the use of curb cuts to disconnect impervious areas. The RSIS states in Section 4.3 (d):

> *Curb requirements may be waived by the appropriate municipal approving agency, and shoulders and/or drainage swales used when it can be shown that: shoulders are required by CAFRA; soil and/or topography make the use of shoulders and/or drainage swales preferable; and/or the community desires to preserve its rural character by using shoulders and/or drainage swales instead of curbs.*

In addition, the top of the curbing may be set level with the impervious and downstream pervious surfaces to allow sheet flow from one to the other. Similar opportunities to use level curbs and/or curb cuts may also exist at nonresidential developments.

It is important to note that, in designing and utilizing unconnected impervious areas, consideration must be given, on a case-by-case basis, to sensitive or limiting geographic conditions such as Karst topography and rough, irregular topography.

E. Vegetated Roofs

Vegetated roofs, also known as green roofs, are an innovative way to reduce impervious surfaces at development sites in New Jersey. They have been used successfully in several European countries, including Germany. A vegetated or green roof consists of a lightweight vegetated planting bed that is installed on a new or existing roof. This enables the roof to retain precipitation on and within the planting bed and on the surface of the vegetation. This stored water is later released through evapotranspiration, thereby reducing the volume of runoff from the roof. The exact amount of rainfall storage (and runoff reduction) will depend upon the depth and porosity of the planting bed and, to a lesser degree, the type and density of vegetation.

Vegetated roofs can be implemented using specialized commercial products. A common arrangement consists of an impervious synthetic underdrain system that allows drainage of water from the roof surface (known as a geomembrane) and a 1 to 6-inch thick layer of lightweight planting media. The type of vegetation to be used should be based on access and maintenance requirements and secondary uses of specific roof areas. Except for periodic fertilization and watering, a meadow-like planting of perennial plants can require minimal maintenance.

When designing new systems or converting existing roofs to green roofs, adequate capacity and easy access to gutters, underdrains, downspouts, and other components of the roof's drainage system must be provided. Clogging of underdrains must be prevented through a combination of sound design and regular inspection and maintenance. Overflows must also be provided to address drainage system malfunctions and rainfalls that exceed the system's design storm. Green roofs will be most effective during the spring and summer growing season, with somewhat reduced effectiveness during the late fall and winter months. Depending on the type of vegetation selected and the amount of rainfall, there may be a need for occasional watering and perhaps fertilization of the vegetative cover. Therefore, special provisions must be provided to readily enable such activities.

The structural integrity of the roof and the building must support any loading resulting from the vegetation, soil, and rainfall stored in the rooftop. In general, the slope (horizontal to vertical) of the roof can vary between 12:1 and 4:1. Steeper roofs will usually require erosion protection to hold the planting media in place at least until the plants become established. The roof slope must not exceed 1:1. Relatively flat roofs require an underdrain layer, while steeper roofs can drain by gravity.

4. Time of Concentration Modifications

Time of concentration (Tc) is technically defined as "the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed."[1] Stated more simply, it represents the time needed to drain runoff from an area. Changes in peak flow result from changes in Tc from drainage areas, with longer times yielding smaller peak runoff rates and shorter times causing greater ones. Site factors that affect a drainage area's time of concentration include flow length, flow regime, surface roughness, channel shape, and slope.[2] Typically, land development modifies most if not all of these factors in ways that cause the time of concentration of a drainage area to be shorter (and, therefore the peak runoff rates to be greater) after development than prior to development.

However, during site design, it may be possible to avoid or minimize this decrease in time of concentration by controlling the various site factors that affect it. Considerations for three factors are presented below. In reviewing these considerations, it must be remembered that, although the time of concentration of a drainage area is computed for a specific flow path (as determined by the technical definition above), it is actually a representative time for an entire drainage area. As such, the modifications discussed below that pertain to sheet flow from a drainage area to a more defined conveyance system (such as a channel or storm sewer) must not only be applied along the specific Tc route, but throughout the entire area where the sheet flow is occurring.

For certain areas in New Jersey, such as those with Karst topography, the flat topography of the Pinelands and shore areas, and the rough terrain of the northwest, the development of a time of concentration may be difficult. In such cases, the designer should confer with the applicable review agencies in order to develop a representative Tc route and time.

A. Surface Roughness Changes

Based upon hydraulic theory, surface roughness coefficients used in sheet flow computations are based on the land cover of a drainage area, with areas of dense vegetation having generally higher coefficients (and longer times of concentration) than smoother surfaces such as paved or grassed areas. This surface roughness can also vary with season and degree of maintenance, particularly for turf grass areas. Therefore, site designers should preserve existing native vegetation or use native plants to restore disturbed areas (as discussed above in *1. Vegetation and Landscaping*) in order to increase surface roughness and time of concentration, and consequently reduce the peak flows from a drainage area.

B. Slope Reduction

As noted above, ground slope is another important factor in determining a drainage area's time of concentration and peak discharge. Reducing slopes in graded areas can help minimize Tc reductions and peak flow increases. In addition, terraces and reduced slope channels can be constructed on a sloping area to provide additional travel time. Terraces can also be used to redirect runoff to flow along rather than across the slope, decreasing the slope and increasing the flow length and, subsequently, the time of concentration. Care should also be taken to ensure that the grading of vegetated areas is sufficient to allow for positive drainage as required by local or state regulations, particularly adjacent to buildings and other structures.

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[1] USDA Soil Conservation Service Technical Release 55, June 1986, Urban Hydrology for Small Watersheds.

[2] Ibid.

C. Vegetated Conveyance

The use of vegetated conveyance measures such as channels and swales can increase the surface roughness along the Tc flow path and increase the overall Tc. Grade stabilization structures can also be added to further decrease the flow velocity. In addition, vegetated channels can provide opportunities for runoff treatment, runoff infiltration, and groundwater discharge. Such measures can replace conventional storm sewer systems in small drainage areas. Site specific conditions such as slope, soil type, drainage area, and site constraints must be considered in the design of a vegetated channel or swale. Additional requirements are presented in the Standards for Soil Erosion and Sediment Control in New Jersey. The local Soil Conservation District will review the project to ensure stability.

In designing vegetated conveyance measures, care should be taken to protect transitions to and from culverts from erosion caused by flow acceleration and turbulence. In addition, vegetated channels and swales should be constructed only in areas with sufficient sunlight to adequately maintain vegetation. The channels must also be able to drain and dry out between storm events. As an alternative to grasses, the channel could be planted with ground covers that tolerate frequent short-duration flooding. The vegetation must be tolerant of the hydrologic regime associated with the channel.

In the design of any site features to control or modify time of concentration, it should be noted that the effectiveness of the design may vary with runoff rate and, therefore, storm frequency. As a result, modifications to such factors as slope or surface roughness may have a significant effect on the time of concentration for a one-year storm event, but little or no effect on a larger 10 or 100-year event. Therefore, it may be necessary (and even prudent) to vary Tc with storm frequency, utilizing the longer one for the frequent events associated with stormwater quality and the shorter (and more conservative) one for the more extreme erosion and flood control storms. Care should also be taken when analyzing a time of concentration to ensure that the watershed it represents is relatively homogenous. Otherwise, the drainage area may need to be divided into subareas with a separate Tc computed for each.

Structural Stormwater Management Measures

In addition to the nonstructural LID-BMPs presented in the previous section, structural stormwater management measures can also be used to implement low impact development. Known as structural LID-BMPs, these structural measures are identified as low impact BMPs by storing, infiltrating, and/or treating runoff close to its source. Unlike typical structural BMPs that are centrally located along a site's drainage system, structural LID-BMPs are normally dispersed throughout a development site and, like the nonstructural LID measures discussed above, provide ways to more closely mimic the site's predeveloped hydrology than standard structural BMPs.

As structural facilities, however, the configuration, operation, and maintenance of structural LID-BMPs are similar to standard structural BMPs, although their location closer to the runoff source typically allows them to be smaller in size. An example of this relationship is the use of bioretention basins as structural LID-BMPs in a residential subdivision. Also known as raingardens, they are typically located on each lot in the subdivision and, as such, each receives considerably less runoff than would a single, centralized bioretention basin. Nevertheless, similar to the centralized bioretention basin, each basin would be designed and constructed in accordance with the technical standards presented in Chapter 9. Designers should take care to ensure that sufficient setbacks are provided to protect adjacent structures from impacts due to the anticipated functioning of LID-BMPs.

The integration of bioretention basins and other structural BMPs throughout a development site can be viewed as applying low impact development techniques. Many standard BMPs can be done at an LID scale. Drywells, infiltration systems, bioretention basins, and both surface and subsurface detention basins can all be downsized to address stormwater runoff close to its source, as opposed to a centralized location at the end of a stormwater collection and drainage system. Detailed design, construction, and maintenance information on various structural BMPs is presented in Chapter 9.

Preventative Source Controls

The most effective way to address water quality concerns is by preventing pollutants from being part of stormwater runoff. Pollution prevention techniques should be incorporated into site designs, especially at commercial and light industrial sites, to minimize the potential impact those activities may have on stormwater runoff quality. Preventative source controls, while more limited, can also be applied in residential development, particularly in preventing floatables (trash and debris) from entering storm sewer drainage systems.

Preventative source controls can prevent the accumulation of trash and debris in drainage systems by providing trash receptacles at appropriate locations throughout the site. The benefits are realized only if regular trash collection is provided; this should be included as part of the site maintenance plan. The installation of litter fences, especially at commercial properties, to prevent the blowing of litter off the site is another measure that addresses the accumulation of trash and debris. At industrial/commercial sites, maintenance plans should include regular sweeping or manual collection of litter. In residential developments, the inclusion of "pet waste stations" in the site design of dense housing developments such as apartment, townhouse and condominium communities prevents pollutants from entering the stormwater system. Pet waste stations should include bags for picking up pet waste and containers for pet waste disposal. Providing these stations will increase the likelihood that pet waste is properly disposed and prevent it from being washed into streams as part of stormwater runoff.

Site design features can also prevent the discharge of trash and debris into receiving streams. Storm drain inlets, trash racks, or structural BMPs are types of features that prevent the discharge of trash and debris. The New Jersey Pollutant Discharge Elimination System stormwater general permits issued under the Municipal Stormwater Regulation Program provide information on storm drain inlets that are designed specifically to prevent the discharge of large trash and debris from drainage systems by reducing the size of each individual clear space in both the grate and curb opening. Where allowed and consistent with the design standard, alternative devices may be substituted for these storm drain inlets.

Some site design features help to prevent or contain spills and other harmful accumulations of pollutants at industrial or commercial developments. These include roofs, overhangs, knee walls, berms, secondary containment, stormwater diversion devices, oil/grit separators and other manufactured treatment devices, and indoor storage. Specifically, berms and secondary containment can contain spills of fuels or other chemicals, and roofs and walls can prevent or minimize exposure of stormwater to activities and materials such as fueling and maintenance, trash, waste motor oil, storage or handling of landscape and garden chemicals (including fertilizers and pesticides) at retail stores, and storage or handling of raw materials, intermediate products, final products, and by-products at warehouses or manufacturing plants. Stormwater diversion devices, such as curbing and berms, can divert stormwater away from areas where it may come into contact with materials or activities that could affect stormwater quality. Oil/grit separators and other manufactured treatment devices may contain certain spills and treat stormwater that has come into contact with spills or residual material from spills. Also, the inclusion in the site design of adequate indoor storage of raw materials, intermediate products, final products, and by-products at commercial and industrial sites is the best method for preventing potential stormwater quality issues.

Stormwater as a Resource

Stormwater runoff from precipitation is often viewed as a nuisance. However, an increase in stormwater runoff is an indicator of reduced infiltration and recharge to groundwater. As such, this negative view of stormwater runoff must be corrected to more accurately consider stormwater as a resource vital to achieving more sustainable development.

For example, stormwater runoff from roofs can be captured for future re-use using a variety of collection and storage devices. These systems can be installed above or below ground. Above ground systems could be simple rain barrels that overflow onto a splash pad. Underground systems may be concrete structures requiring a pump to empty them or, if the topography allows it, they may drain by gravity. The size of this BMP depends on the contributing roof area. In commercial or high-density residential applications, roof water cisterns can be incorporated into landscaping features such as water fountains and ponds. Where space permits, underground cisterns can discharge to an infiltration trench.

It is important to note that all collection and storage devices must be emptied between storm events in order to be considered effective in reducing site runoff volumes. In addition, the total system storage volume must be evaluated to determine its effectiveness as a runoff volume control measure. Nevertheless, re-use of the collected stormwater in place of potable water from an onsite well or public water supply will help minimize the site's over environmental impacts, reduce site operating costs, and help achieve a more sustainable environment.

Additional Considerations

As described above, low impact development typically relies on an array of nonstructural and relatively small structural BMPs distributed throughout a land development site to manage stormwater runoff quantity and quality. This distributed approach to stormwater management contrasts with the more traditional use of centralized stormwater facilities in New Jersey. However, as discussed briefly at the beginning of this chapter, this distributed approach means that the responsibility for successful operation and maintenance of the various LID-BMPs will not be centrally located at a municipality or other government entity. Instead, such responsibility will be distributed over a variety of property owners with varying interests, knowledge, abilities, and resources. As such, it is vital to have public understanding of and support for the various LID-BMPs that a municipality authorizes for use in its stormwater management program and land development regulations. Such understanding and support must include both an appreciation for the necessary role that the LID-BMPs play in meeting a development site's stormwater obligations and a strong, enforceable commitment to preserve and maintain them.

This is particularly true for nonstructural LID-BMPs, which may rely on such techniques as preserving existing or planting new vegetation, minimizing building footprints, and limiting lot impervious cover and/or disturbance limits to effectively manage stormwater runoff and prevent downstream environmental and property damage. The Stormwater Rule at Section 5.3(c) requires the deed restriction of LID-BMPs since such practices may not be readily recognized by property owners as stormwater management measures or facilities, and they may be more prone to neglect, abandonment, or removal than centralized structural BMPs unless the property owners fully recognize, understand, and support their use.

Similar problems may also arise with structural LID-BMPs which, due to their smaller size and their location on individual lots much closer to homes than larger, centralized facilities, may be overlooked as vital stormwater management measures and similarly neglected or abandoned. In the worst case, a resident or property owner may remove a vital structural LID-BMP located on their property. Such action may occur due to an alternative need for the land (e.g., house addition, driveway expansion, storage shed), adverse aesthetic impacts, or excessive maintenance demands. Regardless of the reasons, a municipality may find it extremely difficult to have the eliminated LID-BMP either restored or replaced by a centralized facility.

Therefore, it is vital that each municipality critically evaluate the range of available nonstructural and structural LID-BMPs presented in this manual and elsewhere and authorize the use of only those that they can rely on to be properly operated, maintained, and preserved by their residents, property owners, and municipal employees. Failure to achieve such acceptance, operation, and maintenance can lead to flooding, erosion, and runoff pollution; damage to downstream waterways and property; and threats to public safety.

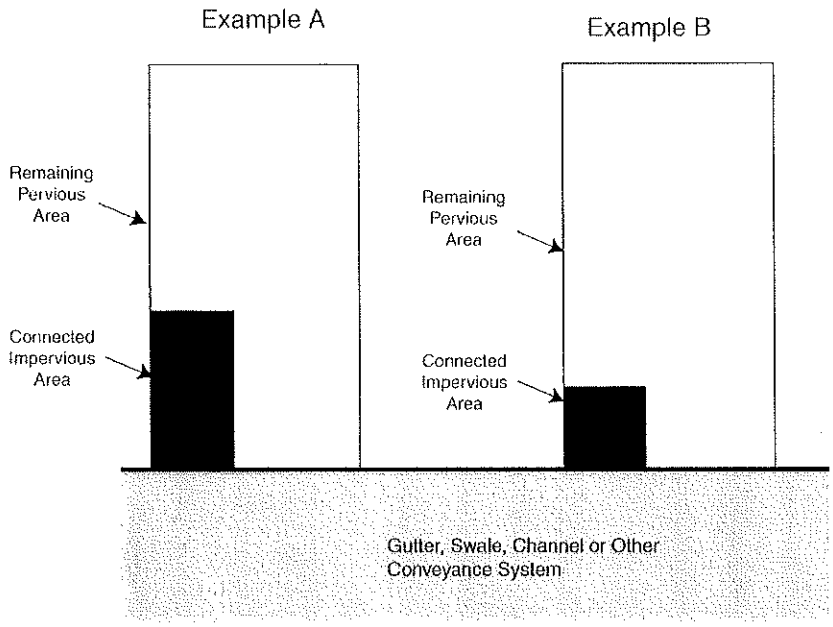
To assist in this evaluation, physical details and operation and maintenance requirements for a range of structural BMPs are presented in Chapter 9.

When evaluating LID-BMPs for authorization and incorporation into their land development ordinances and standards (as required by the NJDEP Stormwater Management Rules), a municipality should consider the following:

1. Permitting the use of certain LID-BMPs to manage the runoff from small, frequent storm events (such as those required by the NJDEP Stormwater Management Rules for groundwater recharge and stormwater quality), but prohibiting their consideration when addressing erosion and flood control requirements that typically involve larger, less frequent but more hazardous events. For example, a municipality may allow a site designer to use rain barrels and/or small, on-lot infiltration basins (also known as raingardens) to meet groundwater recharge and stormwater quality requirements, but may also require that such measures be ignored when meeting erosion and flood control standards.
2. Requiring deed restrictions or adopting ordinances that prohibit the alteration or elimination of on-lot LID-BMPs approved for use at a land development and officially identified as such. Such restrictions and ordinances should clearly define the right of the municipality to restore such LID-BMPs and the means by which it will be accomplished and financed.
3. Requiring deed restrictions or adopting ordinances that require land owners to properly maintain structural LID-BMPs located on their properties.
4. Requiring signage of LID-BMPs to indicate their function and use.
5. Preparing leaflets, brochures, and/or manuals for property owners on the function and importance of LID-BMPs and their maintenance and preservation. Similar efforts targeting such activities as proper septic system operation, recycling, lawn fertilization, and pet waste disposal have proven successful in many municipalities. Soil test kits and information regarding lawn fertilization are available for homeowners from the Rutgers Cooperative Extension.

Low Impact Development Example Calculations

Figure 2-1: Schematic of Lot with Connected Impervious Areas



Reduction of Runoff Volumes Due to Reduced Impervious Surfaces

Note: The computations were done by evaluating the runoff from the pervious and the impervious areas separately, and summing the volumes.

Example A

Given: A 32670 sf lot with 27470 sf lawn, HSG "B", CN = 61, 5200 sf impervious surface, CN = 98.
No impervious cover is disconnected
P_2 = 3.3 inches, P_{10} = 5.2 inches, and P_{100} = 7.5 inches

From the NRCS Runoff Equation, the following runoff volumes are generated:

2-year = 2444 cf
10-year = 5567 cf
100-year = 10175 cf

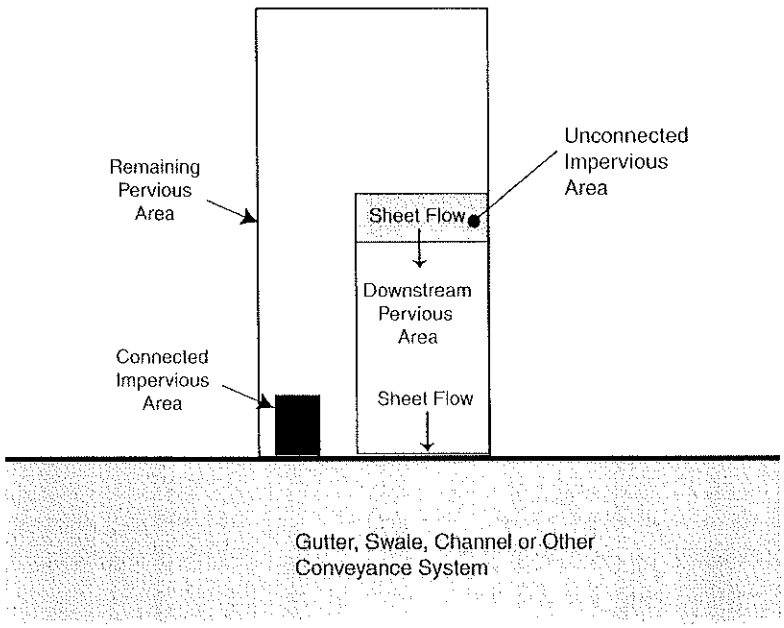
Example B

Given: A 32670 sf lot with 29870 sf lawn, HSG "B", CN = 61, 2800 sf impervious surface, CN = 98.
No impervious cover is disconnected
P_2 = 3.3 inches, P_{10} = 5.2 inches, and P_{100} = 7.5 inches

From the NRCS Runoff Equation, the following runoff volumes are generated:

2-year = 1927 cf
10-year = 4872 cf
100-year = 9336 cf

Figure 2-2: Schematic of Lot with Connected and Unconnected Impervious Areas



Changes in Runoff Volumes Due to Disconnection of Impervious Surfaces

Example C

Given: A 32670 sf lot with 29870 sf lawn, HSG "B", CN = 61, 2800 sf impervious surface of total impervious area, CN = 98.
2000 sf of impervious area discharges to 8900 sf of lawn, and 800 sf impervious area is directly connected
P_2 = 3.3 inches, P_{10} = 5.2 inches, and P_{100} = 7.5 inches

**NRCS Method:

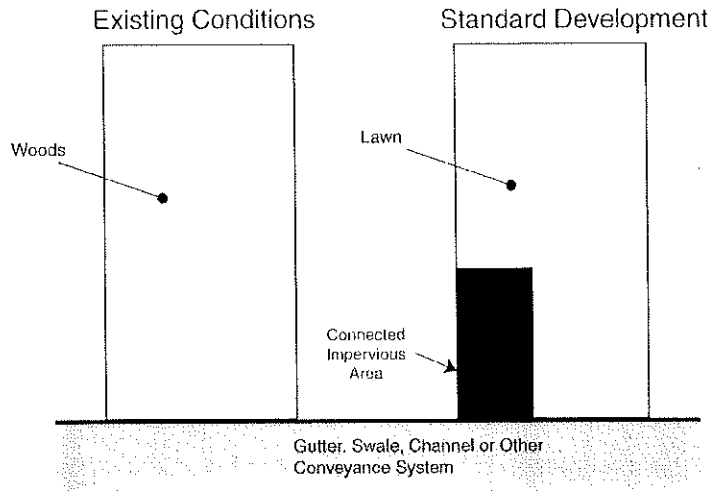
2-year = 1625 cf
10-year = 4515 cf
100-year = 8947 cf

Two-Step Method (discussed in Chapter 5):

2-year = 1650 cf
10-year = 4580 cf
100-year = 9055 cf

**Note: The computations were done by evaluating the runoff from the pervious, impervious, and unconnected impervious areas separately, and summing the volumes. The equation for Figure 2-4, shown in Appendix F of the USDA Urban Hydrology for Small Watersheds, was used for the volume of unconnected impervious areas.

Figure 2-3: Schematic of Existing Lot and Standard Development Lot



Comparison of Changes in Runoff Due to Low Impact Development Techniques

Predeveloped Condition

0.75 acre lot
20,650 sf woods, HSG "B"
12,020 sf woods, HSG "C"
P_2 = 3.3 inches, P_{10} = 5.2 inches, and P_{100} = 7.5 inch

Tc = 0.52 hours
125 lf sheet flow, 1.3% slope, n = 0.40
135 lf shallow concentrated flow, 1.4% slope, unpaved

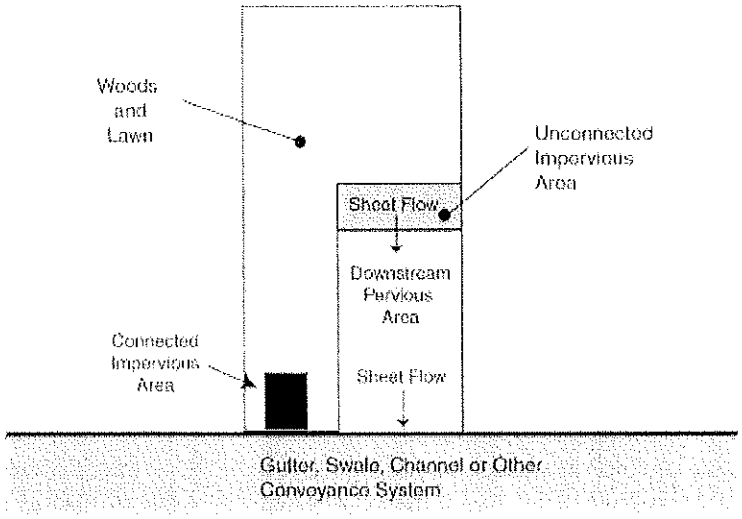
Postdeveloped Condition (Standard Development Lot)

0.75 acre lot
5200 sf of total impervious area, directly connected, Tc = 0.1 hours
P_2 = 3.3 inches, P_{10} = 5.2 inches, and P_{100} = 7.5 inch

Vegetated Area, Tc = 0.32 hours
125 lf sheet flow, 1.6% slope, n = 0.24
135 lf shallow conc flow, 1.4% slope, unpaved

Area (sf)	Land Use	HSG
17214	Lawn (good condition)	B
10256	Lawn (good condition)	C
3436	Impervious (directly connected)	B
1764	Impervious (directly connected)	C

Figure 2-4: Schematic of Lot With LID Techniques



Postdeveloped Condition (With LID Techniques)

0.75 acre lot, 2800 sf of total impervious area

800 sf of impervious area, directly connected, Tc = 0.1 hours

2000 sf of impervious area, unconnected, discharging to 8906 sf of lawn

P_2 = 3.3 inches, P_{10} = 5.2 inches, and P_{100} = 7.5 inch

Nonstructural stormwater management strategies used: minimized land disturbance; minimized compaction; maximized the protection of vegetation; minimized the decrease in post-development time of concentration through retaining existing wooded area; and minimized and disconnected impervious cover.

Vegetated Area, Tc = 0.52 hours

125 lf sheet flow, 1.3% slope, n = 0.40

135 lf shallow conc flow, 2.1% slope, unpaved

Area (sf)	Land Use	HSG
17524	Woods (good condition)	B
1564	Lawn (good condition)	B
1876	Lawn (good condition)	C

Unconnected Impervious Area, Tc = 0.23 hours

100 lf sheet flow, 2.1% slope, n = 0.24

Note: The time of concentration was developed from the receiving pervious area alone.

Distribution of Pervious Areas Receiving Unconnected Impervious Area Runoff		
Area (sf)	**Land Use**	**HSG**
1562	Lawn (good condition)	B
7344	Lawn (good condition)	C

Peak Flow Rates and Volumes

	Existing Conditions	Proposed Conditions (Standard Development)	Proposed Conditions (Nonstructural Stormwater Management Strategies)	
			Two-Step Method	NRCS Method
2-year	0.15 cfs 0.030 ac-ft	0.48 cfs 0.067 ac-ft	0.29 cfs 0.043 ac-ft	0.27 cfs 0.041 ac-ft
10-year	0.62 cfs 0.093 ac-ft	1.18 cfs 0.150 ac-ft	.81 cfs 0.116 ac-ft	.78 cfs 0.109 ac-ft
100-year	1.35 cfs 0.192 ac-ft	2.19 cfs 0.261 ac-ft	1.61 cfs 0.214 ac-ft	1.58 cfs 0.211 ac-ft

References

Johnston, J. and Newton, J. 1992. Building Green: A Guide for Using Plants on Roofs, Walls and Pavements. London: The London Ecology Unit.

Lieseche, H., et al. 1989. Fundamentals of Roof-Greening (Grundlagen der Dachbegrunung). Platzer Verlag, Berlin, Germany. (Available in German language only).

New Jersey Department of Agriculture. 1999. Standards for Soil Erosion and Sediment Control in New Jersey. New Jersey Department of Agriculture, Trenton, NJ.

Osmundson, T. H. 1999. Roof Gardens: History, Design, and Construction, W.W. Norton & Co.

Pennsylvania Association of Conservation Districts. 1998. Pennsylvania Handbook for Best Management Practices in Urban Areas. Harrisburg, Pennsylvania.

Prince George's County. 2001. Bioretention Manual, Department of Environmental Resources, Prince George's County, Maryland.

Schueler, T. R. 2000. "Is Rooftop Runoff Really Clean?" Article 8 in "The Practice of Watershed Protection" Published by Center for Watershed Protection, Ellicott City, Maryland. Original Source: Technical Note 25 from Watershed Protection Techniques, 1(2): 84-85.

Tourbier, J. T. and R. Westmacott. 1981. Water Resources Protection Technology—A Handbook to Protect Water Resources in Urban Development. Washington, D.C.: The Urban Land Institute.

Tourbier, J. T. and R. Westmacott. 1974. Water Resources Protection Measures in Land Development. Final Report prepared for the U.S. Department of the Interior, Water Resources Center, University of Delaware.

University of Maryland. 1991. Landscape Design to Reduce Surface Water Pollution in Residential Areas, Cooperative Extension Services, University of Maryland, College Park, Maryland.

U.S. Department of Agriculture. 1986. Urban Hydrology for Small Watersheds. Technical Release Number 55 (TR-55). National Technical Information Service.

Velazquez, L. 2000. "Greenroofs.com" http://www.greenroofs.com/.

Washington State Department of Ecology. 2000. Stormwater Management for Western Washington, Volume V, Runoff Treatment BMPs, Publication 99-15, Final Draft.

New Jersey Stormwater Best Management Practices Manual

February 2004

CHAPTER 3

Regional and Municipal Stormwater Management Plans

Regional Stormwater Management Plans

Regional stormwater management planning is a water resource management strategy that identifies and develops solutions to problems that can be managed most effectively on a regional basis. The product of this planning process, the regional stormwater management plan (RSWMP), spans the boundaries of individual properties, neighborhoods, municipalities, and even county borders. A plan may address an existing water quantity issue, such as localized flooding; an existing water quality issue, such as excess pollutant loading; or issues of water quantity and quality that may be generated by future development. Regional stormwater planning creates a combination of regulations and actions tailored to the specific needs of a drainage area, but it does not reduce environmental protection. Rather, it allows regulations more flexibility to match the concerns, conditions, and features of regions that are connected by a common drainage area.

Well-designed RSWMPs share common elements. First, they are collaborative. Adoption and implementation of an RSWMP depends on the cooperation of county and municipal governing bodies, regulatory agencies, and environmental organizations. Any plan designed without their active involvement and consent has dim prospects for adoption. Second, they focus on identifying and solving specific problems. Shared regional problems, such as recurring flooding, unswimmable lakes, reduced stream flows, or contaminated public water supplies, can drive the collaboration needed to trigger and sustain the planning and adoption process. Specific problems also lend themselves to specific, measurable, and quantifiable implementation steps. For example, an RSWMP can spell out the specific measures required to reduce pollutant loads determined by the TMDL (total maximum daily load) process. Third, an RSWMP's recommendations are based on sound engineering and science geared to local land use conditions. All measures included in an RSWMP must be supported by a rationale that includes a feasibility analysis for achieving specific objectives as well as a monitoring plan to gauge long-run effectiveness of each measure. Plans must be reviewed every five years at a minimum. Fourth and finally, RSWMPs include a strong emphasis on maintenance and monitoring to ensure long-term functioning of the structures, measures, and programs recommended by the plan.

Regional stormwater management planning represents a fundamental shift in thinking – and execution. Traditionally, stormwater has been planned for and managed on a site-by-site basis, with the combined effect of thousands of individual stormwater management decisions in one watershed creating unintended consequences. For example, a detention or retention basin may make perfect sense to manage stormwater for an individual property. Typically, these basins were designed to ensure that peak runoff rates from a site did not increase after the property was developed. However, when hundreds of such basins simultaneously retain and then release stormwater in a regional drainage area, they can actually increase flooding and downstream erosion by extending peak runoff rates and increasing non-peak flows. As development increase in a drainage area, this site-by-site planning failed to account for the increased volume of runoff caused by regional increases in development. To address these increased volumes, recent regulations, including the Stormwater Management Rules, require stormwater management plans to reduce peak flows leaving a site. The regulations are based on analyses that demonstrate how to prevent increases in the flows that cause both flooding and erosion. However, this statewide method for addressing flooding and erosion may not be the optimum solution for managing runoff for a specific drainage area. For example, an RSWMP may recommend longer detention times at the top of a watershed to release water more slowly into local streams, and the plan may call for reduced detention times in more urbanized sections of the watershed where storage space is limited.

RSWMPs optimize flexible use of stormwater management measures by providing the authority to create new, customized regulatory requirements and by setting priorities for actions that address the specific stormwater quality, quantity, and recharge objectives within the planning area. Although performance standards can be changed from those proposed in the Stormwater Management Rules, RSWMPs must avoid adverse impacts downstream of the planning area. Regional planning also creates more options for groundwater recharge. Local topography, geology, and soil conditions that restrict infiltration may present daunting design challenges for some sites and municipalities, while well-suited recharge sites may lie just up- or downstream. In each case, better solutions become available with regional planning.

Sizing an RSWMP

Determining the size of a drainage area is one of the first technical challenges in creating an RSWMP. Regional stormwater management is fundamentally a problem-centered planning process, so the size of an RSWMP drainage area may depend on the nature and location of previously identified local concerns such as water quality impairment, erosion damage, reduced stream flows, sedimentation, inadequate groundwater recharge, or flooding. RSWMPs are created to address existing problems or to anticipate and avoid future ones. Local interest groups may already have specific concerns that can be addressed with a regional plan. TMDL implementation plans may identify regional stormwater management plans as a long-term management measure to address impairment for a specific stream segment.

A build-out analysis may identify additional problems during the assessment portion of regional plan development. A regional plan developed for the Jackson Brook in Morris County, for example, was driven initially by flooding concerns, but it also proposes improvements to reduce pollutant loads projected under full development conditions. A regional plan proposed for the Mulhockaway Creek seeks to anticipate and address concerns about development in an environmentally sensitive area of the South Branch of the Raritan River. A plan proposed for the Cedar Grove Brook in Franklin Township is targeting water quality issues in an urbanized area just upstream from water supply intakes.

Available funding is a key variable in determining the size of a regional area for a plan. Budgets for developing RSWMPs typically exceed $100,000 because they often require extensive collection and complex analysis of field data. Those costs tend to limit the size of the drainage area to be studied, and the regional plans completed or proposed in New Jersey tend to fall between 5 and 20 square miles. The budget for a

12-square-mile drainage area around the Mulhockaway Creek drainage area, for example, is projected at $300,000. The budget to develop the plan for the 5-square-mile drainage area around Cedar Grove Creek was $200,000. The cost of implementing an RSWMP, of course, depends on its findings and recommendations. If writing a plan can easily run into six figures, implementing one can easily exceed $1 million if construction of large stormwater management structures is called for in the plan. These costs, however, are dependent on the goals and objectives of the plan and the specific conditions of the area; therefore, costs can vary significantly between regional stormwater management plans.

In New Jersey, with its history of municipal autonomy know as "home rule," smaller drainage areas tend to be more politically feasible. Regional stormwater planning requires municipalities to align their zoning and development standards with the plan, so drainage areas that involve three or four neighboring municipalities with a common concern may have a realistic chance of aligning development standards to solve their shared problem. That possibility would likely diminish dramatically if the regional plan involves tens of municipalities lacking a common, immediate problem.

Beginning the Process

By law and by definition, the development of a regional stormwater management plan is a participatory process. In fact, N.J.A.C. 7:8-3, the regulations authorizing optional regional plans require the creation of a broadly representative regional planning committee as the first step in the process. That committee then designates a lead planning agency to marshal the technical and administrative resources required to develop and implement a regional plan.

From a technical standpoint, plan development begins with characterizing and assessing the drainage area by gathering and reviewing all relevant water quality and quantity information currently available. This requires scouring for all available data from sources including:

- state and Federal Emergency Management Agency (FEMA) floodplain maps;
- hydraulic analysis and stream cross section data from stream encroachment permits;
- topographic data from aerial photos with two-foot contours;
- water quality data from New Jersey Pollution Discharge Elimination System (NJPDES) permits or intake waters from local water treatment facilities; and
- monitoring data from the U.S. Geological Survey, the Environmental Protection Agency's STORET database, the NJDEP, local health departments, environmental commissions, or watershed associations.

In New Jersey, local Soil Conservation Districts are a valuable source of field observations on streambanks, erosion, and scouring that can be collected only from walking along stream corridors. Additional information regarding local conditions may be available from the Division of Watershed Management and local environmental organizations. Recent watershed characterization studies, if available, also provide data to focus planning efforts on water quality issues.

If a watershed characterization study is not available, consider performing a relatively quick and inexpensive Geographic Information Systems (GIS) analysis that matches water supply sources with reported water quality degradations and potential pollutant sources.

The full range of steps and requirements for creating, implementing, and adopting an RSWMP are included in N.J.A.C. 7:8-3. A summary of those requirements is outlined in this chapter, including:

- a written statement from each public entity on the committee confirming the authority of each to develop and implement a stormwater management plan;
- a discussion of both the majority and minority positions, if portions of the plan do not represent a consensus of the committee;

- characterization and evaluation of the planning committee's drainage area;
- specific objectives for water quality, groundwater recharge, and water quantity for the planning committee's drainage area;
- specific performance standards for water quality, groundwater recharge, and water quantity for the committee's planning area; and
- stormwater management measures selected by the planning committee and an explanation of why they were chosen.

Steps to Create, Implement and Adopt an RSWMP

Planning the RSWMP Process

Because an RSWMP is both a technical planning procedure and a regulatory process, it requires active participation from organizations that would likely be affected by the plan. In fact, the first step in the RSWMP process is to create a regional stormwater management planning committee and select a lead planning agency for the express purpose of developing a regional plan. The committee is charged with soliciting information from the following interested groups and organizations:

- government agencies at all levels, including Soil Conservation Districts;
- local and regional environmental groups and organizations including lake associations, watershed associations, and environmental commissions;
- water supply and wastewater treatment utilities, authorities, and agencies, and watershed management planning agencies; and
- residents in the drainage area.

The planning committee must designate a lead planning agency to serve as the primary contact for the committee. The Lead Agency must submit a request for the recognition of the regional stormwater plan committee to the NJDEP. This request must include a draft work plan, schedule of activities, and the information used to invite organizations to participate in the planning committee. The NJDEP has 45 days to approve or deny the request or ask for more information.

Data Gathering and Priority Setting

Data gathering and priority setting can be the most expensive steps in the process because they often require time-intensive collection of field data on variables such as stream elevations, erosion hot spots, and water quality. To minimize the cost of gathering this data, the NJDEP encourages planners to make maximum use of existing information, including information on the department's GIS web site (www.state.nj.us/dep/gis) or developed through the watershed management process. This task is ideally suited for analysis and display on Geographic Information Systems, and all maps developed must meet New Jersey's digital data standards in N.J.A.C. 7:1D. The following items should be included in the assessment unless they are not pertinent to a specific analysis.

Maps

The maps must first clearly delineate the drainage area boundaries, showing both existing and projected land uses assuming full development under current zoning. The following layers of information should be included: soils, topography, flood hazard areas, well protection, and groundwater recharge areas. All water bodies designated as water quality-limited surface water as well as environmentally sensitive areas or special classifications should be identified, including river areas designated under the New Jersey Wild and Scenic

Rivers Act or the Federal Wild and Scenic Rivers Act. These maps must identify stormwater management structures, surface water intakes, and public water supply reservoirs in addition to features that are outside the regional planning areas but discharge or flow into the drainage area.

Key Stormwater Management Features

The assessment must include an inventory of all key stormwater management features, including slopes, swales, outfall structures, culverts, and impoundment areas pertinent to stormwater management and required for analyzing the drainage area. Often this data can be gathered only by physically walking stream corridors to record features such as stream widths, streambank conditions, pollutant sources, eroded areas, and other relevant data. This data collection requires trained eyes in the field and often accounts for a substantial portion of the cost of developing an RSWMP.

Modeling and Analysis

Analysis of the drainage area or a water quality, groundwater recharge and water quantity hydrologic and hydraulic model may need to be performed if new performance standards are being proposed. This analysis is critical to identifying the current or potential concerns that drive the entire plan. The analysis must include existing and projected land uses assuming full development under current zoning.

Relevant Current Regulations

The assessment must identify and evaluate existing municipal, county, state, federal, and other regulations related to stormwater management, groundwater recharge, and water quality and quantity, including programs to develop total maximum daily load (TMDLs).

Once the characterization and assessment of the drainage area is complete, the RSWMP must identify current stormwater-related water quality concerns and forecast future ones, assuming full development under current zoning. The inventory should include current and potential stormwater pollutant sources in the regional planning area including urban and suburban development, roads, storm sewers, agricultural or mining operations, and waterfront development. The New Jersey Integrated Water Quality Monitoring and Assessment Report (305(b) and 303(d)) (Integrated List) is required by the Federal Clean Water Act to be prepared biennially and is a valuable source of water quality information. This combined report presents the extent to which New Jersey waters are attaining water quality standards, and identifies waters that are impaired. Sublist 5 of the Integrated List constitutes the list of waters impaired or threatened by pollutants for which one or more TMDLs are needed.

Once identified, these water-quality concerns must be ranked based on criteria determined by the planning committee. They can include: threat to public health, safety and welfare; damage to water supplies; risk of damage to the biological integrity of water bodies; mosquito control; groundwater depletion; or impacts to the ecosystem, among others.

If a TMDL has been adopted for any part of a water body in the planning area, these water-quality objectives must incorporate the loading reductions established in the TMDL for stormwater runoff. If any part of a water body is on Sublist 5 of the Integrated List due to stormwater-related impacts, the plan's objectives must specifically address those pollutants of concern.

Regional stormwater management plans must also identify and rank issues of water quantity and groundwater recharge as well as water quality. Thus, the broad goal of the plan is to eliminate, reduce, or minimize stormwater-related impacts associated with current and future land use. The minimum standard of protection is the level that would be achieved by conforming to New Jersey's Design and Performance Standards for Stormwater Management Measures when implemented throughout the regional stormwater management planning area.

Designing Regional Stormwater Solutions

An RSWMP must include design and performance standards to meet the New Jersey water quality, water quantity, and groundwater recharge standards in N.J.A.C. 7:8-3.5. However, because an RSWMP addresses concerns on a regional basis, the design and performance standards need not be uniform throughout the planning area if they satisfy N.J.A.C. 7:8-5 when considered as a whole. Any alternative standards must be at least as protective when implemented throughout the regional stormwater management planning area.

Once the objectives and performance standards have been identified, an RSWMP must outline the stormwater management measures needed to achieve the objectives. The plan may include the following guidelines for new or existing land uses or other measures: design and performance standards for storm water quality, stormwater quantity, or groundwater recharge for new development; modifications to existing stormwater management structural controls; elimination of illegal or illicit discharges; prevention or minimization of the exposure of pollutants to stormwater; or control of floatables. The plan may also include measures to enhance, protect, or preserve land or water areas for purposes of flood control, water quality protection, or conservation of natural resources. And, because many stormwater management concerns can be traced directly to the lifestyle choices of watershed residents, a plan may choose to emphasize public education programs that address root causes of water quantity and quality impacts.

Whatever measures are selected, the plan must include two important additional features. First, the plan must explain the committee's rationale for including the selected measure. The rationale should include a feasibility and cost/benefit analysis, an estimate of reduction in pollutant loads, and a projection of performance longevity. Second, the plan must specifically address maintenance requirements for each stormwater management measure, including preventative and corrective maintenance, a long-term maintenance implementation schedule, and clear identification of the organization or entity responsible for implementation and maintenance.

Implementation and Evaluation Strategies

The implementation strategy begins by identifying the agency assigned to coordinate plan implementation, including long-term monitoring requirements. The plan must identify the agency appointed to implement and monitor each measure in the plan along with a timetable for implementation. It must include a process to evaluate the entire plan at least once every five years and should include a budget that projects both long- and short-term costs for each measure. The strategy should identify possible current and potential funding sources to implement the RSWMP.

The long-term monitoring program should provide information about land use, water quality, water quantity, groundwater, and riparian and aquatic habitat conditions. Monitoring data may include information from watershed management agencies and monitoring programs operated by other agencies, including volunteer programs.

Once complete, an RSWMP will be submitted for review to the NJDEP and, if applicable, to the designated water quality management planning agency as an amendment to areawide water quality management plans. If the plan is approved, the NJDEP will propose to amend the areawide water quality management plan as outlined in N.J.A.C. 7:15-3.4(g). Any performance standards developed under an RSWMP adopted by the NJDEP in effect supersedes the minimum design and performance standards in N.J.A.C. 7:8-5 of the Stormwater Management Rules. NJDEP will use the plan requirements to review stormwater management requirements for activities currently regulated by the Freshwater Wetland Protection Act, Coastal Zone Management Rules, Flood Hazard Area Control Act Rules, New Jersey Pollution Discharge Elimination System Rules, and Dam Safety Standards. Each municipality in the regional stormwater management planning area must incorporate the applicable provisions of the plan into a new or amended municipal stormwater management plan. In addition, the stormwater management review for residential developments, which are based on the Residential Site Improvement Standards, will be based on the regional stormwater management plan. The requirements of the plan apply only to stormwater management criteria of other regulatory programs; additional requirements may be imposed as necessary under each program.

Municipal Stormwater Management Plans

A municipal stormwater management plan (MSWMP) documents the strategy of a specific municipality to address stormwater-related impacts. MSWMPs provide the structure and process for addressing stormwater management in the municipality. They are required by the Environmental Protection Agency's Phase II Stormwater Permitting Rules; the mandatory elements of the plan are described in the Stormwater Management Rules.

The municipal plan must address and achieve the goals of stormwater management discussed in N.J.A.C. 7:8-2. For new development, the plan must incorporate the performance standards for water quantity, water quality, and groundwater recharge in the Stormwater Management Rules at N.J.A.C. 7:8-5. If alternate standards have been established by an adopted regional stormwater management plan (RSWMP), the MSWMP must be consistent with it. A copy of the ordinances incorporating the performance standards must be included in the plan.

The MSWMP must be coordinated and consistent with other regulations on stormwater management issues such as those of the Soil Conservation Districts and the Residential Site Improvement Standards. The MSWMP may also address existing stormwater issues such as those identified in an RSWMP. In addition to specific design criteria, maintenance and safety requirements are a critical component. Preventative and corrective maintenance strategies must be included in the plan to ensure long-term effectiveness of stormwater management facilities. Safety standards discussed in Subchapter 6 of the Stormwater Management Rules must also be included in the MSWMP.

The plan must provide a view of the impacts of existing zoning and environmentally constrained areas on the municipality's landscape. In addition, the plan must include: maps of existing streams, groundwater recharge, and wellhead protection areas; build-out conditions based on existing zoning; and an evaluation of the existing master plan and land use ordinances that identifies areas to be amended to enable the implementation of nonstructural stormwater management techniques identified in the Rules. In order for the municipality to grant variances or exemptions from the design and performance standards for groundwater recharge and stormwater runoff quality and quantity, the municipality must provide a mitigation strategy in the MSWMP. The municipality should use the information provided in the plan to ensure that stormwater management objectives are completely addressed in the implementation of the municipal plan and ordinances.

MSWMPs are subject to review by county planning agencies to determine whether they meet the standards required by the Stormwater Management Rules. A copy of the proposed plan must also be sent to the Department of Environmental Protection, Division of Watershed Management. The county must approve, conditionally approve, or disapprove the plan in writing within 60 days. Generally, the plan becomes effective upon approval by the county; however, in the case of conditional approvals, the plan becomes effective after the municipality meets the conditions of approval.

A sample municipal stormwater management plan is provided in Appendix C.

Mitigation

Municipal stormwater management plans must incorporate design and performance standards that are as protective as those outlined in the Stormwater Management Rules or alternative standards in an adopted regional stormwater management plan. These design and performance standards focus on three areas: maintaining groundwater recharge from proposed development, minimizing the proposed development's impact on flooding, and minimizing the proposed development's water quality impact on state waters. Some projects have unique, site-specific conditions that prevent them from strict compliance with the performance standards. In order for the municipality to grant a waiver or exemption from strict compliance

with the groundwater recharge and stormwater runoff quality and quantity requirements, the MSWMP must include a mitigation process documented in a mitigation plan contained within the larger MSWMP.

The mitigation plan must identify the measures required to offset any potential impact created by granting the variance or exemption to the performance standards. Several strategies can be used to mitigate a development project and its impacts. Applicants can: identify, design, and implement a compensating measure to mitigate impacts; complete a project identified by the municipality as equivalent to the environmental impact created by the exemption or variance; or, provide funding for municipal projects that would address existing stormwater impacts.

The preferred option is to identify a mitigation project within the drainage area that directly compensates for the projected impact of the variance or exception. For example, because of natural site constraints, a proposed development might be unable to fully meet the groundwater recharge criteria, with the projected impact being an annual net loss of 50,000 cubic feet of groundwater recharge volume. In this case, a mitigation plan might require recovery of the lost recharge volume by capturing existing runoff from an impervious area on a site within the same drainage basin. Applicants can be directed to identify potential properties suitable for the mitigation project and secure the easements necessary to implement the projects.

Municipalities can plan for mitigation by identifying property owned by the municipality or by securing easements, as conditions of planning and zoning board approvals, that would allow implementation of future mitigation measures. Municipalities should develop a list of projects that need to be implemented throughout the municipality that would compensate for groundwater recharge, stormwater quality, and stormwater quantity impacts. Project mitigation is simplified when the municipality identifies and ranks a series of projects an applicant can select, especially on land owned or controlled by the municipality. The selection process should be clearly stated so the applicant and the municipality have predictability in the mitigation process. In its mitigation plan, a municipality can assign credits for proposed projects that address groundwater recharge and stormwater runoff quantity and quality problems within the drainage area.

If direct mitigation for the projected environmental impact is not feasible, an MSWMP may permit a non-equivalent project mitigation. Using the development example above, a mitigation plan may require a project that helps alleviate an existing impairment, such as fecal contamination in local streams, rather than one that compensates for the loss of groundwater recharge. Non-equivalent mitigation projects allow a municipality to target issues of greatest concern within a drainage area and secure the resources to correct them. In this example, the non-equivalent mitigation option might be pursued if close examination of local water resources indicates that fecal impairment is a more critical parameter in the receiving stream than small losses in groundwater recharge and baseflow. Clearly, the non-equivalent mitigation option must be cautiously approached; in this example, the long-term impacts of cumulative losses in groundwater recharge on the aquifer and baseflow must be carefully considered before granting a variance or exception.

The third, and least preferred, mitigation option is to require funding for specific projects within the municipality that would retrofit existing groundwater recharge and stormwater quality or quantity issues. In urban redevelopment areas, funding projects that address stormwater impacts on a regional basis, such as the development or implementation of regional stormwater management plans, may be more effective than a project that provides direct compensation for the performance standard. Planners implementing this option should ensure that the funding results in projects that provide adequate protection to compensate for the impact created by failing to strictly comply with the performance standards in the Stormwater Management Rules.

All mitigation plans and reviews should consider the location of mitigation projects in relation to the property where the projected damage will occur. For example, if a project is unable to achieve the stormwater quantity performance standards upstream of an inadequate culvert, a mitigation project downstream of that culvert would not offer similar protection. If the groundwater recharge is the major contributor to a wetlands area, the new project should continue to provide recharge to the wetlands area. A municipality can develop a mitigation plan that includes any or all of the options discussed above. Plans can

be as simple or as complex as the municipality chooses, provided they afford sufficient protection of the water resources. However, mitigation should not be an option until it is clearly demonstrated that on-site compliance is not practical.

Mitigation requirements should include a hierarchy of options that clearly offset the effect on groundwater recharge, stormwater quantity control, and/or stormwater quality control that was created by granting the variance or exemption. Mitigation must occur within the same drainage basin as that of the proposed development so that it provides benefits and protection similar to those that would have been achieved if the stormwater and recharge performance standards had been completely satisfied. Because these problems span political boundaries, mitigation projects could be located in adjacent municipalities within the drainage area with the cooperation of the municipalities, especially if a regional stormwater management plan has been developed for the drainage basin. The mitigation planning and approval process must ensure that long-term maintenance is achieved by clearly assigning responsibility for maintenance and by securing the funding and resources required to perform it.

Mitigation plans can differ greatly from municipality to municipality. As part of the mitigation plan development, consideration should be given to a specific municipality's water resource needs and ability to implement the plan. The following text is an example of a mitigation plan.

If a proposed development requests a variance or exemption from strict compliance with the groundwater recharge, stormwater quantity and stormwater quality requirements outlined in the Municipal Stormwater Management Plan and ordinances, the applicant must provide mitigation in accordance with the following:

1. A mitigation project must be implemented in the same drainage area as the proposed development. The project must provide additional groundwater recharge benefits, or protection from stormwater runoff quality and quantity from previously developed property that does not currently meet the design and performance standards outlined in the Municipal Stormwater Management Plan.
   - The applicant can select a project listed on the Municipal Stormwater Management Plan to compensate for the deficit from the performance standards resulting from the proposed project.
   - The applicant can obtain the necessary agreements to create a project to compensate for the deficit from the performance standards resulting from the proposed project.
   - The applicant must ensure the long-term maintenance of the project including the maintenance requirements under Chapters 8 and 9.
2. If a suitable mitigation site cannot be located in the same drainage area as the proposed development, as discussed under Option 1, the municipality may allow the applicant to provide funding to the municipality for an environmental enhancement project that has been identified in this Municipal Stormwater Management Plan. *[This option would be available only if the MSWMP includes a list of environmental enhancement projects that provide groundwater recharge, control flooding, or control nonpoint source pollution.]* The funding must be equal to or greater than the cost to implement the mitigation outlined above, including the costs associated with purchasing the property or easement for mitigation and the costs associated with the long-term maintenance requirements of the mitigation measure.

Build-Out

A build-out analysis allows a municipality to project future development based on existing zoning and land-use regulations. It develops a picture, projected visually on a map, of what will happen if land is developed to the maximum extent allowed by law. A build-out analysis is not only useful for communities with undeveloped land. Areas with significant redevelopment potential should be considered in developing a build-out analysis. Many urban and older suburban municipalities contain properties that are not developed to the full extent allowed under current zoning. For example, properties zoned for industrial use may contain residential developments. Or, a developer might assemble several small residential and retail properties for demolition and redevelopment as an office complex. A build-out analysis can identify those properties and project impacts of their potential redevelopment.

Each municipal stormwater management plan is required to include a build-out analysis with information about the municipality based on the HUC14 boundaries. A hydrologic unit code 14 (HUC14) is a specific drainage area defined by the U.S. Geological Survey. For every individual HUC14 area in the municipality, the full development impervious cover and the anticipated pollutant loading based on full development must be determined.

A build-out analysis has two phases. The first visually depicts changes on a map and is best performed using a Geographic Information System (GIS), which is a computerized system for developing, analyzing, and displaying locational data. GIS allows planners to combine data sources such as zoning maps, tax maps, HUC14, and topographic maps, into "layers" that can be displayed on one map.

- Begin by constructing a base map of your community that includes the municipal boundary, existing roads, surface water bodies, HUC14 boundaries, impervious cover, existing development by land use types, groundwater recharge areas, and wellhead protection area layers. Existing GIS information sources may be helpful in the development of this plan, such as the NJDEP-GIS website at http://www.state.nj.us/dep/gis. Counties, watershed associations, and universities may also have information useful for the development of the base map.
- Identify and delineate land that cannot be developed because of legal restrictions, physical constraints, or environmental sensitivity. Examples include lands in permanently preserved open space, public ownership, deed restrictions, utility easements, steep slopes, wetlands, floodplains, and Category 1 Waters with the associated special water resource protection areas.
- Identify and delineate developable land under current zoning and land use regulations, as well as land that is not currently developed or restricted as discussed above. Identify and delineate developed areas within the municipality that have significant redevelopment potential and that have not been developed to the maximum allowed. For these undeveloped and underdeveloped areas, determine maximum future development by projecting the largest number of housing units allowed in residential zones and the largest number of buildings and most intensive land uses in commercial and industrial zones.

The second phase quantifies the impact of the changes based on information provided by the maps. This includes calculations of percentage of impervious surfaces, number of housing units and their density, and remaining farmland and open space acreage. GIS can also assist in this computation by providing values for specific sets of layers such as the combination of the municipality, HUC14, and impervious area layers. This set of variables can provide the impervious cover for each HUC14 required by the Stormwater Management Rules. Values can be exported to other programs from GIS for more comprehensive computations, including the pollutant loading calculations also required by the regulations.

The pollutant load computation is a planning tool that helps municipalities evaluate anticipated pollutant loads from future development. Nonpoint source pollutant loads from current conditions should be compared to build-out conditions. If BMPs are required for the development of undeveloped or

underdeveloped areas by regulation, the implementation of BMPs and their impacts on loading should be incorporated into the analysis.

To calculate pollutant loads from land uses for both current and build-out conditions, the table of values below for total suspended solids, nitrogen, and phosphorus can be used for a broad perspective on a municipal level. To utilize the table, relate the zones on the zoning map to the listed land uses. Other pollutant loading values may also be used provided that the values are a better depiction of the municipality. Pollutant loads are required for each HUC14 in the municipality. For each land use within the HUC14, multiply the total acreage by the assigned load factor, which is given in pounds per acre per year. The total pollutant load for the HUC14 will be the sum of the loads for each land use.

Table 3-1: Pollutant Loads by Land Cover

Land Cover	TP load (lbs/acre/yr)	TN load (lbs/acre/yr)	TSS load (lbs/acre/yr)
High, Medium Density Residential	1.4	15	140
Low Density, Rural Residential	0.6	5	100
Commercial	2.1	22	200
Industrial	1.5	16	200
Urban, Mixed Urban, Other Urban	1.0	10	120
Agriculture	1.3	10	300
Forest, Water, Wetlands	0.1	3	40
Barrenland/Transitional Area	0.5	5	60

Note: References for Table 3-1 are provided at the end of this chapter.

The build-out analysis can go further than the requirements in the regulations. In addition to pollutant loads and impervious surfaces, the analysis can be used to assess open space plans, and to project school population and demand on municipal services. The build-out analysis can greatly benefit a municipality by envisioning its future so that steps can be taken to prevent unwanted impacts or plan for future needs. Finally, the build-out analysis should include a summary with critical findings, conclusions, and recommendations.

It is important to note that, although the pollutant loads for agricultural lands are higher than those for low density residential for the parameters in Table 3-1, converting agricultural lands to residential typically results in an increase in pollutant loads for metals and petroleum hydrocarbons; it is recommended that each municipality calculate build-out pollutant loads for each. Also, the total load of suspended solids due to stormwater runoff may decrease due to the conversion of agricultural lands to low density residential, but the percentage of impervious surfaces increases dramatically. If increases in stormwater runoff flows, due to the increase of impervious surfaces, are not managed properly, these high flows will increase stream bank erosion, thereby increasing sediment loads to the receiving waters.

Evaluation of Master Plan and Municipal Ordinances

The master plan and ordinances of the municipality must be analyzed as part of the requirements for the municipal stormwater management plan. They must be assessed to determine which aspects of the master plan and ordinances limit the use of nonstructural stormwater management strategies, as discussed in N.J.A.C. 7:8-5.3. These strategies include minimum disturbance, disconnection and minimization of impervious surfaces, pollution prevention techniques, and minimization of lawns. Elements of the plan and ordinances to be evaluated can include items such as minimum parking spaces, curbing, minimum lawn areas, and landscaping. Recommendations for revisions to the master plan and ordinances should be included in the MSWMP.

To fulfill the requirement that nonstructural stormwater management strategies be incorporated into local regulations and plans, as outlined in N.J.A.C. 7:8-5.3(b), municipal engineers and municipal planners must work together. This allows the municipality to address the issue cost-effectively using expertise already on staff.

In essence, this task requires that municipalities review and update their master plans (including the land use plan element), official maps, and development regulations (including zoning ordinance) to implement the principles of the nine nonstructural stormwater strategies in N.J.A.C. 7:8-5.3(b). *Chapter 2: Low Impact Development Techniques* can assist municipalities in the review of these documents to determine where changes should be made. A checklist is also provided in *Appendix B: Municipal Regulations Checklist – A Checklist for Incorporating Nonstructural Stormwater Management Strategies into Local Regulations.*

References

County of Morris, Department of Planning and Development. March 2001. Jackson Brook Watershed Stormwater Management Plan. Prepared by Killam Associates in association with Najarian Associates.

Horner, R.R., J.J. Skupien, E.H. Livingston and H.E. Shaver. August 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. In cooperation with the U.S. Environmental Protection Agency. Terrene Institute, Washington, pp 235-248.

Personal communication with Daniel Van Abs. October 25, 2002

Personal communication with Tavit O. Najarian. November 11, 2002.

Personal communication with Christopher Obropta. November 12, 2002, February 21 to March 5, 2003.

U.S. Environmental Protection Agency. March 2003. How to Do a Build-out Analysis. Green Communities Website. http://www.epa.gov/greenkit/build_out.htm.

References for Table 1: Pollutant Loads by Land Cover

Database of Total Phosphorus, Total Nitrogen, and Total Suspended Solids Export Coefficients

A database of literature values was assembled that includes approximately 4,000 values accompanied by site-specific characteristics such as location, soil type, mean annual rainfall, and site percent-impervious. In conjunction with the database, the contractor reported on recommendations for selecting values for use in New Jersey. Analysis of mean annual rainfall data revealed noticeable trends, and, of the categories analyzed, was shown to have the most influence on the reported export coefficients. Incorporating this and other contractor recommendations, the NJDEP took steps to identify appropriate export values by first filtering the database to include only those studies whose reported mean annual rainfall was between 40 and 51 inches. From the remaining studies, total phosphorus, total nitrogen, and total suspended solids values were selected based on best professional judgment for eight land use categories.

The sources incorporated in the database include a variety of governmental and non-governmental documents. All values used to develop the database and the total phosphorus values in this document are included in the following reference list.

Export Coefficient Database Reference List

Allison, F.E., E.M. Roller and J.E. Adams. 1959. Soil Fertility Studies in Lysimeters Containing Lakeland Sand. Tech. Bull. 1199, U.S. Dept. of Agriculture, Washington, D.C. p. 1-62.

Apicella, G. 2001. Urban Runoff, Wetlands and Waterfowl Effects on Water Quality in Alley Creek and Little Neck Bay. TMDL Science Issues Conference, WEF Specialty Conference.

Athayde, D. N, P. E. Shelly, E. D. Driscoll, D. Gaboury and G.B. Boyd. 1983. Results of the Nationwide Urban Runoff Program: Final Report. USEPA Water Planning Division. Washington, D.C.

Avco Economic Systems Corporation. 1970. Storm Water Pollution from Urban Land Activity. Rep.11034 FKL 07/70, Federal Water Qual. Adm., U.S. Dept. of Interior, Washington, D.C. p. 325.

Bannerman, R., K. Baun, M. Bohm, P. E. Hughes and D. A. Graczyk. 1984. Evaluation of Urban Nonpoint Source Pollution Management in Milwaukee County, Wisconsin, Report No. PB84-114164, U.S. Environmental Protection Agency, Region V, Chicago, IL.

Bengtson, R.L. and C.E. Carter. 1989. Simulating Soil Erosion in the Lower Mississippi Valley with the CREAMS Model. From: Application of Water Quality Models for Agricultural and Forested Watersheds, edited by D.B. Beasley and D.L Thomas. Southern Cooperative Series Bulletin No. 338.

Broadbent, F.E. and H.D. Chapman. 1950. A Lysimeter Investigation of Gains, Losses and Balance of Salts and Plant Nutrients in an Irrigated Soil. Soil Sci. Soc. Amer. Proc. 14:261-269.

Carter, Gail P.. 1998. Estimation of Nonpoint Source Phosphorus and Nitrogen Loads in Five Watersheds in New Jersey's Atlantic Coastal Drainage Basin. Surveying and Land Information Systems, Vol. 58, no 3. pp. 167-177.

CH2M Hill. 2000. Technical Memorandum 1, Urban Stormwater Pollution Assessment, prepared for North Carolina Department of Environment and Natural Resources, Division of Water Quality.

Claytor, R.A. and T.R. Schueler. 1996. "Design of Stormwater Filtering Systems," The Center for Watershed Protection, Prepared for Chesapeake Research Consortium, Inc.

Corsi, S.R., D.J. Graczyk, D.W. Owens and R.T. Bannerman. 1997. Unit-Area Loads of Suspended Sediment, Suspended Solids, and Total Phosphorus From Small Watersheds of Wisconsin. USGS FS-195-97.

Delaware Valley Regional Planning Commission. 1977. Average Pollutant Concentrations Associated with Urban Agriculture and Forest Land Use. Working Paper 5.01-1, Extent of NPS Problems.

Eck, P. 1957. Fertility Erosion Selectiveness on Three Wisconsin Soils. Ph. D. Thesis, Univ. of Wisconsin, Madison, WI.

F.X. Brown, Inc. 1993. Diagnostic-Feasibility Study of Strawbridge Lake. FXB Project Number NJ1246-01.

Frink, C.R. 1991. Estimating Nutrient Exports to Estuaries. Journal of Environmental Quality. 20:717-724.

Horner, R., B. W. Mar, L. E. Reinelt, J. S. Richey and J. M. Lee. 1986. Design of monitoring programs for determination of ecological change resulting from nonpoint source water pollution in Washington State. University of Washington, Department of Civil Engineering, Seattle, WA.

Horner, R.R. 1992. Water Quality Criteria/Pollutant Loading Estimation/Treatment Effectiveness Estimation. In R.W. Beck and Associates. Covington Master Drainage Plan. King County Surface Water Management Division, Seattle, WA.

Horner, Richard R., Joseph J. Skupien, Eric H. Livingston and H. Earl Shaver. 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. Prepared by the Terrene Institute, Washington, DC, in cooperation with the U.S. Environmental Protection Agency. EPA/840/B-92/002.

Johnston, W.R., F. Ittihadieh, R.M. Daum and A.F. Pillsbury. 1965. Nitrogen and Phosphorus in Tile Drainage Effluent. Soil Sci. Soc. Amer. Proc. 29:287-289.

Knoblauch, H.C., L. Kolodny and G.D. Brill. 1942. Erosion Losses of Major Plant Nutrients and Organic Matter from Collington Sandy Loam. Soil Sci. 53:369-378.

Loehr, R.C. 1974. Characteristics and comparative magnitude of non-point sources. Journal of WPCF 46(11):1849-1872.

Lopes, T.J., S.G. Dionne. 1998. A Review of Semivolatile and Volatile Organic Compounds in Highway Runoff and Urban Stormwater. U.S. Geological Survey, U.S. Department of Interior.

Marsalek, J. 1978. Pollution Due to Urban Runoff: Unit Loads and Abatement Measure, Pollution from Land Use Activities Reference Group. International Joint Commission, Windsor, Ontario.

McFarland, Anne M.S and L. M. Hauck. 2001. Determining Nutrient Export Coefficients and Source Loading Uncertainty Using In-stream Monitoring Data. Journal of the American Water Resources Association, pp. 223, 37. No. 1, February.

Menzel, R. G., E. D. Rhoades, A. E. Olness and S. J. Smith. 1978. Variability of Annual Nutrient and Sediment Discharges in Runoff from Oklahoma Cropland and Rangeland. Journal of Environmental Quality, 7:401-406.

Mills, W.B., D.B. Porcella, M.J. Ungs, S.A. Gherini, K.V. Summers, L. Mok, G.L. Rupp, G.L. Bowie. 1985. Water Quality Assessment – A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water – Part I and II. EPA-600/6-85-002A&B.

Minshall, N.E., M.S. Nichols and S.A. Witzel. 1969. Plant Nutrients in Base Flow of Streams in Southwestern Wisconsin. Water Resources. 5(3):706-713.

Mundy, C., M. Bergman. 1998. Technical Memorandum No. 29, The Pollution Load Screening Model: A tool for the 1995 District Water Management Plan and the 1996 Local Government Water Resource Atlases, Department of Water Resources, St. Johns River Water Management District.

NCDWQ. 1998. Neuse River Basinwide Water Quality Plan, Chapter 5, Section A.

Nelson, M.E. 1989. Predicting Nitrogen Concentrations in Ground Water An Analytical Model. IEP, Inc.

Northeast Florida Water Management District. 1994. St. Marks and Wakulla Rivers Resource Assessment and Greenway Protection Plan. Appendix 4.

Northern Virginia Planning District Commission. 1979. Guidebook for Screening Urban Nonpoint Pollution Management Strategies. Prepared for the Metropolitan Washington Council of Governments.

Novotny, V. and H. Olem. 1994. Water Quality: Prevention, Identification, and Management of Diffuse Pollution. Van Nostrand Reinhold, NY.

Omernik, J.M. 1976. The influence of land use on stream nutrient levels, U.S. EPA, January. EPA-60/3-76-014.

Omni Environmental Corporation. 1991. Literature Search on Stormwater Pollutant Loading Rates. Literature cited from DVRPC 1977; Wanielista et al. 1977; Whipple and Hunter 1977; NVPDC 1980; USEPA 1983; Mills et al. 1985; Nelson 1989; Walker et al. 1989.

Omni Environmental Corporation. 1999. Whippany River Watershed Program Stormwater Model Calibration and Verification Report.

Overcash, M. R., F. J. Humenik and J. R. Miner. 1983. Livestock Waste Management, Vol. II, CRC Press, Inc., Boca Raton, FL.

Pacific Northwest Environmental Research Laboratory. 1974. Relationships Between Drainage Area Characteristics and Non-Point Source Nutrients in Streams. Prepared for the National Environmental Research Center, August 1974.

Panuska, J.C. and R.A. Lillie. 1995. Phosphorus Loadings from Wisconsin Watersheds: Recommended Phosphorus Export Coefficients for Agricultural and Forested Watersheds. Research Management Findings, Bureau of Research, Wisconsin Department of Natural Resources, Number 38.

Pitt, R.E. 1991. Nonpoint Source Water Pollution Management. Dep. Civil Eng., Univ. Alabama, Birmingham, AL.

Polls, Irwin and Richard Lanyon. 1980. Pollutant Concentrations from Homogeneous Land Uses. Journal of the Environmental Engineering Division.

Prey, J., D. Hart, A. Holy, J. Steuer and J. Thomas. 1996. A Stormwater Demonstration Project in Support of the Lake Superior Binational Program: Summary. Wisconsin Dept. of Natural Resources. (http://www.dnr.state.wi.us/org/water/wm/nps/tpubs/summary/lakesup.htm)

Rast, W. and G.F. Lee. 1978. Summary Analysis of the North American (U.S. Portion) OECD Eutrophication Project: Nutrient Loading -- Lake Response Relationships and Trophic State Indices., EPA-600/3-78-008.

Reckhow, K.H., M.N. Beaulac and J.T. Simpson. 1980. Modeling of Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients. Report No. EPA 440/5-80-011. U.S. EPA, Washington, D.C.

Ryding, S. and W. Rast. 1989. The Control of Eutrophication of Lakes and Reservoirs. Man and the Biosphere Series, United Nations Educational Scientific and Cultural Organization, Paris, France.

Schueler, T.R. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Prepared for the Metropolitan Washington Council of Governments.

Sonzogni, W.C. and G.F. Lee. 1974. Nutrient Sources for Lake Mendota - 1972. Trans. Wisc. Acad. Sci. Arts Lett. 62:133-164.

Uchrin, C.G. and T.J. Maldanato. 1991. Evaluation of Hydrocarbons in Urban Runoff and in Detention Basins. Water Writes. Water Research Institute, Division of Coastal and Environmental Studies, Rutgers University.

United States Geological Survey, U.S. Department of the Interior. 1998. Comparison of NPDES Program Findings for Selected Cities in the United States, USGS Fact Sheet, January.

USEPA. 1987. Guide to Nonpoint Source Pollution Control. U.S. EPA, Criteria and Standards Division, Washington D.C.

USEPA. 1993. Urban Runoff Pollution Prevention and Control Planning (handbook). EPA/625/R-93/004.

USEPA. 2000. Watershed Analysis and Management (WAM) Guide for Tribes. (http://www.epa.gov/owow/watershed/wacademy/wam/)

Uttormark, P.D., J.D. Chapin and K.M. Green. 1974. Estimating nutrient loadings of lakes from non-point sources. (WRIL 160609). EPA-660/3-74-020. U.S. Environmental Protection Agency, Washington, D.C.

Walker, J.F. 1989. Spreadsheet Watershed Modeling for Nonpoint Source Pollution Management in a Wisconsin Basin, Water Resources Bulletin, Vol. 25, no. 1, pp. 139-147.

Wanielista, M.P., Y.A. Yousef and W.M. McLellon. 1977. Nonpoint Source Effects on Water Quality, Journal Water Pollution Control Federation, Part 3, pp. 441-451.

Washington State Department of Ecology. 2000. Stormwater Management Manual for Western Washington: Volume I Minimum Technical Requirements. Publication No. 99-11.

Weidner, R.B., A.G. Christianson, S.R. Weibel and G.G. Robeck. 1969. Rural Runoff as a Factor in Stream Pollution. J. Water Pollution. Con. Fed. 36(7):914-924.

Whipple, W. and J.V. Hunter. 1977. Nonpoint Sources and Planning for Water Pollution Control. Journal Water Pollution Control Federation. pp. 15-23.

Whipple, W., et al. 1978. Effect of Storm Frequency on Pollution from Urban Runoff, J. Water Pollution Control Federation. 50:974-980.

Winter, J.G. and H.C. Duthie. 2000. Export Coefficient Modeling to assess phosporus loading in an urban watershed. Journal of American Water Resources Association. Vol. 36 No. 5.

Zanoni, A.E. 1970. Eutrophic Evaluation of a Small Multi-Land Use Watershed. Tech. Completion Rep. OWRR A-014-Wis., Water Resources Center, Univ. of Wisconsin, Madison, WI.

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CHAPTER 4

Stormwater Pollutant Removal Criteria

This chapter presents the criteria and methodologies necessary to determine the pollutant removal rates of stormwater management measures used individually and in series to meet the stormwater quality requirements of the Stormwater Management Rules at N.J.A.C. 7:8. According to these Rules, a "major development" project that creates at least 0.25 acres of new or additional impervious surface must include stormwater management measures that reduce the average annual total suspended solids (TSS) load in the development site's post-construction runoff by 80 percent. This 80 percent requirement has been based, in part, upon Section 6217(g) of the 1990 Coastal Zone Management Act Reauthorization Amendments as enforced by the U.S. Environmental Protection Agency. In addition, these stormwater management measures must reduce the average annual nutrient load in the post-construction runoff by the maximum extent feasible. This requirement has been included in the Stormwater Management Rules because nutrients, consisting primarily of various forms of nitrogen and phosphorous, are recognized as a major class of stormwater pollutants from land development.

The stormwater management measures used to reduce the average annual TSS and nutrient loads can be structural and/or nonstructural in nature. To achieve the reduction requirements, they must be designed to treat the runoff from the stormwater quality design storm, a 1.25-inch/2-hour variable rate rainfall event. Details of the stormwater quality design storm are presented in *Chapter 5: Computing Stormwater Runoff Rates and Volumes*. Details of nonstructural and structural stormwater management measures, also known as Best Management Practices (BMPs), are presented respectively in *Chapter 2: Low Impact Development Techniques* and *Chapter 9: Structural Stormwater Management Measures*.

TSS Removal Rates for Individual BMPs

As noted above, the Stormwater Management Rules require an 80 percent TSS reduction in the post-construction runoff from a land development site that increases impervious surface by 0.25 acres or more. This reduction is to be achieved by conveying the site's runoff through one or more onsite BMPs that have the ability to remove a portion of the TSS load. To demonstrate compliance with this requirement, the NJDEP has adopted official TSS removal rates for each of the BMPs described in detail in Chapter 9. These BMPs and their adopted TSS removal rates are presented below in Table 4-1. Different removal rates and BMPs may be utilized if supporting information is provided and accepted by the applicable review agencies.

It is important to note that the TSS removal rates shown in Table 4-1 have been based upon several sources of BMP research and monitoring data as well as consultation with numerous stormwater management experts. As demonstrated by that research, actual TSS removals at specific BMPs during specific storm events will depend upon a number of site factors and can be highly variable. As such, the TSS removal rates presented in Table 4-1 are considered representative values that are based upon a recognition of this variability and the state's need to develop and implement a statewide stormwater management program. Furthermore, the TSS removal rates are also considered to accurately represent the relative TSS removal efficiencies of the various BMPs listed in the table.

Table 4-1: TSS Removal Rates for BMPs

Best Management Practice (BMP)	Adopted TSS Removal Rate (%)
Bioretention System	90
Constructed Stormwater Wetland	90
Dry Well	Volume Reduction Only[1]
Extended Detention Basin	40 to 60[2]
Infiltration Structure	80
Manufactured Treatment Device	See N.J.A.C. 7:8-5.7(d)[3]
Pervious Paving System	Volume Reduction Or 80[4]
Sand Filter	80
Vegetative Filter	60-80
Wet Pond	50-90[5]

[1] See text below.
[2] Final rate based upon detention time. See Chapter 9.
[3] To be determined through testing on a case-by-case basis. See text below.
[4] If system includes a runoff storage bed that functions as an infiltration basin. See Chapter 9.
[5] Final rate based upon pool volume and detention time. See Chapter 9.

As shown in Table 4-1, a dry well and certain types of pervious paving do not have an adopted TSS removal rate. This is due to the fact that, as described in Chapter 9, a dry well is intended to infiltrate runoff only from a roof and other impervious area with minimal TSS loading. A pervious paving system without a runoff storage bed can reduce the runoff volume from standard paving, but is not used to treat runoff from other impervious areas. As such, these systems are not considered to be effective in reducing the overall TSS load from a development site. However, in recognition of their infiltration ability, both BMPs can be used to reduce the volume of development site runoff and, consequently, the size and cost of other onsite BMPs. Use of these "volume reduction" BMPs are illustrated in Example 4-2 below and described in detail in Chapter 5.

In addition, Table 4-1 also indicates that the adopted TSS removal rates for manufactured treatment devices must be determined on a case-by-case basis. Manufactured treatment devices are proprietary water quality devices that use a variety of stormwater treatment techniques. They have and continue to be developed by a variety of companies. As such, the actual TSS removal rate for a specific device will depend on a number of factors, and a single representative TSS removal rate cannot be developed. Instead, the NJDEP's Division of Science, Research & Technology (DSRT) is responsible for certifying final pollutant removal rates for all manufactured treatment devices. This certification process is described in detail in Chapter 9.

Finally, as noted in Table 4-1, the adopted TSS removal rates for extended detention basins and wet ponds will vary depending on such specific features as detention time and permanent pool volume. Details for each BMP are also provided in Chapter 9.

TSS Removal Rates for BMPs in Series

The TSS removal rates specified in Table 4-1 for certain BMPs range as low as 40 percent, which indicates that these BMPs will not be able to meet the 80 percent TSS reduction requirement by themselves. As such, it will be necessary at times to use a series of BMPs in a treatment train to achieve the required 80 percent TSS removal rate. In such cases, the total removal rate of the BMP treatment train is based on the removal rate of the second BMP applied to the fraction of the TSS load remaining after the runoff has passed through the first BMP (Massachusetts DEP, 1997).

A simplified equation for the total TSS removal rate (R) for two BMPs in series is:

$$R = A + B - [(A \times B) / 100] \qquad \text{(Equation 4-1)}$$

Where:

R = Total TSS Removal Rate

A = TSS Removal Rate of the First or Upstream BMP

B = TSS Removal Rate of the Second or Downstream BMP

The use of this equation is demonstrated in Example 4-1 below.

Example 4-1: Total TSS Removal Rate for BMPs in Series

A stormwater management system consists of both a vegetative filter and an extended detention basin to collect and treat runoff from a small commercial parking lot. Runoff from the parking lot will sheet flow off the parking lot through the filter strip, which will have a turf grass surface cover, before being discharged to the extended detention basin. The extended detention basin will have a detention time of 18 hours.

From Table 4-1 and Chapter 9, the adopted TSS removal rates for these individual BMPs are:

Turf Grass Vegetative Filter = 60%

Extended Detention Basin with 18-Hour Detention Time = 50%

From Equation 4-1,

$R = A + B - [(A \times B) / 100]$

$R = 60 + 50 - [(60 \times 50) / 100] = 110 - 30 = 80\%$ Total TSS Removal Rate

It should be noted that the total TSS removal rate of the stormwater management system described in Example 4-1 above can also be computed by the following technique:

Initial TSS Load Upstream of Vegetated Filter Strip = 1.0

TSS Load Removed by Vegetated Filter Strip = 1.0 X 60% Removal Rate = 0.6

Remaining TSS Load Downstream of Vegetated Filter Strip = 1.0 – 0.6 = 0.4

TSS Load Removed by Extended Detention Basin = 0.4 X 50% Removal Rate = 0.2

Final TSS Load Downstream of Extended Detention Basin = 0.4 – 0.2 = 0.2

Total TSS Removal Rate = 1.0 – 0.2 = 0.8 or 80%

This technique can also be used in place of Equation 4-1 when there are more than two BMPs in series.

Guidelines for Arranging BMPs in Series

As described in Example 4-1, it may be necessary or desirable to use a series of BMPs in a treatment train to provide adequate TSS removal. In selecting the order or arrangement of the individual BMPs, the following general guidelines should be followed:

1. Arrange the BMPs from upstream to downstream in ascending order of TSS removal rate. In this arrangement, the BMP with the lowest TSS removal rate would be located at the upstream end of the treatment train. Downstream BMPs should have progressively higher TSS removal rates.
2. Arrange the BMPs from upstream to downstream in ascending order of nutrient removal rate. Similar to 1 above, the BMP with the lowest nutrient removal rate would be located at the upstream end of the treatment train in this arrangement. Downstream BMPs should have progressively higher nutrient removal rates.
3. Arrange the BMPs from upstream to downstream by their relative ease of sediment and debris removal. In this arrangement, the BMP from which it is easiest to remove collected sediment and debris would be located at the upstream end of the treatment train. In downstream BMPs, it should be progressively more difficult to remove sediment and debris.

In applying these guidelines, it is recommended that they generally be applied in the order presented above. As such, a series of BMPs would be preliminarily arranged in accordance with their relative TSS removal rates (Guideline 1). This preliminary arrangement would then be refined by the BMPs' relative nutrient removal rate (Guideline 2) and then their ease of sediment and debris removal (Guideline 3). Two or more

iterations may be necessary to select the optimum arrangement, which should also include consideration for site conditions and the abilities and equipment of the party responsible for the BMPs' maintenance.

Finally, it should be noted that, unless otherwise approved by the applicable reviewing agencies or specifically indicated in the certification of a specific manufactured treatment device, all manufactured treatment devices that achieve TSS removal primarily through swirling and/or baffles should be placed at the upstream end of a treatment train.

Sites with Multiple Discharge Points and Subareas

In general, if runoff is discharged from a site at multiple points, the 80 percent TSS removal requirement will have to be applied at each discharge point. However, the application of this requirement will depend upon the exact amount of physical and hydraulic separation between the various discharge points. If the runoff from two or more discharge points combine into a single waterway or conveyance system before leaving the site, these separate discharge points can be considered as a single one for purposes of computing TSS removal.

In addition, where there are multiple onsite subareas to a single discharge point, the removal rates for the subareas can be combined through a weighted averaging technique. It should be noted that the averaging of TSS removal rates is applicable only where the anticipated pollutant loadings from each of the subareas are similar. As such, the TSS removal rate for an onsite BMP receiving runoff from a commercial parking lot cannot be averaged with a second onsite BMP serving a lawn or landscaped area.

Example 4-2 below provides further explanations of the procedures described above for computing TSS removal rates at sites with both multiple discharge points and subareas.

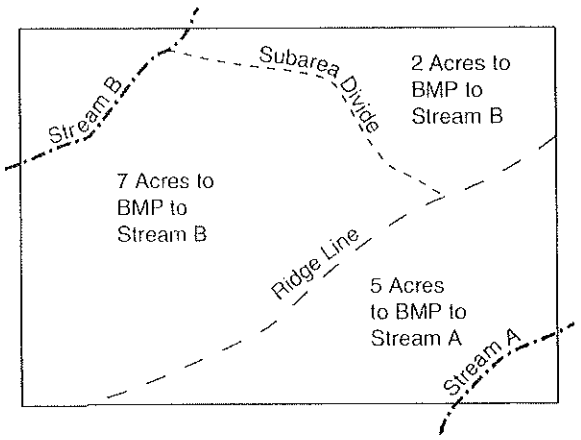
Example 4-2: TSS Removal Rates at Sites with Multiple Discharge Points and Subareas

A 15-acre site has a ridge running through it from northeast to southwest. Five acres of the site drain in a southeasterly direction to Stream A, while the remaining 10 acres drain in a northwesterly direction to Stream B. Since Stream A and B do not join on the site, each portion of the site will have to be evaluated separately for compliance with the 80 percent TSS removal requirement.

Southeast Drainage to Stream A

The site runoff to Stream A will first be routed through a bioretention system.

The bioretention system TSS removal rate is 90 percent. This exceeds the 80 percent removal requirements and meets the TSS removal requirement for the southeast drainage area.



Northwest Drainage to Stream B

One acre of rooftop runoff from the stormwater quality design storm will be directed to dry wells, thereby reducing the drainage area to be served by other BMPs by 1 acre. The remaining 9 acres to Stream B are divided into two subareas of 2 and 7 acres, respectively. A vegetative filter will treat the runoff from one of the subareas, while a constructed stormwater wetland will treat the runoff from other. The anticipated pollutant loadings from each subarea are similar.

The TSS removal rate for a vegetative filter with meadow is 70 percent, which is not sufficient by itself to meet the 80 percent TSS removal requirement. However, the constructed stormwater wetland TSS removal rate is 90 percent, which exceeds the 80 percent TSS removal requirement. By averaging of removal rates, the use of these two BMPs may be sufficient to meet the 80 percent removal requirement for this portion of the site.

Two alternatives to address the TSS load in the runoff from the northwest portion of the site to Stream B are presented below.

OPTION A: The meadow vegetative filter will be used to treat the runoff from the 7 acre subarea, while the constructed stormwater wetland will be used in the 2 acre subarea.

Apply the various TSS removal rates to the areas to be treated by each BMP and determine the average TSS removal rate for the entire northwest portion of the site.

7 Acres X 70% TSS Removal for Vegetative Filter= 4.9

2 Acres X 90% TSS Removal for Wetland = 1.8

Total Acreage-Removal Rate = 4.9 + 1.8 = 6.7

6.7 Total Acreage-Removal Rate / 9 Acres = 0.74 or 74% Average TSS Removal Rate

Therefore, for Option A, the northwest portion of the site does not meet the 80 percent TSS removal requirement.

OPTION B: The vegetative filter will be used to treat the runoff from the 2 acre subarea, while the constructed stormwater wetland will be used in the 7 acre subarea.

Once again, apply the various TSS removal rates to the areas to be treated by each BMP and determine the average TSS removal rate for the entire northwest portion of the site.

2 Acres X 70% TSS Removal for Vegetative Filter = 1.4

7 Acres X 90% TSS Removal for Wetland = 6.3

Total Acreage-Removal Rate = 1.4 + 6.3 = 7.7

7.7 Total Acreage-Removal Rate / 9 Acres = 0.86 or 86% Average TSS Removal Rate

Therefore, for Option B, the northwest portion of the site does meet the 80 percent TSS removal requirement.

Nutrients

In addition to TSS removal, the Stormwater Management Rules also require the reduction of post-construction nutrients to the maximum extent feasible. In general, to demonstrate compliance with this requirement, a two step approach should be used. First, the input of nutrients to the drainage area should be limited as much as feasible. Second, when selecting a stormwater management measure to address the TSS removal requirement, the measure with the best nutrient removal rate that also best meets the site's constraints should be chosen. Details of each step in this approach are provided below.

Reducing Nutrient Input

A significant amount of nutrients are in stormwater runoff due to fertilization of lawns. As described in Chapter 2, lawns should be minimized in favor of other vegetated cover. Existing site areas with desirable vegetation communities should be left in a natural state and forested areas and meadows should be considered as alternatives to the standard lawn. Ground covers provide aesthetically pleasing, innovative landscapes that are adaptable to the local environment. These types of land cover reduce lawn area and the consequent need for fertilization. A landscape design that minimizes the use of lawn can be beneficial in preventing pesticides, as well as nutrients from fertilizers, from stormwater runoff.

Soil testing determines the soil nutrient level as well as pH. Using the test results to determine the appropriate application of lime and fertilizer required for lawn areas will increase efficient uptake and decrease associated costs of lawn maintenance as well as minimize nutrient input. Low or no phosphorous fertilizers may be adequate to maintain the health of the landscape after the vegetation has fully established. Soil test kits are available at most lawn and garden care centers as well as through the Rutgers Cooperative Extension county offices. Fertilization specifications must be included in the maintenance manual.

Pet waste is another source of nutrients in stormwater runoff. To prevent or minimize pet waste problems, residents must be required to pick up after their animal and dispose of the material in the toilet or garbage. Homeowner associations must include this condition in homeowner's agreements. Signage should be located strategically throughout the development to reinforce this criterion. Education is critical to successful pet waste management.

Nutrient Removal Rates

Site conditions and the need to reduce post-construction TSS by 80 percent are primary factors in the selection of appropriate BMPs for a development site. However, removal of nutrients such as phosphorous and the various forms of nitrogen must also be considered in this selection process. The chosen BMP must meet the TSS criteria, but must also maximize nutrient removal for the site. To assist with the selection of BMPs for nutrients, information regarding estimated nutrient removal rates is provided in Table 4-2.

Table 4.2 – Typical Phosphorous and Nitrogen Removal Rates for BMPs

Best Management Practice (BMP)	Total Phosphorous Removal Rate (%)	Total Nitrogen Removal Rate (%)
Bioretention Basin	60	30
Constructed Stormwater Wetland	50	30
Extended Detention Basin	20	20
Infiltration Basin	60	50
Manufactured Treatment Devices	See N.J.A.C. 7:8-5.7(d)	See N.J.A.C. 7:8-5.7(d)
Pervious Paving[2]	60	50
Sand Filter	50	35
Vegetative Filter	30	30
Wet Pond	50	30

The nutrient removal rates presented in Table 4-2 should be considered typical values based upon data from a range of research studies. Due to the multiple forms and complex behavior of nutrients in stormwater runoff and the similarly complex processes by which nutrient loading is altered by BMPs, actual removal rates for specific BMPs and development sites may vary.

The nutrient removal data in Table 4-2 is intended to assist designers in the selection of appropriate BMPs to meet both the 80 percent TSS and maximum feasible nutrient removal requirements in the NJDEP Stormwater Management Rules. During this selection process, primary consideration should be given to achieving the Rules' 80 percent TSS removal requirement with one or more BMPs that are compatible with and responsive to site conditions and constraints, maintenance needs, and safety concerns. The selection process should then be further refined to achieve the Rules' maximum feasible nutrient requirement utilizing the structural BMP data in Figure 4.2 and, as necessary, other appropriate resources. In doing so, it should be remembered that many nonstructural BMPs can also help achieve the nutrient removal requirement, and must be considered prior to the use of structural BMPs.

The nutrient removal data in Table 4-2 can also be used to optimize existing BMP retrofits.

Additional Considerations

From the information presented in this chapter, it should be evident that BMPs are intended to reduce the pollutants in stormwater runoff. However, sometimes an unintended consequence of stormwater management facilities is their attractiveness to waterfowl, such as Canada geese. Canada geese are attracted to lawn areas adjacent to water bodies. As such, wet ponds and other stormwater management structures can appeal to these waterfowl, whose resulting fecal input can result in an increase in nutrient loading to systems that are intended to reduce such pollutants. As a result, adjustments to a BMP's design and/or maintenance plan may be necessary to discourage waterfowl from contributing pollutants to the stormwater measure. Additional guidance on Canada geese is available in Management of Canada Geese in Suburban Areas: A Guide to the Basics, available at http://www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/Goosedraft.pdf.

References

Claytor, R. and T. Schueler. December. 1996. Design of Stormwater Filtering Systems. The Center for Watershed Protection. Ellicott City, MD.

Center for Watershed Protection. March 2003. Impacts of Impervious Cover on Aquatic Systems – Watershed Protection Research Monograph No. 1. Ellicott City, MD.

Desbonnet, A., P. Pogue, V. Lee, and N Wolff. 1994. Vegetated Buffers in the Coastal Zone – A Summary Review and Bibliography, Coastal Resources Center Technical Report No. 2064. University of Rhode Island Graduate School of Oceanography. Narragansett, RI.

Horner, R.R., J.J. Skupien, E.H. Livingston and H.E. Shaver. August 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. In cooperation with U.S. Environmental Protection Agency. Terrene Institute, Washington, D.C.

Langan, T. National Stormwater BMP Database, NSW Statistical Summary 6-18-03 Tables.

New Jersey Department of Agriculture. November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.

New Jersey Department of Environmental Protection and Department of Agriculture. December 1994. Stormwater and Nonpoint Source Pollution Control Best Management Practices.

Schueler, T.R. July 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R., P.A. Kumble and M. Heraty. March 1992. A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C.

Massachusetts Department of Environmental Protection. 1997. Stormwater Management Volume Two: Stormwater Technical Handbook.

Schueler, T.R. and R.A. Claytor. 2000. Maryland Stormwater Design Manual. Maryland Department of the Environment. Baltimore, MD.

Strecker, E.W., M.M. Quigley, B. Urbonas. Results of Analyses of the Expended EPA/ASCS National BMP Database.

Winer, R. June 2000. National Pollutant Removal Performance Database for Stormwater Treatment Practices, 2nd Edition, Center for Watershed Protection.

Wong, S.L. and R.H. McCuen. Design of Vegetated Buffer Strips for Runoff and Sediment Control.

CHAPTER 5

Computing Stormwater Runoff Rates and Volumes

This chapter discusses the fundamentals of computing stormwater runoff rates and volumes from rainfall through the use of various mathematical methods. To do so effectively, the chapter also describes the fundamentals of the rainfall-runoff process that these methods attempt to simulate. Guidance is also provided in the use of the Natural Resources Conservation Service, Rational, and Modified Rational Methods that are specifically recommended and/or required by the NJDEP Stormwater Management Rules at N.J.A.C. 7:8. This guidance includes use of the methods to comply with the Rules' groundwater recharge, stormwater quality, and stormwater quantity requirements.

Fundamentals

The actual physical processes that convert rainfall to runoff are both complex and highly variable. As such, these processes cannot be replicated mathematically with exact certainty. However, through the use of simplifying assumptions and empirical data, there are several mathematical models and equations that can simulate these processes and predict resultant runoff volumes and rates with acceptable accuracy.

The selection of the appropriate model or equation depends upon a number of factors.

Desired Results

Some methods, such as the Rational Method, can be used to produce estimates of peak runoff rates, but cannot predict total runoff volumes. Other methods, conversely, can only produce estimates of total runoff volumes, while others, such as the Natural Resources Conservation Service (NRCS) methods, can accurately predict both total runoff volume and peak rate, and even entire runoff hydrographs.

Drainage Area Size

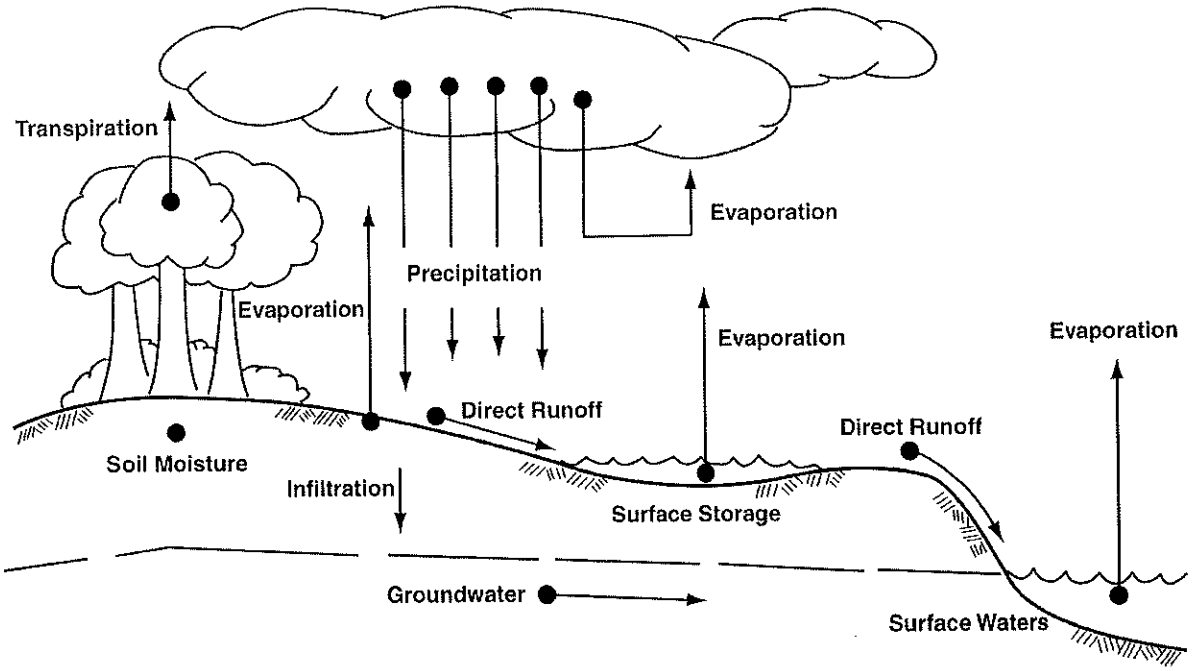
Due to their assumptions and/or theoretical basis, some methods can accurately predict runoff volumes or rates only for single drainage areas of 20 acres or less, while other methods can be applied to watersheds of 20 square miles or more with 100 or more subareas.

Data Availability

Simple methods, such as the Rational or Modified Rational Methods, require limited rainfall and drainage area data, while other, more sophisticated methods have extensive data needs, including long-term rainfall and temperature data as well as drainage area soils, subsoil, and ground cover information. In general, the more data-intensive models can produce more comprehensive runoff predictions.

In general, stormwater runoff can be described as a by-product of rainfall's interaction with the land. This interaction is one of several processes that the earth's water may go through as it continually cycles between the land and the atmosphere. In addition, stormwater runoff is only one of many forms water may take during one of these cycles, known scientifically as the hydrologic cycle. Shown in Figure 5-1 below, the hydrologic cycle depicts both the primary forms that water can take and the cyclical processes that produce them. In addition to runoff, these processes include precipitation, evaporation from surfaces or the atmosphere, evapotranspiration by plants, and infiltration into the soil or groundwater. As such, water that precipitates as rainfall can wind up or at least spend time on ground or plant surfaces, in the atmosphere, within the various soil layers, or in waterways and water bodies.

Figure 5-1: The Hydrologic Cycle



Source: Fundamentals of Urban Runoff Management.

In general, all runoff computation methods are, to some degree, mathematical expressions of the hydrologic cycle. However, most transform its cyclical character to a linear one, treating rainfall as an input and producing runoff as an output. During this transformation, each method uses mathematical approximations of the real rainfall-runoff processes to produce its estimates of runoff volume and/or rate. As described above, each method has its own complexity, data needs, accuracy, and range of results.

As the key input, rainfall is generally characterized by its size, intensity, and the frequency of its occurrence. The size of a rain storm is the total precipitation that occurs over a particular duration. How

often this size of storm is likely to reoccur is called its recurrence interval. For instance, a rainfall of certain duration that occurs, on average, once every 25 years would have an average recurrence interval of 25 years or be called a 25-year storm.

Since storms have been shown to be mathematically random events, their recurrence can also be specified as an annual probability. The equation for converting between recurrence interval and annual probability is:

Annual probability (in percent) = 100/recurrence interval (in years)

For example, the 25-year storm noted above could also be described as having a probability of 4 percent (=100/25) or a 4 percent chance of being equaled or exceeded in any given year. Similarly, a 2-year storm has a 50 percent chance (=100/2), a 10-year storm has a 10 percent chance (=100/10), and a 100-year storm has a 1 percent chance (=100/100) of being equaled or exceeded in a given year. Resultant runoff peak rates and volumes events can also be described in such terms.

Runoff volumes are influenced primarily by the total amount of rainfall. However, runoff rates resulting from a given rainfall, including the peak rate or discharge, are influenced primarily by the rainfall's distribution, which is how the rainfall rate or intensity varies over a period of time. Studies of rainfall records show that actual storm distributions and durations can vary considerably from event to event. A rainfall may be evenly distributed over a time period or can vary widely within that same period. Its duration can also be long or very short. These different types of rain events can produce extremely different runoff volumes and peak discharges.

Runoff computation methods deal with this rainfall variability in one of two general ways. Many methods, including the Rational and NRCS methods, rely on a hypothetical rain event known as a design storm for their rainfall input. This single, hypothetical storm event is based on a compilation of local or regional rainfall data recorded over an extended time period. To use a design storm, the user must make some assumptions about the antecedent ground and waterway conditions that exist at its start. Most runoff computations are based on average antecedent conditions, although wetter or drier conditions can also be used depending upon the user's interests and concerns.

Instead of compiling long-term rainfall data into a single design storm, other runoff computation methods address the variability of real rain events by analyzing a long series of them, computing runoff rate and volume estimates for each. While such methods need only the exact antecedent conditions that existed prior to the first storm, they must mathematically account for changes in ground and waterway conditions during intervening dry periods. Therefore, such methods are generally more complex than design storm methods and, obviously, require extensive rainfall data for the drainage area or watershed under analysis. Their results, however, are based on the actual long-term rainfall history of the watershed instead of a single, hypothetical design storm.

In addition to rainfall and antecedent conditions, other factors that can significantly affect both runoff volume and peak discharge are the hydrologic characteristics of the soils in the watershed and the type of surface that covers those soils. This cover may vary from pervious surfaces such as woods and grass to impervious surfaces such as roofs, roadways, and parking lots. Another factor that can greatly influence the peak runoff rate or discharge is the time of concentration (Tc). This is a measure of how quickly or slowly a watershed will respond to rainfall input and is usually measured as the time required for runoff to travel from the hydraulically most distant point in the watershed to the point of analysis at the watershed's lower end. Factors such as surface roughness, irregularity, length, and slope generally affect a watershed's Tc.

In summary, runoff computation methods attempt to mathematically reproduce or simulate the hydrologic cycle. They treat rainfall as an input, converting it into estimates of resultant runoff volume and/or rate. There are certain characteristics of both the rainfall event and the area upon which it falls that can influence the resulting runoff. These include:

1. High intensity rainfall will generally produce a greater peak discharge than a rainfall that occurs over a longer time period.
2. Highly porous or permeable soils that can rapidly infiltrate rainfall generally produce less runoff volume than soils with more restrictive infiltration.
3. Dense vegetation such as woodland intercepts and help infiltrates rainfall, thereby reducing runoff volumes and rates.
4. Conversely, impervious areas such as roadways and rooftops prevent infiltration and increase runoff volumes and rates.
5. Drainage areas with shorter times of concentration will have higher peak runoff rates than those with a longer Tc.

Runoff Computation Methods

As described in the Stormwater Management Rules, the NJDEP has specified that one of two general runoff computation methods be used to compute runoff rates and volumes. These are the NRCS methodology, which consists of several components, and the Rational Method (and the associated Modified Rational Method), which are generally limited to drainage areas less than 20 acres. A general description of each method is provided below.

NRCS Methodology

The USDA Natural Resources Conservation Service (NRCS) methodology is perhaps the most widely used method for computing stormwater runoff rates, volumes, and hydrographs. It uses a hypothetical design storm and an empirical nonlinear runoff equation to compute runoff volumes and a dimensionless unit hydrograph to convert the volumes into runoff hydrographs. The methodology is particularly useful for comparing pre- and post-development peak rates, volumes, and hydrographs. The key component of the NRCS runoff equation is the NRCS Curve Number (CN), which is based on soil permeability, surface cover, hydrologic condition, and antecedent moisture. Watershed or drainage area time of concentration is the key component of the dimensionless unit hydrograph.

Several runoff computation methods use the overall NRCS methodology. The most commonly used are the June 1986 *Technical Release 55 – Urban Hydrology for Small Watersheds* (TR-55), the April 2002 *WinTR-55 – Small Watershed Hydrology* computer program, and *Technical Release 20 – Computer Program for Project Formulation: Hydrology* (TR-20) published by the NRCS. The computer programs *HEC-1 Flood Hydrograph Package* and *HEC-HMS Hydrologic Modeling System* published by the U.S. Army Corps of Engineers' Hydrologic Engineering Center also contain components of the NRCS methodology. A complete description of the NRCS methodology can be found in the NRCS *National Engineering Handbook Section 4 – Hydrology* (NEH-4).

Rational Method

The Rational Method uses an empirical linear equation to compute the peak runoff rate from a selected period of uniform rainfall intensity. Originally developed more than 100 years ago, it continues to be useful in estimating runoff from simple, relatively small drainage areas such as parking lots. Use of the Rational Method should be limited to drainage areas less than 20 acres with generally uniform surface cover and topography. It is important to note that the Rational Method can be used only to compute peak runoff rates. Since it is not based on a total storm duration, but rather a period of rain that produces the peak runoff rate, the method cannot compute runoff volumes unless the user assumes a total storm duration. Complete descriptions of the Rational Method can be found in many hydrology and drainage textbooks.

Modified Rational Method

The Modified Rational Method is a somewhat recent adaptation of the Rational Method that can be used to not only compute peak runoff rates, but also to estimate runoff volumes and hydrographs. This method uses the same input data and coefficients as the Rational Method along with the further assumption that, for the selected storm frequency, the duration of peak-producing rainfall is also the entire storm duration. Since, theoretically, there are an infinite number of rainfall intensities and associated durations with the same frequency or probability, the Modified Rational Method requires that several of these events be analyzed in the method to determine the most severe. Similar to the Rational Method, there are several urban hydrology and drainage publications that contain descriptions of the Modified Rational Method, including Appendix A-9 of the *Standards for Soil Erosion and Sediment Control in New Jersey* published by the New Jersey State Soil Conservation Committee. Use of the Modified Rational Method should also be limited to drainage areas less than 20 acres with generally uniform surface cover and topography.

Design Storms

To fully comply with the NJDEP Stormwater Management Rules, stormwater runoff must be computed for three types of rainfall or storm events. These storms are associated with the groundwater recharge, stormwater quality, and stormwater quantity requirements in the Rules. A description of each storm and the techniques used to model it in the NRCS, Rational and Modified Rational methods are presented below.

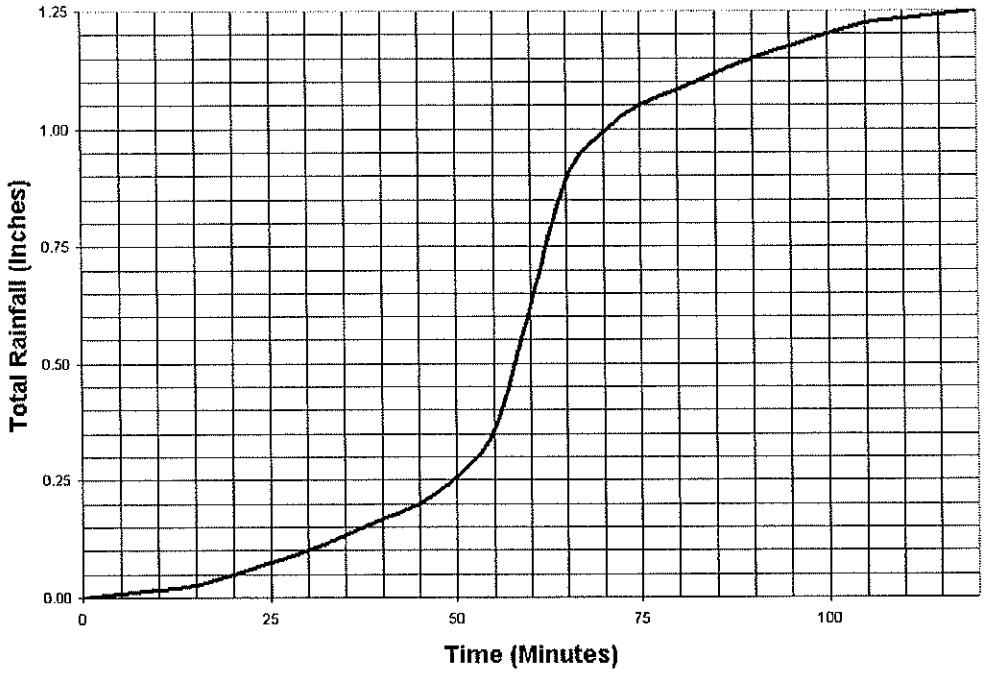
Groundwater Recharge Design Storm

As described in detail in *Chapter 6: Groundwater Recharge*, the NJDEP's groundwater recharge requirements are actually met through the analysis of a series of rainfall events derived from long-term New Jersey data. However, these events can also be expressed by an equivalent groundwater recharge design storm that represents the largest rainfall that must be controlled by a groundwater recharge facility. Due to the relatively small size of both the statistical rainfall series and the equivalent Design Storm, the NJDEP has developed specialized equations to compute the resultant runoff volume from each. The basis and use of these equations are described in detail in *Chapter 6: Groundwater Recharge.*

Stormwater Quality Design Storm

This is the rainfall event used to analyze and design structural and nonstructural stormwater quality measures (known as Best Management Practices or BMPs). As described in the Stormwater Management Rules, the NJDEP stormwater quality design storm has a total rainfall depth of 1.25 inches and a total duration of two hours. During its duration, the rain falls in a nonlinear pattern as depicted in Figure 5-2 below. This rainfall pattern or distribution is based on Trenton, New Jersey rainfall data collected between 1913 and 1975 and contains intermediate rainfall intensities that have the same probability or recurrence interval as the storm's total rainfall and duration. As such, for times of concentration up to two hours, the stormwater quality design storm can be used to compute runoff volumes, peak rates, and hydrographs of equal probability. This ensures that all stormwater quality BMPs, whether they are based on total runoff volume or peak runoff rate, will provide the same level of stormwater pollution control.

Figure 5-2: NJDEP 1.25-Inch/2-Hour Stormwater Quality Design Storm



The NJDEP stormwater quality design storm can be used to analyze and design stormwater quality BMPs based on the Rational, Modified Rational, or NRCS methods. Selection of the appropriate method will depend on the type of BMP selected and its required design data. BMPs that essentially store, treat, and slowly release the stormwater quality design storm runoff (such as extended detention basins, wet ponds, constructed stormwater wetlands, and sand filters) generally require a runoff volume at the very least and, ideally, an entire runoff hydrograph. This mandates the use of either the NRCS methodology or Modified Rational Method. However, BMPs that treat the stormwater quality design storm runoff as it is conveyed through them (such a filter strip, buffer or manufactured treatment device) generally require only a peak runoff rate. This can be computed using either the NRCS or Rational Methods. Further information on the use of these methods is presented below. When using either the Rational or Modified Rational Methods, it is important to remember their 20-acre drainage area limitations.

Table 5-1 was prepared for those using the NRCS methodology to compute stormwater quality design storm runoff peaks or hydrographs. It contains cumulative and incremental rainfall values for the stormwater quality design storm in five minute increments. These values can be used in computer programs such as TR-20, HEC-1, HEC-HMS, and other programs that both contain the NRCS methodology and allow user-specified rainfalls.

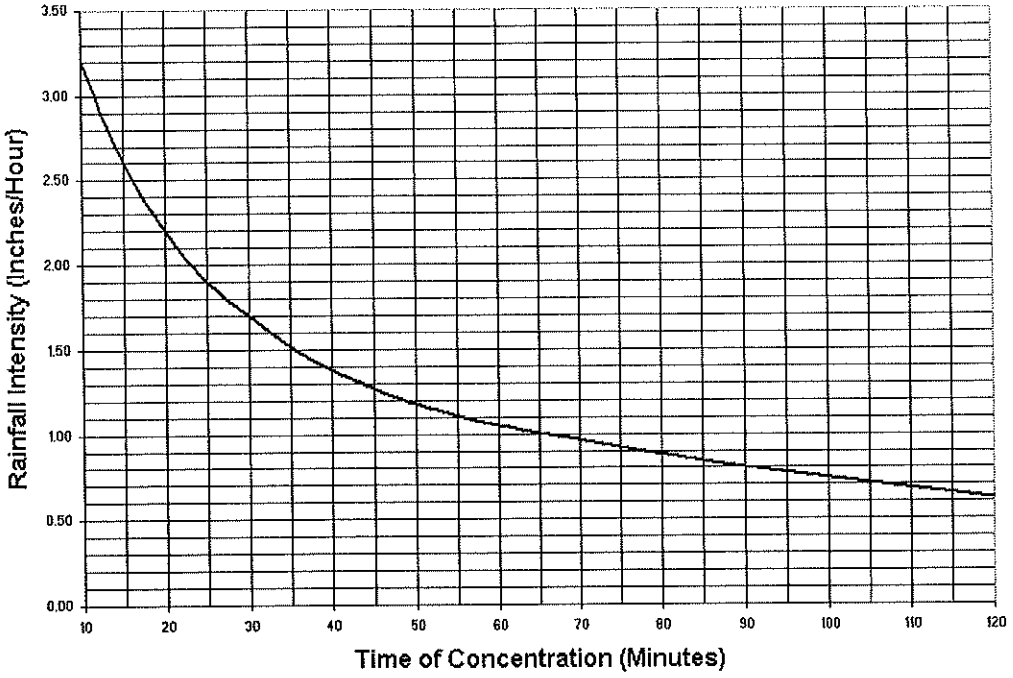
Table 5-1: NJDEP 1.25-Inch/2-Hour Stormwater Quality Design Storm Cumulative and Incremental Rainfall Distributions

Time (minutes)	Cumulative Rainfall (inches)	Incremental Rainfall (inches)	Time (minutes)	Cumulative Rainfall (inches)	Incremental Rainfall (inches)
0	0.0000	0.0000	65	0.8917	0.2667
5	0.0083	0.0083	70	0.9917	0.1000
10	0.0166	0.0083	75	1.0500	0.0583
15	0.0250	0.0084	80	1.0840	0.0340
20	0.0500	0.0250	85	1.1170	0.0330
25	0.0750	0.0250	90	1.1500	0.0330
30	0.1000	0.0250	95	1.1750	0.0250
35	0.1330	0.0330	100	1.2000	0.0250
40	0.1660	0.0330	105	1.2250	0.0250
45	0.2000	0.0340	110	1.2334	0.0084
50	0.2583	0.0583	115	1.2417	0.0083
55	0.3583	0.1000	120	1.2500	0.0083
60	0.6250	0.2667			

Note: See Figure 5-1 for plot of cumulative rainfall distribution.

Figure 5-3 was prepared for those using the Rational Method to compute stormwater quality design storm runoff peaks. It presents the stormwater quality design storm as a rainfall intensity-duration curve that allows the user to determine the appropriate rainfall intensity for the selected time of concentration.

Figure 5-3: NJDEP 1.25-Inch/2-Hour Stormwater Quality Design Storm Rainfall Intensity-Duration Curve



Finally, when using the Modified Rational Method to compute a stormwater quality design storm hydrograph, the entire 2-hour storm duration at an average intensity of 0.625-inches/hour can be used. Example 5-1 below demonstrates this procedure.

Important Note: While the stormwater quality design storm actually falls in a variable pattern, use of the 2-hour average rate described above and demonstrated in Example 5-1 is consistent with the assumptions of the Modified Rational Method. In addition, analysis and experience has shown that the structural BMPs that store and slowly release the stormwater quality design storm hydrograph (such as extended detention basins, wet ponds, bioretention facilities, constructed wetlands, and sand filters) are not particularly sensitive to rainfall pattern. If such sensitivity does exist for a particular BMP, the designer should use the NRCS methodology, which allows for consideration of the stormwater quality design storm's variable rainfall pattern.

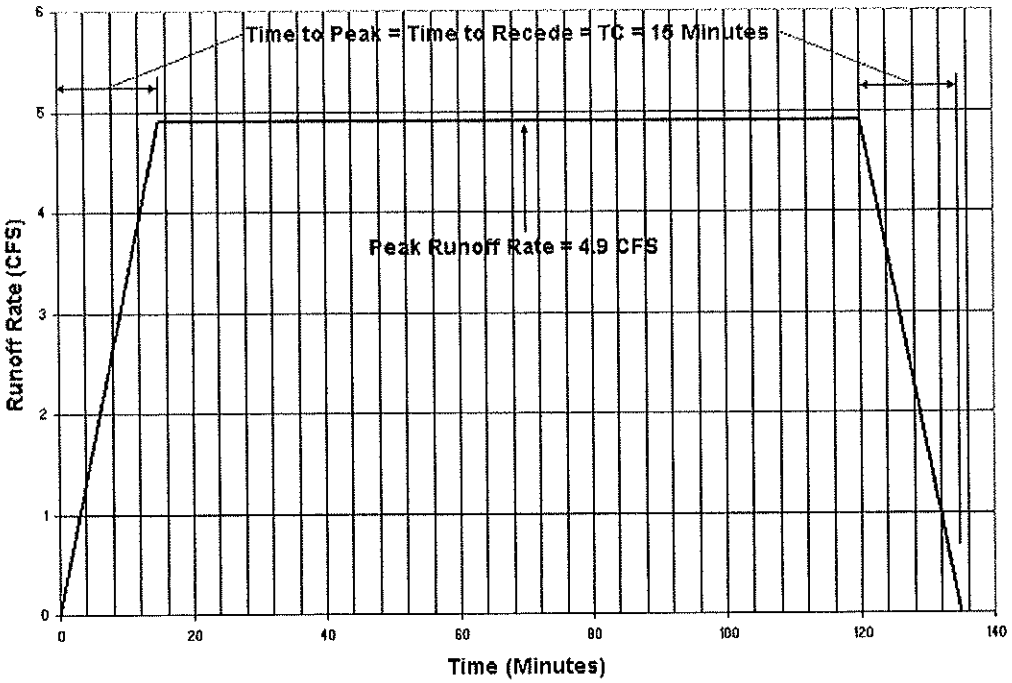
Example 5-1: NJDEP 1.25-Inch/2-Hour Stormwater Quality Design Storm Hydrograph Computation with Modified Rational Method

Description: A 10-acre development site has a Rational C value of 0.78 and a time of concentration of 15 minutes. Construct a runoff hydrograph from the site for the 1.25-inch/2-hour stormwater quality design storm using the Modified Rational Method.

C = 0.78 Average I = 1.25-inches/2-hours = 0.625 inches per hour
Area = 10 acres Tc = 15 minutes Storm duration = 2 hours

Q = runoff rate (cubic feet per second) = CIA
C = Rational Method runoff coefficient
I = rainfall intensity (inches per hour)
A = drainage area (acres)
D = storm duration (hours)
Q = (0.78) (0.625 inches per hour)(10 acres) = 4.9 CFS

In the Modified Rational Method, the runoff hydrograph is then constructed as shown here:



Finally, the total runoff volume is equal to the area under the hydrograph, which is equal to the peak runoff rate times the duration of the storm.

V = peak runoff rate x storm duration = Q x D

V = 4.9 cubic feet/second x 2 hours x 3600 seconds/hour

V = 35280 cubic feet = 0.81 acre-feet

Stormwater Quantity Storms

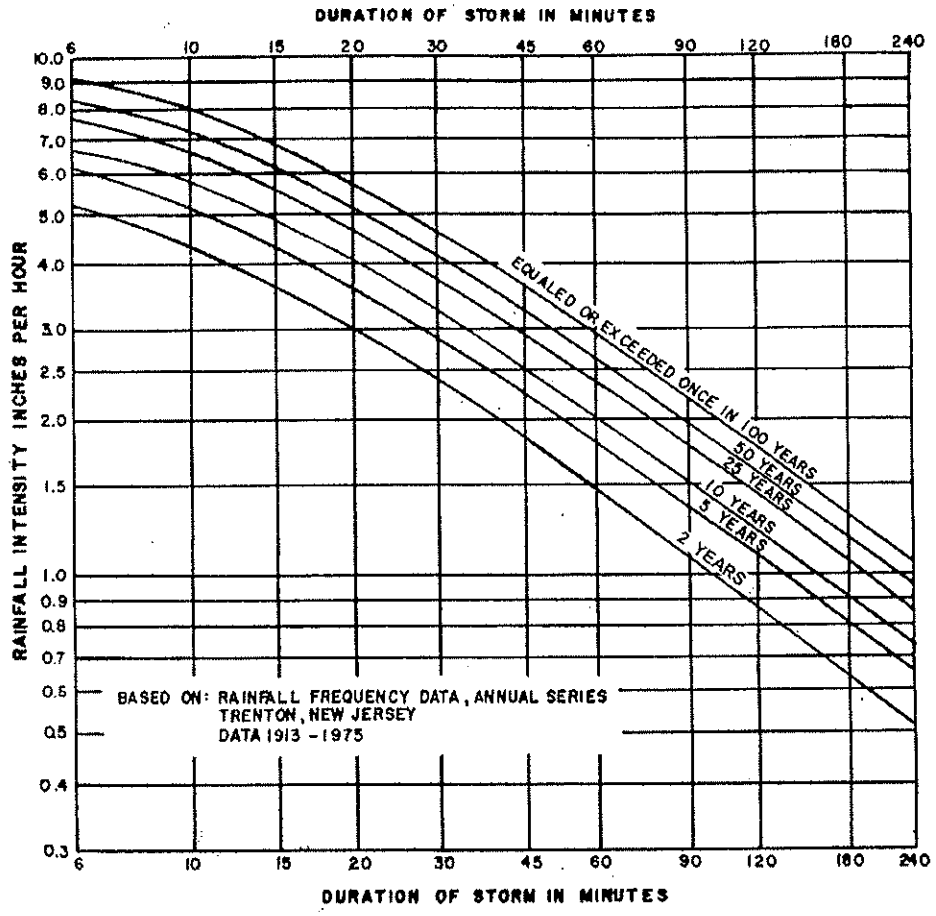
As described in the Stormwater Management Rules, the three storm frequencies of primary concern for stormwater quantity control are the 2, 10, and 100-year events. These storms are of such concern due to their potential to cause or aggravate downstream erosion and/or flooding. In certain instances, however, additional storm frequencies may need to be analyzed to ensure that downstream peak runoff rates and/or velocities are not increased by a land development or redevelopment project.

Selection of the appropriate stormwater quantity storm data will depend on the runoff estimation method being used. When using the NRCS methodology, the NRCS Type III Storm distribution should be selected. Details and data regarding this distribution can be found in the NRCS *Technical Release 55 – Urban Hydrology for Small Watersheds*. When using the Rational Method, the rainfall intensity-duration-frequency (IDF) curves shown in Figure 5-4 may be used. These curves were developed from Trenton area rainfall data between 1913 and 1975 and were adapted from Figure 2.1-2 in the *Technical Manual for Stream Encroachment Permits* prepared by the NJDEP Land Use Regulation Program. IDF curves based on rainfall data collected closer to an actual land development or redevelopment site may also be used if such data covers a sufficiently long time period and is analyzed by appropriate statistical methods.

Use of Long Term or Single Event Rainfall Data

As discussed in the *Fundamentals* section above, long term rainfall data for a watershed or development site may be used in certain runoff computations methods. Long term data can be used as input to the rainfall-runoff computations in place of a hypothetical, statistically-based design storm and, in certain instances, may be a more accurate or representative form of this input. In other instances, rainfall records from a significant historic storm in the watershed may also be used to test or verify a runoff computation or BMP design initially based on a hypothetical design storm. While the use of long term or single event rainfall data is not specifically required in the NJDEP Stormwater Management Rules, it is also not prohibited, since such uses may improve the effectiveness and/or reliability of a runoff computation or BMP design. Analysts and designers wishing to use such data should confer with the relevant review agencies prior to such use to ensure the suitability and acceptability of both the data and the computation method.

Figure 5-4: Rainfall Intensity-Duration-Frequency Curves



Note: Adapted from Figure 2.1-2 in the NJDEP *Technical Manual for Stream Encroachment Permits*.

Modeling Various Site Conditions

This section provides guidance for modeling various site conditions within a drainage area or watershed that may be encountered in the analysis and/or design of structural and nonstructural BMPs. This guidance is provided, where applicable, for the NRCS, Rational, and Modified Rational Methods and is intended to facilitate computation of required runoff volumes, peak rates, and hydrographs. A summary of the guidance for each computation method is presented at this end of this section in Table 5-2.

Pre-Developed Site Land Cover and Hydrologic Condition

As specified in the NJDEP Stormwater Management Rules, the predeveloped land cover at a development site must be assumed to be woods unless it can be verified that a different land cover has existed for at least five years prior to the analysis. Similarly, the predeveloped land cover must be assumed to be in good hydrologic condition for all land covers.

Sites With Pervious and Directly Connected Impervious Cover

It is virtually inevitable that a land development or redevelopment site will have a mixture of pervious and directly connected impervious surfaces, particularly under post-development conditions. As defined by the NRCS and others, impervious surfaces are directly connected when runoff from them can flow as shallow concentrated, channel, or pipe flow directly to the downstream drainage system. While such conditions pose no significant modeling problems for simple, linear methods such as the Rational and Modified Rational Methods, inaccuracies may occur for small rainfall depths when using more detailed, nonlinear methods such as the NRCS methodology. Analysis of such conditions using each method is presented here.

- **Rational and Modified Rational Methods:** Due to the linear character of the basic Rational Equation, a representative Rational Runoff Coefficient (C) can be computed for the entire site by standard area weighting techniques.
- **NRCS Methodology:** Due to the nonlinear character of the NRCS runoff equation and, primarily, the presence of the initial abstraction term Ia, inaccurate runoff estimates can result when the mixture of pervious and directly connected impervious surfaces within a drainage area or watershed are modeled with a weighted average NRCS Curve Number (CN). As discussed in the NRCS' TR-55, "the combination of impervious areas with pervious areas can imply a significant initial loss that may not take place." This problem will be particularly acute for small rainfalls less than an inch or two where the large (but incorrect) initial loss can be 50 percent or more of the total rainfall.

To avoid these errors, it is recommended that runoff volumes be computed separately from the pervious and directly connected impervious portions of the drainage area and then combined into a weighted average runoff volume. This volume averaging technique produces more accurate estimates of total runoff volume than the standard average Curve Number approach. At a minimum, it should generally be used for all rainfalls less than approximately 4 inches in depth. This would include the 1.25-inch/2-hour stormwater quality design storm and the 1-year and 2-year 24-hour storms. The technique can also be used for larger rainfall depths at the designer's discretion.

Example 5-2 below further illustrates this problem and the recommended volume averaging solution for the stormwater quality design storm.

Example 5-2: Site With Pervious and Directly Connected Impervious Cover Runoff Volume Computation Using NRCS Methodology

Description: A 3-acre development site is comprised of 1 acre of impervious surface and 2 acres of lawn and woods with an NRCS Curve Number (CN) of 65. The entire impervious surface is directly connected to the site's drainage system. Compute the site's total runoff volume for the 1.25-inch stormwater quality design storm using the Weighted Average CN technique. Compare the results with the Weighted Average Volume technique.

Stormwater Quality Design Storm = P = 1.25 inches

Total drainage area = 3 acres

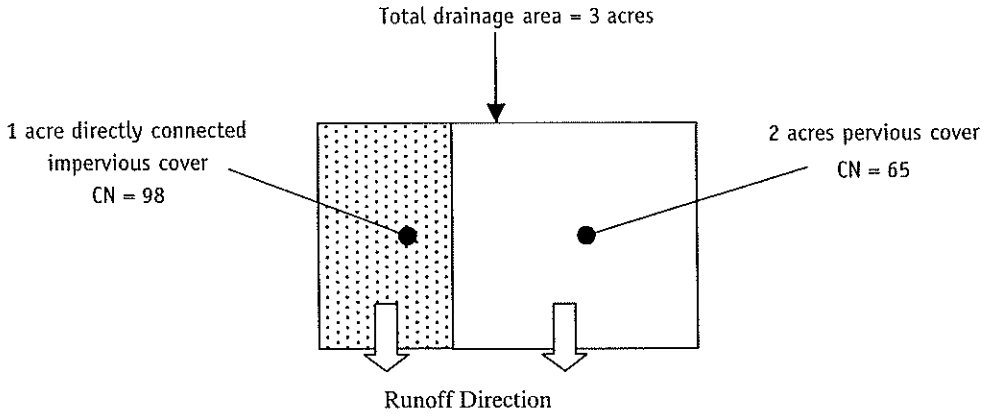
Impervious area = 1 acre (1/3 of total area)

Pervious area = 2 acres (2/3 of total area)

Pervious cover = mixture of lawn and woods Pervious CN = 65

Impervious cover = asphalt Impervious CN = 98

Note: All impervious cover is connected to the drainage system



1. Using Weighted Average Curve Number Technique

Weighted CN = (65)(2/3) + (98)(1/3) = 76

$$\text{Average } S = \frac{1000}{CN} - 10 = \frac{1000}{76} - 10 = 3.16 \text{ inches}$$

Average initial abstraction = Ia = 0.2S = (0.2)(3.16) = 0.63 inches

0.8S = (0.8)(3.16) = 2.53 inches

$$\text{Runoff volume} = Q = \frac{(P - 0.2S)^2}{P + 0.8S} = \frac{(1.25 - 0.63)^2}{1.25 + 2.53} = 0.10 \text{ inches}$$

Runoff volume = (0.10 inches/12 inches per foot)(3 acres)(43,560 sf per acre)

Total site runoff volume = 1089 cubic feet

2. Using Weighted Average Volume Technique

Impervious Area

$$\text{Impervious area } S = \frac{1000}{CN} - 10 = \frac{1000}{98} - 10 = 0.20 \text{ inches}$$

$$\text{Impervious area initial abstraction} = 0.2S = (0.2)(0.20) = 0.04 \text{ inches}$$

$$0.8S = (0.8)(0.20) = 0.16 \text{ inches}$$

$$\text{Impervious area runoff volume} = Q = \frac{(P - 0.2\,S)^2}{P + 0.8\,S} = \frac{(1.25 - 0.04)^2}{1.25 + 0.16} = 1.04 \text{ inches}$$

Runoff volume = (1.04 inches/12 inches per foot)(1 acre)(43,560 sf per acre)

Impervious area runoff volume = 3775 cubic feet

Pervious Area

$$\text{Pervious area } S = \frac{1000}{CN} - 10 = \frac{1000}{65} - 10 = 5.38 \text{ inches}$$

$$\text{Pervious area initial abstraction} = 0.2S = (0.2)(5.38) = 1.08 \text{ inches}$$

$$0.8S = (0.8)(5.38) = 4.30 \text{ inches}$$

$$\text{Pervious area runoff volume} = Q = \frac{(P - 0.2\,S)^2}{P + 0.8\,S} = \frac{(1.25 - 1.08)^2}{1.25 + 4.30} = 0.005 \text{ inches}$$

Runoff volume = (0.005 inches/12 inches per foot)(2 acres)(43,560 sf per acre)

Pervious area runoff volume = 36 cubic feet

Total site runoff volume = 3775 + 36 = 3811 cubic feet
(vs. 1089 cubic feet using weighted average CN)

As can be seen in Example 5-2 above, the weighted average CN technique produced an estimated stormwater quality design storm runoff volume that was less than 30 percent of the volume produced by the weighted average volume technique. Perhaps more significantly, the example also demonstrates how virtually the entire site runoff for the stormwater quality design storm comes from the impervious portion and that very little comes from the pervious portion (i.e., 3775 cubic feet vs. 36 cubic feet). The significant but erroneous initial loss that the NRCS cautions about in TR-55 can also be seen in the 0.63 inch initial abstraction for the entire site (including 1 acre of impervious surface) produced by the weighted average CN technique.

It is important to note that, in computing a weighted average runoff volume from the development site, Example 5-2 does not address the resultant peak discharge or hydrograph from the site. If both the pervious and directly connected impervious site areas will have the same time of concentration, the weighted runoff volume can then be used directly to compute the peak site discharge or hydrograph. However, if these areas will respond to rainfall with different times of concentration, separate hydrographs should be computed for each and then combined to produce the peak site discharge or hydrograph.

Sites with Unconnected Impervious Cover

As described in detail in *Chapter 2: Low Impact Development Techniques*, an important nonstructural BMP will be new impervious cover that is not directly connected to a site's drainage system. Instead, runoff from these impervious areas will sheet flow onto adjacent pervious areas, where a portion of the impervious area runoff will be given a second opportunity to infiltrate into the soil. Under certain conditions described below, this can help provide both groundwater recharge and stormwater quality treatment for small rainfalls as well as reduce the overall runoff volume that must be treated and/or controlled in a structural BMP downstream. Unconnected impervious areas may either by on-grade (e.g., a parking lot) or above-grade (e.g., a roof), while downstream pervious areas may either be constructed (e.g., lawn) or natural (e.g., woods or meadow).

In most circumstances, impervious areas can be considered unconnected under the following conditions:

1. All runoff from the unconnected impervious area must be sheet flow.
2. Upon entering the downstream pervious area, all runoff must remain as sheet flow.
3. Flow from the impervious surface must enter the downstream pervious area as sheet flow or, in the case of roofs, from downspouts equipped with splash pads, level spreaders, or dispersion trenches that reduce flow velocity and induce sheet flow in the downstream pervious area.
5. All discharges onto the downstream pervious surfaces must be stable and nonerosive.
6. The shape, slope, and vegetated cover in the downstream pervious area must be sufficient to maintain sheet flow throughout it length. Maximum slope of the downstream pervious area is 8 percent.
7. The maximum roof area that can be drained by a single downspout is 600 square feet.

To determine the hydrologic effects of unconnected impervious cover, the combined effects of the impervious area disconnection and the subsequent infiltration in downstream pervious areas must be quantified. Techniques to do so are presented below.

- **Rational and Modified Rational Methods:** Due to the character of the basic Rational Equation, there is currently no technique for addressing the effects of unconnected impervious cover. As such, neither the Rational nor Modified Rational Methods can be recommended at this time for use at sites with unconnected impervious areas.
- **Methodology Using NRCS Equations:** Computation of the resultant runoff from unconnected impervious areas can be performed using two different methods. The first method is described in the NRCS TR-55. The second method is a two-step technique using the NRCS runoff equation. Both methods are discussed in detail below. Additional discussion and computed examples of unconnected impervious cover are presented in *Chapter 2: Low Impact Development Techniques*.
    - **NRCS TR-55 Methodology:** This method is based on the procedures to compute runoff from unconnected impervious surfaces described in the NRCS TR-55. Complete details of these procedures are described in Chapter 2 of TR-55. It should be noted that the TR-55 procedures are applicable only to sites with less than 30 percent total impervious coverage. In addition, the size of the downstream pervious area must be at least twice as large as the unconnected impervious area.
    - **Two-Step Technique:** This method is a two-step technique using the NRCS runoff equation. First, the resultant runoff from the unconnected impervious area should be computed separately, using the NRCS runoff equation in a manner similar to the technique described above for impervious surfaces. However, once the runoff from the unconnected impervious area is computed, it should then be considered as additional rainfall on the downstream pervious area it sheet flows onto. As a result, these pervious areas will effectively be subject to

their own direct rainfall as well as the "rainfall" flowing from the upstream unconnected impervious areas. The resultant runoff from the downstream pervious areas in response to this combined rainfall can then be computed using the NRCS runoff equation again.

Example 5-3 illustrates this two-step runoff computation technique for unconnected impervious areas. In reviewing the example, it is important to note that the unconnected impervious area runoff depth must be converted to an equivalent uniform rainfall depth over the entire downstream pervious area based on the relative sizes of the unconnected impervious and downstream pervious areas.

Example 5-3: Site With Unconnected Impervious Cover Runoff Volume Computation Using Two-Step Technique

Description: A 3-acre development site is comprised of 1 acre of impervious surface and 2 acres of lawn and woods with an NRCS Curve Number (CN) of 65. Runoff from the entire impervious surface sheet flows onto to the pervious portion of the site before entering the site's drainage system. Compute the total runoff volume for the 1.25-inch stormwater quality design storm using the NRCS methodology.

Stormwater Quality Design Storm = P = 1.25 inches

Total drainage area = 3 acres

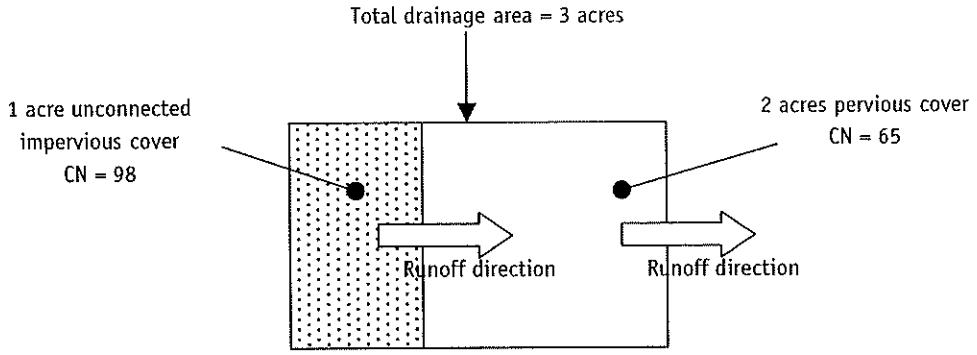
Impervious area = 1 acre (1/3 of total area)

Pervious area = 2 acres (2/3 of total area)

Pervious cover = mixture of lawn and woods pervious CN = 65

Impervious cover = asphalt impervious CN = 98

Note: All impervious area runoff sheet flows onto downstream pervious area



Impervious Area

$$\text{Impervious area } S = \frac{1000}{CN} - 10 = \frac{1000}{98} - 10 = 0.20 \text{ inches}$$

Impervious area initial abstraction = 0.2S = (0.2)(0.20) = 0.04 inches

0.8S = (0.8)(0.20) = 0.16 inches

$$\text{Impervious area runoff volume} = Q = \frac{(P - 0.2S)^2}{P + 0.8S} = \frac{(1.25 - 0.04)^2}{1.25 + 0.16} = 1.04 \text{ inches}$$

Runoff volume = (1.04 inches/12 inches per foot)(1 acre)(43,560 sf per acre)

Impervious area runoff volume = 3775 cubic feet

Equivalent rainfall depth on downstream pervious area =

(3775 cubic feet)/(2 acres)(43,560 sf per acre) = 0.043 feet = 0.52 inches

Pervious Area

Total effective rainfall = direct rainfall + unconnected impervious area runoff

= 1.25 inches + 0.52 inches = 1.77 inches total

$$\text{Pervious area } S = \frac{1000}{CN} - 10 = \frac{1000}{65} - 10 = 5.38 \text{ inches}$$

Pervious area initial abstraction = 0.2S = (0.2)(5.38) = 1.08 inches

0.8S = (0.8)(5.38) = 4.30 inches

$$\text{Pervious area runoff volume} = Q = \frac{(P - 0.2S)^2}{P + 0.8S} = \frac{(1.77 - 1.08)^2}{1.77 + 4.30} = 0.08 \text{ inches}$$

Runoff volume = (0.08 inches/12 inches per foot)(2 acres)(43,560 sf per acre)
= 581 cubic feet

Pervious area runoff volume = total runoff volume = 581 cubic feet

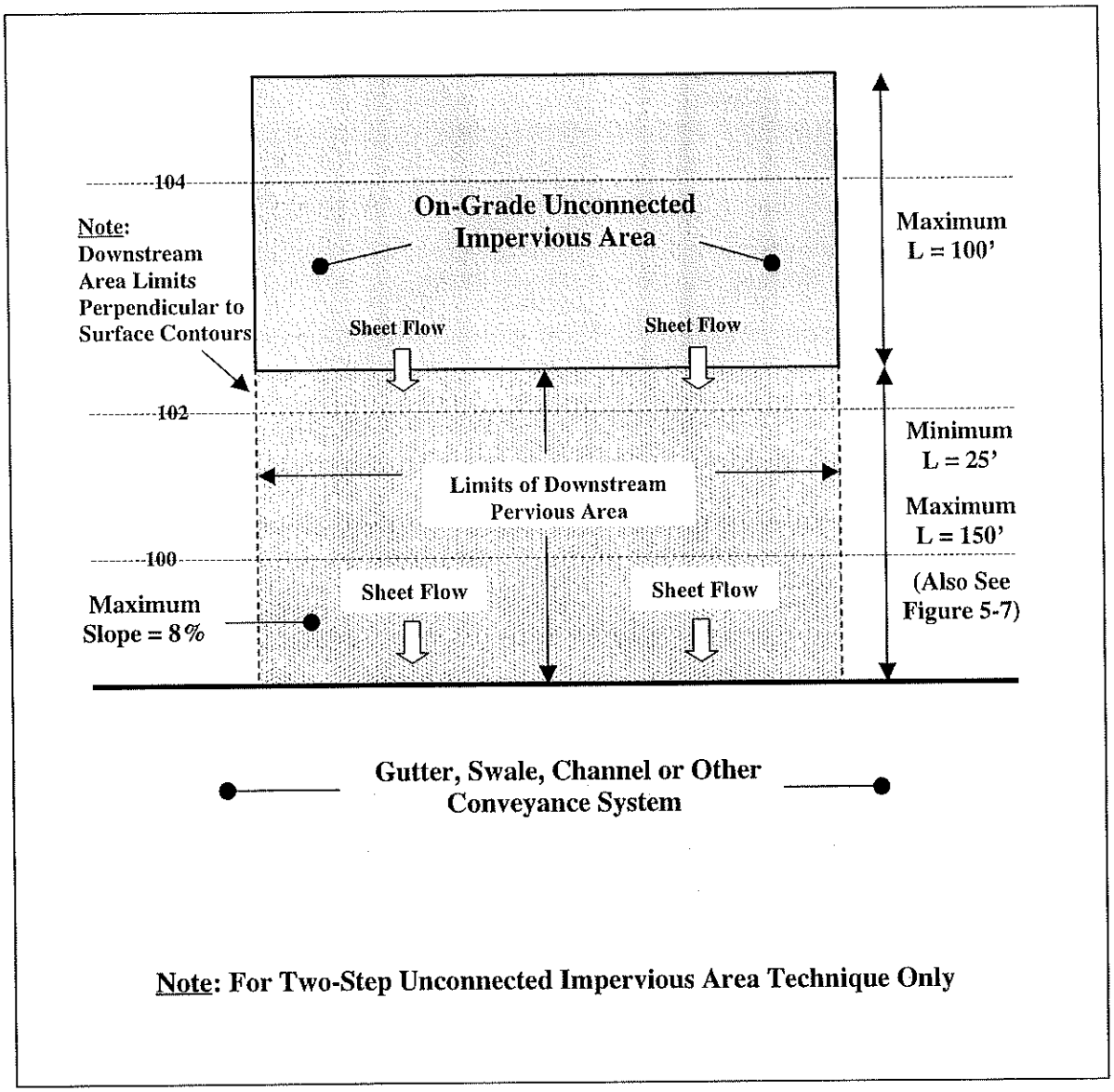
From the above example, it can be seen that a key parameter in the two-step runoff computation technique for unconnected impervious cover is the effective size of the downstream pervious area. The following three criteria, in conjunction with the seven requirements for all unconnected impervious areas shown above, should be used to determine the effective size of this downstream area:

1. The minimum sheet flow length across the downstream pervious area is 25 feet.
2. The maximum sheet flow length across the unconnected impervious area is 100 feet.
3. While the total flow length area may be greater, the maximum sheet flow length across the downstream pervious area that can be used to compute the total resultant runoff volume is 150 feet.

These criteria are illustrated below in Figures 5-5 and 5-6 for both on-grade and above-grade unconnected impervious areas, respectively. Additional criteria for determining the lower limits of the downstream pervious area are presented in Figure 5-7. When using Figure 5-6 with overlapping pervious areas downstream of roof downspouts, the overlapping areas should be counted only once in the computation of the total pervious area downstream of the roof.

Finally, when computing the peak runoff rate or hydrograph from an area with unconnected impervious cover, the time of concentration of the combined impervious and downstream pervious area should be based upon the Tc of the downstream pervious area only, with the Tc route beginning as sheet flow at the upper end of the pervious area.

Figure 5-5: Downstream Pervious Area Criteria for On-Grade Unconnected Impervious Area



Note: For Two-Step Unconnected Impervious Area Technique Only

Figure 5-6: Downstream Pervious Area Criteria for Above-Grade Unconnected Impervious Area

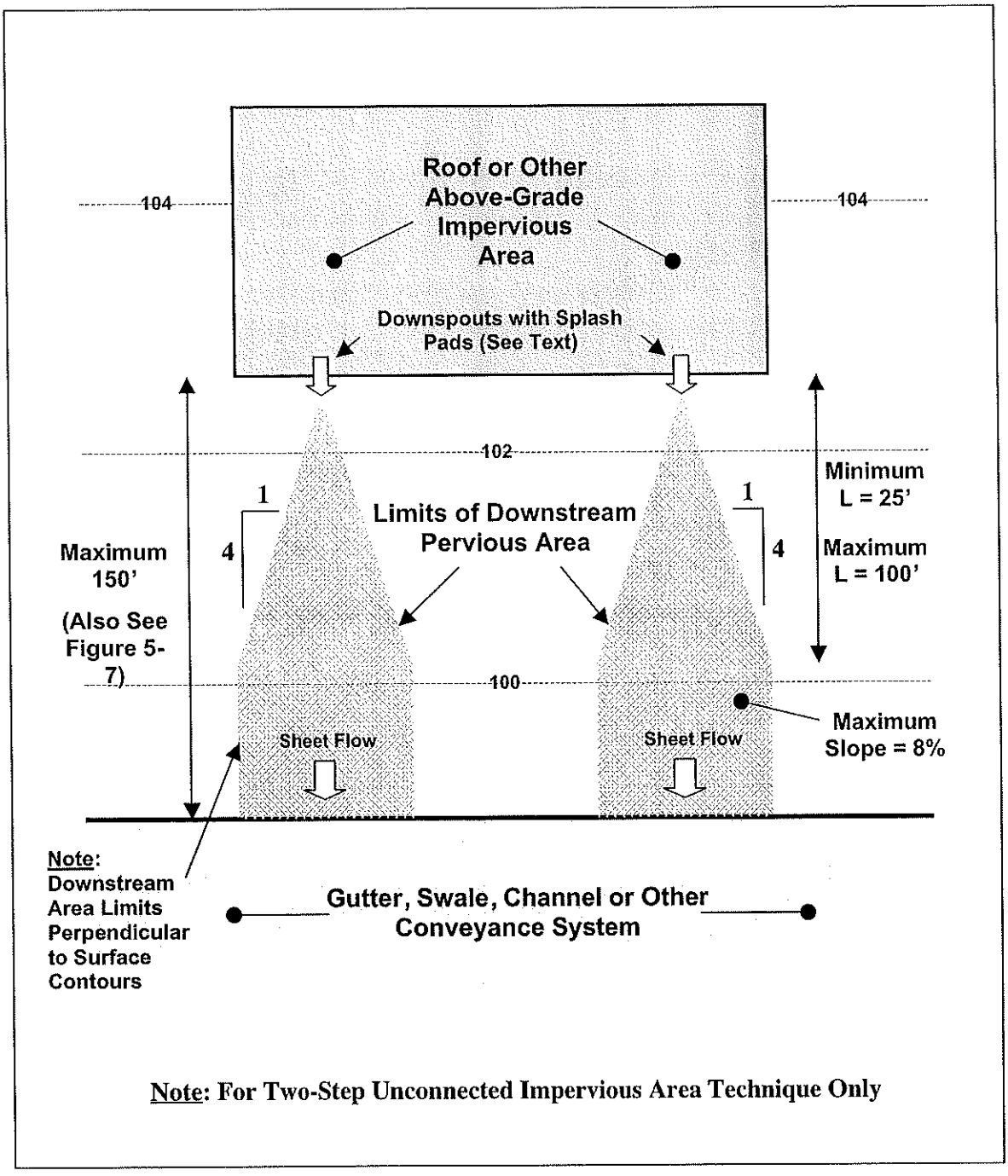
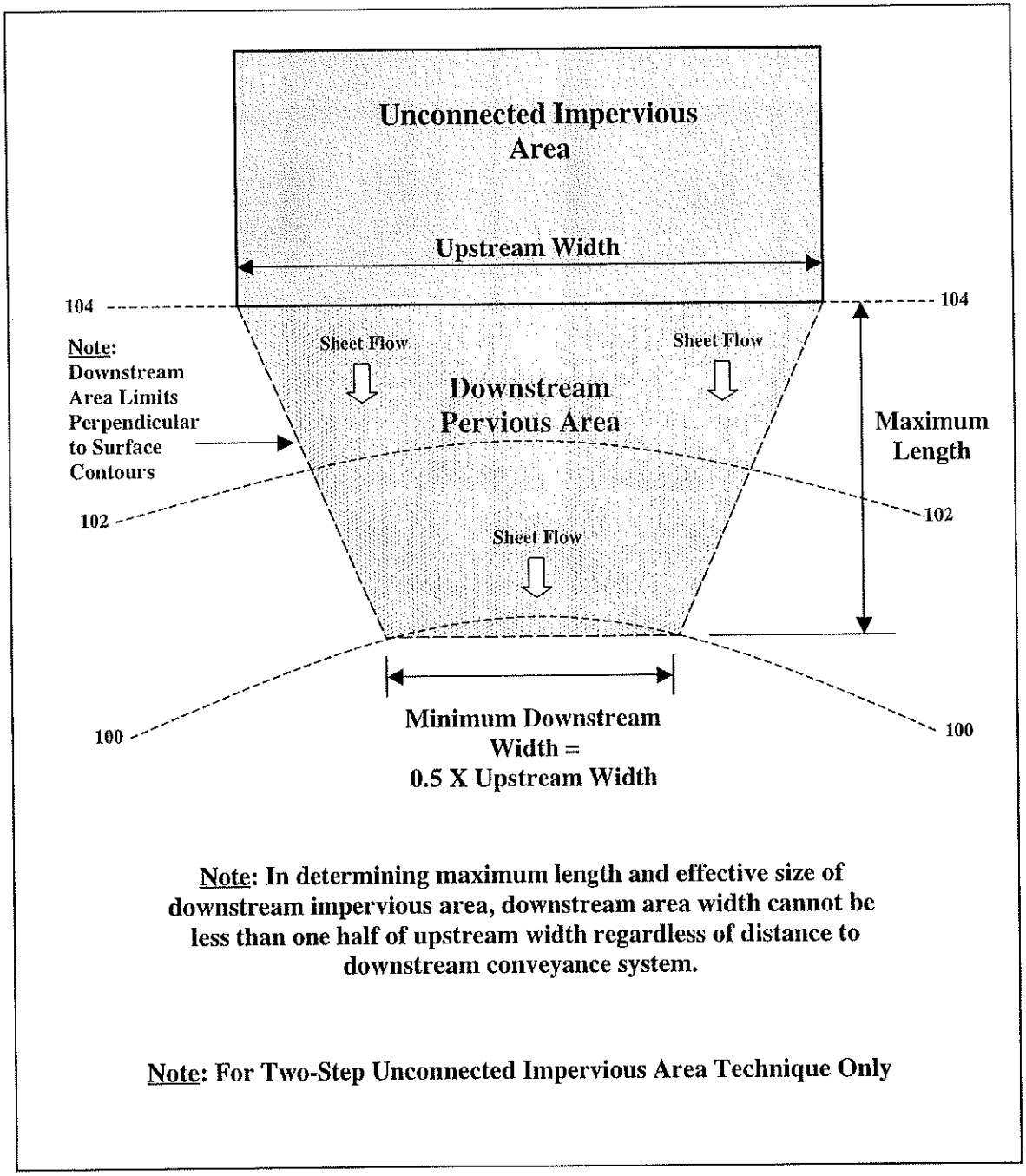


Figure 5-7: Additional Downstream Pervious Area Length and Effective Size Criteria



Sites With Groundwater Recharge

As required by the NJDEP Stormwater Management Rules and described in detail in *Chapter 6: Groundwater Recharge*, land development projects must maintain 100 percent of the site's annual pre-developed groundwater recharge. At most sites, this will require the design and construction of a groundwater recharge BMP that allows the runoff from the groundwater recharge design storm to infiltrate into the site's subsoil. This amount of infiltration can also be used by a designer to help meet the stormwater quality requirements of the Rules. Techniques to do so are presented below. However, to ensure downstream safety and channel stability, the amount of groundwater recharge provided at a development site *cannot* be considered when complying with the Rules' stormwater quantity requirements (i.e., control of the 2, 10, and 100-year storms).

Rational and Modified Rational Methods

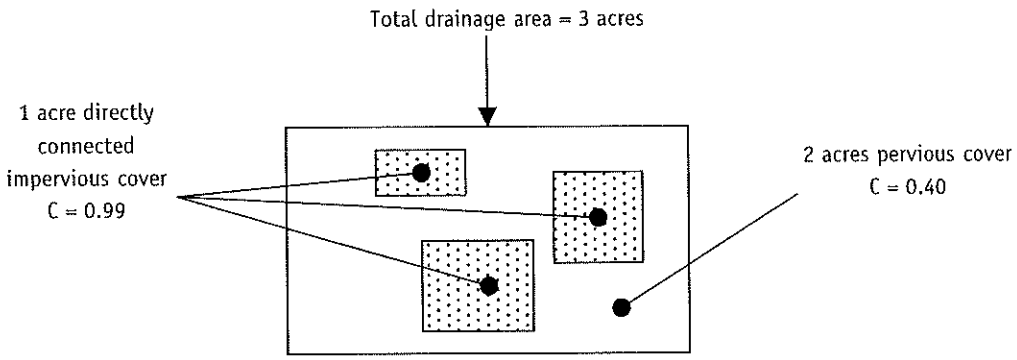
When computing a peak runoff rate for the stormwater quality design storm using the Rational Method, the size of that portion of the site that contributes runoff to the groundwater recharge BMP can be reduced by the ratio of the total groundwater recharge design storm to the 1.25-inch stormwater quality design storm. Similar procedures can be used in most instances to construct a reduced inflow hydrograph for use in the Modified Rational Method. Examples 5-4 and 5-5 below demonstrate these techniques.

Example 5-4: Sites With Groundwater Recharge
Stormwater Quality Design Storm Peak Flow Computation Using Rational Method

Description: A 3-acre development site is comprised of 1 acre of impervious surface (Rational C = 0.99) and 2 acres of lawn and woods (Rational C = 0.40). The post-development time of concentration (Tc) is 20 minutes. All runoff from a 0.5-inch recharge design storm on the impervious surface is recharged. Runoff from larger storms on the impervious surface flows directly to the site's drainage system. Compute the site's total peak runoff rate for the 1.25-inch stormwater quality design storm using the Rational Method.

Recharge Design Storm = 0.5 inches on impervious cover only
Total Stormwater Quality Design Storm = 1.25 inches on entire site
Post-developed Tc = 20 minutes
Maximum Stormwater Quality Design Storm I = 2.2 inches (see Figure 5-3)

Total drainage area = 3 acres
Impervious area = 1 acre (1/3 of total area)
Pervious area = 2 acres (2/3 of total area)
Pervious cover = mixture of lawn and woods pervious C = 0.40
Impervious cover = asphalt impervious C = 0.99
Note: All impervious cover is directly connected to the drainage system



Adjusted impervious area due to recharge =

$$\text{Total impervious area} \times \frac{\text{(Stormwater Quality Design Storm - Groundwater Recharge Design Storm)}}{\text{Stormwater Quality Design Storm}}$$

$$= 1 \text{ acre} \times \frac{(1.25 \text{ inches} - 0.5 \text{ inches})}{1.25 \text{ inches}}$$

$$= 1 \text{ acre} \times \frac{0.75 \text{ inches}}{1.25 \text{ inches}} = 1 \text{ acre} \times 0.6 = 0.6 \text{ acres}$$

Adjusted total site area = 0.6 acres impervious + 2.0 acres pervious = 2.6 acres

$$\text{Composite site C} = \frac{(0.6 \text{ acres impervious} \times 0.99) + (2.0 \text{ acres pervious} \times 0.40)}{2.6 \text{ acres total}}$$

$$= \frac{0.59 + 0.8}{2.6} = \frac{1.39}{2.6} = 0.53$$

Peak Stormwater Quality Design Storm runoff rate = C I A
= 0.53 x 2.2 inches per hour x 2.6 acres = 3.0 CFS

Note: Without considering groundwater recharge credit, the peak rate would be:

Total area = 3.0 acres

$$C = \frac{(1.0 \times 0.99) + (2.0 \times 0.40)}{3.0} = \frac{1.79}{3.0} = 0.60$$

Peak stormwater quality runoff rate = 0.60 x 2.2 x 3.0 = 4.0 CFS

Example 5-5: Sites With Groundwater Recharge
Stormwater Quality Design Storm Hydrograph Using Modified Rational Method

Description: For land development site described in Example 5-4 above, compute runoff hydrograph for entire site using Modified Rational Method.

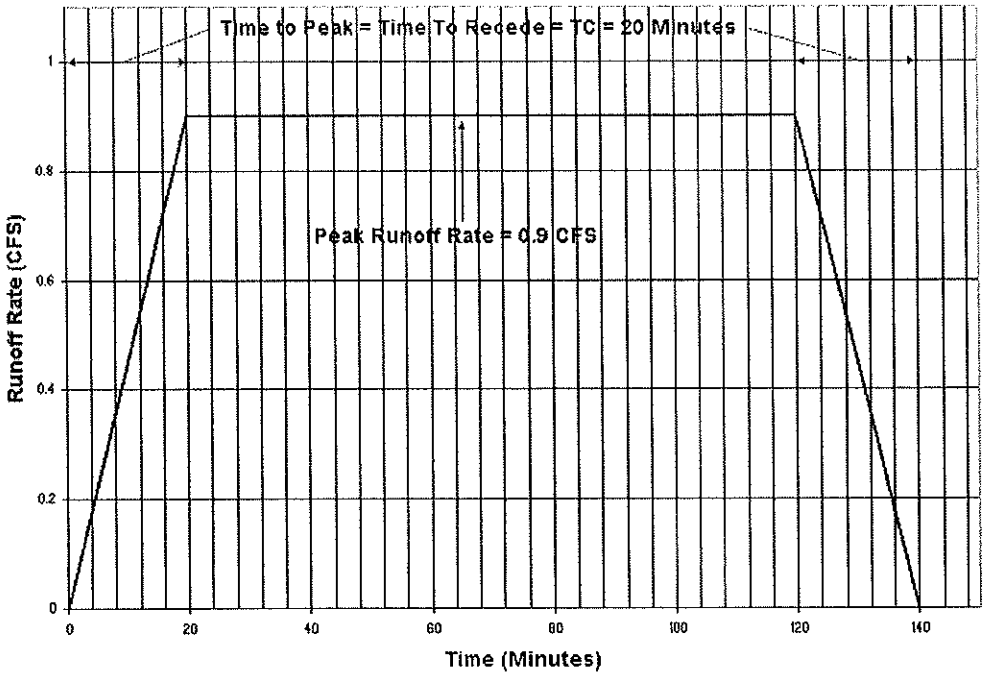
Adjusted total site area = 2.6 acres

Composite site C = 0.54

Average Stormwater Quality Design Storm I = 1.25-inches/2- hours = 0.625 inches per hour

Q = C I A = 0.54 x 0.625 x 2.6 Acres = 0.9 CFS

The Modified Rational Method runoff hydrograph is then constructed as shown below:



Note: See Example 5-1 for procedures to construct Modified Rational Method runoff hydrograph. Also see Important Note on page 5-8 regarding use of Modified Rational Method to compute a runoff hydrograph for the stormwater quality design storm.

It is important to note in Examples 5-4 and 5-5 that runoff from only a portion of the site was recharged during the 0.5-inch groundwater recharge design storm and that those areas were distributed throughout the site. This means that the remaining site areas would still be capable of generating runoff and that the overall site would produce runoff throughout the entire stormwater quality design storm. These conditions permitted the assumptions inherent in the Rational and Modified Rational Methods to be reasonably met when computing both the peak runoff rate and hydrograph from the larger, 1.25-inch stormwater quality design storm. Such site conditions are expected to be typical of most land developments.

However, in cases where the groundwater recharge design storm runoff from the entire drainage area is recharged, the assumptions of the Rational and Modified Rational Methods cannot be met. As such, neither method can be recommended for computing the peak site runoff if the recharge volume is to be considered. In such cases, the designer can either continue to use either method without considering the recharge volume or use the NRCS methodology with the actual, nonlinear stormwater quality design storm as shown in Figure 5-2 and Table 5-1.

NRCS Methodology

When using the NRCS methodology to compute the total stormwater quality design storm runoff volume from a development site where all or a portion of the site's groundwater recharge design storm runoff is recharged, the relative amount of recharged runoff volume can be deducted from the total stormwater quality design storm volume. However, due to the nonlinearity of the NRCS runoff equation, such a deduction must be based on the *volume* of groundwater recharge design storm runoff from the recharged area and not simply the size of the recharged areas. Example 5-6 below describes this technique. When computing the peak stormwater quality design storm runoff rate or hydrograph from such a site with the NRCS methodology, it will be necessary to route the stormwater quality design storm hydrograph through the recharge facility. Since the recharge facility will be designed to contain only the normally smaller groundwater recharge design storm, an accurate stage-discharge relationship for the facility's overflow must be included in the routing computations in order to obtain an accurate peak runoff rate or hydrograph.

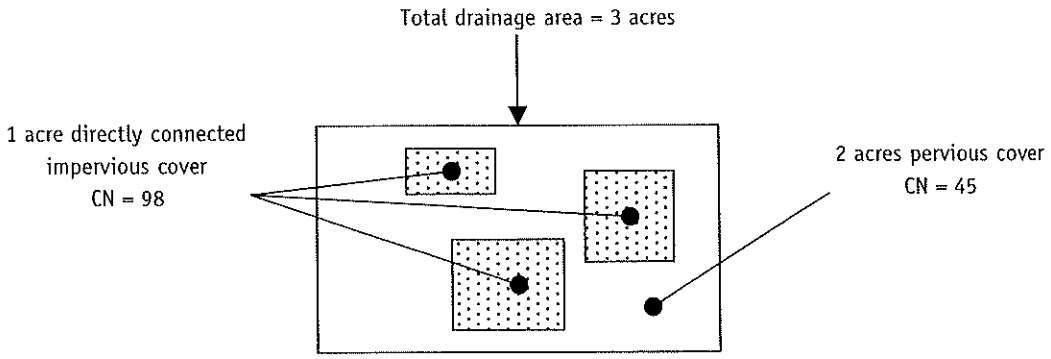
Example 5-6: Sites With Groundwater Recharge
Stormwater Quality Design Storm Volume Using NRCS Methodology

Description: A 3-acre development site is comprised of 1 acre of impervious surface and 2 acres of lawn and woods with an NRCS Curve Number (CN) of 65. Runoff from the entire impervious surface is recharged during a 0.5-inch groundwater recharge design storm. Runoff from larger storms on the impervious surface flows directly to the site's drainage system. Compute the total stormwater quality design storm runoff volume from the site using the NRCS methodology.

Groundwater Recharge Design Storm = 0.5 inches on impervious cover only
Total Stormwater Quality Design Storm = 1.25 inches on entire site

Total drainage area = 3 acres
Impervious area = 1 acre (1/3 of total area)
Pervious area = 2 acres (2/3 of total area)
Pervious cover = mixture of lawn and woods pervious CN = 65
Impervious cover = asphalt impervious CN = 98

Note: All impervious cover is directly connected to the drainage system



Impervious Area

$$\text{Impervious area } S = \frac{1000}{CN} - 10 = \frac{1000}{98} \pm 10 = 0.20 \text{ inches}$$

Impervious area initial abstraction = 0.2S = (0.2)(0.20) = 0.04 inches

0.8S = (0.8)(0.20) = 0.16 inches

Groundwater Recharge Design Storm = 0.5 inches

$$\text{Recharged runoff volume for Groundwater Recharge Design Storm} = Q = \frac{(P - 0.2\,S)^2}{P + 0.8\,S}$$

$$= \frac{(0.50 - 0.04)^2}{0.50 + 0.16} = 0.32 \text{ inches}$$

Stormwater Quality Design Storm = 1.25 inches

$$\text{Runoff volume for Stormwater Quality Design Storm} = Q = \frac{(P - 0.2\,S)^2}{P + 0.8\,S}$$

$$= \frac{(1.25 - 0.04)^2}{1.25 + 0.16} = 1.04 \text{ inches}$$

Difference in runoff volumes = 1.04 inches - 0.32 inches = 0.72 inches

Net impervious area runoff volume =

(0.72 inches/12 inches per foot)(1 acre)(43,560 SF per acre)

= 2614 cubic feet

Pervious Area

$$\text{Pervious area } S = \frac{1000}{CN} - 10 = \frac{1000}{65} \pm 10 = 5.38 \text{ inches}$$

Pervious area initial abstraction = 0.2S = (0.2)(5.38) = 1.08 inches

0.8S = (0.8)(5.38) = 4.30 inches

$$\text{Pervious area runoff volume} = Q = \frac{(P - 0.2\,S)^2}{P + 0.8\,S} = \frac{(1.25 \pm 1.08)^2}{1.25 + 4.30} = 0.005 \text{ inches}$$

Runoff volume = (0.005 inches/12 inches per foot)(2 acres)(43,560 SF per acre)

Total pervious area runoff volume = 36 cubic feet

Total site runoff volume = 2614 + 36 = 2650 cubic feet

Note: in Example 5-2, where none of the impervious surface runoff was recharged, the same site produced 3811 cubic feet of runoff for the stormwater quality design storm.

Time of Concentration Considerations

Computation of a peak runoff rate or hydrograph will require an estimate of a drainage area's time of concentration (Tc). In performing Tc calculations, designers should consider the following factors.

- **Maximum sheet flow length:** When using the segmental Tc procedures contained in Chapter 3 of the NRCS *Technical Release 55 – Urban Hydrology for Small Watersheds* (TR-55), the maximum sheet flow length recommended by the NRCS is 150 feet. According to the NRCS, longer lengths may be used only in special cases, such as smooth, uniformly graded parking lots or athletic fields. In addition, it may be appropriate to use a longer sheet flow length in wooded areas with Hydrologic Soil Group A or B soils and ground slopes of 2 percent or flatter. In such areas, high infiltration rates, low sheet flow velocities, and the presence of surface irregularities that store and reinfiltrate runoff may limit the generation of runoff to such an extent that a larger than normal area (and therefore a longer than normal sheet flow length) is needed to produce sufficient runoff rates to exceed sheet flow depths and create shallow concentrated flow.
- **Maximum sheet flow roughness coefficient:** According to the NRCS, the maximum Manning's Roughness Coefficient (n) to be used in the Sheet Flow Equation in Chapter 3 of TR-55 is 0.040.
- **Tc routes:** Consideration must be given to the hydraulic conditions that exist along a selected Tc route, particularly in pre-developed drainage areas. Tc routes should not cross through significant flow constrictions and ponding areas without considering the peak flow and time attenuation effects of such areas. As noted in the NJDEP Stormwater Management Rules, such areas can occur at hedgerows, undersized culverts, fill areas, sinkholes, and isolated ponding areas. In general, a separate subarea tributary to such areas should be created and its runoff routed through the area before combining with downstream runoff.
- In certain areas with highly irregular topography, large surface storage volumes, high soil infiltration rates, and/or Karst topography, the segmental Tc method described in Chapter 3 of TR-55 may not be appropriate. In such areas, alternative Tc methods should be used.

Table 5-2: Summary of Modeling Guidance for Various Site Conditions Rational, Modified Rational and NRCS Methods[1]

Site Condition or Parameter	Rational Method	Modified Rational Method	NRCS-Based Methods
Mixture of pervious and directly connected impervious surface	Use standard procedures	Use standard procedures	Use weighted average runoff volume
Unconnected impervious surface	Use not recommended	Use not recommended	TR-55 or Two-Step Technique
Groundwater recharge areas	Reduce effective size of recharge area[2]	Reduce effective size of recharge area[2]	Reduce runoff volume by recharge volume
Time of concentration	Maximum sheet flow length = 150 feet Maximum sheet flow n = 0.40 Include effects of storage and ponding areas		

Notes: Table presents summaries only. See text for complete descriptions for each computation method.
For sites with combination of recharge and non-recharge areas. Methods not recommended where entire area is recharged. See text for details.

References

Horner, R.R., J.J. Skupien, E.H. Livingston and H.E. Shaver. 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. In cooperation with U.S. Environmental Protection Agency. Terrene Institute, Washington, D.C.

Lucas, W.C. October 2002. DURMM: Delaware Urban Runoff Management Model Users Manual. Delaware Department of Natural Resources and Environmental Conservation.

McCuen, Richard H. Development and Evaluation of TR-55 Composite Curve Number for Unconnected Imperviousness.

Northeast National Technical Center. June 1986. Hydrology Technical Note No. N4 – Time of Concentration. USDA Natural Resources Conservation Service.

Northeast National Technical Center. 1986. Memorandum: Sheet Flow in the Northeast. USDA Natural Resources Conservation Service.

New Jersey Department of Agriculture. November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.

New Jersey Department of Environmental Protection, Land Use Management Program. September 1995. Technical Manual for Stream Encroachment Permits.

New Jersey Department of Environmental Protection and Department of Agriculture. December 1994. Stormwater and Nonpoint Source Pollution Control Best Management Practices.

Pitt, R., J. Lantrip and R. Harrison. December 1999. Infiltration through Disturbed Urban Soils and Compost-Amended Soil Effects on Runoff Quality and Quantity. U.S. Environmental Protection Agency.

Schueler, T.R. July 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments. Washington, D.C.Schueler, T.R. and R.A. Claytor. 2000. Maryland Stormwater Design Manual. Maryland Department of the Environment. Baltimore, MD.

U.S. Army Corps of Engineers Hydrologic Engineering Center. HEC-1 Flood Hydrograph Package Users Manual.

U.S. Army Corps of Engineers Hydrologic Engineering Center. HEC-HMS Hydrologic Modeling System Users Manual.

USDA Natural Resources Conservation Service. National Engineering Handbook, Part 630, Hydrology.

USDA Natural Resources Conservation Service. Technical Release 20 – Project Formulation – Hydrology.

USDA Natural Resources Conservation Service. June 1986. Technical Release 55 – Urban Hydrology for Small Watersheds.

USDA Natural Resources Conservation Service. April 2002. Win-TR55 – User Manual.

Viessman, W. Jr., J.W. Knapp, G.L. Lewis and T.E. Harbaugh. 1977 Introduction to Hydrology – Second Edition. Harper & Row. New York.

Walesh, S.G. 1989. Urban Surface Water Management. John Wiley & Sons, Inc. New York.

Wanielista, M.P. and Y.A. Yousef. 1993. Stormwater Management. John Wiley & Sons, Inc. New York.

Whipple, W., N.S. Grigg, T. Grizzard, C.W. Randall, R.P. Shubinski and L.S. Tucker. 1983. Stormwater Management in Urbanizing Areas. Prentice-Hall, Inc. Englewood Cliffs, New Jersey.

CHAPTER 6

Groundwater Recharge

This chapter presents the standards, data, and procedures necessary to meet the groundwater recharge requirements of the NJDEP Stormwater Management Rules at N.J.A.C. 7:8. According to these Rules, a "major development" project, which is one that disturbs at least 1 acre of land or creates at least 0.25 acres of new or additional impervious surface, must include nonstructural and/or structural stormwater management measures that prevent the loss of groundwater recharge at the project site. This requirement is included in the Rules because the loss of groundwater recharge can adversely impact the health of streams and wetlands and the yield of water supply wells. Urban redevelopment and certain linear development projects are exempt from the groundwater recharge requirements, while waivers may obtained under certain conditions for public roadway, railroad, and pedestrian walkway enlargements. Complete details can be found in Subchapter 5 of the Stormwater Management Rules.

Specifically, the Stormwater Management Rules require that a proposed major land development comply with one of the following two groundwater recharge requirements:

Requirement 1: That 100 percent of the site's average annual pre-developed groundwater recharge volume be maintained after development; or

Requirement 2: That 100 percent of the difference between the site's pre- and post-development 2-Year runoff volumes be infiltrated.

The Stormwater Management Rules allow the site designer to select which requirement to follow. The Rules also state that compliance with either of the above alternative requirements must be demonstrated through hydrologic and hydraulic analysis. Regardless of which alternative requirement is selected, such an analysis will generally begin with a computation of the existing (or pre-developed) hydrologic conditions at the proposed development site. In the case of Requirement 1, these conditions will focus on the annual amount of groundwater recharge that occurs at the site under pre-developed conditions while, for Requirement 2, the focus will instead be on the pre-developed volume of 2-Year site runoff.

These computations will then be followed by similar ones for the proposed (or post-developed) conditions at the site. A comparison of the results of either of these pre- and post-development computations will then yield the annual volume of groundwater that must be recharged (Requirement 1) or 2-Year storm runoff volume that must be infiltrated (Requirement 2) through one or more structural recharge or infiltration BMPs. Ideally, the planning and design of the proposed site will have incorporated nonstructural measures to such an extent that the need for structural facilities is reduced to a practical minimum.

Finally, once the analysis of pre- and post-development conditions has established the need for structural recharge (Requirement 1) or infiltration (Requirement 2) BMPs, the hydrologic and hydraulic analysis would next focus on the actual design of such facilities. This process would include answering such questions such as:

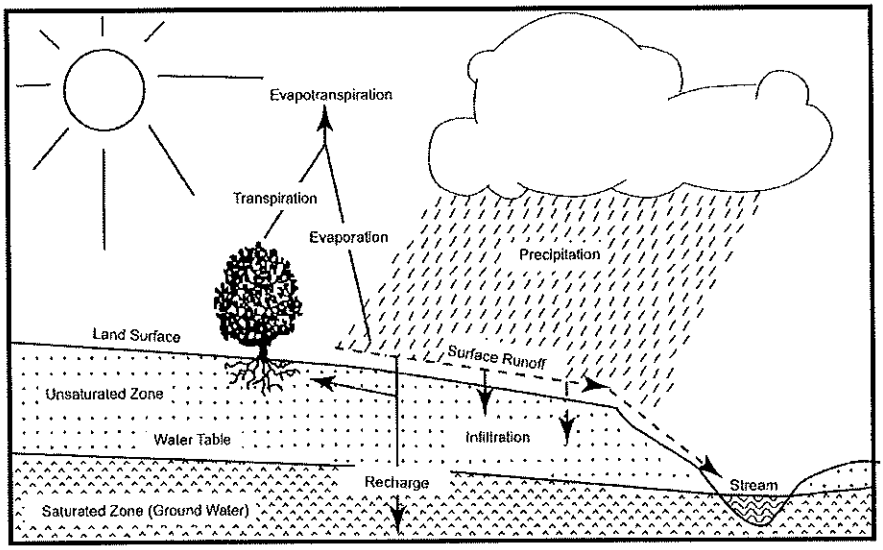
- Should the required recharge or infiltration be achieved at a single facility or several located throughout the development site?
- Should the facilities be located above or below ground?
- Which portions of the development site should be utilized to generate runoff to the facilities?
- What facility dimensions are required?
- Where should the facilities be located on the site relative to buildings, septic systems, property lines, and other sensitive areas?

This chapter presents the groundwater recharge information necessary to perform the hydrologic and hydraulic analysis required for Requirement 1 (maintaining pre-developed annual recharge volumes). Information necessary for the analysis required for Requirement 2 (infiltrating the increased 2-Year runoff volume) is presented in *Chapter 5: Computing Stormwater Runoff Rates and Volumes*. Design information regarding structural recharge and infiltration BMPs can be found in this chapter and *Chapter 9: Structural Stormwater Management Measures*.

Fundamentals

In both the NJDEP Stormwater Management Rules and this manual, groundwater recharge is defined as precipitation that infiltrates into the soil and is not evapotranspired. Instead, the infiltrated precipitation moves downward to a depth below the root zone of the surface vegetation, where it cannot be removed by that vegetation through uptake and evapotranspiration. At such a depth, it is considered available to enter the soil's saturated zone and become groundwater. The role of groundwater recharge in the overall hydrologic cycle is illustrated in Figure 6-1 below.

Figure 6-1: Groundwater Recharge in the Hydrologic Cycle



Source: New Jersey Geological Survey Report GSR-32.

According to the New Jersey Geological Survey (NJGS):

> *The potential for natural groundwater recharge begins with precipitation (rain, snow, hail, sleet). Some of the precipitation never seeps into the soil, but instead leaves the system as surface runoff. The water that seeps into the soil is infiltration. Part of the water that does infiltrate is returned to the atmosphere through evapotranspiration. Evapotranspiration refers to water that is returned to the atmosphere from vegetated areas by evaporation from the soil and plant surfaces and soil water that is taken up by plant roots and transpired through plant leaves or needles. Infiltrated water that is not returned to the atmosphere by evapotranspiration moves vertically downward and, upon reaching the saturated zone, becomes ground water. This ground water could be in a geologic material that is either an aquifer or nonaquifer, depending on whether it can yield satisfactory quantities to wells.* (NJGS GSR-32)

In addition to supplying water to wells, groundwater can also provide base flow to streams, wetlands, and other water bodies, directly affecting the ecology and geomorphology of these resources.

The potentially adverse impacts of land development on groundwater recharge have long been recognized. From the description presented above, it can be seen that land development activities that either cover permeable soils with impervious surfaces or reduce the soils' permeability through disturbance and compaction will reduce the rate of groundwater recharge that occurs under pre-developed site conditions. As noted above, such reductions in groundwater recharge can adversely impact streams, wetlands, and other water bodies by reducing the volume and rate of base flow to them. Reductions in groundwater recharge to aquifers can also adversely impact the yield of water supply wells. As a result, the New Jersey Stormwater Management Rules require that pre-developed groundwater recharge rates be maintained at land development sites under post-development conditions.

Computing Groundwater Recharge

Overview

As described above, the groundwater recharge requirements of the NJDEP Stormwater Management Rules can be met by demonstrating that the average volume of precipitation that is annually recharged to the groundwater at a major land development site under pre-developed conditions will be maintained following site development. As described in detail below, this can be achieved through a combination of natural recharge over the developed site's pervious surfaces and artificial recharge through groundwater recharge BMPs constructed at the site. The BMP volume is based on an average annual distribution of runoff-producing precipitation events at the site, the impervious drainage area to the BMP, and the losses that may occur to the infiltrated runoff before it can travel below the root zone of surrounding vegetation and become groundwater.

The data and analytic procedures necessary to meet these requirements have been developed by the New Jersey Department of Environmental Protection (NJDEP) with assistance from the New Jersey Geologic Survey (NJGS), the U.S. Geologic Survey (USGS), and professional consultants, and have been compiled into the New Jersey Groundwater Recharge Spreadsheet (NJGRS), a Microsoft Excel-based computer spreadsheet program. The NJGRS is intended for use by site planners, designers, engineers, and reviewers to determine average annual groundwater recharge amounts under both pre- and post-development site conditions and to design the groundwater recharge BMPs necessary to maintain 100 percent of the pre-developed site's annual groundwater recharge rate. Information regarding the NJGRS, including a detailed User's Guide, an example problem, and instructions on how to download the NJGRS from the NJDEP stormwater management website, is presented below. Details of the program's theoretical basis, equations, and supporting databases are also summarized.

In general, the analytic procedures utilized by the NJGRS to achieve compliance with the groundwater recharge requirements of the Stormwater Management Rules (described as Requirement 1 above) can be summarized by the following computational steps:

1. Compute the average amount of annual groundwater recharge occurring over the land development site under pre-developed site conditions.
2. Compute the average amount of annual groundwater recharge occurring over the land development site under post-developed conditions. Such site conditions should reflect the use, to the maximum extent practicable, of nonstructural stormwater management measures at the post-developed site in accordance with the Stormwater Management Rules. Details of such nonstructural measures are presented in *Chapter 2: Low Impact Development Techniques*.
3. Compute any resulting annual groundwater recharge deficit by subtracting the post-developed annual recharge amount in Step 2 from the pre-developed annual amount in Step 1. This deficit represents the average annual amount of groundwater recharge that must be achieved at the development site through structural groundwater recharge BMPs.
4. Determine the storage volume and related dimensions of the structural groundwater recharge BMP that will be required to satisfy the average annual groundwater recharge deficit computed in Step 3 above. In doing so, the BMP volume must be based on the average annual distribution of runoff-producing precipitation events at the development site, the size of the drainage area over which these events will occur (and from which runoff will be collected or captured for recharge), and the infiltration, evapotranspiration, and other losses that may occur to the recharged runoff in the BMP before it can actually enter the groundwater.

Theoretical Basis of Computations

Computation of the average annual groundwater recharge at a land development site under either pre- or post-developed conditions (as described above in Steps 1 and 2) can be performed with the New Jersey Groundwater Recharge Spreadsheet (NJGRS). This Microsoft Excel-based spreadsheet is based on the data and computational procedures contained in the 1993 *Geological Survey Report GSR-32: A Method for Evaluating Ground Water Recharge Areas in New Jersey* developed by the NJGS. As described in the report, GSR-32 utilizes precipitation, soil, land cover, and climate data, and rainfall-runoff and mass balance computations to estimate average annual groundwater recharge amounts at sites within any New Jersey municipality under a variety of surface and development conditions. All pertinent GSR-32 databases and computational algorithms have been incorporated into the NJGRS. As such, use of the NJGRS is governed, in part, by the assumptions and limitations of GSR-32.

Design of the required recharge BMP (as described in Step 4 above) to compensate for the developed site's groundwater recharge deficit (as described in Step 3 above) can also be performed with the NJGRS. The design computations in the NJGRS are based on a number of analytic techniques and databases. Conceptually, a groundwater recharge BMP will recharge the runoff it receives from its drainage area for all storms up to a particular precipitation depth, which can be referred to as the BMP's groundwater recharge design storm. While the recharge BMP will also receive runoff from larger storms, it will only recharge that portion of the runoff that equals the Recharge Design Storm runoff. The remaining runoff from these larger storms will overflow or otherwise bypass the BMP. It is important to note that the range of precipitation depths typically involved in the design of a groundwater recharge BMP are relatively small when compared to depths associated with runoff quality or quantity control. As a result, the NJGRS requires that the entire drainage area to a recharge BMP be impervious, since pervious surfaces would typically not be able to produce a sufficient amount of rechargeable runoff from such small precipitation depths.

Assuming that all of the precipitation falling in a recharge BMP's impervious drainage area can be collected and recharged (i.e., no runoff, infiltration, or recharge losses), computation of the BMP's Recharge Design Storm depth can be conceptually illustrated with the following conversion equation:

$$\begin{array}{c}\text{Total Average}\\ \text{Annual Recharge}\\ \text{Deficit}\end{array} = \begin{array}{c}\text{Annual Sum of}\\ \text{Recharge Design and}\\ \text{Smaller Storm}\\ \text{Depths}\end{array} + \left[\begin{array}{c}\text{Recharge Design}\\ \text{Storm Depth}\end{array} \times \begin{array}{c}\text{Number of}\\ \text{Larger}\\ \text{Storms}\end{array}\right]$$

The above equation shows that, with appropriate precipitation data and ignoring all losses, the total annual recharge deficit at a land development site can be converted to the sum of two precipitation amounts, both of which are based on a single groundwater recharge design storm. The first amount is the sum of all storm depths up to and including the Recharge Design Storm that would occur at the site in an average year. The second amount is the product of the Recharge Design Storm depth times the number of larger storms that would also occur at the site in that same average year.

Unfortunately, most of the ease and simplicity of the conversion equation shown above is gained through its two assumptions: that appropriate precipitation data is available, and that all of the precipitation falling on the BMP's impervious drainage area can be recharged without loss. In reality, compiling such precipitation data for a specific land development site requires considerable effort and resources and must be repeated for each new development site. In addition, precipitation losses will occur and must be taken into consideration in the design of a recharge BMP. As noted above, these losses, which will vary with the total precipitation depth, include those occurring in the conversion of precipitation to runoff, including surface storage, evaporation, and infiltration through cracks, joints, and seams in the drainage area's impervious surface. Further losses will occur once the runoff is delivered to the recharge BMP, primarily in

the form of evapotranspiration by the vegetation above, beneath, and/or adjacent to the BMP. Further complications arise when one attempts to estimate these variable losses. While equations exist to predict such losses for individual storm events, there are none readily available that can do so for an annual precipitation depth.

The NJGRS addresses these problems in several ways. Regarding the need for appropriate precipitation data for all possible development site locations in New Jersey, the NJGRS developers compiled and analyzed 52 years of daily precipitation data collected at 92 precipitation stations throughout New Jersey between 1948 and 1999. To ensure a proper database, only precipitation depths greater than 0.04 inches were considered, since this depth was considered the minimum amount necessary to produce runoff from impervious surfaces. All daily values at each station were sorted for each year and then averaged over the 52 year period of record. Next, all values with the same rank were averaged across all 92 stations to produce an average annual series of 79 precipitation events for the state. Finally, this series was normalized by dividing each event value by 46.32 inches, which was the average annual precipitation for the 92 stations. This produced an average annual series of 79 precipitation events, expressed as a percentage of total annual precipitation, that are analyzed individually by the NJGRS to compute the runoff, infiltration, and recharge losses and the resulting annual groundwater recharge achieved by a recharge BMP at a land development site in any New Jersey municipality.

This average annual series of precipitation events for New Jersey is shown below in Figures 6-2 and 6-3. Figure 6-2 depicts the precipitation depth, expressed as a percentage of total average annual rainfall, of each event in the series in ascending order, while Figure 6-3 depicts, also in ascending order, the events' cumulative percentage of the average annual rainfall. More detailed information about each specific event in the average annual series is contained in the NJGRS' databases. The average annual precipitation series shown in Figure 6-2 is used by NJGRS to produce a site-specific, year-long series of design storms by multiplying each event value in the series by the average annual precipitation in the municipality where the recharge BMP is located. Since the NJGRS also contains average annual precipitation values for each New Jersey municipality, the NJGRS user can generate this site-specific average annual design series simply by specifying the municipality and county in which the development site is located.

Figure 6-2: Average Annual Precipitation Series in NJGRS

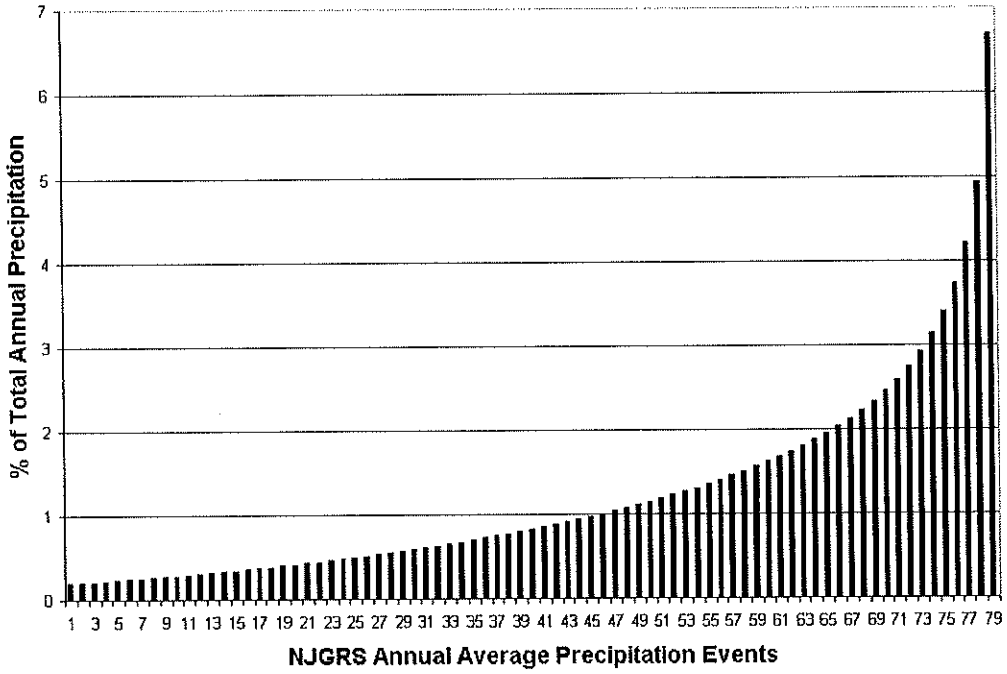
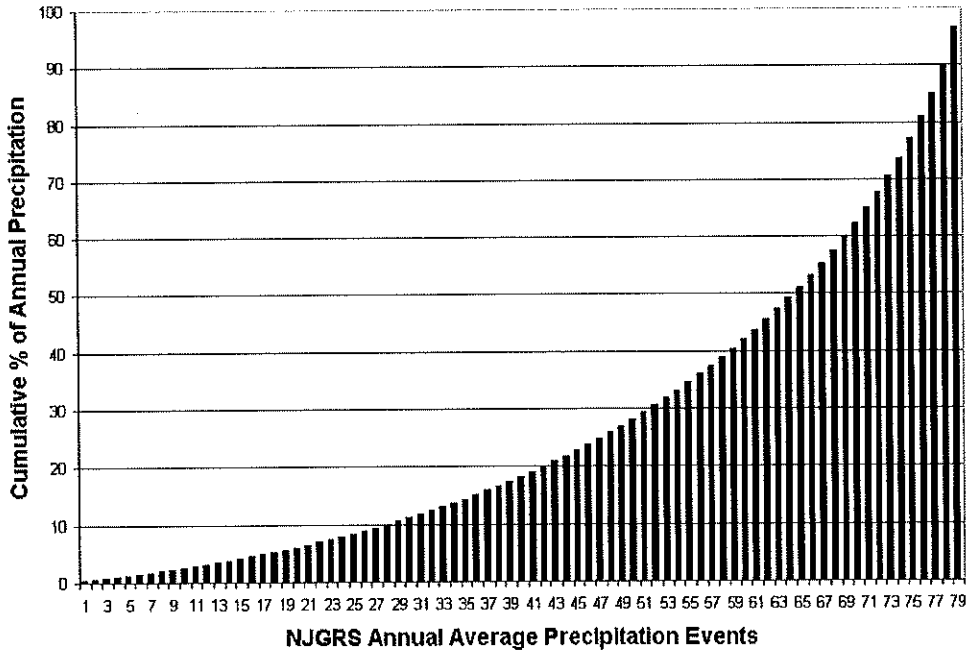


Figure 6-3: Cumulative Total of Average Annual Precipitation Series in NJGRS



Once an average annual design series is computed for the specific recharge BMP site, the NJGRS next addresses the problem of precipitation losses. As noted above, all of the possible losses that will occur, from the time the precipitation falls on the BMP's impervious drainage area to when the recharged water moves below the root zone of the vegetation in or adjacent to the BMP, must be accounted for in order to accurately compute the actual volume that will be recharged. Such losses can include infiltration and surface storage losses on the drainage area surface as the precipitation is converted into runoff, as well as evapotranspiration and infiltration losses as the runoff is converted to recharge within the BMP itself. To compute runoff losses, the NJGRS uses one of three equations depending upon the total depth of the event. These equations are applied to each event in the average annual design series to compute the resultant runoff for each one. This resultant runoff is then used in additional equations that estimate the losses that will occur for each design event once the runoff enters the recharge BMP.

When computing runoff losses for design event depths less than 0.0408 inches, the NJGRS assumes that the entire precipitation depth is consumed by surface storage, infiltration, and other losses and no runoff is produced.

For design event depths between 0.04 and 1.25 inches, the NJGRS uses the following equation to compute runoff:

$$Q = 0.95\ (P - 0.0408)\ 0.90$$

where:

Q = Runoff Depth in Inches
P = Precipitation Depth in Inches

For design event depths greater than 1.25 inches, the NJGRS uses the NRCS Runoff Equation with a Runoff Curve Number (CN) of 98:

$$Q = \frac{(P - 0.04)^2}{(P + 0.16)}$$

where:

Q = Runoff Depth in Inches
P = Precipitation Depth in Inches

As noted above, the resultant runoff depth for each design event is then applied to specialized equations developed specifically for the NJGRS to estimate the losses that will occur to the runoff after it is stored in the recharge BMP. These losses will depend upon a number of factors, including the climate at the development site, the specific vegetation and soil conditions at the recharge BMP location, and the depth of the BMP relative to the vegetation's root zone. A complete description of the loss equations used in the NJGRS is presented in the program's User's Guide. By subtracting these losses from the stored runoff, the amount of runoff that is actually recharged for each design event is computed. The NJGRS then adds up the recharge amounts from each design event to obtain a total annual recharge amount, which is then compared with the average annual recharge deficit created by the development to determine whether the recharge BMP's performance is adequate. Similar to the computation of the average annual design series described above, the NJGRS' loss computations are performed automatically each time the user provides new development site or recharge BMP data and then requests a BMP design update. The NJGRS will then either evaluate the performance of the proposed recharge BMP or, if requested, compute the effective BMP storage depth or surface area necessary to offset the development's annual recharge deficit.

New Jersey Groundwater Recharge Spreadsheet (NJGRS)

General Instructions

As described above, the New Jersey Groundwater Recharge Spreadsheet (NJGRS) is a Microsoft Excel-based computer spreadsheet program. It is typically used in a two step procedure, utilizing first the Annual Recharge worksheet and then the BMP Calculations worksheet in the program. During the first step, the average annual groundwater recharge amounts at the site under pre- and post-developed conditions are estimated based upon site data provided by the user. From these estimates, the program computes the average annual groundwater recharge deficit caused by the site development that must be offset by a groundwater recharge BMP. During the second step, this recharge BMP is sized based upon user-specified information regarding both the BMP and its location at the development site. General information regarding each step is provided below. Specific information about the program's use and computation methods are provided in the NJGRS User's Guide, which is presented at the end of this chapter.

It should be noted that, as a spreadsheet, certain cells of the program are reserved for user input while others provide intermediate and final results. All user input cells are shaded with a tan color while spreadsheet output cells are shaded with gray. Only the tan, user-input cells should be changed. In addition, the spreadsheet contains several combinations of commands known as macros. While these macros are essential to the spreadsheet's operations, they are unsigned and, as such, their presence may conflict with the Excel program's security settings in the user's computer. These conflicts would be identified to the user through an error or warning message immediately after opening the NJGRS. If such conflicts are encountered, they can usually be addressed by setting the Excel macro security level to Medium. *The user should determine whether this level of security is acceptable for their own system.* The user would then be prompted to enable the NJGRS macros each time the spreadsheet is opened.

Finally, upon completing use of the NJGRS for a specific project, the user will be asked whether the changes made during use should be saved. While such decisions are at the discretion of each user, it may be helpful for training purposes to retain the spreadsheet original settings, which match those in the NJGRS User's Guide. In this case, a copy of the revised NJGRS with project specific data entered can be saved with a project-specific name using the *Save As* command under *File* on the Excel command line.

Annual Recharge Worksheet

Annual groundwater recharge at a land development site under both pre- and post-developed (or existing and proposed) site conditions can be estimated using the Annual Recharge worksheet in the NJGRS. As discussed above, these estimates are based on the methodology contained in *Geological Survey Report GSR-32: A Method for Evaluating Ground Water Recharge Areas in New Jersey* (GSR-32) developed by the New Jersey Geological Survey. In general, use of this worksheet requires the following user input:

1. Name of municipality and county in which the project site is located (Cell C3). Upon input of this data through use of a drop-down list, the NJGRS will immediately display the average annual precipitation and climate factor for the site's municipality from the GSR-32 databases in the NJGRS. The user can also specify a project name, description, and date in the lines provided (Cells K1, K2, and K3).
2. Land use and land cover (LULC) data for the site under both pre- and post-developed conditions. This data will consist of the area (in acres), LULC characteristics, and soil series name for up to 15 land segments of the pre- and post-developed site. The NJGRS will issue a warning message if the total area specified under pre-developed conditions is different than post-developed. The LULC data and soil series names are listed in a drop-down list next to the respective input cells. It is

important to note that the LULC categories in the drop-down list are based on those contained in Table 2-2 of the NRCS *Technical Release 55 – Urban Hydrology for Small Watersheds*. For a correlation between these LULC categories and those in GSR-32, upon which the NJGRS is based, see Table 6-1 below.

Table 6-1: NJGRS/TR-55 and GSR-32 LULC Descriptions

NJGRS/TR-55 LULC Descriptions	GSR-32 LULC Descriptions
Brush	Brush
Gravel, Dirt	Unvegetated
Impervious Areas	Unlandscaped Developed
Meadow, Pasture, Grassland or Range	Agricultural – Pasture
Open Space	Landscape Open Space
Residential 1 to 2 Acre	1 - 2 Acre Lots
Residential 1/2 to 1 Acre	1/2 - 1 Acre Lots
Residential 1/3 to 1/4 Acre	1/8 - 1/2 Acre Lots
Residential 1/8 Acre or Less	1/8 Acre Lots
Row Crop	Agricultural – General
Small Grain or Legumes	Agricultural – Cropland, Legume
Urban Districts	Landscaped Developed
Woods	Woods
Woods – Grass Combination	Wooded – General

As noted in the NJGRS User's Guide, it is important to specify a site's LULC characteristics as accurately as possible. Therefore, while a 1/4 acre residential site could be specified in the NJGRS by the "Residential 1/3 to 1/4 Acre" LULC description in Table 6-1, it is generally more accurate to divide the site into impervious and pervious areas and specify each as a separate land segment in the NJGRS. For example, at a 1/4 acre residential site with a total area of 10 acres consisting of 40 percent connected impervious and 60 percent grassed surfaces and a single soil series, it would be more appropriate to specify the site's LULC characteristics in the program as a separate 4 acre impervious area land segment and a 6 acre open space land segment. This separation of connected impervious and pervious areas is similar to the technique for computing runoff volume using the NRCS methodology in Chapter 5. It should be noted that the total impervious area for post-developed conditions displayed in Cell M23 of the Annual Recharge worksheet will be based only on those post-developed land segments specified as impervious.

When using the above technique, it should be noted that if any impervious areas at a development site are unconnected (see Chapters 2 and 5 for complete details and requirements), the area used in the impervious surface designations described above for these unconnected areas should be one half of the actual area. For example, if a site has 3 acres of directly connected impervious surface, but 2 acres of unconnected impervious area, the total impervious area specified in the NJGRS can be 3 + (0.5)(2) or 4

acres. This 50 percent reduction in the size of unconnected impervious areas accounts for the runoff re-infiltration that can occur downstream of such areas and is consistent with the runoff computations for such areas contained in TR-55. To keep the total site area correct, the user should remember to specify the "remainder" of the unconnected impervious area as a pervious one with the appropriate soil series and LULC based upon the actual pervious area downstream of the unconnected impervious area.

It should also be noted that if a proposed recharge BMP will have a specific location within a land development site with similarly specific LULC and soil characteristics, that portion of the site should be specified as a separate land segment on the Annual Recharge worksheet. This is true even if that segment will be covered with an impervious surface. Doing this will allow the NJGRS to more accurately compute the losses and resultant recharge at the BMP. More details are presented below in the NJGRS User's Guide, including the need to specify this segment on the BMP Calculation worksheet.

From the above, it can be seen that the more generalized Residential and Urban District LULC descriptions in Table 6-1 above should be used only for general planning studies of groundwater recharge requirements, particularly at sites with multiple lots of similar size and impervious coverage where each lot will have a separate groundwater recharge BMP. Since the soil series in which each BMP will be located may vary from lot to lot, the general LULC descriptions can be used to compute typical or general groundwater recharge requirements and BMP dimensions for the entire site. These general values can then be refined on a lot by lot basis during later, more detailed project phases with specific lot and BMP information.

Finally, in accordance with NJGS Report GSR-32, which is the basis of the NJGRS, zero recharge volume will be computed for any land segment specified for either pre- or post-development conditions that contain soils that are hydric. See Report GSR-32 for more details.

BMP Calculations Worksheet

The dimensions of a groundwater recharge BMP can be either determined or tested using the BMP Calculations worksheet in the NJGRS. This worksheet can be used to calculate the effective depth required at a recharge BMP if the impervious drainage area and BMP area are specified. Conversely, the worksheet can also be used to calculate the required area of the BMP if the drainage area and effective BMP depth are specified. Finally, the BMP Calculations worksheet can be used to analyze a specific recharge BMP with a certain area and effective depth to see what amount of annual groundwater recharge it can provide.

As explained in the NJGRS User's Guide, it is critical that the surface area of a recharge BMP (variable ABMP) be specified in the program as accurately as possible. This is because the program uses the ratio of the BMP's drainage area and surface area to determine the resultant depth of runoff in the BMP for each storm event analyzed. In addition, a recharge BMP's effective depth (variable dBMP) represents the maximum equivalent water depth that can be achieved in the BMP before overflow begins. Therefore, if the proposed recharge BMP will consist, for example, of a subsurface, vertical-walled chamber, dBMP will simply be the maximum achievable depth before the chamber is full and overflow occurs. However, if the proposed BMP will be filled with broken stone or other suitable material, dBMP will be the product of the BMP's actual or physical depth and the void ratio of the fill material.

For recharge BMPs that consist of a combination of filled and open areas (e.g., a perforated pipe within a stone filled trench) or for irregular-shaped BMPs with nonvertical sides, dBMP can be computed by dividing the BMP's total storage volume by its surface area (ABMP). For BMPs with varying surface areas (e.g., a trapezoidal infiltration basin with sloping sides or a perforated elliptical pipe), the user should exercise discretion in selecting the correct surface area to use. In most cases, the average surface area would be appropriate. In all cases, the user should always verify that the product of the specified surface area (ABMP) and effective depth (dBMP) equals the BMP's total storage volume (variable VBMP in Cell G12). More information and recommendations can be found in the NJGRS User's Guide.

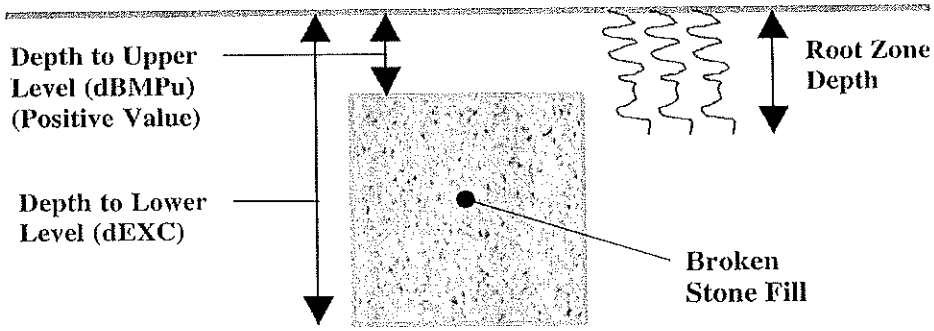
In addition to the above, it is important to note that the BMP Calculations Worksheet assumes that all runoff stored in the recharge BMP at depths at or below dBMP (i.e., the maximum storage depth in the BMP) will be infiltrated into the soils below the BMP and that any greater runoff amounts will overflow the BMP. As such, the BMP Calculations Worksheet cannot directly model a recharge BMP that will infiltrate some of its runoff while it is simultaneously discharging some through an overflow or other outlet. Examples of such a recharge BMP would include an extended detention basin where stored runoff is simultaneously infiltrated through the basin bottom and out its outlet structure. For such BMPs, alternative BMP calculation techniques will be required.

With regards to BMP location, if a recharge BMP will be located within a particular post-developed land segment specified on the Annual Recharge worksheet, it should be specified in Cell C9 (variable C9) of the BMP Calculations worksheet. As described earlier, doing so will allow the NJGRS to more accurately compute the losses and resultant recharge at the BMP. If this land segment is not specified on the BMP Calculations worksheet, the NJGRS will, by default, use average soil and loss factors based on all of the post-developed land segments specified on the Annual Groundwater Recharge worksheet.

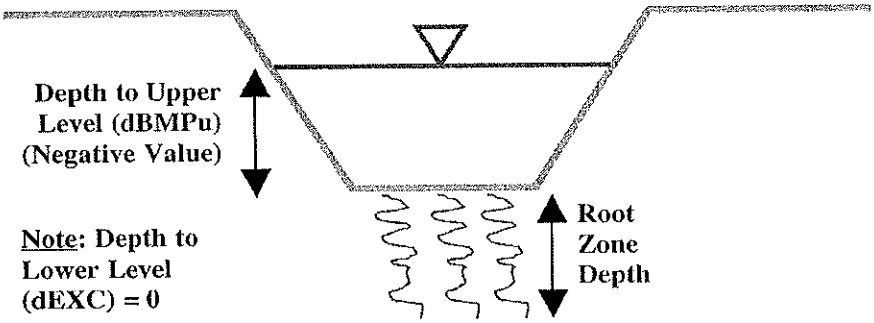
The BMP Calculations worksheet can analyze a recharge BMP located either on grade or constructed below grade through excavation. An excavated BMP can be either a surface or subsurface BMP. The specific type of BMP is described in the BMP Calculations worksheet through its effective depth (dBMP) and two additional vertical distances. The first is the vertical distance from the vegetated ground surface to the maximum water surface level in the BMP (variable dBMPu in Cell C7). This value is positive if the maximum level is below the vegetated ground surface and negative if above the vegetated ground surface. The second is the vertical distance from the vegetated ground surface to the bottom of the BMP (variable dEXC in Cell C8). For example, if the top of a 36-inch deep stone-filled infiltration trench is located 24 inches below ground level, dBMPu would be 24 inches and dEXC would be 60 inches (i.e., dBMPu plus the 36-inch actual depth of the trench). It should be noted, however, that since the trench is filled with gravel with a certain void ratio, the BMP's effective depth (dBMP) would be 36 inches times that void ratio. Using the dBMPu and dEXC variables, virtually all types of recharge BMPs can be specified, including "above the surface," "semi-buried," and "completely buried" BMPs. See Figure 6-4 below and the NJGRS User's Guide for more information.

Figure 6-4: Examples of Depths to Upper (dBMPu) and Lower (dEXC) Levels of Recharge BMP

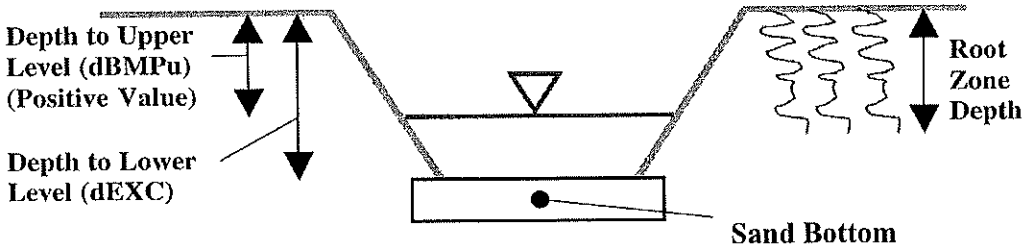
Subsurface Recharge BMP



Vegetated, Surface Recharge BMP



Unvegetated Surface Recharge BMP



In using the BMP Calculations worksheet, it is important to note that, by default, the NJGRS takes the values from the Annual Recharge worksheet for the Post-Development Recharge Deficit Volume (Cell K24) and the Total Impervious Area (Cell M23) and specifies them as initial values on the BMP Calculations worksheet for the Post-Development Deficit Recharge (variable Vdef in Cell C14) and Post-Development Impervious Area (variable Aimp in Cell C15). This allows solution of the site's total recharge deficit by a single groundwater recharge BMP that will receive runoff from a developed site's entire impervious area (if specified as impervious land segments). However, in many instances, the single groundwater recharge BMP will receive runoff from only a portion of the site's impervious area (e.g., only roof runoff). In such cases, the user must specify the exact size of Aimp (impervious area to the BMP) in Cell C15. Failure to do this for such BMPs will result in an overestimation of the amount of runoff captured by the BMP and erroneous BMP dimensions and/or recharge amounts.

At other sites, it may be necessary or desirable to utilize more than one groundwater recharge BMP to meet the site's recharge requirements. In such cases, each BMP will not only receive runoff from a portion of the site's impervious surface, but each will also seek to provide only a portion of the site's total recharge deficit. In such cases, the user must specify both the exact Aimp and Vdef (Post-Development Deficit) for each BMP in Cells C14 and 15 of the BMP Calculations worksheet. *In such cases, the user must also use a separate NJGRS spreadsheet for each BMP. Using multiple copies of the BMP Calculations worksheet within a single spreadsheet can yield erroneous results.*

In addition, computational problems can occur if, in designing a recharge BMP, the user selects either an initial BMP surface area (ABMP) or effective depth (dBMP) that is drastically different than the actual value needed to meet the required recharge deficit. If this occurs, the NJGRS may not be able to compute the correct value and will, instead, display excessive large answers or divide by zero messages. If this occurs, the user should adjust the initial value to one that more closely approximates the final answer and rerun the worksheet.

The BMP Calculations worksheet will also present various characteristics of the recharge BMP, including its effectiveness in converting runoff to infiltrated water and then recharged groundwater. See the NJGRS User's Guide presented at the end of this chapter for more information.

BMP Calculation Messages

The BMP Calculations worksheet provides three important messages to check the validity of the computed results. The Volume Balance message (Cell J11) is a check of the Annual BMP Recharge Volume in Cell G14 against the Post-Development Deficit Recharge (variable Vdef in Cell C14). If these values are equal, the problem is solved successfully and the message in this section will read "OK." However, if the BMP's annual recharge volume does not equal Vdef, the message instructs the user to continue to solve the problem. This may also occur if the user changes any of the BMP design parameters and forgets to solve the problem by clicking on any of the two solve buttons.

The dBMP Check message (Cell J12) checks the validity of the value inputted for the dBMP, the BMP's effective depth in Cell C6. If this value is greater than the difference between the depths to the BMP's upper and lower surfaces (variables dBMPu and dEXC in Cells C7 and C8, a warning message is issued telling the user to adjust dBMP. dEXC Check (Cell J13) is the third message. It checks the validity of dEXC to ensure it is larger than dBMPu. If it is not, a message will appear instructing the user to make dEXC larger than dBMPu.

Below these messages is a report on the location of the BMP as specified by the user in Cell C9 (variable segBMP). If the user has entered a valid segment number for segBMP, the message will read "OK." If the user enters a zero for segBMP, the message will read "Location is selected as distributed or undetermined." However, if the user enters a land segment number that was not previously defined in the Annual Recharge

worksheet under Post-Developed Conditions, the message will say: "Land Segment Number Selected for BMP is not Defined." The user should then make appropriate corrections to segBMP.

See the NJGRS User's Guide for more information regarding calculation check messages and warnings.

Additional Information

In addition to the above, the following important features and characteristics of the NJGRS should be noted:

1. The NJGRS gives the user the opportunity to specify what percentage of a development site's annual groundwater recharge deficit must be retained (Cell K23 of the Annual Recharge worksheet). However, it should be noted that the program's default value is 100 percent which, as noted above, is the amount required by the NJDEP Stormwater Management Rules.
2. The pre- and post-development average annual recharge at a development site is a function, in part, of the municipality in which the site is located. Therefore, changing the name of the municipality in Cell C3 of the Annual Recharge worksheet will change both the pre- and post-development recharge volumes. Similarly, if the user wishes to analyze a site in a different municipality, the new municipality's name must be entered through the drop-down list in Cell C3 in order to accurately compute pre-and post-development recharge amounts.
3. In Cell K6 of the BMP Calculations worksheet, the NJGRS will display the "Inches of Rainfall to Capture." This value is also displayed graphically in Chart 1 of the NJGRS along with other pertinent BMP performance information. This value specifies the minimum depth of rainfall over the BMP's impervious drainage area that must be collected to meet the development site's average annual recharge deficit. It is also the maximum event rainfall that the BMP can store without overflowing and, as such, it is equal to the BMP's Recharge Design Storm depth described previously in "Theoretical Basis of Calculations." This design storm depth is important, as it can be used to estimate the resultant groundwater recharge design storm runoff from a development site with groundwater recharge BMPs. See Examples 4, 5 and 6 in Chapter 5 for more details on this procedure.
4. At the time of the NJGRS' development, all soil series mapped in New Jersey were included in its databases. Nevertheless, instances may arise where a soil series identified at a land development site has not been included. In such instances, the user should select a similar soil series from the program's database. In doing so, the following criteria should be utilized, generally in the order presented:
    - Select a NJGRS soil series within the same Hydrologic Soil Group (HSG) as the site soil.
    - Within the same HSG, select an NJGRS soil series with similar textural characteristics and classification as the soil.
    - If the site soil includes a fragipan, bedrock, or other restrictive layer below its surface, select an NJGRS soil series with a similar restrictive depth.
    - If more than one choice of NJGRS soil series appears reasonable, the user may then analyze and compare the annual groundwater recharge amounts for each using the NJGRS program to help make a final selection.

Recharge BMP Design Guidelines

In general, the design of a groundwater recharge BMP to offset a development site's groundwater recharge deficit should follow the standards and guidelines for dry wells, infiltration basins, and pervious paving systems with storage beds presented in Chapter 9. This includes utilizing soil permeability data obtained from tests such as those contained in Standards for Individual Subsurface Sewage Disposal Systems at N.J.A.C. 7:9A at the site of the proposed recharge BMP. In addition, the recharge BMP design must be based on the following guidelines:

1. Computation of the pre- and post-development annual groundwater recharge rate and the annual recharge deficit should be based upon the New Jersey Geological Survey Report GSR-32 A Method For Evaluating Ground-Water-Recharge Areas in New Jersey, which is incorporated into the NJGRS.
2. Only the directly connected impervious portions of a recharge BMP's drainage area can be used to compute runoff to the BMP. In the NJGRS, the input parameter Aimp, which is the size of the recharge BMP's drainage area, must represent only directly connected impervious surfaces. This is particularly relevant for infiltration basins and pervious paving systems used for groundwater recharge that may also have pervious and unconnected impervious areas draining to them.
3. Runoff collected from roofs and other above-grade surfaces can be directly conveyed to a recharge BMP. However, roof gutter guards and/or sumps or traps equipped with clean-outs should be included upstream of the recharge BMP wherever possible to minimize the amount of sediment or other solids that can enter the BMP.
4. Runoff collected from parking lots, driveway, roads, and other on-grade impervious surfaces and conveyed to a subsurface recharge BMP must be pretreated to remove 80 percent of TSS in order to prevent the loss of storage volume and/or recharge capacity due to sedimentation and clogging. Exceptions may be possible for patios, tennis courts, and similar on-grade impervious surfaces with minimal TSS loadings on case-by-case basis. Such treatment can also be used to meet the site's overall TSS removal requirements. In addition, all on-grade drainage areas to a subsurface recharge BMP should consist only of impervious surfaces. Exceptions to this requirement may include roadway right-of-ways, vegetated parking lot medians, planting and landscape beds, and other pervious surfaces provided that they comprise only a small percentage of the total drainage area and will not generate an excessive amount of TSS or other material that might adversely impact the subsurface recharge BMP. As noted above, if such areas are part of the actual drainage area, they must not be included in the drainage area size (variable Aimp) used in the NJGRS' BMP Calculations worksheet to design the recharge BMP.

   In addition, it should be noted that, since the BMP Calculations Worksheet assumes that all runoff from a recharge BMP's impervious drainage area will be delivered to the BMP, it cannot directly account for runoff losses incurred at a pretreatment measure located between the drainage area and the recharge BMP. If such losses will occur due to the selected pretreatment measure, appropriate compensating adjustments may be attempted in the BMP Calculations Worksheet input data or alternative BMP calculation techniques utilized.
5. In general, County Soil Surveys prepared by the U.S. Department of Agriculture and the State Soil Conservation Committee can be used to obtain the soil series data required for the determination of annual land development site recharge rates and deficits and the dimensions of recharge BMPs using the NJGRS program. However, site soil tests will be required at the actual location of a proposed recharge BMP in order to confirm the BMP's ability to function properly without failure. Such tests should include a determination of the textural classification and permeability of the soil

at the bottom of the proposed recharge BMP. As noted above, permeability testing can be conducted in accordance with Standards for Individual Subsurface Sewage Disposal Systems at N.J.A.C. 7:9A.

Depending upon the type, location, use, and maximum design storm of the selected recharge BMP, minimum design soil permeability rates will vary from 0.2 to 0.5 inches per hour and that a factor of safety of 2 must be applied when converting a tested permeability rate to a design rate. In addition, the soil permeability rate must allow the recharge BMP to fully drain its maximum design storm runoff volume within 72 hours. Recharge BMP locations that fail to meet these two requirements should be rejected and alternative onsite locations selected. A groundwater recharge waiver may be sought from the applicable reviewing agencies if suitable permeability rates cannot be found at any recharge BMP locations on the development site.

See Chapter 9 for details on structural best management practices that can be used as recharge BMPs, including minimum design permeability rates. Such BMPs include dry wells (Chapter 9.3), infiltration basins (Chapter 9.5), and certain types of pervious paving systems (Chapter 9.7).

6. The results of the BMP site soil testing should be compared with the County Soil Survey data used in the NJGRS' annual recharge and BMP design computations to ensure reasonable data consistency. If significant differences exist between the BMP site soil test results and the County Soil Survey data, additional development site soil tests are recommended to determine and evaluate the extent of the data inconsistency and the need for revised annual recharge and BMP design computations based upon the site soil test results. All significant inconsistencies should be discussed with the local Soil Conservation District prior to proceeding with such redesign to help ensure that the site soil data is accurate. It should also be noted that significant inconsistencies between development site soil tests and the County Soil Survey may warrant revisions to the site's stormwater quality and quantity storm computations.
7. The development site areas that extensive site soil testing determine to have permeability rates less than 0.2 inches per hour may be considered to belong to Hydrologic Soil Group D in the NJGRS program. For such areas, the user may use any HSG D soil in the NJGRS soil series database to define such site areas in the NJGRS' Annual Recharge worksheet. In accordance with the assumptions of both the NJGRS program and N.J. Geological Survey's Geological Survey Report GSR-32: A Method for Evaluating Ground Water Recharge Areas in New Jersey, such areas will not produce any groundwater recharge. Once again, the assignment of HSG D to any development site areas should be discussed with the local Soil Conservation District prior to proceeding to help ensure that the site soil data is accurate.

The New Jersey Groundwater Recharge Spreadsheet (NJGRS)

User's Guide

Version 2.0 – November 2003

There are two computational worksheets in the NJGRS spreadsheet:

- **Annual Recharge:** This worksheet, which resides on the first page of the spreadsheet, is used to estimate the annual groundwater recharge volumes that occur naturally under the Pre-Developed and Post-Developed Conditions. Based on the value of *"percent of Pre-Developed Annual Recharge to Preserve"* that the user provides (NJDEP currently requires 100 percent for this parameter), the worksheet calculates the *"Post-Development Annual Recharge Deficit"* in cubic feet. This is the annual recharge volume that must be provided by one or more groundwater recharge BMPs.
- **BMP Calculations:** This worksheet, which resides on the second page of the spreadsheet, is used to design the required size and configuration of one or more groundwater recharge BMPs to satisfy the *"Post-Development Annual Recharge Deficit"* calculated in the Annual Recharge worksheet.

NOTE: Only the above worksheets in the NJ Groundwater Recharge Spreadsheet are for user input. Charts 1 through 3 can be viewed for visual inspection of the results. Other worksheets in the spreadsheet are either for internal calculations or contain the databases used by calculations. The user should refrain from changing anything in these worksheets.

Part 1: Using the Annual Recharge Worksheet

Figure 1: Screen Capture Showing the Annual Recharge Worksheet

New Jersey Groundwater Recharge Spreadsheet Version 2.0 (November 2003)

Annual Groundwater Recharge Analysis (based on GSR-32)

Select Township ↓	Average Annual P (in)	Climatic Factor
MIDDLESEX CO., PERTH AMBOY CITY	47.8	1.53

Project Name: Sample Project
Description: This is a test application
Analysis Date: 09/01/03

Pre-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	1.4	Open space	Woodstown	12.9	65,498
2	0.3	Gravel, dirt	Woodstown	6.9	7,536
3	3.5	Woods-grass combination	Woodstown	13.5	171,255
4	1.4	Open space	Keyport	13.4	68,140
5	0.5	Gravel, dirt	Keyport	7.5	13,657
6	3.3	Woods-grass combination	Keyport	13.0	165,963
7					
8					
9					
10					
11					
12					
13					
14					
15					
Total =	10.4			Total Annual Recharge (in)	Total Annual Recharge (cu-ft)
				13.0	492,054

Post-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	1.5	Impervious areas	Impvd	0.0	-
2	1.0	Gravel, dirt	Woodstown	6.9	40,191
3	3.65	Open space	Keyport	13.4	177,667
4	3.85	Open space	Woodstown	12.9	170,762
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
Total =	10.4			Total Annual Recharge (in)	Total Annual Recharge (cu.ft)
				10.3	388,620

Annual Recharge Requirements Calculation

% of Pre-Developed Annual Recharge to Preserve =	100%	
Post-Development Annual Recharge Deficit=	103,435	(cubic feet)
Total Impervious Area (sq.ft)	65,340	

Recharge Efficiency Parameters Calculations (area averages)

RWC= 3.94	(in)	DRWC= 3.94	(in)
ERWC = 0.93	(in)	EDRWC= 0.93	(in)

Procedure to fill the Pre-Development and Post-Development Conditions Tables

For each land segment, first enter the area, then select TR-55 Land Cover, then select Soil. Start from the top of the table and proceed downward. Don't leave blank rows (with Ac.0) in between your segment entries. Rows with Ac.0 will not be displayed or used in calculations. For impervious areas outside of standard lots select "Impervious Areas" as the Land Cover. Soil type for impervious areas are only required if an infiltration facility will be built within these areas.

- Figure 1 is a screen capture from an example application of the Annual Recharge Worksheet. All user-input cells are tan colored. All gray colored cells are used to show calculation results or internal validity checks and must *not* be changed by the user. The three cells at the upper right corner of the sheet are where the user can input project information. These inputs are optional, but they can help in identifying the project and the alternative being analyzed.
- As the first step, the user must select the project's municipality. Click once on the municipality cell (Cell C3) and select the project's county and municipality from the drop-down list of all New Jersey municipalities, which is arranged by county in alphabetical order. Once the user has selected a municipality, the values of average annual precipitation and the climate factor are set for that municipality in the two cells to the immediate right of the municipality's name (Cells D3 and E3).
- The next step is to provide information about pre-developed site conditions. The first column is the land segment number (Cells A6 to A20). Up to 15 different land segments can be inputted in this table.

  NOTE: If you have more than 15 different land segments, try to combine similar segments together or subdivide your area into smaller areas not consisting of more than 15 land segments.

- For each land segment, first enter the area in acres. Then select an appropriate TR-55 land cover description from the drop-down list of standard NRCS land cover descriptions. Finally, select the segments soil series from the drop-down list. Note that, as soon as the area for a segment is entered, the entries for other columns become visible and selectable. Start from the top of table and proceed downward. Do not leave blank rows (with zero area) between land segment entries; rows with zero areas will not be displayed or used in calculations.

  NOTE: Once you click on any of these cells a pop-up help message will appear to briefly tell you about the required input for that cell.

- As can be seen from the list of available TR-55 land cover descriptions in the drop-down list, there may be more than one way to describe the pre-developed land cover at a project site, particularly when that cover is a mixture of pervious and impervious surfaces such as a single family residential development. For assistance, see the guidelines in the New Jersey Groundwater Recharge Spreadsheet (NJGRS) section of Chapter 6 for selecting segment limits and land cover descriptions. Finally, it should be noted that, under the Pre-Developed Conditions section, it is not necessary to specify the soil series for site segments with impervious land cover, since the natural recharge in these segments is set at zero.

  NOTE: If the soil you select for a land segment is hydric, recharge will be set to zero for that segment.

- Once the user has completed inputting all land covers in the table for the Pre-Developed Conditions, check the total area in acres (Cell B21) to ensure that the total project area is correct. The last two columns of this table show the naturally occurring average annual recharge amount as a depth (in inches over the segment area) and a volume (in cubic feet) for each land segment. At the bottom of these columns (Cells E22 and F22), the average recharge depth (in inches) and the total annual recharge volume (in cubic feet) over the total area under Pre-Developed Conditions is given. This number is later used in the calculation of any post-development recharge deficit.
- The above procedure can also be used to enter the required data for the post-developed site conditions. In doing so, please note the following additional requirements:

  1. To correctly compute the performance and/or required size of a proposed groundwater recharge BMP, the area in which the BMP will be located must be entered as a separate site

segment with its associated soil series. The number of this segment must also be specified on the BMP Calculations spreadsheet (see below).

2. As noted above, it is normally not necessary to specify the soil series within an impervious site segment. However, the soil series of the impervious segment must be specified if a proposed groundwater recharge BMP will be located within or below it (e.g., a stone-filled infiltration trench below a parking lot). As noted in 1 above, the soil series is necessary in order to accurately compute the performance and/or required size of the proposed BMP.

- Finally, as noted above, see the guidelines in the New Jersey Groundwater Recharge Spreadsheet (NJGRS) section of Chapter 6 for further assistance in selecting appropriate segment limits and TR-55 land cover descriptions for post-developed site conditions.

  NOTE: Soil series selected for the impervious areas in the Post-Developed Conditions table are automatically displayed in orange, signifying that they have no effect on the site's natural annual recharge calculation (i.e., recharge set to zero for all land segments classified as "Impervious areas" regardless of the soil type), but that they can affect the artificial annual recharge volume of any groundwater recharge BMP set below them.

- Once the user has completed inputting all land segment information in the table for the Post-Developed Conditions, once again check the total project area (Cell I21) to ensure that the total post-development project area is correct.

  NOTE: If the total area in the Post-Developed Conditions is different from the total area in the Pre-Developed Conditions, a warning message will appear to the right of the total Post-Developed project area (Cell J21).

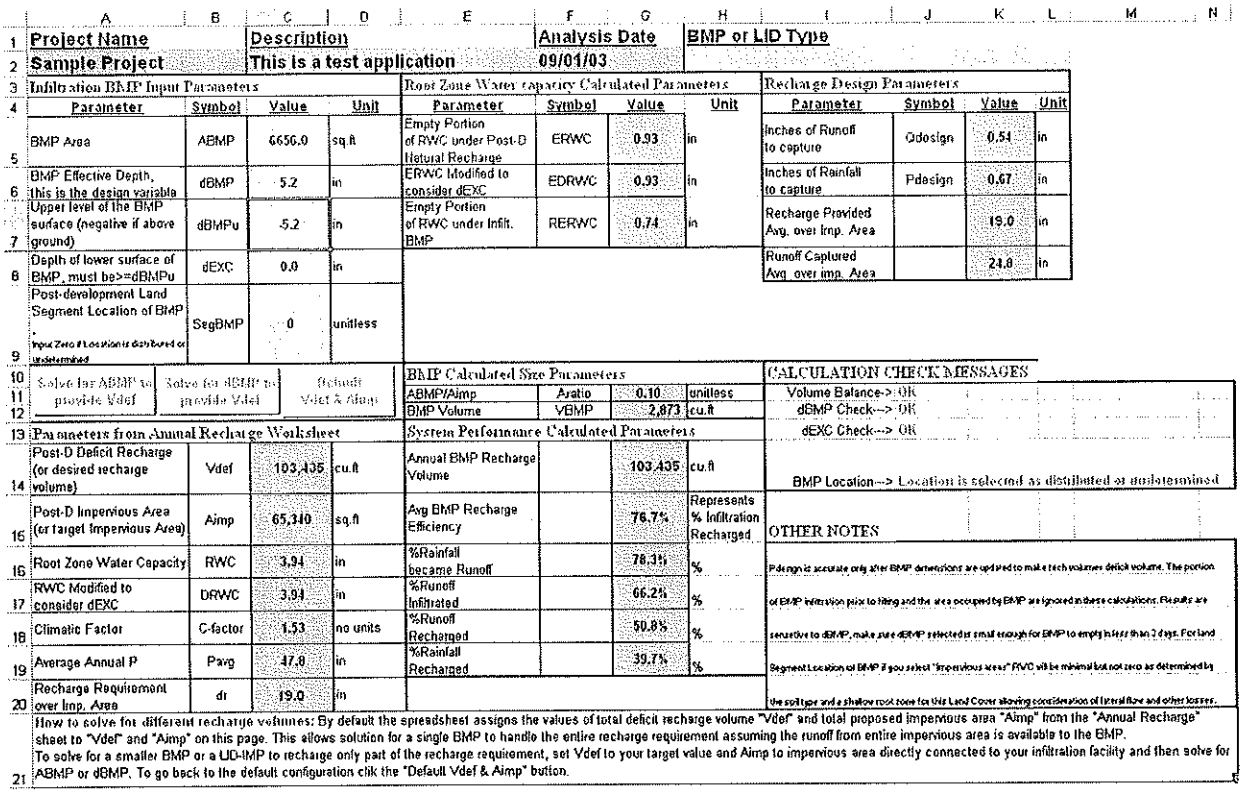
- As an additional check, the total impervious area (in square feet) under Post-Developed conditions will be shown at the bottom right of this table (Cell M23). Please note that this value reflects only those impervious areas specified as separate project segments and does not include any impervious areas within those segments specified by the standard TR-55 residential or urban land descriptions. The last two columns of this table show the naturally occurring average annual recharge depth (in inches) and volume (in cubic feet) for each land segment. At the bottom of these columns (Cells L22 and M22), the average recharge depth (in inches) and the total annual recharge volume (in cubic feet) over the total area under Post-Developed Conditions is given. This number is also used later in the calculation of any Post-Development recharge deficit.
- Immediately below the Post-Developed Conditions table is the Annual Recharge Requirements Calculation section. The user needs to input the "percent of Pre-Developed Annual Recharge to Preserve" (Cell K23) to set the percentage of the recharge under Pre-Developed Conditions that must be maintained under the Post-Developed Conditions. The NJDEP Stormwater Management Rules at N.J.A.C. 7:8 currently requires this value to be 100 percent, which is the spreadsheet's default value. The spreadsheet then computes the difference between the total annual recharge volumes for Pre- and Post-Developed Conditions and multiplies it by the "percent of Pre-Developed Annual Recharge to Preserve." The resulting value is shown as the "Post-Development Annual Recharge Deficit" in the worksheet (Cell K24). This amount is 103,435 cubic feet in the case of the example in Figure 1. This is the volume of groundwater recharge that must be artificially recharged under Post-Developed Conditions annually through groundwater recharge BMPs.
- The "Recharge Efficiency Parameter Calculations" table shown below the "Post-Development Annual Recharge Deficit" show the parameters calculated by this worksheet that are later used in the BMP Calculations worksheet.

  NOTE: The Appendix to this guide provides the basic equations and defines the variables used in Recharge Efficiency Parameter Calculations.

Part 2: Using the BMP Calculations Worksheet

This worksheet allows the proper sizing of groundwater recharge BMPs to provide the desired or required volume of annual groundwater recharge. Alternatively, it can be used to evaluate the performance of a user-specified recharge BMP. As described in Chapter 2, groundwater recharge BMPs can also be referred to as Low Impact Development BMPs (or LID-BMPs), depending on their size and location in the project site.

Figure 2: Screen Capture from the BMP Calculations Worksheet



	A	B	C	D	E	F	G	H	I	J	K	L
1	Project Name		Description			Analysis Date		BMP or LID Type				
2	Sample Project		This is a test application			09/01/03						
3	Infiltration BMP Input Parameters				Root Zone Water capacity Calculated Parameters				Recharge Design Parameters			
4	Parameter	Symbol	Value	Unit	Parameter	Symbol	Value	Unit	Parameter	Symbol	Value	Unit
5	BMP Area	ABMP	6656.0	sq.ft	Empty Portion of RWC under Post-D Natural Recharge	ERWC	0.93	in	Inches of Runoff to capture	Qdesign	0.54	in
6	BMP Effective Depth, this is the design variable	dBMP	5.2	in	ERWC Modified to consider dEXC	EDRWC	0.93	in	Inches of Rainfall to capture	Pdesign	0.67	in
7	Upper level of the BMP surface (negative if above ground)	dBMPu	-5.2	in	Empty Portion of RWC under Infilt. BMP	RERWC	0.74	in	Recharge Provided Avg. over Imp. Area		19.0	in
8	Depth of lower surface of BMP, must be>=dBMPu	dEXC	0.0	in					Runoff Captured Avg. over imp. Area		24.8	in
9	Post-development Land Segment Location of BMP. Input Zero if Location is distributed or undetermined	SegBMP	0	unitless								
10	Solve for ABMP to provide Vdef	Solve for dBMP to provide Vdef	Default Vdef & Aimp		BMP Calculated Size Parameters				CALCULATION CHECK MESSAGES			
11					ABMP/Aimp	Aratio	0.10	unitless	Volume Balance--> OK			
12					BMP Volume	VBMP	2,873	cu.ft	dBMP Check--> OK			
13	Parameters from Annual Recharge Worksheet				System Performance Calculated Parameters				dEXC Check--> OK			
14	Post-D Deficit Recharge (or desired recharge volume)	Vdef	103,435	cu.ft	Annual BMP Recharge Volume		103,435	cu.ft	BMP Location--> Location is selected as distributed or undetermined			
15	Post-D Impervious Area (or target Impervious Area)	Aimp	65,340	sq.ft	Avg BMP Recharge Efficiency		76.7%	Represents % Infiltration Recharged	OTHER NOTES			
16	Root Zone Water Capacity	RWC	3.94	in	%Rainfall became Runoff		78.3%	%	Pdesign is accurate only after BMP dimensions are updated to make tech volumes deficit volume. The portion			
17	RWC Modified to consider dEXC	DRWC	3.94	in	%Runoff Infiltrated		66.2%	%	of BMP infiltration prior to filling and the area occupied by BMP are ignored in these calculations. Results are			
18	Climatic Factor	C-factor	1.53	no units	%Runoff Recharged		50.8%	%	sensitive to dBMP, make sure dBMP selected is small enough for BMP to empty in less than 3 days. For land			
19	Average Annual P	Pavg	47.8	in	%Rainfall Recharged		39.7%	%	Segment Location of BMP if you select "impervious areas" RWC will be minimal but not zero as determined by			
20	Recharge Requirement over Imp. Area	dr	19.0	in					the soil type and a shallow root zone for this Land Cover allowing consideration of lateral flow and other losses.			
21	How to solve for different recharge volumes: By default the spreadsheet assigns the values of total deficit recharge volume "Vdef" and total proposed impervious area "Aimp" from the "Annual Recharge" sheet to "Vdef" and "Aimp" on this page. This allows solution for a single BMP to handle the entire recharge requirement assuming the runoff from entire impervious area is available to the BMP. To solve for a smaller BMP or a LID-IMP to recharge only part of the recharge requirement, set Vdef to your target value and Aimp to impervious area directly connected to your infiltration facility and then solve for ABMP or dBMP. To go back to the default configuration clik the "Default Vdef & Aimp" button.											

- Figure 2 is a screen capture from a portion of the BMP Calculations worksheet. While most of the calculations in this worksheet are performed in a separate worksheet, the portion shown in Figure 2 can be studied to understand the worksheet usage. There are several sections and solve buttons in this part of the worksheet, as explained below.

  NOTE: The three entries for Project Name, Description and Analysis Date are automatically copied from the Annual Recharge Sheet to the top of this sheet. The user can optionally input information regarding Groundwater Recharge BMP type.

Recharge BMP Input Parameters

- The user may start by inputting an initial value for the BMP surface area in square feet (variable ABMP) in Cell C5. In the NJGRS program, the variable ABMP is used in conjunction with the size of the recharge BMP's drainage area to determine the depth of stored runoff in the BMP resulting from a specific rain event. If a specific recharge BMP is being analyzed, ABMP will be based on the

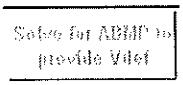
actual area of the BMP. If the spreadsheet is being used to determine the required recharge BMP dimensions, this value should be an initial estimate of the required surface area to satisfy the Post-Developed Recharge Deficit volume. This deficit volume (variable Vdef) is shown in Cell C14 and is either user-specified or, by default, taken from the Post-Development Annual Recharge Defici computed on the Annual Recharge worksheet (Cell K24).

- Next, a value for the recharge BMP's effective storage depth (variable dBMP) must be specified in inches in Cell C6. In the NJGRS program, dBMP represents the maximum equivalent water depth that can be achieved in the BMP before overflow begins. Therefore, if the proposed recharge BMP will, for example, be a subsurface, vertical-walled chamber, dBMP will simply be the maximum achievable depth before the chamber is full and overflow occurs. However, if the proposed BMP will be filled with broken stone or other suitable material, dBMP will be the product of the BMP's actual or physical depth and the void ratio of the fill. For recharge BMPs that consist of a combination of filled and open areas (e.g., a perforated pipe within a stone filled trench) or for irregular, nonrectangular BMP shapes (e.g., a perforated elliptical pipe or an infiltration basin with sloping sides), dBMP can be computed by dividing the BMP's total storage volume by its surface area.
- Just like the BMP surface area variable ABMP, the dBMP value entered for effective storage depth can be either a given value for a specific recharge BMP or an initial guess for a BMP to be sized by the spreadsheet. If this second option is selected, the user should remember that the resultant dBMP computed by the program may or may not be its actual or physical depth, depending on whether the BMP uses broken stone or other media in which to store runoff.
- In addition to dBMP, the user must also provide two additional recharge BMP depths. In Cell C7, the variable dBMPu is the vertical distance from the vegetated ground surface to the maximum water level of the BMP. This value should be positive if the maximum level is below the ground surface and negative if above the vegetated ground surface. In Cell C8, the variable dEXC is the vertical distance from the vegetated ground surface to the bottom of the BMP. For example, if the top of a 36-inch deep stone-filled infiltration trench (void ratio = 0.33) is located 24 inches below ground level, dBMPu would be 24 inches and dEXC would be 60 inches (i.e., dBMPu plus the 36-inch actual or physical depth of the trench). Remember, however, that since the trench is filled with gravel, the effective BMP depth (dBMP) would be 12 inches (i.e., 36 inches times 0.33). Using the dBMPu and dEXC variables, virtually all types of recharge BMPs can be specified, including "above the surface," "semi-buried," and "completely buried" BMPs. See Figure 6-4 for additional examples of dBMPu and dEXC.
- The next input cell on the BMP Calculations worksheet is the variable segBMP (Cell C9). This variable represents the post-developed site segment (as specified on the Annual Recharge worksheet) in which the proposed recharge BMP will be located. For example, if the recharge BMP is proposed to be built in Land Segment 3 in the Post-Developed Conditions table shown in Figure 1, then enter 3 for segBMP on the BMP Calculations worksheet.

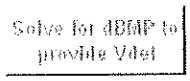
  NOTE: Input zero for segBMP if the location of the BMP is still undetermined or a series of identical BMPs will be distributed over multiple site segments.

- The last input cell on the BMP Calculations worksheet is the variable Aimp (Cell C15). Similar to the variable Vdef in Cell C14, Aimp is either user-specified or, by default, taken from the Total Impervious Area computed on the Annual Recharge worksheet (Cell M23).

- Once values and/or initial guesses are entered in the input cells, either of two solve buttons can be used to solve the design problem. These buttons are described below.



NOTE: Click this button to automatically evaluate the value of ABMP that provides Vdef given all other input values.



NOTE: Click this button to automatically evaluate the value of dBMP that provides Vdef given all other input values.

If the initial guess values you enter for ABMP or dBMP are drastically off from what is needed to satisfy Vdef (i.e., too small or too big, too shallow or too deep), the program may not be able to find the right answer. You can tell the answers are not acceptable because negative values or division by zero signs will show up. If this happens just change your ABMP and/or dBMP values to more realistic numbers and solve the problem again.

- It is important to remember that, by default, the spreadsheet takes the values computed on the Annual Recharge worksheet for the Post-Development Recharge Deficit Volume (Cell K24) and the Total Impervious Area (Cell M23) and specifies them as initial values on the BMP Calculations worksheet for the Post-Development Deficit Recharge (variable Vdef in Cell C14) and Post-Development Impervious Area (variable Aimp in Cell C15). This allows solution of the site's total recharge deficit by a single groundwater recharge BMP that will receive runoff from the site's entire impervious area. However, in many instances, the single groundwater recharge BMP will receive runoff from only a portion of the site's impervious area (e.g., only roof runoff). In such cases, the user must specify the exact size of Aimp (impervious area to the BMP) in Cell C15. Failure to do this for such BMPs will result in an overestimation of the amount of runoff captured by the BMP and erroneous BMP dimensions and/or recharge amounts.
- At other sites, it may be necessary or desirable to utilize more than one groundwater recharge BMP to meet the site's recharge requirements. In such cases, each BMP will not only receive runoff from a portion of the site's impervious surface, but each will also seek to provide only a portion of the site's total recharge deficit. In such cases, the user must specify both the exact Aimp and Vdef (Post-Development Deficit) for each BMP in Cells C14 and 15 of the BMP Calculations worksheet. *IMPORTANT: In such cases, the user* must *also use a separate NJGRS spreadsheet for each BMP. Using multiple copies of the BMP Calculations worksheet within a single spreadsheet can yield erroneous results.*

NOTE: These procedures area also summarized in a note at the bottom of the BMP Calculations worksheet.



NOTE: Click this button to retrieve the initial, default values of Vdef and Aimp from the Annual Recharge worksheet.

- Similar to the Annual Recharge worksheet, the user-input cells in the BMP Calculations worksheet are tan colored. This includes the cells for Vdef and Aimp so that they can be altered from their default values by the user. As described above, these cells are initially assigned default values from the Annual Recharge worksheet so the user does not have to input values for certain sites and BMPs. All gray colored cells are used to show calculation results or internal validity checks and must *not* be changed by the user.

NOTE: Remember that the default configuration assumes that the runoff from the site's entire impervious area (set by specifying one or more land segments to "Impervious Areas" on the Annual Recharge worksheet) will drain to the BMP. If only a portion of this impervious area will do so, the correct impervious area must be specified for Aimp (Cell C15) on the BMP Recharge worksheet.

- The values shown in Figure 2 above are the final results obtained by solving for ABMP (with a constant dBMP of 5.2 inches) to satisfy the entire annual recharge deficit of 103,435 cubic feet (which is the default Vdef value from the Annual Recharge worksheet). The user can tell the results are correct by comparing the calculated Annual BMP Recharge Volume amount in Cell G14 (under the "System Performance Calculated Parameters" heading) with the Vdef amount in Cell C14. In addition, the user can see that the volume balance is shown to be "OK" (Cell J11) in the "Calculation Check Messages" section.

Parameters from Annual Recharge Worksheet

- This section of the BMP Calculations worksheet contains various parameters initially computed in and then transferred from the Annual Recharge worksheet. As noted above, the initial values for Vdef (Cell C14) and Aimp (Cell C15) are taken from the Post-Development Recharge Deficit Volume (Cell K24) and the Total Impervious Area (Cell M23) on the Annual Recharge worksheet. A complete description of when the user must specify other values for these parameters is presented above. The values for Root Zone Water Capacity (variable RWM in Cell C16) and RWC Modified to Consider dEXC (variable DRWC in Cell C17) are automatically adjusted to reflect the user's choice for the excavation depth (variable dEXC) of the BMP. The values for Climatic Factor (variable C-Factor in Cell C18) and Average Annual P (variable Pavg in Cell C19) are constant values for the municipality selected in Cell C3 of the Annual Recharge worksheet. It is important to note that if the user wishes to analyze a site in a different municipality, the user must go back to the Annual Recharge worksheet and change the municipality's name in order to obtain the correct C-Factor and Pavg values on the BMP Calculations worksheet.

  WARNING: By changing the municipality, you also change the site's annual recharge deficit.

- The final value shown in this section of the BMP Calculations worksheet is the Recharge Requirement over Impervious Area (variable dr in Cell C20). This value is the average depth of annual recharge in inches over the impervious area (Aimp) specified (either by default or the user) in Cell C15. The value of dr is calculated by dividing Vdef by Aimp.

Root Zone Water Capacity Calculated Parameters

- This section of the BMP Calculations worksheet contains the calculated results for three root zone water capacity parameters. These values are needed for estimating the recharge efficiency of the groundwater recharge BMP under consideration. These parameters enable the NJGRS spreadsheet to estimate what portion of the infiltrated water from the BMP will travel downward below the root zone of the surrounding vegetation. As described above, this degree of water movement is the technical definition of groundwater recharge. The values of these three root zone water capacity parameters are automatically adjusted for the municipality and LULC segment in which the BMP is to be located. If the variable segBMP (Cell C9) is set to zero, weighted averages of these three parameters are utilized based on all the land segments specified on the Annual Recharge worksheet.

  NOTE: See the Appendix to this guide for more information about these three root zone water capacity parameters.

BMP Calculated Size Parameters

- This section of the BMP Calculations worksheet contains values for two recharge BMP design parameters. The parameter Aratio (Cell G11) is computed by dividing the area (ABMP) of the BMP by the impervious area (Aimp) draining to it. The parameter VBMP (Cell G12) is the maximum storage volume in the BMP. It is computed by multiplying the BMP area (ABMP) by its effective depth (dBMP). These values can be checked by the user to help ensure that the ABMP, Aimp, and dBMP values have been inputted and used correctly by the NJGRS spreadsheet.

System Performance Calculated Parameters

- This section of the BMP Calculations worksheet contains various calculated BMP performance values. Of these, the Annual BMP Recharge Volume value (Cell G14) is the most important, since it must match the Post-Development Deficit Recharge value (variable Vdef in Cell C14) for the BMP to completely satisfy the site's annual recharge deficit or target recharge volume (as described above).
- The next parameter, Average BMP Recharge Efficiency (Cell G15), specifies the percentage of infiltrated water that is recharged (i.e., travels below the root zone) over an average year. This efficiency depends on many factors, including the project location, land cover, soil types, BMP dimensions, and depth of BMP. For the example shown in Figure 2 above, the recharge efficiency of the selected BMP is 76.7 percent.
- The remaining performance values in this section (Cells G16 to G19) are self-explanatory.

Recharge Design Parameters

- Inches of Runoff to Capture (variable Qdesign in Cell K5) is the first value in this section of the BMP Calculations worksheet. This value is the minimum depth of runoff over the BMP's tributary impervious area that must be captured and directed to the BMP to allow it to meet the site's groundwater recharge deficit. Similarly, Inches of Rainfall to Capture (variable Pdesign in Cell K6) specifies the minimum depth of rainfall over the BMP's impervious area that must be similarly controlled by the BMP to meet the site's recharge deficit. This value is also the maximum event rainfall the BMP can store without overflowing and, therefore, is the design rainfall for the BMP as described above.
- The next parameter in this section, Recharge Provided Average over Impervious Area (Cell K7) is the total annual depth of groundwater recharge provided by the BMP. For a site's recharge deficit to be met, this value must equal the Recharge Requirement over Impervious Area (variable dr in Cell C20). Runoff Captured Average over Impervious Area (Cell K8) is the last parameter in this section. It is the total annual depth of runoff over the impervious area tributary to the BMP that infiltrates into the ground. As such, it does not contain that part of the impervious area runoff to the BMP that overflows from the BMP during rainfall events greater than the BMP's design rainfall (Pdesign).

Calculation Check Messages

- This section the BMP Calculations worksheet provides three important messages to check the validity of the computed results. The Volume Balance message (Cell J11) is a check of the Annual BMP Recharge Volume in Cell G14 against the Post-Development Deficit Recharge (variable Vdef in Cell C14). If these values are equal, the problem is solved successfully and the message in this section should read "OK." However, if the BMP's annual recharge volume does not equal Vdef, the message instructs the user to continue to solve the problem. This may also occur if the user changes any of the BMP design parameters and forgets to solve the problem by clicking on any of the two solve buttons described above.
- The dBMP Check message (Cell J12) checks the validity of the value inputted for the dBMP, the BMP's effective depth in Cell C6. If this value is greater than the difference between the depths to the BMP's upper and lower surfaces (variables dBMPu and dEXC in Cells C7 and C8, a warning message is issued telling the user to adjust dBMP. dEXC Check (Cell J13) is the third message. It checks the validity of dEXC to make sure it is larger than dBMPu. If it is not, a message will appear instructing the user to make dEXC larger than dBMPu.
- Below these messages is a report on the location of the BMP as specified by the user in Cell C9 (variable segBMP). If the user has entered a valid segment number for segBMP, the message will read "OK." If the user enters a zero for segBMP, the message will read "Location is selected as distributed or undetermined." However, if the user enters a land segment number that was not previously defined in the Annual Recharge worksheet under Post-Developed Conditions, the message will say "Land Segment Number Selected for BMP is not Defined." The user should then make appropriate corrections to segBMP.

Other Notes

- This section of the BMP Calculations worksheet contains notes regarding the assumptions and limitations of the calculations in this worksheet. In the current version of the spreadsheet, these notes refer to the following aspects of spreadsheet use:
    1. The variable Pdesign (Cell K6) is accurate only after the BMP's annual recharge volume (Cell G14) is equal to the site's recharge deficit (variable Vdef in Cell C14). In addition, Pdesign is computed from the results of the BMP's performance. It is not used to compute that performance.
    2. A recharge BMP results are sensitive to its effective depth (dBMP in Cell C6). The user must ensure that the selected dBMP is small enough for the BMP to empty in less than 72 hours.
    3. If a BMP is located within an impervious Post-Development land segment, the Root Zone Water Capacity (variable RWC in Cell C16) at the BMP will be minimal, but not zero. This allows consideration for lateral flow and other losses at the BMP.

A P P E N D I X

Basic Equations and Variables Used in Recharge Efficiency Parameters Calculations

Basic Equations for Soil Water Capacity

A. Equation from GSR-32:

RWC = Root Depth x AWC (1)

RWC: Root Zone Water Capacity, (inch)

AWC: Available Water Capacity, (inch/ft)

B. New Equation:

ERWC = (1-0.5 x C-Factor) x RWC (2)

ERWC: Empty Root Zone Water Capacity under natural recharge, (inch)

C-Factor: Climate Factor = Ratio of precipitation to potential ET, (unitless)

Range of Values in NJ: RWC: (0.3, 14.35), C-Factor: (1.18-1.83)

ERWC: (0.02, 5.88)

Infiltration and Artificial Recharge under BMP or LID-IMP

$$\text{Average Annual Total Infiltration Depth} = \sum_{i=1}^{n} \text{Minimum } (Qi/Aratio, dBMP) \quad (3)$$

n = total number of runoff producing precipitation events in an average year

Aratio = Ratio of surface area of BMP (ABMP) to the impervious surface area served by the BMP (Aimp), unitless.

Find Average Empty RWC under Infiltration Facility

A. Modification to account for the buried depth of the facility

We know that dBMPb = dEXC- Max(0,dBMPu);

We can define the following relationship:

DRWC = Max {0, Root Depth- 0.5 dBMPb - (dEXC- dBMPb)} AWC

which can be simplified to:

DRWC = Max (0, Root Depth- dEXC+ 0.5 dBMPb) AWC (4)

DRWC = Root zone water capacity under BMP modified for the buried portion of the BMP and calculated over all land segments, (inch)

B. Define the empty portion of EDRWC

EDRWC = (1- 0.5 x C-Factor) x DRWC (5)

EDRWC = Empty Portion of DRWC, (inch)

C. Account for the effect of moisture supplied by infiltration facility in reduction of empty portion of root zone

$$REavg = (1/n) \sum_{i=1}^{n} \text{Maximum } (EDRWC - infi) \quad (6)$$

REavg = DRWC modified to account for infiltration under BMP, (inch)

infi = Infiltration depth in BMP during "i"th event (inch)

$$RERWC = (n/365) \times REavg + [(365-n)/n] \times EDRWC \quad (7)$$

RERWC = Average empty root zone water capacity under BMP operation calculated for the average RWC of all land segments (inch)

$$RBMP = \sum_{i=1}^{n} \text{Maximum } (infi - RERWC, 0) \quad (8)$$

RBMP = Total infiltration depth under BMP during an average year, (inch)

$$\text{BMP Recharge Efficiency} = \frac{RBMP}{\sum_{i=1}^{n} infi} \quad (9)$$

In equations (8) and (9), results are very sensitive to C-Factor. As C-Factor increases, natural recharge increases and recharge deficit due to development increases. The NJGRS equations imply that if a development is constructed in an area of high natural recharge, the recharge efficiency of a BMP at the site would also be high. Therefore, the size of required recharge BMP should not be unduly large in areas with a large C-Factor.

The above parameters are calculated in the spreadsheet for each land segment as well as for the entire area (area weighted average) under Post-Developed Conditions. If the user specifies the location of the recharge BMP, the relevant parameters of the same land segment will be used. If the user does not specify the location, the average soil and loss factors based on all of the post-developed land segments specified on the Annual Groundwater recharge worksheet will be used.

References

American Society of Civil Engineers. 2001. Standard Guidelines for Artificial Recharge of Ground Water – EWRI/ASCE 34-01. Reston, Virginia.

Bouwer, H. 2002. Artificial Recharge of Groundwater: Hydrogeology and Engineering. Hydrogeology Journal (2002) 10:121-142.

deVries, J.J. and Simmers, I. 2002. Groundwater Recharge: An Overview of Processes and Challenges. Hydrogeology Journal (2002) 10:5-17.

Lerner, D.N. 2002. Identifying and Quantifying Urban Recharge: A Review. Hydrogeology Journal (2002) 10:143-152.

Linsley, R.K. Jr., Kohler, M.A., and Paulhus, J.L.H. 1975. Hydrology for Engineers. McGraw-Hill. New York.

Maryland Department of the Environment. 2000. 2000 Maryland Stormwater Design Manual – Volume I – Stormwater Management Criteria. Water Management Adminstration. Baltimore, MD.

Scanlon, B.R., Healy, R.W., and Cook, P.G. 2002. Choosing Appropriate Techniques for Quantifying Groundwater Recharge. Hydrogeology Journal (2002) 10:18-39.

Sophocleous, M. 2002. Interactions Between Groundwater and Surface Water: The State of the Science. Hydrogeology Journal (2002) 10:52-67.

USDA Natural Resources Conservation Service. National Engineering Handbook, Part 630, Hydrology.

USDA Natural Resources Conservation Service. June 1986. Technical Release 55 – Urban Hydrology for Small Watersheds.

Viessman, W. Jr., Knapp, J.W., Lewis, G. L., and Harbaugh, T.E. 1977. Introduction to Hydrology – Second Edition. Harper & Row. New York.

Zomorodi, K. 2002. Development of Groundwater Recharge and LID Computational Techniques for New Jersey. Dewberry & Davis, LLC. Fairfax, Virginia.

CHAPTER 7

Landscaping

Landscaping is critical to improving both the function and appearance of stormwater best management practices (BMPs). This chapter provides landscaping criteria and plant selection guidance for effective stormwater BMPs. Part 1 describes the natural plant communities of New Jersey based on plant hardiness zones and physiographic regions. Plant selection for stormwater BMPs should match as closely as possible the natural plant communities of that region. Part 2 outlines general guidance that should be considered when landscaping any stormwater BMP. Part 3 presents more specific guidance on landscaping criteria and plant selection for individual BMP designs described in Chapter 9. These include:

- constructed stormwater wetlands;
- infiltration basins and sand filter practices;
- bioretention systems;
- open channels;
- vegetative filters and forested buffers;
- wet ponds; and
- extended detention basins.

Part 4 considers plant acquisition and planting guidelines. Part 5 deals with other plant considerations, such as vegetation maintenance, invasive species, plant availability, and costs.[1]

Native Species

This manual encourages the use of native plants in stormwater management facilities. Native plants are defined as species that evolved naturally to live in this region. Practically speaking, this specifically refers to species that lived in New Jersey before Europeans explored and settled in America. Many introduced species were weeds brought in by accident; others were intentionally introduced and cultivated for use as medicinal herbs, spices, dyes, fiber plants, and ornamentals.

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[1] Parts of this chapter were adopted directly from the 2000 Maryland Stormwater Design Manual (Schueler and Claytor 2000). The chapter also contains material added and adapted to the physiography, plant life, and growing conditions of New Jersey.

Introduced species often escape cultivation and begin reproducing in the wild. This is significant ecologically because many introduced species out-compete or even replace indigenous species in the wild. Some introduced or aggressive species are invasive, have few predators, and can take over naturally occurring species at an alarming rate. These include reed canary grass (Phalaris arundinacea), phragmites (Phragmites communis), kudzu (Pueraria spp.), purple loosetrife (Lythrum salicara), Norway maple (Acer platanoides), autumn olive (Elaeagnus umbellata), Japanese honeysuckle (Lonicera japonica), Japanese rose (Rosa muliflora), garlic mustard (Alliaria officinalis), birdsfoot trefoil (Lotus corniculatus), lesser celandine (Ranunculus ficaria), and cattail (Typha latifolia). By planting non-aggressive, native species in stormwater management facilities, we can protect New Jersey's natural heritage, encourage biodiversity, and provide a legacy for future generations.

Note: Although both phragmites and cattails can be invasive, they also provide water quality and some wildlife benefits. These species should not necessarily be recommended and, if they do appear on site, it is questionable whether a considerable amount of effort or money should be spent controlling or eradicating these species.

Native species have distinct genetic advantages over non-native species for planting in New Jersey. Because they have evolved to live here naturally, indigenous plants are best suited for our local climate. This translates into greater survivorship and less replacement maintenance during the life of a stormwater management facility. Both of these attributes provide cost savings for facility owners.

Finally, people often plant exotic species for their ornamental value. While it is important to plant aesthetic stormwater management facilities for public acceptance and maintenance of property value, it is not necessary to introduce foreign species for this purpose. Many native species can be used as ornamentals. The following species are part of New Jersey's natural heritage and provide high aesthetic value throughout the year: rhododendron (Rhododendron maximum), pink azalea (Rhododendron nudiflorum), red maple (Acer rubrum), pin oak (Quercus palustris), sycamore (Platanus occidentalis), flowering and shrub dogwoods (Cornus spp.), mountain laurel (Kalmia latifolia), willow (Salix spp.), white pine (Pinus strobus), Atlantic white cedar (Chamaecyparis thyoides), American holly (Ilex americana), swamp rose (Rosa palustris), sunflowers (Helianthus spp.), lobelias (Lobelia spp), pickerel weed (Pontederia cordata), swamp rose mallow (Hibiscus moscheutos), and yellow pond lily (Nuphar avena).

When selecting ornamentals for stormwater management facilities, planting preference should be given to native ornamentals. Refer to the plant lists in Part 5 for a list of native species available for stormwater management facility planting.

Part 1: Natural Plant Communities of New Jersey

Plant Hardiness Zones

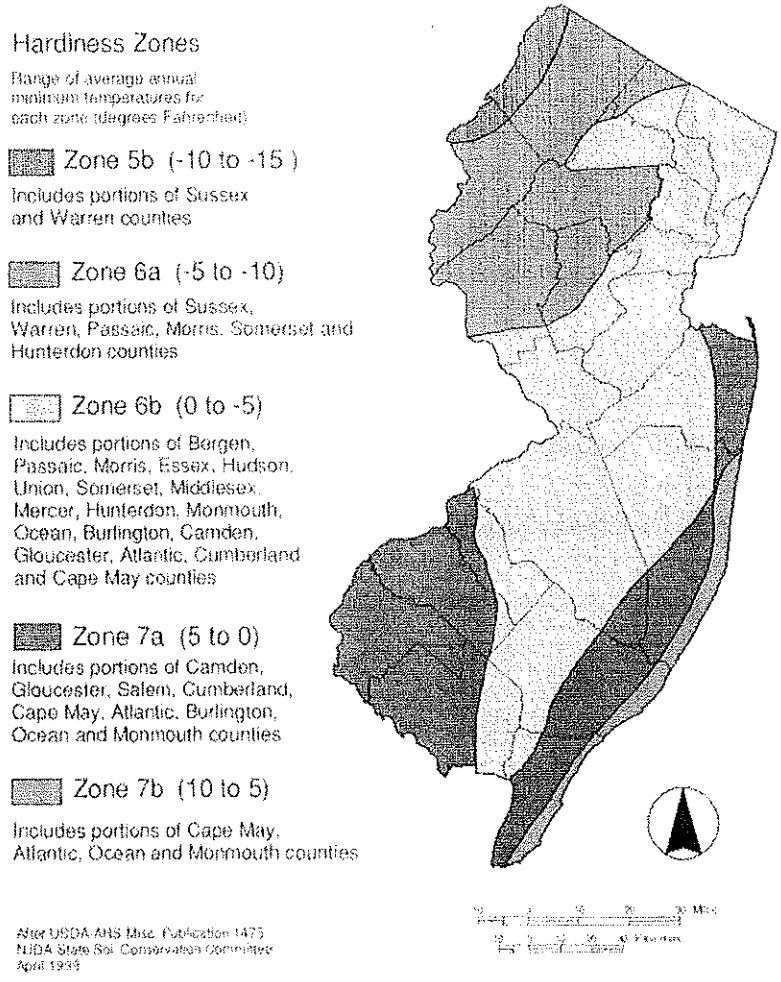
Hardiness zones are based on historical annual minimum temperatures recorded in an area. A BMP's location in relation to plant hardiness zones is important because plants differ in their ability to withstand very cold winters. This does not imply that plants are not affected by summer temperatures; New Jersey summers can be very hot, and heat tolerance should be considered in plant selection as well.

It is best to recommend plants known to thrive in specific hardiness zones. The plant list included at the end of this chapter identifies the hardiness zones for each species listed as a general planting guide. It should be noted, however, that certain site factors can create microclimates or environmental conditions that permit the growth of plants not listed as hardy for that zone. By investigating numerous references and using personal experience, a designer should be able to confidently recommend plants that will survive in microclimates.

Table 7-1: USDA Hardiness Zones for New Jersey

Zone		USDA Minimum Temperature
Temperate Zone 5	a	-20 to -15
	b	-15 to -10
Temperate Zone 6	a	-10 to -5
	b	-5 to 0
Temperate Zone 7	a	0 to 5
	b	5 to 10

Figure 7-1: USDA Plant Hardiness Zones' Average Annual Minimum Temperature (New Jersey)



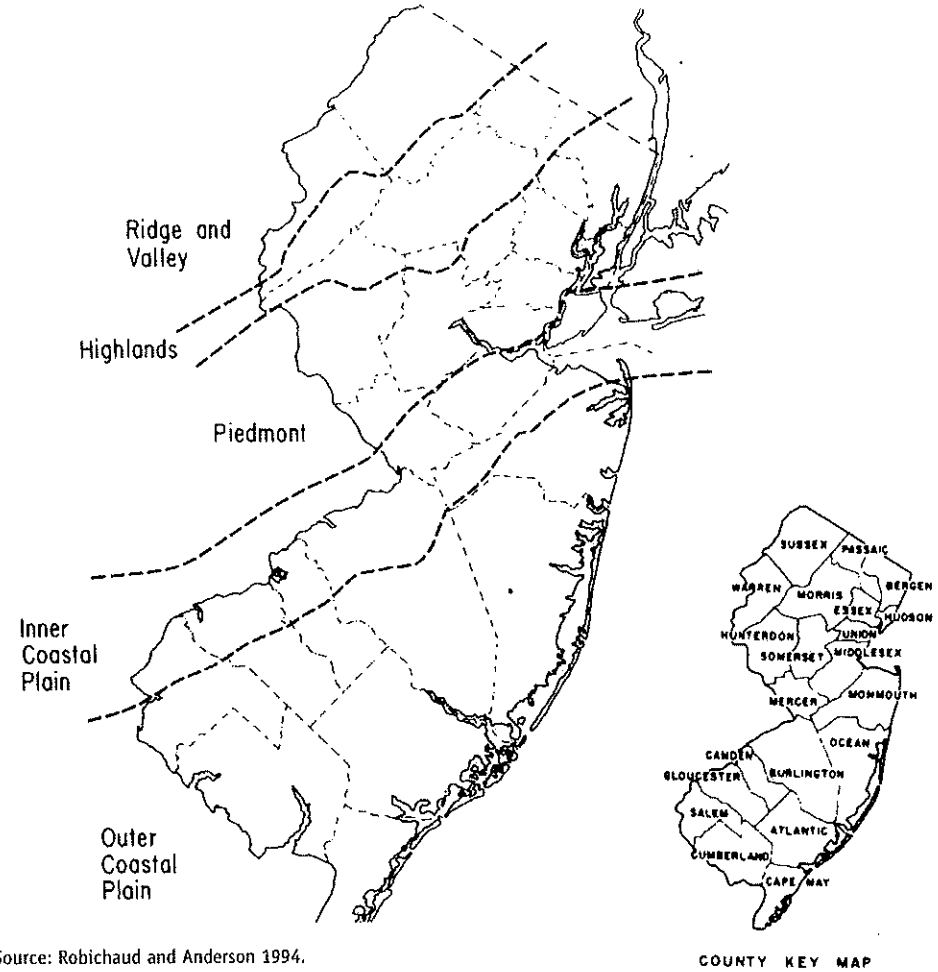
This figure can be viewed in color in the PDF version of this chapter available at http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

Physiographic Provinces

New Jersey's five physiographic sections describe distinct geographic regions in the state with similar physical and environmental conditions (Figure 7-2). These physiographic provinces include, from west to east, the Ridge and Valley, Highlands, Piedmont, Inner Coastal Plain, and Outer Coastal Plain. Each physiographic region is defined by unique geological strata, soil type, drainage patterns, moisture content, temperature, and degree of slope, which often dictate the predominant vegetation. Because the predominant vegetation has evolved to live in these specific conditions, a successful stormwater management facility planting design can be achieved through mimicking these natural associations.

The five physiographic regions are described below with associated vegetation listed for general planting guidance. [2] For more detailed information and plant listings, please refer to Plant Communities of New Jersey (Robichaud and Anderson 1994).

Figure 7-2: The Five Physiographic Sections of New Jersey



Source: Robichaud and Anderson 1994.

[2] These descriptions were adapted, in part, from Robichaud and Anderson 1994, and Robichaud and Buell 1973.

Ridge and Valley Section

The Ridge and Valley physiographic province in the northwestern corner of New Jersey covers 635 square miles or about 7 per cent of the total land in New Jersey. It occupies a large part of Warren and Sussex counties. Ridges and valleys occur in this section because parent rock formations underlying the ridges and the valleys differ. Softer rocks such as limestone and shale erode faster than the more resistant sandstone and conglomerates. The lowest valley levels occur wherever limestone underlies the surface; the areas of shale, a slightly more resistant rock, are about 200 to 400 feet higher than the limestone, and ridges occur wherever the bedrock material is more resistant to erosion, such as sandstone or conglomerate rock.

Differences in parent rock material not only account for the variation in relief, but also create contrasts in the kind and amount of soil coverage. In general, the soil covering the Kittatinny and other ridges in this section is poor in quality from the standpoint of vegetation. The soil layer is thin on the ridges, with bedrock exposed in many places. Also, the ridge soil tends to be very acidic and of low fertility and, often, very stony.

In contrast, the soils in the valleys, derived from limestone and shale that were covered by glacial till, are for the most part deeper, more fertile, and well drained. Peat or large muck deposits (thick layers of organic material) may occur where shallow glacial lakes once existed. These were later invaded by vegetation, the dead remains of which accumulated as peat or muck.

Highlands Section

The Highlands physiographic province is located southeast of the Ridge and Valley section and covers about 900 square miles or approximately 12 per cent of New Jersey's land area. As shown in Figure 7-2, this section is broader at the north, where it is about 20 miles wide; at its southern end bordering the Delaware River Valley, it is only 10 miles wide. The Highlands region also has parallel ridges and valleys, but these differ from the Ridge and Valley section in the type of parent rock underlying the surface. Also, the ridges are more massive and generally much broader, while the valleys are narrower and have steeper slopes. Frequent rock outcroppings occur. Glacially formed lakes, such as Lake Hopatcong and Green Pond, contrast with adjacent ridges to make the Highlands a very scenic area of New Jersey.

The geologic formations of the Highlands region are estimated to be approximately 1 billion years old. Elevations in the northern part of the basin in the Highlands average approximately 1,000 feet above mean sea level, while the southern part of the Highlands show valley contours reaching a low of 350 feet. Ridges of the Highlands have resisted erosion due to the very hard rock, sandstone, gneiss, granite, marble, quartzite, igneous, and metamorphic material of which they are made. Highland valleys consist of much softer materials of limestone or shale, making them less resistant to erosion. The soils of the Highlands have been weathered from glacial till deposits and eroding bedrock and are generally shallow and stony, with frequent rock outcrops.

Piedmont Section

The Piedmont physiographic province, which occupies about 21 per cent of New Jersey's land area, is composed mostly of shale, sandstone, and argillite formations that are typically red or brownish-red in color. These formations are less resistant to erosion than the adjacent Highland gneissic rock and so, in comparison to the Highlands, the Piedmont is actually a lowland. The Piedmont section slopes gently southeastward from about 400 feet above sea level at its northwestern margin, to an elevation less than 100 feet at its southern margin bordering the Delaware, and to sea level at Newark Bay. Flat in some areas, the Piedmont contour is slightly rolling with mostly gentle slopes; however, in some areas, rivers have cut rather steep-sided valleys.

Interestingly, in the Piedmont, several ridge formations tower over the adjacent lowlands – the three Watchung Mountains (850, 650, and 350 feet high), Cushetunk Mountain, the Sourlands, and the Palisades. These ridges are made of intrusive or extrusive lava material known as diabase and basaltic rocks, both of which are much harder than the shale and sandstone of the Piedmont. While the diabase and basalt have resisted erosion, the less resistant shale and sandstone have been worn down, resulting in the lower elevations.

Differences in rock formations, combined with the fact that glacial deposits of varying age covered only part of the Piedmont, have resulted in a variety of soil types within the area. These variations appear to be less important to vegetation than the variation of soil water drainage.

Exposed rock and soil at the surface of the Piedmont is the product of intense weathering of local bedrock and the influence that glacial ice sheets had on the landscape. Continuous cycles of freezing and thawing in the rocks and soils produced landform characteristics consisting of subsurface depressions and uneven ground. Boulder fields, like those found on the Rocky Hill Ridge, were heaved to the surface by the expanding and contracting of the permafrost during glacial periods. During the interglacial periods when the ice sheets retreated, massive loads of sediment were deposited in meltwater streams. Remnants of these outwash sediments formed thin, patchy deposits known as till on the surface of the Piedmont uplands. Riverbeds, stream valleys, and other lowlands were filled with glacial sediments, forming river terraces and wide outwash plains. Silt, clay, and fine sand deposits filled the bottoms of glacially formed lakes and ponds, which have since become swamps and meadows layered with peat and muck. Subsequent weathering and erosion have continued to shape and reshape the surface and produce the modern soil profile of the Piedmont.

Common Species of Ridge and Valley, Highlands, and Piedmont Sections

Tree Species	Understory
• Hickory • Chestnut oak • Scarlet oak • Scrub oak • White oak • Red oak • Black oak • Scrub pine • Pitch pine • Short leaf pine • White pine • Hemlocks • Beech • Black jack oak • Sugar maple	• Sweet fern • Flowering dogwood • Black haw • Chinquapin • Sassafras • Redbud • Mountain laurel • Blueberry • Fringe tree • Pink azalea • Spicebush • Maple-leaved arrowwood

Inner and Outer Coastal Plain Sections

The Inner and Outer Coastal Plain provinces are recognized by flat or gently rolling topography and elevations rising from sea level to a height of 373 feet. Coastal Plain marshes and swampy tidal flats occur throughout the New Jersey Coastal Zone. Sands, sandy loams, and silt loams resulting from sea deposits make up the soils of the Coastal Plain. The climate is mild and sometimes rainy, similar to that found further south. Because of low topographic relief and proximity to sea level, extensive swamp areas are common to the Coastal Plain province. Most notable are the Atlantic White Cedar swamps found in the Pinelands.

Common Species of the Inner and Outer Coaster Plain Sections

Tree Species	Understory
• Loblolly pine • Virginia pine • Pitch pine • Pond pine • Sweet gum • Willow oak • Water oak • Basket oak • Pin oak • Post oak • Spanish oak • Black cottonwood • Pale hickory • Bitternut hickory • Sweet bay • American holly • Beech • Tulip tree • River birch	• Blueberry • Huckleberry • Greenbrier • Sand blackberry • Beach plum • Beach heather • Bay berry • Sweet pepper bush • Azalea • Maleberry • Stagger bush • Fetter bush • Inkberry • Alder buckhorn

Floodplain Regions

Floodplains occur across New Jersey's physiographic provinces as low-lying areas adjacent to streams and rivers. Floodplain plant communities are similar across most of the state because of common soil characteristics governed by occasional flooding and high groundwater. Stormwater management facilities are often located in floodplains, and plant associations in these areas can provide valuable information for successful BMP plantings.

Common Species of Floodplain Regions

Tree Species	Understory
• River birch • Willows • Silver maple • Sweet gum • Sycamore • Box elder • Green ash • American elm • Swamp white oak • Basswood • Hackberry	• Shrub willows • Ninebark • Silky and redosier dogwoods • Sweet pepperbush • Buttonbush • Spicebush • Winterberry and inkberry holly • Elderberry • Alders

Three Hydrologic Zones

Before planting within a stormwater management facility, it is necessary to determine which hydrologic zones will be created. Hydrologic zones describe the degree to which an area is inundated by water. Plants have differing tolerances to inundation; as an aid to landscape designers, these tolerance levels have been divided into six zones for which corresponding plant species have been identified.

Part 4 includes a native plant list with appropriate hydrologic zones designated for each species. The hydrologic zones that are bracketed "[ ]" are where the plants tend to occur. There may be other zones listed outside of these brackets. These plants may occur in these zones, but are not typically found in them. On occasion, plants may be found outside of their hardiness and hydrologic zone. Plants tend to grow anywhere they can compete and survive. Additionally, hydrologic conditions in a stormwater management facility may fluctuate in unpredictable ways; thus, the use of plants capable of tolerating wide varieties of hydrologic conditions greatly increases a successful planting. Conversely, plants suited for specific hydrologic conditions may perish when hydrologic conditions fluctuate, expose the soil, and increase the chance for erosion.

Part 2: General Landscaping Guidance for all Stormwater BMPs

- Plant trees and shrubs at least 15 feet from a dam's toe of slope.
- Do not plant trees or shrubs known to have long taproots within the vicinity of earth dams or subsurface drainage facilities.
- Plant trees and shrubs at least 15 feet from perforated pipes.
- Plant trees and shrubs at least 25 feet from a riser structure.
- Provide 15-foot clearance from a non-clogging, low flow orifice.
- Herbaceous embankment plantings should be limited to 10 inches in height to ensure visibility for inspectors looking for burrowing rodents that may compromise the integrity of the embankment.
- Provide additional stabilization methods for slopes steeper than 2:1, such as turf reinforcement mats or erosion control blankets. Use seed mixes with quick germination rates in this area. Augment temporary seeding measures with container crowns or root mats of more permanent plant material.
- Use erosion control blankets and fabrics in channels that are subject to frequent wash-outs.
- Stabilize all emergency spillways with plant material that can withstand strong flows.
- Root material should be fibrous and substantial, but lack a taproot.
- Place sod in channels that are not stabilized by erosion control blankets.
- Divert flows temporarily from seeded areas until plants are stabilized.
- Check water tolerances of existing plant materials prior to inundating the area.
- Stabilize aquatic and safety benches with emergent wetland plants and wet seed mixes.
- Do not block maintenance access to structures with trees or shrubs.
- To reduce thermal warming, shade inflow and outflow channels as well as the southern exposure of ponds, when possible.
- Avoid plantings that will require routine or intensive chemical applications, i.e., turf areas.
- Have soil tested to determine whether amendments are needed.
- Indigenous plant species should be specified over exotic or foreign species because they are well adapted to local on-site soil conditions and require few or no additional amendments.
- Decrease the areas where turf is used. Use low-maintenance ground cover to absorb run-off.
- Plant riparian buffers with trees, shrubs, and native grasses, where possible, to stabilize banks and provide shade.
- Maintain and frame desirable views. Be careful not to block views at entrances, exits, or difficult road curves. Screen unattractive views into the site. Aesthetics and visual characteristics should be a prime consideration.
- Use plants to prohibit pedestrian access to pools or slopes that may be unsafe.
- Carefully consider the long-term vegetation management strategy for the BMP, keeping in mind the maintenance legacy for future owners. Keep maintenance areas and access free of vegetation to allow vehicle clearance. Provide a planting surface that can withstand compaction from vehicles using maintenance access roads. Make sure the facility maintenance agreement includes requirements that ensure vegetation cover in perpetuity.
- If a BMP is likely to receive excessive amounts of de-icing salt, salt tolerant plants should be used.
- Provide signage for stormwater management areas to help educate the public, and for wildflower areas, when possible, to designate limits of mowing.
- Avoid the overuse of any plant materials, e.g., maples.
- Preserve existing natural vegetation when possible.

Soil Preparation

It is necessary to test the soil in which you are about to plant in order to determine pH, whether acid, neutral, or alkaline; major soil nutrients, nitrogen, phosphorus, and potassium; and minerals such as chelated iron and lime.

Have soil samples analyzed by experienced and qualified individuals such as those at the Rutgers Cooperative Extension, who will explain the results in writing and recommend which soil amendments would be required. Certain soil conditions, such as marine clays (glauconite), can present serious constraints to the growth of plant materials and may require the guidance of qualified professionals. When poor soils cannot be amended, seed mixes and plant material must be selected to establish ground cover as quickly as possible.

Areas recently involved in construction can become compacted so that plant roots cannot penetrate the soil. Seeds will lie on the surface of compacted soils and are often washed away or eaten by birds. For planting success, soils should be loosened to a 4-inch depth. Hard soils may require discing to a deeper depth. The soil should be loosened regardless of the ground cover to improve seed contact with the soil, increase germination rates, and allow the roots to penetrate the soil. For areas to be sodded, discing is necessary so that roots can penetrate the soil. Good growing conditions can prevent poor vegetative cover, which saves money because vegetation will not need to be replanted.

Whenever possible, topsoil should be spread to a depth of 4 to 6 inches over the entire area to be planted. This provides organic matter and important nutrients for the plant material. The use of topsoil allows vegetation to become established faster and roots to penetrate deeper. This ensures quicker and more complete stabilization, making it less likely that the plants will wash out during a heavy storm.

If topsoil has been stockpiled in deep mounds for a long period of time, it is necessary to test the soil for pH as well as microbial activity. If the microbial activity has been destroyed, inoculate the soil after application.

Because newly installed plant material requires water to recover from the shock of being transplanted, be sure that a source of water is provided, especially during dry periods. This will reduce plant loss and provide the new plant materials a chance to establish root growth.

Part 3: Specific Landscaping Criteria for BMPs

It is important to recognize that plants typically found in wetlands may be cultivated in non-wetland conditions; hence the importance of obtaining plants cultivated in similar hydrologic and soil conditions as those present in the stormwater management facility. A plant typically found in wetlands, but cultivated in non-wetland conditions, may not survive if installed in wetland conditions.

Ponds and Constructed Wetlands

Before planting within a stormwater management facility, determine which hydrologic zones will be created. Hydrologic zones describe the degree to which an area is inundated by water. Plants have differing tolerances to inundation; the six zones described in this section will dictate which plants will survive where. Every facility does not necessarily exhibit all of these zones.

Table 7-2: Hydrologic Zones

Zone	Zone Description	Hydrologic Conditions
Zone 1	Deep water pool	1-6 feet deep permanent pool
Zone 2	Shallow water bench	6 inches to 1 foot deep
Zone 3	Shoreline fringe	Regularly inundated
Zone 4	Riparian fringe	Periodically inundated
Zone 5	Floodplain terrace	Infrequently inundated
Zone 6	Upland slopes	Seldom or never inundated

Zone 1: Deep Water Pool (1 to 6 feet)

Ponds and wetlands both have deep pool areas that comprise Zone 1. These pools range from 1 to 6 feet in depth and are best colonized by submergent plants, if at all. This pondscaping zone has not been routinely planted for several reasons: first, the availability of plant materials that can survive and grow in this zone is limited; and second, it is feared that plants could clog the stormwater facility outlet structure. In many cases, these plants will gradually become established through natural recolonization, i.e., transport of plant fragments from other ponds via the feet and legs of waterfowl. If submerged plant material becomes more commercially available and clogging concerns are addressed, this area can be planted. The function of the planting is to reduce resedimentation and improve oxidation while creating a greater aquatic habitat.

Select plants that can:

- withstand constant inundation of water of 1 foot or greater in depth;
- withstand being submerged partially or entirely;
- enhance pollutant uptake; and
- provide food and cover for waterfowl, desirable insects, and other aquatic life.

Suggested emergent or submergent species include, but are not limited to: spatterdock (Nuphar luteum), water lily (Nymphaea odorata), duckweed (Lemna spp.), duck potato (Saggitaria latifolia), wild celery (Vallisneria americana), sago pondweed (Potamogeton pectinatus), and redhead grass (Potamogeton perfoliatus).

Zone 2: Shallow Water Bench (6 inches to 1 foot)

Zone 2 includes all areas that are inundated below the normal pool to a depth of 1 foot; it is the primary area where emergent plants will grow in stormwater wetlands. Zone 2 also coincides with the aquatic bench found in stormwater ponds. This zone offers ideal conditions for the growth of many emergent wetland species. These areas may be located at the edge of the pond or on low mounds of earth below the surface of the water within the pond. When planted, Zone 2 can be an important habitat for many aquatic and non-aquatic animals, creating a diverse food chain that includes predators that provide natural regulation of mosquito populations, thereby reducing the need for insecticide applications.

Select plants that can:

- withstand constant inundation of water to depths between six inches and 1 foot deep;
- be partially submerged;
- enhance pollutant uptake; and
- provide food and cover for waterfowl, desirable insects, and other aquatic life.

Plants will stabilize the bottom and edge of the pond, absorbing wave impacts and reducing erosion when the water level fluctuates. In addition to slowing water velocities and increasing sediment deposition rates, plants can reduce re-suspension of sediments caused by the wind. Plants can also soften the engineered contours of the pond and conceal drawdowns during dry weather.

Appropriate herbaceous species include: water plantain (Alisma plantago-aquatica), three-sided sedge (Dulchium arundinaceum), managrasses (Glyceria spp.), soft rush (Juncus effusus), arrow arum (Peltandra virginica), smartweeds (Polygonum spp.), pickerelweed (Pontederia cordata), lizard tail (Saururus cernuus), many bulrushes (Scirpus spp.), and giant bur-reed (Sparganium eurycarpum).

Zone 3: Shoreline Fringe (regularly inundated)

Zone 3 encompasses the shoreline of a pond or wetland and extends vertically about 1 foot from the normal pool. This zone may be periodically inundated if storm events are subject to extended detention. This zone occurs in a wet pond or shallow marsh and can be the most difficult to establish since plants must be able to withstand inundation of water during storms, when wind might blow water into the area, or the occasional drought during the summer. To stabilize the soil in this zone, Zone 3 must have a vigorous cover.

Select plants that can:

- stabilize the shoreline to minimize erosion caused by wave and wind action or water fluctuation;
- withstand occasional inundation of water, as plants will be partially submerged at times;
- shade the shoreline, whenever possible, especially the southern exposure, to help reduce water temperature;
- enhance pollutant uptake;
- provide food and cover for waterfowl, songbirds, and wildlife (large plants can be selected and located to control overpopulation of waterfowl);
- be located to reduce human access to potential hazards without blocking maintenance access;
- have very low maintenance requirements because they may be difficult or impossible to reach;

- be resistant to disease and other problems that require chemical applications, since chemical application is not advised in stormwater ponds; and
- be native plants, when possible, because they are low-maintenance and disease-resistant.

Many of the emergent wetlands plants outlined in Table 7-3 also thrive in Zone 3. Some other herbaceous species that do well include: cardinal flower (Lobelia cardinalis), blue flag iris (Iris versicolor), sweet flag (Acorus calamus), Marsh marigold (Caltha palustris), swamp milkweed (Asclepsis incarnata), bentgrass/redtop (Agrostis spp.), switchgrass (Panicum virgatum), Canada bluejoint (Calamagrostis canadensis), many bulrushes (Scirpus spp.), and spike rushes (Eleocharis spp.).

If shading is needed along the shoreline, the following woody species are suggested: river birch (Betula nigra), green ash (Fraxinus pennsylvanica), white ash (Fraxinus americana), pussy willow (Salix discolor), swamp rose (Rosa palustris), buttonbush (Cephalanthus occidentalis), highbush blueberry (Vaccinium spp.), red osier/silky dogwood (Cornus stolonifera/amomum), grey dogwood (Cornus racemosa), arrowood (Viburnum dentatum), spicebush (Lindera Benzoin), sweetbells (Leucothoe racemosa), sweet pepperbush (Clethra alnifolia), winterberry (Ilex verticillata), inkberry holly (Ilex glabra), serviceberry (Amelanchier spp.), black willow (Salix nigra), red maple (Acer rubrum), willow oak (Quercus phellos), swamp white oak (Quercus bicolor), pin oak (Quercus palustris), sweetgum (Liquidambar styraciflua), black gum (Nyssa sylvatica), sweet bay magnolia (Magnolia virginiana), and American sycamore (Platanus occidentalis).

Zone 4: Riparian Fringe (periodically inundated)

Zone 4 extends from 1 to 4 feet above the normal pool. Plants in this zone are subject to periodic inundation after storms and may experience saturated or partly saturated soil. Nearly all of the temporary extended detention area is included within this zone.

Select plants that can:

- withstand periodic inundation of water after storms, as well as occasional drought during the warm summer months;
- stabilize the ground from erosion caused by run-off;
- shade the low-flow channel to reduce pool warming whenever possible;
- enhance pollutant uptake;
- be very low maintenance, as they may be difficult or impossible to access;
- provide food and cover for waterfowl, songbirds, and wildlife (plants may also be selected and located to control overpopulation of waterfowl); and
- be located to reduce pedestrian access to the deeper pools.

Native plants are preferred because they are low-maintenance and disease-resistant. Frequently used plant species in Zone 4 include: many asters (Aster spp.) and goldenrods (Solidago spp.), beebalm (Monarda didyma), bergamont (Monarda fistulosa), lobelias (lobelia spp.), coneflower(Rudbeckia spp.), violets (Viola spp.), lilies (Lilium spp.), primrose (Oenothera spp.), milkwort (Polygala spp.), flatsedge (Cyperus spp.), hollies (Ilex spp.), steeplebush (Spirea tomentosa), serviceberry (Amelanchier arborea), nannyberry (Viburnurn lentago), sweet pepperbush (Clethra alnifolia), bayberry (Morella pensylvanica), elderberry (Sambucus canadensis), sweetbay magnolia (Magnolia virginiana), hawthorn (Crategus), shrub dogwoods (Cornus spp.), green ash (Fraxinus pennsylvanica), river birch (Betula nigra), sweetgum (Liquidambar styraciflua), American hornbeam (Carpinus caroliniana), persimmon (Diospyros virginiana), and red maple (Acer rubrum).

Zone 5: Floodplain Terrace (infrequently inundated)

Zone 5 is periodically inundated by floodwaters that quickly recede in a day or less. Operationally, Zone 5 extends from the maximum two-year or Cpv water surface elevation up to the 10 or 100-year maximum water surface elevation. Key landscaping objectives for Zone 5 are to stabilize the steep slopes characteristic of this zone and establish low maintenance natural vegetation.

Select plants that can:

- withstand occasional but brief inundation during storms and, between storms, typical moisture conditions that may be moist, slightly wet, or even swinging entirely to drought conditions during the dry weather period;
- stabilize the basin slopes from erosion;
- be very low maintenance as ground cover since they may be difficult to access on steep slopes or mowing frequency may be limited (a dense tree cover may help reduce maintenance and discourage resident geese); and
- provide food and cover for waterfowl, songbirds, and wildlife.

Placement of plant material in Zone 5 is often critical. Some commonly planted species in Zone 5 include: phlox (Phlox spp.), solomon's seal (Polygonatum biflorum), many fescues (Festuca spp.), many viburnums (Viburnum spp.), Virginia rose (Rosa virginiana), American hornbeam (Carpinus caroliniana), cherries (Prunus spp.), willow oak (Quercus phellos), hickories (Carya spp.), and witch-hazel (Hamamelis virginiana).

Zone 6: Upland Slopes (seldom or never inundated)

This zone extends above the maximum 100-year water surface elevation and often includes the outer buffer of a pond or wetland. Unlike other zones, this upland area may have sidewalks, bike paths, retaining walls, and maintenance access roads. Care should be taken to locate plants so they will not overgrow these routes or create hiding places that might make the area unsafe. Plant selections should be made based on soil condition, light, and function within the landscape because little or no water inundation will occur. Ground covers should require infrequent mowing to reduce the cost of maintaining this landscape.

Placement of plants in Zone 6 is important since they are often used to create a visual focal point, frame a desirable view, screen undesirable views, serve as a buffer, or provide shade to allow a greater variety of plant materials. Particular attention should be paid to seasonal color and texture of these plantings.

Some frequently used plant species in Zone 6 include: fine fescues (Festuca spp.), basswood (Tilia americana), Flowering dogwood (Cornus florida), Sassafras (Sassafras albidum), American beech (Fagus grandifolia), white ash (Fraxinus americana), scarlet oak (Quercus coccinea), white oak (Quercus alba), Black oak (Quercus velutina), and pine species (Pinus spp.).

Infiltration and Filter Systems

Infiltration and filter systems either take advantage of existing permeable soils or create a permeable medium such as sand for groundwater recharge and stormwater quality control. In some instances where permeability is great, these facilities are used for quantity control as well. The most common systems include infiltration trenches, infiltration basins, sand filters, and organic filters.

When properly planted, vegetation will thrive and enhance the functioning of these systems. For example, pre-treatment buffers will trap sediments that often are binded with phosphorous and metals. Vegetation planted in the facility will aid in nutrient uptake and water storage. Additionally, plant roots will provide arteries for stormwater to permeate soil for groundwater recharge. Successful plantings provide aesthetic value and wildlife habitat, making these facilities more desirable to the public.

Figure 7-3: Plan View of Hydrologic Zones Around Stormwater Basin

PONDSCAPING ZONE 3

New England Aster, Marsh Aster, Marsh Marigold, Tussock Sedge, Spotted Joe Pye Weed, Forget Me Nots, Inkberry, Willow species, Shrub Dogwood, Pin Oak, River Birch, Sycamore, Swamp White Oak.

PONDSCAPING ZONE 4

Purple Cone Flower, Birds Foot Trefoil, Slender Rush, Deer Tongue Grass, Switch Grass, Serviceberry, Gray Birch, Hackberry, Sweet Pepper Bush (Coastal Plain), Gray Stem Dogwood, Redosier Dogwood, Green Ash, Black Gum.

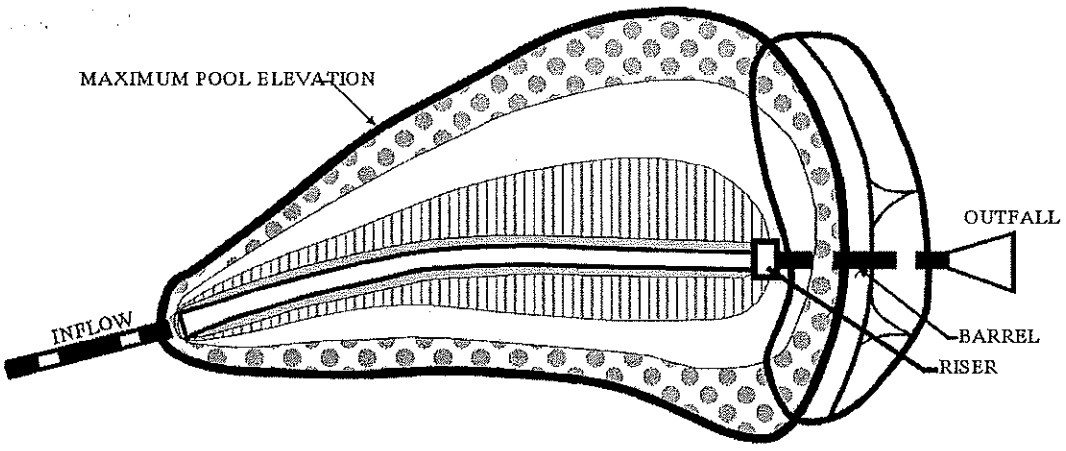
PONDSCAPING ZONE 5

Many wildflowers and native grasses. American Holly, Witch Hazel, Ninebark, Red Oak, American Elderberry, Lowbush Blueberry, Maple Leaf Viburnum, Nannyberry, Blackhaw Viburnum.

PONDSCAPING ZONE 6

(Floodplain) Mostly native ornamentals as long as soils drain well. Many natives. All species must be able to tolerate flood plain conditions. Hackberry, Pitch Pine, Sheep Fescue, Wildflowers, many native grasses.

Note: Tree and shrub setback requirements from the dam embankment, riser, and pipes should be strictly followed.



PLAN VIEW

Source: Adapted from Schueler and Claytor 2000.

Figure 7-4: Plan View of a Shallow Marsh Planting

PONDSCAPING ZONE 1
12"-36" depth: Water Lily, Deep Water Duck Potato, Sago Pond Plant

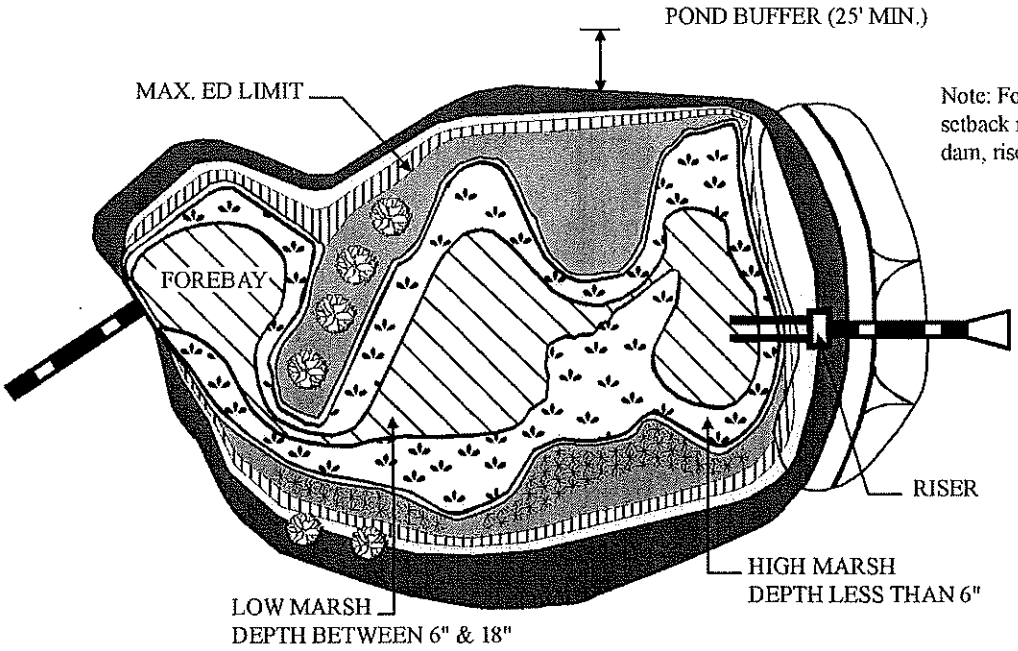
PONDSCAPING ZONE 2
0"-12" depth: Blue Flag Iris, Duck Potato, Flowering Bulrush, Softrush, Sedges

PONDSCAPING ZONE 3
New England Aster, Marsh Aster, Tussock Sedge, Spotted Joe Pye Weed, Inkberry, Shrub willow and Dogwood species, Pin Oak, River Birch, Sycamore, Swamp White Oak

PONDSCAPING ZONE 4
Slender Rush, Deer Tongue Grass, Switch Grass, Service Berry, Gray Birch, Hackberry, Sweet Pepper Bush, Gray Stem Dogwood, Red Osier Dogwood, Green Ash, Black Gum

PONDSCAPING ZONE 5
(Many Wildflowers & Native Grasses), American Holly, Witch Hazel, Ninebark, Red Oak, American Elderberry, American Hemlock, Lowbush Blueberry, Nannyberry, Blackhaw Viburnum

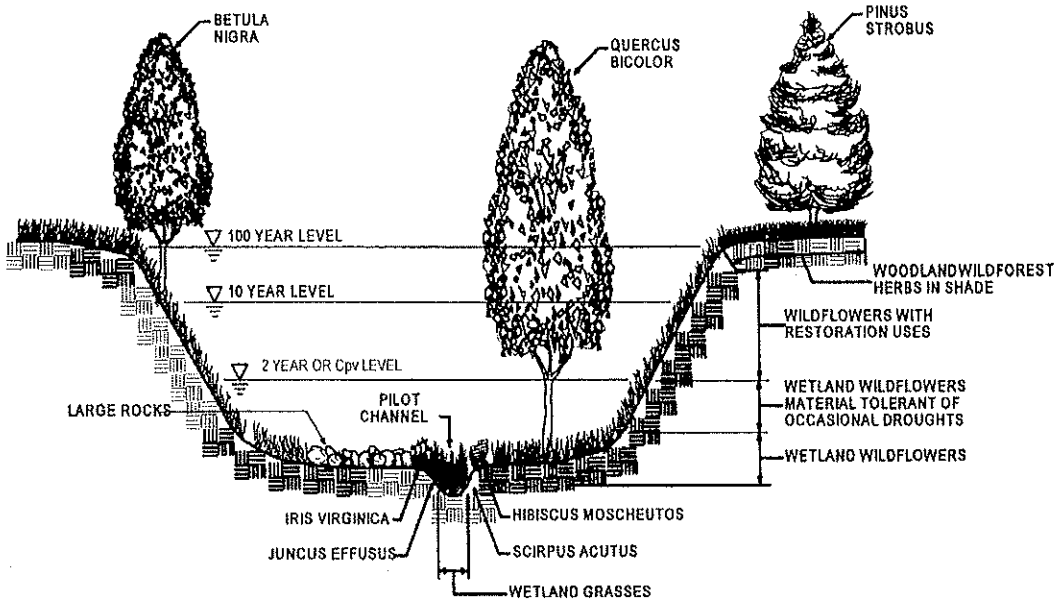
PONDSCAPING ZONE 6
(Floodplain) Mostly ornamentals as long as soil drains well, many natives. All species must be able to tolerate floodplain conditions. Hackberry, Pitch Pine, Sheep Fescue, Wildflowers, Grasses



Note: Follow tree and shrub setback requirements from the dam, riser, and pipes.

Source: Adapted from Schueler and Claytor 2000.

Figure 7-5: Section of a Typical Stormwater Management Detention Pond



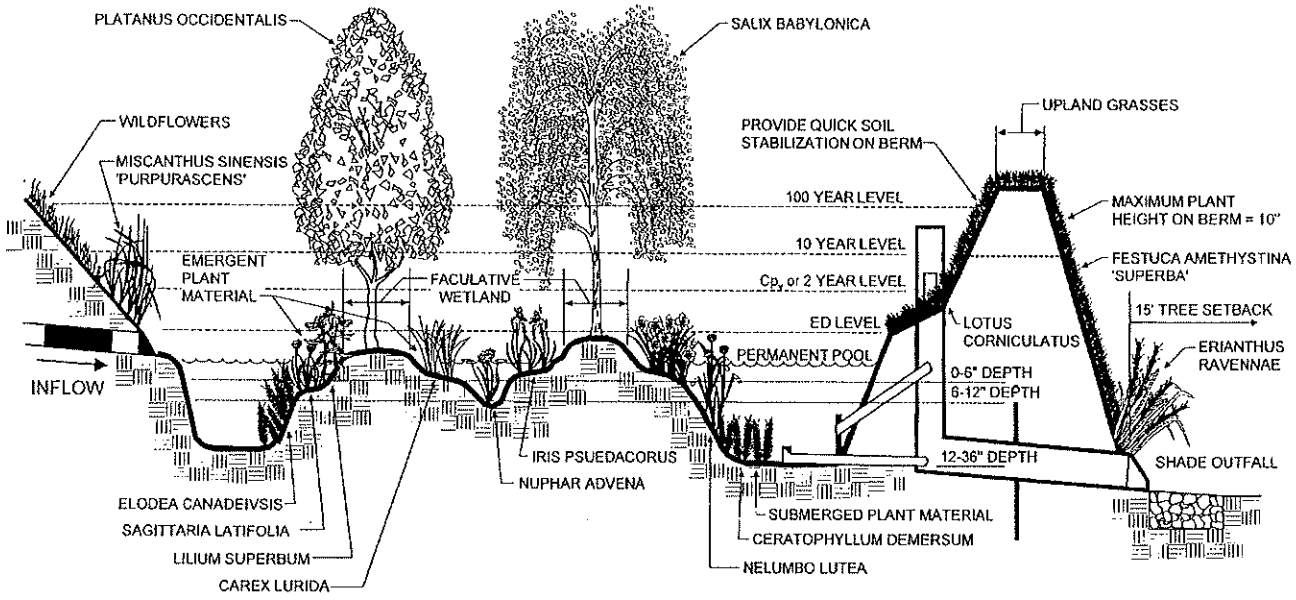
Source: Claytor and Schueler 1997.

Design Constraints

- Planting buffer strips of at least 20 feet will cause sediments to settle out before reaching the facility, thereby reducing the possibility of clogging.
- Determine areas that will be saturated with water as well as water table depth so that appropriate plants may be selected (hydrology will be similar to bioretention facilities, see Figure 7-7 and Table 7-4 for planting material guidance).
- Plants known to send down deep taproots should be avoided in systems where filter fabric is used as part of the facility design.
- Test soil conditions to determine whether soil amendments are necessary.
- Plants should be located to allow access for structure maintenance.
- Stabilize heavy flow areas with erosion control mats or sod.
- Temporarily divert flows from seeded areas until vegetation is established.

See Figure 7-6 for additional design considerations.

Figure 7-6: Section of Typical Shallow Extended Detention Marsh System



Source: Claytor and Schueler 1997.

Part 4: Bioretention

Soil Bed Characteristics

The characteristics of the soil for the bioretention facility are perhaps as important as the facility location, size, and treatment volume. The soil must be permeable enough to allow runoff to filter through the media, while having characteristics suitable to promote and sustain a robust vegetative cover crop. In addition, much of the nutrient pollutant uptake (nitrogen and phosphorus) is accomplished through absorption and microbial activity within the soil profile. Therefore, the soils must balance soil chemistry and physical properties to support biotic communities above and below ground.

Table 7-3: Common Emergent Wetland Plant Species Used for Stormwater Wetlands and on Aquatic Benches of Stormwater Ponds

Common Name	Scientific Name	Inundation Tolerance
Arrow arum	Peltandra virginica	up to 12"
Arrowhead/Duck potato	Saggitaria latifolia	up to 12"
Pickerelweed	Pontederia cordata	up to 12"
Blunt spike rush	Eleocharis obtusa	up to 3"
Bushy beardgrass	Andropogon glomeratus	up to 3"
Common three-square	Scirpus pungens	up to 6"
Iris (blue flag)	Iris versicolor	up to 6"
Marsh hibiscus	Hibiscus moscheutos	up to 3"
Spatterdock	Nuphar luteum	up to 36"
Sedges	Carex spp.	up to 6"
Soft rush	Juncus effusus	up to 6"
Switchgrass	Panicum virgatum	up to 3"

Note 1: Inundation tolerance is maximum inches below the normal pool; most plants prefer shallower depths than the maximum indicated.

Note 2: For additional plant options, consult the stormwater planting list in Section 5. Other good sources include the NJDA Standards for Soil Erosion and Sediment Control in New Jersey, Design of Stormwater Wetland Systems (Schueler 1992), and Wetland Planting Guide for the Northeastern United States (Thunhorst 1993).

Details of the planting soil are discussed in *Chapter 9.1 Standard for Bioretention Systems*. The soil should be free of stones, stumps, roots, or other woody material over 1 inch in diameter. Brush or seeds from noxious weeds, such as Johnson grass, Mugwort, Nutsedge, Purple loosestrife, and Canadian thistle should not be present in the soils. Placement of the planting soil should be in lifts of 12 to 18 inches, loosely compacted (tamped lightly with a dozer or backhoe bucket). Specific soil characteristics are presented in Table 7-4.

Mulch Layer

The mulch layer plays an important role in the performance of the bioretention system by helping to maintain soil moisture and avoiding surface sealing that reduces permeability. Mulch helps prevent erosion and provides a microenvironment suitable for soil biota at the mulch/soil interface. It also serves as a pre-treatment layer, trapping the finer sediments that remain suspended after the primary pretreatment.

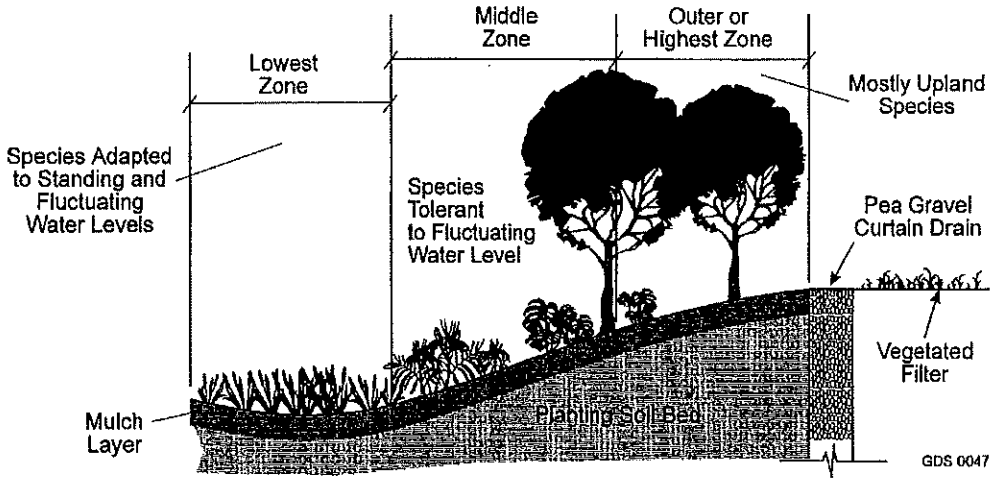
The mulch layer should be standard landscape style, single or double, shredded hardwood mulch or chips. The mulch layer should be well aged (stockpiled or stored for at least 12 months), uniform in color, and free of other materials such as weed seeds, soil, roots, etc. The mulch should be applied to a maximum depth of 3 inches. Grass clippings should not be used as a mulch material.

Table 7-4: Planting Soil Characteristics

Parameter	Value
pH range	5.2 to 7.00
Organic matter	1.5 to 4.0%
Magnesium	35 lbs. per acre, minimum
Phosphorus (P2O5)	75 lbs. per acre, minimum
Potassium (K2O)	85 lbs. per acre, minimum
Soluble salts	< = 500 ppm
Clay	10 to 25%
Silt	30 to 55%
Sand	35 to 60%

Source: Adapted from Schueler and Claytor 2000.

Figure 7-7: Planting Zones for a Bioretention Facility



Source: Claytor and Schueler 1997.

Plant Material Guidance

Plant materials should conform to the American Nursery and Landscape Association publication American Standard Nursery Stock and be selected from certified, reputable nurseries. A landscape architect or other qualified designer should specify a sequence of construction, a description of the contractor's responsibilities, planting schedule and installation specifications, initial maintenance, and a warranty period stipulating expectations of plant survival. *Planting Guidance* below presents some typical issues for planting specifications.

Open Channels

Consult Table 7-7 for grass species that perform well in the stressful environment of an open channel. For more detailed information, consult the Standards for Soil Erosion and Sediment Control in New Jersey. If a BMP is likely to receive excessive amounts of de-icing salt, salt tolerant plants should be used.

Planting Guidance

Plant material selection should be based on the goal of simulating a terrestrial forested community of native species. Bioretention simulates an upland-species ecosystem. The community should be dominated by trees, but have a distinct community of understory trees, shrubs, and herbaceous materials. By creating a diverse, dense plant cover, a bioretention facility will be able to treat stormwater runoff and withstand urban stresses from insects, disease, drought, temperature, wind, and exposure.

Planting Plan Design Considerations

- Native plant species should be specified, not exotic or foreign species.
- Appropriate vegetation should be selected based on the zone of hydric tolerance (see Table 7-2).
- Species layout should generally be random and natural.
- A canopy should be established with an understory of shrubs and herbaceous materials.
- Woody vegetation should not be specified in the vicinity of inflow locations.
- Trees should be planted primarily along the perimeter of the bioretention area.
- Exotic (non-native) vegetation should not be specified.
- Urban stressors (e.g., wind, sun, exposure, insect and disease infestation, and drought) should be considered when laying out the planting plan.
- Aesthetics and visual characteristics should be a prime consideration.
- Traffic and safety issues must be considered.
- Existing and proposed utilities must be identified and considered.

The proper selection and installation of plant materials is key to a successful system. There are essentially three zones within a bioretention facility (Figure 7-7). The lowest elevation supports plant species adapted to standing and fluctuating water levels. The middle elevation supports plants that prefer drier soil conditions but can tolerate occasional inundation by water. The outer edge is the highest elevation and generally supports plants adapted to dryer conditions. A sample of appropriate plant materials for bioretention facilities is included in Table 7-5. The layout of plant material should be flexible, but should follow the general principals described in Table 7-6. The objective is to have a system that resembles a random and natural plant layout while maintaining optimal conditions for plant establishment and growth. For a more extensive bioretention plan, consult the Design Manual for Use of Bioretention in Stormwater Management (ETA&B 1993) or Design of Stormwater Filtering Systems (Claytor and Schueler1997).

Table 7-5: Commonly Used Species for Bioretention Areas

Trees	Shrubs	Herbaceous Species
Acer rubrum Red maple	*Clethra alnifolia* Sweet pepperbush	*Andropogon glomeratus* Lowland broomsedge
Betula nigra River birch	*Ilex verticillata* Winterberry	*Eupatorium purpureum* Sweet-scented Joe Pye weed
Juniperus virginiata Eastern red cedar	*Cephalathus occidentalis* Buttonbush	*Scripus pungens* Three square bulrush
Chionanthus virginicus Fringe-tree	*Hamemelis virginiana* Witch hazel	*Iris versicolor* Blue flag
Nyssa sylvatica Black gum	*Vaccinium corymbosum* Highbush blueberry	*Lobelia cardinalis* Cardinal flower
Diospyros virginiana Persimmon	*Ilex glabra* Inkberry	*Panicum virgatum* Switchgrass
Platanus occidentalis Sycamore	*Ilex verticillata* Winterberry	*Dichanthelium clandestinium* Deertongue
Quercus palustris Pin oak	*Viburnum dentatum* Arrowwood	*Rudbeckia laciniata* Cutleaf coneflower
Quercus phellos Willow oak	*Lindera benzoin* Spicebush	*Scirpus cyperinus* Woolgrass
Salix nigra Black willow	*Morella pennsylvanica* Bayberry	*Vernonia noveboracensis* New York ironweed
Note: For more plant section options for bioretention, consult Design Manual for Use of Bioretention in Stormwater Management (ETA&B 1993) or Design of Stormwater Filtering Systems (Claytor and Schueler 1997).		

Table 7-6: Planting Specification Issues for Bioretention Areas

Specification Element	Elements
Sequence of construction	Describe site preparation activities, soil amendments, etc.; address erosion and sediment control procedures; specify step-by-step procedure for plant installation through site clean up.
Contractor's responsibilities	Specify the contractor's responsibilities, such as watering, care of plant material during transport, timeliness of installation, repairs due to vandalism, etc.
Planting schedule and specifications	Specify the plants to be installed, the type of materials (e.g., B&B, bare root, containerized); time of year of installations, sequence of installation of types of plants; fertilization, stabilization seeding, if required; watering and general care.
Maintenance	Specify inspection periods; mulching frequency (annual mulching is most common); removal and replacement of dead and diseased vegetation; treatment of diseased trees; watering schedule after initial installation (once per day for 14 days is common); repair and replacement of staking and wires.
Warranty	Specify the warranty period, the required survival rate, and the expected condition of plant species at the end of the warranty period.

Table 7-7: Common Grass Species for Open Channels

Common Name	Scientific Name	Notes
Alkali saltgrass	Puccinellia distans	Cool, good for wet, saline swales
Fowl bluegrass	Poa palustris	Cool, good for wet swales
Canada bluejoint	Calamagrostis canadensis	Cool, good for wet swales
Creeping bentgrass	Agrostis palustris	Cool, good for wet swales, salt tolerant
Red fescue	Festuca rubra	Cool, not for wet swales
Redtop	Agrostis gigantea	Cool, good for wet swales
Rough bluegrass	Poa trivialis	Cool, good for wet, shady swales
Switchgrass	Panicum virgatum	Warm, good for wet swales, some salt tolerance
Wildrye	Elymus virginicus/riparius	Cool, good for shady, wet swales

Notes: These grasses are sod forming and can withstand frequent inundation, and are ideal for the swale or grass channel environment. A few are also salt-tolerant. Cool refers to cool season grasses that grow during the cooler temperatures of spring and fall. Warm refers to warm season grasses that grow most vigorously during the hot, mid-summer months.

Where possible, one or more of these grasses should be in the seed mixes. For a more thorough listing of seed mixes see Table 7-8 in Part 5 or consult the Standards for Soil Erosion and Sediment Control in New Jersey.

Vegetative Filters and Stream Buffers

For design and plant selection of vegetative filter strips and stream buffers, consult the USDA Natural Resources Conservation Service, New Jersey Conservation Practice Standards No. 342 "Critical Area Planting," No. 393 "Filter Strip," or No. 391 "Riparian Stream Buffers," available on the web at www.nj.nrcs.usda.gov through the Electronic Field Office Technical Guide (eFOTG).

Part 5: Obtaining and Planting Native Wetland Plant Propagules

There are many ways to obtain plant materials for wetland revegetation, not all of which are appropriate for every project. The process of choosing which plants will be used, in what form, and how they will be obtained should be thought out as far ahead of time as possible. Several criteria will help you make these decisions:

- Have a clear idea of the project goals and objectives (as basic as whether restoration includes woody or herbaceous vegetation or both, and what wetland functions are desired – wildlife food and habitat, water quality improvement, or soil stabilization).
- Know the hydrology on site. Some plants will tolerate only certain water levels, and some plant materials can be established only under particular hydrologic regimes. For example, it makes no sense to select seeds of a shallow water emergent for an area with standing water over 3 feet deep. The seeds will not germinate, and even if they did, the plant would not tolerate those conditions.
- Determine other unique site factors. What are the soils like? Are there micro-topographies that can be exploited? Are geese or deer a problem? Is the site shaded or in full sun?

Once you have decided on the list of potential species for the site, you need to choose the appropriate plant form. Often, this decision is based on project budget, material cost, and the acceptable level of failure. Seeds are usually less expensive than container plants, but generally do not yield great successes and take longer to establish.

Part of the choice of appropriate plant forms depends on what is available. See Tables 7-9 and 7-10 for a complete listing of plant species and available plant forms. Into this mix comes the issue of ecotypes. An ecotype is a population of plants that has become genetically differentiated in response to the conditions of a particular habitat, and it has a distinctive limit of tolerance to environmental factors. For example, wetland plants growing around a pond in Maine are likely to have later flowering times and be more cold hardy than plants of the same species growing around a pond in Florida. When restoring wetland vegetation, consider using local ecotypes as much as possible. Using plants that are already adapted to your conditions can contribute greatly to the success of a revegetation project.

Herbaceous Plants

Herbaceous (non-woody) plants such as grasses, sedges, rushes, and wildflowers are available in many forms, some of which you can readily assemble for a project.

Seed

Using seed to revegetate a wetland is often a low-cost technique, especially if you plan to collect seed yourself. Purchasing seed is more expensive than collecting, but a collection made by a professional ensures that you have good quality seed and allows you to use some species with which you may be unfamiliar. Seeding a wetland can be tricky, since water levels must be carefully controlled. Seed needs to remain close to the soil surface to receive the three elements necessary for germination: moisture (not inundation), heat, and light. Most herbaceous wetland seed requires some pre-germination treatment, either stratification, a period of exposure to cold, moist conditions, and/or scarification (abrasion of the seedcoat) before they will germinate. If seeds are planted in the fall right after cleaning, winter freeze-thaw and bacterial activity may take care of these requirements. For a spring seeding, it is important to know whether the seed has been treated. Generally, there is a greater chance for failure when using seeds rather than plants for revegetation, and little information is available for direct seeding many species. However, seeding can be used in conjunction with other planting methods to enhance restoration.

Dormant Propagules

Dormant propagules are overwintering, underground plant parts such as rhizomes, bulbs, corms, and tubers. These parts are fairly easy to work with; they can be purchased from vendors and transplanted into project sites. Revegetating a wetland with these materials is recommended over seeding because plant material is more likely to survive. Some important points to keep in mind:

- Store collected propagules in a cool, moist (not wet) location until needed. These materials have a much shorter shelf-life than seeds, so collect as close to planting time as possible.
- Dormant propagules are best purchased from local wetland plant vendors. This helps ensure that local ecotypes are used. Locally purchased plants are usually of high quality since long distance shipping is eliminated. When the plant materials shipment arrives, inspect the plants; propagules should be firm, not mushy. If they appear to be decomposing or smell bad, do not accept them.
- In temperate regions, wetland plant materials require a cold treatment to break dormancy. Planting propagules during fall, winter, or early spring will ensure that they receive the cold period necessary to develop normally.

Bare Root Plants and Plugs

Herbaceous plants are commonly grown in greenhouse flats, producing plants with a 2-inch root ball or "plug." Some, however, may be sold as bare-root clumps. Bare-root plants are best planted in the early spring, whereas plants grown in a potting mix can generally be planted through mid-summer. Some nurseries grow deeper rooting species such as warm-season grasses in cone shaped containers referred to as Cone-tainers™ or Deep '38s™ (referring to the number of plants in a flat).

Container Plants

Using container plants (quart size or larger) to restore vegetation on a site can be costly, but healthy plants with intact root balls have an advantage over other plant materials in that they do not need to expend energy on re-growing fine roots (as is the case with bareroot materials), germinating, and growing roots and shoots (as is the case with seeds and dormant vegetative propagules). Container materials can be planted at any time of the year, as long as the ground is not frozen and there is adequate moisture. Some nurseries only contract-grow container material since this size plant requires more time to grow.

Handling Herbaceous Plants

While you will most likely not be propagating and growing your own container plants, you may find, especially if a project is delayed, that you will have to pot up and store bareroot plants, dormant propagules, donor plugs, or even seeds that have limited longevity. Wetland plants are not particularly fussy, so they do not require special soil. Clean topsoil is fine for most species. Be careful not to use soil with a lot of weed seeds, or you may end up transporting problem plants into the wetland. If clean topsoil is not available, you can use bagged topsoil. A 1:1 mix of sand and peat is also useful, especially for germinating small seeds of herbaceous species. While many wetland plants can grow under normal watering regimes, you can cut down on watering and acclimate them to the intended site by letting containers sit in tubs partially filled with water.

In the normal scheme of things, you will be buying your container plants from a wetland plant vendor. As with the other materials discussed, try to find as local a supplier as possible to minimize any difficulties the plants will have adapting to local climate conditions. Inspect container plants for overall health and appearance – plant leaves should not appear pale or have yellowing or brown tips, and stems should be

firm, not spindly. Look for evidence of pests or diseases – holes, wilting, or actual bug sightings should be cause to question the quality of materials. Pull plants from containers to look for strong root systems, with lots of white roots. If you specify particular sizes for materials, be sure that plants' roots fill the containers. Herbaceous materials can be sold in various sizes, but are most commonly available as plugs, quarts, or gallon sized containers. They are grown from seed, cuttings, vegetative propagules, or division. Containers may be made of plastic or biodegradable material such as peat, paper, or fiber.

Woody Plants

Woody plants for wetland revegetation are available in many of the same forms as herbaceous species; however, working with woody plants can take a bit more planning since they grow more slowly than herbaceous plants and it can take several growing seasons for materials to be ready for transplanting.

Seed

The advantages and disadvantages to working with woody plant seed are similar to those for herbaceous seed, that is, using seed is generally inexpensive, but can be tricky, particularly with species whose seed is preferred animal food (e.g., acorns).

Woody plant seed vendors can provide seeds for your project, but these suppliers are rare and, depending on your area, it may be difficult to obtain seed of local origin unless you collect it yourself. Try to get viability or germination information for any seeds you purchase.

Hardwood Cuttings

Stem cuttings from woody plants made during the dormant season are known as hardwood cuttings. These types of plant materials are particularly useful for revegetation on wetland edges and banks, just above the water line within the saturated soil zone. Cuttings are available to a limited extent from nurseries. Disadvantages to using hardwood cuttings include that they can dry out quickly, and that they may have high mortality rates, depending on site conditions.

The best candidates for hardwood cuttings are species of willow, poplar, and shrub dogwoods; these root readily without special treatment. Generally, cuttings are made from one to three-year-old stems, at least 18 inches long and .5 to 1.25 inches in diameter for best results; older materials do not root as readily.

Hardwood cuttings should be stored cold and moist until spring planting. To prime cuttings to form roots quickly after planting, soak cuttings in water for at least 24 hours prior to planting. This process swells the tissue that will expand from the cuttings to form roots.

Bareroot Plants

Bareroot trees and shrubs are commonly grown by native plant nurseries, and are fairly low-cost materials to work with. They are easy to store, transport, and plant, but survival is not as good as with materials that have intact roots.

When purchasing bareroot plants, look for good quality seedlings with a height of at least 18 inches and a root collar of 3/8 inches. Plants should have a substantial root mass left – about equal to the top. Do not accept materials that appear to have too much top growth to the amount of root. Plants should be firm and the growing layer underneath the bark should be green when a small area of the bark is scratched off.

Store bareroot plants in a cool, damp, dark location. Moist sawdust or soil can be packed loosely around the plants to prevent the roots from drying out. Bareroot plants can be stored successfully for several months prior to planting, as long as their roots do not dry out or freeze, and they do not leaf out.

Container Plants and Balled and Burlapped Material

The most expensive and cumbersome restoration materials, but also the most successful in terms of survival, are container plants. Balled and burlapped (B&B) plants are expensive, but can have lower survival rates because of the loss of roots when dug from nursery beds (similar to bareroot materials). Both types can be planted at any time of the year, so long as hydrologic conditions are favorable and the ground is not frozen.

There are probably few instances when you would actually go through the process of ordering container materials for a project, and it is therefore useful to know what to expect when you purchase trees and shrubs from commercial growers. Order early – as soon as you know what you need for a project, start shopping. It can take two growing seasons or longer to propagate woody plants, especially seedlings. Be sure to specify plant size: if you ask only for specific container sizes, you may end up with tiny plants.

Before you accept delivery of container or B&B stock, look at the quality of the materials, particularly the roots. With container plants, remove several plants from the pots and check roots to be sure they fill the pots and are large enough to support the top growth without being pot-bound. Large, thick roots circling inside the pots or girdling other roots are indicative of plants that have outgrown their containers and were not transplanted to larger pots in time. B&B plants should have solid root balls with enough of the root systems present to support the top growth of the plants.

Overall quality is important. Plants for revegetation sites need not be perfect landscape specimens, but they should be vigorous and healthy, with no leaf damage, wilting, or pest insects. Healthy plant material is most able to tolerate less than ideal conditions and survive on a restoration site.

Direct Seeding of Wetland Plants

Many wetland plants are very difficult to seed in the wild. Wetland plant seeds usually require three things to germinate: heat, water, and light. The need for light means that wetland plant seeds must be seeded on the surface and cannot be covered with soil. Planting the seed with a drill will cover the seed, especially if packer wheels or drag chains are used.

Many species have a very hard seed coat that takes up to a year or longer to break down enough for the embryo to germinate. Many species require special stratification treatments to prepare the seed for planting. These treatments include everything from acid wash to mechanical scarification, from pre-chilling to extremely high temperature soil conditions. Occasionally, dormant seeding (seeding during the late fall or winter after the plants have gone dormant) can be successful, but it depends on the species.

Not having absolute control of the water going into the wetland or riparian area is the most common mistake that occurs when seeding wetland plants. Without good water control, when water enters the system the newly planted seeds will float to the water surface and move to the water's edge, where wave action will deposit the seed in a very narrow zone. The seed will germinate here and the stand will generally be quite successful so long as the hydrologic conditions are maintained for the various species deposited there. With good water control, the seeds, for the most part, will stay in place, and the stand will cover the wetland bottom instead of just around the fringe.

Some species, when seeded in a greenhouse setting, require a cold-hot stratification environment for successful germination. This means that the seeds are placed in cold storage at 32-36° F for 30 to 60 days and are then planted in moist soil containers at about 100° F. Heat is one of the essential requirements for germination and growth.

Based on these difficulties, using direct seeding of herbaceous plants as the primary means of revegetating a site will require more attention to planning and control of site hydrology during the establishment period. It also means you will need to know the specific germination/stratification requirements (if any) the targeted species require. Typically, direct seeding of herbaceous species is not used as the primary means of active revegetation, but as a method to increase the overall species diversity in a wetland, especially around the perimeter, and to establish populations of specific target species. The use of wetland herbaceous plugs is recommended over the use of wetland seed. However, the grass seeding mixtures in Table 7-8 may be used to quickly vegetate newly prepared wetland or fringe areas. Seeding alone may also be used if natural regeneration of indigenous species is desired.

Table 7-8: Grass Mixtures for Quickly Vegetating Wetland Sites

Species	Common Name	Remarks
Agrostis gigantea	Redtop	SP,I,CG
Agrostis palustris	Creeping bentgrass	P,I,CG
Calamagrostis candensis	Canada bluejoint	P,N,CG
Cinna arundinacea	Wood reedgrass	P,N,CG
Dicanthelium clandestinum	Deertongue	P,N,WG
Elymus virginicus VA./riparius	Riparian wildrye	P,N,CG
Lolium multiflorum	Annual ryegrass	A,I,CG
Panicum virgatum	Switchgrass	P,N,WG
Poa trivialis	Rough bluegrass	P,I,CG
Poa palustris	Fowl bluegrass	P,N,CG
Puccinellia distans	Alkali saltgrass	P,N,CG
Tripsacum dactyloides	Eastern gamagrass	P,N,WG

Legend:

P = perennial	CG = cool-season grass
A = annual	WG = warm-season grass
I = introduced	CL = cool-season legume
N = native	SP = short-lived perennial

Note: Warm-season grass seeding rates are based on Pure Live Seed (PLS).

Suitable Seed Mixtures

SEED MIX 1: Warm-season mixture suitable for highly acid soils. Provides excellent wildlife value.

Blackwell switchgrass	3 lbs./ac. PLS
Tioga deertongue	5 lbs./ac. PLS
Annual ryegrass (nurse)	5 lbs./ac. PLS

SEED MIX 2: Cool-season mixture suitable for highly erosive areas. Provides fair wildlife value.

Canada bluejoint	2 lbs./ac.
Redtop	1 lbs./ac.

SEED MIX 3: All native mixture suitable for somewhat acid soils. Provides good to excellent wildlife value.

Blackwell switchgrass	3 lbs./ac. PLS
Tioga deertongue	5 lbs./ac. PLS
Wild rye	5 lbs./ac.

SEED MIX 4: Turfgrass mixture suitable for moist, shady areas.

Rough bluegrass	25 lbs./ac.
Creeping bentgrass	10 lbs./ac.

SEED MIX 5: Native grass mixture for shady sites/forested floodplains.

Wood reedgrass	2 lbs./ac.
VA or Riparian wildrye	5 lbs./ac.

SEED MIX 6: Mixture for providing quick, temporary cover in areas where planting may be delayed due to seasonal restrictions, e.g, seed in late fall, plant permanent vegetation the following spring. Excellent wildlife value.

Redtop	1 lbs./ac.
Annual ryegrass	8 lbs./ac.

SEED MIX 7: This mixture is suitable for wet, saline areas, i.e., along roadsides, adjacent to tidal areas.

Creeping bentgrass	10 lbs./ac.
Alkali saltgrass	5 lbs./ac.

SEED MIX 8: Permanent cover mix providing quick perennial cover for saturated areas that will not be planted with other species.

Eastern gamagrass	5 lbs./ac. PLS
Redtop or creeping bentgrass	2 lbs./ac.
Fowl bluegrass	5 lbs./ac.
Wild rye	8 lbs./ac.
Switchgrass	5 lbs./ac. PLS

If aesthetics are desired, the following wildflowers are tolerant of saturated conditions and any or all may be added to the above mixtures at the rates specified:

Asclepias incarnata (Swamp milkweed)	2 lbs./ac.
Aster novae-angliae (New England aster)	0.5 lb./ac.
Aster novi-belgii (New York aster)	0.5 lb./ac.
Bidens frondosa (Beggar's tick sunflower)	1 lb./ac.
Caltha palustris (Marsh marigold)	0.5 lb./ac.
Chelone glabra (Turtlehead)	1 lb./ac.
Eupatorium fistulosum (Joe-pye weed)	1 lb./ac.
Helenium autumnale (Sneezeweed)	1 lb./ac.
Lobelia cardinalis (Cardinal flower)	0.5 lb./ac.
Lobelia siphilitica (Blue lobelia)	0.5 lb./ac.
Mimulus ringens (Monkey flower)	1 lb./ac.
Rudbeckia laciniata (Green-headed coneflower)	1 lb./ac.
Solidago rugosa (Wrinkle-leaf goldenrod)	0.5 lb./ac.
Solidago patula (Rough goldenrod)	0.5 lb./ac.
Verbena hastata (Blue vervain)	1 lb./ac.
Vernonia noveboracensis (New York ironweed)	2 lbs./ac.

Wetland Transplanting with Plugs

Natural wetland systems normally have high species diversity. When selecting plant species for the project wetland, try to copy a nearby natural wetland using these techniques:

- Identify the particular hydrology in areas where the individual plant species are growing.
- Make note of how deep the water is.
- Try to imagine how long the plants will be inundated.
- Determine whether the plants are in flowing or relatively stagnant water.

Rarely will a natural wetland be totally stagnant through time. Generally, there is water flowing into the wetland from somewhere, either above ground or from groundwater. Spring and fall overturn, as well as wind mixing, helps to circulate the water.

Next, prepare the planting area. The easiest way to plant wetland species plugs is by flooding your planting site. Standing water is much easier to plant than dry soil (this also ensures that the watering system, whatever it may be, works before you plant). Make sure the soil is saturated enough so that you can dig a hole with your hand. This is more successful with fine soils than with coarse soils. Take the plug trays and place them in a Styrofoam cooler (you will not need the lid). Try to cover most of the roots with water while in transit. At the planting site, drain off most of the water so the cooler will float. Use the cooler to move the plugs around the wetland as you plant. Select a spot in your wetland to put a plug, reach into the water with your hand and dig out a hole deep enough for the plug to fit all the way in. Push the plug into the hole and pack around it with your hand. Make sure all of the roots are covered with soil. Be careful to not dislodge the plug and expose the roots when moving around. Start at one end of the planting site and work toward the opposite end.

Spacing of the plugs is a common concern. Research has indicated that many wetland plants will typically spread about 9 to 12 inches in a full growing season. Typically, wetland species are planted on 18 inch centers. Even though it takes fewer plants to plant an area at a wider spacing, plantings at wider spacing have less overall success than planting at a closer spacing. The exact reason for this is unknown, but it could be a sympathetic response to plants of the same species. If the project budget does not allow for the purchase of enough plants to cover the wetland bottom, plant the plugs on 18 inch centers, but plant them in copses or patches that are about 10 feet square or in diameter. Space the copses about 10 feet apart. The copses can be planted to different species according to the hydrology. For hydrologic Zone 2, Scheuler (1996) recommends planting at least five to seven species of emergent plants, three of which should be arrowhead (Sagittaria latifolia), three square (Scirpus pungens), and soft-stem bulrush (Scirpus tabernaemontanii). Based on experience, these three species will establish readily and spread quickly without being too aggressive. Over time, the plants will spread out into the unplanted areas. The additional species selected for the wetland system can be chosen to mimic natural wetlands in the area and/or enhance water quality, wildlife value, or aesthetics. Generally, it is best to keep water levels as shallow as possible to promote greater species diversity and assimilate a higher concentration of pollutants. High nutrient inflows and greatly fluctuating water levels tend to promote the more aggressive species such as reed canarygrass, cattails, and phragmites.

The optimum planting window for wetland plants is from March through late July. Planting plugs in the fall and winter has resulted in frost heaving of the plugs so that only about one-third of the plug remained in the ground. The availability of water is critical – wetland plants like it hot and wet. They tend to spread faster with warmer temperatures. If you plant in the spring, it will take the plants a while to get going, but they will have a longer establishment period. Fall planting will generally result in lower establishment success because of the shorter growing season and frost heaving damage.

The plants can be successfully established in a wide variety of soil textures. Successful wetland plantings have occurred in areas that are clay with no organic matter to gravelly textures. The biggest problem is

digging the holes. The soil texture will often limit the equipment available to dig the holes. In clay bottoms, a small bulldozer or tractor with a ripper tooth can be used to dig lines across the bottom about 8 inches deep.

In general, fertilizer is not necessary, but its use depends on the site and the soils. If during construction the bottoms have been cut down to the subsoil and all of the naturally present nutrients have been removed, fertilization will probably be necessary unless the water coming into the wetland has a high nutrient load.

After planting, release the water into the site slowly. The young plants have not fully developed the aerenchymous material necessary for them to survive in anaerobic soils and standing water. After the initial planting, be careful not to raise the water level to more than about 1 inch above the substrate. Too much water at this time may stress the new plants. Maintain the water at about 1 inch for about one week, to inhibit the germination and growth of any terrestrial species that may be present in the restored wetland. The water level can then be lowered to the substrate surface for 15 to 20 days. This will expose the mud surface, stimulating any wetland seeds that were brought in with your transplants to germinate as well as increase the rate of spread of the transplants. You can then raise the water level 1 to 2 inches for another week. Then lower the water to the substrate surface for another 15 to 20 days. After this period, slowly raise the water level to 4 to 6 inches for three to five days. Continue to gradually increase the water depth to 6 to 8 inches. The aerenchymous tissues in the plant shoots are what supply the roots with oxygen, so be careful not to raise the water over the tops of the emergent vegetation. If the plants are not showing any stress, continue to carefully raise the water level to 12 to 20 inches, if possible. These suggested water level depths must be modified based on the species used. Some species will not tolerate inundation at these suggested depths or durations. When in doubt, defer to the hydrology conditions on natural reference sites where the species occurs. The goal here is to inundate the transition zone between wetland and upland as much as possible to control any invading terrestrial species. After about 20 days lower the water level to about 2 to 3 inches (Hammer 1992). For the rest of the growing season, adjust the water level to maximize the desired community type. The key to determining the appropriate water level is to monitor the emergent wetland plant community. Raise the water level if weed problems surface. Lower the water level to encourage emergent wetland plant growth and spread. The key is to fluctuate the water level. Natural wetlands rarely have a constant water level. Many species cannot tolerate a constant water level and will begin to die out; species more tolerant to standing water will increase, and the plant diversity that was so carefully planned for will be lost.

Management during the establishment year is important to ensure that the plants do not get too much water or too little. Weed control is important especially during the establishment year because of the low water levels and exposed, unvegetated areas. A good weed control plan needs to be in place before planting. Monitoring the planting for three to five years after the establishment year will help maintain the planting and provide useful information for future plantings.

Recommendations

- Always match the plant species to the hydrology associated with that species. In general, purchase the largest plugs you can. Planting technique will often determine the size of the plugs and the ease of planting.
- Plant the plugs on 18 to 24 inch centers. Plant in patches rather than wider spacing.
- Fertilizer is generally not necessary unless the water coming into the site is relatively clean or construction has cut into the subsoil.
- Plants will spread faster under saturated soil conditions than in standing water. However, terrestrial weeds will move in to saturated soils much faster than flooded soils. Fluctuating the water level helps the plants spread and decreases terrestrial weed establishment.

- Water control is extremely important during the establishment year.
- Weed control must be planned and budgeted at the beginning of the project.
- Monitoring is essential for the success of the project. Monitoring requires time and money allocated in the budget, and a specific person identified to carry it out.
- Successful wetland plantings take significant planning and a good understanding of the hydrology at each site.

Upland Seeding

There are three main factors to consider when planning the upland seeding phase o stormwater basin: season of seeding, seeding rates, and method of application. Season of seeding is important because some seed may require stratification before germination. Other seed, such as legume species, should probably not be seeded until spring. Seeding rate concerns both economics and plant competition. Too much seed on a site puts unnecessary cost into the total process and, at the same time, a thinner stand will emerge because of plant competition for nutrients traditionally in short supply on disturbed soils. Ideally, the site should have been prepared the previous fall if a spring seeding is desired. Usually, spring seedings are conducted between periods of wet and dry weather (commonly in March to the first of May). There may be a problem getting heavy equipment onto the site to prepare a seedbed in the early spring following a wet winter that has saturated the soil profile. (Refer to the USDA-NRCS Conservation Practice Standard-342 "Critical Area Planting" or the Standards for Soil Erosion and Sediment Control in New Jersey for seed mixtures and mulching information.)

Part 6: Other Considerations in Stormwater BMP Landscaping

Use or Function

In selecting plants, consider their desired function in the landscape. Is the plant needed as ground cover, soil stabilizer, or a source of shade? Will the plant be placed to frame a view, create focus, or provide an accent? Does the location require that you provide seasonal interest to neighboring properties? Does the adjacent use provide conflicts or potential problems and require a barrier, screen, or buffer? Nearly every plant and plant location should be provided to serve some function in addition to any aesthetic appeal.

Plant Characteristics

Certain plant characteristics, such as size and shape, are so obvious they may actually be overlooked in the plant selection. For example, tree limbs, after several years, can grow into power lines. A wide growing shrub may block an important line of sight to oncoming vehicular traffic. A small tree, when full grown, could block the view from a second story window. Consider how these characteristics can work for you or against you, today and in the future.

Other plant characteristics must be considered to determine how plants provide seasonal interest and whether plants will fit with the landscape today and through the seasons and years to come. Some of these characteristics are: color, texture, growth rate, and seasonal interest, i.e., flowers, fruit, leaves, and stems/bark.

Growth Rate

If shade is required in large amounts, quickly, a sycamore might be chosen over an oak. In urban or suburban settings, a plant's seasonal interest may be of greater importance. Residents living next to a stormwater system may desire that the facility be appealing or interesting to look at throughout the year. For example, willows are usually the first trees to grow leaves signaling the coming of spring. Pink and white dogwoods bloom in mid-spring to early summer, while witch hazel has a yellow bloom every fall, which can be contrasted with the red fall foliage of a sugar maple. Careful attention to the design and planting of a facility can result in greater public acceptance and increased property value.

Availability and Cost

Often overlooked in plant selection is the availability from wholesalers and the cost of the plant material. Many plants listed in landscape books are not readily available from local nurseries. Without knowledge of what is available, time spent researching and finding the one plant that meets all needs will be wasted. That plant may require shipping, making it more costly than the budget may allow. Some planting requirements may require a special effort to find the specific plant that fulfills the needs of the site and the functions of the plant in the landscape. In some cases, it may be cost effective to investigate nursery suppliers for the availability of wetland seed mixtures. Specifications of the seed mix should include wetland seed types and the relative proportion of each species. Some suppliers provide seed mixtures suitable for specific wetland, upland, or riparian habitat conditions. This option may best be employed in small stormwater facilities, such as pocket wetlands and open swales, or to complement woody vegetation plantings in larger facilities. A complete listing of wetland plant suppliers is available on the USDA-NRCS Plant Materials Program website (www.Plant-Materials.nrcs.usda.gov).

Vegetation Maintenance

To ensure grass vigor, maintain the copse as an upland meadow, which includes cutting no shorter than 6 to 8 inches high. If a more manicured lawn setting is desired, more mowing and special attention to turf health will be needed. Some communities consider the tall wetlands-type vegetation (typically, cattails or rushes) that may grow in dry ponds to be unaesthetic. Some of this vegetation is actually beneficial as it provides water quality benefits and wildlife habitat. Some vegetative needs include:

- pH adjustment (as required);
- pruning;
- pest control;
- reseeding;
- thatch removal; and
- weed removal.

Sediment Filtration

Vegetative cover outside of an embankment filters sediment from runoff as it flows into a pond. It also prevents erosion of the pond banks. A minimum vegetated filter strip BMP is ideal around wet ponds.

Surrounding Vegetation Fertilization (not recommended, except in special cases)

It is important not to over-fertilize the surrounding vegetation. Doing so could result in excess nutrients being washed into the pond, which can contribute to excessive algae growth. As a general rule, the nutrient needs of the surrounding vegetation should be evaluated by testing the pH and nutrient content of the soil prior to fertilization. The adjustment of pH may be necessary to maintain vegetation. Fertilization of all turf areas should occur in the fall.

Purple Loosestrife

If your wetland and/or stormwater management area becomes invaded with purple loosestrife, there are methods to reduce its presence. It is important to catch its presence early, which is evident by the long purple flowering head or inflorescence. To manually rid the wetland and/or stormwater management area of purple loosestrife, it is important to ensure that the rhizomes (large tuberous root systems) are removed as well as the plant (above ground portion) prior to flowering (June through September). Plant parts, immediately upon removal, should be placed in a bag to prevent further spread of the species. If it is not possible to do this, regularly remove the flower heads before the seeds are dispersed. This will help keep this plant at bay. Digging is not recommended as it creates disturbance, which may favor the spread of the species. Herbicides are generally not effective for purple loosestrife as its seeds are long-lived and this solution is therefore short-term. If herbicide applications are used, they will need to be repeated for several years. As a caution, purple loosestrife may be available at local nurseries. Do not introduce this plant into pond areas.

Cattails and Common Reeds (phragmites)

It is important to determine which plants were originally planted when the pond or stormwater wetland was constructed. Cattails planted in these areas are one of the most beneficial plants in improving water quality. It must be noted that ponds and stormwater wetlands were originally designed with the intent of retaining

stormwater and/or treating stormwater. The concept of wildlife habitat was an ancillary benefit at best and not generally the goal prior to the mid-1990s.

Shallow water (less than 2 feet) will often be taken over by water loving plants. Dense, tall emergent vegetation, most commonly cattails and phragmites, may limit waterfowl use of a pond. Cattails provide good wildlife habitat, but can take over a shallow pond. Phragmites is much more invasive, taller, and generally does not provide for a scenic view. Once established, phragmites is very difficult to completely eradicate.

Dense stands of cattails and phragmites can reduce populations of invertebrates, amphibians, and reptiles, and may possibly increase mosquito populations. It is important to keep some areas of open water. Eradication of these species generally requires assistance from a natural resource professional. A natural resource professional is a person who has been trained in ecology and/or environmental assessment, including soils, plants, animals, air quality, human involvement, and water quantity and quality.

With respect to diversity, research has shown that lower pollutant inputs generally yield greater plant diversity. Conversely, higher pollutant inputs yield lower plant diversity. Hence, if your pond becomes populated with phragmites, cattails or both, it may indicate a high pollutant load. These species, among others, are two of the best plants for improving water quality.

Stormwater Plant Lists

The following pages present lists of herbaceous and woody vegetation native to New Jersey and suitable for planting in stormwater management facilities. The lists are intended as a guide for general planting purposes and planning considerations. Knowledgeable landscape designers and nursery suppliers may provide additional information for considering specific conditions for successful plant establishment and accounting for the variable nature of stormwater hydrology.

The planting lists are in alphabetical order according to the common name, with the scientific name also provided. Life forms indicate whether a plant species is an annual, perennial, grass, grass-like, fern, tree, or shrub.

Each plant species has a corresponding hydrology zone to indicate the most suitable planting location for successful establishment. While the most common zones for planting are listed in parenthesis, the listing of additional zones indicates that a plant may survive over a broad range of hydrological conditions.

The wetland indicator status has been included to show "the estimated probability of a species occurring in wetlands versus nonwetlands." The indicator categories are defined as follows:

- Obligate wetland (OBL): Plants that nearly always (more than 99 per cent of the time) occur in wetlands under natural conditions.
- Facultative Wetland (FACW): Plants that usually occur in wetlands (from 67 to 99 per cent of the time), but are occasionally found in nonwetlands.
- Facultative (FAC): Plants that are equally likely to occur in wetlands and nonwetlands and are found in wetlands from 34 to 66 per cent of the time.
- Facultative Upland (FACU): Plants that usually occur in nonwetlands (from 67 to 99 per cent of the time), but are occasionally found in wetlands (from 1 to 33 per cent of the time).
- Upland (UPL): Plants that almost always (more than 99 per cent of the time), under natural conditions, occur in nonwetlands.

A given indicator status shown with a "+" or a "-" means that the species is more (+) or less (-) often found in wetlands than other plants with the same indicator status without the "+" or "-" designation.

Since the wetland indicator status alone does not provide an indication of the depth or duration of flooding that a plant will tolerate, the "Inundation Tolerance" section is designed to provide further guidance. Where a plant species is capable of surviving in standing water, a "Yes" is designated in this column. Additional information is provided for depth of inundation for aquatic vegetation and tolerance for seasonal inundation, saturated soil conditions, or tolerance to salt. Because individual plants often have unique life requirements difficult to convey in a general listing, it will be necessary to research specific information on the plant species proposed in order to ensure successful plant establishment.

Commercial availability indicates whether the plant is available as seed, plant form (bare-root, plug, or container), or both. The plant form listed first is the most common form supplied by nurseries. The availability of some species varies from one year to the next. It is best to determine the quantity needed and the plant form desired for each individual species well ahead of time (at least six months).

Table 7-9, a list of herbaceous stormwater plants, begins on the next page, followed by Table 7-10, a list of woody vegetation.

Table 7-9: Stormwater Plant List – Herbaceous Vegetation

Common Name	Scientific Name	Plant Type	Hydrologic Zone	Wetland Indicator	Inundation Tolerance	Commercial Availability
Arrow arum	Peltandra virginica	Grass-like	[1,2],3	OBL	Yes	Plants, Seed
Arrowhead, bull-tongue	Sagittaria lancifolia	Perennial	[1,2],3	OBL	Yes	Plants
Arrowhead, duck potato	Sagittaria latifolia	Perennial	[1,2],3	OBL	0-2'	Plants, Bare-root, Seed
Arrowhead, grass-leaf	Sagittaria graminea	Perennial	[1,2],3	OBL	0-1'	Plants
Aster, calico	Aster lateriflorus	Perennial	[2,3,4]	FACW-	Seasonal	Seed, Plants
Aster, New England	Aster novae-angliae	Perennial	[2,3],4	FACW	Yes	Seed, Plants
Aster, New York	Aster novibelgil	Perennial	[2,3],4	FACW+	Yes	Seed, Plants
Aster, panicled	Aster simplex (lanceolatus)	Perennial	[2,3],4	FACW	Yes	Seed, Plants
Aster, white heath	Aster ericoides	Perennial	3,[4,5,6]	FACU	No	Seed
Aster, white wood	Aster divercatus	Perennial	4,[5,6]	NI	No	Plants
Beachgrass, American	Ammophila breviligulata	Grass	4[5,6]	FACU-	No	Dormant culms Plants
Beardtongue	Penstemon digitalis	Perennial	3,4,5	FAC	No	Plants, Seed
Beebalm	Monarda didyma	Perennial	3,[4,5]	FAC+	Saturated	Plants, Seed
Beggars-tick	Bidens connata	Annual	[2,3],4	FACW+	Yes	Seed
Beggars-tick	Bidens frondosa	Annual	2,[3,4]	FACW	Yes	Seed
Bentgrass, creeping	Agrostis palustris	Grass	[2,3],4	FACW	Yes	Seed
Bergamot, wild	Monarda fistulosa	Perennial	[4,5,6]	UPL	No	Plants, Seed
Black-eyed susan	Rudbeckia hirta	Perennial	4,[5,6]	FACU-	No	Plugs, Seed
Bladderwort, common	Utricularia macrorhiza	Perennial	[1,2],3	OBL	Yes	Plants
Blue lobelia	Lobelia siphilitica	Perennial	1,[2,3],4	FACW+	Yes	Plants, Seed
Bluebells, Virginia	Mertensia virginica	Perennial	[2,31,4	FACW	Yes	Plants, Seed
Bluegrass, fowl	Poa palustris	Grass	[2,3],4	FACW	Yes	Seed
Bluegrass, rough	Poa trivialis	Grass	2,[3,4],5	FACW	Seasonal	Seed
Bluestem, big	Andropogon gerardii	Grass	[4,5],6	FAC	No	Seed, Plants
Bluestem, little	Schizachyrium scoparium	Grass	6	FACU	No	Seed, Plants
Boneset	Eupatorium perfoliatum	Perennial	[2,3],4	FACW+	Yes	Plants, Seed
Broomsedge	Andropogon virginicus	Grass	[4,5],6	FACU	No	Seed
Broomsedge, lowland	Andropogon glomeratus	Grass	[2,3],4	FACW+	Yes	Plants
Bulrush, alkali	Scirpus robustus	Grass-like	1,[2],3	OBL	Salt, edge	Plants
Bulrush, chairmakers	Scirpus americanus	Grass-like	[1,2],3	OBL	0-6"	Plants, Seed
Bulrush, green	Scirpus atrovirens	Grass-like	[1,2,],3	OBL	Yes	Plants, Seed
Bulrush, hardstemmed	Scirpus acutus	Grass-like	[1,2],3	OBL	0-3'	Plants, Seed

Common Name	Scientific Name	Plant Type	Hydrologic Zone	Wetland Indicator	Inundation Tolerance	Commercial Availability
Bulrush, river	Scirpus fluviatilis	Grass-like	[1,2],3	OBL	0-1'	Seed
Bulrush, softstem	Scirpus tabermontanii	Grass-like	[1,2],3	OBL	0-1'	Plants, Seed
Bulrush, three-square	Scirpus pungens	Grass-like	[2,3],4	FACW+	0-6"	Plants, Seed
Burnet, Canada	Sanguisorba canadensis	Perennial	4,[5,6]	FACW+	Yes	Plants
Burreed, American	Sparganium americanum	Emergent Perennial	[1,2],3	OBL	0-1'	Plants, Seed
Burreed, giant	Sparganium eurycarpum	Emergent Perennial	[1,2],3	OBL	Yes	Plants, Seed
Bushclover, roundheaded	Lespedeza capitata	Legume	4,5,6	FACU	No	Seed, Plants
Butter-cup, yellow water	Ranunculus flabellaris	Perennial	[2,3,4]	FACW	Yes	Plants
Butterflyweed	Asclepias tuberosa	Perennial	[5,6]	NI	No	Plants, Seed
Cardinal flower	Lobelia cardinalis	Perennial	1,[2,3],4	FACW+	Yes	Plants, Seed
Celery, wild	Vallisneria americana	Perennial	[1,2],3	OBL	Yes	Plants, Seed
Club, golden	Orontium aquaticum	Perennial	[1,2],3	OBL	Yes	Plants
Columbine, wild	Aquilegia canadensis	Perennial	[3,4],5	FAC	No	Plants, Seed
Coneflower, brown-eyed	Rudbeckia triloba	Perennial	4,[5,6]	FACU	No	Plants, Seed
Coneflower, cut-leaf	Rudbeckia laciniata	Perennial	[2,3],4	FACW	Yes	Seed, Plants
Coneflower, orange	Rudbeckia fulgida	Perennial	[3,4],5	FAC	No	Seed
Cordgrass, big	Spartina cynosuroides	Grass	[1,2],3	OBL	Tidal-fresh	Plugs
Cordgrass, prairie	Spartina pectinata	Grass	[1,2],3	OBL	Tidal-fresh	Plants, Seed
Cordgrass, saltmarsh	Spartina alterniflora	Grass	[1,2],3	OBL	Salt, edge	Plants, Seed
Cordgrass, saltmeadow	Spartina patens	Grass	1,[2,3],4	FACW+	Salt, edge	Plants
Coreopsis, dwarf plains	Coreopsis tinctoria	Annual	3,[4,5],6	FAC-	No	Seed, Plants
Coreopsis, lance-leaved	Coreopsis lanceolata	Perennial	5,6	FACU	No	Seed, Plants
Coreopsis, pink	Coreopsis rosea	Perennial	2,[3,4]	FACW	Yes	Seed, Plants
Coreopsis, tall	Coreopsis tripteris	Perennial	[2,3],4	FAC	Yes	Plants, Seed
Cutgrass, rice	Leersia oryzoides	Grass	[1,2],3	OBL	0-6"	Plants, Seed
Dragon-head, false (obedient plant)	Physostegia virginiana	Perennial	2,[3,4],5	FAC+	Saturated	Plants, Seed
False-hellebore, American	Veratrum viride	Perennial	[2,3,4]	FACW+	Yes	Plants, Seed
False-solomon's-seal	Smilacina racemosa	Perennial	[4,5],6	FACU-	No	Seed
Fern, cinnamon	Osmunda cinnamomea	Fern	[2,3],4	FACW	Saturated	Plants
Fern, New York	Thelypteris noveboracensis	Fern	[3,4],5	FAC	Saturated	Plants, Seed
Fern, royal	Osmunda regalis	Fern	[1,2],3	OBL	Saturated	Plugs
Fern, sensitive	Onoclea sensibilis	Fern	[2,3],4	FACW	Saturated	Plants, Seed
Fescue, hard	Festuca duriuscula	Grass	[3,4,5,6]	NI	No	Seed
Fescue, red	Festuca rubra	Grass	[4,5]	FACU	No	Seed
Fescue, sheeps	Festuca ovina	Grass	[4,5],6	NI	No	Seed
Gamagrass, eastern	Tripsacum dactyloides	Grass	2,[3,4],5	FACW	Yes	Seed

Common Name	Scientific Name	Plant Type	Hydrologic Zone	Wetland Indicator	Inundation Tolerance	Commercial Availability
Goldenrod, roughleaf	Solidago patula	Perennial	1,[2,3,]	OBL	Yes	Seed
Goldenrod, seaside	Solidago sempervirens	Perennial	[2,3],4	FACW	Yes	Plants, Seed
Goldenrod, silverrod	Solidago bicolor	Perennial	5,6	NI	No	Plants, Seed
Goldenrod, stiff	Solidago rigida	Perennial	5,6	UPL	No	Plants, Seed
Goldenrod, wrinkleleaf	Solidago rugosa	Perennial	3,[4,5]	FAC	No	Plants, Seed
Grass, alkali	Puccinellia distans	Grass	[1,2],3	OBL	Yes	Seed
Grass, deertongue	Dichanthelium clandestinium	Grass	[2,3],4	FAC+	Seasonal	Seed
Grass, Japanese millet	Echinochloa frumentcea	Annual Grass	[2,3],4	NI	Yes	Seed
Grass, redtop	Agrostis gigantea	Grass	[2,3,],4	FACW	Yes	Seed
Hornwort, common	Ceratopliyilurn dernersurn	Perennial	[1,21,3	OBL	1-5	Plants
Horsetail, rough	Equisetum hyemale	Fern-like	[2,3],4	FACW	Yes	Plants
Indiangrass	Sorghastrum nutans	Grass	5,6	UPL	No	Seed, Plants
Iris, blue flag	Iris versicolor	Perennial	[1,2],3	OBL	0-6"	Plants, Seed
Iris, yellow flag	Iris pseudacorus	Perennial	[3,4],5	FAC	No	Plants, Seed
Ironweed, New York	Vernonia noveboracensis	Perennial	[2,3],4	FACW+	Yes	Plants, Seed
Jack-in-the-pulpit, swamp	Arisaerna triphyllurn	Perennial	[2,3],4	FACW	Seasonal	Plants
Jacob's ladder	Polemonium reptans	Perennial	[4,5],6	FACU	No	Seed
Jacob's-ladder, bog	Polernoniurn van-bruntlae	Perennial	[3,4],5	FAC+	Saturated	Plants
Joe-pye, purple	Eupatoriadelphus purpureus	Perennial	3,[4,5]	FAC	Yes	Plants, Seed
Joe-pye, spotted	Eupatorium maculatus	Perennial	2,[3,4]	FACW	Yes	Plants, Seed
Lily, turk's-cap	Lilium superbum	Perennial	[2,3,4]	FACW+	Yes	Plants, Seed
Lizards tail	Saururus cernuus	Perennial	2,3,4	OBL	0-1'	Plants
Lotus, American	Nelumbo lutea	Perennial	[1,2],3	OBL	1-5'	Plants, Seed
Lovegrass, purple/tumble	Eragrostis spectabilis	Grass	[5,6]	NI	No	Plants, Seed
Mallow, swamp rose	Hibiscus moscheutos	Perennial	2,3	OBL	0-3"	Plants
Mallow, Virginia seashore	Kosteletzkya virginica	Perennial	[1,2],3	OBL	Yes, saltedge	Plants
Managrass, American	Glyceria grandis	Grass	[1,2],3	OBL	Yes	Plants, Seed
Managrass, Atlantic	Glyceria obtusa	Grass	[1,2],3	OBL	0-1'	Plants, Seed
Managrass, fowl	Glyceria striata	Grass	[1,2],3	OBL	Seasonal	Plants, Seed
Managrass, rattlesnake	Glyceria canadensis	Grass	[1,2],3	OBL	0-1'	Plants, Seed
Marsh marigold	Caltha palustris	Perennial	3,4	OBL	6", saturated	Plants, Seed
Marsh-mallow, common	Althaea officinalis	Perennial	[1,2,3]	FACW+	Yes	Plants, Seed
Meadow-rue, tall	Thalictrum pubescens	Perennial	[2,3,4]	FACW+	Yes	Seed, Plants
Milkweed, swamp	Asclepias incarnata	Perennial	2,3	OBL	Saturated	Plants, Seed
Monkey-flower	Mimulus ringens	Perennial	[1,2],3	OBL	Yes	Plants, Seed

Common Name	Scientific Name	Plant Type	Hydrologic Zone	Wetland Indicator	Inundation Tolerance	Commercial Availability
Mountain-mint, slender	Pycnantheinum tenuifolium	Perennial	[2,3,4]	FACW	Yes	Plants, Seed
Nutsedge/ chufa	Cyperus esculentus	Grass-like	[2,3],4	FACW	Yes	Seed, Plants
Panicgrass, coastal	Panicum amarulum	Grass	3,4,[5,6]	FACU-	Yes	Seed, Plants
Partridge-berry	Mitchella repens	Groundcover	[4,5],6	FACU	No	Plants
Pennsylvania smartweed	Polygonum pensylvanicum	Annual	[2,3]	FACW	0-6"	Plants, Seed
Phlox, meadow	Phlox maculata	Perennial	[2,3,4]	FACW	Yes	Plants
Phlox, thick-leaf	Phlox carolina	Perennial	4,[5,6]	FACU	No	Plants
Pickerelweed	Pontederia cordata	Perennial	2,3	OBL	0-1'	Plants, Seed
Pondweed, long-leaf	Potamogeton nodosus	Perennial	[1,2]	OBL	1' min-6'	Plants
Pondweed, sago	Potamogeton pectinatus	Perennial	[1,2]	OBL	1' min-24'	Plants
Primrose, evening	Oenothera biennis	Perennial	4,[5,6]	FACU-	No	Seed
Reedgrass, bluejoint	Calamagrostis canadensis	Grass	1,[2,3]	FACW+	6", saturated	Seed, Plants
Reedgrass, wood	Cinna arundinacea	Perennial	2,[3,4]	FACW+	Yes	Plants, Seed
Rush, baltic	Juncus balticus	Grass	[2,3],4	FACW	Yes	Plants, Seed
Rush, bayonet	Juncus militaris	Grass-like	[2,3],4	OBL	Yes	Plants, Seed
Rush, blackgrass	Juncus gerardii	Grass-like	[2,3],4	FACW+	Yes, saltedge	Plants, Seed
Rush, Canada	Juncus canadensis	Grass-like	[1,2],3	OBL	Yes	Plants, Seed
Rush, needlegrass	Juncus roemerianus	Grass-like	[1,2],3	OBL	Yes, saltedge	Plants, Seed
Rush, soft	Juncus effusus	Grass-like	[2,3],4	FACW+	0-1	Plants, Seed
Saltgrass, seashore	Distichlis spicata	Grass	[2,3,],4	FACW+	Salt, edge	Plants
Sedge, awl	Carex stipata	Grass-like	[4,5],6	NI	No	Plants, Seed
Sedge, bearded	Carex comosa	Grass-like	[1,2],3	OBL	6" , saturated	Plants, Seed
Sedge, bladder	Carex intumescens	Grass-like	1,[2,3]	FACW+	Yes	Plants, Seed
Sedge, broom	Carex scoparia	Grass-like	[3,4],5	FACW	Yes	Plants, Seed
Sedge, fox	Carex vulpinoidea	Grass-like	[1,2],3	OBL	Sat. 0-6"	Plants, Seed
Sedge, fringed	Carex crinita	Grass-like	[1,2],3	OBL	Yes	Plants, Seed
Sedge, hop	Carex lupulina	Grass-like	[1,2],3	OBL	Yes	Seed
Sedge, lakebank	Carex lacustris	Grass-like	[1,2],3	OBL	Sat. 0-2	Plants, Seed
Sedge, pennsylvania	Carex pennsylvanica	Grass-like	[5,6]	NI	No	Plants
Sedge, shallow	Carex lurida	Grass-like	[1,2],3	OBL	Yes	Plants, Seed
Sedge, short's	Carex shortiana	Grass-like	3,[4,5]	FAC	Yes	Plants
Sedge, three-sided	Dulichium arundinaceum	Grass-like	1,[2,3]	OBL	Yes	Plants, Seed
Sedge, tussock	Carex stricta	Grass-like	[1,2],3	OBL	Sat, 0-6"	Plants, Seed
Sedge, yellow-fruit	Carex annectens	Grass-like	[2,3]4	FACW+	Yes	Plants, Seed
Seedbox	Ludwigia x lacustris	Annual	[1,2],3	OBL	Yes	Plants, Seed
Senna, Maryland	Cassia marilandica	Legume	3,[4,5]	FAC	Saturated	Seed

Common Name	Scientific Name	Plant Type	Hydrologic Zone	Wetland Indicator	Inundation Tolerance	Commercial Availability
Sneezeweed, common	Helenium autumnale	Perennial	[2,3],4	FACW+	Yes	Seed
Solomon's-seal, small	Polygonatum biflorum	Perennial	[4,5],6	FACU	No	Plants
Spikerush, blunt	Eleocharis obtusa	Grass-like	[1,2],3	OBL	0-6"	Plants
Spikerush, creeping	Eleocharis palustris	Grass-like	[1,2],3	OBL	Seasonal	Plants,Seed
Spikerush, square-stem	Eleocharis quadrangulata	Grass-like	[1,2],3	OBL	0-1'	Plants
St. John'swort, marsh	Triadenum virginicum	Perennial	[1,2],3	OBL	Yes	Seed
Swamp-loosestrife, hairy	Decodon verticillatus	Perennial	[1,2],3	OBL	Yes	Plants
Sweetflag	Acorus americanus	Perennial	1,[2,3]	OBL	Yes	Plants, Seed
Switchgrass	Panicum virgatum	Grass	2,[3,4],5	FAC	Seasonal	Seed & Plants
Turtlehead, red	Chelone obliqua	Perennial	[1,2],3	OBL	Yes	Plants
Turtlehead, white	Chelone glabra	Perennial	[1,2],3	OBL	Yes	Plants, Seed
Vervain, blue	Verbena hastata	Perennial	[2,3]4	FACW+	Yes	Plants, Seed
Virginia/riparian wild rye	Elymus virginicus/riparius	Grass	2,[3,4]	FACW-	Yes	Seed & Plants
Water-lily, white	Nymphaea odorata	Perennial	[1,2],3	OBL	1-3'	Plants
Water-lily, yellow (spatterdock)	Nuphars luteum	Perennial	[1,2],3	OBL	1-3'	Plants
Water-plantain	Alisma plantago-aquatica	Perennial	[2,3],4	OBL	Yes	Plants, Seed
Woolgrass	Scirpus cyperinus	Grass-like	[2,3],4	FACW	Yes	Plants, Seed

Table 7-10: Stormwater Plant List – Woody Vegetation

Common Name	Scientific Name	Form	Zone	Indicator	Inundation	Commercial Availability
Alder, brook-side	Alnus serrulata	Tree	[1,2],3	OBL	0-3"	Yes
Alder, speckled	Alnus rugosa	Tree	[2,3]	FACW+	Yes	Yes
Arrow-wood, southern	Viburnum dentatum	Shrub	[3,4],5	FAC	Seasonal	Yes
Ash, black	Fraxinus nigra	Tree	[2,3],4	FACW	Saturated	Yes
Ash, green	Fraxinus pennsylvanica	Tree	[2,3],4	FACW	Seasonal	Yes
Ash, white	Fraxinus americana	Tree	[4,5],6	FACU	No	Yes
Aspen, big-tooth	Populus grandidentata	Tree	[4,5,6]	FACU	No	Yes, limited
Aspen, quaking	Populus tremuloides	Tree	[4,5],6	FACU	Yes	Yes, limited
Azalea, dwarf	Rhododendron atlanticum	Shrub	[2,3,4],5	FAC	Yes	No
Azalea, smooth	Rhododendron arborescens	Shrub	[3,4],5	FAC	Yes	Yes
Azalea, swamp	Rhododendron viscosum	Shrub	[1,2,3],4	OBL	Seasonal	Yes
Basswood, American	Tilia americana	Tree	3,[4,5],6	FACU	No	Yes
Bayberry, northern	Myrica pennsylvanica	Shrub	[3,4],5	FAC	Seasonal	Yes
Bayberry, southern	Myrica cerifera	Shrub	2,[3,4],5	FAC	Reg.inunda	Yes
Beech, American	Fagus grandifolia	Tree	[4,5],6	FACU	No	Yes
Birch, gray	Betula populifolia	Tree	[3,4],5	FAC	Seasonal	Yes
Birch, river	Betula nigra	Tree	[2,3],4	FACW	Seasonal	Yes
Birch, yellow	Betula lutea	Tree	[3,4],5	FAC	Yes	No
Black gum, swamp tupelo	Nyssa sylvatica	Tree	1,[2,3]	FACW+	Seasonal	Yes
Black-haw	Viburnum prunifolium	Shrub	[3,4,5],6	FACU	Yes	Yes
Blueberry, bog	Vaccinium uliginosum	Shrub	2,3,4,5,6	FACU+	Yes	No
Blueberry, highbush	Vaccinium corymbosum	Shrub	[2,3]	FACW-	Seasonal	Yes
Blueberry, lowbush	Vaccinium angustifolium	Shrub	3,[4,5,6]	FACU-	No	Yes
Box-elder	Acer negundo	Tree	2,[3,4]	FAC+	Seasonal	Yes
Butternut	Juglans cinerea	Tree	[3,4,5,6]	FACU+	Yes	Yes
Buttonbush, common	Cephalanthus occidentalis	Shrub	[1,2],3	OBL	0-3'	Yes
Cedar, atlantic white	Chamaecyparis thyoides	Tree	[1,2],3	OBL	Saturated	Yes
Cedar, eastern red	Juniperus virginiana	Shrub	4,5,6	FACU	No	Yes
Cedar, northern white	Thuja occidentalis	Tree	[2,3],4	FACW	Seasonal	Yes
Cherry, black	Prunus serotina	Tree	[4,5],6	FACU	No	Yes
Cherry, choke	Prunus virginiana	Tree	4,5,6	FACU	Yes	Yes
Cotton-wood, eastern	Populus deltoides	Tree	[3,4],5	FAC	Seasonal	Yes
Dangle-berry	Gaylussacia frondosa	Shrub	2,[3,4],5	FAC	Yes	Yes, limited

Common Name	Scientific Name	Form	Zone	Indicator	Inundation	Commercial Availability
Dog-hobble, coastal	Leucothoe axillaris	Shrub	[2,3,4],5	FACW+	Yes	Yes, limited
Dogwood, flowering	Cornus florida	Shrub-Tree	4,5,6	FACU-	No	Yes
Dogwood, gray	Cornus racemosa	Shrub	[3,4],5	UPL	Seasonal	Yes
Dogwood, redtwig	Cornus serecia	Shrub	1,2[3,4],5	FACW+	Yes	Yes
Dogwood, silky	Cornus amomum	Shrub	[2,3],4	FACW	Seasonal	Yes
Elm, slippery	Ulmus rubra	Tree	[3,4],5	FAC	Yes	Yes
Fetterbush	Leucothoe racemosa	Shrub	3,[4,5],6	FACW	Yes	Yes, limited
Fetter-bush	Lyonia lucida	Shrub	[2,3,4],5	FACW	Yes	Yes, limited
Germander, American	Teucrium canadense	Shrub	[2,3,4],5	FACW	Yes	No
Groundsel tree	Baccheris halimifolia	Shrub	[2,3],4	FACW	0-6"	Yes
Gum, sweet	Liquidambar styraciflua	Tree	[3,4],5	FAC	Yes	Yes
Hackberry, common	Celtis occidentalis	Shrub-Tree	4,5,6	FACU	Seasonal	Yes
Hawthorn, cockspur	Crataegus crus-galli	Tree	2,[3,4,5],6	FACU	Yes	No
Hawthorn, downy	Crataegus mollis	Tree	1,2,[3,4,5]	FACU	Yes	Yes, limited
Hawthorn, parsley	Crataegus marshallii	Tree	[1,2,3,4],5,	FACU+	Yes	Yes, limited
Hazel-nut, American	Corylus americana	Shrub	3,[4,5,6]	FACU-	No	Yes
Hazel-nut, beaked	Corylus cornuta	Shrub	3,[4,5,6]	FACU-	No	No
Hemlock, eastern	Tsuga canadensis	Tree	4,5,6	FACU	No	Yes
Hickory, big shellbark	Carya laciniosa	Tree	[3,4],5	FAC	Yes	Yes
Hickory, bitter-nut	Carya cordiformis	Tree	4,[5,6]	FACU+	No	Yes
Hickory, pecan	Carya illinoensis	Tree	[4,5],6	FACU	Yes	Yes
Hickory, red	Carya ovalis	Tree	4,[5,6]	FACU-	No	No
Hickory, shag-bark	Carya ovata	Tree	4,[5,6]	FACU-	Yes	Yes
Hickory, sweet pignut	Carya glabra	Tree	[4,5],6	FACU-	No	No
Holly, American	Ilex opaca	Shrub	4,5,6	FACU	Limited	Yes
Holly, deciduous	Ilex decidua	Shrub	1,[2,3,4,5]	FACW-, FACW	Seasonal	Yes
Hop-hornbeam, eastern	Ostrya virginiana	Shrub-Tree	[3,4,5,6]	FACU-	Seasonal	Yes
Hornbeam, American	Carpinus caroliniana	Tree	[3,4],5	FAC	Some	Yes
Huckleberry, black	Gaylussacia baccata	Shrub	3,[4,5],6	FACU	No	No
Huckleberry, dwarf	Gaylussacia dumosa	Shrub	2,[3,4],5	FAC	Yes	No
Hydrangea, wild	Hydrangea arborescens	Shrub	3,[4,5,6]	UPL, FACU	No	No
Inkberry	Ilex glabra	Shrub	[2,3],4	FACW-	Seasonal	Yes
Laurel, mountain	Kairnia latifolia	Shrub	4,5,6	FACU	No	Yes
Locust, black	Robinia pseudoacacia	Tree	4,[5,6]	FACU	Yes	Yes
Magnolia, sweet bay	Magnolia virginiana	Tree	[3,4],5	FAC	Yes	Yes
Maleberry	Lyonia ligustrina	Shrub	[2,3,4],5	FACW	Yes	Yes, limited
Maple, mountain	Acer spicatum	Tree	4,5,6	FACU	No	No
Maple, red	Acer rubrum	Tree	[3,4],5	FAC	Seasonal	Yes
Maple, silver	Acer saccharinum	Tree	[2,3],4	FACW	Seasonal	Yes

Common Name	Scientific Name	Form	Zone	Indicator	Inundation	Commercial Availability
Maple, striped	Acer pensylvanicum	Shrub-Tree	3,[4,5,6]	FACU	No	No
Marsh elder	Iva frutescens	Shrub	1,[2,3]	FACW+		Yes
Meadow-sweet, broad-leaf	Spiraea latifolia	Shrub	[2,3,4]	FACW+	Yes	Yes
Meadow-sweet, narrow-leaf	Spiraea alba	Shrub	[1,2,3,4],5	FACW+	Yes	No
Nannyberry	Vi burn urn lentago	Shrub	[3,4],5	FAC	Seasonal	Yes
Ninebark, eastern	Physocarpus opulifolius	Shrub	[2,3],4	FACW-	Yes	Yes
Oak, bur	Quercus rnacrocarpa	Tree	3,[4,5],6	FAC-	Yes	Yes
Oak, chestnut	Quercus prinus	Tree	4,5,6	FACU	No	Yes
Oak, chinkapin	Quercus rnuhlenbergii	Tree	[3,4],5	FAC	Yes	Yes
Oak, overcup	Quercus lyrata	Tree	[1,2],3	OBL	Yes	Yes
Oak, pin	Quercus palustris	Tree	[2,3],4	FACW	Seasonal	Yes
Oak, post	Quercus stellata	Tree	3,[4,5,6]	NI	No	Yes, limited
Oak, red	Quercus rubra	Tree	6	FACU-	No	Yes
Oak, scarlet	Quercus coccinea	Tree	6		No	Yes
Oak, shumard	Quercus shumardii	Tree	2,[3,4]	FAC+	Yes	Yes
Oak, swamp chestnut	Quercus michauxii	Tree	1,[2,3,4,5]	FACW	Yes	Yes
Oak, swamp white	Quercus bicolor	Tree	1,[2,3]	FACW+	Seasonal	Yes
Oak, water	Quercus nigra	Tree	[3,4],5	FAC	Seasonal	Yes
Oak, white	Quercus alba	Tree	[4,5,6]	FACU	Yes	Yes
Oak, willow	Quercus phellos	Tree	2,[3,4]	FAC+	Seasonal	Yes
Pepper-bush, sweet	Clethra alnifolia	Shrub	2[3,4]	FAC+	Seasonal	Yes
Pine, eastern white	Pinus strobus	Tree	4,5,6	FACU	No	Yes
Pine, loblolly	Pinus taeda	Tree	3,[4,5],6	FAC-	Seasonal	Yes
Pine, pitch	Pinus rigida	Tree	4,5,6	FACU	Seasonal	Yes
Pine, pond	Pinus serotina	Tree	[1,2],3	OBL	Yes	No
Pine, virginia	Pinus viginiana	Tree	6		No	Yes
Redbud, eastern	Cercis canadensis	Shrub-Tree	3[4,5,6]	UPL, FACU	No	Yes
Rh000dendron, rosebay	Rhododendron maximum	Shrub	[3,4],5	FAC	Yes	No
Rhododendron	Rhododendron canadense	Shrub	1,[2,3,4],5	FACW	Yes	Yes, limited
Rose, pasture	Rosa carolina	Shrub	[5,6]	NI	No	Yes
Rose, swamp	Rosa palustris	Shrub	[2,3]4	OBL	Yes	Yes
Rose, virginia	Rosa virginiana	Shrub	[3,4]5	FAC	Seasonal	Yes
Rosemary, bog	Andromeda polifolia	Shrub	[1,2],3	OBL	Yes	No
Sand-myrtle	Leiophyllum buxifolium	Shrub	3,4[5,6]	FACU-	No	No
Sassafras	Sassafras albidum	Tree	3,[4,5,6]	FACU-	No	Yes
Service-berry, downy	Amelanchier arborea	Shrub-Tree	2,[3,4,5]	FAC-	Yes	Yes
Sheep-laurel	Kalmia angustifolia	Shrub	3,[4,5],6	FAC	Yes	Yes

Common Name	Scientific Name	Form	Zone	Indicator	Inundation	Commercial Availability
Silver-berry, American	Elaeagnus commutata	Shrub	[6]	NI	No	No
Stagger-bush, piedmont	Lyonia mariana	Shrub	[3,4],5,6	FAC-	Yes	Yes, limited
Steeple-bush	Spiraea tomentosa	Shrub	1,[2,3,4],5	FACW	Yes	Yes
Strawberry-bush, American	Euonymus americanus	Shrub	1,[2,3,4,5]	FAC	Yes	Yes
Sugar-berry	Celtis laevigata	Shrub	1,[2,3,4,5],6	FACW	Yes	Yes
Sycamore, amer1can	Platanus occidentalis	Tree	[2,3],4	FACW-	Saturated	Yes
Teaberry	Gaultheria procumbens	Shrub	3,[4,5],6	FACU	No	Yes
Tree, tulip	Liriodendron tulipifera	Tree	[4,5],6	FACU	Yes	Yes
Viburnum, maple-leaf	Viburnum acerifolium	Shrub	3,[4,5,6]	NI	No	Yes
Viburnum, possum-haw	Viburnum nudum	Shrub	[1,2],3	OBL	Yes	Yes
Willow, black	Salix nigra	Tree	[2,3]	FACWI-	Seasonal	Yes
Willow, pussy	Salix discolor	Shrub	[2,3],4	FACW	Yes	Yes
Willow, silky	Salix sericea	Shrub	[1,2],3	OBL	Yes	Yes
Willow, tall prairie	Salix humilis	Shrub	3,[4,5],6	FACU	No	No
Willow, virginia	Itea virginica	Shrub	[1,2],3	OBL	0-6~	Yes
Winterberry, common	Ilex verticillata	Shrub	1,[2,3]	FACW+	Seasonal	Yes
Witch-alder, dwarf	Fothergilla gardenii	Shrub	1,[2,3,4],5	FACW	Yes	Yes
Witch-hazel, American	Hamamelis virginiana	Shrub-Tree	3,[4,5],6	FAC-	No	Yes
Withe-rod	Viburnum cassinoides	Shrub	1,[2,3,4],5	FACW	Yes	Yes
Yew, American	Taxus canadensis	Shrub	[3,4,5],6	FAC	Yes	Yes

References

The following is a list of resources used in compiling these guidelines and lists of plant materials, including references from the Maryland Stormwater Design Manual, from which some parts were adopted.

American Nursery and Landscape Association. 1996. American Standard for Nursery Stock. Washington, D.C.

Art, Henry W. 1986. A Garden of Wildflowers, 101 Native Species and How to Grow Them. Storey Communications, Inc. Pownal, VT.

Bentrup, G and J.C. Hoag. 1998. The practical streambank bioengineering guide: a user's guide for natural streambank stabilization techniques in the arid and semi-arid west. USDA-NRCS Plant Materials Center.

Carlson, J.R. 1992. "Selection, production, and use of riparian plant materials for the Western United States." Intermountain Forest Nursery Association, T. Landis, compiler, USDA for. Serv. Gen. Tech. Rep. RM-211, Fort Collins, CO.

Clausen, Ruth Rogers and Ekstrom, Nicolas, H. 1989. Perennials for American Gardens. Random House. New York, NY.

Claytor, Richard A. and Schueler, Thomas R. 1997. Design of Stormwater Filtering Systems: Appendix B and C. Chesapeake Bay Consortium. Silver Spring, MD.

Dirr, Michael A. 1990. Manual of Woody Landscape Plants, Their Identification, Ornamental Characteristics, Culture, Propagation, and Uses. 4th Edition. Stipes Publishing Company. Champaign, IL.

Engineering Technology Associates Inc. and Biohabitats, Inc. (ETA&B). 1993. Design Manual for Use of Bioretention in Stormwater Management. Prince Georges County Dept. of Environmental Resources. Upper Marlboro, MD.

Fournier, Michael. 1996. Observations of Wetland Species. Wetland Technical Note. USDA-NRCS, Cape May Plant Materials Center.

Fournier, Michael, Glennon, Robert, Miller, C.F. 1996. Interspecies Competition of Native Wetland Plants. Society for Ecological Restoration International Meeting-poster presentation. Rutgers University.

Greenlee, John. 1992. The Encyclopedia of Ornamental Grasses, How to Grow and Use Over 250 Beautiful and Versatile Plants. Rodale Press. Emmaus, PA.

Grelsson, G. and C. Nilsson. 1991. Vegetation and seed-bank relationships on lakeshores. Freshwater Biol. 26: 199-207.

Hammer, D.A. 1992. Creating Freshwater Wetlands. Lewis Publishers, Boca Raton, FL.

Hill, Steven R. and Duke, Peggy K. 1985-86. 100 Poisonous Plants of Maryland. Bulletin No. 314. University of Maryland Cooperative Extension Services. Ellicott City, MD.

Hoag, J.C. 1994. Seed collection and hydrology of six different species of wetland plants. USDA NRCS Plant Materials Center, Riparian/Wetland Project Information Series 6, Aberdeen, ID.

Hoag, J.C. and M.E. Sellers. 1995. Use of greenhouse propagated wetland plants versus live transplants to vegetate constructed or created wetlands. USDA NRCS Plant Materials Center, Riparian/Wetland Project Information Series 7, Aberdeen, ID.

Hoag, J.C. and T.A. Landis. (Manuscript in preparation) 2000. Plant Materials for Riparian Revegetation. Native Plant Journal, Vol. 2, Issue 1, January 2001.

Hoag, J.C., M. Sellers and M. Zierke. 1992. Interagency Riparian/Wetland Plant Development Project: 4th quarter FY1992 progress report. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID.

Hoag, J.C., M.E. Sellers, and M. Zierke. 1995. Wetland plant propagation tips. View from a wetland, No. 1 (1994-1995). USDA NRCS Plant Materials Center, Riparian/Wetland Project Newsletter, Aberdeen, ID.

Hough, Mary Y. 1983. New Jersey Wild Plants. Harmony Press. Harmony, NJ.

Leck, M.A. 1989. Wetland seed banks. In: Ecology of Soil Seed Banks, Leck, M.A., V.T. Packer, and R.L. Simpson (eds.), Academic Press, Inc.: San Diego, CA. p. 283-305.

Longenecker, G. 1983. Woody Plant List for West Virginia. Landscape Architecture Department, Division of Resource Management, West Virginia University. Morgantown, WV.

Manning, M.E., S.R. Swanson, T. Svejcar, and J. Trent. 1989. Rooting characteristics of four intermountain meadow community types. Journal of Range Management 42:309-312.

Maryland Natural Heritage Program, Department of Natural Resources. 1994. Invasive and Exotic Plants of Wetlands and Floodplains in Maryland. Maryland Natural Heritage Program, Department of Natural Resources, Tawes State Office Building. Annapolis, MD.

Maryland Natural Heritage Program, Department of Natural Resources. 1994. Rare Species of Submerged Aquatic Vegetation in Maryland. Maryland Natural Heritage Program, Department of Natural Resources, Tawes State Office Building. Annapolis, MD.

Miles, B. 1996. Wildflower Perennials for Your Garden, A Detailed Guide to Years of Bloom from America's Native Heritage. Stackpole Books. Mechanicsburg, PA.

Newcomb, L. 1977. Newcomb's Wildflower Guide. Little Brown and Company. Boston, MA.

New Jersey Department of Agriculture, July, 1999, Standards for Soil Erosion and Sediment Control in New Jersey, New Jersey Department of Agriculture, Trenton, NJ.

Ogle, D. and J.C. Hoag. 2000. Stormwater plant materials, a resource guide. Detailed information on appropriate plant materials for Best Management Practices. City of Boise, Public Works Department, Boise, ID.

Robichaud, Beryl and Anderson, Karl 1994, Plant Communities of New Jersey, Rutgers University Press, New Brunswick, NJ.

Robichaud, Beryl and Murray F. Buell. 1973. Vegetation of New Jersey: a study of landscape diversity. New Brunswick, N.J.: Rutgers University Press.

Reed, Porter B. Jr. 1998. National List of Plant Species that Occur in Wetlands: Northeast (Region 1), For National Wetlands Inventory. U.S. Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C.

Salisbury, E. 1970. The pioneer vegetation of exposed muds and its biological features. Phil. Trans. Royal Soc. London, Ser. B 259: 207-255.

Schueler, Thomas R. 1996. Design of Stormwater Wetland Systems: Guidelines for Creating Diverse and Effective Stormwater Wetland Systems in the Mid-Atlantic Region. Department of Environmental Programs Metropolitan Washington Council of Governments, Metropolitan Information Center. Washington, D.C.

Schueler, Thomas R. 1992. Design of Stormwater Wetland Systems: Guidelines for Creating Diverse and Effective Stormwater Wetlands in the Mid-Atlantic Region. Department of Environmental Programs Metropolitan Washington Council of Governments, Metropolitan Information Center. Washington, D.C.

Schueler, Thomas R. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Department of Environmental Programs Metropolitan Washington Council of Governments, Metropolitan Information Center. Washington, D.C.

Schueler, Thomas R. and Claytor, Richard A. 2000. Maryland Stormwater Design Manual. Maryland Department of the Environment. Baltimore, MD.

The Pennsylvania State University, College of Agriculture, Cooperative Extension Service. Weed Identification. File No. IVC9 10M386, U. Ed. 85-439 and File No. IVC9 10M587 U.Ed. 86-356. The Pennsylvania State University, College of Agriculture, Cooperative Extension Service. University Park, PA.

Thunhorst, Gwendolyn A. 1993. Wetland Planting Guide for the Northeastern United States: Plants for Wetland Creation, Restoration, and Enhancement, Environmental Concern, Inc. St. Michael, MD.

Tiner, Ralph W. Jr. 1988. Field Guide to Non-Tidal Wetland Identification. U.S. Fish and Wildlife Service and New Jersey Department of Natural Resources and New Jersey Geological Survey. Annapolis, MD.

USDA-Natural Resources Conservation Service & Environmental Protection Agency. A Handbook of Constructed Wetlands. Vol. 1 General Considerations and Vol. 5 Stormwater. Interagency Core Group.

USDA-Natural Resources Conservation Service. 2003. Wetland Restoration, Enhancement, and Management Handbook. Wetland Science Institute.

New Jersey Stormwater
Best Management Practices Manual

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CHAPTER 8

Maintenance and Retrofit of Stormwater Management Measures

Maintenance of Stormwater Management Measures

Research and experience have demonstrated that regular and thorough maintenance is necessary for stormwater management measures to perform effectively and reliably. They have also demonstrated that failure to perform such maintenance can lead to diminished performance, deterioration, and failure, in addition to a range of health and safety problems including mosquito breeding, vermin, and the potential for drowning. The potential for such problems to develop is accentuated by many of the very features and characteristics that allow stormwater management measures to do their job, including standing or slowing moving water, dense vegetation, forebays, trash racks, dams, and the need to continually function in all types of weather. As implied by their name, stormwater management measures are also expected to become the repositories for sediment, nutrients, trash, debris, and other pollutants targeted by the NJDEP Stormwater Management Rules. For this reason, stormwater management measures share maintenance requirements with more mundane items as vacuum cleaner bags, car motor filters, and floor mats, all of which require regular inspection and cleaning, sediment and debris removal, and periodic replacement.

In recognition of these needs and potential problems, the NJDEP Stormwater Management Rules require that a maintenance plan be developed for all stormwater management measures incorporated into the design of a major development. This maintenance plan must contain specific preventative and corrective maintenance tasks, schedules, cost estimates, and the name, address, and telephone number of the person or persons responsible for the measures' maintenance.

In accordance with the Rules, this section of Chapter 8 has been developed to provide guidelines for the development of such maintenance plans. Specific maintenance guidance for structural stormwater management measures is presented in *Chapter 9: Structural Stormwater Management Measures*. Additional maintenance information is also provided in the NJDEP Stormwater Management Facility Maintenance Manual, including maintenance tasks and equipment, inspection procedures and schedules, ownership responsibilities, and design recommendations to minimize and facilitate inspection and maintenance tasks.

Finally, it should be noted that a stormwater management measure that includes a dam as defined in the NJDEP Dam Safety Standards at N.J.A.C. 7:20 must also have an operations and maintenance manual for the dam as described at 7:20-1.11.

Maintenance Plan Contents

According to the NJDEP Stormwater Management Rules, all maintenance plans for stormwater management measures must include the following:

1. The name, address, and telephone number of the person or persons responsible for the preventative and corrective maintenance of the stormwater management measure. If the plan identifies a party other than the owner or developer as having responsibility for maintenance, i.e., a public entity or homeowners' association, the plan must include a copy of the other party's written agreement to assume this responsibility. This agreement must include a copy of any ordinance or regulation that requires the owner or developer to dedicate the stormwater management measure and/or its maintenance to the other party.
2. Specific preventative and corrective maintenance tasks such as removal of sediment, trash, and debris; mowing, pruning, and restoration of vegetation; restoration of eroded areas; elimination of mosquito breeding habitats; control of aquatic vegetation; and repair or replacement of damaged or deteriorated components. Detailed maintenance information for specific structural stormwater management measures is presented in Chapter 9. Maintenance needs of nonstructural measures are discussed in *Chapter 2: Low Impact Development Techniques*.
3. A schedule of regular inspections and tasks. Detailed inspection tasks and schedules for specific structural stormwater management measures are presented in Chapter 9.
4. Cost estimates of maintenance tasks, including sediment, trash, and debris removal.
5. Detailed logs of all preventative and corrective maintenance performed at the stormwater management measure, including all maintenance-related work orders.

In addition, as described in the NJDEP Stormwater Management Facility Maintenance Manual, the following items should also be included in the maintenance plan:

1. Maintenance equipment, tools, and supplies necessary to perform the various preventative and corrective maintenance tasks specified in the plan. Sources of specialized, proprietary, and nonstandard equipment, tools, and supplies should also be provided.
2. Recommended corrective responses to various emergency conditions that may be encountered at the stormwater management measure. It should be noted that, if the stormwater management measure includes a Class I or II dam as defined in the NJDEP Dam Safety Standards at N.J.A.C. 7:20, an emergency action plan for the dam is also required. See N.J.A.C. 7:20-1.7(f) for more information.
3. Maintenance, repair, and replacement instructions for specialized, proprietary, and nonstandard measure components, including manufacturers' product instructions and user manuals.
4. Procedures and equipment required to protect the safety of inspection and maintenance personnel.
5. Approved disposal and recycling sites and procedures for sediment, trash, debris, and other material removed from the measure during maintenance operations.
6. Originals or copies of manufacturers' warranties on pertinent measure components.
7. As-built construction plans of the stormwater management measure and copies of pertinent construction documents such as laboratory test results, permits, and completion certificates.

Maintenance Plan Considerations

In addition to the plan contents described above, a maintenance plan should address the following important aspects of stormwater management measure maintenance.

Access

All stormwater management measures' components must be readily accessible for inspection and maintenance. Therefore, trees, shrubs, and underbrush must be pruned or trimmed as necessary to maintain access to the stormwater management measure via roadways, paths, and ramps. This includes paths through perimeter vegetation to permanent pools, aquatic benches, and safety ledges to allow for the inspection and control of mosquito breeding. In addition, the exact limits of inspection and maintenance easements and rights-of-way should be specified on stormwater management measure plans and included in the maintenance plan.

Training of Maintenance Personnel

Maintenance training begins with a basic description of the purpose and function of the overall stormwater management measure and its major components. Such understanding will enable maintenance personnel to provide more effective component maintenance and more readily detect maintenance-related problems. Depending on the size, character, location, and components of a stormwater management measure, maintenance personnel may also require training in specialized inspection and maintenance tasks and/or the operation and care of specialized maintenance equipment. Training should also be provided in the need for and use of all required safety equipment and procedures.

Aesthetics

The impacts of the aesthetics of the stormwater management measures on the surrounding community should be included in the consideration for the design and selection of the stormwater management measure.

Required Maintenance Plan Procedures

Once the maintenance plan is completed, the NJDEP Stormwater Management Rules require that the following procedures be followed:

1. Copies of the maintenance plan must be provided to the owner and operator of the stormwater management measure. Copies must also be submitted to all reviewing agencies as part of each agency's approval process. In addition, a copy should be provided to the local mosquito control or extermination commission upon request.
2. The title and date of the maintenance plan and the name, address, and telephone number of the person with stormwater management measure maintenance responsibility as specified in the plan must be recorded on the deed of the property on which the measure is located. Any change in this information due, for example to a change in property ownership, must also be recorded on the deed.
3. The person with maintenance responsibility must evaluate the maintenance plan for effectiveness at least annually and revise as necessary.
4. A detailed, written log of all preventative and corrective maintenance performed at the stormwater management measure must be kept, including a record of all inspections and copies of maintenance-related work orders.
5. The person with maintenance responsibility must retain and, upon request, make available the maintenance plan and associated logs and other records for review by a public entity with administrative, health, environmental, or safety authority over the site.

Retrofit of Existing Stormwater Management Measures

Retrofitting can be defined as expanding, modifying, or otherwise upgrading existing stormwater management measures. As such, retrofitting stormwater management measures can reduce some of the adverse groundwater recharge and stormwater quantity and quality impacts caused by existing land developments. In many instances, existing stormwater management measures can be dramatically improved, and downstream water bodies protected, through effective retrofitting.

Beginning in the 1970s, many new developments were constructed with stormwater detention facilities. Many of these facilities were built to control the stormwater quantity impacts of 10-year, 25-year, and/or 100-year storms. However, smaller storm events that are typically responsible for the majority of stormwater quality and streambank erosion problems may not have been addressed. Therefore, retrofitting such facilities to also control these smaller storm events can begin to address these problems.

Another important benefit of retrofitting stormwater management facilities is the opportunity to correct site nuisances, maintenance problems, and aesthetic concerns. Retrofitting also allows a community to keep pace with new stormwater management regulations or objectives. It can help a community address a particular stormwater quantity or quality problem that has developed as a result of deficiencies in its existing or past stormwater regulations or a problem that has been identified through a regional plan or TMDL. Addressing such problems through the construction of new stormwater management measures at future land developments may be impractical or even impossible, leaving retrofitting as the only effective technique.

In addition to such basic considerations as need and cost, three important factors must be considered when evaluating retrofit possibilities: health and safety, effectiveness, and maintenance. All three should be thoroughly reviewed before undertaking a stormwater management measure retrofit to help justify the cost and effort and ensure the retrofitted measure's long-term success.

Health and Safety

A retrofit must not increase health and safety risks in any way. For example, the storage volume in an existing detention basin presently used for stormwater quantity control must not be reduced to provide new stormwater quality enhancement without ensuring that the lost quantity storage will not adversely increase peak basin outflows and cause downstream flooding or erosion. Similarly, an existing, well-functioning wet pond must not be converted to a constructed stormwater wetland for enhanced stormwater quality control if the potential for mosquito breeding will increase significantly without adequate additional control measures.

Effectiveness

In many retrofit situations, it may not be possible to upgrade the stormwater management measure to meet all current groundwater recharge and stormwater quality and quantity standards. This means that relative performance improvements for a range of retrofits must be evaluated to determine which one represents the optimum combination of effectiveness, viability, and cost. As a result, the final retrofit selected for an existing stormwater measure will have to be based on its relative rather than absolute effectiveness. In such relative determinations, both the costs and benefits of the evaluated retrofits become more influential factors than when an absolute performance standard is used.

Maintenance

It should be expected that if a retrofit will increase a stormwater management measure's pollutant removal capability, it will also increase the rate and total volume of sediment, trash, debris, and other stormwater pollution that will accumulate in the measure. In addition, the chemical or biological composition of this sediment may be of significantly lower quality, and potentially either hazardous or toxic,

than the sediment previously captured. Finally, the retrofit may increase the number and/or complexity of components in an existing stormwater management measure. All of these factors can cause increases in the level, frequency, complexity, and/or cost of the present inspection and maintenance efforts performed at the stormwater management measure. Increased staffing, improved equipment, and more specialized training may be required to properly maintain the new, retrofitted measure. Therefore, the extent and impacts of any increased inspection and/or maintenance requirements should be determined and thoroughly evaluated.

Once a retrofit has been determined to be safe, effective, and manageable, two basic approaches can be followed: modify an existing stormwater management measure or construct a new or additional one. Basins designed primarily for flood control may be retrofitted to enhance stormwater quality and groundwater recharge benefits. For example, the pollutant removal rates of an existing detention basin can be improved by creating an extended detention wetland. However, as noted above, the retrofit must maintain the basin's existing flood and erosion control capabilities. As a result, the basin's total storage volume may need to be increased. In addition, new measures such as infiltration systems, permeable paving, and bioretention systems can be introduced at sites where the soil permeability and depth to the seasonal high water table are suitable. Areas for such new measures include parking lot islands, vacant land, and roadside swales.

In addition to structural measures, nonstructural stormwater management measures can be used to enhance the stormwater management of an existing development site. Roofs are one of the largest sources of concentrated runoff from commercial developments. Clean roof runoff can be directed by downspouts to a dry well, disconnecting a portion of the runoff from the storm sewer system and both reducing runoff volume and restoring groundwater recharge. Flat roofs can be retrofitted with vegetation, which can reduce the stormwater impacts of the building. Overflow parking areas and fire lanes can utilize pervious paving systems, which can also reduce runoff and enhance recharge. Vegetative filters can be incorporated into existing developments where runoff from paved or intensely managed turf areas can be discharged across the filters. This may require the removal or slotting of existing curbs along the edge of parking lots or roads. Parking lots with vegetated aisle dividers may be particularly amendable to this type of filter strip application.

In addition, catch basins and drain inlets that are part of a traditional curb and gutter stormwater collection system can be retrofitted with one of several different manufactured treatment devices that catch sediments, trash, organic matter, and other particulates. These proprietary devices are particularly useful in areas with limited space. Several varieties of manufactured treatment devices are available for installation at strategic locations near a discharge point or as a pre-treatment to an existing basin. Additional information regarding manufactured treatment devices is provided in *Chapter 9: Structural Stormwater Management Measures*.

Finally, education should be considered as a retrofit component. Control of household waste, fertilizers, and pesticides can dramatically reduce concentrations or problem pollutants that adversely affect downstream water quality. Prevention is most often the best method for eliminating pollutants from stormwater runoff. *Chapter 2: Low Impact Development Techniques* provides important information regarding stormwater pollution prevention.

References

Livingston E.H., H.E. Shaver, R.R. Horner and J.J. Skupien. May 1997. Institutional Aspects of Urban Runoff Management: A Guide for Program Development and Implementation. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

Livingston E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

Ocean County Planning and Engineering Departments and Killam Associates. June 1989. Stormwater Management Facilities Maintenance Manual. New Jersey Department of Environmental Protection. Trenton, NJ.

CHAPTER 9.0

Structural Stormwater Management Measures

This chapter presents specific planning, design, construction, and maintenance information about a range of structural stormwater management measures that may be used to address the groundwater recharge and stormwater quality and quantity requirements of the NJDEP Stormwater Management Rules at N.J.A.C. 7:8. The specific structural measures, also known as structural Best Management Practices (BMPs), included in this chapter are:

9.1 – Bioretention Systems

9.2 – Constructed Stormwater Wetlands

9.3 – Dry Wells

9.4 – Extended Detention Basins

9.5 – Infiltration Basins

9.6 – Manufactured Treatment Devices

9.7 – Pervious Paving Systems

9.8 – Rooftop Vegetated Cover (Reserved)

9.9 – Sand Filters

9.10 – Vegetative Filters

9.11 – Wet Ponds

Information regarding each BMP is presented in a separate subchapter, which consists of the following sections.

Definition – Most if not all BMPs are actually rather complex stormwater management systems that have multiple components and utilize several physical, chemical, and biological processes. In addition, many of these components and processes are shared by multiple BMPs. This can often cause confusion over where in the manual users can find information regarding a specific BMP. To prevent this confusion, the

Definition section provides a definitive description of the BMP, including its major components and processes. It also presents the BMP's adopted TSS removal rate.

Purpose – This section describes the uses for which the BMP is particularly suited. This includes groundwater recharge and runoff quality and quantity control as well as ancillary uses such as recreation, wildlife habitat, and open space preservation. This information is intended to help manual users decide whether a particular BMP is capable of meeting their project needs.

Conditions Where Practice Applies – In addition to sharing many components and processes, all BMPs also have unique features and requirements. These must be recognized and met during a BMP's planning, design, and review phases if the BMP is to provide effective, efficient, and enduring service. This section concisely presents these BMP features and requirements so that manual users can decide whether a particular BMP is appropriate for their project

Design Criteria – This section presents specific BMP design criteria that must be met for a particular BMP to achieve the TSS removal rates adopted in the Stormwater Management Rules at N.J.A.C. 7:8. The design criteria also provides the information necessary to address groundwater recharge and stormwater quantity performance standards. The criteria presented in this section vary with each BMP and can range from required runoff storage volumes to maximum drainage area size to minimum soil permeabilities.

Maintenance – Effective BMP performance requires regular and effective maintenance. In addition, the NJDEP Stormwater Management Rules require that all structural BMPs have a specific maintenance plan that must be followed by those responsible for its operation and maintenance. This section provides specific maintenance information which, in combination with *Chapter 8: Maintenance and Retrofit of Stormwater Management Measures,* can be used to develop such a plan and to help ensure the effective, efficient, and enduring service envisioned by the BMP designer.

Considerations – This section presents valuable information that should be considered during a particular BMP's planning, design, review and/or construction phases. While not mandatory, this information is intended to promote BMPs that comprehensively meet the expectations of their designers, reviewers, owners, and maintenance personnel.

Recommendations – As noted above, all BMPs have unique features, requirements, ancillary functions, and maintenance needs. This section identifies various factors that, while not necessarily a mandatory design criteria, should nevertheless be included in the development of a BMP's design whenever possible.

References – This section identifies the major published sources of technical information that were used by the NJDEP in the development of each BMP's subchapter.

Regarding references, it is important to note that the information presented in each BMP subchapter was developed not only from published sources, but also through detailed technical discussions held at numerous BMP Manual Technical and Advisory Committee meetings hosted by the NJDEP. The information and conclusions developed at these meetings reflect the technical knowledge of the committee members, which was derived, in part, from numerous published and unpublished sources.

In recognition of the continued growth of our stormwater management knowledge, it should also be noted that compliance with the NJDEP Stormwater Management Rules is not limited to the BMPs presented in this chapter. Other BMPs that possess similar levels of effectiveness, efficiency, and endurance may also be utilized provided that such levels can be similarly demonstrated.

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Best Management Practices Manual

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CHAPTER 9.1

Standard for Bioretention Systems

Definition

A bioretention system consists of a soil bed planted with native vegetation located above an underdrained sand layer. It can be configured as either a bioretention basin or a bioretention swale. Stormwater runoff entering the bioretention system is filtered first through the vegetation and then the sand/soil mixture before being conveyed downstream by the underdrain system. Runoff storage depths above the planting bed surface are typically shallow. The adopted TSS removal rate for bioretention systems is 90 percent.

Purpose

Bioretention systems are used to remove a wide range of pollutants, such as suspended solids, nutrients, metals, hydrocarbons, and bacteria from stormwater runoff. They can also be used to reduce peak runoff rates and increase stormwater infiltration when designed as a multi-stage, multi-function facility.

Conditions Where Practice Applies

Bioretention systems can be used to filter runoff from both residential and nonresidential developments. Runoff inflow should preferably be overland flow to prevent disturbance to the vegetation and soil bed. Concentrated inflow from a drainage pipe or swale must include adequate erosion protection and energy dissipation measures.

Bioretention systems are most effective if they receive runoff as close to its source as possible. They can vary in size and can receive and treat runoff from a variety of drainage areas within a land development site. They can be installed in lawns, median strips, parking lot islands, unused lot areas, and certain easements. They are intended to receive and filter storm runoff from both impervious areas and lawns.

A bioretention system must not be placed into operation until the contributing drainage area is completely stabilized. Therefore, system construction must either be delayed or upstream runoff diverted around the system until such stabilization is achieved. Such diversions must continue until stabilization is achieved. Additional information is provided in the section on Recommendations, Construction Specifications.

The elevation of the Seasonal High Water Table (SHWT) is critical to ensure proper functioning of the bioretention basin, and must be evaluated to ensure that the SHWT is at least 1 foot below the bottom of the bioretention basin's underdrain system during non-drought conditions. Finally, both the SHWT and the permeability of the soil below the system are critical for bioretention systems that utilize infiltration rather than an underdrain system. See *9.5 Infiltration Basins* for more information on the requirements and design of this type of bioretention system.

Finally, a bioretention system must have a maintenance plan and, if privately owned, should be protected by easement, deed restriction, ordinance, or other legal measures that prevent its neglect, adverse alteration, and removal.

Design Criteria

The basic design parameters for a bioretention system are its storage volume, the thickness, character, and permeability rate of its planting soil bed, and the hydraulic capacity of its underdrain. The system must have sufficient storage volume above the surface of the bed to contain the design runoff volume without overflow. The thickness and character of the bed itself must provide adequate pollutant removal, while the bed's permeability rate must be sufficient to drain the stored runoff within 72 hours. The underdrain must also have sufficient hydraulic capacity. Details of these and other design parameters are presented below. The components of a typical bioretention system are shown in Figure 9.1-1.

A. Storage Volume, Depth, and Duration

Bioretention systems shall be designed to treat the runoff volume generated by the stormwater quality design storm. Techniques to compute this volume are discussed in *Chapter 5: Computing Stormwater Runoff Rates and Volumes*. The maximum water depth during treatment of the stormwater quality design storm shall be 12 inches in a bioretention basin and 18 inches in a bioretention swale. The minimum diameter of any outlet or overflow orifice is 2.5 inches.

The bottom of a bioretention system, including any underdrain piping or gravel layer, must be a minimum of 1 foot above the seasonal high groundwater table. The planting soil bed and underdrain system shall be designed to fully drain the stormwater quality design storm runoff volume within 72 hours.

B. Permeability Rates

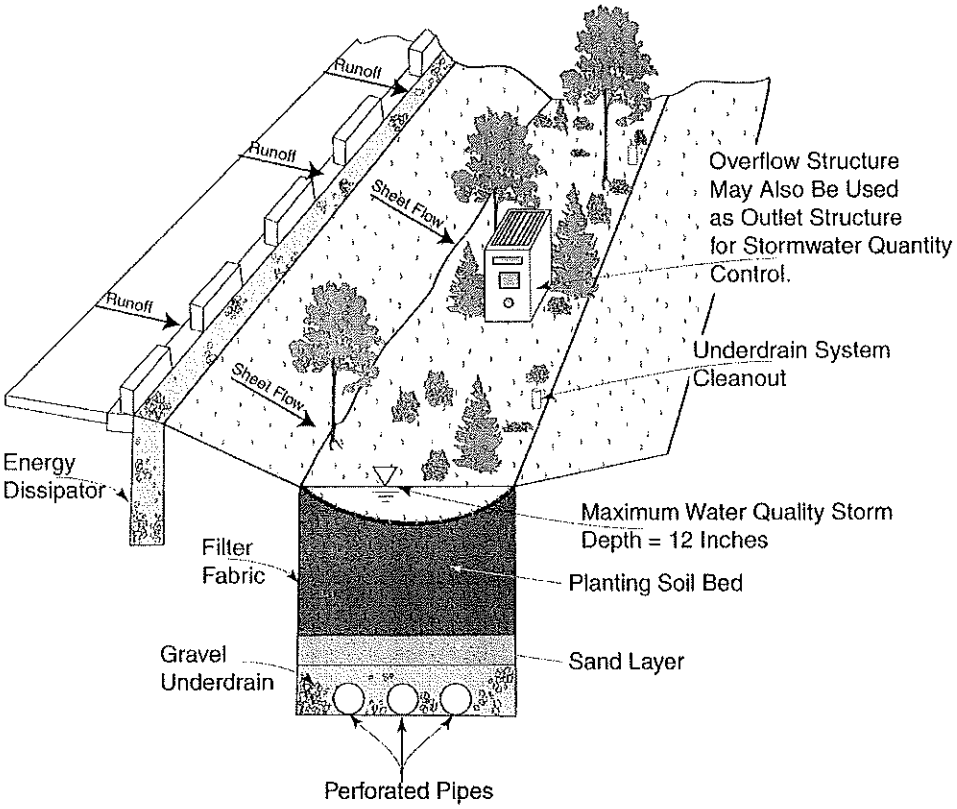
The design permeability rate through the planting soil bed must be sufficient to fully drain the stormwater quality design storm runoff volume within 72 hours. This permeability rate must be determined by field or laboratory testing. Since the actual permeability rate may vary from test results and may also decrease over time due to soil bed consolidation or the accumulation of sediments removed from the treated stormwater, a factor of safety of two shall be applied to the tested permeability rate to determine the design permeability rate. Therefore, if the tested permeability rate of the soil bed material is 4 inches/hour, the design rate would be 2 inches/hour (i.e., 4 inches per hour/2). This design rate would then be used to compute the system's stormwater quality design storm drain time.

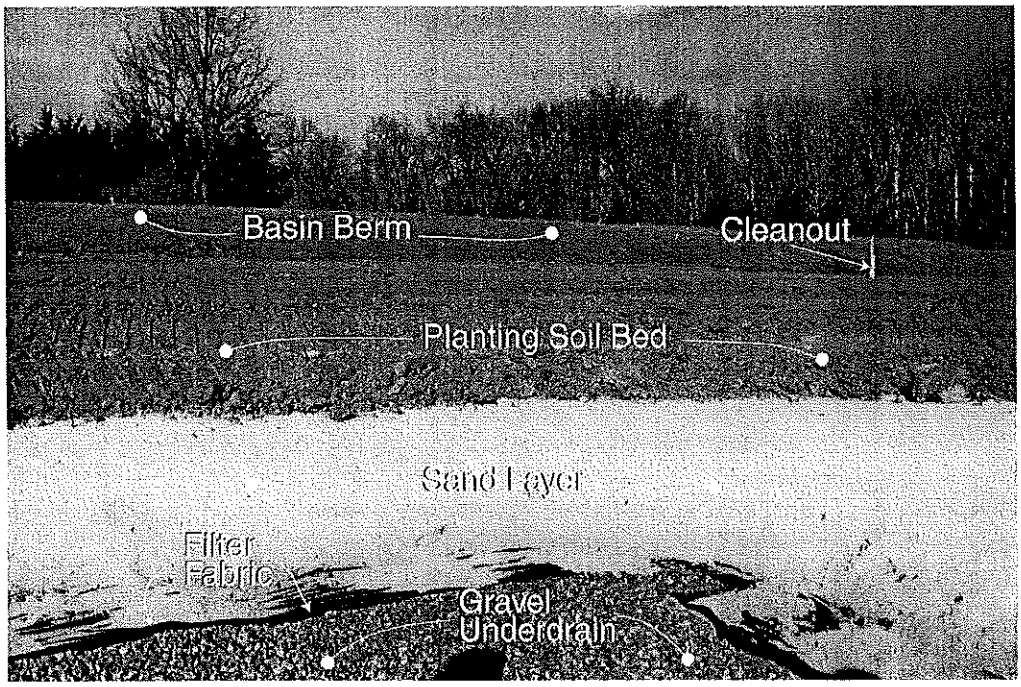
C. Planting Soil Bed

The planting soil bed provides the environment for water and nutrients to be made available to the vegetation. The soil particles can adsorb some additional pollutants through cation exchange, and voids within the soil particles can store a portion of the stormwater quality design storm runoff volume. The planting soil bed material should consist of 10 to 15 percent clays, a minimum 65 percent sands, with the balance as silts. The material's pH should range from 5.5 to 6.5. The material shall be placed in 12 to 18 inch lifts. The total depth or thickness of the planting soil bed should be a minimum of 3 feet.

As noted above, the design permeability rate of the soil bed material must be sufficient to drain the stormwater quality design storm runoff volume within 72 hours. Filter fabric should be placed along the sides of the planting soil bed to prevent the migration of soil particles from the adjacent soil into the planting soil bed.

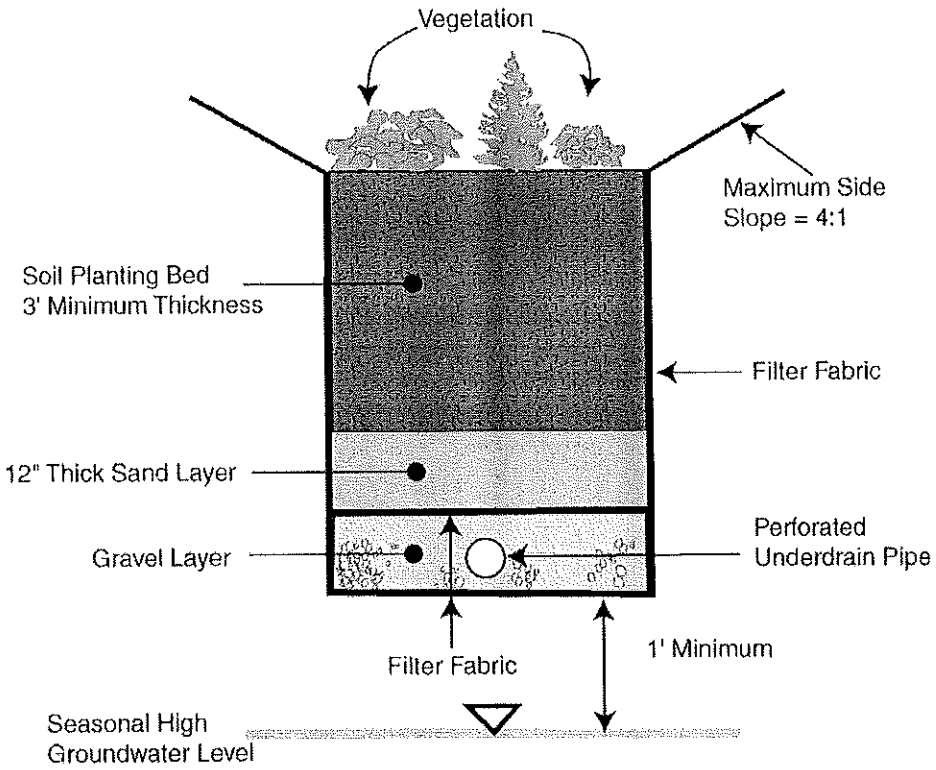
Figure 9.1-1: Bioretention System Components





This figure can be viewed in color in the PDF version of this chapter available at http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm
Source: Adapted from Claytor and Schueler, 1996.

Figure 9.1-2 Bioretention Systems Details



D. Vegetation

The vegetation in a bioretention system removes some of the nutrients and other pollutants in the stormwater inflow. The environment around the root systems breaks down some pollutants and converts others to less harmful compounds. The use of native plant material is recommended for bioretention systems wherever possible. The goal of the planting plan should be to simulate a forest-shrub community of primarily upland type. As there will be various wetness zones within a well-designed and constructed bioretention system, plants must be selected and placed appropriately. In general, trees should dominate the perimeter zone that is subject to less frequent inundation. Shrubs and herbaceous species that are adapted to moister conditions and expected pollutant loads should be selected for the wetter zones. The number of stems per acre should average 1,000, with tree spacing of 12 feet and shrub spacing of 8 feet.

E. Sand Layer

The sand layer serves as a transition between the planting soil bed and the gravel layer and underdrain pipes. It must have a minimum thickness of 12 inches and consist of clean medium aggregate concrete sand (AASSHTO M-6/ASTM C-33). To ensure proper system operation, the sand layer must have a permeability rate at least twice as fast as the design permeability rate of the planting soil bed.

F. Gravel Layer and Underdrain

The gravel layer serves as bedding material and conveyance medium for the underdrain pipes. It must have sufficient thickness to provide a minimum of 3 inches of gravel above and below the pipes. It should consist of 0.5 to 1.5 inch clean broken stone or pea gravel (AASHTO M-43).

The underdrain piping must be rigid Schedule 40 PVC pipe (AASHTO M-278) laid at a minimum slope of 0.50 percent. The portion of drain piping beneath the planting soil bed and sand layer must be perforated. All remaining underdrain piping, including cleanouts, must be nonperforated. All joints must be secure and watertight. Cleanouts must be located at the upstream and downstream ends of the perforated section of the underdrain and extend to or above the surface of the planting soil bed. Additional cleanouts should be installed as needed, particularly at underdrain pipe bends and connections. Cleanouts can also serve to drain standing water stored above clogged or malfunctioning planting soil beds.

The underdrain piping must connect to a downstream storm sewer manhole, catch basin, channel, swale, or ground surface at a location that is not subject to blockage by debris or sediment and is readily accessible for inspection and maintenance. Blind connections to downstream storm sewers are prohibited. To ensure proper system operation, the gravel layer and perforated underdrain piping must have a conveyance rate at least twice as fast as the design permeability rate of the sand layer.

G. Inflows

To reduce the potential for erosion, scour, and disturbance to vegetation, stormwater inflows to a bioretention system should occur as sheet flow where practical. Stone strips or aprons may be used at the downstream edge of upstream impervious surfaces to further dissipate sheet flow velocities and flow patterns. All points of concentrated inflow to a bioretention system must have adequate erosion protection measures designed in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey.

H. Overflows

All bioretention systems must be able to safely convey system overflows to downstream drainage systems. The capacity of the overflow must be consistent with the remainder of the site's drainage system and sufficient to provide safe, stable discharge of stormwater in the event of an overflow. Bioretention systems classified as dams under the NJDEP Dam Safety Standards at N.J.A.C. 7:20 must also meet the overflow requirements of these Standards. Overflow capacity can be provided by a hydraulic structure such as a drain inlet, weir, or catch basin, or a surface feature such as a swale or open channel as site conditions allow. See *Chapter 9.4: Standard for Extended Detention Basins* for details of outflow and overflow structures in multi-purpose bioretention systems that also provide stormwater quantity control.

I. Tailwater

The hydraulic design of the underdrain and overflow systems, as well as any stormwater quantity control outlets, must consider any significant tailwater effects of downstream waterways or facilities. This includes instances where the lowest invert in the outlet or overflow structure is below the flood hazard area design flood elevation of a receiving stream.

H. On-line and Off-line Systems

Bioretention systems may be constructed on-line or off-line. On-line systems receive upstream runoff from all storms, providing runoff treatment for the stormwater quality design storm and conveying the runoff from larger storms through an overflow. Multi-purpose on-line systems also store and attenuate these larger

storms to provide runoff quantity control. In such systems, the invert of the lowest stormwater quantity control outlet is set at or above the maximum stormwater quality design storm water surface. In off-line bioretention systems, most or all of the runoff from storms larger than the stormwater quality design storm bypasses the system through an upstream diversion. This not only reduces the size of the required system storage volume, but also reduces the system's long-term pollutant loading and associated maintenance.

Maintenance

Effective bioretention system performance requires regular and effective maintenance. *Chapter 8: Maintenance and Retrofit of Stormwater Management Measures* provides information and requirements for preparing a maintenance plan for stormwater management facilities, including bioretention systems. Specific maintenance requirements for bioretention systems are presented below. These requirements must be included in the system's maintenance plan.

A. General Maintenance

All bioretention system components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually as well as after every storm exceeding 1 inch of rainfall. Such components may include bottoms, trash racks, low flow channels, outlet structures, riprap or gabion aprons, and cleanouts.

Sediment removal should take place when the basin is thoroughly dry. Disposal of debris, trash, sediment, and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

B. Vegetated Areas

Mowing and/or trimming of vegetation must be performed on a regular schedule based on specific site conditions. Grass should be mowed at least once a month during the growing season. Vegetated areas must be inspected at least annually for erosion and scour. Vegetated areas should also be inspected at least annually for unwanted growth, which should be removed with minimum disruption to the planting soil bed and remaining vegetation.

When establishing or restoring vegetation, biweekly inspections of vegetation health should be performed during the first growing season or until the vegetation is established. Once established, inspections of vegetation health, density, and diversity should be performed at least twice annually during both the growing and non-growing seasons. The vegetative cover should be maintained at 85 percent. If vegetation has greater than 50 percent damage, the area should be reestablished in accordance with the original specifications and the inspection requirements presented above.

All use of fertilizers, mechanical treatments, pesticides and other means to assure optimum vegetation health should not compromise the intended purpose of the bioretention system. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

C. Structural Components

All structural components must be inspected for cracking, subsidence, spalling, erosion, and deterioration at least annually.

D. Other Maintenance Criteria

The maintenance plan must indicate the approximate time it would normally take to drain the maximum design storm runoff volume below the ground surface in the bioretention system. This normal drain time should then be used to evaluate the system's actual performance. If significant increases or decreases in the normal drain time are observed or if the 72 hour maximum is exceeded, the system's planting soil bed, underdrain system, and both groundwater and tailwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the system.

The planting soil bed at the bottom of the system should be inspected at least twice annually. The permeability rate of the soil bed material may also be retested. If the water fails to infiltrate 72 hours after the end of the storm, corrective measures must be taken.

Considerations

A. Optional Surface Mulch Layer

The mulch layer on the surface of the planting soil bed provides an environment for plant growth by maintaining moisture, providing microorganisms, and decomposing incoming organic matter. The mulch layer may also act as a filter for finer particles still in suspension and maintain an environment for the microbial community to help break down urban runoff pollutants. The mulch layer should consist of standard 1 to 2 inch shredded hardwood or chips. It should be applied to a depth of 2 to 4 inches and replenished as necessary. However, prior to utilizing a mulch layer, consideration should be given to problems caused by scour and floatation during storm events and the potential for mosquito breeding.

Recommendations

A. Site Considerations

The planning of a bioretention system should consider the topography and geologic and ecological characteristics of both the proposed system site and contiguous areas. Bioretention systems should not be planned in areas where mature trees would have to be removed or where Karst topography is present.

B. Construction

During basin construction, precautions must be taken to prevent planting soil bed compaction by construction equipment and sediment contamination by runoff. Basin excavation and planting soil placement should be performed with equipment placed outside the basin bottom whenever possible. Light earth moving equipment with oversized tires or tracks should be utilized when the basin must be entered.

Bioretention basins are susceptible to clogging and subsequent failure if significant sediment loads are allowed to enter the structure. Therefore, using a bioretention basin site for construction sediment control is discouraged. When unavoidable, excavation for the sediment basin should be a minimum of 2 feet above the final design elevation of the basin bottom. Sediment can then accumulate and be removed during site construction without disturbing the final basin bottom, which should be established only after all other construction within its drainage area is completed and the drainage area stabilized. If basin construction cannot be delayed until then and the basin will not be used for sediment control, diversion berms should be placed around the basin's perimeter during all phases of construction to divert all sediment and runoff

completely away from the basin. These berms should not be removed until all construction within the basin's drainage area is completed and the area stabilized.

To prevent compaction of the soil below the basin that will reduce its infiltration capacity, bioretention basins designed for infiltration (instead of an underdrain system) should be excavated with light earth moving equipment, preferably with tracks or over-sized tires located outside the basin bottom. Once the basin's final construction phase is reached, the floor of the basin must be deeply tilled with a rotary tiller or disc harrow and smoothed over with a leveling drag or equivalent grading equipment.

Upon stabilization of the bioretention basin and its drainage area, the infiltration rate of the planting soil bed must be retested to ensure that the rate assumed in the computations is provided at the basin. The permeability rate of the subsoil below the basin must also be retested after construction at bioretention basins that utilize infiltration rather than an underdrain system.

C. Pretreatment

As with all other best management practices, pretreatment can extend the functional life and increase the pollutant removal capability of a bioretention system. Pretreatment can reduce incoming velocities and capture coarser sediments, which will extend the life of the system. This is usually accomplished through such means as a vegetative filter, a forebay, or a manufactured treatment device. Information on vegetative filters and manufactured treatment devices is presented in Chapters 9.10 and 9.6, respectively.

Forebays can be included at the inflow points to a bioretention system to capture coarse sediments, trash, and debris, which can simplify and reduce the frequency of system maintenance. A forebay should be sized to hold the sediment volume expected between clean-outs.

References

Claytor, R. and T. Schueler. December 1996. Design of Stormwater Filtering Systems. The Center for Watershed Protection. Ellicott City, MD.

Livingston E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

Lucas, William C. March 2003. Draft Green Technology: The Delaware Urban Runoff Management Approach. TRC Omni Environmental Corporation.

New Jersey Department of Agriculture. November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.

Ocean County Planning and Engineering Departments and Killam Associates. June 1989. Stormwater Management Facilities Maintenance Manual. New Jersey Department of Environmental Protection. Trenton, NJ.

Pennsylvania Association of Conservation Districts, CH2MHill et al. 1998. Bioretention Standard and Specification, Pennsylvania Handbook of Best Management Practices for Developing Areas. Harrisburg, PA.

Schueler, Thomas R. and Richard A. Claytor. 2000. Maryland Stormwater Design Manual. Maryland Department of the Environment. Baltimore, MD.

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CHAPTER 9.2

Standard for Constructed Stormwater Wetlands

Definition

Constructed stormwater wetlands are wetland systems designed to maximize the removal of pollutants from stormwater runoff through settling and both uptake and filtering by vegetation. Constructed stormwater wetlands temporarily store runoff in relatively shallow pools that support conditions suitable for the growth of wetland plants. The adopted removal rate for constructed stormwater wetlands is 90 percent.

Purpose

Constructed stormwater wetlands are used to remove a wide range of stormwater pollutants from land development sites as well as provide wildlife habitat and aesthetic features. Constructed stormwater wetlands can also be used to reduce peak runoff rates when designed as a multi-stage, multi-function facility.

Conditions Where Practice Applies

Constructed stormwater wetlands require sufficient drainage areas and dry weather base flows to function properly. The minimum drainage area to a constructed stormwater wetland is 10 acres to 25 acres, depending on the type of wetland. See text below for details.

Constructed stormwater wetlands should not be located within natural wetland areas, since they will typically not have the same full range of ecological functions. While providing some habitat and aesthetic values, constructed stormwater wetlands are designed primarily for pollutant removal and erosion and flood control.

It is important to note that a constructed stormwater wetland must be able to maintain its permanent pool level. If the soil at the wetland site is not sufficiently impermeable to prevent excessive seepage, construction of an impermeable liner or other soil modifications will be necessary.

Finally, a constructed stormwater wetland must have a maintenance plan and, if privately owned, should be protected by easement, deed restriction, ordinance, or other legal measures that prevent its neglect, adverse alteration, and removal.

Design Criteria

The basic design parameters for a constructed stormwater wetland are the storage volumes within its various zones. In general, the total volume within these zones must be equal to the design runoff volume. An exception to this requirement is made for an extended detention wetland. In addition, the character, diversity, and hardiness of the wetland vegetation must be sufficient to provide adequate pollutant removal. Details of these and other design parameters are presented below.

Constructed stormwater wetlands typically consist of three zones: pool, marsh, and semi-wet. Depending upon their relative size and the normal or dry weather depth of standing water, the pool zone may be further characterized as either a pond, micropond, or forebay. Similarly, the marsh zone may be further characterized as either high or low marsh based again upon the normal standing water depth in each.

Depending on the presence and relative storage volume of the pool, marsh, and semi-wet zones, a constructed stormwater wetland may be considered to be one of three types: pond wetland, marsh wetland, or extended detention wetland. As described in detail below, a pond wetland consists primarily of a relatively deep pool with a smaller marsh zone outside it. Conversely, a marsh wetland has a greater area of marsh than pool zone. Finally, an extended detention wetland consists of both pool and marsh zones within an extended detention basin.

Table 9.2-1 below presents pertinent design criteria for each type of constructed stormwater wetland. As shown in the table, each type (i.e., pond, marsh, and extended detention wetland) allocates different percentages of the total stormwater quality design storm runoff volume to its pool, marsh, and semi-wet zones. In a pond wetland, this volume is distributed 70 percent to 30 percent between the pool and marsh zones. Conversely, in a marsh wetland, the total runoff volume is distributed 30 percent to 70 percent between the pool and marsh zones. Both of these zone volumes are based on their normal standing water level.

However, in an extended detention wetland, only 50 percent of the stormwater quality design storm runoff volume is allocated to the pool and wetland zones, with 40 percent of this amount (or 20 percent of the total stormwater quality design storm runoff volume) provided in the pool zone and 60 percent (or 30 percent of the total runoff volume) provided in the marsh zone. The remaining 50 percent of the stormwater quality design storm runoff volume is provided in the wetland's semi-wet zone above the normal standing water level, where it is temporarily stored and slowly released similar to an extended detention basin. As noted in Table 9.2-1, the detention time in the semi-wet zone of an extended detention wetland must meet the same detention time requirements as an extended detention basin. These requirements are presented in *Chapter 9.4: Standard for Extended Detention Basins*. The minimum diameter of any outlet orifice in all wetland types is 2.5 inches.

The components of a typical stormwater wetland are illustrated in Figure 9.2-1. Pertinent design criteria for each component are presented in Table 9.2-1. Additional details of each type of constructed stormwater wetland and the components of each are described below.

A. Pool Zone

Pools generally have standing water depths of 2 to 6 feet and primarily support submerged and floating vegetation. Due to their depths, support for emergent vegetation is normally limited. As noted above, the pool zone may consist of a pond, micropond, and/or forebay, depending on their relative sizes and depths. Descriptions of these pool types are presented below.

1. Pond

Ponds generally have standing water depths of 4 to 6 feet and, depending on the type, may comprise the largest portion of a constructed stormwater wetland. Ponds provide for the majority of particulate settling in a constructed stormwater wetland.

2. Micropond

In general, a micropond also has a standing water depth of 4 to 6 feet, but is smaller in surface area than a standard pond. A micropond is normally located immediately upstream of the outlet from a constructed stormwater wetland. At that location, it both protects the outlet from clogging by debris and provides some degree of particulate settling. Since a micropond does not provide the same degree of settling as a standard pond, it is normally combined with a larger area of marsh than a standard pond.

3. Forebay

Forebays are located at points of concentrated inflow to constructed stormwater wetlands. As such, they serve as pretreatment measures by removing coarser sediments, trash, and debris. They typically have normal standing water depths of 2 to 4 feet.

B. Marsh Zone

Marshes have shallower standing water depths than ponds, generally ranging from 6 to 18 inches. At such depths, they primarily support emergent wetland vegetation. As noted above, a marsh is classified as either a high or low marsh, depending on the exact depth of standing water.

1. Low Marsh

A low marsh has a standing water depth of 6 to 18 inches. It is suitable for the growth of several emergent wetland plant species.

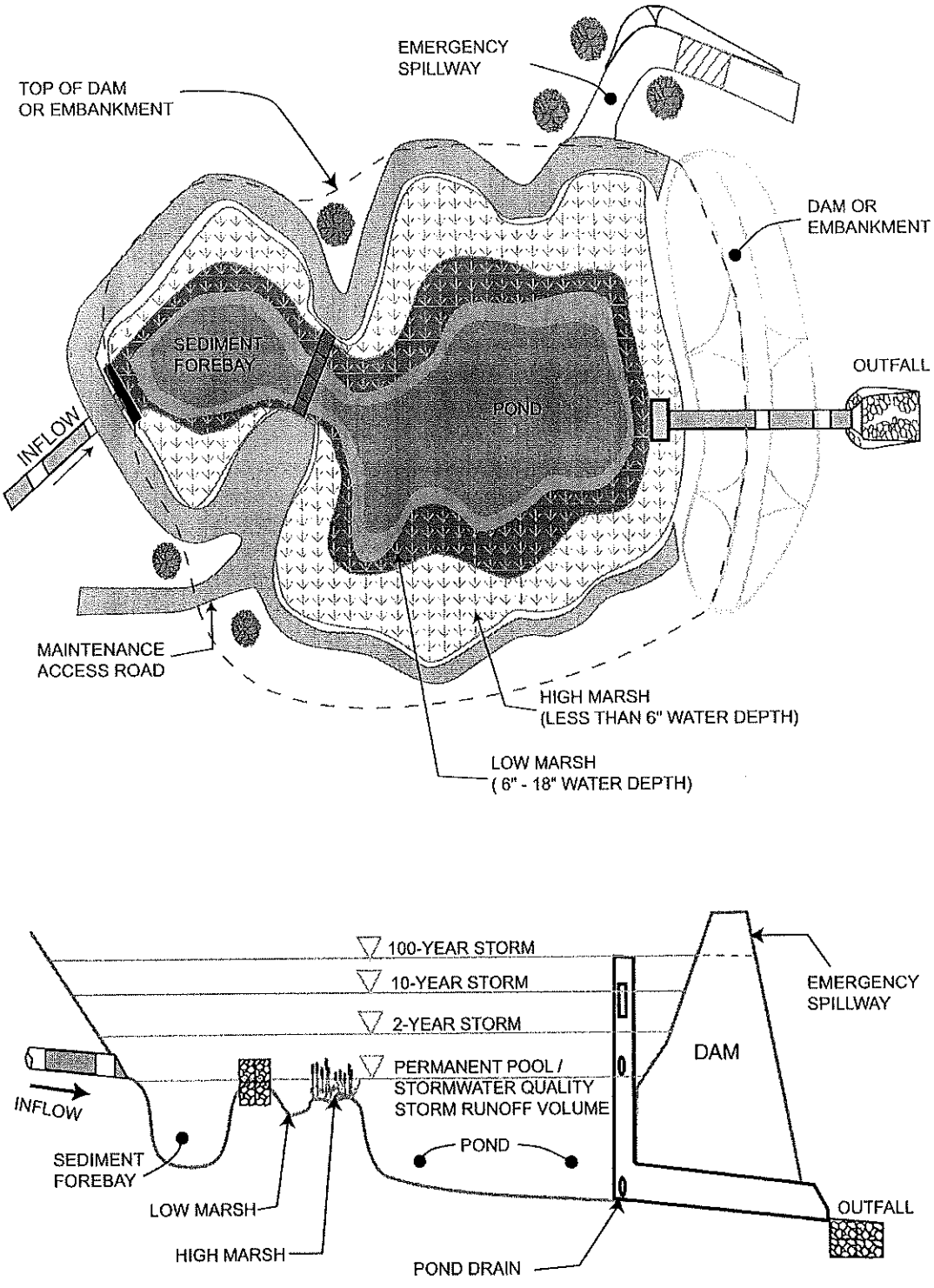
2. High Marsh

A high marsh has a maximum standing water depth of 6 inches. Due to its shallower depth, it will have a higher standing water surface area to volume ratio than a low marsh. It will normally support a greater density and diversity of emergent wetland species than a low marsh.

C. Semi-Wet Zone

The semi-wet zone in a constructed stormwater wetland is located above the pool and marsh zones and is inundated only during storm events. As a result, it can support both wetland and upland plants.

Figure 9.2-1: Constructed Stormwater Wetland Components



Source: Adapted from Schueler and Claytor 2000.

This figure can be viewed in color in the PDF version of this chapter available at http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

Table 9.2-1: Design Criteria for Constructed Stormwater Wetlands

Wetland Design Feature	Type of Constructed Stormwater Wetland		
	Pond	Marsh	Extended Detention
Minimum Drainage Area (Acres)	25	25	10
Minimum Length to Width Ratio	1:1	1:1	1:1
Allocation of Stormwater Quality Design Storm Runoff Volume (Pool / Marsh / Semi-Wet*)	70 / 30 / 0	30 / 70 / 0	20 / 30 / 50*
Pool Volume (Forebay / Micropond / Pond)	10 / 0 / 60	10 / 20 / 0	10 / 10 / 0
Marsh Volume (Low / High)	20 / 10	45 / 25	20 / 10
Sediment Removal Frequency (Years)	10	2 to 5	2 to 5
Outlet Configuration	Reverse-Slope Pipe or Broad Crested Weir	Reverse-Slope Pipe or Broad Crested Weir	Reverse-Slope Pipe or Broad Crested Weir

* In an Extended Detention Wetland, 50 percent of the stormwater quality design storm runoff volume is temporarily stored in the semi-wet zone. Release of this volume must meet the detention time requirements for extended detention basins (see text above and Chapter 9.4).

D. Types of Constructed Stormwater Wetlands

1. Pond Wetlands

Pond wetlands consist primarily of ponds with standing water depths ranging from 4 to 6 feet in normal or dry weather conditions. Pond wetlands utilize at least one pond component in conjunction with high and low marshes. The pond is typically the component that provides for the majority of particulate pollutant removal. This removal is augmented by a forebay, which also reduces the velocity of the runoff entering the wetland. The marsh zones provide additional treatment of the runoff, particularly for soluble pollutants.

Pond wetlands require less site area than marsh wetlands and generally achieve a higher pollutant removal rate than the other types of constructed stormwater wetland. See Table 9.2-1 for the relative stormwater quality design storm runoff volumes to be provided in each wetland component.

2. Marsh Wetlands

Marsh wetlands consist primarily of marsh zones with standing water depths ranging up to 18 inches during normal or dry weather conditions. These zones are further configured as low and high marsh components as described above. The remainder of the stormwater quality design storm runoff volume storage is provided by a micropond. See Table 9.2-1 for the relative stormwater quality design storm runoff volumes to be provided in each wetland component.

Marsh wetlands should be designed with sinuous pathways to increase retention time and contact area. Marsh wetlands require greater site area than other types of constructed stormwater wetlands. In order to have the base and/or groundwater flow rate necessary to support emergent plants and

minimize mosquito breeding, marsh wetlands may also require greater drainage areas than the other types. This is due to the relatively larger area of a marsh wetland as compared with either a pond or extended detention wetland. This larger area requires greater rates of normal inflow to generate the necessary flow velocities and volume changeover rates.

3. Extended Detention Wetlands

Unlike pond and marsh wetlands, an extended detention wetland temporarily stores a portion of the stormwater quality design storm runoff volume in the semi-wet zone above its normal standing water level. This temporary runoff storage, which must be slowly released in a manner similar to an extended detention basin, allows the use of relatively smaller pool and marsh zones. As a result, extended detention wetlands require less site area than pond or marsh wetlands. See Table 9.2-1 for the relative stormwater quality design storm runoff volumes to be provided in each wetland component. See *Chapter 9.4: Standard for Extended Detention Basins* for the required detention times for the temporary semi-wet zone storage.

Due to the use of the semi-wet zone, water levels in an extended detention wetland will also increase more during storm events than pond or marsh wetlands. Therefore, the area of wetland vegetation in an extended detention wetland can expand beyond the normal standing water limits occupied by the pool and marsh zones. Wetland plants that tolerate intermittent flooding and dry periods should be selected for these areas.

E. Drainage Area

The minimum drainage area to a constructed stormwater wetland generally varies from 10 to 25 acres, depending on the type of constructed stormwater wetland. Smaller drainage areas may be permissible if detailed analysis indicates that sufficient base or groundwater inflow is available. See Table 9.2-1 for details. See also *D. Types of Constructed Stormwater Wetlands* above and *B. Water Budget* in the *Recommendations* section below for discussions of base and groundwater flow needs.

F. Overflows

All constructed stormwater wetlands must be able to convey overflows to downstream drainage systems in a safe and stable manner. Constructed stormwater wetlands classified as dams under the NJDEP Dam Safety Standards at N.J.A.C. 7:20 must also meet the overflow requirements of these Standards.

G. Tailwater

The design of all hydraulic outlets must consider any significant tailwater effects of downstream waterways or facilities. This includes instances where the lowest invert in the outlet or overflow structure is below the flood hazard area design flood elevation of a receiving stream.

H. On-Line and Off-Line Systems

Constructed stormwater wetlands may be constructed on-line or off-line. On-line systems receive upstream runoff from all storms, providing runoff treatment for the stormwater quality design storm and conveying the runoff from larger storms through an outlet or overflow. Multi-purpose on-line systems also store and attenuate these larger storms to provide runoff quantity control. In such systems, the invert of the lowest stormwater quantity control outlet is set at or above the normal permanent pool level. In off-line constructed stormwater wetlands, most or all of the runoff from storms larger than the stormwater quality design storm bypass the basin through an upstream diversion. This not only reduces the size of the required

basin storage volume, but reduces the basin's long-term pollutant loading and associated maintenance. In selecting an off-line design, the potential effects on wetland vegetation and ecology of diverting higher volume runoff events should be considered.

I. Safety Ledges

Safety ledges must be constructed on the slopes of all constructed stormwater wetlands with a permanent pool of water deeper than 3 feet. Two ledges must be constructed, each 4 to 6 feet in width. The first or upper ledge must be located between 1 and 1.5 feet above the normal standing water level. The second or lower ledge must be located approximately 2.5 feet below the normal standing water level.

Maintenance

Effective constructed stormwater wetland performance requires regular and effective maintenance. *Chapter 8: Maintenance and Retrofit of Stormwater Management Measures* provides information and requirements for preparing a maintenance plan for stormwater management facilities, including constructed stormwater wetlands. Specific maintenance requirements for constructed stormwater wetlands are presented below. These requirements must be included in the wetland's maintenance plan.

A. General Maintenance

All constructed stormwater wetland components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually as well as after every storm exceeding 1 inch of rainfall. Such components may include forebays, bottoms, trash racks, outlet structures, and riprap or gabion aprons.

Disposal of debris, trash, sediment, and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

B. Vegetated Areas

Mowing and/or trimming of vegetation must be performed on a regular schedule based on specific site conditions. Grass should be mowed at least once a month during the growing season. Vegetated areas must be inspected at least annually for erosion and scour. Vegetated areas should also be inspected at least annually for unwanted growth, which should be removed with minimum disruption to the remaining vegetation.

When establishing or restoring vegetation, biweekly inspections of vegetation health should be performed during the first growing season or until the vegetation is established. Once established, inspections of vegetation health, density, and diversity should be performed at least twice annually during both the growing and non-growing seasons. The vegetative cover should be maintained at 85 percent. If vegetation has greater than 50 percent damage, the area should be reestablished in accordance with the original specifications and the inspection requirements presented above.

The types and distribution of the dominant plants must also be assessed during the semi-annual wetland inspections described above. This assessment should be based on the health and relative extent of both the original species remaining and all volunteer species that have subsequently grown in the wetland. Appropriate steps must be taken to achieve and maintain an acceptable balance of original and volunteer species in accordance with the intent of the wetland's original design.

All use of fertilizers, mechanical treatments, pesticides and other means to assure optimum vegetation health should not compromise the intended purpose of the constructed stormwater wetland. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

C. Structural Components

All structural components must be inspected for cracking, subsidence, spalling, erosion, and deterioration at least annually.

D. Other Maintenance Criteria

The maintenance plan must indicate the approximate time it would normally take to drain the maximum design storm runoff and return the various wetland pools to their normal standing water levels. This drain or drawdown time should then be used to evaluate the wetland's actual performance. If significant increases or decreases in the normal drain time are observed, the wetland's outlet structure, forebay, and groundwater and tailwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the wetland.

Considerations

Constructed stormwater wetlands are limited by a number of site constraints, including soil types, depth to groundwater, contributing drainage area, and available land area at the site.

A. Construction

The following minimum setback requirements should apply to stormwater wetland installations:

Distance from a septic system leach field = 50 feet.

Distance from a septic system tank = 25 feet.

Distance from a property line = 10 feet.

Distance from a private well = 50 feet.

A seven-step process is recommended for the preparation of the wetland bed prior to planting (Schueler 1992).

1. Prepare final pondscaping and grading plans for the stormwater wetland. At this time order wetland plant stock from aquatic nurseries.
2. Once the stormwater wetland volume has been excavated, the wetland should be graded to create the major internal features (pool, safety ledge, marshes, etc.).
3. After the mulch or topsoil has been added, the stormwater wetland needs to be graded to its final elevations. All wetland features above the normal pool should be stabilized temporarily.
4. After grading to final elevations, the pond drain should be closed and the pool allowed to fill. Usually nothing should be done to the stormwater wetland for six to nine months or until the next planting season. A good design recommendation is to evaluate the wetland elevations during a standing period of approximately six months. During this time the stormwater wetland can experience storm flows and inundation, so that it can be determined where the pondscaping zones are located and whether the final grade and microtopography will persist overtime.
5. Before planting, the stormwater wetland depths should be measured to the nearest inch to confirm planting depth. The pondscape plan may be modified at this time to reflect altered depths or availability of plant stock.

6. Erosion controls should be strictly applied during the standing and planting periods. All vegetated areas above the normal pool elevation should be stabilized during the standing period, usually with hydroseeding.
7. The stormwater wetland should be de-watered at least three days before planting since a dry wetland is easier to plant than a wet one.

Topsoil and/or wetland mulch is added to the stormwater wetland excavation. Since deep subsoils often lack the nutrients and organic matter to support vigorous plant growth, the addition of mulch or topsoil is important. If it is available, wetland mulch is preferable to topsoil.

B. Site Constraints

Medium-fine texture soils (such as loams and silt loams) are best to establish vegetation, retain surface water, permit groundwater discharge, and capture pollutants. At sites where infiltration is too rapid to sustain permanent soil saturation, an impermeable liner may be required. Where the potential for groundwater contamination is high, such as runoff from sites with a high potential pollutant load, the use of liners is recommended. At sites where bedrock is close to the surface, high excavation costs may make constructed stormwater wetlands infeasible.

C. Design Approach

A pondscaping plan should be developed for each constructed stormwater wetland. This plan should include hydrological calculations (or water budget), a wetland design and configuration, elevations and grades, a site/soil analysis, and estimated depth zones. The plan should also contain the location, quantity, and propagation methods for the wetland plants. Site preparation requirements, maintenance requirements, and a maintenance schedule are also necessary components of the plan.

The water budget should demonstrate that there will be a continuous supply of water to sustain the constructed stormwater wetland. The water budget should be developed during site selection and checked after preliminary site design. Drying periods of longer than two months have been shown to adversely effect plant community richness, so the water balance should confirm that drying will not exceed two months.

D. Effectiveness

A review of the existing performance data indicates that the removal efficiencies of constructed stormwater wetlands are slightly higher than those of conventional pond systems, e.g. as wet ponds or dry extended detention ponds. Of the three designs described above, the pond/wetland system has shown the most reliable terms of overall performance.

Studies have also indicated that removal efficiencies of constructed stormwater wetlands decline if they are covered by ice or receive snow melt. Performance also declines during the non-growing season and during the fall when the vegetation dies back. Until vegetation is well established, pollutant removal efficiencies may be lower than expected.

E. Regulatory Issues

A constructed stormwater wetlands, once constructed, may be regulated by the Freshwater Wetlands Protection Act, and require additional permits for subsequent maintenance or amendment of the constructed stormwater wetland.

Recommendations

A. Vegetation

Establishment and maintenance of the wetland vegetation is an important consideration when planning a stormwater wetland. The following is a series of recommendations (Horner et al. 1994) for creating constructed stormwater wetlands.

In selecting plants, consider the prospects for success more than selection of native species. Since diversification will occur naturally, use a minimum of adaptable species. Give priority to perennial species that establish rapidly. Select species adaptable to the broadest ranges of depth, frequency and duration of inundation (hydroperiod). Give priority to species that have already been used successfully in constructed stormwater wetlands and that are commercially available. Match site conditions to the environmental requirements of plant selections. Avoid using only species that are foraged by the wildlife expected on site.

Establishment of woody species should follow herbaceous species. Add vegetation that will achieve other objectives, in addition to pollution control. Monoculture planting should be avoided due to increased risk of loss from pests and disease. When possible field collected plants should be used in lieu of nursery plants. Plants collected from the field have already adapted and are acclimated to the region. These plants generally require less care than greenhouse plants. If nursery plants are used they should be obtained locally, or from an area with similar climatic conditions as the eco-region of the constructed wetland. Alternating plant species with varying root depths have a greater opportunity of pollutant removal.

Stormwater wetland vegetation development can also be enhanced through the natural recruitment of species from nearby wetland sites. However, transplanting wetland vegetation is still the most reliable method of propagating stormwater wetland vegetation, and it provides cover quickly. Plants are commercially available through wetland plant nurseries.

The plant community will develop best when the soils are enriched with plant roots, rhizomes, and seed banks. Use of wetlands mulch enhances the diversity of the plant community and speeds establishment. Wetlands mulch is hydric soil that contains vegetative plant material. The upper 6 inches of donor soil should be obtained at the end of the growing season, and kept moist until installation. Drawbacks to using constructed stormwater wetlands mulch are its unpredictable content.

During the initial planting precautions should be undertaken to prevent and prohibit animals from grazing until plant communities are well established. Such precautions could be deer fencing, muskrat trapping, planting after seasonal bird migrations, or attracting birds of prey and bats to control nutria populations

B. Water Budget

The water budget should demonstrate that there will be a continuous supply of water to sustain the stormwater wetland. The water budget should demonstrate that the water supply to the stormwater wetland is greater than the expected loss rate. As discussed above, drying periods of longer than two months have been shown to adversely affect plan community richness, so the water balance should confirm that drying will not exceed two months (Schueler 1992).

C. Wetlands Area

The constructed wetlands should have a minimum surface area in relation to the contributing watershed area. The reliability of pollutant removal tends to increase as the stormwater wetland to watershed ratio increases, although this relationship is not always consistent. Above ground berms or high marsh wedges should be placed at approximately 50 foot intervals, at right angles to the direction of the flow to increase the dry weather flow path within the stormwater wetland.

D. Outlet Configuration

A hooded outlet is recommended with an invert or crest elevation at least 1 foot below the normal pool surface.

A bottom drain pipe with an inverted elbow to prevent sediment clogging should be installed for complete draining of the constructed stormwater wetland for emergency purposes or routine maintenance. Both the outlet pipe and the bottom drain pipe should be fitted with adjustable valves at the outlet ends to regulate flows. Spillways should be designed in conformance with state regulations and criteria for dam safety.

E. Pretreatment

As with all other best management practices, pretreatment can extend the functional life and increase the pollutant removal capability of a constructed stormwater wetland. Pretreatment can reduce incoming velocities and capture coarser sediments, which will extend the life of the system. This is usually accomplished through such means as a vegetative filter and/or a manufactured treatment device. Information on vegetative filters and manufactured treatment devices is presented in Chapters 9.10 and 9.6, respectively.

As shown in Figure 9.2-1, forebays at the inflow points to a constructed stormwater wetland can capture coarse sediments, trash, and debris, which can simplify and reduce the frequency of system maintenance. A forebay should be sized in accordance with Table 9.2-1 to hold the sediment volume expected between clean-outs.

References

Horner, R.R., J.J. Skupien, E.H. Livingston and H.E. Shaver. August 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. In cooperation with U.S. Environmental Protection Agency. Terrene Institute, Washington, D.C.

Livingston E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

New Jersey Department of Agriculture. November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.

New Jersey Department of Environmental Protection and Department of Agriculture. December 1994. Stormwater and Nonpoint Source Pollution Control Best Management Practices.

Ocean County Planning and Engineering Departments and Killam Associates. June 1989. Stormwater Management Facilities Maintenance Manual. New Jersey Department of Environmental Protection. Trenton, NJ.

Schueler, T.R. July 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R., Anacostia Restoration Team. October 1992. Design of Stormwater Wetland Systems – Guidelines for Creating Diverse and Effective Stormwater Wetland Systems in the Mid-Atlantic Region. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R., P.A. Kumble and M. Heraty. March 1992. A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R. and R.A. Claytor. 2000. Maryland Stormwater Design Manual. Maryland Department of the Environment. Baltimore, MD.

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CHAPTER 9.3

Standard for Dry Wells

Definition

A dry well is a subsurface storage facility that receives and temporarily stores stormwater runoff from roofs of structures. Discharge of this stored runoff from a dry well occurs through infiltration into the surrounding soils. A dry well may be either a structural chamber and/or an excavated pit filled with aggregate. Due to the relatively low level of expected pollutants in roof runoff, a dry well cannot be used to directly comply with the suspended solids and nutrient removal requirements contained in the NJDEP Stormwater Management Rules at N.J.A.C. 7:8. However, due to its storage capacity, a dry well may be used to reduce the total stormwater quality design storm runoff volume that a roof would ordinarily discharge to downstream stormwater management facilities.

Purpose

Dry wells can be used to reduce the increased volume of stormwater runoff caused by roofs of buildings. While generally not a significant source of runoff pollution, roofs are one of the most important sources of new or increased runoff volume from land development sites. Dry wells can also be used to indirectly enhance water quality by reducing the amount of stormwater quality design storm runoff volume to be treated by the other, downstream stormwater management facilities.

Dry wells can also be used to meet the groundwater recharge requirements of the NJDEP Stormwater Management Rules. See *Recharge BMP Design Guidelines* in *Chapter 6: Groundwater Recharge* for a complete discussion of these requirements and the use of dry wells and other groundwater recharge facilities to meet them.

Conditions Where Practice Applies

The use of dry wells is applicable only where their subgrade soils have the required permeability rates. Specific soil permeability requirements are presented below in *Design Criteria*.

Like other BMPs that rely on infiltration, dry wells are not appropriate for areas where high pollutant or sediment loading is anticipated due to the potential for groundwater contamination. Specifically, dry wells must not be used in the following locations:

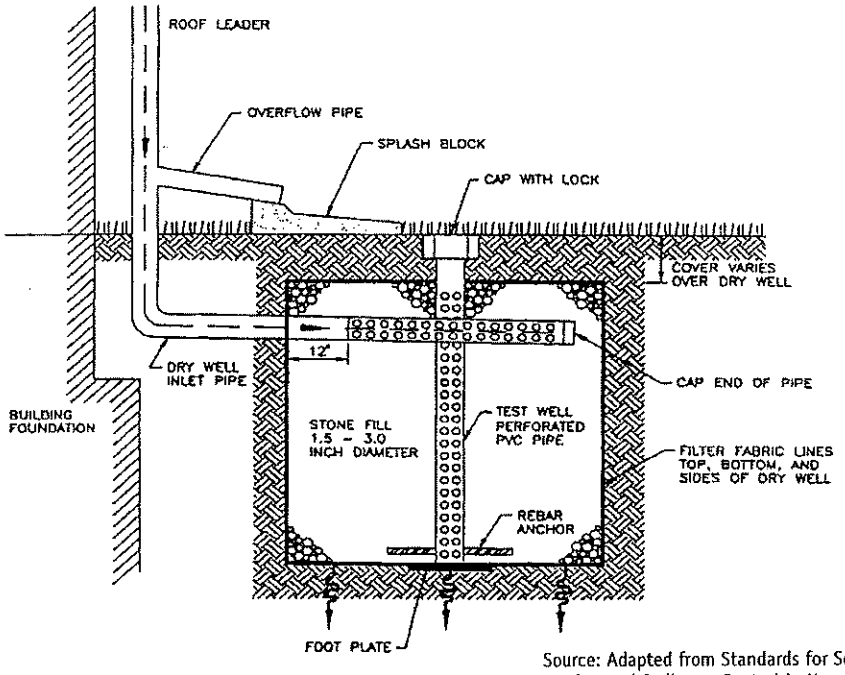
- Industrial and commercial areas where solvents and/or petroleum products are loaded, unloaded, stored, or applied; or pesticides are loaded, unloaded, or stored.

- Areas where hazardous materials are expected to be present in greater than "reportable quantities" as defined by the U.S. Environmental Protection Agency in the Code of Federal Regulations at 40 CFR 302.4.
- Areas where dry well use would be inconsistent with an NJDEP-approved remedial action work plan or landfill closure plan.
- Areas with high risks for spills of toxic materials such as gas stations and vehicle maintenance facilities.
- Areas where industrial stormwater runoff is exposed to "source material." "Source material" means any material(s) or machinery, located at an industrial facility, that is directly or indirectly related to process, manufacturing or other industrial activities, that could be a source of pollutants in any industrial stormwater discharge to groundwater. Source materials include, but are not limited to raw materials, intermediate products, final products, waste materials, by-products, industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

In addition, as required by the NJDEP Stormwater Management Rules, dry wells must not be used where their installation would create a significant risk for basement seepage or flooding, cause surficial flooding of groundwater, or interfere with the operation of subsurface sewage disposal systems and other subsurface structures. Such adverse impacts must be assessed and avoided by the design engineer.

Dry wells must be located and configured where their construction will not compact the soils below the dry well. Finally, a dry well must have a maintenance plan and, if privately owned, should be protected by easement, deed restriction, ordinance, or other legal measures that prevent its neglect, adverse alteration, and removal.

Figure 9.3-1: Dry Well Components



Source: Adapted from Standards for Soil Erosion and Sediment Control in New Jersey

Design Criteria

The basic design parameters for a dry well are its storage volume and the permeability rate of the subgrade soils. A dry well must have sufficient storage volume to contain the design runoff volume without overflow, while the subgrade soils' permeability rate must be sufficient to drain the stored runoff within 72 hours. Details of these and other design parameters are presented below. The components of a typical dry well are shown above in Figure 9.3-1.

A. Storage Volume, Depth, and Duration

A dry well must be designed to treat the total runoff volume generated by the dry well's maximum design storm. This may either be the groundwater recharge or stormwater quality design storm, depending upon the dry well's proposed use. Techniques to compute these volumes are discussed in *Chapter 6: Groundwater Recharge* and *Chapter 5: Computing Stormwater Runoff Rates and Volumes*. A dry well must also fully drain this runoff volume within 72 hours. Runoff storage for greater times can render the dry well ineffective and may result in anaerobic conditions, odor, and both water quality and mosquito breeding problems. The bottom of the dry well must be at least 2 feet above seasonal high water table or bedrock and be as level as possible to uniformly distribute runoff infiltration over the subgrade soils.

As discussed in *Considerations* below, construction of a dry well must be done without compacting the dry well's subgrade soils. As such, all excavation must be performed by equipment placed outside the dry well whenever possible. This requirement should be considered when designing the dimensions and total storage volume of a dry well.

It is important to note that the use of dry wells is recommended in this manual only for the stormwater quality design storm and smaller storm events. Use of dry wells for larger storm events and the requirements by which such dry wells are to be designed, constructed, and maintained should be reviewed and approved by all applicable reviewing agencies.

B. Permeability Rates

The minimum design permeability rate of the subgrade soils below a dry well will depend upon the dry well's location and maximum design storm. The use of dry wells for stormwater quality or quantity control is feasible only where the soils are sufficiently permeable to allow a reasonable rate of infiltration. Therefore, dry wells designed for storms greater than the groundwater recharge storm can be constructed only in areas with Hydrologic Soil Group A and B soils. Additional permeability requirements are presented below in Table 9.3-1.

Table 9.3-1: Minimum Design Permeability Rates for Dry Wells

Maximum Design Storm	Minimum Design Permeability Rate (Inches/Hour)
Groundwater Recharge*	0.2
Stormwater Quality	0.5
*See text for required diversion of runoff from greater storms.	

It is important to note that, for dry wells that are used only for groundwater recharge (see Table 9.3-1 above), all runoff from storms greater than the dry well's groundwater recharge storm must be directed around the dry well by a diversion structure or device located upstream of the dry well. If the dry well does receive runoff and associated pollutants from greater storm events, a minimum permeability rate of 0.5 inches/hour must be used. Minor basin inflows from greater storms during normal operation of the diversion are permissible provided they represent a small percentage of the total storm runoff volume. For example, the dry well overflow pipe shown in Figure 9.3-1 can serve as such a diversion if it is located vertically as close to the ground surface as practical. Details of a dry well's groundwater recharge storm are presented in Chapter 6.

In addition to the above, the design permeability rate of the subgrade soils must be sufficient to fully drain the dry well's maximum design storm runoff volume within 72 hours. This design permeability rate must be determined by field or laboratory testing. See *A. Soil Characteristics* in *Considerations* below for more information. Since the actual permeability rate may vary from test results and may also decrease over time due to soil bed consolidation or the accumulation of sediments removed from the treated stormwater, a factor of safety of two must be applied to the tested permeability rate to determine the design permeability rate. Therefore, if the tested permeability rate of the subgrade soils is 4 inches/hour, the design rate would be 2 inches/hour (i.e., 4 inches per hour/2). This design rate would then be used to compute the dry well's maximum design storm drain time.

C. Drainage Area

The maximum drainage area to a dry well is 1 acre.

D. Overflows

All dry wells must be able to safely convey system overflows to downstream drainage systems. The capacity of the overflow must be consistent with the remainder of the site's drainage system and sufficient to provide safe, stable discharge of stormwater in the event of an overflow. The downstream drainage system must have sufficient capacity to convey the overflow from the dry well.

Maintenance

Effective dry well performance requires regular and effective maintenance. *Chapter 8: Maintenance and Retrofit of Stormwater Management Measures* provides information and requirements for preparing a maintenance plan for stormwater management facilities, including dry wells. Specific maintenance requirements for dry wells are presented below. These requirements must be included in the dry well's maintenance plan.

A. General Maintenance

A dry well should be inspected at least four times annually as well as after every storm exceeding 1 inch of rainfall. The water level in the test well should be the primary means of measuring infiltration rates and drain times. Pumping stored runoff from an impaired or failed dry well can also be accomplished through the test well. Therefore, adequate inspection and maintenance access to the test well must be provided.

Disposal of debris, trash, sediment, and other waste material removed from a dry well should be done at suitable disposal/recycling sites and in compliance with local, state, and federal waste regulations.

B. Other Maintenance Criteria

The maintenance plan must indicate the approximate time it would normally take to drain the maximum design storm runoff volume from the dry well. This normal drain time should then be used to evaluate the dry well's actual performance. If significant increases in the normal drain time are observed or if it exceeds the 72 hour maximum, appropriate measures must be taken to comply with the drain time requirements and maintain the proper functioning of the dry well.

Considerations

A. Soil Characteristics

Soils are perhaps the most important consideration for site suitability. In general, County Soil Surveys can be used to obtain necessary soil data for the planning and preliminary design of dry wells. However, for final design and construction, soil tests are required at the exact location of a proposed dry well in order to confirm its ability to function properly without failure or interference.

Such tests should include a determination of the textural classification and permeability of the subgrade soil at and below the bottom of the proposed dry well. The recommended minimum depth for subgrade soil analysis is 5 feet below the bottom of the drywell or to the groundwater table. Soil permeability testing can be conducted in accordance with the Standards for Individual Subsurface Sewage Disposal Systems at N.J.A.C. 7:9A. See *Design Criteria* above for further soil requirements.

In addition, the results of a dry well's soil testing should be compared with the County Soil Survey data used in the computation of development site runoff and the design of specific site BMPs, including the proposed dry well, to ensure reasonable data consistency. If significant differences exist between the dry well's soil test results and the County Soil Survey data, additional development site soil tests are recommended to determine and evaluate the extent of the data inconsistency and the need for revised site runoff and BMP design computations. All significant inconsistencies should be discussed with the local Soil Conservation District prior to proceeding with such redesign to help ensure that the final site soil data is accurate.

B. Construction

For dry wells, protection of the subgrade soils from compaction by construction equipment and contamination and clogging by sediment are vital. Prior to its construction, the area to be used for the dry well should be cordoned off to prevent construction equipment and stockpiled materials from compacting the subgrade soils. During dry well construction, precautions should be taken to prevent both subgrade soil compaction and sediment contamination. All excavation should be performed with the lightest practical excavation equipment. All excavation equipment should be placed outside the limits of the dry well.

To help prevent subgrade soil contamination and clogging by sediment, dry well construction should be delayed until all other construction areas that may temporarily or permanently drain to the dry well are stabilized. This delayed construction emphasizes the need, as described above, to cordon off the dry well area to prevent compaction by construction equipment and material storage during other site construction activities. Similarly, use of the dry well as a sediment basin is strongly discouraged. Where unavoidable, excavation for the sediment basin should be a minimum of 2 feet above the final design elevation of the dry well bottom. Accumulated sediment can then be removed without disturbing the subgrade soils at the dry well bottom, which should be established only after all construction within the dry well's drainage area is completed and the drainage area stabilized.

If dry well construction cannot be delayed until its drainage area is stabilized, diversion piping or other suitable measures should be installed during all phases of construction to divert all runoff and sediment away from the dry well. These diversion measures should not be removed until all construction within the dry well's drainage area is completed and the drainage area stabilized.

Stone fill aggregate should be placed in lifts and compacted using plate compactors. A maximum loose lift thickness of 12 inches is recommended.

A preconstruction meeting should be held to review the specific construction requirements and restrictions of dry wells with the contractor.

Recommendations

A. Pretreatment

As with all other best management practices, pretreatment can extend the functional life of a dry well. While generally not a significant source of runoff pollution, roofs can nevertheless be the source of particulates and organic matter and, during site construction, sediment and debris. Therefore, roof gutter guards and/or sumps or traps (equipped with clean-outs) in the conduits to a dry well should be included wherever practical to minimize the amount of sediment and other particulates that can enter the dry well.

References

Horner, R.R., Skupien, J.J., Livingston E.H. and Shaver, H.E., August 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. In cooperation with U.S. Environmental Protection Agency. Terrene Institute, Washington, D.C.

Livingston E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

New Jersey Department of Agriculture. November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.

New Jersey Department of Environmental Protection and Department of Agriculture. December 1994. Stormwater and Nonpoint Source Pollution Control Best Management Practices.

Ocean County Planning and Engineering Departments and Killam Associates. June 1989. Stormwater Management Facilities Maintenance Manual. New Jersey Department of Environmental Protection. Trenton, NJ.

Schueler, T.R. July 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R., P.A. Kumble and M. Heraty. March 1992. A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R. and R.A. Claytor. 2000. Maryland Stormwater Design Manual. Maryland Department of the Environment. Baltimore, MD.

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CHAPTER 9.4

Standard for Extended Detention Basins

Definition

An extended detention basin is a facility constructed through filling and/or excavation that provides temporary storage of stormwater runoff. It has an outlet structure that detains and attenuates runoff inflows and promotes the settlement of pollutants. An extended detention basin is normally designed as a multi-stage facility that provides runoff storage and attenuation for both stormwater quality and quantity management. The adopted TSS removal rate for extended detention basins is 40 to 60 percent, depending on the duration of detention time provided in the basin.

Purpose

Extended detention basins are used to address both the stormwater runoff quantity and quality impacts of land development. The lower stages of an extended detention basin can detain runoff from the stormwater quality design storm for extended periods of time, thereby promoting pollutant removal through sedimentation. Higher stages in the basin can also attenuate the peak rates of runoff from larger storms for flood and erosion control. Extended detention basins are designed for complete evacuation of runoff and normally remain dry between storm events. However, to enhance soluble pollutant removal, the lower stages of an extended detention basin may also be designed with a permanent pool and partially function as either a wetland or retention basin (see *Chapter 9.2: Standard for Constructed Stormwater Wetlands* and *Chapter 9.11: Standard for Wet Ponds*).

Conditions Where Practice Applies

Extended detention basins may be used at sites where significant increases in runoff are expected from site development. In addition, standard detention basins may be retrofitted or converted to extended detention by increasing the time over which the basin releases the stormwater quality design storm runoff volume, provided that erosion and flood control volumes and outflow rates are not adversely altered.

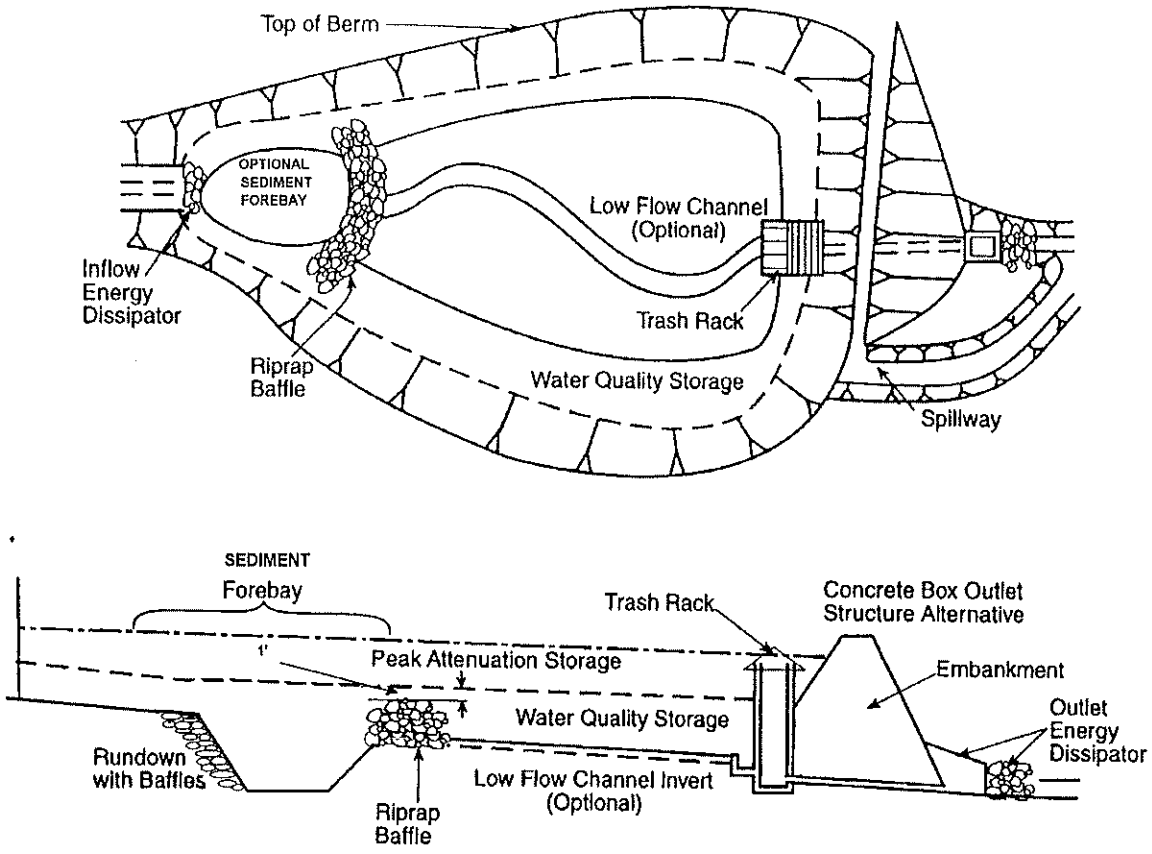
Extended detention basins can be used at residential, commercial, and industrial development sites. However, their limited effectiveness in removing both particulate and soluble pollutants may limit their use for water quality treatment.

Finally, an extended detention basin must have a maintenance plan and, if privately owned, should be protected by easement, deed restriction, ordinance, or other legal measures that prevent its neglect, adverse alteration, and removal.

Design Criteria

The basic design parameters for an extended detention basin are its storage volume and detention time. An extended detention basin must have the correct combination of storage volume and outflow capacity to contain and slowly discharge the design runoff volume over a prescribed period of time. Details of these and other design parameters are presented below. The components of a typical extended detention basin are shown in Figure 9.4-1.

Figure 9.4-1: Extended Detention Basin Components



Source: Adopted from Pennsylvania Handbook of Best Management Practices for Developing Areas, which adapted the figure from Dam Design and Construction Standards, Fairfax County, Virginia.

A. Storage Volume, Depth, and Duration

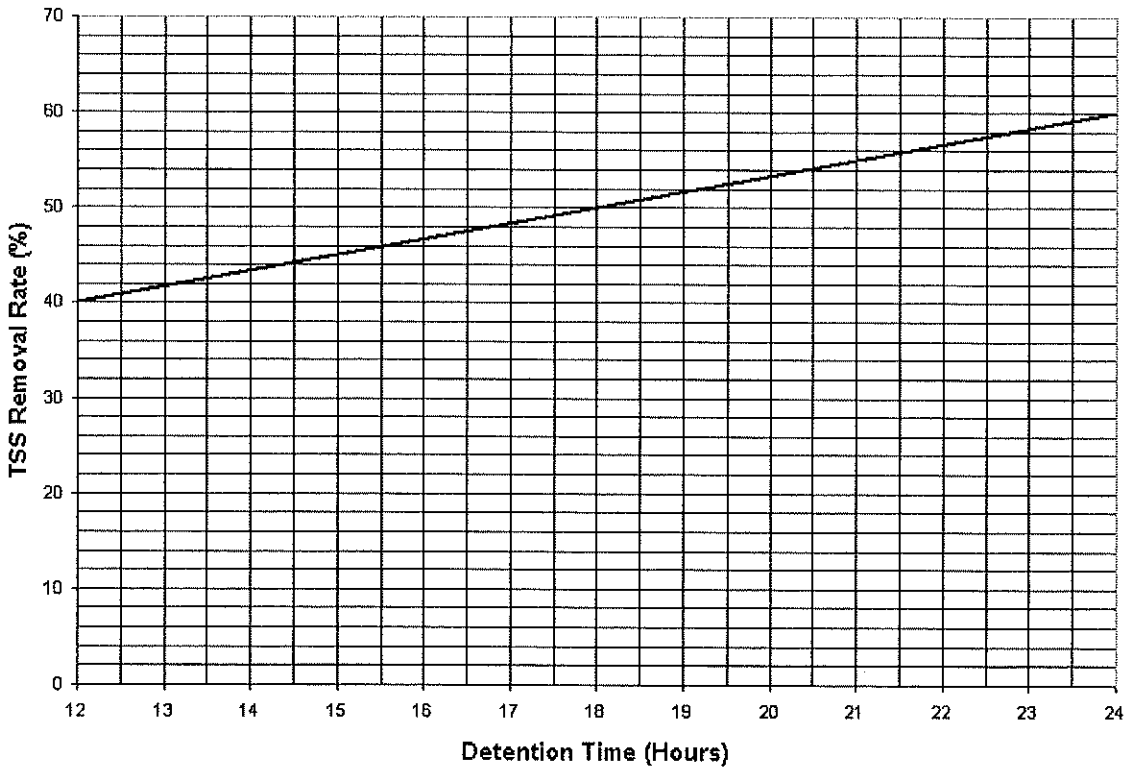
Extended detention basins should be designed to treat the runoff volume generated by the stormwater quality design storm. Techniques to compute this volume are discussed in *Chapter 5: Computing Stormwater Runoff Rates and Volumes*. To achieve a 60 percent TSS removal rate, a minimum of 10 percent of this runoff volume must remain in the basin 24 hours after the peak basin water surface and maximum runoff storage volume is achieved. This applies to all types of land developments.

It should be noted that the time from when the maximum storage volume is achieved until only 10 percent of that volume remains in an extended detention basin is defined as the basin's detention time. As noted above, a 24-hour detention time is required in an extended detention basin in order to achieve a 60 percent TSS removal rate. Figure 9.4-2 below can be used to determine the TSS removal rates at extended detention basins with detention times of 12 to 24 hours. The minimum diameter of any outlet orifice must be 2.5 inches.

The lowest elevation in an extended detention basin, excluding low flow channels, must be at least 1 foot above the seasonal high groundwater table. The lowest elevation in any low flow channel, including any underdrain pipes and bedding material, must be at or above the seasonal high groundwater table.

To enhance safety by minimizing standing water depths, the vertical distance between the basin bottom and the elevation of the first stormwater quantity control outlet (normally set equal to the maximum stormwater quality design storm water surface) should be no greater than 3 feet wherever practical.

Figure 9.4-2: TSS Removal Rate vs. Detention Time



B. Overflows

All extended detention basins must be able to safely convey system overflows to downstream drainage systems. The capacity of the overflow must be sufficient to provide safe, stable discharge of stormwater in the event of an overflow. Extended detention basins that are classified as dams under the NJDEP Dam Safety Standards at N.J.A.C. 7:20 must also meet the overflow requirements of these Standards.

C. Tailwater

The hydraulic design of the outlet structure, outlet pipe, emergency spillway, and underdrain systems in an extended detention basin must consider any significant tailwater effects of downstream waterways or facilities. This includes instances where the lowest invert in the outlet or overflow structure is below the flood hazard area design flood elevation of a receiving stream.

D. Other Components

Information regarding outlet structures, bottom and side slopes, trash racks, low flow channels, conduit outlet protection, and vegetative cover can be found in both the Soil Erosion and Sediment Control Standards for New Jersey and the NJDEP Stormwater Management Facilities Maintenance Manual.

E. Subsurface Extended Detention Basins

A subsurface detention basin is located entirely below the ground surface. Runoff may be stored in a vault, perforated pipe, and/or stone bed. If a stone bed is utilized for any part of the storage volume, all runoff to the subsurface basin must either be pretreated or the basin's storage volume increased to account for the loss of volume in the stone bed due to sediment accumulation. This loss should be based upon the expected life of the basin. This increase is due to the impracticality of removing this sediment from the stone storage bed. This pretreatment must remove at least 50 percent of the TSS in the runoff from the basin's maximum design storm.

Following pretreatment, additional TSS removal can then be provided by the subsurface extended detention basin as the secondary BMP in a treatment train. Computation of the total TSS removal rate is described in *Chapter 4: Stormwater Pollution Removal Criteria*. See *Recommendations* below for additional information on runoff pretreatment.

Maintenance

Effective extended detention basin performance requires regular and effective maintenance. *Chapter 8: Maintenance and Retrofit of Stormwater Management Measures* provides information and requirements for preparing a maintenance plan for stormwater management facilities, including extended detention basins. Specific maintenance requirements for extended detention basins are presented below. These requirements must be included in the basin's maintenance plan.

A. General Maintenance

All extended detention basin components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually as well as after every storm exceeding 1 inch of rainfall. Such components may include bottoms, trash racks, low flow channels, outlet structures, riprap or gabion aprons, and inlets.

Sediment removal should take place when the basin is thoroughly dry. Disposal of debris, trash, sediment, and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

B. Vegetated Areas

Mowing and/or trimming of vegetation must be performed on a regular schedule based on specific site conditions. Grass should be mowed at least once a month during the growing season. Vegetated areas must be inspected at least annually for erosion and scour. Vegetated areas should also be inspected at least annually for unwanted growth, which should be removed with minimum disruption to the bottom surface and remaining vegetation.

When establishing or restoring vegetation, biweekly inspections of vegetation health should be performed during the first growing season or until the vegetation is established. Once established, inspections of vegetation health, density, and diversity should be performed at least twice annually during both the growing and non-growing seasons. The vegetative cover should be maintained at 85 percent. If vegetation has greater than 50 percent damage, the area should be reestablished in accordance with the original specifications and the inspection requirements presented above.

All use of fertilizers, mechanical treatments, pesticides, and other means to assure optimum vegetation health must not compromise the intended purpose of the extended detention basin. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

C. Structural Components

All structural components must be inspected for cracking, subsidence, spalling, erosion, and deterioration at least annually.

D. Other Maintenance Criteria

The maintenance plan must indicate the approximate time it would normally take to completely drain the maximum design storm runoff volume from the basin. This normal drain time should then be used to evaluate the basin's actual performance. If significant increases or decreases in the normal drain time are observed, the basin's outlet structure, underdrain system, and both groundwater and tailwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the basin.

Considerations

For effective stormwater quality control, the basin must collect as much site runoff as possible, especially from the site's roadways, parking lots, and other impervious areas. The majority of the key pollutants that are removed by extended detention basins originate on these surfaces.

A typical extended detention basin will range from 3 to 12 feet in depth. Depth is often limited by groundwater conditions or the need for positive drainage from excavated basins. At the location of the proposed extended detention basin, the depth to seasonal high groundwater table must be determined. If the basin intercepts the groundwater, it may result in a loss of runoff storage volume, mosquito breeding, and difficulty maintaining the basin bottom.

When designing an extended detention basin, bottom soils should be examined. If soils are relatively impermeable (USDA Hydrologic Soil Group "D"), a dry extended detention basin may exhibit problems with standing water. Conversely, if soils are very permeable (Group "A") the effects on groundwater should be considered. If bedrock lies close to the surface of the soil, excavation for necessary storage volume may be too costly and difficult. In Karst landscapes, other alternatives to detention basins should be examined.

Recommendations

A. Pretreatment

As with all other best management practices, pretreatment can extend the functional life and increase the pollutant removal capability of an extended detention system. Pretreatment can reduce incoming velocities and capture coarser sediments, which will extend the life of the system. This is usually accomplished through such means as a vegetative filters, a forebay, or a manufactured treatment device. Information on vegetative filters and manufactured treatment devices is presented in Chapters 9.10 and 9.6, respectively.

Forebays can also be included at the inflow points to an extended detention basin to capture coarse sediments, trash, and debris, which can simplify and reduce the frequency of system maintenance. A forebay should be sized to hold the sediment volume expected between clean-outs.

It should be remembered that the runoff to all subsurface extended detention basins that utilize stone beds to store runoff must be pretreated. This pretreatment must provide 50 percent removal of TSS for the maximum design storm runoff to the basin. See *E. Subsurface Extended Detention Basins* in *Design Criteria* above for more information.

B. Sediment Accumulation

A properly designed extended detention basin will accumulate considerable amounts of sediment over time, leading to the loss of the detention volume and, thus, both runoff quality and quantity control effectiveness. Therefore, depending on the clean-out intervals, an increase in an extended detention basin's maximum design storm storage volume should be considered to compensate for this expected loss of storage volume. See *E. Subsurface Extended Detention Basins* in *Design Criteria* above for more information on required volume increases in subsurface basins.

C. Flow Paths

An extended detention basin relies on the process of sedimentation for removal of runoff pollutants. Therefore, the basin should be designed to maximize the degree of sedimentation. Flow path lengths should be maximized and long, narrow basin configurations with length to width ratios from 2:1 to 3:1 should be utilized. Basins that are shallow and have larger surface area to depth ratios will provide better pollutant removal efficiencies than smaller, deeper basins.

D. Wetland Creation

It may be possible to establish a wetland area in the bottom stage of an extended detention basin to increase the pollutant removal rate. See *Chapter 9.2: Standard for Constructed Stormwater Wetlands* for more information.

References

Horner, R.R., J.J. Skupien, E.H. Livingston and H.E. Shaver. August 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. In cooperation with U.S. Environmental Protection Agency. Terrene Institute, Washington, D.C.

Livingston E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

New Jersey Department of Agriculture. November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.

New Jersey Department of Environmental Protection and Department of Agriculture. December 1994. Stormwater and Nonpoint Source Pollution Control Best Management Practices.

Ocean County Planning and Engineering Departments and Killam Associates. June 1989. Stormwater Management Facilities Maintenance Manual. New Jersey Department of Environmental Protection. Trenton, NJ.

Pennsylvania Handbook of Best Management Practices for Developing Area. 1998. Prepared by CH2M Hill for Pennsylvania Association of Conservation Districts. Pennsylvania Department of Environmental Protection, and Natural Resources Conservation Service.

Schueler, T.R., P.A. Kumble and M. Heraty. March 1992. A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C.

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CHAPTER 9.5

Standard for Infiltration Basins

Definition

An infiltration basin is a facility constructed within highly permeable soils that provides temporary storage of stormwater runoff. An infiltration basin does not normally have a structural outlet to discharge runoff from the stormwater quality design storm. Instead, outflow from an infiltration basin is through the surrounding soil. An infiltration basin may also be combined with an extended detention basin to provide additional runoff storage for both stormwater quality and quantity management. The adopted TSS removal rate for infiltration basins is 80 percent.

It should be noted that a dry well is a specialized infiltration facility intended only for roof runoff. See *Chapter 9.3: Standard for Dry Wells* for further details.

Purpose

Infiltration basins are used to remove pollutants and to infiltrate stormwater back into the ground. Such infiltration also helps to reduce increases in both the peak rate and total volume of runoff caused by land development. Pollutant removal is achieved through filtration of the runoff through the soil as well as biological and chemical activity within the soil.

Infiltration basins may also be used to meet the groundwater recharge requirements of the NJDEP Stormwater Management Rules. See *Recharge BMP Design Guidelines* in *Chapter 6: Groundwater Recharge* for a complete discussion of these requirements and the use of infiltration basins and other groundwater recharge facilities to meet them.

Conditions Where Practice Applies

The use of infiltration basins is applicable only where the soils have the required permeability rates. Specific soil permeability requirements are presented below in *Design Criteria*.

Like other BMPs that rely on infiltration, infiltration basins are not appropriate for areas where high pollutant or sediment loading is anticipated due to the potential for groundwater contamination.

Specifically, infiltration basins must not be used in the following locations:

- Industrial and commercial areas where solvents and/or petroleum products are loaded, unloaded, stored, or applied or pesticides are loaded, unloaded, or stored.
- Areas where hazardous materials are expected to be present in greater than "reportable quantities" as defined by the U.S. Environmental Protection Agency in the Code of Federal Regulations at 40 CFR 302.4.
- Areas where infiltration basin use would be inconsistent with an NJDEP-approved remedial action work plan or landfill closure plan.
- Areas with high risks for spills of toxic materials such as gas stations and vehicle maintenance facilities.
- Areas where industrial stormwater runoff is exposed to "source material." "Source material" means any material(s) or machinery, located at an industrial facility, that is directly or indirectly related to process, manufacturing, or other industrial activities, that could be a source of pollutants in any industrial stormwater discharge to groundwater. Source materials include, but are not limited to raw materials, intermediate products, final products, waste materials, by-products, industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

In addition, as required by the Stormwater Management Rules, infiltration basins must not be used where their installation would create a significant risk for basement seepage or flooding, cause surficial flooding of groundwater, or interfere with the operation of subsurface sewage disposal systems and other subsurface structures. Such adverse impacts must be assessed and avoided by the design engineer.

Infiltration basins must be configured and located where their construction will not compact the soils below the basin. In addition, an infiltration basin must not be placed into operation until the contributing drainage area is completely stabilized. Basin construction must either be delayed until such stabilization is achieved, or upstream runoff must be diverted around the basin. Such diversions must continue until stabilization is achieved.

Finally, an infiltration basin must have a maintenance plan and, if privately owned, should be protected by easement, deed restriction, ordinance, or other legal measures that prevent its neglect, adverse alteration, and removal.

Design Criteria

The components of a typical infiltration basin are shown in Figure 9.5-1. Additional details of each component are described below.

A. Storage Volume, Depth, and Duration

An infiltration basin must be designed to treat the total runoff volume generated by the basin's maximum design storm. This may either be the groundwater recharge or stormwater quality design storm, depending upon the basin's proposed use. Techniques to compute these volumes are discussed in *Chapter 6: Groundwater Recharge* and *Chapter 5: Computing Stormwater Runoff Rates and Volumes*. An infiltration basin must also fully drain this runoff volume within 72 hours. Runoff storage for greater times can render the basin ineffective and may result in anaerobic conditions, odor, and both water quality and mosquito breeding problems. The bottom of the infiltration basin must be at least 2 feet above seasonal high water table or bedrock. For surface basins, this distance must be measured from the bottom of the sand layer as shown in Figure 9.5-1. The basin bottom must be as level as possible to uniformly distribute runoff infiltration over the subgrade soils.

To enhance safety by minimizing standing water depths, the vertical distance between the basin bottom and the maximum design storm water surface in surface infiltration basins should be no greater than 2 feet.

As discussed in *Considerations* below, construction of an infiltration basin must be done without compacting the basin's subgrade soils. As such, all excavation must be performed by equipment placed outside the basin whenever possible. This requirement should be considered when designing the dimensions and total storage volume of an infiltration basin.

It is important to note that the use of infiltration basins is recommended in this manual only for the stormwater quality design storm and smaller storm events. Use of infiltration basins for larger storm events and the requirements by which such basins are to be designed, constructed, and maintained should be reviewed and approved by all applicable reviewing agencies.

B. Permeability Rates

The minimum design permeability rate of the soils below an infiltration basin will depend upon the basin's location and maximum design storm. The use of infiltration basins for stormwater quality control is feasible only where soil is sufficiently permeable to allow a reasonable rate of infiltration. Therefore, infiltration basins designed for storms greater than the groundwater recharge storm can be constructed only in areas with Hydrologic Soil Group A and B soils. Additional permeability requirements are presented below in Table 9.5-1.

Table 9.5-1: Minimum Design Permeability Rates for Infiltration Basins

Maximum Design Storm	Basin Location	Minimum Design Permeability Rate (Inches/Hour)
Groundwater Recharge*	Subsurface	0.2
Groundwater Recharge	Surface	0.5
Stormwater Quality	Surface and Subsurface	0.5
*See text for required diversion of runoff from greater storms.		

It is important to note that, for subsurface infiltration basins that are used only for groundwater recharge (see Table 9.5-1 above), all runoff from storms greater than the basin's groundwater recharge storm must be directed around the basin by a diversion structure or device located upstream of the basin. If the basin does receive runoff and associated pollutants from greater storm events, a minimum permeability rate of 0.5 inches/hour must be used. Minor basin inflows from greater storms during normal operation of the diversion are permissible provided they represent a small percentage of the total storm runoff volume. Details of an infiltration basin's groundwater recharge storm are presented in *Chapter 6*. See *E. Online and Offline Systems* below for additional information.

In addition to the above, the design permeability rate of the soil must be sufficient to fully drain the infiltration basin's maximum design storm runoff volume within 72 hours. This design permeability rate must be determined by field or laboratory testing. See *A. Soil Characteristics* in *Considerations* below for more information. Since the actual permeability rate may vary from test results and may also decrease over time due to soil bed consolidation or the accumulation of sediments removed from the treated stormwater, a

factor of safety of two must be applied to the tested permeability rate to determine the design permeability rate. Therefore, if the tested permeability rate of the soils is 4 inches/hour, the design rate would be 2 inches/hour (i.e., 4 inches per hour/2). This design rate would then be used to compute the basin's maximum design storm drain time.

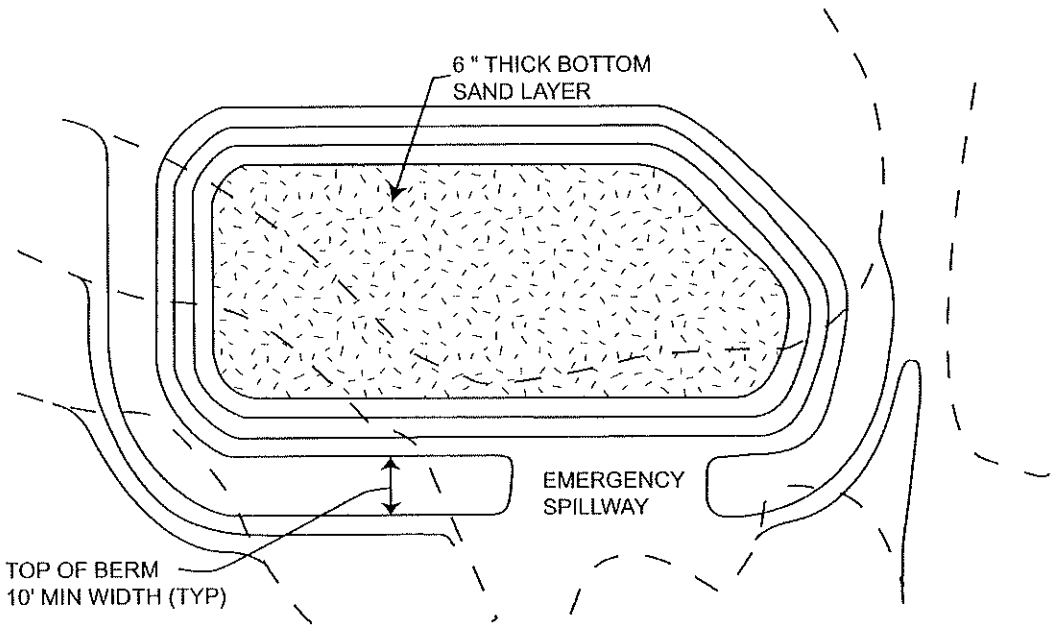
C. Bottom Sand Layer

To help ensure maintenance of the design permeability rate over time, a 6 inch layer of sand must be placed on the bottom of an infiltration basin (see Figure 9.5-1). This sand layer can intercept silt, sediment, and debris that could otherwise clog the top layer of the soil below the basin. The sand layer will also facilitate silt, sediment, and debris removal from the basin and can be readily restored following removal operations. The sand layer must meet the specifications of a K5 soil. This must be certified by a professional engineer licensed in the State of New Jersey.

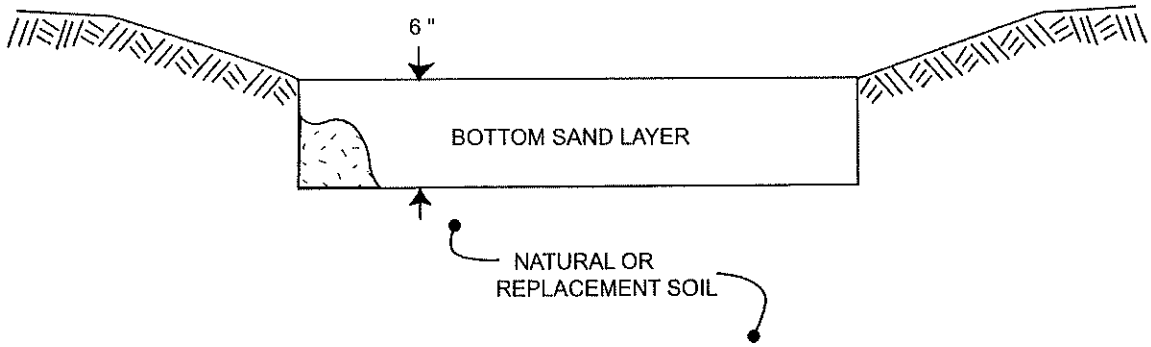
D. Overflows

All infiltration basins must be able to convey overflows to downstream drainage systems in a safe and stable manner. Infiltration basins that are classified as dams under the NJDEP Dam Safety Standards at N.J.A.C. 7:20 must also meet the overflow requirements of these Standards.

Figure 9.5-1: Infiltration Basin Components



PLAN



SECTION

NOTES

1. BOTTOM SAND LAYER MUST CONSIST OF K5 SAND WITH A MAXIMUM OF 15% FINES AND A MINIMUM PERMEABILITY RATE OF 20 INCHES PER HOUR.

2. BASIN CONSTRUCTION MUST NOT COMPACT SOILS BELOW BASIN BOTTOM.

3. SEE TEXT FOR ADDITIONAL REQUIREMENTS.

Source: Adapted from T&M Associates.

E. On-Line and Off-Line Systems

Infiltration basins may be constructed either on-line or off-line. On-line systems receive upstream runoff from all storms, providing runoff treatment for the maximum design storm and conveying the runoff from larger storms through an overflow. With the proper soil and drainage area conditions, an infiltration basin may also be combined with a detention basin to provide runoff quantity control in the detention portion of the basin. In such systems the invert of the lowest stormwater quantity control outlet is set at or above the maximum stormwater quality design storm water surface.

In off-line infiltration basins, most or all of the runoff from storms larger than the maximum design storm bypass the basin through an upstream diversion. This not only reduces the size of the required basin storage volume, but also reduces the basin's long-term pollutant loading and associated maintenance. See *B. Permeability Rates* above for additional information on diversion requirements, particularly for subsurface infiltration basins used only for groundwater recharge.

F. Subsurface Infiltration Basins

A subsurface infiltration basin is located entirely below the ground surface. It may consist of a vault, perforated pipe, and/or stone bed. However, due to the greater difficulty in removing silt, sediment, and debris, all runoff to a subsurface infiltration basin must be pretreated. This pretreatment must remove 80 percent of the TSS in the runoff from the basin's maximum design storm.

Following pretreatment, additional TSS removal can then be provided by the subsurface infiltration basin as the secondary BMP in a treatment train. Computation of the total TSS removal rate is described in *Chapter 4: Stormwater Pollution Removal Criteria*. See *A. Pretreatment* in *Recommendations* below for information on runoff pretreatment.

G. Basis of Design

The design of an infiltration basin is based upon Darcy's Law:

$$Q = KIA$$

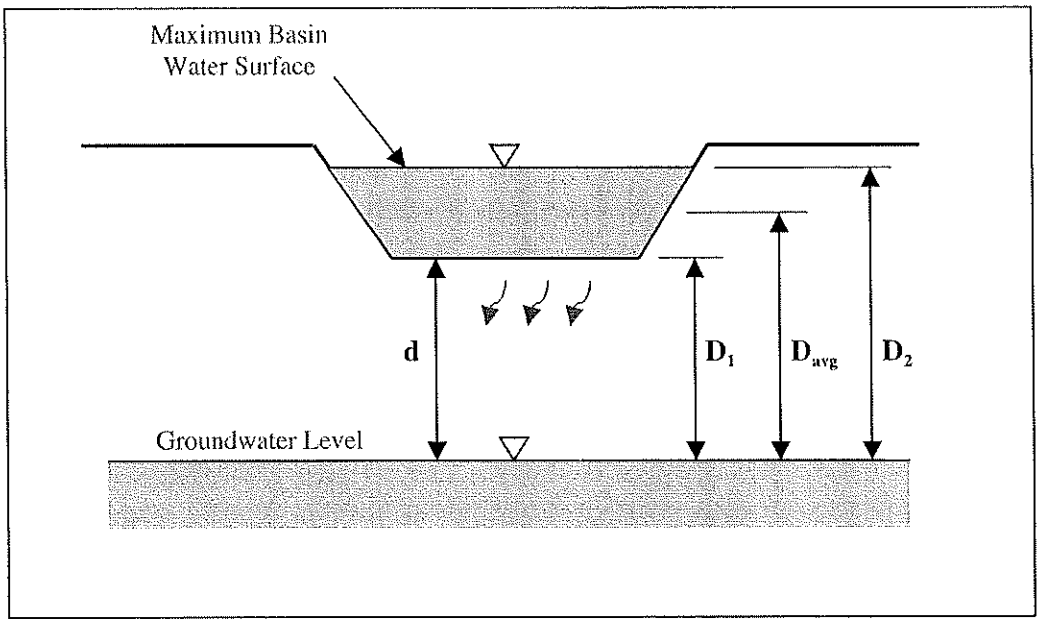
where:

Q = the rate of infiltration in cubic feet per second (cfs)
K = the hydraulic conductivity of the soil in feet per second (fps)
I = the hydraulic gradient
A = the area of infiltration in square feet (sf)

From the variables shown in Figure 9.5-2 below:

Average Hydraulic Gradient = D_{avg}/d
Minimum Hydraulic Gradient = D_1/d
Maximum Hydraulic Gradient = D_2/d

Figure 9.5-2: Schematic of Darcy's Law



The hydraulic conductivity is either field measured or laboratory measured for the soil on site. A number of percolation tests should be done to obtain a reliable measurement of permeability of the underlying soil.

Maintenance

Effective infiltration basin performance requires regular and effective maintenance. *Chapter 8: Maintenance and Retrofit of Stormwater Management Measures* contains information and requirements for preparing a maintenance plan for stormwater management facilities, including infiltration basins. Specific maintenance requirements for infiltration basins are presented below. These requirements must be included in the basin's maintenance plan.

A. General Maintenance

All infiltration basin components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually as well as after every storm exceeding 1 inch of rainfall. Such components may include bottoms, riprap or gabion aprons, and inflow points. This applies to both surface and subsurface infiltration basins.

Sediment removal should take place when the basin is thoroughly dry. Disposal of debris, trash, sediment, and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

Studies have shown that readily visible stormwater management facilities like infiltration basins receive more frequent and thorough maintenance than those in less visible, more remote locations. Readily visible facilities can also be inspected faster and more easily by maintenance and mosquito control personnel.

B. Vegetated Areas

Mowing and/or trimming of vegetation must be performed on a regular schedule based on specific site conditions. Grass should be mowed at least once a month during the growing season. Vegetated areas must also be inspected at least annually for erosion and scour. The structure must be inspected for unwanted tree growth at least once a year.

When establishing or restoring vegetation, biweekly inspections of vegetation health should be performed during the first growing season or until the vegetation is established. Once established, inspections of vegetation health, density, and diversity should be performed at least twice annually during both the growing and non-growing season. If vegetation has greater than 50 percent damage, the area should be reestablished in accordance with the original specifications and the inspection requirements presented above.

All use of fertilizers, mechanical treatments, pesticides, and other means to assure optimum vegetation health must not compromise the intended purpose of the infiltration basin. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

All vegetated areas should be inspected at least annually for unwanted growth, which should be removed with minimum disruption to the remaining vegetation and basin subsoil.

C. Structural Components

All structural components must be inspected for cracking, subsidence, spalling, erosion, and deterioration at least annually.

D. Other Maintenance Criteria

The maintenance plan must indicate the approximate time it would normally take to drain the maximum design storm runoff volume below the bottom of the basin. This normal drain or drawdown time should then be used to evaluate the basin's actual performance. If significant increases or decreases in the normal drain time are observed, the basin's bottom surface, subsoil, and both groundwater and tailwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the basin. This applies to both surface and subsurface infiltration basins.

The bottom sand layer in a surface infiltration basin should be inspected at least monthly as well as after every storm exceeding 1 inch of rainfall. The permeability rate of the soil below the basin may also be retested periodically. If the water fails to infiltrate 72 hours after the end of the storm, corrective measures must be taken. Annual tilling by light equipment can assist in maintaining infiltration capacity and break up clogged surfaces.

Considerations

Infiltration basins can present some practical design problems. When planning for an infiltration basin that provides stormwater quality treatment, consideration should be given to soil characteristics, depth to the groundwater table, sensitivity of the region, and runoff water quality. Particular care must be taken when constructing infiltration basins in areas underlain by carbonate rocks known as Karst landscapes. See Appendix A10 of the Standards for Soil Erosion and Sediment Control in New Jersey for further guidance in Karst landscape areas.

A. Soil Characteristics

Soils are perhaps the most important consideration for site suitability. In general, County Soil Surveys can be used to obtain necessary soil data for the planning and preliminary design of infiltration basins. However, for final design and construction, soil tests are required at the exact location of a proposed basin in order to confirm its ability to function properly without failure.

Such tests should include a determination of the textural classification and permeability of the subgrade soil at and below the bottom of the proposed infiltration basin. The recommended minimum depth for subgrade soil analysis is 5 feet below the bottom of the basin or to the groundwater table. Soil permeability testing can be conducted in accordance with the Standards for Individual Subsurface Sewage Disposal Systems at N.J.A.C. 7:9A. See *Design Criteria* above for further subgrade soil requirements.

In addition, the results of a basin's soil testing should be compared with the County Soil Survey data used in the computation of development site runoff and the design of specific site BMPs, including the proposed infiltration basin, to ensure reasonable data consistency. If significant differences exist between the basin's soil test results and the County Soil Survey data, additional development site soil tests are recommended to determine and evaluate the extent of the data inconsistency and the need for revised site runoff and BMP design computations. All significant inconsistencies should be discussed with the local Soil Conservation District prior to proceeding with such redesign to help ensure that the final site soil data is accurate.

B. Construction

For infiltration basins, protection of the subgrade soils from compaction by construction equipment and contamination and clogging by sediment are vital. Prior to its construction, the area to be used for the infiltration basin should be cordoned off to prevent construction equipment and stockpiled materials from compacting the subgrade soils. During basin construction, precautions should be taken to prevent both subgrade soil compaction and sediment contamination. All excavation should be performed with the lightest practical excavation equipment. All excavation equipment should be placed outside the limits of the basin.

To help prevent subgrade soil contamination and clogging by sediment, basin construction should be delayed until all other construction within in its drainage area is completed and the drainage area stabilized. This delayed construction emphasizes the need, as described above, to cordon off the basin area to prevent compaction by construction equipment and material storage during other site construction activities. Similarly, use of an infiltration basin as a sediment basin is strongly discouraged. Where unavoidable, excavation for the sediment basin should be a minimum of 2 feet above the final design elevation of the basin bottom. Accumulated sediment can then be removed without disturbing the subgrade soils at the basin bottom, which should be established only after all construction within the basin's drainage area is completed and the drainage area stabilized.

Once the final grading phase of a surface infiltration basin is reached, the bottom of the basin should be deeply tilled with a rotary tiller or disc harrow and then smoothed out with a leveling drag or equivalent grading equipment. These procedures should preferably be performed with equipment located outside the basin bottom. If this is not possible, it should be performed with light-weight, rubber-tired equipment.

If basin construction cannot be delayed until its drainage area is stabilized, diversion berms or other suitable measures should be placed around the basin's perimeter during all phases of construction to divert all runoff and sediment away from the basin. These diversion measures should not be removed until all construction within the basin's drainage area is completed and the drainage area stabilized.

Broken stone fill used in subsurface infiltration basins should be placed in lifts and compacted using plate compactors. A maximum loose lift thickness of 12 inches is recommended.

A preconstruction meeting should be held to review the specific construction requirements and restrictions of infiltration basins with the contractor.

C. Runoff Quality

The quality of runoff entering an infiltration basin is a primary consideration in determining whether infiltration is advisable and, if so, in designing the basin itself. The planning of an infiltration basin must consider which pollutants will be present in the runoff and whether these pollutants will degrade groundwater quality. Certain soils can have a limited capacity for the treatment of bacteria and the soluble forms of nitrogen, phosphorus, and other pollutants like road salts and pesticides. Such pollutants are either attenuated in the soil column or go directly to the water table. Unfortunately, the soils that normally have the highest and, therefore, most suitable permeability rates also have the least ability to treat such pollutants. As a result, pretreatment of soluble pollutants prior to entry into the infiltration basin may be necessary in these soils. Pretreatment measures may include vegetative filters, bioretention systems (where the infiltration basin takes the place of the standard underdrain), and certain sand filters. Alternatively, the existing soil below the infiltration basin bottom may be augmented or replaced by soils with greater soluble pollutant removal rates.

Recommendations

A. Pretreatment

As with all other best management practices, pretreatment can extend the functional life and increase the pollutant removal capability of an infiltration basin. Pretreatment can reduce incoming velocities and capture coarser sediments, which will extend the life of the system. This is usually accomplished through such means as a vegetative filters, a forebay, and/or a manufactured treatment device. Information on vegetative filters and manufactured treatment devices is presented in Subchapters 9.10 and 9.6, respectively.

Forebays can be included at the inflow points to an infiltration basin to capture coarse sediments, trash, and debris, which can simplify and reduce the frequency of system maintenance. A forebay should be sized to hold the sediment volume expected between clean-outs.

As described above, it should be remembered that the runoff to all subsurface infiltration basins must be pretreated. This pretreatment must provide 80 percent removal of TSS for the maximum design storm runoff. See *Recharge BMP Design Guidelines* in *Chapter 6: Groundwater Recharge* for additional pretreatment information for subsurface infiltration basins used for groundwater recharge.

This pretreatment requirement does not apply to roofs and other above-grade surfaces. However, roof gutter guards and/or sumps or traps (equipped with clean-outs) in the conduits to a subsurface infiltration basin should be included wherever practical to minimize the amount of sediment and other particulates that can enter the basin.

B. Sensitivity of the Area

The planning of an infiltration basin site should consider the geologic and ecological sensitivity of the proposed site. Sensitive areas include FW1 streams, areas near drinking water supply wells, and areas of high aquifer recharge. Infiltration basins should be sited at least 100 feet from a drinking water supply well. They should also be sited away from foundations to avoid seepage problems. Measures should be taken in areas of aquifer recharge to ensure good quality water is being infiltrated to protect ground water supplies. Infiltration basins should be located away from septic systems to help prevent septic system failure and other adverse system interference.

C. Slopes

Topography of the location is an important consideration for basin operation. Ideally, basin construction should not occur where surrounding slopes are greater than 10 percent. The grading of the basin floor should be as level as possible (with the slope approaching zero) to achieve uniform spreading across the breadth and the length of the basin.

Grading and landscaping throughout the infiltration basin and its components must be designed to facilitate mowing, trimming, sediment and debris removal, and other maintenance activities.

References

Horner, R.R., J.J. Skupien, E.H. Livingston and H.E. Shaver. August 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. In cooperation with U.S. Environmental Protection Agency. Terrene Institute, Washington, D.C.

Livingston E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

New Jersey Department of Agriculture, November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.

New Jersey Department of Environmental Protection and Department of Agriculture. December 1994. Stormwater and Nonpoint Source Pollution Control Best Management Practices.

Ocean County Planning and Engineering Departments and Killam Associates. June 1989. Stormwater Management Facilities Maintenance Manual. New Jersey Department of Environmental Protection. Trenton, NJ.

Schueler, T.R.. July 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R., P.A. Kumble and M. Heraty. March 1992. A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R. and R.A. Claytor. 2000. Maryland Stormwater Design Manual. Maryland Department of the Environment. Baltimore, MD.

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CHAPTER 9.6

Standard for Manufactured Treatment Devices

Definition

A manufactured treatment device is a pre-fabricated stormwater treatment structure utilizing settling, filtration, absorptive/adsorptive materials, vortex separation, vegetative components, and/or other appropriate technology to remove pollutants from stormwater runoff.

The TSS removal rate for manufactured treatment devices is based on the NJDEP certification of the pollutant removal rates on a case-by-case basis. Details are provided below. Other pollutants, such as nutrients, metals, hydrocarbons, and bacteria can be included in the verification/certification process if the data supports their removal efficiencies.

Purpose

Manufactured treatment devices are intended to capture sediments, metals, hydrocarbons, floatables, and/or other pollutants in stormwater runoff before being conveyed to a storm sewer system, additional stormwater quality treatment measure, or waterbody.

Conditions Where Practice Applies

A manufactured treatment device is adequate for small drainage areas that contain a predominance of impervious cover that is likely to contribute high hydrocarbon and sediment loadings, such as small parking lots and gas stations. For larger sites, multiple devices may be necessary. Devices are normally used for pre-treatment of runoff before discharging to other, more effective stormwater quality treatment facilities.

In addition, a manufactured treatment device must have a maintenance plan and, if privately owned, should be protected by easement, deed restriction, ordinance, or other legal measures that prevent its neglect, adverse alteration, and removal.

Design Criteria

In addition to its certified pollutant removal rate, the basic design parameters for a manufactured treatment device will depend on the techniques it employs to remove particulate and dissolved pollutants from runoff. In general, the design of devices that treat runoff with no significant storage and flow rate attenuation must be based upon the peak design flow rate. However, devices that do provide storage and flow rate attenuation must be based, at a minimum, on the design runoff volume and, in some instances, on a routing of the design runoff hydrograph. Details of these and other design parameters are presented below.

A. Pollutant Removal Rates

The NJDEP Division of Science, Research & Technology (DSRT) is responsible for certifying final pollutant removal rates for all manufactured treatment devices. This final certification process must be based upon one of the following:

1. Verification of the device's pollutant removal rates by the N.J. Corporation for Advanced Technology (NJCAT) in accordance with the New Jersey Energy and Environmental Technology Verification Program at N.J.S.A. 13:D-134 et seq. This verification must be conducted in accordance with the protocol "Stormwater Best Management Practices Demonstration Tier II Protocol for Interstate Reciprocity" as developed under the Environmental Council of States (ECOS) and Technology Acceptance and Reciprocity Partnership (TARP). This stormwater protocol ensures that technologies are evaluated in a uniform manner assuring minimum standards for quality assurance and quality control (QA/QC). In addition, the protocol establishes an interstate reciprocity pathway for technology and regulatory acceptance.
2. Verification of the device's pollutant removal rates by another TARP state, or another state or government agency that is recognized by New Jersey through a formal reciprocity agreement, provided that such verification is conducted in accordance with the protocol "Stormwater Best Management Practices Demonstration Tier II Protocol for Interstate Reciprocity."
3. Verification of the device's pollutant removal rates by other third party testing organizations (i.e., NSF), provided that such verification is conducted in accordance with the protocol "Stormwater Best Management Practices Demonstration Tier II Protocol for Interstate Reciprocity." Other testing protocols may be considered if it is determined by the NJDEP to be equivalent to the Tier II Protocol.

It should be noted that the pollutant removal rates for a manufactured treatment device may be granted interim conditional certification by the NJDEP provided that the manufacturer submits an interim verification report through NJCAT and further agrees to apply for and complete the final certification process described above. All interim certifications are effective for a limited time period, as determined on a case-by-case basis by the NJDEP.

B. Flow Rates and Storage Volumes

To achieve its assigned TSS removal rate, a manufactured treatment device must be designed to treat the runoff generated by the stormwater quality design storm. Techniques to compute the runoff rates and volume from this storm event are discussed in *Chapter 5: Computing Stormwater Runoff Rates and Volumes*. Depending on the device's pollutant removal technique(s), the primary design parameter for a manufactured treatment device will normally be either the peak rate and/or total runoff volume from the stormwater quality design storm. Devices that convey inflow with little or no storage and provide pollutant removal only through such techniques as vortex flow, filtration, and/or absorption must be based on the peak rate of

stormwater quality design storm runoff. Devices that store and convey runoff more slowly and provide pollutant removal through such techniques as sedimentation and/or filtration must also be based on the total volume of runoff. Hydraulic losses through a device must be considered in the design of all related upstream and downstream drainage system components.

C. Overflows

All manufactured treatment devices must be able to safely overflow or bypass flows in excess of the stormwater quality design storm to downstream drainage systems. The capacity of the overflow or bypass must be consistent with the remainder of the site's drainage system. All such flows must be conveyed in such a manner that trapped material, including floatables, is not resuspended and released. The designer must also check the capacity of the downstream conveyance system to ensure the adequacy of the overflow or bypass. All manufactured treatment devices must also have similar provisions to safely overflow and/or bypass runoff in the event of internal component clogging, blockage, and/or failure.

D. Tailwater

The hydraulic design of all manufactured treatment devices must consider any significant tailwater effects of downstream waterways or facilities. This includes instances where the lowest invert in the outlet or overflow structure is below the flood hazard area design flood elevation of a receiving stream.

E. Subsurface Devices

All subsurface or underground devices must be designed for HS-20 traffic loading at the surface. All joints and connections must be watertight. The manhole cover or other approved permanent marker for the treatment device must clearly indicate that it is a pollutant-trapping device. Sufficient and suitable access must be provided for each chamber in the device for inspection and maintenance activities. This must include adequate clearance from adjacent structures to allow for placement and operation of maintenance equipment. All subsurface devices must also be installed a minimum of 20 feet from a septic tank/drainage field. Any subsurface device within 20 feet of a slope greater than 2:1 requires a geotechnical review.

F. On-line and Off-line Devices

Manufactured treatment devices may be constructed on-line or off-line. On-line systems receive upstream runoff from all storms, providing runoff treatment for the stormwater quality design storm and conveying the runoff from larger storms through an overflow. In off-line devices, most or all of the runoff from storms larger than the stormwater quality design storm bypass the device through an upstream diversion. This not only reduces the size of the required device overflow, but also reduces the device's long-term pollutant loading and associated maintenance, and the threat of resuspension and release of trapped material by larger storm inflows.

Maintenance

Effective performance of a manufactured treatment device requires regular and effective maintenance. *Chapter 8: Maintenance and Retrofit of Stormwater Management Measures* provides information and requirements for preparing a maintenance plan for stormwater management facilities, including manufactured treatment devices. Specific maintenance requirements for these devices are presented below. These requirements must be included in the device's maintenance plan.

A. General Maintenance

All manufactured treatment devices should be inspected and maintained in accordance with the manufacturer's instructions and/or recommendations and any maintenance requirements associated with the device's certification by the NJDEP Office of Innovative Technology. In addition, all device components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually as well as after every storm exceeding 1 inch of rainfall. Disposal of debris, trash, sediment, and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

B. Vegetation

In those devices utilizing vegetation, trimming of vegetation must be performed on a regular schedule based on specific site conditions. Vegetated areas must be inspected at least annually for erosion and scour as well as unwanted growth, which should be removed with minimum disruption to the planting soil bed and remaining vegetation. All use of fertilizers, mechanical treatments, pesticides, and other means to ensure optimum vegetation health in devices utilizing vegetation should not compromise the intended purpose of the device. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

C. Structural Components

All structural components must be inspected for cracking, subsidence, spalling, erosion, and deterioration at least annually.

D. Other Maintenance Criteria

The maintenance plan must indicate the maximum level of oil, sediment, and debris accumulation allowed before removal is required. These levels should then be monitored during device inspections to help determine the need for removal and other device maintenance.

References

Livingston E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

New Jersey Department of Agriculture, November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.

New Jersey Department of Environmental Protection. Stormwater Best Management Practices Demonstration Tier II Protocol for Interstate Reciprocity. Environmental Council of States (ECOS) and Technology Acceptance and Reciprocity Partnership (TARP)

New Jersey Department of Environmental Protection and Department of Agriculture. December 1994. Stormwater and Nonpoint Source Pollution Control Best Management Practices.

Ocean County Planning and Engineering Departments and Killam Associates. June 1989. Stormwater Management Facilities Maintenance Manual. New Jersey Department of Environmental Protection. Trenton, NJ.

Schueler, T.R. July 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R., P.A. Kumble and M. Heraty. March 1992. A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C.

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C H A P T E R 9 . 7

Standard for Pervious Paving Systems

Definition

Pervious paving systems are paved areas that produce less stormwater runoff than areas paved with conventional paving. This reduction is achieved primarily through the infiltration of a greater portion of the rain falling on the area than would occur with conventional paving. This increased infiltration occurs either through the paving material itself or through void spaces between individual paving blocks known as pavers.

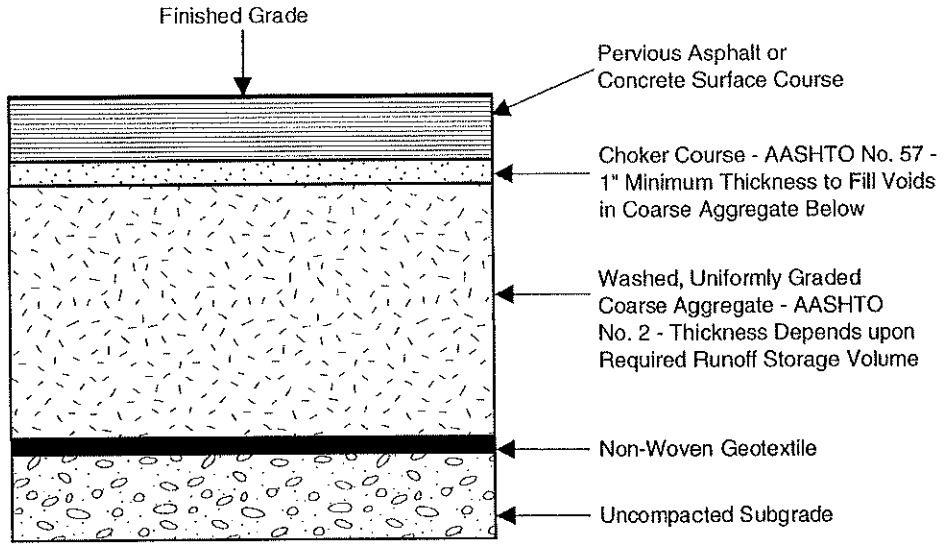
Pervious paving systems are divided into three general types. Each type depends primarily upon the nature of the pervious paving surface course and the presence or absence of a runoff storage bed beneath the surface course. These three types are summarized in Table 9.7-1 and discussed below. Porous paving and permeable paver with storage bed systems treat the stormwater quality design storm runoff through storage and infiltration. Therefore, these systems have adopted TSS removal rates similar to infiltration structures. The adopted TSS removal rate for each type of pervious paving system is presented in Table 9.7-1.

Table 9.7-1: Types of Pervious Paving Systems

Type of Paving System	General Description of Paving System	Adopted TSS Removal Rate
Porous paving	Porous asphalt or concrete paving constructed over runoff storage bed of uniformly graded broken stone	80%
Permeable pavers with storage bed	Impervious concrete pavers with surface voids constructed over runoff storage bed of uniformly graded broken stone	80%
Permeable pavers without storage bed	Impervious concrete pavers with surface voids constructed over structural bed of sand and crushed stone	Volume reduction only

Porous paving systems consist of a porous asphalt or concrete surface course placed over a bed of uniformly graded broken stone. The broken stone bed is placed on an uncompacted earthen subgrade and is used to temporarily store the runoff that moves vertically through the porous asphalt or concrete into the bed. The high rate of infiltration through the porous paving is achieved through the elimination of the finer aggregates that are typically used in conventional paving. The remaining aggregates are bound together with an asphalt or Portland cement binder. The lack of the finer aggregate sizes creates voids in the normally dense paving that allow runoff occurring on the paving to move vertically through the paving and into the void spaces of the broken stone storage bed below. From there, the stored runoff then infiltrates over time into the uncompacted subgrade soils similar to an Infiltration Basin. The depth of the bed, which also provides structural support to the porous surface course, depends upon the volume and rate of rainfall that the porous paving system has been designed to store and infiltrate and the void ratio of the broken stone. A typical detail of a porous paving system is shown in Figure 9.7-1.

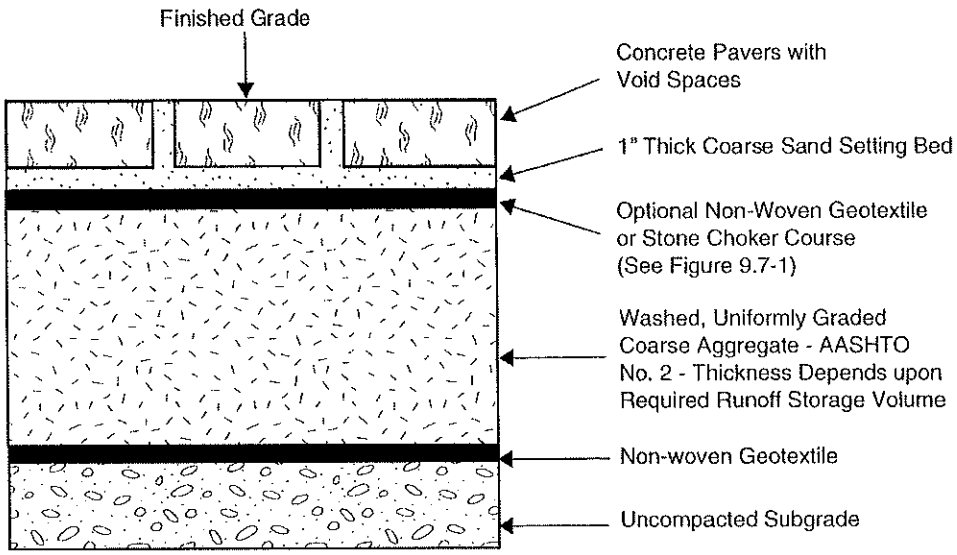
Figure 9.7-1: Porous Paving Details



Source: Cahill Associates.

A permeable paver with storage bed system also has a subsurface storage bed and functions in a similar manner to a porous paving system. However, instead of a continuous porous asphalt or concrete surface course, the system's surface consists of impervious concrete blocks known as pavers that either have void spaces cast into their surfaces or interlock in such a way as to create such void spaces. These void spaces allow runoff from the impervious paver surface to collect and move vertically past the individual pavers into the broken stone storage bed below. Similar to a porous paving system, the runoff stored in the broken stone storage bed, which also provides structural support to the pavers, then infiltrates over time into the uncompacted subgrade soils. A typical detail of a permeable paver with storage bed system is shown in Figure 9.7-2.

Figure 9.7-2: Permeable Pavers with Storage Base

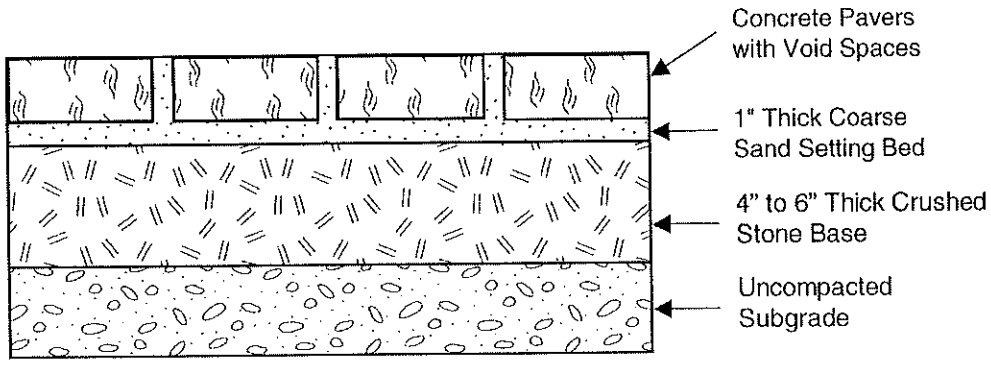


It is important to note that both a porous paving system and a permeable paver with storage bed system function in the same manner as any other infiltration-based BMP such as an infiltration basin or dry well. That is, the fundamental means of runoff quantity control is into and through the subgrade soils below the BMP. Therefore, in terms of runoff quantity control, the porous paving or permeable paver surface course acts solely as a conveyance measure that delivers the surface course runoff to the subgrade soils. In addition, the broken stone storage bed serves only to temporarily store the runoff transmitted through the surface course. For these reasons, the design and use of porous paving and permeable paver with storage bed systems are generally subject to the same design, operation, and maintenance requirements of all other infiltration-based BMPs. Details of these requirements are presented in *Design Criteria* below.

In addition to runoff volume control, porous paving and permeable paver with storage bed systems also provide stormwater quality control through the infiltration process when designed to store and infiltrate the stormwater quality design storm runoff volume. This is again similar to other infiltration-based BMPs such as infiltration basins. In addition, the porous or permeable paver surface course in such systems can be considered to provide pretreatment of the runoff to their respective subsurface storage beds.

Permeable pavers without a storage bed is the third type of pervious paving system. As described by its name, this type of system does not have a broken stone runoff storage bed beneath it. Instead, the permeable pavers are placed on a generally thinner bed of sand and crushed stone that provides only structural support to the paver surface course and has no significant runoff storage volume. This lack of storage volume prevents the system from storing and infiltrating the relatively larger volumes of runoff typically achieved by a porous paving or permeable paver with storage bed system. However, because of the void spaces in the paver surface, a portion of the runoff from the pavers, albeit smaller than the storage bed systems, can still collect in the surface voids spaces and infiltrate through the sand and crushed stone bed and into the subgrade soils. A typical detail of a permeable paver without storage bed system is shown in Figure 9.7-3.

Figure 9.7-3: Permeable Paver without Storage Base



Purpose

In general, pervious paving systems are used to reduce runoff rates and volumes from paved, on-grade surfaces such as patios, walkways, driveways, fire lanes, and parking spaces. Pervious paving systems with runoff storage beds below them achieve these reductions through the delivery and storage of runoff and eventual infiltration into the subgrade soils. Through this infiltration process, these types of pervious paving systems also achieve stormwater quality treatment.

Porous paving and permeable paver with storage bed systems may also be used to meet the groundwater recharge requirements of the NJDEP Stormwater Management Rules. See *Recharge BMP Design Guidelines* in *Chapter 6: Groundwater Recharge* for a complete discussion of these requirements and the use of pervious paving and other groundwater recharge facilities to meet them.

Permeable pavers without storage bed systems also achieve reductions in runoff rates and volumes, primarily by generating less surface runoff than conventional paving. However, due to the lack of a runoff storage bed and significant runoff infiltration, these types of pervious paving systems achieve less runoff reductions than systems with storage beds. For similar reasons, they also do not provide any significant stormwater quality treatment. However, the reduction in runoff rates and volumes they do achieve may reduce the volume of stormwater quality design storm runoff to be treated by other, downstream stormwater management facilities.

Conditions Where Practice Applies

As noted above, porous paving and permeable pavers with storage bed systems function as infiltration facilities. As such, the use of such pervious paving systems is applicable only where their subgrade soils have the required permeability rates. Specific soil permeability requirements are presented below in *Design Criteria*.

Like other BMPs that rely on infiltration, porous paving and permeable pavers with storage bed systems are not appropriate for areas where high pollutant or sediment loading is anticipated due to the potential for groundwater contamination. Specifically, such systems must not be used in the following locations:

- Industrial and commercial areas where solvents and/or petroleum products are loaded, unloaded, stored, or applied or pesticides are loaded, unloaded, or stored.

- Areas where hazardous materials are expected to be present in greater than "reportable quantities" as defined by the U.S. Environmental Protection Agency in the Code of Federal Regulations at 40 CFR 302.4.
- Areas where system use would be inconsistent with an NJDEP-approved remedial action work plan or landfill closure plan.
- Areas with high risks for spills of toxic materials such as gas stations and vehicle maintenance facilities.
- Areas where industrial stormwater runoff is exposed to "source material." "Source material" means any material(s) or machinery, located at an industrial facility, that is directly or indirectly related to process, manufacturing, or other industrial activities, that could be a source of pollutants in any industrial stormwater discharge to groundwater. Source materials include, but are not limited to raw materials, intermediate products, final products, waste materials, by-products, industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

In addition, as required by the Stormwater Management Rules, porous paving and permeable pavers with storage bed systems must not be used where their installation would create a significant risk for basement seepage or flooding, cause surficial flooding of groundwater, or interfere with the operation of subsurface sewage disposal systems and other subsurface structures. Such adverse impacts must be assessed and avoided by the design engineer.

Porous paving and permeable pavers with storage bed systems must be configured and located where their construction will not compact the soils below the system. In addition, such systems must not be placed into operation until the contributing drainage area is completely stabilized. System construction must either be delayed until such stabilization is achieved, or upstream runoff must be diverted around the system. Such diversions must continue until stabilization is achieved.

Due to the reduced shear strength of the surface course, all pervious paving systems are limited to areas of relatively infrequent use by light vehicles. This includes parking lot spaces and secondary aisles, single family residential driveways, sidewalks and walkways, golf cart paths, fire and emergency access lanes, and overflow parking areas. In general, they should not be used in high traffic areas such as roadways, multiple family and nonresidential driveways, and primary parking lot aisles or in any area subject to use by heavy vehicles and other equipment.

One pervious paving use strategy is to alternate areas with impervious and pervious paving. In these instances, conventional paving would be reserved for the heavily trafficked corridors. A wide variety of concrete and brick permeable paving systems are available. These can be combined with conventional and porous paving systems to achieve functional and aesthetically pleasing designs.

Finally, all three types of pervious paving systems must have a maintenance plan and, if privately owned, should be protected by easement, deed restriction, ordinance, or other legal measures that prevent its neglect, adverse alteration, and removal.

Design Criteria

The design criteria for pervious paving systems will depend upon the type of system to be used. Details of each system type are presented in Figures 9.7-1, 9.7-2, and 9.7-3 above. Design criteria for each type are presented below.

A. Storage Volume, Depth, and Duration

Porous paving and permeable paver with storage bed systems must be designed to treat the total runoff volume generated by the system's maximum design storm. This may be either the groundwater recharge or stormwater quality design storm depending upon the system's proposed use. Techniques to compute these volumes are discussed in *Chapter 6: Groundwater Recharge* and *Chapter 5: Computing Stormwater Runoff Rates and Volumes*. Such systems must also all fully drain this runoff volume within 72 hours. Runoff storage for greater times can render the systems ineffective and may result in anaerobic conditions and water quality problems. The bottom of these types of pervious paving systems must be at least 2 feet above seasonal high water table or bedrock. This distance must be measured from the bottom of the storage bed as shown in Figures 9.7-1 and 9.7-2. The system bottom must be as level as possible to uniformly distribute runoff infiltration over the subgrade soils.

As discussed in *Considerations* below, construction of all pervious paving systems must be done without compacting the system's subgrade soils. As such, all excavation must be performed by equipment placed outside the system's limits whenever possible. This requirement should be considered when designing the dimensions and total volume of a system's broken stone storage bed or crushed stone base.

It is important to note that the use of both porous paving and permeable pavers with storage bed systems is recommended in this manual only for the stormwater quality design storm and smaller storm events. Use of such systems for larger storm events and the requirements by which such systems are to be designed, constructed, and maintained should be reviewed and approved by all applicable reviewing agencies.

Since permeable paver without storage bed systems do not rely on significant runoff infiltration, they may be used for all frequency storm events.

B. Permeability Rates

The minimum design permeability rate of the soils below porous and permeable paving systems with storage beds will depend upon the pervious paving system's location and maximum design storm. The use of storage beds for stormwater quality control is feasible only where the soil is sufficiently permeable to allow a reasonable rate of infiltration. Therefore, porous paving and permeable paver with storage bed systems can be constructed only in areas with Hydrologic Soil Group A and B soils.

For porous paving and permeable paver with storage bed systems, the minimum design permeability rate of the subgrade soils below a system's runoff storage bed is 0.5 inches per hour. In addition, the design permeability rate of the soils must be sufficient to fully drain the system's maximum design storm runoff volume within 72 hours. This design permeability rate must be determined by field or laboratory testing. See *A. Soil Characteristics* in *Considerations* below for more information. Since the actual permeability rate may vary from test results and may also decrease over time due to soil bed consolidation or the accumulation of sediments removed from the treated stormwater, a factor of safety of two must be applied to the tested permeability rate to determine the design permeability rate. Therefore, if the tested permeability rate of the soils is 4 inches/hour, the design rate would be 2 inches/hour (i.e., 4 inches per hour/2). This design rate would then be used to compute the system's maximum design storm drain time.

Due to its role as a runoff conveyance measure to the storage bed below, the porous surface course of a porous paving system must have a minimum permeability rate at least twice the maximum intensity of the

system's design storm. In the case of systems designed for the stormwater quality design storm, this permeability rate would be 6.4 inches per hour (i.e., 2 X 3.2 inches per hour, which is the stormwater quality design storm's maximum intensity). Similarly, the minimum permeability of the material used to fill the void spaces of a permeable paver with storage bed system must also meet this requirement. However, since the void spaces in a permeable paver system comprise only a portion of the entire system surface, this minimum rate must be multiplied by the ratio of the entire system surface area to the area of the void spaces. Therefore, the void space material in a permeable paver with storage bed system comprised of 20 percent void space must have a minimum permeability of 2 X (1.0/0.2) or 10 times the maximum design storm intensity. For such systems designed for the stormwater quality design storm, this rate would be 3.2 X 10 or 32 inches per hour.

Since a permeable paver without storage bed system does not rely on significant runoff infiltration, its use does not require a minimum subgrade soil or void space material permeability rate. However, as described below, its ability to reduce runoff rates and volumes below those produced by conventional paving will depend upon both of these system characteristics.

To allow pervious paving surface courses to achieve their design permeability rates, the maximum surface course slope of all pervious paving systems is 5 percent.

C. Pretreatment

As with all other best management practices, pretreatment can extend the functional life and increase the pollutant removal capability of a pervious paving system that receives runoff from areas other than its own surface course. Pretreatment can reduce incoming velocities and capture coarser sediments, which will extend the life and reduce the required maintenance of the system. This is usually accomplished through the use of a vegetative filter immediately upstream of the pervious paving system. Steps can also be taken during the system's design to limit the amount of runoff from upstream areas that will flow to the system.

Runoff collected from parking lots, driveway, roads, and other on-grade surfaces that is conveyed directly to a porous paving or permeable paver storage bed without passing through the system's surface course must be pretreated in order to prevent the loss of storage volume and/or recharge capacity due to sedimentation and clogging. Such pretreatment must provide 80 percent removal of TSS for the system's maximum design storm runoff. This treatment can also be used to meet the site's overall TSS removal requirements.

This pretreatment requirement does not apply to roofs and other above-grade surfaces. However, roof gutter guards and/or sumps or traps (equipped with clean-outs) in the conduits to the system's storage bed should be included wherever practical to minimize the amount of sediment and other particulates that can enter the storage bed.

D. Computing Runoff Rates

In general, runoff to downstream areas from porous paving and permeable paver with storage bed systems will need to be computed under two circumstances. The first occurs when the capacity of the runoff storage bed is exceeded and the water level in the bed rises to the system's surface course. The second circumstance occurs when the intensity of precipitation exceeds the minimum permeability of the system's surface course. See *B. Permeability Rates* above for a discussion of these rates for each type of storage bed system. Once either or both of these circumstances occurs, the resultant system runoff rate to downstream areas for the remainder of the storm can be determined by subtracting the minimum system permeability rate from the rainfall rate. In the case of variable rate storm events such as the stormwater quality design storm or the NRCS Type III Storm, this must be done in a series of appropriate-length time increments over the remaining storm duration.

Runoff from permeable paver without storage bed systems must be computed for all storm events and can be performed by two methods. The first method is based upon a weighted average runoff coefficient (C) for the Rational or Modified Rational Methods or a weighted average Curve Number (CN) for the NRCS methodology. These values should be based upon the relative areas of the impervious pavers and pervious void spaces in the system's surface. The C or CN value for the paver area should be based upon an impervious surface, while the C or CN value for the void space should be based upon the type of material or surface cover in the void space and the Hydrologic Soil Group of the subgrade soil. In selecting this void space coefficient, all void spaces with vegetated covers should be assumed to be in poor hydrologic condition and all void spaces with bare soil or gravel fill should be based upon soil or gravel roadways.

The second method of computing runoff from permeable paver without storage bed systems considers the pavers to be unconnected impervious areas that drain onto the pervious void spaces. The resultant runoff from the system can then be based upon the unconnected impervious surface methods described in *Chapter 5*. In doing so, the criteria for selecting the appropriate CN for the void space must be based upon the criteria described in the preceding paragraph. In addition, it should be noted that the TR-55 method for unconnected impervious areas as described in *Chapter 5* cannot be used if the void space area is less than 70 percent of the total system area (i.e., the impervious portion of the entire system area exceeds 30 percent).

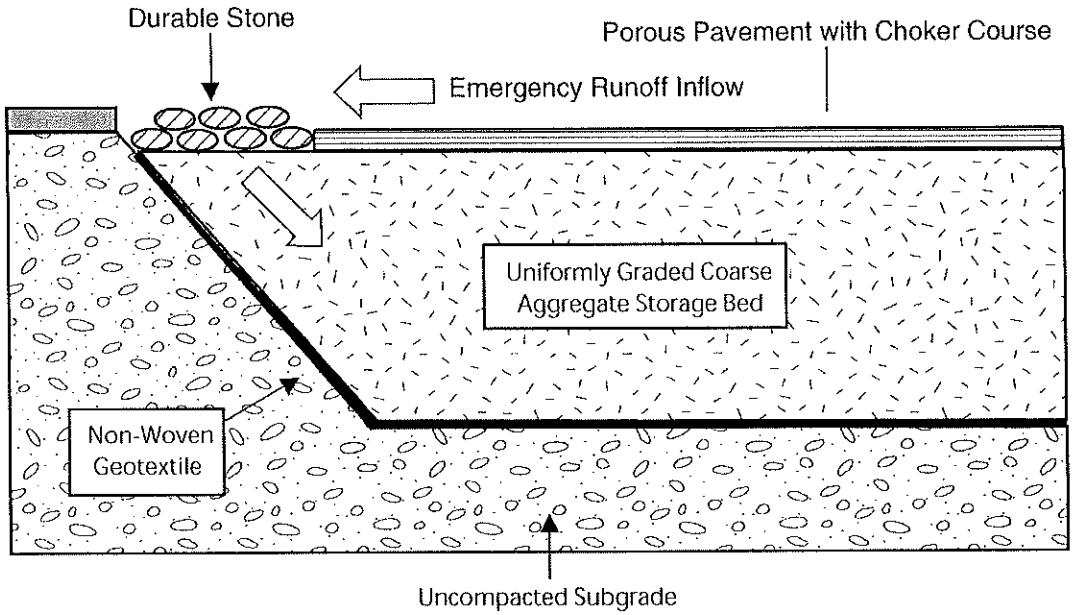
E. Overflows

All porous paving and permeable paver with storage bed systems must be able to safely convey system overflows to downstream drainage systems. The capacity of the overflow must be consistent with the remainder of the site's drainage system and sufficient to provide safe, stable discharge of stormwater in the event of an overflow. The downstream drainage system must have sufficient capacity to convey the overflow from the pervious paving system.

F. Emergency Inflows

All porous paving and permeable paver with storage bed systems must have measures that will allow runoff from the maximum design storm to enter the runoff storage bed in the event that the porous or permeable paver surface course becomes clogged or otherwise incapable of conveying the maximum design storm runoff to the bed. This may be accomplished in different ways, including surface drain inlets connected to a series of perforated pipes laid throughout the storage bed or by extending the storage bed beyond the edge of the surface course and connecting it to the surface as shown in Figure 9.7-4.

Figure 9.7-4: Example of Porous Paving Emergency Inflow



Note: Emergency inflow may also be provided by surface drain inlets and perforated pipes in the storage bed. See text for details.

Source: Cahill Associates.

G. System Components

The typical components of each type of pervious paving system are shown in Figures 9.7-1, 9.7-2 and 9.7-3. While variations are permissible based upon specific site conditions, the typical system components shown in these figures should be included in all system designs. This includes the sand and crushed stone base below a permeable paver without storage bed system shown in Figure 9.7-3. All such systems constructed without these components must be treated as conventional paved surfaces for the purpose of all runoff and pollutant load computations.

The recommended aggregate for porous asphalt and concrete paving systems are shown in Table 9.7-2. For porous asphalt systems, the recommended amount of asphalt binder is 5.75 to 6.00 percent by weight. Lower amounts of binder have resulted in inadequate surface course shear strength and durability. As shown in Figures 9.7-1 and 9.7-2, the runoff storage beds in both porous paving and permeable paver with storage bed systems should be clean washed, uniformly graded AASHTO No. 2 broken stone. It is particularly important that this stone be washed to keep stone dust and other fine particles that can clog the surface of the subgrade soils from entering the storage bed. The interface between the porous or permeable paver surface course and the storage bed stone should be leveled with a choker course of AASHTO No. 57 broken stone with a minimum thickness of 1 inch. Finally, as shown in Figures 9.7-1 and 9.7-2, the interface between the storage bed stone and the subgrade soil should be lined with a non-woven geotextile. Additional system details are shown in the figures.

Table 9.7-2 – Porous Asphalt Paving Mix

U.S. Standard Sieve Size	Percent Passing
1/2 inch	100%
3/8 inch	95%
#4	35%
#8	15%
#16	10%
#30	2%

Source: Cahill Associates

Maintenance

Effective pervious paving system performance requires regular and effective maintenance. *Chapter 8: Maintenance and Retrofit of Stormwater Management Measures* contains information and requirements for preparing a maintenance plan for stormwater management facilities, including pervious paving systems. Specific maintenance requirements for all system types are presented below. These requirements must be included in the system's maintenance plan.

General Maintenance

The surface course of all pervious paving systems must be inspected for cracking, subsidence, spalling, deterioration, erosion, and the growth of unwanted vegetation at least once a year. Remedial measures must be taken as soon as practical.

Care must be taken when removing snow from the pervious paving surface courses. Pervious paving surface courses can be damaged by snow plows or loader buckets that are set too low to the ground. This is particularly true at permeable paver systems where differential settlement of pavers has occurred. Sand, grit, or cinders should not be used on pervious paving surface courses for snow or ice control.

If mud or sediment is tracked onto the surface course of a pervious paving system, it must be removed as soon as possible. Removal should take place when the surface course is thoroughly dry. Disposal of debris, trash, sediment, and other waste matter removed from pervious paving surface courses should be done at suitable disposal/recycling sites and in compliance with local, state, and federal waste regulations.

B. Porous Paving Systems

The surface course of a porous paving system must be vacuum swept at least four times a year. This should be following by a high pressure hosing. All dislodged sediment and other particulate matter must be removed and properly disposed.

C. Permeable Paver Systems

Maintenance of permeable pavers should be consistent with the manufacturer's recommendations.

D. Vegetation

Mowing and/or trimming of turf grass used with permeable pavers must be performed on a regular schedule based on specific site conditions. Grass should be mowed at least once a month during the growing season. All vegetated areas must be inspected at least annually for erosion and scour. Vegetated areas should also be inspected at least annually for unwanted growth, which should be removed with minimum disruption to the paver and remaining vegetation.

When establishing or restoring vegetation, biweekly inspections of vegetation health should be performed during the first growing season or until the vegetation is established. Once established, inspections of vegetation health, density, and diversity should be performed at least twice annually during both the growing and non-growing seasons. The vegetative cover should be maintained at 85 percent. If vegetation has greater than 50 percent damage, the area should be reestablished in accordance with the original specifications and the inspection requirements presented above.

All use of fertilizers, pesticides and other means to assure optimum vegetation health should not compromise the intended purpose of a pervious paving system. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

E. Other Maintenance Criteria

The maintenance plan must indicate the approximate time it would normally take to drain the maximum design storm runoff volume below the pervious paving system's surface course. This normal drain time should then be used to evaluate the system's actual performance. If significant increases or decreases in the normal drain time are observed or if the 72 hour maximum is exceeded, the various system components and groundwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the system.

Considerations

Pervious paving systems can present some practical design problems, particularly those with subsurface runoff storage beds that rely on infiltration to discharge the stored runoff. When planning such systems, consideration should be given to soil characteristics, depth to the seasonal high groundwater table, sensitivity of the region, and runoff quality. Particular care must be taken when constructing all pervious paving systems in areas underlain by carbonate rocks known as Karst landscapes. See Appendix A10 of the Standards for Soil Erosion and Sediment Control in New Jersey for further guidance in Karst areas. Further considerations are presented below.

A. Soil Characteristics

Soils are perhaps the most important consideration for site suitability. In general, County Soil Surveys can be used to obtain necessary soil data for system planning purposes, the preliminary design of all pervious paving systems, and the final design of permeable paver without storage bed systems. However, for the final design and construction of porous paving and permeable paver with storage bed systems, soil tests are required at the exact location of a proposed system in order to confirm its ability to function properly without failure.

Such tests should include a determination of the textural classification and permeability of the subgrade soil at and below the bottom of the proposed system's storage bed. The recommended minimum depth for subgrade soil analysis is 5 feet below the bottom of the storage bed or to the groundwater table. Soil permeability testing can be conducted in accordance with the Standards for Individual Subsurface Sewage Disposal Systems at N.J.A.C. 7:9A. See *Design Criteria* above for further subgrade soil requirements.

In addition, the results of a system's soil testing should be compared with the County Soil Survey data used in the computation of development site runoff and the design of specific site BMPs, including the proposed pervious paving system, to ensure reasonable data consistency. If significant differences exist between the system's soil test results and the County Soil Survey data, additional development site soil tests are recommended to determine and evaluate the extent of the data inconsistency and the need for revised site runoff and BMP design computations. All significant inconsistencies should be discussed with the local Soil Conservation District prior to proceeding with such redesign to help ensure that the final site soil data is accurate.

B. Construction

Similar to other infiltration facilities, the construction of all pervious paver systems must follow certain procedures and sequences. Additional construction requirements are also required for specific systems due to their particular nature and components. Details are provided below.

1. All Pervious Paving Systems

For all pervious paving systems, protection of the subgrade soils from compaction by construction equipment and contamination and clogging by sediment are vital. Prior to its construction, the area to be used for the pervious paving system should be cordoned off to prevent construction equipment and stockpiled materials from compacting the subgrade soils. During system construction, precautions should be taken to prevent both subgrade soil compaction and sediment contamination. All excavation should be performed with the lightest practical excavation equipment. All excavation equipment should be placed outside the limits of the system's storage bed or base.

To help prevent subgrade soil contamination and clogging by sediment, system construction should be delayed until all other construction within in its drainage area is completed and the drainage area stabilized. This delayed construction emphasizes the need, as described above, to cordon off the system area to prevent compaction by construction equipment and material storage during other site construction activities. Similarly, use of a pervious paving system area as a sediment basin is strongly discouraged. Where unavoidable, excavation for the sediment basin should be a minimum of 2 feet above the final design elevation of the system's storage bed or base. Accumulated sediment can then be removed without disturbing the subgrade soils at the system's bottom, which should be established only after all construction within the system's drainage area is completed and the drainage area stabilized.

If system construction cannot be delayed until its drainage area is stabilized, diversion berms or other suitable measures should be placed around the system's perimeter during all phases of construction to divert all runoff and sediment away from the system. These diversion measures should not be removed until all construction within the system's drainage area is completed and the drainage area stabilized.

A preconstruction meeting should be held to review the specific construction requirements and restrictions of all pervious paving systems with the contractor.

2. Porous Paving Systems

Broken stone in runoff storage beds should be placed in lifts and compacted using plate compactors. A maximum loose lift thickness of 12 inches is recommended. In addition, the following construction requirements for porous asphalt paving systems are recommended by the USEPA:

- Paving temperature = 240° to 260° F.
- Minimum air temperature for paving = 50° F.
- Compact paving with one to two passes with 10-ton roller.
- No vehicular use for a minimum of two days after paving completed.

3. Permeable Paver Systems

Broken stone in runoff storage beds should be placed in lifts and compacted using plate compactors. A maximum loose lift thickness of 12 inches is recommended. In order to provide the runoff quantity and quality benefits described above in *Definition*, the subgrade soils below all permeable paver systems cannot be stabilized through compaction or with cement or other stabilizing agents that reduce the soils' permeability. All permeable paver systems constructed with such stabilization must be treated as conventional paved surfaces for the purpose of all runoff and pollutant load computations.

C. Runoff Quality

The quality of the runoff entering a porous paving or permeable paver with storage bed system is a primary consideration in determining whether such systems are advisable and, if so, in designing the systems themselves. The planning of such systems must consider which pollutants will be present in the runoff and whether these pollutants will degrade groundwater quality. Certain soils can have a limited capacity for the treatment of bacteria and the soluble forms of nitrogen, phosphorus, and other pollutants like road salts and pesticides. Such pollutants are either attenuated in the soil column or go directly to the water table. Unfortunately, the soils that normally have the highest and, therefore, most suitable permeability rates also have the least ability to treat such pollutants. As a result, pretreatment of soluble pollutants prior to entry into a pervious paving system's storage bed may be necessary in these soils. Pretreatment measures may include vegetated filter strips, bioretention systems (where the infiltration basin takes the place of the standard underdrain), and certain sand filters. Alternatively, the existing soil below the infiltration basin bottom may be augmented or replaced by soils with greater soluble pollutant removal rates.

Recommendations

A. Sensitivity of the Area

Since they rely on runoff infiltration, the planning of porous paving or permeable paver with storage bed systems should consider the geologic and ecological sensitivity of the proposed site. Sensitive areas include FW1 streams, areas near drinking water supply wells, and areas of high aquifer recharge. Such pervious paving systems should be sited at least 100 feet from a drinking water supply well. They should also be sited away from foundations to avoid seepage problems. Measures should be taken in areas of aquifer recharge to ensure good quality water is being infiltrated to protect groundwater supplies. Porous paving and permeable paver with storage bed systems should also be located away from septic systems to help prevent septic system failure and other adverse system interference.

References

Adams, Michelle C.. May/June 2003. Porous Asphalt Pavement with Recharge Beds: 20 Years & Still Working. Stormwater, Volume 4, Number 3. Forester Communications. Santa Barbara, CA.

American Society of Civil Engineers. 1992. Design and Construction of Urban Stormwater Management Systems.

Boutiette, L. and C. Duerring. 1994. Nonpoint Source Management Manual – Publication No. 17356-500-500G/93-67-00. Commonwealth of Massachusetts, Department of Environmental Protection.

Horner, R.R., J.J. Skupien, E.H. Livingston and H.E. Shaver. 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. In cooperation with U.S. Environmental Protection Agency. Terrene Institute, Washington, D.C.

James, W. March/April 2002. Green Roads: Research into Permeable Pavers. Stormwater, Volume 3, Number 2. Forester Communications. Santa Barbara, CA.

Livingston E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

Logsdon, A.D. February 2002. Permeable Pave Stones – Permitting Infiltration and Reducing Storm Water Runoff. CE News, Volume 14, Number 1. Mercor Media. Alpharetta, GA.

New Jersey Department of Agriculture. November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.

New Jersey Department of Environmental Protection and Department of Agriculture. December 1994. Stormwater and Nonpoint Source Pollution Control Best Management Practices.

Ocean County Planning and Engineering Departments and Killam Associates. June 1989. Stormwater Management Facilities Maintenance Manual. New Jersey Department of Environmental Protection. Trenton, NJ.

Pennsylvania Association of Conservation Districts and Pennsylvania Department of Environmental Protection. 1998. Pennsylvania Handbook of Best Management Practices for Developing Areas.

Schueler, T.R. July 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R., P.A. Kumble and M. Heraty. March 1992. A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R. 1995. Site Planning for Urban Stream Protection, Chapter 7 – Green Parking Lots. Metropolitan Washington Council of Governments. Published by the Center for Watershed Protection.

U.S. Environmental Protection Agency. September 1999. Storm Water Technology Fact Sheet – Porous Pavement.

New Jersey Stormwater
Best Management Practices Manual

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CHAPTER 9.9

Standard for Sand Filters

Definition

A sand filter consists of a forebay and underdrained sand bed. It can be configured as either a surface or subsurface facility. Runoff entering the sand filter is conveyed first through the forebay, which removes trash, debris, and coarse sediment, and then through the sand bed to an outlet pipe. Sand filters use solids settling, filtering, and adsorption processes to reduce pollutant concentrations in stormwater. The adopted TSS removal rate for sand filters is 80 percent.

Purpose

Sand filters are normally used to remove relatively large amounts of sediments, metals, hydrocarbons, and floatables from stormwater runoff.

Conditions Where Practice Applies

Sand filters are normally used in highly impervious areas with relatively high TSS, heavy metal, and hydrocarbon loadings such as roads, driveways, drive-up lanes, parking lots, and urban areas. However, due to their relatively high sediment removal capabilities, sand filters are not generally recommended in pervious drainage areas where high coarse sediment loads and organic material such as leaves can quickly clog the sand bed. Where such loadings cannot be avoided, pretreatment is recommended. Since sand filters can be located underground, they can also be used in areas with limited surface space.

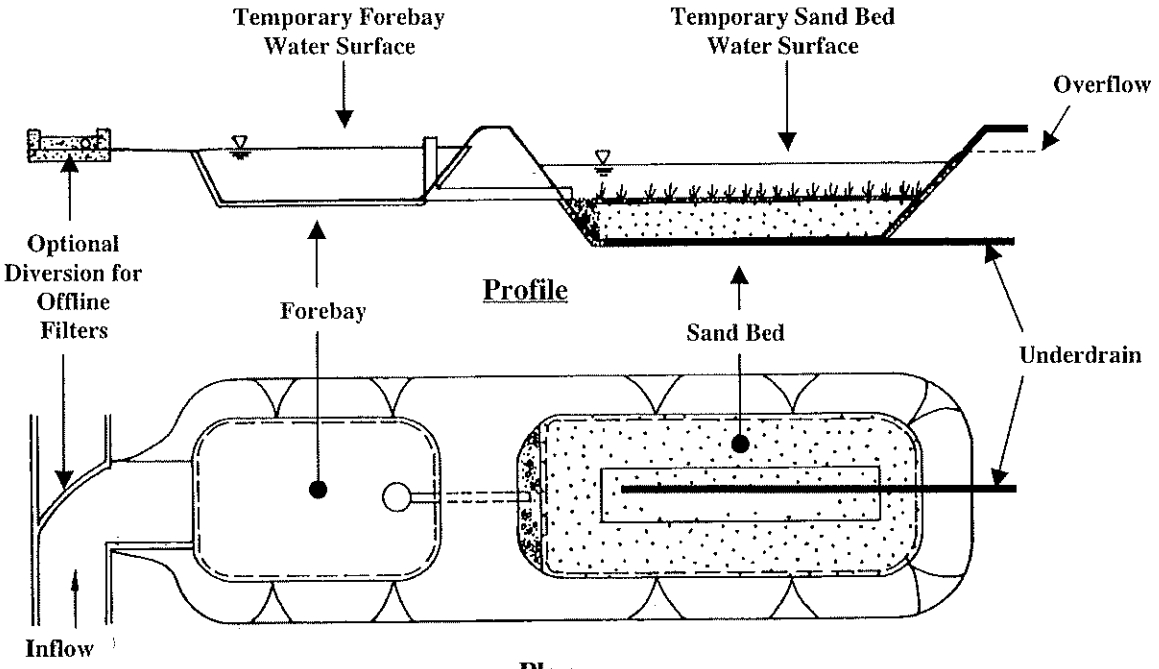
A sand filter must have a maintenance plan and, if privately owned, should be protected by easement, deed restriction, ordinance, or other legal measures that prevent its neglect, adverse alteration, and removal.

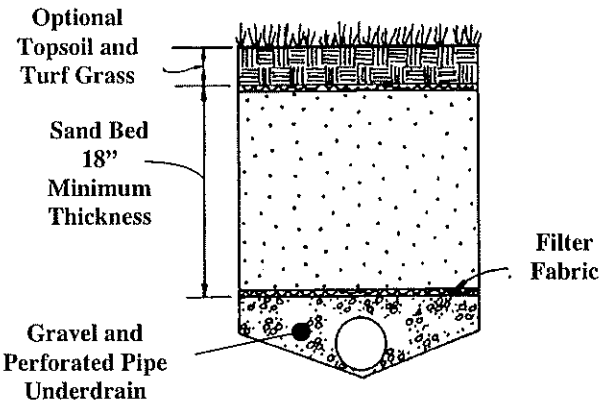
Design Criteria

In general, all sand filters consist of four basic components or zones: 1) Forebay Zone, 2) Sand Bed Zone, 3) Sand Bed Underdrain, and 4) Overflow. These and other typical sand filter components are shown in Figures 9.9-1, 2, and 3. These figures depict, respectively, a surface, subsurface, and perimeter sand filter, which are the three sand filter types discussed in this manual.

The basic design parameters for all three of these sand filter types are the surface areas and the temporary storage volumes in their forebay and sand bed zones and the thickness and infiltration rate of their sand beds. There must be sufficient total temporary storage volume within the forebay and sand bed zones (including the sand bed itself) to contain the design runoff volume and direct it thought the sand bed without overflow. The thickness of the sand bed must provide adequate pollutant removal, while the bed's permeability or infiltration rate must be sufficient to drain the stored runoff within 72 hours. In addition, the capacity of the sand bed underdrain must allow the sand bed to drain freely, while the overflow must safely convey the runoff from storms greater than the design storm. Details of these and other design parameters are presented below.

Figure 9.9-1: Typical Surface Sand Filter Components

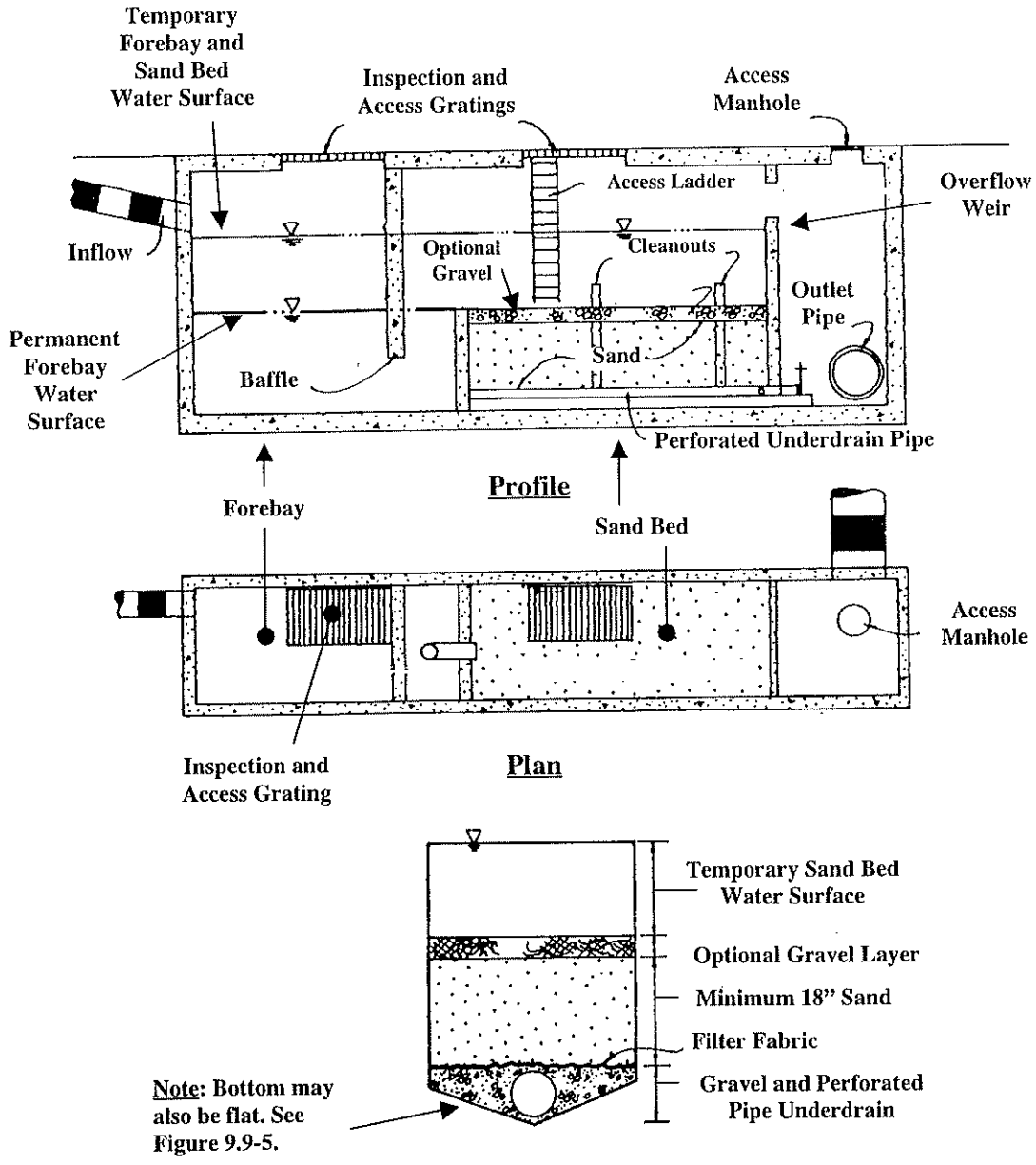




Typical Sand Bed Section

Source: Adapted from Claytor and Schueler, 1996.

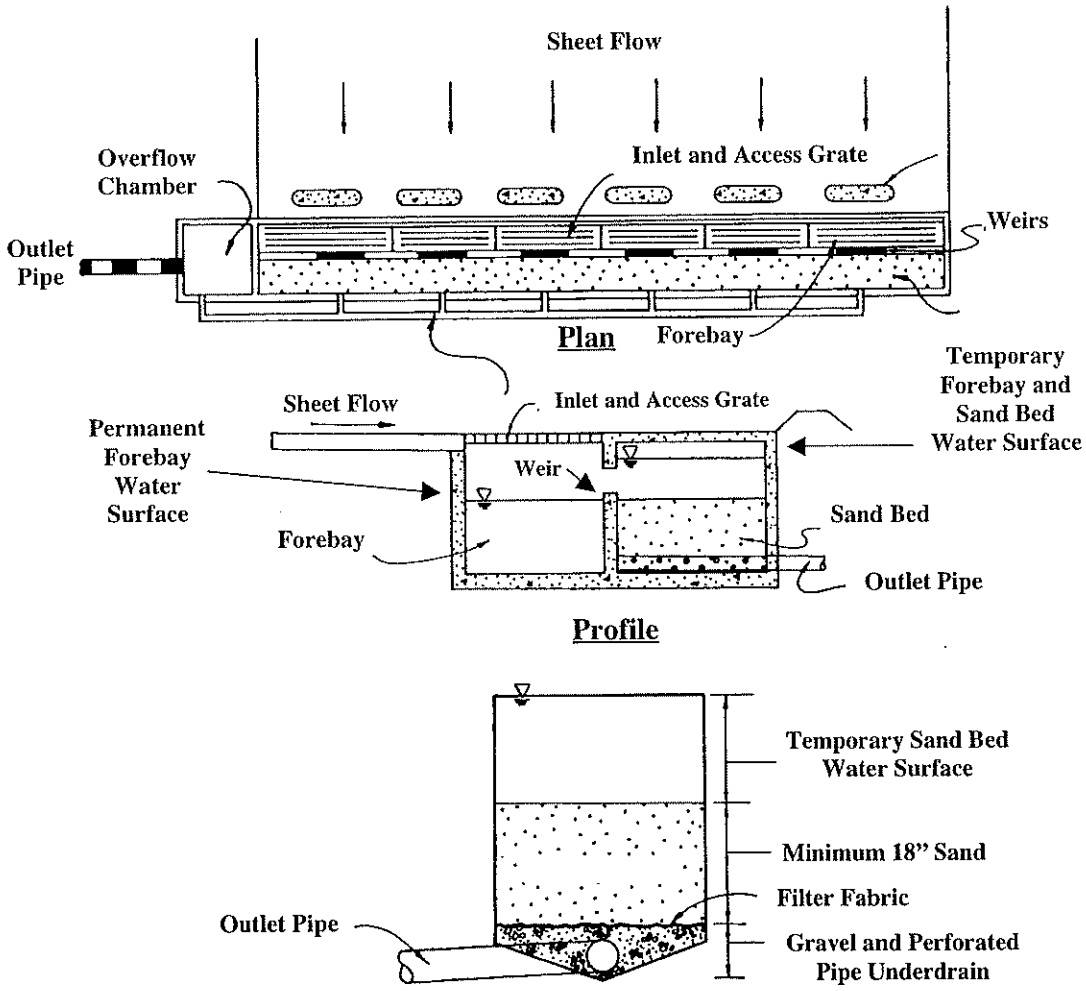
Figure 9.9-2: Typical Subsurface Sand Filter Components



Typical Sand Bed Section

Source: Adapted from Claytor and Schueler, 1996.

Figure 9.9-3: Typical Perimeter Sand Filter Components



Typical Sand Bed Section

Note: Bottom may also be flat.
See Figure 9.9-5.

Source: Adapted from Claytor and Schueler, 1996.

A. Storage Volume and Duration

Sand filters must be designed to treat the runoff volume generated by the stormwater quality design storm. Techniques to compute this volume are discussed in *Chapter 5: Computing Stormwater Runoff Rates and Volumes*. The maximum time required to fully drain the stormwater quality design storm runoff volume is 72 hours. As shown in Table 9.9-1, a design drain time of 36 hours must be used when designing the sand bed.

B. Component Dimensions, Areas, and Volumes

The required volumes, areas, and dimensions of the various sand filter components are shown in Table 9.9-1. Several of these parameters are depicted in Figure 9.9-4.

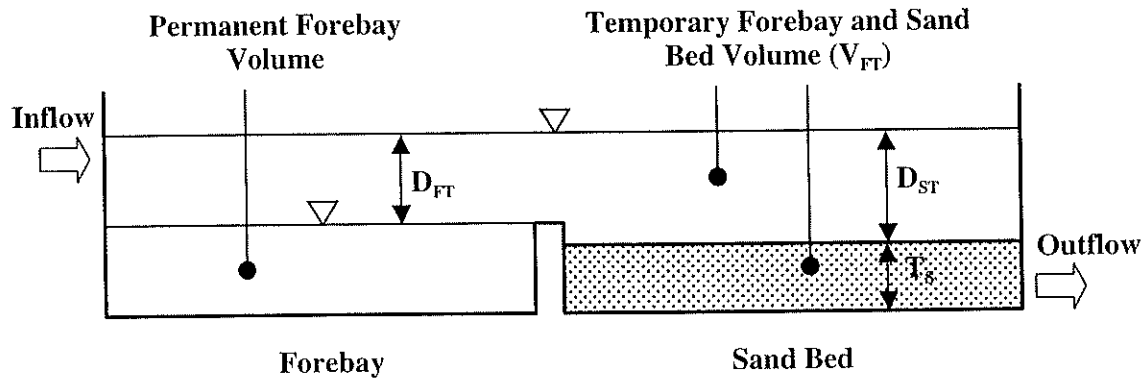
Table 9.9-1: Typical Sand Filter Design Parameters

#	Parameter Description	Parameter	Parameter Value		
			Surface Filter	Subsurface Filter	Perimeter Filter
1	Total Temporary Volume in Forebay and Sand Bed Zones[1]	V_{QS}	Stormwater Quality Design Storm Runoff Volume	Stormwater Quality Design Storm Runoff Volume	Stormwater Quality Design Storm Runoff Volume
2	Approximate Temporary Sand Bed Volume[2]	V_{ST}	$(0.5)(V_{QS})$	$(0.5)(V_{QS})$	$(0.5)(V_{QS})$
3	Minimum Sand Bed Thickness	TH_S	18 Inches	18 Inches	18 Inches
4	Sand Bed Design Porosity	n	0.3	0.3	0.3
5	Sand Bed Design Permeability	k	4 Feet per Day	4 Feet per Day	4 Feet per Day
6	Sand Bed Design Drain Time	T_D	1.5 Days	1.5 Days	1.5 Days
7	Minimum Sand Bed Surface Area	A_S	See Equation 9.9-1	See Equation 9.9-1	See Equation 9.9-1
8	Approximate Temporary Forebay Volume[3]	V_{FT}	$(0.5)(V_{QS})$	$(0.5)(V_{QS})$	$(0.5)(V_{QS})$
9	Minimum Forebay Surface Area	A_F	$(0.05)(V_{QS})$	$(0.05)(V_{QS})$	$(0.05)(V_{QS})$
10	Minimum Temporary Forebay Depth	D_{FT}	2 Feet	N/A	N/A
11	Minimum Permanent Forebay Depth	D_{FP}	N/A[4]	2 Feet	2 Feet
12	Overall Minimum Length to Width Ratio	L/W	2	2	N/A

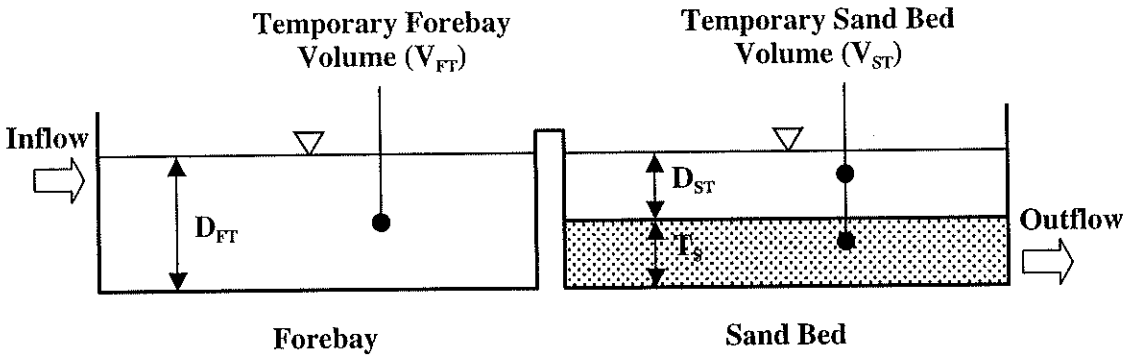
Notes:

1. Includes temporary storage volume in sand, but excludes storage volume in forebay permanent pool.
2. Includes temporary storage volume in sand.
3. Excludes storage volume in forebay permanent pool.
4. Forebay in surface sand filter typically does not have permanent pool.

Figure 9.9-4: Sand Filter Schematics



Schematic for Subsurface and Perimeter Sand Filters



Schematic for Surface Sand Filters

Source: Adapted from Claytor and Schueler, 1996.

C. General Design Procedure

Due to the number of design parameters, the design of a sand filter is generally a trial and error process to some degree. Utilizing the design parameters in Table 9.9-1 and the sand filter schematics shown in Figure 9.9-4, the general design procedure for sand filters is as follows:

1. Determine the runoff volume (V_{QS}) and peak discharge rate (Q_{QDS}) to the sand filter for the stormwater quality design storm. From Line 1 in Table 9.9-1, the total temporary storage volume in the sand filter's forebay and sand bed zones (including the storage volume within the sand bed, but excluding any permanent forebay storage volume) must equal V_{QS}.
2. Determine the approximate required volumes of the sand filter's forebay and sand bed zones. As shown on Lines 2 and 8 in Table 9.9-1, these volumes should each be approximately equal to one half of the stormwater quality design storm runoff volume (V_{QS}).
3. Estimate the maximum temporary depths in the sand bed (D_{ST}) and forebay (D_{FT}) zones for the stormwater quality design storm. This estimate should be based on an analysis of site conditions, including the difference between the invert elevation of the downstream conveyance system and the maximum ground elevation at the filter site. Analysis of this elevation difference should include consideration for the minimum sand bed thickness (T_{H5}) on Line 3 and either the minimum temporary forebay depth (D_{FT}) for surface filters on Line 10 or the permanent forebay depth (D_{FP}) for subsurface and perimeter filters on Line 11 of Table 9.9-1. As shown in Figure 9.9-4, the maximum temporary depth in the sand bed zone (D_{ST}) is measured from the top of the sand bed, while the maximum temporary forebay depth (D_{FT}) is measured from any permanent forebay water surface.
4. Compute the minimum forebay surface area (A_F). As shown on Line 9 of Table 9.9-1, this minimum area is $(0.05)(V_{QS})$. It should be noted that the 0.05 multiplier in the equation has the units of area per volume or L^2/L^3. As such, the equation yields square feet of forebay area from cubic feet of stormwater quality design storm runoff volume.
5. From the maximum temporary depth in the forebay (D_{FT}) from Step 3 and the minimum forebay area (A_F) from Step 4, compute the total temporary storage volume in the forebay (V_{FT}). Compare this volume with the approximate required forebay volume computed in Step 2. Adjust the maximum temporary forebay depth (D_{FT}) and/or forebay area (A_F) as necessary to achieve a total temporary forebay storage volume (V_{FT}) as close as practical to the required forebay volume from Step 2. While adjusting the forebay surface area (A_F) by varying its length and width, remember that the forebay will be located immediately adjacent to the sand bed zone and that the recommended minimum overall length to width ratio of these combined zones in surface and subsurface filters is two to one.
6. As shown on Line 7 of Table 9.9-1, compute the minimum sand bed surface area (A_S) using the following equation:

$$A_S = (V_{QS})(TH_S) / [(k)(D_{ST}/2 + TH_S)(T_D)] \qquad \text{(Equation 9.9-1)}$$

Where:

A_S = Minimum Sand Bed Surface Area (in square feet)
V_{QS} = Runoff Volume from the Stormwater Quality Design Storm (in cubic feet)
TH_S = Thickness of Sand in Sand Bed (in feet)
k = Sand Bed Design Permeability (in feet per day)
D_{ST} = Maximum Temporary Sand Bed Depth (in feet)
T_D = Sand Bed Drain Time (in days)

As shown in Table 9.9-1, the following parameter design values for Equation 9.9-1 are recommended:

Minimum Sand Thickness in Sand Bed (TH_S) = 18 inches
Sand Bed Design Permeability (k) = 4 feet per day
Sand Bed Design Drain Time = 1.5 days

7. Compute the total temporary storage volume in the sand bed zone (V_{ST}) from the following equation:

$$V_{ST} = (A_S)(D_{ST}) + (A_S)(TH_S)(n) \qquad \text{(Equation 9.9-2)}$$

Where:

V_{ST} = Temporary Sand Bed Storage Volume (in cubic feet)
A_S = Sand Bed Surface Area (in square feet)
D_{ST} = Maximum Temporary Sand Bed Depth (in feet)
TH_S = Thickness of Sand in Sand Bed (in feet)
n = Sand Bed Design Porosity

As shown in Table 9.9-1, the following parameter design values for Equation 9.9-2 are recommended:

Minimum Sand Thickness in Sand Bed (TH_S) = 18 inches
Sand Bed Design Porosity (n) = 0.3

8. Compare the total temporary sand bed storage volume (V_{ST}) with the approximate required sand bed zone volume computed in Step 2. As shown on Line 2 of Table 9.9-1, this temporary sand bed storage volume should be approximately one half of the stormwater quality design storm runoff volume (V_{QS}). In addition, add the total temporary sand bed volume (V_{ST}) to the total temporary forebay storage volume (V_{FT}) to determine the total temporary storage volume in the sand filter. As shown on Line 1 of Table 9.9-1, this total temporary storage volume must equal the stormwater quality design storm runoff volume (V_{QS}). Adjust the maximum temporary sand bed depth (D_{ST}) and/or sand bed area (A_S) as necessary to achieve a total temporary sand bed storage volume (V_{ST}) as close as practical to the required sand bed volume from Step 2 and a total filter volume equal to V_{QS}. Once again, while adjusting the sand bed surface area (A_S) by varying its length and width, remember that the sand bed will be located immediately adjacent to the forebay and that the recommended minimum overall length to width ratio of these combined zones in surface and subsurface filters is two to one.

D. Filter Bed Sand

The sand used in the sand bed must meet the specifications for clean medium aggregate concrete sand in accordance with AASHTO M-6 or ASTM C-33. This must be certified by a professional engineer licensed in the State of New Jersey.

E. Gravel Layer and Underdrain

The gravel layer serves as bedding material for the underdrain pipes. It must have sufficient thickness to provide a minimum of 2 inches of gravel above and below the pipes. It should consist of 0.5" to 1.5" clean broken stone or pea gravel (AASHTO M-43).

The underdrain piping must be rigid Schedule 40 PVC pipe in accordance with AASHTO M278. Perforated underdrain piping should have a minimum of 3/8-inch diameter perforations at 6-inch centers

with four perforations per annular row. The portion of drain piping beneath the sand bed must be perforated. All remaining underdrain piping, including cleanouts, must be nonperforated. All joints must be secure and watertight. Cleanouts must be located at the upstream and downstream ends of the perforated section of the underdrain and extend to or above the surface of the sand bed. Additional cleanouts should be installed as needed.

The underdrain piping must connect to a downstream storm sewer manhole, catch basin, channel, swale, or ground surface at a location that is not subject to blockage by debris or sediment and is readily accessible for inspection and maintenance. Blind connections to downstream storm sewers are prohibited. To ensure proper system operation, the gravel layer and perforated underdrain piping must have infiltration rates at least twice as fast as the design infiltration rate of the sand bed.

Additional details of typical sand filter underdrains are shown in Figure 9.9-5.

F. Overflows

All sand filters must be able to safely convey overflows to downstream drainage systems. The capacity of the overflow must be consistent with the remainder of the site's drainage system and sufficient to provide safe, stable discharge of stormwater in the event of an overflow. Sand filters that are classified as dams under the NJDEP Dam Safety Standards at N.J.A.C. 7:20 must also meet the overflow requirements of these Standards. Overflow capacity can be provided by a hydraulic structure such as a weir or orifice, or a surface feature such as a swale or open channel, as filter location and site conditions allow.

G. Tailwater

The hydraulic design of the underdrain and overflow systems, as well as any stormwater quantity control outlets, must consider any significant tailwater effects of downstream waterways or facilities. This includes instances where the lowest invert in the outlet or overflow structure is below the flood hazard area design flood elevation of a receiving stream.

H. On-line and Off-line Systems

In general, most sand filters are constructed off-line. In off-line sand filters, most or all of the runoff from storms larger than the stormwater quality design storm bypass the filter through an upstream diversion. This not only reduces the size of the required filter overflow, but also reduces the filter's long-term pollutant loading and associated maintenance and the threat of erosion and scour caused by larger storm inflows. However, sand filters may also be constructed on-line. On-line filters receive upstream runoff from all storms, providing runoff treatment for the stormwater quality design storm and conveying the runoff from larger storms through an overflow. Multi-purpose on-line filters also store and attenuate these larger storms to provide runoff quantity control. In such filters, the invert of the lowest stormwater quantity control outlet is set at or above the maximum stormwater quality design storm water surface.

Maintenance

Effective sand filter performance requires regular and effective maintenance. *Chapter 8: Maintenance and Retrofit of Stormwater Management Practices* provides information and requirements for preparing a maintenance plan for stormwater management facilities, including sand filters. Specific maintenance requirements for sand filters are presented below. These requirements must be included in the filter's maintenance plan.

A. General Maintenance

All sand filter components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually as well as after every storm exceeding 1 inch of rainfall. Such components may include inlets and diversion structures, forebays, sand beds, and overflows.

Sediment removal should take place when all runoff has drained from the sand bed and the sand is reasonably dry. In addition, runoff should be drained or pumped from forebays with permanent pools before removing sediment. Disposal of debris, trash, sediment, and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state, and federal waste regulations.

B. Vegetated Areas

In surface sand filters with turf grass bottom surfaces, mowing and/or trimming of vegetation must be performed on a regular schedule based on specific site conditions. Grass should be mowed at least once a month during the growing season. Vegetated areas must also be inspected at least annually for erosion and scour. The filter bottom must be inspected for unwanted underbrush and tree growth at least once a year.

When establishing or restoring vegetation, biweekly inspections of vegetation health should be performed during the first growing season or until the vegetation is established. Once established, inspections of vegetation health, density, and diversity should be performed during both the growing and non-growing season at least twice annually. If vegetation has greater than 50 percent damage, the area should be reestablished in accordance with the original specifications and the inspection requirements presented above.

All use of fertilizers, mechanical treatments, pesticides and other means to assure optimum vegetation health must not compromise the intended purpose of the sand filter. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

C. Structural Components

All structural components must be inspected for cracking, subsidence, spalling, erosion, and deterioration at least annually.

D. Other Maintenance Criteria

The maintenance plan must indicate the approximate time it would normally take to drain the maximum design storm runoff volume below the top of the filter's sand bed. This normal drain or drawdown time should then be used to evaluate the filter's actual performance. If significant increases or decreases in the normal drain time are observed, the filter's sand bed, underdrain system, and tailwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the filter.

The sand bed should be inspected at least twice annually. The infiltration rate of the sand bed material may also be retested. If the water fails to infiltrate 72 hours after the end of the stormwater quality design storm, corrective measures must be taken.

Considerations

A. Forebay and Sand Bed Drains

Wherever possible in subsurface and perimeter filters, a drain and valve should be provided in the forebay to permit draining of all standing water and facilitate sediment removal. This drain and valve can be connected to the sand bed underdrain system.

B. Drainage Area Stabilization

No runoff should enter the filter's sand bed until the upstream drainage area is completely stabilized and site construction is completed.

C. Watertight Construction

Underground sand filters should always be constructed completely watertight, especially if treating runoff from "hotspots" or over extremely sensitive groundwater areas.

D. Pretreatment

As with all other best management practices, pretreatment can extend the functional life and increase the pollutant removal capability of a sand filter. Pretreatment can reduce incoming velocities and capture coarser sediments, which will extend the life of the system. This is usually accomplished through such means as a vegetative filters and/or a manufactured treatment device. Information on vegetative filters and manufactured treatment devices is presented in Chapters 9.10 and 9.6, respectively.

As shown in Figures 9.9-1, 9.9-2, and 9.9-3, forebays at the inflow points to sand filters can capture coarse sediments, trash, and debris, which can simplify and reduce the frequency of filter maintenance. A forebay should be sized in accordance with Table 9.9-1 to hold the sediment volume expected between clean-outs.

References

Claytor, R. and T. Schueler. December 1996. Design of Stormwater Filtering Systems. The Center for Watershed Protection. Ellicott City, MD.

Horner, R.R., J.J. Skupien, E.H. Livingston and H.E. Shaver. 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. In cooperation with U.S. Environmental Protection Agency. Terrene Institute, Washington, D.C.

Livingston E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

New Jersey Department of Agriculture. November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.

New Jersey Department of Environmental Protection and Department of Agriculture. December 1994. Stormwater and Nonpoint Source Pollution Control Best Management Practices.

Ocean County Planning and Engineering Departments and Killam Associates. June 1989. Stormwater Management Facilities Maintenance Manual. New Jersey Department of Environmental Protection. Trenton, NJ.

Schueler, T.R., P.A. Kumble and M. Heraty. March 1992. A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R. and R.A. Claytor. 2000. Maryland Stormwater Design Manual. Maryland Department of the Environment. Baltimore, MD.

New Jersey Stormwater
Best Management Practices Manual

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CHAPTER 9.10

Standard for Vegetative Filters

Definition

A vegetative filter is an area designed to remove suspended solids and other pollutants from stormwater runoff flowing through a length of vegetation called a vegetated filter strip. The vegetation in a filter strip can range from turf and native grasses to herbaceous and woody vegetation, all of which can either be planted or indigenous. It is important to note that all runoff to a vegetated filter strip must both enter and flow through the strip as sheet flow. Failure to do so can severely reduce and even eliminate the filter strip's pollutant removal capabilities.

The total suspended solid (TSS) removal rate for vegetative filters will depend upon the vegetated cover in the filter strip. Table 9.10-1 below presents the adopted TSS removal rates for various vegetated covers.

Table 9.10-1: Adopted TSS Removal Rates for Vegetated Filter Strips

Vegetated Cover	Adopted TSS Removal Rate
Turf grass	60 %
Native Grasses, Meadow, and Planted Woods	70 %
Indigenous woods	80 %

For filter strips with multiple vegetated covers, the final TSS removal rate should be based upon a weighted average of the adopted rates shown above in Table 9.10-1. This weighted average removal rate should be based upon the relative flow lengths through each cover type. For example, a 50-foot long vegetated filter strip (measured in the direction of flow) that has turf grass in the upper 25 feet and native grasses in the lower 25 feet would have a TSS removal rate of (25/50)(60%) + (25/50)(70%) or 65 percent.

Purpose

A vegetative filter is intended to remove pollutants from runoff flowing through it. Vegetated filter strips can be effective in reducing sediment and other solids and particulates, as well as associated pollutants such as hydrocarbons, heavy metals, and nutrients. The pollutant removal mechanisms include sedimentation, filtration, adsorption, infiltration, biological uptake, and microbacterial activity.

Vegetated filter strips with planted or indigenous woods may also create shade along water bodies that lower aquatic temperatures, provide a source of detritus and large woody debris for fish and other aquatic organisms, and provide habitat and corridors for wildlife.

Condition Where Practice Applies

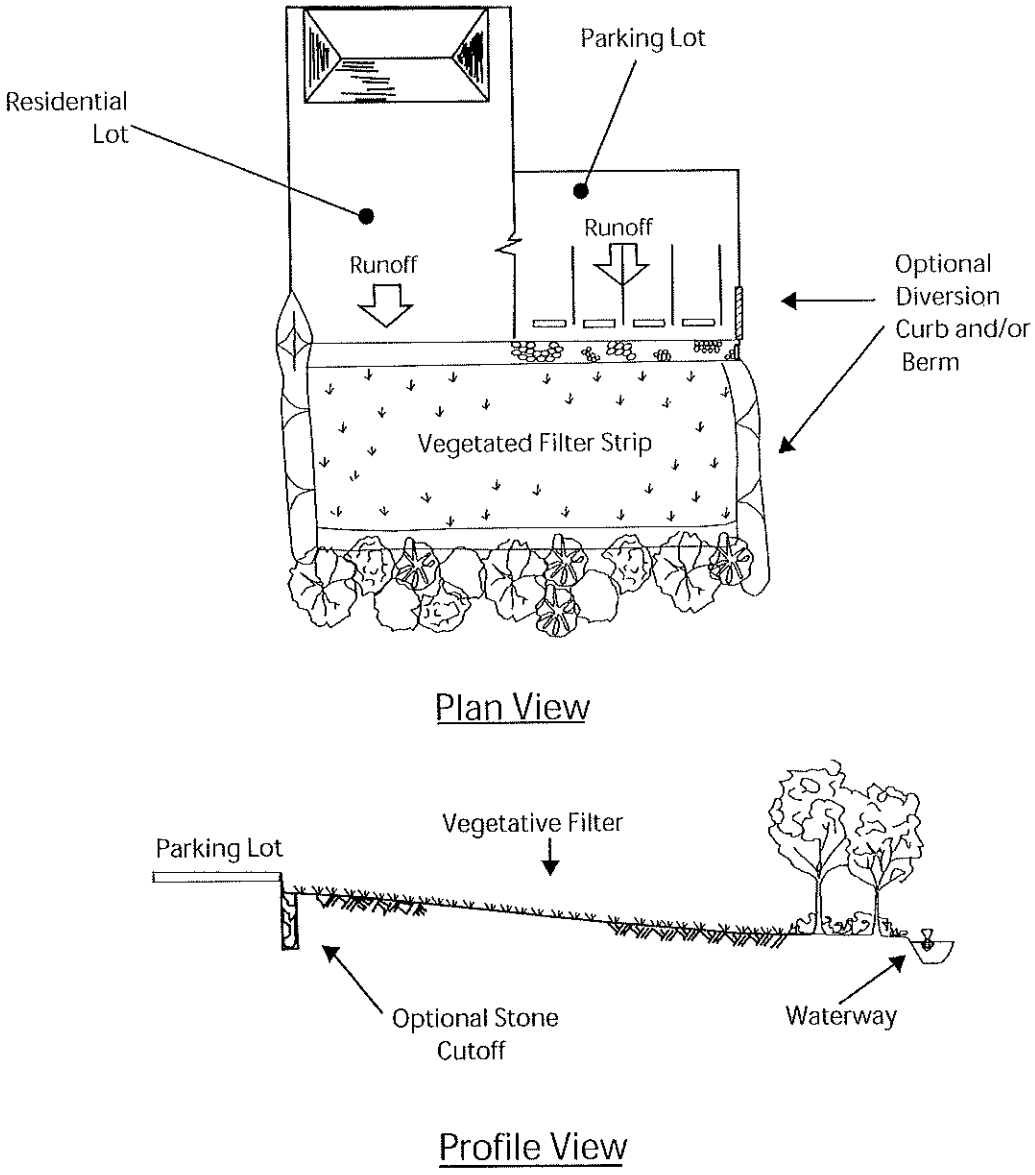
A vegetative filter can be effective only where the runoff entering and flowing through the strip remains as sheet flow and does not concentrate. This sheet flow requirement limits the use of vegetated filter strips in two ways. First, the area used for the filter strip itself must be mildly sloped and uniformly graded to maintain sheet flow or, in the case of indigenous areas, have surface features that retard, pond, and/or disperse runoff generally over the entire filter width. Second, since the runoff to a filter strip must enter the strip as sheet flow, the drainage area to the strip must also be uniformly graded and have a relatively horizontal downstream edge where it meets the upstream end of the filter strip. Such drainage areas may include yards, parking lots, and driveways where runoff flows as sheet flow. As a result, an area with irregular grading and other surface features that cause runoff to concentrate could neither be used as a vegetated filter strip nor have its runoff treated by one. For the same reasons, vegetated filter strips are also not intended to treat concentrated discharges from storm sewers, swales, and channels.

As detailed below in *Design Criteria*, additional factors must be considered. First, the vegetation in all filter strips must be dense and remain healthy and, in the case of planted or indigenous woods, have an effective mulch or duff layer. In addition, a vegetated filter strip must have a maintenance plan and be protected by an easement, deed restriction, or other legal measure that guarantees its existence and effectiveness in the future. Depending upon their TSS removal rate, vegetated filter strips can be used separately or in conjunction with other stormwater quality practices to achieve an overall pollutant removal goal.

Design Criteria

The primary design parameters for a vegetated filter strip are its slope, type of vegetated cover, and the type of soils within its drainage area. These three parameters are then used to determine the standard filter strip length required to achieve the adopted TSS removal rates shown above in Table 9.10-1. In addition, since runoff from the stormwater quality design storm must enter and continue as sheet flow over this length, the peak runoff rate must be sufficiently low and uniformly distributed to ensure such conditions. This peak runoff rate is achieved by limiting the sheet flow length that runoff will flow before entering the filter strip. This length limitation, in turn, limits the size of the drainage area to the filter strip and, consequently, the peak runoff rate. Details of these and other design parameters are presented below. The components of a typical vegetated filter strip are shown in Figure 9.10-1.

Figure 9.10-1 Vegetative Filter Components



Source: Adapted from Schueler and Claytor 1996.

A. Drainage Area and Runoff Characteristics

As noted above, runoff from a drainage area may be directed to flow through a filter strip provided it enters the filter strip and continues through it as sheet flow. In addition, the peak rate and maximum depth of runoff entering the filter strip must be low enough to allow the strip's vegetated cover to serve as an effective filter. As such, the maximum drainage area to a vegetated filter strip will be limited to an area 100 feet long for impervious surfaces and 150 feet long for pervious surfaces. These lengths are to be measured in the direction of flow to the upstream edge of the filter strip.

In addition, the interface of the drainage area and the upstream edge of the filter strip must be as horizontal as possible (perpendicular to the flow direction) so that runoff will be evenly distributed along the upstream edge of the strip. As shown in Figure 9.10-1, a stone cutoff trench, recessed curb, or other measure may be used along the filter's upstream edge to help distribute the runoff and dissipate some of its energy as it enters the filter strip.

As noted above, the required strip lengths are based in part upon the type of soils within the filter strip's drainage area. Table 9.10-2 below lists the various types of soils and their associated Hydrologic Soil Groups that will affect the strip's required length. County Soil Surveys and onsite soil investigations can be used to determine these soil types. Where more than one type of soil exists in a drainage area, the soil with the smallest particle size (and, consequently, the longest filter strip length) should be used in the filter strip's design.

B. Filter Strip Cover

As noted above, the vegetation in a filter strip can range from turf and native grasses to herbaceous and woody vegetation, all of which can either be planted or indigenous. The type of vegetation used in the filter strip can be very broad, although the best performance is associated with those with dense growth patterns such as turf-forming grasses and dense forest floor vegetation. All vegetation must be dense and healthy. In addition, planted woods must have a mulch layer with a minimum thickness of 3 inches, while indigenous woods must have at least a 1 inch thick natural duff layer.

Further information and references are presented in *Chapter 7: Landscaping*.

C. Filter Strip Grading

As noted above, the area used for a vegetated filter strip itself must be mildly sloped and uniformly graded to maintain sheet flow or, in the case of indigenous areas, have surface features that retard, pond, and/or disperse runoff generally over the entire filter width. As such, indigenous areas such as meadows and woods under consideration as vegetated filter strips should be surveyed and inspected during runoff events to determine runoff flow patterns. Indigenous areas with surface features that obstruct or retard runoff flow, cause ponding, and/or disperse runoff are acceptable, while those with surface features that cause runoff to concentrate are not. It should be noted that such observations must be made with consideration for the proposed volume and peak rate of runoff that the area would receive as a vegetated filter strip.

D. Maximum Filter Strip Slope

In addition to the soils within a vegetated filter strip's drainage area, the soils within the filter strip itself are also important for determining filter strip's maximum allowable slope. Table 9.10-2 below presents maximum filter strip slopes for various vegetated covers and soil types within the filter strip. County Soil Surveys and onsite soil investigations can be used to determine the soil type within a filter strip.

Table 9.10-2: Maximum Filter Strip Slope

Filter Strip Soil Type	Hydrologic Soil Group	Maximum Filter Strip Slope (Percent)	
		Turf Grass, Native Grasses, and Meadows	Planted and Indigenous Woods
Sand	A	7	5
Sandy Loam	B	8	7
Loam, Silt Loam	B	8	8
Sandy Clay Loam	C	8	8
Clay Loam, Silty Clay, Clay	D	8	8

E. Required Filter Strip Length

To achieve the adopted TSS removal rates shown above in Table 9.10-1, the required filter strip length can be determined from Figures 9.10-2 to 6 below based upon the filter strip's slope, vegetated cover, and the soil within its drainage area. As shown in the figures, the minimum length for all vegetated filter strips is 25 feet.

Figure 9.10-2: Vegetated Filter Strip Length
Drainage Area Soil: Sand HSG: A

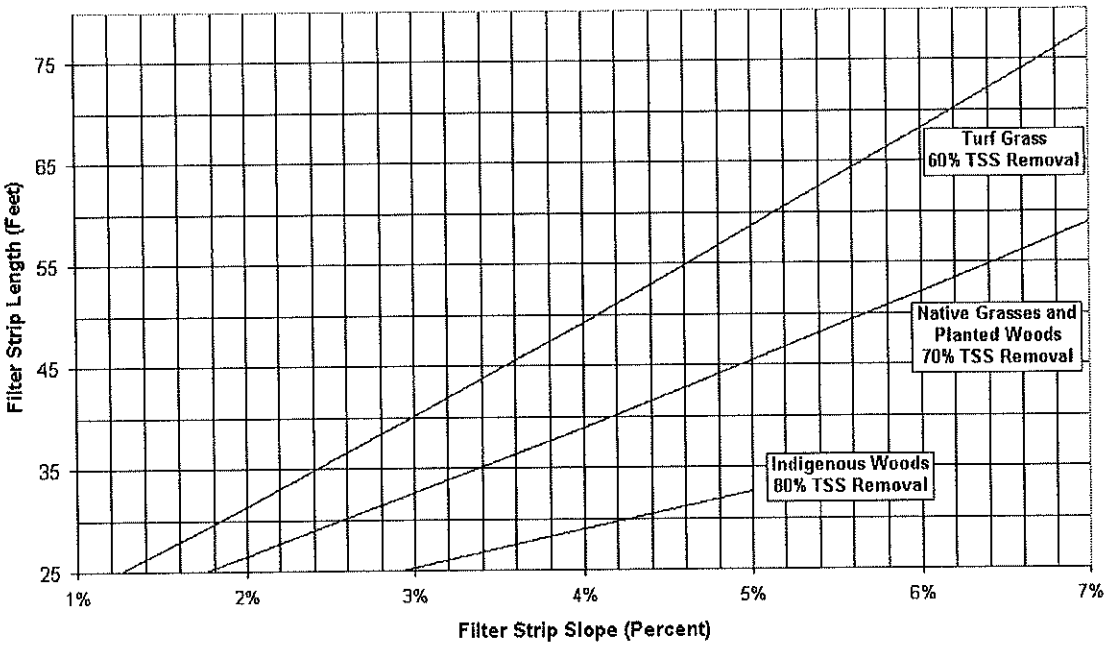


Figure 9.10-3: Vegetated Filter Strip Length
Drainage Area Soil: Sandy Loam HSG: B

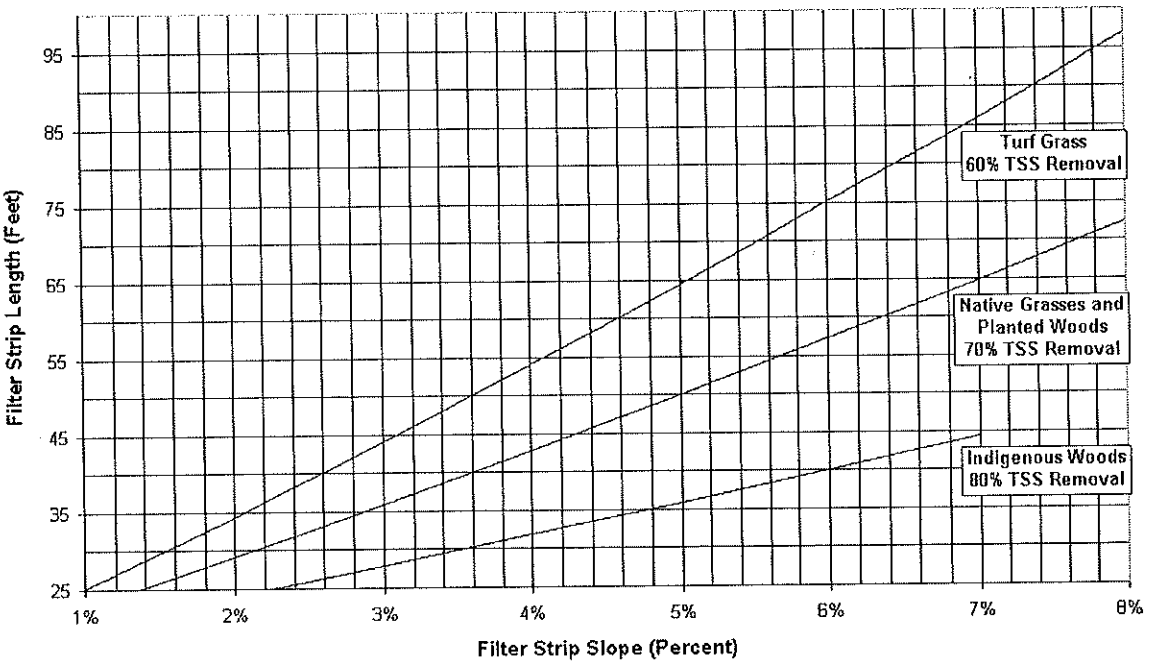


Figure 9.10-4: Vegetated Filter Strip Length
Drainage Area Soil: Loam, Silt Loam HSG: B

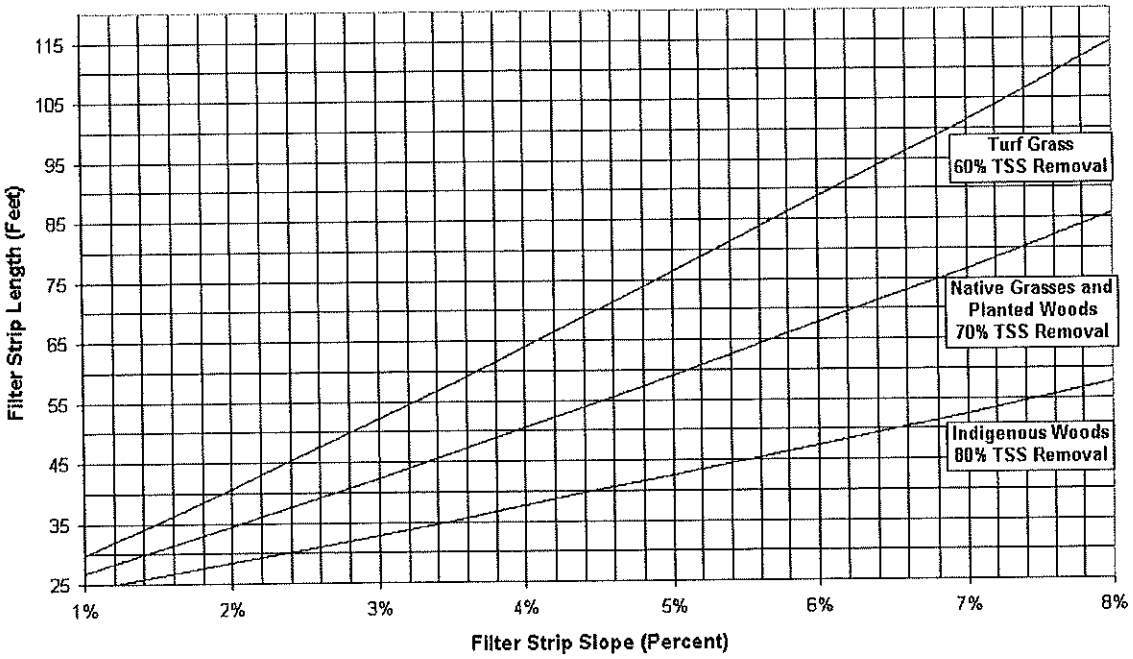


Figure 9.10-5: Vegetated Filter Strip Length
Drainage Area Soil: Sandy Clay Loam HSG: C

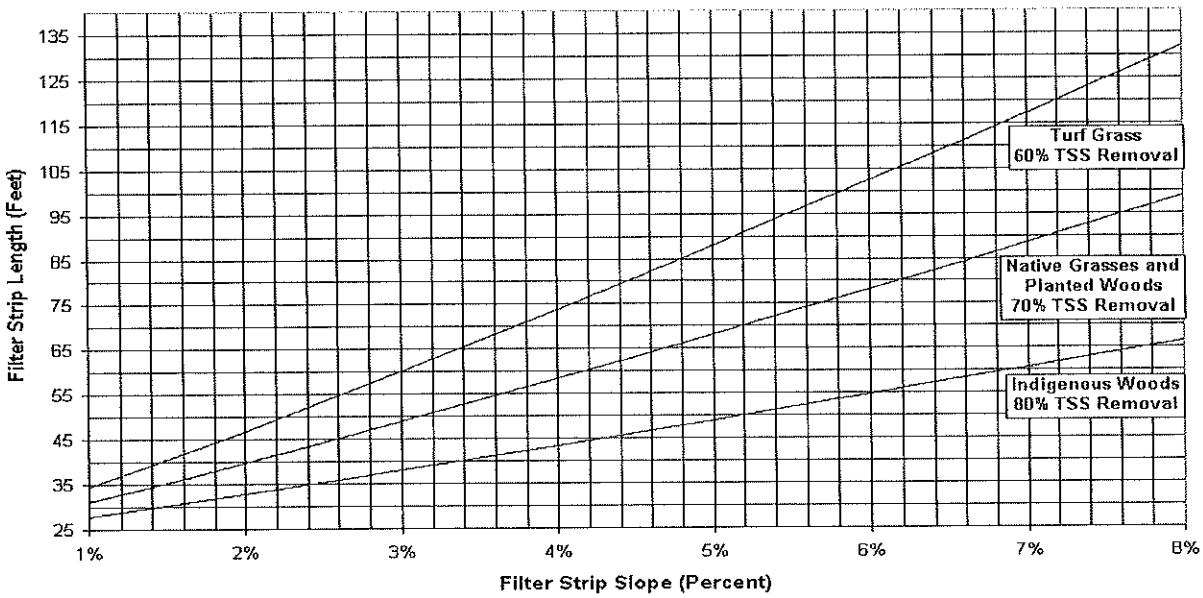
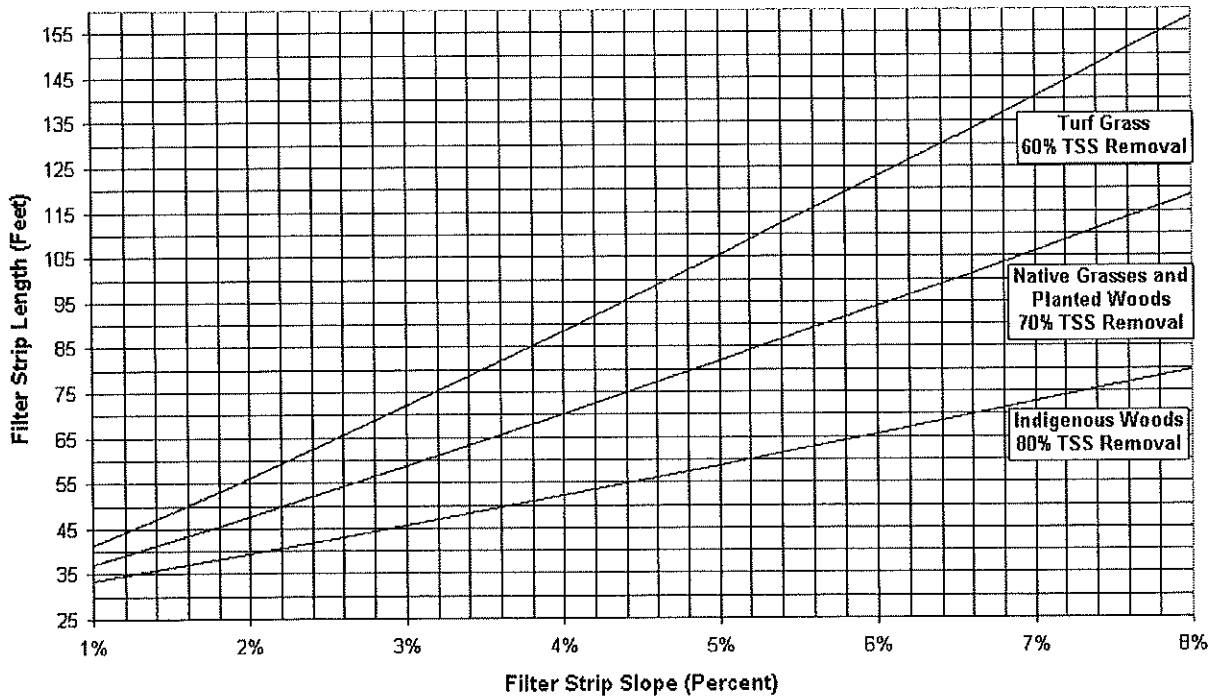


Figure 9.10-6: Vegetated Filter Strip Length
Drainage Area Soil: Clay Loam, Silty Clay, Clay HSG: D



Example 9.10-1: Computing Required Vegetated Filter Strip Length

A vegetated filter strip is to be installed at a uniform 5 percent slope to treat the runoff from a drainage area consisting of a paved parking lot and turf grass lawn. Runoff from the parking lot and lawn will enter the filter strip as sheet flow. The maximum sheet flow lengths across the parking lot and lawn do not exceed 100 and 150 feet, respectively. The soil in the drainage area is a silt loam. Compute the required filter strip length if the strip is to be vegetated with turf grass.

1. Determine the Hydrologic Soil Group of the drainage area soil. From Table 9.10-2, a silt loam is in Hydrologic Soil Group B.
2. Determine the maximum slope of the filter strip. Also from Table 9.10-2, the maximum slope of a turf grass filter strip with Hydrologic Soil Group B soils is 8 percent, which is greater than the 5 percent slope of the proposed filter strip.
3. Determine the required length of the filter strip. From Figure 9.10-4 for silt loam soils, the required length of a turf grass filter strip with a 5 percent slope is approximately 76 feet. The resultant TSS removal rate for the turf grass filter strip will be 60 percent.

Maintenance

Effective vegetated filter strip performance requires regular and effective maintenance. *Chapter 8: Maintenance and Retrofit of Stormwater Management Practices* provides information and requirements for preparing a maintenance plan for stormwater management facilities, including vegetated filter strips. Specific maintenance requirements for vegetated filter strips are presented below. These requirements must be included in the filter strip's maintenance plan.

A. General Maintenance

All vegetated filter strip components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually and after every storm exceeding 1 inch of rainfall. Such components may include vegetated areas and stone cutoffs and, in particular, the upstream edge of the filter strip where coarse sediment and/or debris accumulation could cause inflow to concentrate.

Sediment removal should take place when the filter strip is thoroughly dry. Disposal of debris and trash should be done only at suitable disposal/recycling sites and must comply with all applicable local, state, and federal waste regulations.

B. Vegetated Areas

Mowing and/or trimming of vegetation must be performed on a regular schedule based on specific site conditions. Grass should be mowed at least once a month during the growing season. Vegetated areas must be inspected at least annually for erosion and scour. Vegetated areas should also be inspected at least annually for unwanted growth, which should be removed with minimum disruption to the planting soil bed and remaining vegetation.

When establishing or restoring vegetation, biweekly inspections of vegetation health should be performed during the first growing season or until the vegetation is established. Once established, inspections of vegetation health, density, and diversity should be performed during both the growing and non-growing season at least twice annually. The vegetative cover should be maintained at 85 percent. If

vegetation has greater than 50 percent damage, the area should be reestablished in accordance with the original specifications and the inspection requirements presented above.

All use of fertilizers, mechanical treatments, pesticides and other means to assure optimum vegetation health must not compromise the intended purpose of the vegetative filter. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

All areas of the filter strip should be inspected for excess ponding after significant storm events. Corrective measures should be taken when excessive ponding occurs.

C. Other Maintenance Criteria

The maintenance plan must indicate the approximate time it would normally take for the filter strip to drain the maximum design storm runoff volume and begin to dry. This normal drain time should then be used to evaluate the filter's actual performance. If significant increases or decreases in the normal drain time are observed or if the 72 hour maximum is exceeded, the filter strip's planting soil bed, vegetation, and groundwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements and maintain the proper functioning of the filter strip.

Considerations

A number of factors should be considered when utilizing a vegetated filter strip to treat stormwater runoff. Most importantly, an adequate filter area and length of flow must be provided to achieve the desired treatment. Slopes of less than 5 percent are more effective; steeper slopes require a greater area and length of flow to achieve the same effectiveness. Good surface and subsurface drainage is necessary to ensure satisfactory performance. The designer should also be aware of potential ponding factors during the planning stage. Dry period between flows should be achieved in order to reestablish aerobic soil conditions.

Filter strip vegetation must be fully established before incoming stormwater flow is allowed. At least one full growing season should have elapsed prior to strip functioning as part of the stormwater management system. Further information and references on filter strip vegetation are presented in *Chapter 7*. Species must be appropriate for the region, soil, and shade condition. Mulching is required for both seeded and planted filter strips.

Perhaps the most common, naturally occurring filter strips are those upland vegetative stands associated with floodplains or found adjacent to natural watercourses. In some cases, preservation of these upland areas will allow them to continue to function as filter strips. To help ensure the longevity of these natural areas under altered and perhaps increased pollutant loading, a top dressing of fertilizer and supplemental plantings may be necessary.

References

Abu-Zreig, M. October 2000. Factors Affecting Sediment Trapping in Vegetated Filter Strips: SimulationStudy Using VFSMOD. Hydrological Processes, Volume 15, 1477–1488.

Abu-Zreig, M., R.P. Rudra, and H.R. Whiteley. 2001. Validation of a Vegetated Filter Strip Model (VFSMOD). Hydrological Processes 15, 729-742.

Castelle, A.J. and Johnson, A.W. February 2000. Riparian Vegetation Effectiveness – Technical Bulletin No. 799. National Council for Air and Stream Improvement.

Claytor, R. and T. Schueler. December 1996. Design of Stormwater Filtering Systems. The Center for Watershed Protection. Ellicott City, MD.

Desbonnet, A., P. Pogue, V. Lee and N. Wolff. July 1994. Vegetated Buffers in the Coastal Zone. Coastal Resources Center. University of Rhode Island.

Horner, R.R., J.J. Skupien, E.H. Livingston and H.E. Shaver. August 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. In cooperation with U.S. Environmental Protection Agency. Terrene Institute, Washington, D.C.

Livingston E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

McCuen, R.H. and S.L. Wong. 1982. The Design of Vegetative Buffer Strips for Runoff and Sediment Control. Maryland Department of Natural Resources.

Munoz-Carpena, R., J.E. Parsons, and J.W. Gilliam. 1999. Modeling Hydrology and Sediment Transport in Vegetative Filter Strips. Journal of Hydrology 214 111-129.

New Jersey Department of Agriculture. November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.

New Jersey Department of Environmental Protection and Department of Agriculture. December 1994. Stormwater and Nonpoint Source Pollution Control Best Management Practices.

Ocean County Planning and Engineering Departments and Killam Associates. June 1989. Stormwater Management Facilities Maintenance Manual. New Jersey Department of Environmental Protection. Trenton, NJ.

Schueler, T.R. July 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R., P.A. Kumble and M. Heraty. March 1992. A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C.

Tollner, E.W., B.J. Barfield, C.T. Hann and T.Y. Kao. 1976. Suspended Sediment Filtration Capacity of Simulated Vegetation. Transactions of the ASAE. 10(11). pp. 678-682.

Walsh, P.M., M.E. Barrett, J.F. Malina and R.J. Charbeneau. October 1997. Use of Vegetative Controls for Treatment of Highway Runoff. Center for Research in Water Resources. University of Texas at Austin.

Wenger, S. A. March 1999. Review of the Scientific Literature on Riparian Buffer Width, Extent, and Vegetation. Institute of Ecology. University of Georgia.

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CHAPTER 9.11

Standard for Wet Ponds

Definition

A wet pond is a stormwater facility constructed through filling and/or excavation that provides both permanent and temporary storage of stormwater runoff. It has an outlet structure that creates a permanent pool and detains and attenuates runoff inflows and promotes the settlement of pollutants. A wet pond, also known as a retention basin, can also be designed as a multi-stage facility that also provides extended detention for enhanced stormwater quality design storm treatment and runoff storage and attenuation for stormwater quantity management. The adopted TSS removal rate for wet ponds is 50 to 90 percent depending on the permanent pool storage volume in the pond and, where extended detention is also provided, the duration of detention time provided in the pond.

Purpose

Wet ponds are used to address both the stormwater quantity and quality impacts of land development. A wet pond's permanent pool can retain runoff from the stormwater quality design storm, thereby promoting pollutant removal through sedimentation and biological processing. The permanent pool can also protect deposited sediments from resuspension. Higher stages in the basin can also be used to provide additional stormwater quality treatment through extended detention and/or attenuate the peak rates of runoff from larger storms through the use of multi-stage outlets for flood and erosion control. Wet ponds can also provide aesthetic and recreational benefits as well as water supply for fire protection and/or irrigation.

Conditions Where Practice Applies

Wet ponds require sufficient drainage area and, in turn, dry weather or base flow to maintain the volume and environmental quality of the permanent pool. Therefore, the minimum drainage area to a wet pond must be 20 acres.

Wet ponds should not be located within the limits of natural ponds or wetlands, since they will typically not have the full range of ecological functions as these natural facilities. While providing some habitat and aesthetic values, wet ponds are designed primarily for pollutant removal and erosion and flood control.

It is important to note that a wet pond must be able to maintain its permanent pool level. If the soil at the site is not sufficiently impermeable to prevent excessive seepage, construction of an impermeable liner or other soil modifications will be necessary.

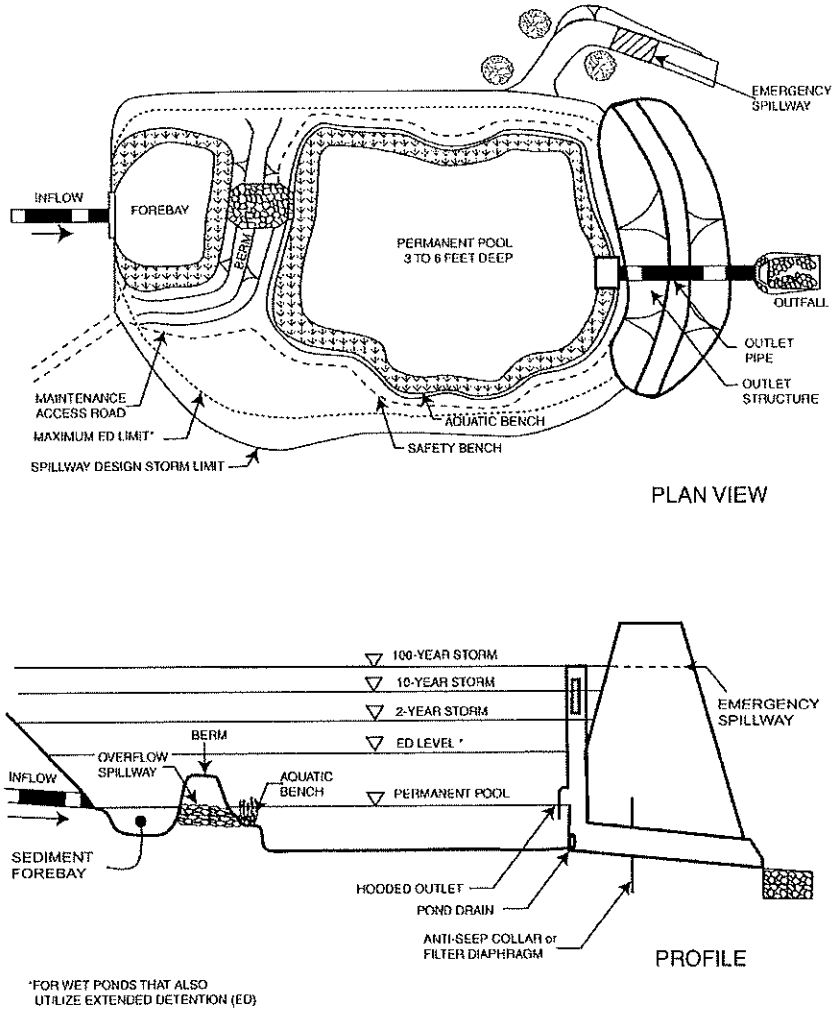
Wet ponds may be limited by the potential for discharge water to be heated in the permanent pool during summer months and should not be used if the receiving waters are ecologically sensitive to temperature change.

Finally, a wet pond must also have a maintenance plan and, if privately owned, should be protected by easement, deed restriction, ordinance, or other legal measures that prevent its neglect, adverse alteration, and removal.

Design Criteria

The basic design parameter for a wet pond is the ratio of its permanent pool volume to the volume of runoff entering the pond. This ratio is used to determine the pond's TSS removal rate. This removal rate can be increased if extended detention storage is also provided above the permanent pool level. Details of these and other design parameters are presented below and summarized in Table 9.11-1. The components of a typical wet pond both with and without extended detention are shown in Figure 9.11-1.

Figure 9.11-1: Wet Pond Components



Source: Adapted from Schueler and Claytor 2000.

A. Storage Volumes

Wet ponds should be designed to treat the runoff volume generated by the stormwater quality design storm. Techniques to compute this volume are discussed in *Chapter 5: Computing Stormwater Runoff Rates and Volumes*. The resultant TSS removal rate for a wet pond will depend on the ratio of its permanent pool volume to the stormwater quality design storm runoff volume. Figure 9.11-2 presents the range of approved TSS removal rates for various permanent pool to runoff volume ratios. As can be seen in the figure, the minimum required permanent pool volume in a wet pond is equal to the stormwater quality design storm runoff volume to the pond. At this 1:1 volume ratio, a wet pond would have a TSS removal rate of 50 percent. This removal rate increases to 80 percent for wet ponds with permanent pool volumes that are three times the stormwater quality design storm runoff volume (i.e., volume ratio of 3:1).

Also shown in Figure 9.11-2 are TSS removal rates in wet ponds that also provide extended detention above the permanent pool water surface. As shown in Figure 9.2-2, a wet pond with a permanent pool to runoff volume ratio of 3:1 that also provides 24 hours of extended detention would have a TSS removal rate of 90 percent. TSS removal rates for other combinations of permanent pool to runoff volume ratios for extended detention times of 12 and 18 hours are also shown in Figure 9.11-2. Definitions and details of extended detention are presented in Section 9.4: Extended Detention Basins.

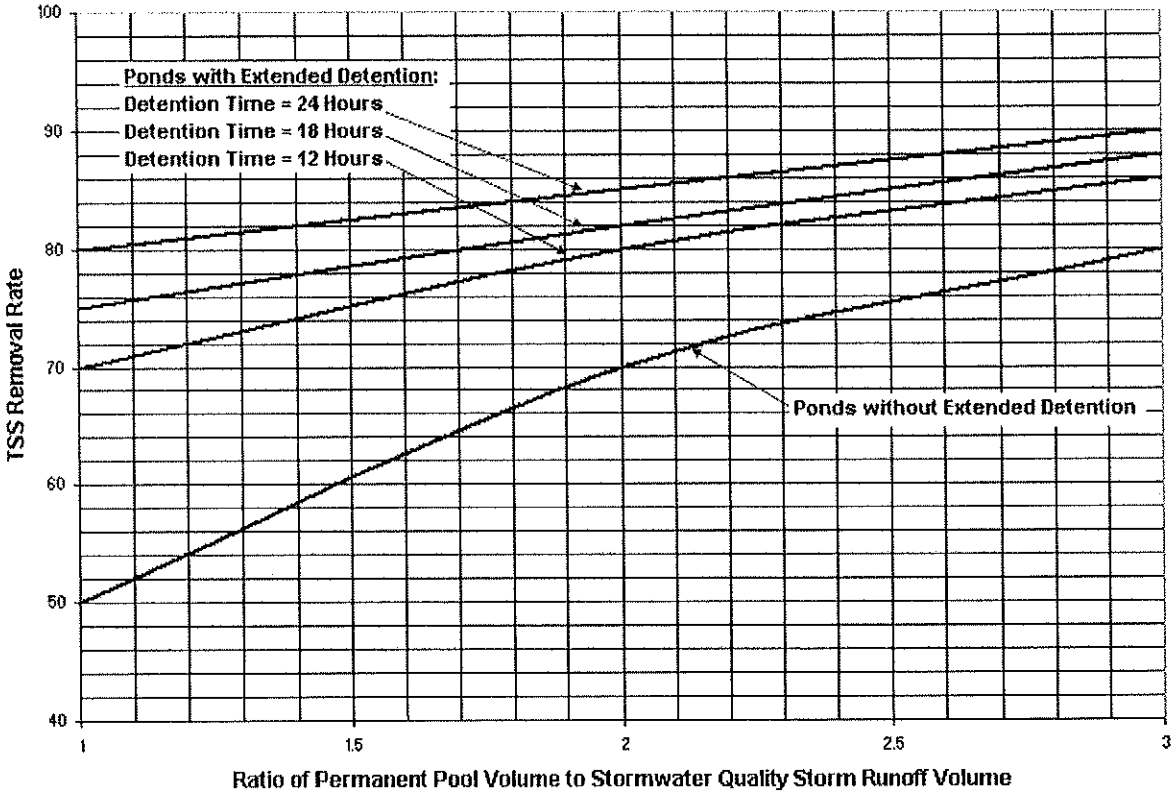
B. Permanent Pool Depth

The depth of a wet pond's permanent pool is an important design parameter. The permanent pool should be shallow enough to avoid thermal stratification and deep enough to minimize algal blooms and resuspension of previously deposited materials by subsequent storms and strong winds. Prevention of thermal stratification will minimize short-circuiting and maintain aerobic bottom waters, thus maximizing pollutant uptake and minimizing the potential release of nutrients to the overlying waters. The mean depth of the permanent pool is obtained by dividing the storage volume by the pool surface area. A mean depth of three to six feet is normally sufficient to maintain a healthy environment within the permanent pool. The outlet structure or riser should be located in a relative deep area to facilitate withdrawal of cold bottom water to help mitigate any downstream thermal impacts. If maintained at the recommended three to six foot depth, the permanent pool can better serve as an aquatic habitat.

C. Permanent Pool Surface Area

The surface area of a wet pond's permanent pool is also an important design parameter as it directly affects the settling rate of particulate solids in the runoff to the pond. The surface area of a permanent pool will depend on site topography, minimum and maximum pool depths, and the desired settling rate. The minimum permanent pool surface area is 0.25 acres.

Figure 9.11-2: TSS Removal Rates for Wet Ponds



D. Drainage Area Size

As noted above, wet ponds require sufficient drainage area and dry weather base flow to function properly. A reliable base flow must be available to maintain the volume and quality of the permanent pool. Therefore, the minimum drainage area to a wet pond is 20 acres. Smaller drainage areas may be permissible if detailed analysis indicates that sufficient base or groundwater inflow is available.

E. Pond Configuration

The length to width ratio of a wet pond should as large as possible to simulate conditions found in plug flow reaction kinetics. Under ideal plug flow conditions, a plug or pulse of runoff enters a pond and is treated by chemical reactions as well as the physical processes of dispersion and settlement as the pulse travels the length of the wet pond. Therefore, the pond's length to width should be at least 3:1 to maximize these treatment processes. In cases where it is impractical to construct wet ponds with these lengths, internal baffles or berms may be added within the pond to the increase the travel length and residence time.

F. Safety Ledges

Safety ledges must be constructed on the slopes of all wet ponds with a permanent pool deeper than three feet. Two ledges must be constructed, each 4 to 6 feet in width. The first or upper ledge must be located between 1 and 1.5 feet above the permanent pool level. The second or lower ledge must be located approximately 2.5 feet below the permanent pool level.

G. Outlet Structure

The riser structure should be equipped with a bottom drain pipe, sized to drain the permanent pool within 40 hours so that sediments may be removed mechanically when necessary. The drain pipe should be controlled by a lockable valve that is readily accessible from the top of the outlet structure. Additional information regarding outlet structures can be found in both the Soil Erosion and Sediment Control Standards for New Jersey and the NJDEP Stormwater Management Facilities Maintenance Manual.

H. Overflows

All wet ponds must be able to safely convey system overflows to downstream drainage systems. The capacity of the overflow must be sufficient to provide safe, stable discharge of stormwater in the event of an overflow. Wet ponds that are classified as dams under the NJDEP Dam Safety Standards at N.J.A.C. 7:20 must also meet the overflow requirements of these Standards, including safe conveyance of the wet pond's spillway design storm.

I. Tailwater

The hydraulic design of the outlet structure, outlet pipe, and emergency spillway in a wet pond must consider any significant tailwater effects of downstream waterways or facilities. This includes instances where the permanent pool level is below the flood hazard area design flood elevation of the receiving stream.

J. Other Components

Information regarding embankments, emergency spillways, bottom and side slopes, trash racks, conduit outlet protection, and vegetative cover can be found in both the Soil Erosion and Sediment Control Standards for New Jersey and the NJDEP Stormwater Management Facilities Maintenance Manual.

Table 9.11-1: Summary of Design Parameters

Design Parameter
Minimum Permanent Pool Volume = Stormwater Quality Design Storm Runoff Volume
Mean Permanent Pool Depth = 3 to 6 Feet
Minimum Permanent Pool Surface Area = 0.25 Acres
Minimum Drainage Area Size = 20 Acres
Maximum Permanent Pool Drain Time = 40 Hours
Recommended Minimum Pool Length to Width Ratio = 3:1

Maintenance

Effective wet pond performance requires regular and effective maintenance. *Chapter 8: Maintenance and Retrofit of Stormwater Management Practices* provides information and requirements for preparing a maintenance plan for stormwater management facilities, including wet ponds. Specific maintenance requirements for wet ponds are presented below. These requirements must be included in the pond's maintenance plan.

A. General Maintenance

All wet pond components expected to receive and/or trap debris and sediment must be inspected for clogging and excessive debris and sediment accumulation at least four times annually as well as after every storm exceeding one inch of rainfall. The primary location for debris and particularly sediment accumulation will be within a wet pond's permanent pool. Additional components may include forebays, inflow points, trash racks, outlet structures, and riprap or gabion aprons.

Disposal of debris, trash, sediment, and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state and federal waste regulations.

Studies have shown that readily visible stormwater management facilities like wet ponds receive more frequent and thorough maintenance than those in less visible, more remote locations. Readily visible facilities can also be inspected faster and more easily by maintenance and mosquito control personnel.

B. Vegetated Areas

Mowing and/or trimming of vegetation must be performed on a regular schedule based on specific site conditions. Grass should be mowed at least once a month during the growing season. Vegetated areas must also be inspected at least annually for erosion and scour. Vegetated areas should also be inspected at least annually for unwanted growth, which should be removed with minimum disruption to the remaining vegetation.

When establishing or restoring vegetation, biweekly inspections of vegetation health should be performed during the first growing season or until the vegetation is established. Once established, inspections of vegetation health, density and diversity should be performed at least twice annually during both the growing and non-growing season. The vegetative cover should be maintained at 85 percent. If vegetation has greater than 50 percent damage, the area should be reestablished in accordance with the original specifications and the inspection requirements presented above.

All use of fertilizers, mechanical treatments, pesticides and other means to ensure optimum vegetation health must not compromise the intended purpose of the wet pond. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible.

C. Structural Components

All structural components must be inspected for cracking, subsidence, spalling, erosion and deterioration at least annually. All outlet valves are to be inspected and exercised at least four times annually.

D. Other Maintenance Criteria

The maintenance plan must indicate the approximate time it would normally take to completely drain the maximum design storm runoff volume and return the pond to its permanent pool level. This normal drain time should then be used to evaluate the pond's actual performance. If significant increases or decreases in the normal drain time are observed, the pond's outlet structure and both groundwater and tailwater levels must be evaluated and appropriate measures taken to comply with the maximum drain time requirements.

Considerations

A. Permanent Pools

The primary component of a wet pond is its permanent pool. To maintain water quality, oxygen levels, control mosquito breeding, and prevent stagnation, an adequate and regular inflow of surface and/or ground water is necessary. Where sufficient oxygen levels and mixing will be difficult to achieve, a fountain or aerator may be included. However, such conditions may be indicative of larger site suitability problems that must be thoroughly investigated before a wet pond is selected for use at a land development site. The potential effects of sediment loading on the permanent pool must also be considered when determining whether a site is suitable for a wet pond. The use of existing lakes and ponds as wet ponds for treatment of stormwater is prohibited.

A well-designed wet pond will accumulate considerable quantities of sediment. The cleanout cycle for a wet pond in a stabilized watershed can vary, with an average cycle of approximately 10 years. Sediment removal at each cycle may cost as much as 20 to 40 percent of the initial construction cost. It should be noted that the exact cleanout cycle and cost will depend on the specific character of the wet pond and its watershed. Therefore, periodic inspections of sediment accumulation in a wet pond are vital to determining how often and how much sediment must be removed. See *Maintenance* above for more information.

In cases where relatively permeable soils are encountered, the risk of seepage losses may be minimized by installing a clay or synthetic liner along the bottom of the pond.

B. Thermal Effects

Thermal effects of the wet pond must be considered since the permanent pool can act as a heat sink between storm events during hot weather. When the water is displaced from the pool, it may be as much as 10 degrees Fahrenheit warmer than the naturally occurring baseflow in the downstream waterway. Runoff to wet ponds from large impervious surfaces can also significantly raise the temperature of runoff during hot weather. The net result of elevated pool temperatures may have an adverse impact on downstream coldwater uses such as trout production.

Therefore, wet pond designers should pay special attention to the potential of thermal effects on downstream water bodies supporting cold water fisheries. Thermal impacts of wet ponds in such areas may be mitigated by:

- Using a deep permanent pool and positioning the outlet pipe to discharge the relatively colder water from near the bottom;
- Planting shade trees on the periphery of the pool to reduce solar warming; and
- Employing a series of pools in sequence rather than a single one.

C. Vegetation

Aquatic vegetation plays an important role in the pollutant removal dynamics of a wet pond. Soluble pollutants, especially nutrients, are removed through biological assimilation by both phytoplankton and macrophytes. Wetland plants can help keep algal proliferation in check by limiting the amount of nutrients available to the phytoplankton. In addition, an organically enriched wetland substrate will provide an ideal environment for bacterial populations to metabolize organic matter and nutrients. Aquatic vegetation may also aid in the regulation of pond water temperature.

Marsh vegetation can also enhance the appearance of the wet pond, stabilize the side-slopes, serve as wildlife habitat, and temporarily conceal unsightly trash and debris. As such, a wet pond may be designed to promote dense growth of appropriate wetland plant species along the banks. A 10 to 15 foot wide wetland vegetation bench starting one foot below the pool surface may be established along the perimeter of the pond. Water tolerant species of vegetative cover for wet pond surfaces should be used. To promote lasting growth, grasses and other vegetative covers should be compatible with prevailing weather and soil conditions and tolerant of periodic inundation and runoff pollutants. An adequate depth of topsoil should be provided below all vegetative covers in uplands. A minimum thickness of six inches is recommended.

D. Designing for Pollutant Removal

Two alternative approaches may be used to design wet pond pollutant removal. The first approach is based on solids settling and assumes that all pollutant removal within the pond occurs due to sedimentation. The Design Criteria section above is based primarily on this approach. The second approach treats the wet pond as a lake with controlled levels of eutrophication to account for the biological and physical/chemical processes that are principal mechanisms for pollutant removal. Both approaches relate the pollutant removal efficiencies to hydraulic residence time.

Design approach should be selected based on the target pollutants as well as site and economic constraints. The controlled eutrophication approach requires longer residence times and larger storage volumes comparable to those of the solids settling approach. However, where the chief concern is to control nutrient levels in waters such as lakes and reservoirs, it is advantageous to use the controlled eutrophication approach. If the major goal is the removal of a broad spectrum of pollutants, especially those adsorbed onto suspended matter (as discussed in *Chapter 4: Stormwater Pollutant Removal Criteria*), it is generally preferable to base the design on the sedimentation approach.

E. Pretreatment

As with all other best management practices, pretreatment can extend the functional life and increase the pollutant removal capability of a wet pond. Pretreatment can reduce incoming velocities and capture coarser sediments, which will extend the life of the system. This is usually accomplished through such means as a vegetative filters and/or a manufactured treatment device. Information on vegetated filter strips and manufactured treatment devices is presented in Chapters 9.10 and 9.6, respectively.

As shown in Figure 9.11-1, forebays at the inflow points to a wet pond can capture coarse sediments, trash and debris, which can simplify and reduce the frequency of pond maintenance. A forebay should be sized to hold the sediment volume expected between clean-outs.

References

Horner, R.R., J.J. Skupien, E.H. Livingston and H.E. Shaver. 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. In cooperation with U.S. Environmental Protection Agency. Terrene Institute, Washington, D.C.

Livingston E.H., H.E. Shaver, J.J. Skupien and R.R. Horner. August 1997. Operation, Maintenance, & Management of Stormwater Management Systems. In cooperation with U.S. Environmental Protection Agency. Watershed Management Institute. Crawfordville, FL.

Maryland Department of the Environment. 2000. Maryland Stormwater Design Manual – Volume I – Stormwater Management Criteria. Water Management Administration. Baltimore, MD.

New Jersey Department of Agriculture. November 1999. Standards for Soil Erosion and Sediment Control in New Jersey. State Soil Conservation Committee. Trenton, NJ.

New Jersey Department of Environmental Protection and Department of Agriculture. December 1994. Stormwater and Nonpoint Source Pollution Control Best Management Practices.

Ocean County Planning and Engineering Departments and Killam Associates. June 1989. Stormwater Management Facilities Maintenance Manual. New Jersey Department of Environmental Protection. Trenton, NJ.

Schueler, T.R. July 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R., P.A. Kumble and M. Heraty. A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C.

Schueler, T.R. and R.A. Claytor. 2000. Maryland Stormwater Design Manual. Maryland Department of the Environment. Baltimore, MD.

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APPENDIX A

Low Impact Development Checklist

A checklist for identifying nonstructural stormwater management strategies incorporated into proposed land development

According to the NJDEP Stormwater Management Rules at N.J.A.C. 7:8, the groundwater recharge, stormwater quality, and stormwater quantity standards established by the Rules for major land development projects must be met by incorporating nine specific nonstructural stormwater management strategies into the project's design to the maximum extent practicable.

To accomplish this, the Rules require an applicant seeking land development approval from a regulatory board or agency to identify those nonstructural strategies that have been incorporated into the project's design. In addition, if an applicant contends that it is not feasible to incorporate any of the specific strategies into the project's design, particularly for engineering, environmental, or safety reasons, the Rules further require that the applicant provide a basis for that contention.

This checklist has been prepared to assist applicants, site designers, and regulatory boards and agencies in ensuring that the nonstructural stormwater management requirements of the Rules are met. It provides an applicant with a means to identify both the nonstructural strategies incorporated into the development's design and the specific low impact development BMPs (LID-BMPs) that have been used to do so. It can also help an applicant explain the engineering, environmental, and/or safety reasons that a specific nonstructural strategy could not be incorporated into the development's design.

The checklist can also assist municipalities and other land development review agencies in the development of specific requirements for both nonstructural strategies and LID-BMPs in zoning and/or land use ordinances and regulations. As such, where requirements consistent with the Rules have been adopted, they may supersede this checklist.

Finally, the checklist can be used during a pre-design meeting between an applicant and pertinent review personnel to discuss local nonstructural strategies and LID-BMPs requirements in order to optimize the development's nonstructural stormwater management design.

Since this checklist is intended to promote the use of nonstructural stormwater management strategies and provide guidance in their incorporation in land development projects, municipalities are permitted to revise it as necessary to meet the goals and objectives of their specific stormwater management program and plan within the limits of N.J.A.C. 7:8.

Low Impact Development Checklist

A checklist for identifying nonstructural stormwater management strategies incorporated into proposed land development

Municipality: _____

County: _____ Date: _____

Review board or agency: _____

Proposed land development name: _____

Lot(s): _____ Block(s): _____

Project or application number: _____

Applicant's name: _____

Applicant's address: _____

_____

Telephone: _____ Fax: _____

Email address: _____

Designer's name: _____

Designer's address: _____

_____

Telephone: _____ Fax: _____

Email address: _____

Part 1: Description of Nonstructural Approach to Site Design

In narrative form, provide an overall description of the nonstructural stormwater management approach and strategies incorporated into the proposed site's design. Attach additional pages as necessary. Details of each nonstructural strategy are provided in Part 3 below.

Part 2: Review of Local Stormwater Management Regulations

Title and date of stormwater management regulations used in development design:

_____

Do regulations include nonstructural requirements? Yes: _____ No: _____

If yes, briefly describe: _____

_____

_____

List LID-BMPs prohibited by local regulations: _____

_____

_____

Pre-design meeting held? Yes: _____ Date: _____ No: _____

Meeting held with: _____

_____

_____

Pre-design site walk held? Yes: _____ Date: _____ No: _____

Site walk held with: _____

_____

_____

Other agencies with stormwater review jurisdiction:

Name: _____

Required approval: _____

Name: _____

Required approval: _____

Name: _____

Required approval: _____

Part 3: Nonstructural Strategies and LID-BMPs in Design

3.1 Vegetation and Landscaping

Effective management of both existing and proposed site vegetation can reduce a development's adverse impacts on groundwater recharges and runoff quality and quantity. This section of the checklist helps identify the vegetation and landscaping strategies and nonstructural LID-BMPs that have been incorporated into the proposed development's design to help maintain existing recharge rates and/or minimize or prevent increases in runoff quantity and pollutant loading.

A. Has an inventory of existing site vegetation been performed? Yes: _____ No: _____

If yes, was this inventory a factor in the site's layout and design? Yes: _____ No: _____

B. Does the site design utilize any of the following nonstructural LID-BMPs?

Preservation of natural areas? Yes: _____ No: _____ If yes, specify % of site: _____

Native ground cover? Yes: _____ No: _____ If yes, specify % of site: _____

Vegetated buffers? Yes: _____ No: _____ If yes, specify % of site: _____

C. Do the land development regulations require these nonstructural LID-BMPs?

Preservation of natural areas? Yes: _____ No: _____ If yes, specify % of site: _____

Native ground cover? Yes: _____ No: _____ If yes, specify % of site: _____

Vegetated buffers? Yes: _____ No: _____ If yes, specify % of site: _____

D. If vegetated filter strips or buffers are utilized, specify their functions:

Reduce runoff volume increases through lower runoff coefficient: Yes: _____ No: _____

Reduce runoff pollutant loads through runoff treatment: Yes: _____ No: _____

Maintain groundwater recharge by preserving natural areas: Yes: _____ No: _____

3.2 Minimize Land Disturbance

Minimizing land disturbance is a nonstructural LID-BMP that can be applied during both the development's construction and post-construction phases. This section of the checklist helps identify those land disturbance strategies and nonstructural LID-BMPs that have been incorporated into the proposed development's design to minimize land disturbance and the resultant change in the site's hydrologic character.

A. Have inventories of existing site soils and slopes been performed? Yes: _____ No: _____

If yes, were these inventories factors in the site's layout and design? Yes: _____ No: _____

B. Does the development's design utilize any of the following nonstructural LID-BMPs?

Restrict permanent site disturbance by land owners? Yes: _____ No: _____

If yes, how: _____

_____

Restrict temporary site disturbance during construction? Yes: _____ No: _____

If yes, how: _____

_____

Consider soils and slopes in selecting disturbance limits? Yes: _____ No: _____

If yes, how: _____

_____

C. Specify percentage of site to be cleared: _____ Regraded: _____

D. Specify percentage of cleared areas done so for buildings: _____

For driveways and parking: _____ For roadways: _____

E. What design criteria and/or site changes would be required to reduce the percentages in C and D above?

_____

_____

_____

F. Specify site's hydrologic soil group (HSG) percentages:

HSG A: _____ HSG B: _____ HSG C: _____ HSG D: _____

G. Specify percentage of each HSG that will be permanently disturbed:

HSG A: _____ HSG B: _____ HSG C: _____ HSG D: _____

H. Locating site disturbance within areas with less permeable soils (HSG C and D) and minimizing disturbance within areas with greater permeable soils (HSG A and B) can help maintain groundwater recharge rates and reduce runoff volume increases. In light of the HSG percentages in F and G above, what other practical measures if any can be taken to achieve this?

_____

_____

_____

I. Does the site include Karst topography? Yes: _____ No: _____

If yes, discuss measures taken to limit Karst impacts:

_____

_____

_____

_____

_____

_____

3.3 Impervious Area Management

New impervious surfaces at a development site can have the greatest adverse effect on groundwater recharge and stormwater quality and quantity. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into a proposed development's design to comprehensively manage the extent and impacts of new impervious surfaces.

A. Specify impervious cover at site: Existing: _____ Proposed: _____

B. Specify maximum site impervious coverage allowed by regulations: _____

C. Compare proposed street cartway widths with those required by regulations:

Type of Street	Proposed Cartway Width (feet)	Required Cartway Width (feet)
Residential access – low intensity		
Residential access – medium intensity		
Residential access – high intensity with parking		
Residential access – high intensity without parking		
Neighborhood		
Minor collector – low intensity without parking		
Minor collector – with one parking lane		
Minor collector – with two parking lanes		
Minor collector – without parking		
Major collector		

D. Compare proposed parking space dimensions with those required by regulations:

Proposed: _____ Regulations: _____

E. Compare proposed number of parking spaces with those required by regulations:

Proposed: _____ Regulations: _____

F. Specify percentage of total site impervious cover created by buildings:

By driveways and parking: _____ By roadways: _____

G. What design criteria and/or site changes would be required to reduce the percentages in F above?

_____

_____

_____

_____

H. Specify percentage of total impervious area that will be unconnected:

Total site: _____ Buildings: _____ Driveways and parking: _____ Roads: _____

I. Specify percentage of total impervious area that will be porous:

Total site: _____ Buildings: _____ Driveways and parking: _____ Roads: _____

J. Specify percentage of total building roof area that will be vegetated: _____

K. Specify percentage of total parking area located beneath buildings: _____

L. Specify percentage of total parking located within multi-level parking deck: _____

3.4 Time of Concentration Modifications

Decreasing a site's time of concentration (Tc) can lead directly to increased site runoff rates which, in turn, can create new and/or aggravate existing erosion and flooding problems downstream. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into the proposed development's design to effectively minimize such Tc decreases.

When reviewing Tc modification strategies, it is important to remember that a drainage area's Tc should reflect the general conditions throughout the area. As a result, Tc modifications must generally be applied throughout a drainage area, not just along a specific Tc route.

A. Specify percentage of site's total stormwater conveyance system length that will be:

Storm sewer: _____ Vegetated swale: _____ Natural channel: _____

Stormwater management facility: _____ Other: _____

Note: the total length of the stormwater conveyance system should be measured from the site's downstream property line to the downstream limit of sheet flow at the system's headwaters.

B. What design criteria and/or site changes would be required to reduce the storm sewer percentages and increase the vegetated swale and natural channel percentages in A above?

_____

_____

_____

C. In conveyance system subareas that have overland or sheet flow over impervious surfaces or turf grass, what practical and effective site changes can be made to:

Decrease overland flow slope: _____

_____

_____

Increase overland flow roughness: _____

_____

_____

3.5 Preventative Source Controls

The most effective way to address water quality concerns is by pollution prevention. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into the proposed development's design to reduce the exposure of pollutants to prevent their release into the stormwater runoff.

A. Trash Receptacles

Specify the number of trash receptacles provided: _____

Specify the spacing between the trash receptacles: _____

Compare trash receptacles proposed with those required by regulations:

Proposed: _____ Regulations: _____

B. Pet Waste Stations

Specify the number of pet waste stations provided: _____

Specify the spacing between the pet waste stations: _____

Compare pet waste stations proposed with those required by regulations:

Proposed: _____ Regulations: _____

C. Inlets, Trash Racks, and Other Devices that Prevent Discharge of Large Trash and Debris

Specify percentage of total inlets that comply with the NJPDES storm drain inlet criteria: _____

D. Maintenance

Specify the frequency of the following maintenance activities:

Street sweeping: Proposed: _____ Regulations: _____

Litter collection: Proposed: _____ Regulations: _____

Identify other stormwater management measures on the site that prevent discharge of large trash and debris:

_____

_____

E. Prevention and Containment of Spills

Identify locations where pollutants are located on the site, and the features that prevent these pollutants from being exposed to stormwater runoff:

Pollutant: _____ Location: _____

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: _____ Location: _____

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: _____ Location: _____

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: _____ Location: _____

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: _____ Location: _____

Part 4: Compliance with Nonstructural Requirements of NJDEP Stormwater Management Rules

1. Based upon the checklist responses above, indicate which nonstructural strategies have been incorporated into the proposed development's design in accordance with N.J.A.C. 7:8-5.3(b):

No.	Nonstructural Strategy	Yes	No
1.	Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss.		
2.	Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces.		
3.	Maximize the protection of natural drainage features and vegetation.		
4.	Minimize the decrease in the pre-construction time of concentration.		
5.	Minimize land disturbance including clearing and grading.		
6.	Minimize soil compaction.		
7.	Provide low maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers, and pesticides.		
8.	Provide vegetated open-channel conveyance systems discharge into and through stable vegetated areas.		
9.	Provide preventative source controls.		

2. For those strategies that have not been incorporated into the proposed development's design, provide engineering, environmental, and/or safety reasons. Attached additional pages as necessary.

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APPENDIX B

Municipal Regulations Checklist

A checklist for incorporating nonstructural stormwater management strategies into local regulations

As part of the requirements for municipal stormwater management plans in the Stormwater Management Rules at N.J.A.C. 7:8-4, municipalities are required to evaluate the municipal master plan, and land use and zoning ordinances to determine what adjustments need to be made to allow the implementation of nonstructural stormwater management techniques, also called low impact development techniques, which are presented in *Chapter 2: Low Impact Development Techniques. Chapter 3: Regional and Municipal Stormwater Management Plans* provides information on the development of municipal stormwater management plans, including the evaluation of the master plan, and land use and zoning ordinances. This checklist was prepared to assist municipalities in identifying the specific ordinances that should be evaluated, and the types of changes to be incorporated to address the requirements of the Stormwater Management Rules.

Part 1: Vegetation and Landscaping

Effective management of both existing and proposed site vegetation can reduce a development's adverse impacts on groundwater recharge and stormwater runoff quality and quantity.

A. Preservation of Natural Areas

Municipal regulations should include requirements to preserve existing vegetated areas, minimize turf grass lawn areas, and use native vegetation.

❑ Yes ❑ No Are applicants required to provide a layout of the existing vegetated areas, and a description of the conditions in those areas?

❑ Yes ❑ No Does the municipality have maximum as well as minimum yard sizing ordinances?

❑ Yes ❑ No Are residents restricted from enlarging existing turf lawn areas?

❑ Yes ❑ No Do the ordinances provide incentives for the use of vegetation as filters for stormwater runoff?

❑ Yes ❑ No Do the ordinances require a specific percentage of permanently preserved open space as part of the evaluation of cluster development?

B. Tree Protection Ordinances

Municipalities often have a tree ordinance to minimize the removal of trees and to replace trees that are removed. However, while tree ordinances protect the number of trees, they do not typically address the associated leaf litter or smaller vegetation that provides additional water quality and quantity benefits. Municipalities should consider enhancing tree ordinances to a forest ordinance that would also maintain the benefits of a forested area.

❑ Yes ❑ No Does the municipality have a tree protection ordinance?

❑ Yes ❑ No Can the municipality include a forest protection ordinance?

❑ Yes ❑ No If forested areas are present at development sites, is there a required percentage of the stand to be preserved?

C. Landscaping Island and Screening Ordinances

Municipalities often have ordinances that require landscaping islands for parking areas. The landscaping islands can provide ideal opportunities for the filtration and disconnection of runoff, or the placement of small LID-BMPs. Screening ordinances limit the view of adjoining properties, parking areas, or loading areas. Low maintenance vegetation can be required in islands and areas used for screening to provide stormwater quality, groundwater recharge, or stormwater quantity benefits.

❑ Yes ❑ No Do the ordinances require landscaping islands in parking lots, or between the roadway and the sidewalk? Can the ordinance be adjusted to require vegetation that is more beneficial for stormwater quality, groundwater recharge, or stormwater quantity, but that does not interfere with driver vision at the intersections?

❑ Yes ❑ No Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

❑ Yes ❑ No Do the ordinances require screening from adjoining properties? Can the screening criteria require the use of vegetation to the maximum extent practicable before the use of walls or berms?

D. Riparian Buffers

Municipalities may have existing buffer and/or floodplain ordinances that require the protection of vegetation adjacent to streams. Municipalities should consult existing regulations adopted by the Department to ensure that riparian buffer or floodplain ordinances reflect the requirements of the Department within these areas. The municipality should consider conservation restrictions and allowable maintenance to ensure the preservation of these areas.

❑ Yes ❑ No Is there a stream buffer or floodplain ordinance in the community?

❑ Yes ❑ No Is the ordinance consistent with existing state regulatory requirements?

❑ Yes ❑ No Does the ordinance require a conservation easement, or other permanent restrictions on buffer areas?

❑ Yes ❑ No Does the ordinance identify or limit when stormwater outfall structures can cross the buffer?

❑ Yes ❑ No Does the ordinance give detailed information on the type of maintenance and/or activities that is allowed in the buffer?

Part 2: Minimizing Land Disturbance

The minimization of disturbance can be used at different phases of a development project. The goal is to limit clearing, grading, and other disturbance associated with development to protect existing features that provide stormwater benefits. Zoning ordinances typically limit the amount of impervious surfaces on building lots, but do not limit the amount of area that can be disturbed during construction. This strategy helps preserve the site's existing hydrologic character, as well as limiting the occurrence of soil compaction.

A. Limits of Disturbance

Designing with the terrain, or site fingerprinting, requires an assessment of the characteristics of the site and the selection of areas for development that would minimize the impact. This can be incorporated into the requirements for existing site conditions and the environmental impact statement. Limits of disturbance should be incorporated into construction plans reviewed and approved by the municipality. Setbacks should be evaluated to determine whether they can be reduced. The following maximum setbacks are recommended for low impact development designs:

- front yard – 20 feet;
- rear yard – 25 feet; and
- side yard – 8 feet.

❑ Yes ❑ No As part of the depiction of existing conditions, are environmentally critical and environmentally constrained areas identified? (Environmentally critical areas are areas or features with significant environmental value, such as steep slopes, stream corridors, natural heritage priority sites, and habitats of threatened and endangered species. Environmentally constrained areas are those with development restrictions, such as wetlands, floodplains, and sites of endangered species.)

❑ Yes ❑ No Can any of the existing setbacks be reduced?

❑ Yes ❑ No Are there maximum turf grass or impervious cover limits in any of the setbacks?

❑ Yes ❑ No Do the ordinances inhibit or prohibit the clearcutting of the project site as part of the construction?

❑ Yes ❑ No Is the traffic of heavy construction vehicles limited to specific areas, such as areas of proposed roadway? Are these areas required to be identified on the plans and marked in the field?

❑ Yes ❑ No Do the ordinances require the identification of specific areas that provide significant hydrologic functions, such as existing surface storage areas, forested areas, riparian corridors, and areas with high groundwater recharge capabilities?

❑ Yes ❑ No Does the municipality require an as-built inspection before issuing a certificate of occupancy? If so, does the inspection include identification of compacted areas, if they exist within the site?

❑ Yes ❑ No Does the municipality require the restoration to compacted areas in accordance with the Soil Erosion and Sediment Control Standards?

B. Open Space and Cluster Development

Open space areas are restricted land that may be set aside for conservation, recreation, or agricultural use, and are often associated with cluster development requirements. Since open space can have a variety of uses, the municipality should evaluate its open space ordinances to determine whether amendments are necessary to provide improved stormwater benefits.

❑ Yes ❑ No Are open space or cluster development designs allowed in the municipality?

❑ Yes ❑ No Are flexible site design incentives available for developers that utilize open space or cluster design options?

❑ Yes ❑ No Are there limitations on the allowable disturbance of existing vegetated areas in open space?

❑ Yes ❑ No Are the requirements to re-establish vegetation in disturbed areas dedicated for open space?

❑ Yes ❑ No Is there a maximum allowable impervious cover in open space areas?

Part 3: Impervious Area Management

The amount of impervious area, and its relationship to adjacent vegetated areas, can significantly change the amount of runoff that needs to be addressed by BMPs. Most of a site's impervious surfaces are typically located in the streets, sidewalks, driveway, and parking areas. These areas are further hampered by requirements for continuous curbing that prevent discharge from impervious surfaces into adjacent vegetated areas.

A. Streets and Driveways

Street widths of 18 to 22 feet are recommended for low impact development designs in low density residential developments. Minimum driveway widths of 9 and 18 feet for one lane and two lanes, respectively, are also recommended. The minimum widths of all streets and driveways should be evaluated to demonstrate that the proposed width is the narrowest possible consistent with safety and traffic concerns and requirements. Municipalities should evaluate which traffic calming features, such as circles, rotaries, medians, and islands, can be vegetated or landscaped. Cul-de-sacs can also be evaluated to reduce the radius area, or to provide a landscape island in the center.

❑ Yes ❑ No Are the street widths the minimum necessary for traffic density, emergency vehicle movement, and roadside parking?

❑ Yes ❑ No Are street features, such as circles, rotaries, or landscaped islands allowed to or required to receive runoff?

❑ Yes ❑ No Are curb cuts or flush curbs with curb stops an allowable alternative to raised curbs?

❑ Yes ❑ No Can the minimum cul-de-sac radius be reduced or is a landscaped island required in the center of the cul-de-sac?

❑ Yes ❑ No Are alternative turn-arounds such as "hammerheads" allowed on short streets in low density residential developments?

❑ Yes ❑ No Can the minimum driveway width be reduced?

❑ Yes ❑ No Are shared driveways permitted in residential developments?

B. Parking Areas and Sidewalks

A mix of uses at a development site can allow for shared parking areas, reducing the total parking area. Municipalities require minimum parking areas, but seldom limit the total number of parking spaces. Table 1 shows recommendations for minimum parking space ratios for low impact design:

Table 1: Low Impact Development Parking Space Ratios

Use	Parking Ratio per 1000 sq. ft. of Gross Floor Area
Professional office building	Less than 3.0
Shopping centers	Less than 4.5

❑ Yes ❑ No Can the parking ratios be reduced?

❑ Yes ❑ No Are the parking requirements set as maximum or median rather than minimum requirements?

❑ Yes ❑ No Is the use of shared parking arrangements allowed to reduce the parking area?

❑ Yes ❑ No Are model shared parking agreements provided?

❑ Yes ❑ No Does the presence of mass transit allow for reduced parking ratios?

❑ Yes ❑ No Is a minimum stall width of 9 feet allowed?

❑ Yes ❑ No Is a minimum stall length of 18 feet allowed?

❑ Yes ❑ No Can the stall lengths be reduced to allow vehicle overhang into a vegetated area?

❑ Yes ❑ No Do ordinances allow for permeable material to be used in overflow parking areas?

❑ Yes ❑ No Do ordinances allow for multi-level parking?

❑ Yes ❑ No Are there incentives to provide parking that reduces impervious cover, rather than providing only surface parking lots?

Sidewalks can be made of pervious material or disconnected from the drainage system to allow runoff to re-infiltrate into the adjacent pervious areas.

❑ Yes ❑ No Do ordinances allow for sidewalks constructed with pervious material?

❑ Yes ❑ No Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

C. Unconnected Impervious Areas

Disconnection of impervious areas can occur in both low density development and high density commercial development, provided sufficient vegetated area is available to accept dispersed stormwater flows. Areas for disconnection include parking lot or cul-de-sac islands, lawn areas, and other vegetated areas.

❑ Yes ❑ No Are developers required to disconnect impervious surfaces to promote pollutant removal and groundwater recharge?

❑ Yes ❑ No Do ordinances allow the reduction of the runoff volume when runoff from impervious areas are re-infiltrated into vegetated areas?

❑ Yes ❑ No Do ordinances allow flush curb and/or curb cuts to allow for runoff to discharge into adjacent vegetated areas as sheet flow?

Part 4: Vegetated Open Channels

The use of vegetated channels, rather than the standard concrete curb and gutter configuration, can decrease flow velocity, and allow for stormwater filtration and re-infiltration. One design option is for vegetated channels that convey smaller storm events, such as the water quality design storm, and provide an overflow into a storm sewer system for larger storm events.

❑ Yes ❑ No Do ordinances allow or require vegetated open channel conveyance instead of the standard curb and gutter designs?

❑ Yes ❑ No Are there established design criteria for vegetated channels?

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APPENDIX C

Sample Municipal Stormwater Management Plan

This is a sample of a municipal stormwater management plan. It was prepared to assist municipalities in developing the municipal stormwater management plans required by the new Stormwater Phase II Permitting Regulations and the Stormwater Management Rules. The plan has all of the required elements outlined in the Stormwater Management Rules at N.J.A.C. 7:8-4.2. The plan also includes additional recommended elements to enable municipalities to better manage the impact of stormwater on the receiving waters of the state from new and existing development. *Throughout the document, italicized text is provided to assist municipalities in the preparation of their own plan.*

Please note that portions of this plan are fictional and intended only as a model to assist municipalities in the development of the stormwater management plan. It is anticipated that municipalities will provide more detail and information than what is presented in this plan.

Note: Figures can be viewed in color in the PDF version of this appendix available at http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

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Introduction

Every plan should include an introduction to identify why the plan is being prepared and a summary of the contents of the plan. Here is sample language.

This Municipal Stormwater Management Plan (MSWMP) documents the strategy for the ABC Township ("the Township") to address stormwater-related impacts. The creation of this plan is required by N.J.A.C. 7:14A-25 Municipal Stormwater Regulations. This plan contains all of the required elements described in N.J.A.C. 7:8 Stormwater Management Rules. The plan addresses groundwater recharge, stormwater quantity, and stormwater quality impacts by incorporating stormwater design and performance standards for new major development, defined as projects that disturb one or more acre of land. These standards are intended to minimize the adverse impact of stormwater runoff on water quality and water quantity and the loss of groundwater recharge that provides baseflow in receiving water bodies. The plan describes long-term operation and maintenance measures for existing and future stormwater facilities.

A "build-out" analysis has been included in this plan based upon existing zoning and land available for development. The plan also addresses the review and update of existing ordinances, the Township Master Plan, and other planning documents to allow for project designs that include low impact development techniques. The final component of this plan is a mitigation strategy for when a variance or exemption of the design and performance standards is sought. As part of the mitigation section of the stormwater plan, specific stormwater management measures are identified to lessen the impact of existing development.

Goals

Although each municipal plan may have different or more specific goals, listed below are the minimum set of goals that should be included in all municipal stormwater management plans.

The goals of this MSWMP are to:

- reduce flood damage, including damage to life and property;
- minimize, to the extent practical, any increase in stormwater runoff from any new development;
- reduce soil erosion from any development or construction project;
- assure the adequacy of existing and proposed culverts and bridges, and other in-stream structures;
- maintain groundwater recharge;
- prevent, to the greatest extent feasible, an increase in nonpoint pollution;
- maintain the integrity of stream channels for their biological functions, as well as for drainage;
- minimize pollutants in stormwater runoff from new and existing development to restore, enhance, and maintain the chemical, physical, and biological integrity of the waters of the state, to protect public health, to safeguard fish and aquatic life and scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial, and other uses of water; and
- protect public safety through the proper design and operation of stormwater basins.

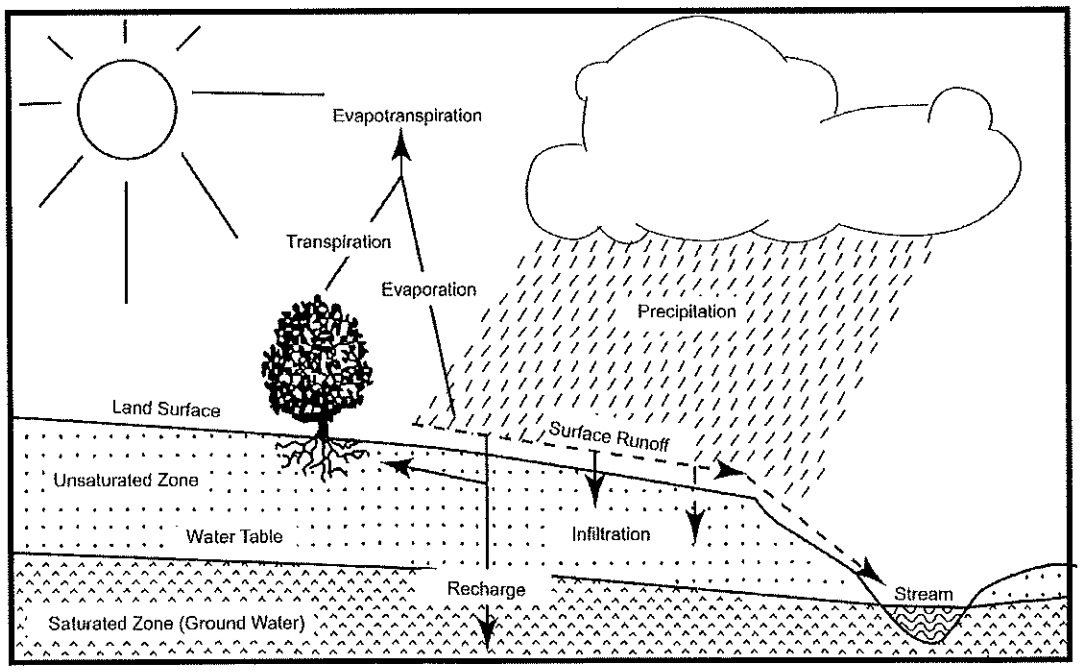
To achieve these goals, this plan outlines specific stormwater design and performance standards for new development. Additionally, the plan proposes stormwater management controls to address impacts from existing development. Preventative and corrective maintenance strategies are included in the plan to ensure long-term effectiveness of stormwater management facilities. The plan also outlines safety standards for stormwater infrastructure to be implemented to protect public safety.

Stormwater Discussion

Some of the readers of the plan may have limited knowledge of stormwater related issues. A brief description of the hydrologic cycle and how development affects the cycle may be useful to the reader. Sample language is provided below.

Land development can dramatically alter the hydrologic cycle (See Figure C-1) of a site and, ultimately, an entire watershed. Prior to development, native vegetation can either directly intercept precipitation or draw that portion that has infiltrated into the ground and return it to the atmosphere through evapotranspiration. Development can remove this beneficial vegetation and replace it with lawn or impervious cover, reducing the site's evapotranspiration and infiltration rates. Clearing and grading a site can remove depressions that store rainfall. Construction activities may also compact the soil and diminish its infiltration ability, resulting in increased volumes and rates of stormwater runoff from the site. Impervious areas that are connected to each other through gutters, channels, and storm sewers can transport runoff more quickly than natural areas. This shortening of the transport or travel time quickens the rainfall-runoff response of the drainage area, causing flow in downstream waterways to peak faster and higher than natural conditions. These increases can create new and aggravate existing downstream flooding and erosion problems and increase the quantity of sediment in the channel. Filtration of runoff and removal of pollutants by surface and channel vegetation is eliminated by storm sewers that discharge runoff directly into a stream. Increases in impervious area can also decrease opportunities for infiltration which, in turn, reduces stream base flow and groundwater recharge. Reduced base flows and increased peak flows produce greater fluctuations between normal and storm flow rates, which can increase channel erosion. Reduced base flows can also negatively impact the hydrology of adjacent wetlands and the health of biological communities that depend on base flows. Finally, erosion and sedimentation can destroy habitat from which some species cannot adapt.

Figure C-1: Groundwater Recharge in the Hydrologic Cycle



Source: New Jersey Geological Survey Report GSR-32.

In addition to increases in runoff peaks, volumes, and loss of groundwater recharge, land development often results in the accumulation of pollutants on the land surface that runoff can mobilize and transport to streams. New impervious surfaces and cleared areas created by development can accumulate a variety of pollutants from the atmosphere, fertilizers, animal wastes, and leakage and wear from vehicles. Pollutants can include metals, suspended solids, hydrocarbons, pathogens, and nutrients.

In addition to increased pollutant loading, land development can adversely affect water quality and stream biota in more subtle ways. For example, stormwater falling on impervious surfaces or stored in detention or retention basins can become heated and raise the temperature of the downstream waterway, adversely affecting cold water fish species such as trout. Development can remove trees along stream banks that normally provide shading, stabilization, and leaf litter that falls into streams and becomes food for the aquatic community.

Background

The plan should include background information on the municipality to help the reader understand its characteristics – size in square miles, population, population changes, waterways, and health of these waterways. For example, is the municipality a rural community rapidly becoming developed or is it an older established community where land use is fairly stable? Is the health of the waterways in the municipality impaired? Are there flooding concerns in the municipality? Also, maps should be included to help the reader visualize the municipality and its physical features.

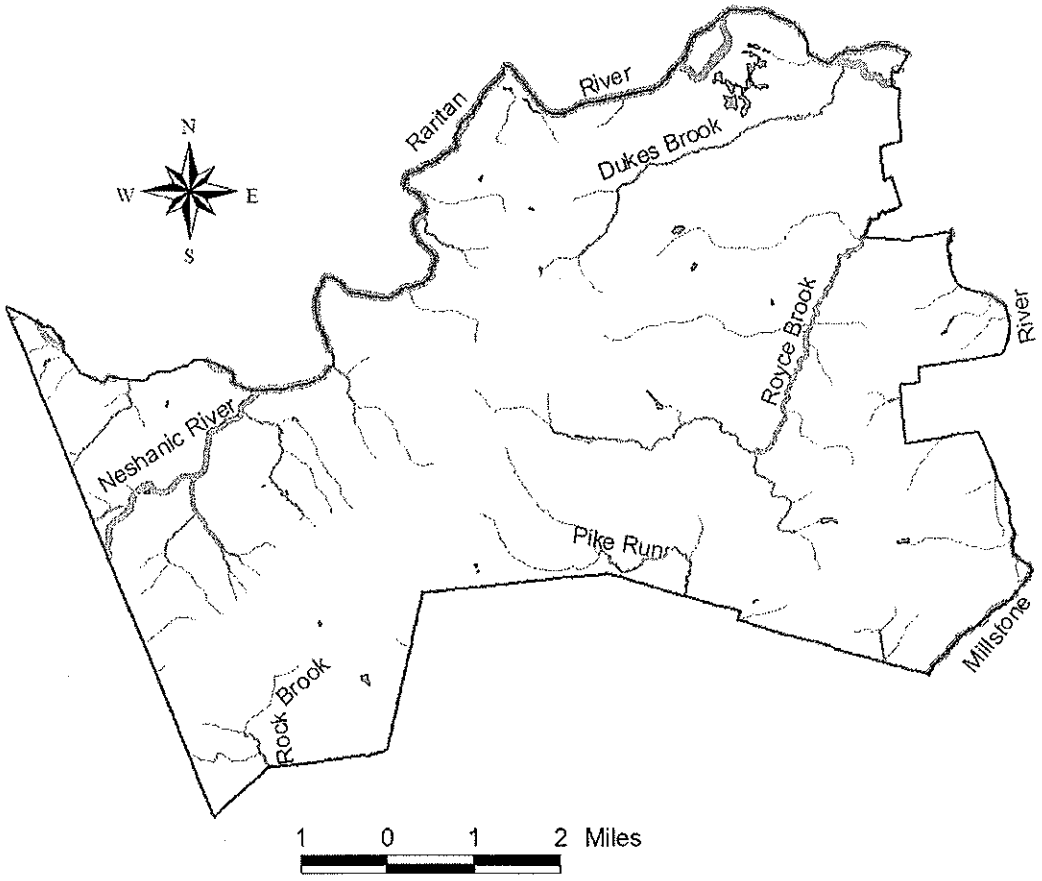
A township was selected for this sample plan so that the mapping and municipal characteristics can be presented along with information as to where to obtain these data. Due to the sample nature of this plan, this section does not present a comprehensive background of the municipality and its stormwater-related issues.

The Township encompasses 55 square mile area in Somerset County, New Jersey. In recent years, the Township has been under significant development pressure. The population of the Township has increased from 19,061 in 1980, to 28,808 in 1990, to 36,634 in 2000. This population increase has resulted in considerable demand for new development; changes in the landscape have most likely increased stormwater runoff volumes and pollutant loads to the waterways of the municipality. Figure C-2 illustrates the waterways in the Township. Figure C-3 depicts the Township boundary on the USGS quadrangle maps.

Each municipality should have population statistics. This information is available from the New Jersey Department of Labor at www.wnjpin.net/OneStopCareerCenter/LaborMarketInformation/lmi25/index.html. Mapping required for a municipal plan is fairly simple, but requires Geographic Information System (GIS) software. Mapping information is available at http://www.nj.gov/dep/gis/lists.html as well as a link to a free version of GIS software, ArcExplorer. Many local watershed associations and environmental commissions have GIS and can help create maps for an MSWMP. Rutgers University Center for Remote Sensing and Spatial Analysis can also assist in preparing these maps. Detailed direction on how to create these maps is provided at http://rwqp.rutgers.edu/univ/nj/.

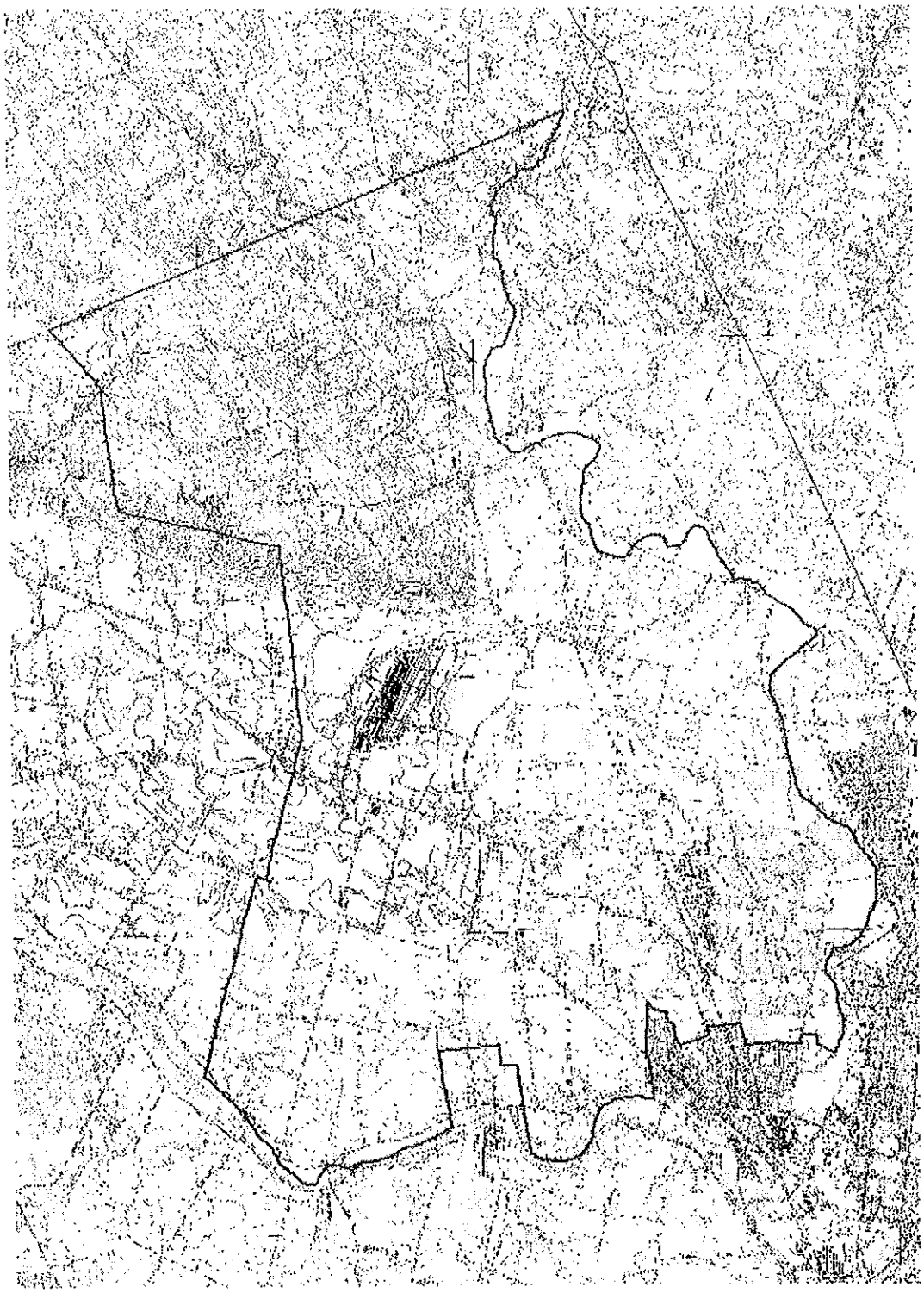
The New Jersey Department of Environmental Protection (NJDEP) has established an Ambient Biomonitoring Network (AMNET) to document the health of the state's waterways. There are over 800 AMNET sites throughout the state of New Jersey. These sites are sampled for benthic macroinvertebrates by NJDEP on a five-year cycle. Streams are classified as non-impaired, moderately impaired, or severely impaired based on the AMNET data. The data is used to generate a New Jersey Impairment Score (NJIS), which is based on a number of biometrics related to benthic macroinvertebrate community dynamics. The two major rivers that border the Township to the north and east, the Raritan River and the Millstone River,

Figure C-2: Township and Its Waterways



This figure can be viewed in color in the PDF version of this appendix available at http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

Figure C-3: Township Boundary on USGS Quadrangles



This figure can be viewed in color in the PDF version of this appendix available at http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

respectively, are both moderately impaired. The five tributaries that flow through the Township to these major rivers are also moderately impaired based on AMNET data. In addition to the AMNET data, the NJDEP and other regulatory agencies collect water quality chemical data on the streams in the state. These data show that the instream total phosphorus concentrations and fecal coliform concentrations of the Raritan River and Millstone River frequently exceed the state's criteria. This means that these rivers are impaired waterways and the NJDEP is required to develop a Total Maximum Daily Load (TMDL) for these pollutants for each waterway.

A TMDL is the amount of a pollutant that can be accepted by a waterbody without causing an exceedance of water quality standards or interfering with the ability to use a waterbody for one or more of its designated uses. The allowable load is allocated to the various sources of the pollutant, such as stormwater and wastewater discharges, which require an NJPDES permit to discharge, and nonpoint source, which includes stormwater runoff from agricultural areas and residential areas, along with a margin of safety. Provisions may also be made for future sources in the form of reserve capacity. An implementation plan is developed to identify how the various sources will be reduced to the designated allocations. Implementation strategies may include improved stormwater treatment plants, adoption of ordinances, reforestation of stream corridors, retrofitting stormwater systems, and other BMPs.

The New Jersey Integrated Water Quality Monitoring and Assessment Report (305(b) and 303(d)) (Integrated List) is required by the federal Clean Water Act to be prepared biennially and is a valuable source of water quality information. This combined report presents the extent to which New Jersey waters are attaining water quality standards, and identifies waters that are impaired. Sublist 5 of the Integrated List constitutes the list of waters impaired or threatened by pollutants, for which one or more TMDLs are needed.

The integrated list is available from the NJDEP website at www.nj.gov/dep/wmm/sgwqt/wat/index.html. Specific data on biological monitoring (AMNET data) is available from the NJDEP web site at www.state.nj.us/dep/wmm/bfbm. Additional data can be found on the United States Geological Survey (USGS) site at www.water.usgs.gov.

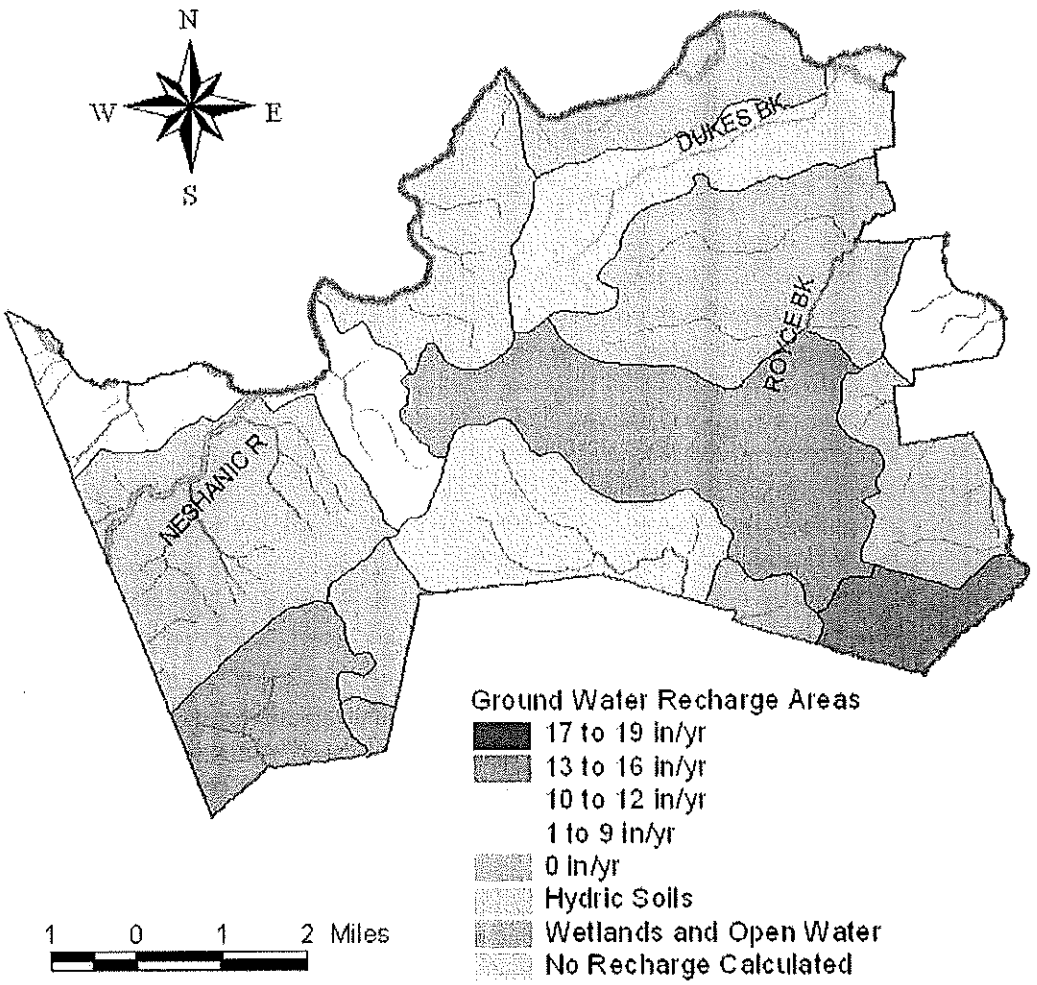
In addition to water quality problems, the Township has exhibited severe water quantity problems including flooding, stream bank erosion, and diminished base flow in its streams. Many of the culverts associated with road crossings in the Township are undersized. During severe storm events, these undersized culverts do not have adequate capacity, thereby causing a backwater effect and flooding upstream.

The municipality should list specific areas that are affected by stormwater quantity problems and the extent. For example, if in a storm event in 2001, considered equivalent to a 20-year design storm, specific areas reached particular elevations, that should be included.

These culverts were designed for much different hydrologic conditions (i.e., less impervious area) than presently exist in the Township. As the imperviousness increased in the Township, the peak and volumes of stream flows also increased. The increased amount of water resulted in stream bank erosion, which resulted in unstable areas at roadway/bridge crossings, and degraded stream habitats. The high imperviousness of the Township has significantly decreased groundwater recharge, decreasing base flows in streams during dry weather periods. Lower base flows can have a negative impact on instream habitat during the summer months. A map of the groundwater recharge areas are shown in Figure C-4. Wellhead protection areas, also required as part of the MSWMP, are shown in Figure C-5.

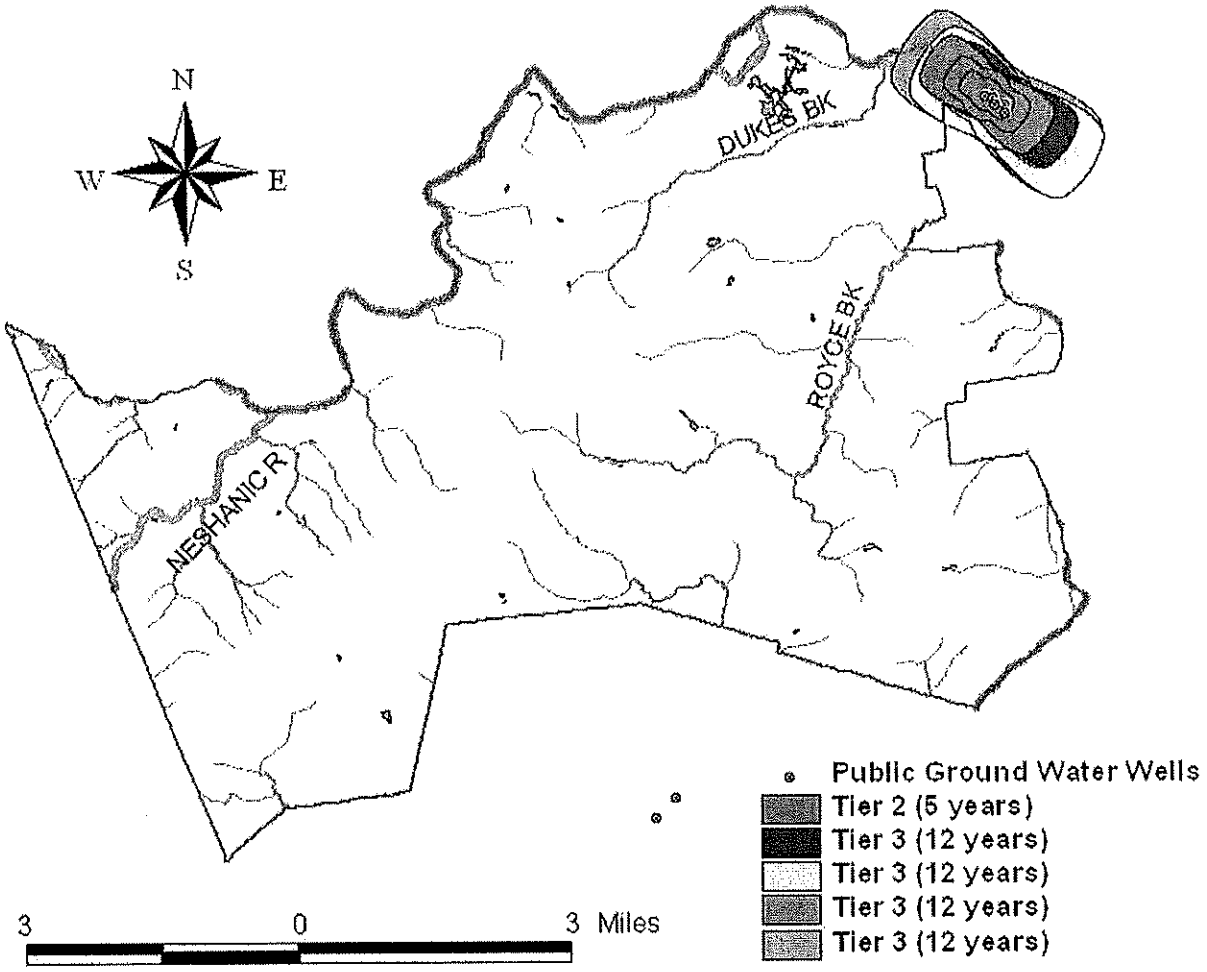
The Township may want to adopt specific ordinances to protect wellhead protection areas to minimize the infiltration of pollutants into aquifers.

Figure C-4: Groundwater Recharge Areas in the Township



This figure can be viewed in color in the PDF version of this appendix available at http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

Figure C-5: Wellhead Protection Areas in the Township



This figure can be viewed in color in the PDF version of this appendix available at http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

Design and Performance Standards

Municipal stormwater management plans must describe how the plan incorporates the design and performance standards in N.J.A.C. 7:8-5 or alternative design and performance standards that were adopted as a part of a regional stormwater management plan or water quality management plan. The design and performance standards should be incorporated into the municipality's stormwater management ordinance to be consistent with this requirement. A sample ordinance is provided in Appendix D: Model Stormwater Control Ordinance for Municipalities *to assist in the incorporation of these design and performance standards into municipal plans. This section should clearly state that the municipality will adopt ordinances consistent with the design and performance standards at N.J.A.C. 7:8-5, ordinances to address maintenance consistent with N.J.A.C. 7:8-5.8, and ordinances to address safety consistent with N.J.A.C. 7:8-6. It should also indicate steps the municipality will take to ensure compliance with these standards.*

The Township will adopt the design and performance standards for stormwater management measures as presented in N.J.A.C. 7:8-5 to minimize the adverse impact of stormwater runoff on water quality and water quantity and loss of groundwater recharge in receiving water bodies. The design and performance standards include the language for maintenance of stormwater management measures consistent with the stormwater management rules at N.J.A.C. 7:8-5.8 Maintenance Requirements, and language for safety standards consistent with N.J.A.C. 7:8-6 Safety Standards for Stormwater Management Basins. The ordinances will be submitted to the county for review and approval within [24 months of the effective date of the Stormwater Management Rules.]

During construction, Township inspectors will observe the construction of the project to ensure that the stormwater management measures are constructed and function as designed.

The simplest method to address the need to incorporate design and performance standards is to adopt the language in the Stormwater Management Rules and model ordinance. However, the municipality may adjust these standards. For example, certain municipalities have designated entities required to assume maintenance responsibility. In some cases, the municipality may choose to assume this responsibility. The municipality may choose to revise land use and zoning ordinances to prescribe how nonstructural stormwater management measures must be addressed. Additional discussion on the relationship of nonstructural stormwater management measures and ordinances are provided in Chapter 2: Low Impact Development Techniques, Chapter 3: Regional and Municipal Stormwater Management Plans, and Appendix B: Municipal Regulations Checklist.

Plan Consistency

The MSWMP must be coordinated with the appropriate Soil Conservation District and any other stormwater management plan, such as an adopted regional stormwater management plan. A short paragraph as given below is sufficient to comply with this requirement unless there is a TMDL for any of the waterways within the municipality. If a TMDL is in place and requires reductions in nonpoint sources within the municipalities, the TMDL requirements should be incorporated into this municipal stormwater management plan. For example, if a TMDL completed for fecal coliform identified the need for a goose management plan to control the impact from the resident geese at a local park, the goose management plan should be incorporated into this municipal stormwater management plan. Another example is that a TMDL may have identified over-fertilization of residential lawns as a source of nutrients to the impaired waterway and recommended development of a no-phosphorus ordinance for a particular section of the Township unless soil testing indicates a lack of sufficient phosphorus in the soil. This ordinance should be incorporated into this municipal stormwater management plan.

The Township is not within a Regional Stormwater Management Planning Area and no TMDLs have been developed for waters within the Township; therefore this plan does not need to be consistent with any regional stormwater management plans (RSWMPs) nor any TMDLs. If any RSWMPs or TMDLs are developed in the future, this Municipal Stormwater Management Plan will be updated to be consistent.

The Municipal Stormwater Management Plan is consistent with the Residential Site Improvement Standards (RSIS) at N.J.A.C. 5:21. The municipality will utilize the most current update of the RSIS in the

stormwater management review of residential areas. This Municipal Stormwater Management Plan will be updated to be consistent with any future updates to the RSIS.

The Township's Stormwater Management Ordinance requires all new development and redevelopment plans to comply with New Jersey's Soil Erosion and Sediment Control Standards. During construction, Township inspectors will observe on-site soil erosion and sediment control measures and report any inconsistencies to the local Soil Conservation District.

Nonstructural Stormwater Management Strategies

In addition to the design and performance standards for nonstructural strategies discussed above, the municipal stormwater management plan must be evaluated to determine how the municipal plan and ordinances should be amended to implement the principles of nonstructural stormwater management. Municipalities are required to evaluate the municipal master plan, and land use and zoning ordinances to determine what adjustments need to be made to allow the implementation of nonstructural stormwater management techniques, also called low impact development techniques, which are presented in Chapter 2: Low Impact Development Techniques. Additional discussion on the relationship of nonstructural stormwater management measures and ordinances is provided in Chapter 3: Regional and Municipal Stormwater Management Plans.

To address this requirement, municipal ordinances and plans must be reviewed to determine where changes can be made to incorporate nonstructural stormwater management strategies. Appendix B: Municipal Regulations Checklist has been provided to assist municipalities.

An example of the changes identified in ordinances is given below. (Note: This is not an exhaustive list of every ordinance that should be evaluated, but presents some examples.) Since many municipal codes are similar in much of the state, the recommendations provided here may prove useful in modifying individual municipal codes. When submitting the plan and ordinances to the county for review and a copy to the Department, all revised ordinances, master plans, and maps must be attached, along with an adoption schedule.

The Township has reviewed the master plan and ordinances, and has provided a list of the sections in the Township land use and zoning ordinances that are to be modified to incorporate nonstructural stormwater management strategies. These are the ordinances identified for revision. Once the ordinance texts are completed, they will be submitted to the county review agency for review and approval within [24 months of the effective date of the Stormwater Management Rules]. A copy will be sent to the Department of Environmental Protection at the time of submission.

Chapter 77 of the Township Code, entitled Development Regulations, was reviewed with regard to incorporating nonstructural stormwater management strategies. Several changes were made to Article VI of this Chapter, entitled "Design and Performance Standards" to incorporate these strategies.

Section 77-39: Buffers requires buffer areas along all lot and street lines separating residential uses from arterial and collector streets, separating a nonresidential use from either a residential use or residential zoning district line, and along all street lines where loading and storage areas can be seen from the street. The landscape requirements for these buffer areas in the existing section do not recommend the use of native vegetation. The language of this section was amended to require the use of native vegetation, which requires less fertilization and watering than non-native species. Additionally, language was included to allow buffer areas to be used for stormwater management by disconnecting impervious surfaces and treating runoff from these impervious surfaces. This section currently requires the preservation of natural wood tracts and limits land disturbance for new construction.

Section 77-41: Cluster Development provides for a cluster development option to preserve land for public and agricultural purposes, to prevent development on environmentally sensitive areas, and to aid in reducing the cost of providing streets, utilities and services in residential developments. This cluster

option is an excellent tool for reducing impervious roads and driveways. The option allows for smaller lots with smaller front and side yard setbacks than traditional development options. It also minimizes the disturbance of large tracts of land, which is a key nonstructural stormwater management strategy. The cluster option is being amended to require that [*insert percentage here*] of the total tract be preserved as common open space for residential area. The cluster option does require that 25 percent of the green or common area be landscaped with trees and/or shrubs. This language was amended to promote the use of native vegetation, which requires less fertilization and watering than non-native ornamental plants. Although the cluster option requires public concrete sidewalks to be installed along all streets, the option requires paths in open space to be mulched or stone to decrease the impervious area.

Section 77-43: Curbs and Gutters requires that concrete curb and gutter, concrete curb, or Belgian block curb be installed along every street within and fronting on a development. This section was amended to allow for curb cuts or flush curbs with curb stops to allow vegetated swales to be used for stormwater conveyance and to allow the disconnection of impervious areas.

Section 77-44: Drainage, Watercourses and Flood Hazard Areas requires that all streets be provided with inlets and pipes where the same are necessary for proper drainage. This section was amended to encourage the used of natural vegetated swales in lieu of inlets and pipes.

Section 77-45: Driveways and Accessways describes the procedure for construction of any new driveway or accessway to any street. This section was amended to allow the use of pervious paving materials to minimize stormwater runoff and promote groundwater recharge.

Section 77-60: Natural Features requires that natural features, such as trees, brooks, swamps, hilltops, and views, be preserved whenever possible, and that care be taken to preserve selected trees to enhance soil stability and landscaped treatment of the area. This section was amended to expand trees to forested areas, to ensure that leaf litter and other beneficial aspects of the forest are maintained in addition to the trees.

Section 77-62: Nonconforming Uses, Structures or Lots requires a variance for existing single family homes proposing additions that exceed the maximum percent impervious. The homeowner must mitigate the impact of the additional impervious surfaces unless the stormwater management plan for the development provided for these increases in impervious surfaces. This mitigation effort must address water quality, flooding, and groundwater recharge as described in Chapter 135. A detailed description of how to develop a mitigation plan is present in the Township Code.

Section 77-63: Off-site and Off-tract Improvements describes essential off-site and off-tract improvements. Language was added to this section to require that any off-site and off-tract stormwater management and drainage improvements must conform to the "Design and Performance Standards" described in this plan and provided in Chapter 135 of the Township Code.

Section 77-64: Off-street Parking and Loading details off-street parking and loading requirements. All parking lots with more than 10 spaces and all loading areas are required to have concrete or Belgian block curbing around the perimeter of the parking and loading areas. This section also requires that concrete or Belgian block curbing be installed around all landscaped areas within the parking lot or loading areas. This section was amended to allow for flush curb with curb stop, or curbing with curb cuts to encourage developers to allow for the discharge of impervious areas into landscaped areas for stormwater management. Also, language was added to allow for use of natural vegetated swales for the

water quality design storm, with overflow for larger storm events into storm sewers. This section also provides guidance on minimum parking space requirements. These requirements are based on the number of dwelling units and/or gross floor area. The section allows a developer to demonstrate that fewer spaces would be required, provided area is set aside for additional spaces if necessary. This section was amended to allow pervious paving to be used in areas to provide overflow parking, vertical parking structures, smaller parking stalls, and shared parking.

Sections 77-66: Performance Standards provide pollution source control. It prohibits materials or wastes to be deposited upon a lot in such form or manner that they can be transferred off the lot, directly or indirectly, by natural forces such as precipitation, evaporation or wind. It also requires that all materials and wastes that might create a pollutant or a hazard be enclosed in appropriate containers.

Section 77-73: Shade Trees requires a minimum of three shade trees per lot to be planted in the front yard. In addition to Section 77-73, the Township has a Tree Preservation Ordinance (Sections 77-160 to 77-165) that restricts and otherwise controls the removal of mature trees throughout the Township. This ordinance recognizes that the preservation of mature trees and forested areas is a key strategy in the management of environmental resources, particularly watershed management, air quality, and ambient heating and cooling. These sections set out a "critical footprint area" that extends 20 feet beyond the driveway and building footprint where clearing of trees cannot occur. This complies with minimizing land disturbance, which is a nonstructural stormwater management strategy. These sections were amended to require the identification of forested areas, and that [*insert percentage here*] of forested areas be protected from disturbance.

Section 77-74: Sidewalks describe sidewalk requirements for the Township. Although sidewalks are not required along all streets, the Township can require them in areas where the probable volume of pedestrian traffic, the development's location in relation to other populated areas and high vehicular traffic, pedestrian access to bus stops, schools, parks, and other public places, and the general type of improvement intended indicate the advisability of providing a pedestrianway. Sidewalks are to be a minimum of four feet wide and constructed of concrete. Language was added to this section to require developers to design sidewalks to discharge stormwater to neighboring lawns where feasible to disconnect these impervious surfaces, or use permeable paving materials where appropriate.

Section 77-77: Soil Erosion and Sediment Control addresses soil erosion and sediment control by referencing Chapter 128, the Township's Soil Erosion and Sediment Control Ordinance. This ordinance requires developers to comply with the New Jersey Soil Erosion and Sediment Control Standards and outlines some general design principles, including: whenever possible, retain and protect natural vegetation; minimize and retain water runoff to facilitate groundwater recharge; and, install diversions, sediment basins, and similar required structures prior to any on-site grading or disturbance.

Section 77-79 Stormwater Runoff addresses stormwater runoff by referencing Chapter 135, the Township's Surface Water Management Ordinance, which was updated to include all requirements outlined in N.J.A.C. 7:8-5. These changes were presented earlier in this document.

Section 77-82: Streets describes the requirements for streets in the Township. The Township has several street classifications, ranging from "Arterial," which has a minimum right-of-way of 80 feet, to "Secondary Local," which has a minimum right-of-way of 50 feet. Street paving widths are a function of the number of units served, whether a street is curbed, whether on-street parking is permitted, whether the interior streets serve lots of two acres or larger, and whether on-site topographical constraints allow design flexibility. Depending on these factors, paving width for secondary local streets has a range from 20 to 32 feet. This section was amended to encourage developers to limit on-street parking to allow for narrower paved widths. This section also required that cul-de-sacs have a minimum radius of 50 feet. Language was added to this section to reduce the minimum radius of cul-de-sac designs. Cul-de-sacs with landscaped islands have a minimum radius of [*insert radius here*], cul-de-sacs with flush curbs have a minimum radius of [*insert radius here*], with a [*insert width here*] reinforced shoulder to accommodate larger equipment and emergency vehicles.

Several changes were made to Article VII of the Township Code entitled "Zoning Districts and Standards." The Township has 11 types of residential districts. Each district has a maximum percent impervious surface allocation, ranging from 5 percent for the MZ District, which has a minimum lot size of five acres for detached single-family homes, to 40 percent for the AM and RCA Districts, which have a minimum lot size of 7,000 square feet for cluster single-family homes. The Township has 12 types of non-residential districts. Each of these districts has a maximum percent impervious surface allocation, ranging from 30 percent for the HOO District to 60 percent for the I-1 District. Although each zone has a maximum allowable percent impervious surface, the Township Code was amended to remind developers that satisfying the percent impervious requirements does not relieve them of responsibility for complying with the Design and Performance Standards for Stormwater Management Measures contained in Chapter 135 – Surface Water Runoff. The Township is evaluating the maximum allowable impervious cover for each zone to determine whether a reduction in impervious cover is appropriate. The Township is also evaluating a maximum percent of disturbance for each zone, for those areas identified as natural features in Section 77-60. Also, if a developer is given a variance to exceed the maximum allowable percent imperviousness, the developer must mitigate the impact of the additional impervious surfaces. This mitigation effort must address water quality, flooding, and groundwater recharge as described in Chapter 135. A detailed description of how to develop a mitigation plan is included in this Municipal Stormwater Management Plan.

Land Use/Build-Out Analysis

If a municipality can document that it has a combined total of less than one square mile of vacant or agricultural lands, the municipality is not required to complete the following build-out analysis. Otherwise, a build-out analysis must be conducted assuming full development under existing zoning for each HUC14 drainage area in the municipality. To satisfy the minimum requirements, the result of the build-out analysis is acreage of impervious surfaces by HUC14 and associated nonpoint loadings attributed to the build-out of the municipality. Although not required by the regulations, a quantitative analysis of the impact of build-out can be calculated, including population and number of school-age children, housing units and housing density, traffic, tax revenues, demands on schools, water supply, sewage, electrical production, and police force. Additional information on the build-out is provided in Chapter 3.

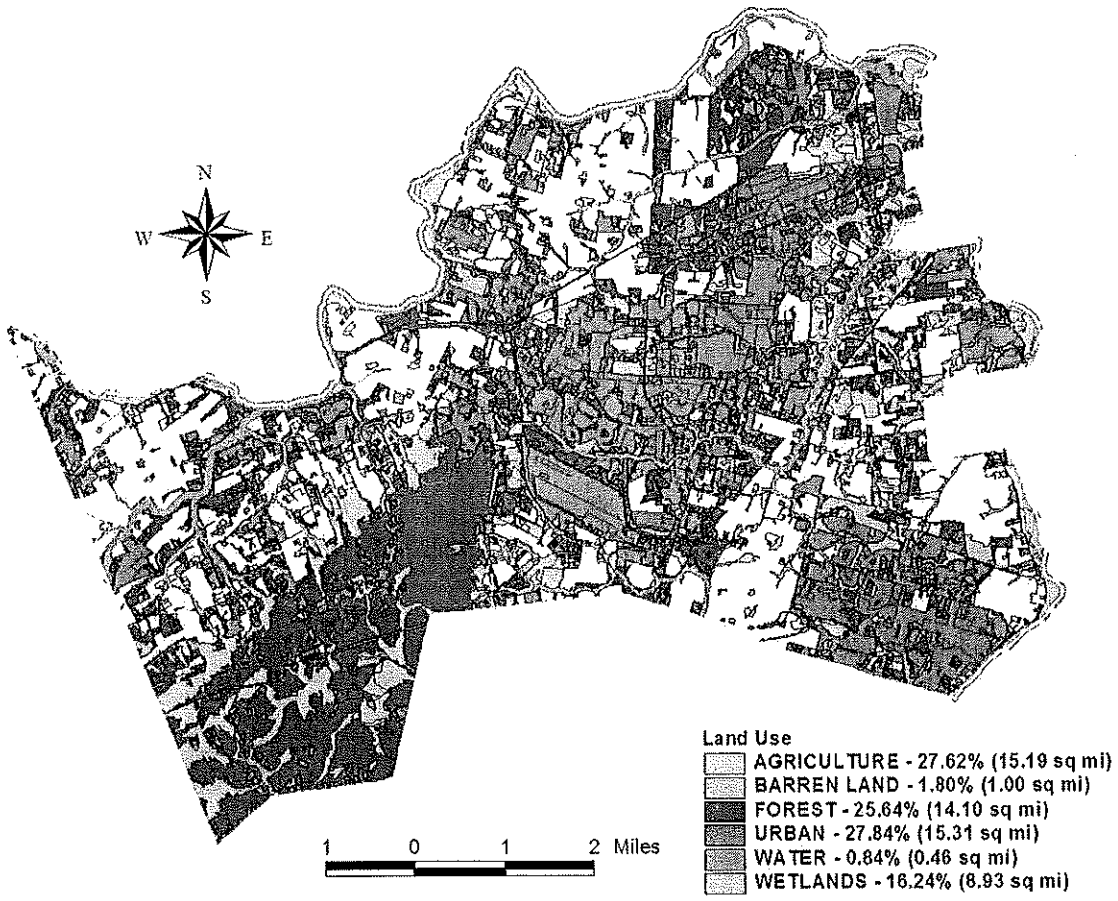
There are four steps to preparing a build-out analysis that satisfies the requirements for the municipal stormwater management plan:

1. *Determine the total land area within each of the HUC14s of the municipality.*
2. *Determine the area of constrained lands within each HUC14 of the municipality.*
3. *Determine the land available for development by simply subtracting the constrained lands from the total land area for each HUC14. In essence, the land available for development is the agricultural, forest and/or barren lands available within each HUC14. Existing residential, commercial, and industrial areas are also eligible for redevelopment and should be considered as land available for development.*
4. *For each HUC14, complete a build-out analysis by using the municipal zoning map and applicable ordinances to determine the acreage of new development. Once the build-out acreage of each land use is determined for each HUC14, nonpoint source loadings can be determined for the build-out scenario. Shown below are examples of build-out analyses for two HUC14s located in the municipality.*

A detailed land use analysis for the Township was conducted. Figure C-6 illustrates the existing land use in the Township based on 1995/97 GIS information from NJDEP. Figure C-7 illustrates the HUC14s within the Township. The Township zoning map is shown in Figure C-8. Figure C-9 illustrates the constrained lands within the Township. *(Note: For this sample plan, every constrained land was not mapped.)* The build-out calculations for impervious cover are shown in Table C-1. As expected when developing agricultural and forest lands, the build-out of these two HUC14s will result in a significant increase in impervious surfaces.

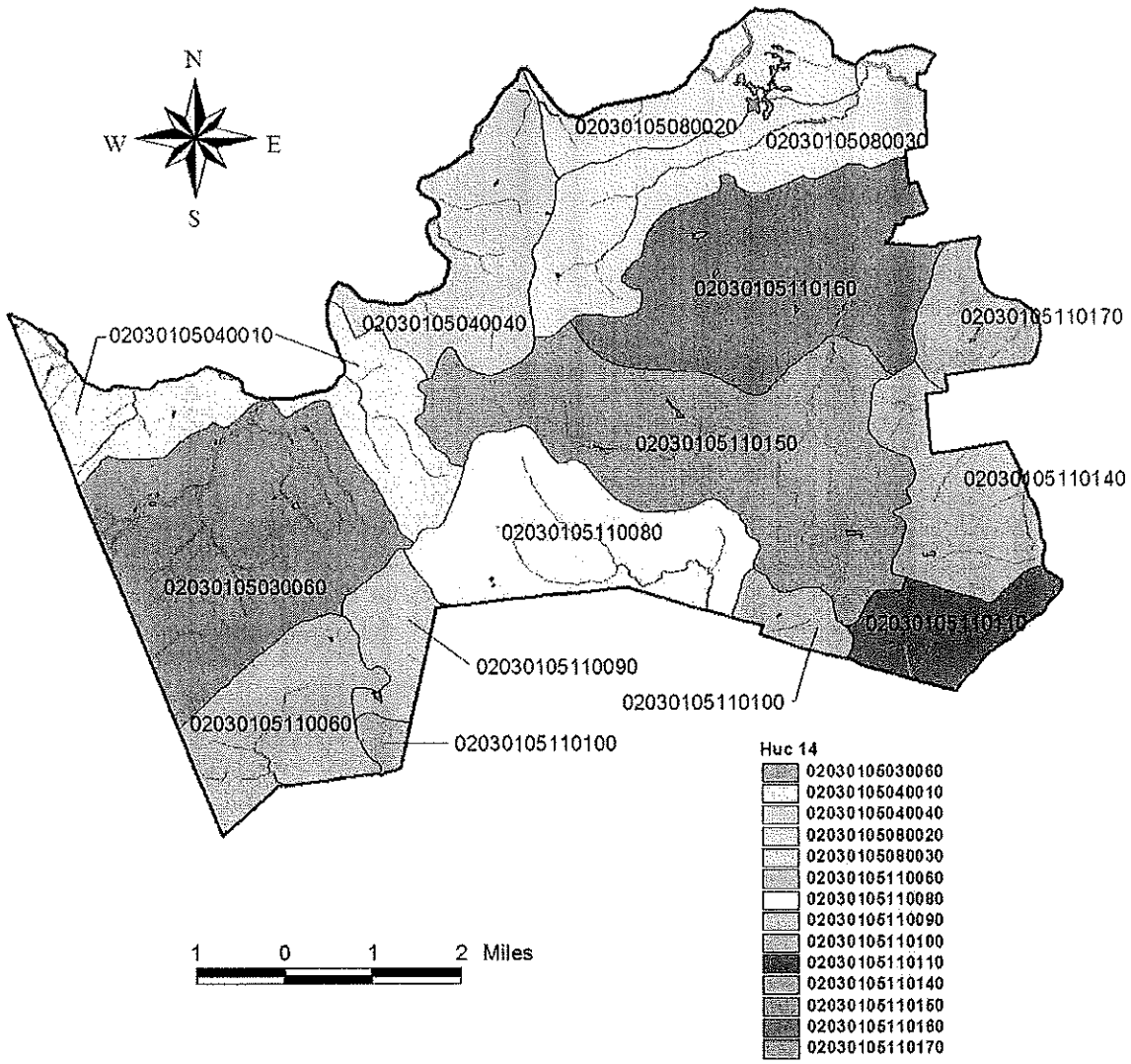
Table C-2 presents the pollutant loading coefficients by land cover. The pollutant loads at full build-out are presented in Table C-3.

Figure C-6: Township's Existing Land Use



This figure can be viewed in color in the PDF version of this appendix available at http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

Figure C-7: Hydrologic Units (HUC14s) Within the Township



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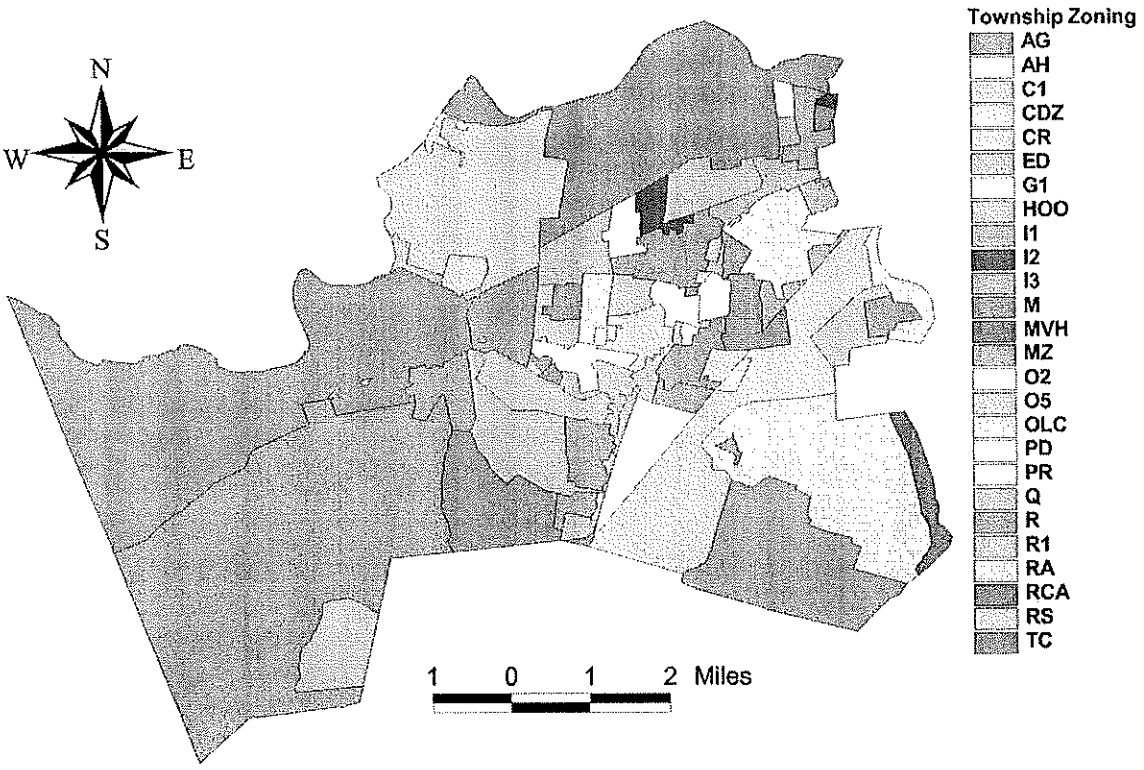
It is important to note that, although the pollutant loads for agricultural lands are higher than those for low density residential for the parameters in Table C-2, converting agricultural lands to residential typically results in an increase in pollutant loads for metals and petroleum hydrocarbons. It is recommended that each municipality calculate build-out pollutant loads for each. Also, total suspended solids loads due to stormwater runoff may decrease due to the conversion of agricultural lands to low density residential, but the percentage of impervious surfaces increases dramatically. If, due to the increase of impervious surfaces, increases in stormwater runoff flows are not managed properly, these high flows will increase streambank erosion, thereby increasing sediment loads to the receiving waters.

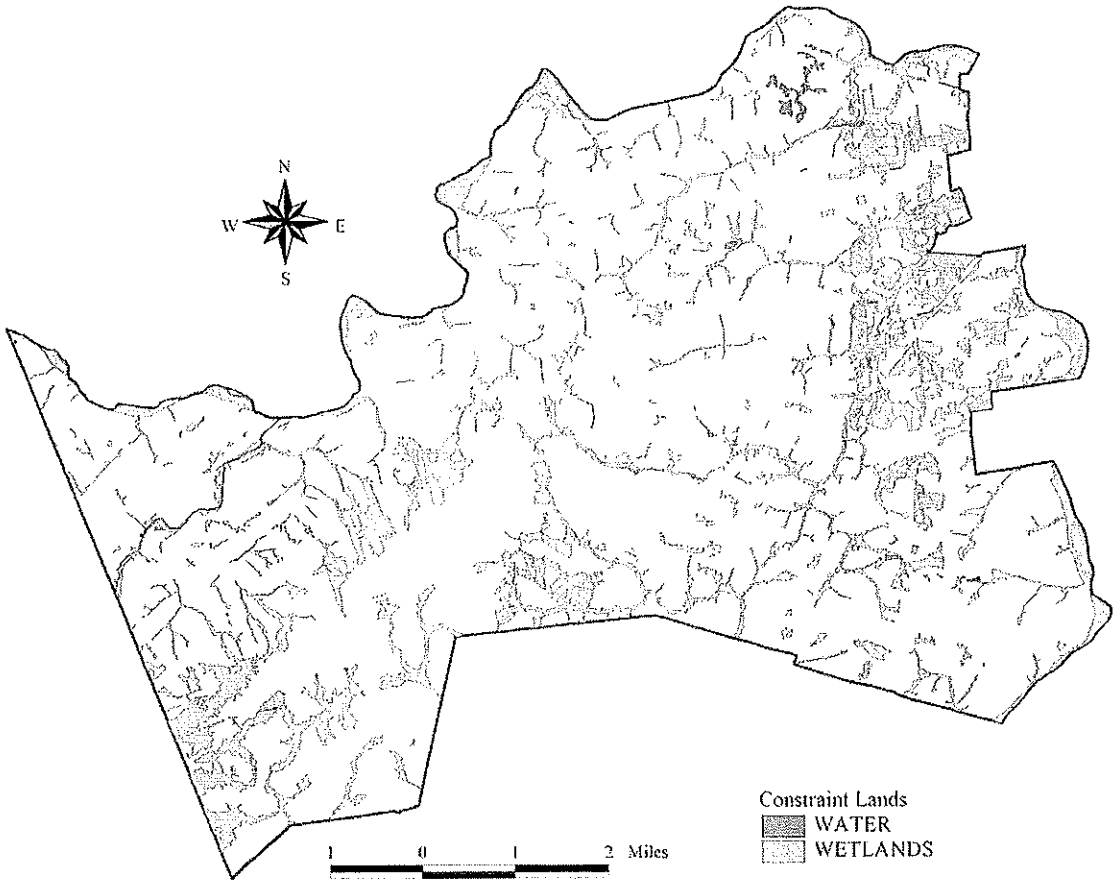
There are a number of resources available for assistance with preparing the build-out analysis, including the Association of New Jersey Environmental Commissions (ANJEC), the Stony Brook-Millstone Watershed Association, Rutgers University's Center for Remote Sensing and Spatial Analysis, the Nonpoint Education of Municipal Officials (NEMO), and USEPA (Green Communities: How to do a Build-Out Analysis at www.epa.gov/greenkit/build-out.htm). The mapping and querying ability of GIS software such as ESRI's ArcView is essential for preparing a build-out analysis in a cost-effective manner.

Figure C-8: Zoning Districts Within the Township



This figure can be viewed in color in the PDF version of this appendix available at http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

Figure C-9: Wetlands and Water Land Uses Within the Township – Constrained Land



This figure can be viewed in color in the PDF version of this appendix available at http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

Table C-1: Sample Build-Out Calculations for Two HUC14s

HUC14 and Zone	Total Area (acres)	Existing Impervious (%)	Existing Impervious (acres)	Wetlands/ Water Area (acres)	Developable Area (acres)	Allowable Impervious (%)	Build-Out Impervious (acres)
02030105110060							
Mountain (MZ)	2,009.84	1.08%	21.68	485.84	1,524.00	5%	76.20
Quarry (Q)	765.52	0.02%	0.18	32.46	733.06	5%	36.65
TOTALS	2,775.36	0.8%	21.86	518.30	2,257.06	5%	112.85
020301050040010							
Agriculture (AG)	2,206.32	2.94%	64.92	327.38	1,878.94	5%	93.95
Neighborhood Shopping Center District (C1)	402.70	1.85%	7.47	7.05	395.65	65%	257.17
Mountain (MZ)	663.23	2.88%	19.12	134.88	528.35	5%	26.42
TOTALS	3,272.25	2.8%	91.51	469.31	2,802.94	13%	377.54

Note: The Mountain, Quarry, and Agricultural Zoning District allow for rural residential development on five acre lots with a maximum percent impervious of 5 percent.

Table C-2: Pollutant Loads by Land Cover

Land Cover	Total Phosphorus Load (lbs/acre/year)	Total Nitrogen Load (lbs/acre/year)	Total Suspended Solids Load (lbs/acre/yr)
High, Medium Density Residential	1.4	15	140
Low Density, Rural Residential	0.6	5	100
Commercial	2.1	22	200
Industrial	1.5	16	200
Urban, Mixed Urban, Other Urban	1.0	10	120
Agricultural	1.3	10	300
Forest, Water, Wetlands	0.1	3	40
Barrenland/Transitional Area	0.5	5	60

Source: NJDEP Stormwater BMP Manual 2004.

Table C-3: Nonpoint Source Loads at Build-Out for Two Example HUC14s

HUC14 and Zone	Build-Out Zoning	Developable Area (acres)	TP (lbs/acre/yr)	TP (lbs/yr)	TN (lbs/acre/yr)	TN (lbs/yr)	TSS (lbs/acre/yr)	TSS (lbs/yr)
02030105110060								
Mountain (MZ)	Rural Residential	1,524	0.60	963	5	7,685	100	153,267
Quarry (Q)	Rural Residential	733	0.60	443	5	3,666	100	73,313
TOTALS		2,257		1,406		11,351		226,580
020301050040010								
Agriculture (AG)	Rural Residential	1,879	0.60	1,160	5	9,589	100	190,491
Neighborhood Shopping Center District (C1)	Commercial	396	2.10	832	22	8,727	200	79,429
Mountain (MZ)	Rural Residential	528	0.60	331	5	2,699	100	53,600
TOTALS		2,803		2,323		21,015		323,520

Mitigation Plans

A mitigation plan is required to grant a variance or exemption from the design and performance standards of a municipal stormwater management plan. The mitigation requirements should offer a hierarchy of options that clearly offset the effect on groundwater recharge, stormwater quantity control, and/or stormwater quality control that was created by granting the variance or exemption. The following fictional example is one of the means a municipality can select for a mitigation plan.

This mitigation plan is provided for a proposed development that is granted a variance or exemption from the stormwater management design and performance standards. Presented is a hierarchy of options.

Mitigation Project Criteria

1. The mitigation project must be implemented in the same drainage area as the proposed development. The project must provide additional groundwater recharge benefits, or protection from stormwater runoff quality and quantity from previously developed property that does not currently meet the design and performance standards outlined in the Municipal Stormwater Management Plan. The developer must ensure the long-term maintenance of the project, including the maintenance requirements under Chapters 8 and 9 of the NJDEP Stormwater BMP Manual.

a. The applicant can select one of the following projects listed to compensate for the deficit from the performance standards resulting from the proposed project. More detailed information on the projects can be obtained from the Township Engineer. Listed below are specific projects that can be used to address the mitigation requirement.

Groundwater Recharge

- Retrofit the L.B. Middle School site and detention basin to provide an additional 300,000 cf of average annual groundwater recharge.
- Replace the existing deteriorated 20,000 sf overflow impervious parking lot at Children's Memorial Soccer Complex with permeable paving to provide 150,000 cf of additional average annual groundwater recharge.

Water Quality

- Retrofit the existing stormwater management facility at Matisse Elementary School to provide the removal of 80 percent of total suspended solids from the parking lot runoff.
- Retrofit the existing parking area at the West Side Municipal Complex to provide the removal of 80 percent of total suspended solids. Due to site constraints, the retrofit BMP must be installed underground and cannot reduce the existing number of parking spaces.

Water Quantity

- Install stormwater management measures in the open space in the Woodlot Development to reduce the peak flow from the upstream development on the receiving stream by 20 cfs, 35 cfs, and 100 cfs for the 2, 10, and 100-year storms respectively.

2. If a suitable site cannot be located in the same drainage area as the proposed development, as discussed in Option 1, the mitigation project may provide mitigation that is not equivalent to the impacts for which the variance or exemption is sought, but that addresses the same issue. For example, if a variance is given because the 80 percent TSS requirement is not met, the selected project may address water quality impacts due to a fecal impairment. Listed below are specific projects that can be used to address the mitigation option.

Water Quality

- Re-establish a vegetative buffer (minimum 50 foot wide) along 1,500 linear feet of the shoreline at Sunshine Pond as a goose control measure and to filter stormwater runoff from the high goose traffic areas.
- Provide goose management measures, including public education at Central Park.

Options 1 and 2 would be available only if the MSWMP includes a list of environmental enhancement projects that provide groundwater recharge, control flooding, or control nonpoint source pollution. These are fictitious projects for the purposes of providing examples for this plan. Although only a brief description of each project is presented here, it is important for the municipality to have sufficient information on each project, including size of the project, permit requirements, land ownership, and estimated project costs (i.e., permitting fees, engineering costs, construction costs, and maintenance costs).

The municipality may allow a developer to provide funding or partial funding to the municipality for an environmental enhancement project that has been identified in a Municipal Stormwater Management Plan, or towards the development of a Regional Stormwater Management Plan. The funding must be equal to or greater than the cost to implement the mitigation outlined above, including costs associated with purchasing the property or easement for mitigation, and the cost associated with the long-term maintenance requirements of the mitigation measure.

New Jersey Stormwater Best Management Practices Manual

April 2004

A P P E N D I X D

Model Stormwater Control Ordinance for Municipalities

Important note: *This sample ordinance is provided to assist municipalities in the development of municipal stormwater control ordinances and the incorporation of design and performance standards into municipal stormwater management plans. It is provided for information purposes only. It is important that current regulations are carefully reviewed before any portion of this draft ordinance is adopted.*
This model ordinance does not include a section on fees. The Department expects that the review of development applications under this ordinance would be an integral part of the municipal review of subdivisions and site plans. As a result, the costs to municipalities of reviewing development applications under this ordinance can be defrayed by fees charged for review of subdivisions and site plans under N.J.S.A. 40:55D-8.b.

Notes are provided in italics throughout this model stormwater control ordinance, and are not intended to be adopted as part of the ordinance.

An editable Word version of this model ordinance is available at:
http://www.njstormwater.org/tier_A/pdf/NJ_SWBMP_D.doc.

Section 1: Scope and Purpose

A. Policy Statement

Flood control, groundwater recharge, and pollutant reduction through nonstructural or low impact techniques shall be explored before relying on structural BMPs. Structural BMPs should be integrated with nonstructural stormwater management strategies and proper maintenance plans. Nonstructural strategies include both environmentally sensitive site design and source controls that prevent pollutants from being placed on the site or from being exposed to stormwater. Source control plans should be developed based upon physical site conditions and the origin, nature, and the anticipated quantity or amount of potential pollutants. Multiple stormwater management BMPs may be necessary to achieve the established performance standards for water quality, quantity, and groundwater recharge.

Note: Municipalities are encouraged to participate in the development of regional stormwater management plans, and to adopt and implement ordinances for specific drainage area performance standards that address local stormwater management and environmental characteristics.

B. Purpose

It is the purpose of this ordinance to establish minimum stormwater management requirements and controls for "major development," as defined in Section 2.

C. Applicability

1. This ordinance shall be applicable to all site plans and subdivisions for the following major developments that require preliminary or final site plan or subdivision review:

   a. Non-residential major developments; and

   b. Aspects of residential major developments that are not pre-empted by the Residential Site Improvement Standards at N.J.A.C. 5:21.

2. This ordinance shall also be applicable to all major developments undertaken by [*insert name of municipality*].

D. Compatibility with Other Permit and Ordinance Requirements

Development approvals issued for subdivisions and site plans pursuant to this ordinance are to be considered an integral part of development approvals under the subdivision and site plan review process and do not relieve the applicant of the responsibility to secure required permits or approvals for activities regulated by any other applicable code, rule, act, or ordinance. In their interpretation and application, the provisions of this ordinance shall be held to be the minimum requirements for the promotion of the public health, safety, and general welfare. This ordinance is not intended to interfere with, abrogate, or annul any other ordinances, rule or regulation, statute, or other provision of law except that, where any provision of this ordinance imposes restrictions different from those imposed by any other ordinance, rule or regulation, or other provision of law, the more restrictive provisions or higher standards shall control.

Section 2: Definitions

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted so as to give them the meaning they have in common usage and to give this ordinance its most reasonable application. The definitions below are the same as or based on the corresponding definitions in the Stormwater Management Rules at N.J.A.C. 7:8-1.2.

"CAFRA Planning Map" means the geographic depiction of the boundaries for Coastal Planning Areas, CAFRA Centers, CAFRA Cores and CAFRA Nodes pursuant to N.J.A.C. 7:7E-5B.3.

"CAFRA Centers, Cores or Nodes" means those areas within boundaries accepted by the Department pursuant to N.J.A.C. 7:8E-5B.

"Compaction" means the increase in soil bulk density.

"Core" means a pedestrian-oriented area of commercial and civic uses serving the surrounding municipality, generally including housing and access to public transportation.

"County review agency" means an agency designated by the County Board of Chosen Freeholders to review municipal stormwater management plans and implementing ordinance(s). The county review agency may either be:

A county planning agency; or

A county water resource association created under N.J.S.A 58:16A-55.5, if the ordinance or resolution delegates authority to approve, conditionally approve, or disapprove municipal stormwater management plans and implementing ordinances.

"Department" means the New Jersey Department of Environmental Protection.

"Designated Center" means a State Development and Redevelopment Plan Center as designated by the State Planning Commission such as urban, regional, town, village, or hamlet.

"Design engineer" means a person professionally qualified and duly licensed in New Jersey to perform engineering services that may include, but not necessarily be limited to, development of project requirements, creation and development of project design and preparation of drawings and specifications.

"Development" means the division of a parcel of land into two or more parcels, the construction, reconstruction, conversion, structural alteration, relocation or enlargement of any building or structure, any mining excavation or landfill, and any use or change in the use of any building or other structure, or land or extension of use of land, by any person, for which permission is required under the Municipal Land Use Law , N.J.S.A. 40:55D-1 et seq. In the case of development of agricultural lands, development means: any activity that requires a State permit; any activity reviewed by the County Agricultural Board (CAB) and the State Agricultural Development Committee (SADC), and municipal review of any activity not exempted by the Right to Farm Act , N.J.S.A 4:1C-1 et seq.

"Drainage area" means a geographic area within which stormwater, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

"Environmentally critical areas" means an area or feature which is of significant environmental value, including but not limited to: stream corridors; natural heritage priority sites; habitat of endangered or threatened species; large areas of contiguous open space or upland forest; steep slopes; and well head protection and groundwater recharge areas. Habitats of endangered or threatened species are identified

using the Department's Landscape Project as approved by the Department's Endangered and Nongame Species Program.

"Empowerment Neighborhood" means a neighborhood designated by the Urban Coordinating Council "in consultation and conjunction with" the New Jersey Redevelopment Authority pursuant to N.J.S.A 55:19-69.

"Erosion" means the detachment and movement of soil or rock fragments by water, wind, ice or gravity.

"Impervious surface" means a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water.

"Infiltration" is the process by which water seeps into the soil from precipitation.

"Major development" means any "development" that provides for ultimately disturbing one or more acres of land. Disturbance for the purpose of this rule is the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation.

"Municipality" means any city, borough, town, township, or village.

"Node" means an area designated by the State Planning Commission concentrating facilities and activities which are not organized in a compact form.

"Nutrient" means a chemical element or compound, such as nitrogen or phosphorus, which is essential to and promotes the development of organisms.

"Person" means any individual, corporation, company, partnership, firm, association, [*insert name of municipality*], or political subdivision of this State subject to municipal jurisdiction pursuant to the Municipal Land Use Law , N.J.S.A. 40:55D-1 et seq.

"Pollutant" means any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, refuse, oil, grease, sewage sludge, munitions, chemical wastes, biological materials, medical wastes, radioactive substance (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.), thermal waste, wrecked or discarded equipment, rock, sand, cellar dirt, industrial, municipal, agricultural, and construction waste or runoff, or other residue discharged directly or indirectly to the land, ground waters or surface waters of the State, or to a domestic treatment works. "Pollutant" includes both hazardous and nonhazardous pollutants.

"Recharge" means the amount of water from precipitation that infiltrates into the ground and is not evapotranspired.

"Sediment" means solid material, mineral or organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

"Site" means the lot or lots upon which a major development is to occur or has occurred.

"Soil" means all unconsolidated mineral and organic material of any origin.

"State Development and Redevelopment Plan Metropolitan Planning Area (PA1)" means an area delineated on the State Plan Policy Map and adopted by the State Planning Commission that is intended to be the focus for much of the state's future redevelopment and revitalization efforts.

"State Plan Policy Map" is defined as the geographic application of the State Development and Redevelopment Plan's goals and statewide policies, and the official map of these goals and policies.

"Stormwater" means water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, or is captured by separate storm sewers or other sewage or drainage facilities, or conveyed by snow removal equipment.

"Stormwater runoff" means water flow on the surface of the ground or in storm sewers, resulting from precipitation.

"Stormwater management basin" means an excavation or embankment and related areas designed to retain stormwater runoff. A stormwater management basin may either be normally dry (that is, a detention basin or infiltration basin), retain water in a permanent pool (a retention basin), or be planted mainly with wetland vegetation (most constructed stormwater wetlands).

"Stormwater management measure" means any structural or nonstructural strategy, practice, technology, process, program, or other method intended to control or reduce stormwater runoff and associated pollutants, or to induce or control the infiltration or groundwater recharge of stormwater or to eliminate illicit or illegal non-stormwater discharges into stormwater conveyances.

"Tidal Flood Hazard Area" means a flood hazard area, which may be influenced by stormwater runoff from inland areas, but which is primarily caused by the Atlantic Ocean.

"Urban Coordinating Council Empowerment Neighborhood" means a neighborhood given priority access to State resources through the New Jersey Redevelopment Authority.

"Urban Enterprise Zones" means a zone designated by the New Jersey Enterprise Zone Authority pursuant to the New Jersey Urban Enterprise Zones Act, N.J.S.A. 52:27H-60 et. seq.

"Urban Redevelopment Area" is defined as previously developed portions of areas:

(1) Delineated on the State Plan Policy Map (SPPM) as the Metropolitan Planning Area (PA1), Designated Centers, Cores or Nodes;

(2) Designated as CAFRA Centers, Cores or Nodes;

(3) Designated as Urban Enterprise Zones; and

(4) Designated as Urban Coordinating Council Empowerment Neighborhoods.

"Waters of the State" means the ocean and its estuaries, all springs, streams, wetlands, and bodies of surface or ground water, whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

"Wetlands" or "wetland" means an area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

Section 3: General Standards

A. Design and Performance Standards for Stormwater Management Measures

1. Stormwater management measures for major development shall be developed to meet the erosion control, groundwater recharge, stormwater runoff quantity, and stormwater runoff quality standards in Section 4. To the maximum extent practicable, these standards shall be met by incorporating nonstructural stormwater management strategies into the design. If these strategies alone are not sufficient to meet these standards, structural stormwater management measures necessary to meet these standards shall be incorporated into the design.

2. The standards in this ordinance apply only to new major development and are intended to minimize the impact of stormwater runoff on water quality and water quantity in receiving water bodies and maintain groundwater recharge. The standards do not apply to new major development to the extent that alternative design and performance standards are applicable under a regional stormwater management plan or Water Quality Management Plan adopted in accordance with Department rules.

   Note: Alternative standards shall provide at least as much protection from stormwater-related loss of groundwater recharge, stormwater quantity and water quality impacts of major development projects as would be provided under the standards in N.J.A.C. 7:8-5.

Section 4: Stormwater Management Requirements for Major Development

A. The development shall incorporate a maintenance plan for the stormwater management measures incorporated into the design of a major development in accordance with Section 10.

B. Stormwater management measures shall avoid adverse impacts of concentrated flow on habitat for threatened and endangered species as documented in the Department' Landscape Project or Natural Heritage Database established under N.J.S.A. 13:1B-15.147 through 15.150, particularly *Helonias bullata* (swamp pink) and/or *Clemmys muhlnebergi* (bog turtle).

C. The following linear development projects are exempt from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements of Sections 4.F and 4.G:

1. The construction of an underground utility line provided that the disturbed areas are revegetated upon completion;

2. The construction of an aboveground utility line provided that the existing conditions are maintained to the maximum extent practicable; and

3. The construction of a public pedestrian access, such as a sidewalk or trail with a maximum width of 14 feet, provided that the access is made of permeable material.

D. A waiver from strict compliance from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements of Sections 4.F and 4.G may be obtained for the enlargement of an existing public roadway or railroad; or the construction or enlargement of a public pedestrian access, provided that the following conditions are met:

1. The applicant demonstrates that there is a public need for the project that cannot be accomplished by any other means;

2. The applicant demonstrates through an alternatives analysis, that through the use of nonstructural and structural stormwater management strategies and measures, the option selected complies with the requirements of Sections 4.F and 4.G to the maximum extent practicable;

3. The applicant demonstrates that, in order to meet the requirements of Sections 4.F and 4.G, existing structures currently in use, such as homes and buildings, would need to be condemned; and

4. The applicant demonstrates that it does not own or have other rights to areas, including the potential to obtain through condemnation lands not falling under D.3 above within the upstream drainage area of the receiving stream, that would provide additional opportunities to mitigate the requirements of Sections 4.F and 4.G that were not achievable on-site.

E. Nonstructural Stormwater Management Strategies

1. To the maximum extent practicable, the standards in Sections 4.F and 4.G shall be met by incorporating nonstructural stormwater management strategies set forth at Section 4.E into the design. The applicant shall identify the nonstructural measures incorporated into the design of the project. If the applicant contends that it is not feasible for engineering, environmental, or safety reasons to incorporate any nonstructural stormwater management measures identified in Paragraph 2 below into the design of a particular project, the applicant shall identify the strategy considered and provide a basis for the contention.

2. Nonstructural stormwater management strategies incorporated into site design shall:

   a. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss;

   b. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces;

   c. Maximize the protection of natural drainage features and vegetation;

   d. Minimize the decrease in the "time of concentration" from pre-construction to post construction. "Time of concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the watershed to the point of interest within a watershed;

   e. Minimize land disturbance including clearing and grading;

   f. Minimize soil compaction;

   g. Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides;

   h. Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas;

   i. Provide other source controls to prevent or minimize the use or exposure of pollutants at the site, in order to prevent or minimize the release of those pollutants into stormwater runoff. Such source controls include, but are not limited to:

(1) Site design features that help to prevent accumulation of trash and debris in drainage systems, including features that satisfy Section 4.E.3. below;

(2) Site design features that help to prevent discharge of trash and debris from drainage systems;

(3) Site design features that help to prevent and/or contain spills or other harmful accumulations of pollutants at industrial or commercial developments; and

(4) When establishing vegetation after land disturbance, applying fertilizer in accordance with the requirements established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., and implementing rules.

3. Site design features identified under Section 4.E.2.i.(2) above shall comply with the following standard to control passage of solid and floatable materials through storm drain inlets. For purposes of this paragraph, "solid and floatable materials" means sediment, debris, trash, and other floating, suspended, or settleable solids. For exemptions to this standard see Section 4.E.3.c below.

a. Design engineers shall use either of the following grates whenever they use a grate in pavement or another ground surface to collect stormwater from that surface into a storm drain or surface water body under that grate:

(1) The New Jersey Department of Transportation (NJDOT) bicycle safe grate, which is described in Chapter 2.4 of the NJDOT Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines (April 1996); or

(2) A different grate, if each individual clear space in that grate has an area of no more than seven (7.0) square inches, or is no greater than 0.5 inches across the smallest dimension.

Examples of grates subject to this standard include grates in grate inlets, the grate portion (non-curb-opening portion) of combination inlets, grates on storm sewer manholes, ditch grates, trench grates, and grates of spacer bars in slotted drains. Examples of ground surfaces include surfaces of roads (including bridges), driveways, parking areas, bikeways, plazas, sidewalks, lawns, fields, open channels, and stormwater basin floors.

b. Whenever design engineers use a curb-opening inlet, the clear space in that curb opening (or each individual clear space, if the curb opening has two or more clear spaces) shall have an area of no more than seven (7.0) square inches, or be no greater than two (2.0) inches across the smallest dimension.

c. This standard does not apply:

(1) Where the review agency determines that this standard would cause inadequate hydraulic performance that could not practicably be overcome by using additional or larger storm drain inlets that meet these standards;

(2) Where flows from the water quality design storm as specified in Section 4.G.1 are conveyed through any device (e.g., end of pipe netting facility, manufactured treatment device, or a catch basin hood) that is designed, at a minimum, to prevent delivery of all solid and floatable materials that could not pass through one of the following:

(a) A rectangular space four and five-eighths inches long and one and one-half inches wide (this option does not apply for outfall netting facilities); or

(b) A bar screen having a bar spacing of 0.5 inches.

(3) Where flows are conveyed through a trash rack that has parallel bars with one-inch (1") spacing between the bars, to the elevation of the water quality design storm as specified in Section 4.G.1; or

(4) Where the New Jersey Department of Environmental Protection determines, pursuant to the New Jersey Register of Historic Places Rules at N.J.A.C. 7:4-7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.

4. Any land area used as a nonstructural stormwater management measure to meet the performance standards in Sections 4.F and 4.G shall be dedicated to a government agency, subjected to a conservation restriction filed with the appropriate County Clerk's office, or subject to an approved equivalent restriction that ensures that measure or an equivalent stormwater management measure approved by the reviewing agency is maintained in perpetuity.

5. Guidance for nonstructural stormwater management strategies is available in the New Jersey Stormwater Best Management Practices Manual. The BMP Manual may be obtained from the address identified in Section 7, or found on the Department's website at www.njstormwater.org.

F. Erosion Control, Groundwater Recharge and Runoff Quantity Standards

1. This subsection contains minimum design and performance standards to control erosion, encourage and control infiltration and groundwater recharge, and control stormwater runoff quantity impacts of major development.

a. The minimum design and performance standards for erosion control are those established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. and implementing rules.

b. The minimum design and performance standards for groundwater recharge are as follows:

(1) The design engineer shall, using the assumptions and factors for stormwater runoff and groundwater recharge calculations at Section 5, either:

(a) Demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures maintain 100 percent of the average annual pre-construction groundwater recharge volume for the site; or

(b) Demonstrate through hydrologic and hydraulic analysis that the increase of stormwater runoff volume from pre-construction to post-construction for the 2-year storm is infiltrated.

(2) This groundwater recharge requirement does not apply to projects within the "urban redevelopment area," or to projects subject to (3) below.

(3) The following types of stormwater shall not be recharged:

(a) Stormwater from areas of high pollutant loading. High pollutant loading areas are areas in industrial and commercial developments where solvents and/or petroleum products are loaded/unloaded, stored, or applied, areas where pesticides are loaded/unloaded or stored; areas where hazardous materials are expected to be present in greater than "reportable quantities" as defined by the United States Environmental Protection Agency (EPA) at 40

CFR 302.4; areas where recharge would be inconsistent with Department approved remedial action work plan or landfill closure plan and areas with high risks for spills of toxic materials, such as gas stations and vehicle maintenance facilities; and

(b) Industrial stormwater exposed to "source material." "Source material" means any material(s) or machinery, located at an industrial facility, that is directly or indirectly related to process, manufacturing or other industrial activities, which could be a source of pollutants in any industrial stormwater discharge to groundwater. Source materials include, but are not limited to, raw materials; intermediate products; final products; waste materials; by-products; industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

(4) The design engineer shall assess the hydraulic impact on the groundwater table and design the site so as to avoid adverse hydraulic impacts. Potential adverse hydraulic impacts include, but are not limited to, exacerbating a naturally or seasonally high water table so as to cause surficial ponding, flooding of basements, or interference with the proper operation of subsurface sewage disposal systems and other subsurface structures in the vicinity or downgradient of the groundwater recharge area.

c. In order to control stormwater runoff quantity impacts, the design engineer shall, using the assumptions and factors for stormwater runoff calculations at Section 5, complete one of the following:

(1) Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the two, 10, and 100-year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events;

(2) Demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the two, 10, and 100-year storm events and that the increased volume or change in timing of stormwater runoff will not increase flood damage at or downstream of the site. This analysis shall include the analysis of impacts of existing land uses and projected land uses assuming full development under existing zoning and land use ordinances in the drainage area;

(3) Design stormwater management measures so that the post-construction peak runoff rates for the 2, 10 and 100 year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates. The percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed. The percentages shall not be applied to post-construction stormwater runoff into tidal flood hazard areas if the increased volume of stormwater runoff will not increase flood damages below the point of discharge; or

(4) In tidal flood hazard areas, stormwater runoff quantity analysis in accordance with (1), (2) and (3) above shall only be applied if the increased volume of stormwater runoff could increase flood damages below the point of discharge.

2. Any application for a new agricultural development that meets the definition of major development at Section 2 shall be submitted to the appropriate Soil Conservation District for review and approval in accordance with the requirements of this section and any applicable Soil Conservation District guidelines for stormwater runoff quantity and erosion control. For the purposes of this section, "agricultural development" means land uses normally associated with the production of food, fiber and livestock for sale. Such uses do not include the development of land for the processing or sale of food and the manufacturing of agriculturally related products.

G. Stormwater Runoff Quality Standards

1. Stormwater management measures shall be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff by 80 percent of the anticipated load from the developed site, expressed as an annual average. Stormwater management measures shall only be required for water quality control if an additional 1/4 acre of impervious surface is being proposed on a development site. The requirement to reduce TSS does not apply to any stormwater runoff in a discharge regulated under a numeric effluent limitation for TSS imposed under the New Jersey Pollution Discharge Elimination System (NJPDES) rules, N.J.A.C. 7:14A, or in a discharge specifically exempt under a NJPDES permit from this requirement. The water quality design storm is 1.25 inches of rainfall in two hours. Water quality calculations shall take into account the distribution of rain from the water quality design storm, as reflected in Table 1. The calculation of the volume of runoff may take into account the implementation of non-structural and structural stormwater management measures.

Table 1: Water Quality Design Storm Distribution

Time (Minutes)	Cumulative Rainfall (Inches)	Time (Minutes)	Cumulative Rainfall (Inches)
0	0.0000	65	0.8917
5	0.0083	70	0.9917
10	0.0166	75	1.0500
15	0.0250	80	1.0840
20	0.0500	85	1.1170
25	0.0750	90	1.1500
30	0.1000	95	1.1750
35	0.1330	100	1.2000
40	0.1660	105	1.2250
45	0.2000	110	1.2334
50	0.2583	115	1.2417
55	0.3583	120	1.2500
60	0.6250		

2. For purposes of TSS reduction calculations, Table 2 below presents the presumed removal rates for certain BMPs designed in accordance with the New Jersey Stormwater Best Management Practices Manual. The BMP Manual may be obtained from the address identified in Section 7, or found on the Department's website at www.njstormwater.org. The BMP Manual and other sources of technical guidance are listed in Section 7. TSS reduction shall be calculated based on the removal rates for the BMPs in Table 2 below. Alternative removal rates and methods of calculating removal rates may be used if the design engineer provides documentation demonstrating the capability of these alternative rates and methods to the review agency. A copy of any approved alternative rate or method of calculating the removal rate shall be provided to the Department at the following address: Division of Watershed Management, New Jersey Department of Environmental Protection, PO Box 418 Trenton, New Jersey, 08625-0418.

3. If more than one BMP in series is necessary to achieve the required 80 percent TSS reduction for a site, the applicant shall utilize the following formula to calculate TSS reduction:

   $R = A + B - (AXB)/100$

   Where

   R = total TSS percent load removal from application of both BMPs, and

   A = the TSS percent removal rate applicable to the first BMP

   B = the TSS percent removal rate applicable to the second BMP

Table 2: TSS Removal Rates for BMPs

Best Management Practice	TSS Percent Removal Rate
Bioretention Systems	90
Constructed Stormwater Wetland	90
Extended Detention Basin	40-60
Infiltration Structure	80
Manufactured Treatment Device	See Section 6.C
Sand Filter	80
Vegetative Filter Strip	60-80
Wet Pond	50-90

4. If there is more than one onsite drainage area, the 80 percent TSS removal rate shall apply to each drainage area, unless the runoff from the subareas converge on site in which case the removal rate can be demonstrated through a calculation using a weighted average.

5. Stormwater management measures shall also be designed to reduce, to the maximum extent feasible, the post-construction nutrient load of the anticipated load from the developed site in stormwater runoff generated from the water quality design storm. In achieving reduction of nutrients to the maximum extent feasible, the design of the site shall include nonstructural strategies and structural

measures that optimize nutrient removal while still achieving the performance standards in Sections 4.F and 4.G.

6. Additional information and examples are contained in the New Jersey Stormwater Best Management Practices Manual, which may be obtained from the address identified in Section 7.

7. In accordance with the definition of FW1 at N.J.A.C. 7:9B-1.4, stormwater management measures shall be designed to prevent any increase in stormwater runoff to waters classified as FW1.

8. Special water resource protection areas shall be established along all waters designated Category One at N.J.A.C. 7:9B, and perennial or intermittent streams that drain into or upstream of the Category One waters as shown on the USGS Quadrangle Maps or in the County Soil Surveys, within the associated HUC14 drainage area. These areas shall be established for the protection of water quality, aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, and exceptional fisheries significance of those established Category One waters. These areas shall be designated and protected as follows:

   a. The applicant shall preserve and maintain a special water resource protection area in accordance with one of the following:

      (1) A 300-foot special water resource protection area shall be provided on each side of the waterway, measured perpendicular to the waterway from the top of the bank outwards or from the centerline of the waterway where the bank is not defined, consisting of existing vegetation or vegetation allowed to follow natural succession is provided. (2) Encroachment within the designated special water resource protection area under Subsection (1) above shall only be allowed where previous development or disturbance has occurred (for example, active agricultural use, parking area or maintained lawn area). The encroachment shall only be allowed where applicant demonstrates that the functional value and overall condition of the special water resource protection area will be maintained to the maximum extent practicable. In no case shall the remaining special water resource protection area be reduced to less than 150 feet as measured perpendicular to the top of bank of the waterway or centerline of the waterway where the bank is undefined. All encroachments proposed under this subparagraph shall be subject to review and approval by the Department.

   b. All stormwater shall be discharged outside of and flow through the special water resource protection area and shall comply with the Standard for Off-Site Stability in the "Standards For Soil Erosion and Sediment Control in New Jersey," established under the Soil Erosion and Sediment Control Act , N.J.S.A. 4:24-39 et seq.

   c. If stormwater discharged outside of and flowing through the special water resource protection area cannot comply with the Standard For Off-Site Stability in the "Standards for Soil Erosion and Sediment Control in New Jersey," established under the Soil Erosion and Sediment Control Act , N.J.S.A. 4:24-39 et seq., then the stabilization measures in accordance with the requirements of the above standards may be placed within the special water resource protection area, provided that:

      (1) Stabilization measures shall not be placed within 150 feet of the Category One waterway;

      (2) Stormwater associated with discharges allowed by this section shall achieve a 95 percent TSS post-construction removal rate;

      (3) Temperature shall be addressed to ensure no impact on the receiving waterway;

(4) The encroachment shall only be allowed where the applicant demonstrates that the functional value and overall condition of the special water resource protection area will be maintained to the maximum extent practicable;

(5) A conceptual project design meeting shall be held with the appropriate Department staff and Soil Conservation District staff to identify necessary stabilization measures; and

(6) All encroachments proposed under this section shall be subject to review and approval by the Department.

d. A stream corridor protection plan may be developed by a regional stormwater management planning committee as an element of a regional stormwater management plan, or by a municipality through an adopted municipal stormwater management plan. If a stream corridor protection plan for a waterway subject to Section 4.G(8) has been approved by the Department of Environmental Protection, then the provisions of the plan shall be the applicable special water resource protection area requirements for that waterway. A stream corridor protection plan for a waterway subject to G.8 shall maintain or enhance the current functional value and overall condition of the special water resource protection area as defined in G.8.a.(1) above. In no case shall a stream corridor protection plan allow the reduction of the Special Water Resource Protection Area to less than 150 feet as measured perpendicular to the waterway subject to this subsection.

e. Paragraph G.8 does not apply to the construction of one individual single family dwelling that is not part of a larger development on a lot receiving preliminary or final subdivision approval on or before February 2, 2004 , provided that the construction begins on or before February 2, 2009.

Section 5: Calculation of Stormwater Runoff and Groundwater Recharge

A. Stormwater runoff shall be calculated in accordance with the following:

1. The design engineer shall calculate runoff using one of the following methods:

   a. The USDA Natural Resources Conservation Service (NRCS) methodology, including the NRCS Runoff Equation and Dimensionless Unit Hydrograph, as described in the NRCS National Engineering Handbook Section 4 – Hydrology and Technical Release 55 – Urban Hydrology for Small Watersheds; or

   b. The Rational Method for peak flow and the Modified Rational Method for hydrograph computations.

2. For the purpose of calculating runoff coefficients and groundwater recharge, there is a presumption that the pre-construction condition of a site or portion thereof is a wooded land use with good hydrologic condition. The term "runoff coefficient" applies to both the NRCS methodology at Section 5.A.1.a and the Rational and Modified Rational Methods at Section 5.A.1.b. A runoff coefficient or a groundwater recharge land cover for an existing condition may be used on all or a portion of the site if the design engineer verifies that the hydrologic condition has existed on the site or portion of the site for at least five years without interruption prior to the time of application. If more than one land cover have existed on the site during the five years immediately prior to the time of application, the land cover with the lowest runoff potential shall be used for the computations. In addition, there is the presumption that the site is in good hydrologic condition (if the land use type is pasture, lawn, or park), with good cover (if the land use type is woods), or with good hydrologic condition and conservation treatment (if the land use type is cultivation).

3. In computing pre-construction stormwater runoff, the design engineer shall account for all significant land features and structures, such as ponds, wetlands, depressions, hedgerows, or culverts, that may reduce pre-construction stormwater runoff rates and volumes.

4. In computing stormwater runoff from all design storms, the design engineer shall consider the relative stormwater runoff rates and/or volumes of pervious and impervious surfaces separately to accurately compute the rates and volume of stormwater runoff from the site. To calculate runoff from unconnected impervious cover, urban impervious area modifications as described in the NRCS Technical Release 55 – Urban Hydrology for Small Watersheds and other methods may be employed.

5. If the invert of the outlet structure of a stormwater management measure is below the flood hazard design flood elevation as defined at N.J.A.C. 7:13, the design engineer shall take into account the effects of tailwater in the design of structural stormwater management measures.

B. Groundwater recharge may be calculated in accordance with the following:

1. The New Jersey Geological Survey Report GSR-32 A Method for Evaluating Ground-Water Recharge Areas in New Jersey, incorporated herein by reference as amended and supplemented. Information regarding the methodology is available from the New Jersey Stormwater Best Management Practices Manual; at http://www.state.nj.us/dep/njgs/; or at New Jersey Geological Survey, 29 Arctic Parkway, P.O. Box 427 Trenton, New Jersey 08625-0427; (609) 984-6587.

Section 6: Standards for Structural Stormwater Management Measures

A. Standards for structural stormwater management measures are as follows:

1. Structural stormwater management measures shall be designed to take into account the existing site conditions, including, for example, environmentally critical areas, wetlands; flood-prone areas; slopes; depth to seasonal high water table; soil type, permeability and texture; drainage area and drainage patterns; and the presence of solution-prone carbonate rocks (limestone).

2. Structural stormwater management measures shall be designed to minimize maintenance, facilitate maintenance and repairs, and ensure proper functioning. Trash racks shall be installed at the intake to the outlet structure as appropriate, and shall have parallel bars with one-inch (1") spacing between the bars to the elevation of the water quality design storm. For elevations higher than the water quality design storm, the parallel bars at the outlet structure shall be spaced no greater than one-third (1/3) the width of the diameter of the orifice or one-third (1/3) the width of the weir, with a minimum spacing between bars of one-inch and a maximum spacing between bars of six inches. In addition, the design of trash racks must comply with the requirements of Section 8.D.

3. Structural stormwater management measures shall be designed, constructed, and installed to be strong, durable, and corrosion resistant. Measures that are consistent with the relevant portions of the Residential Site Improvement Standards at N.J.A.C. 5:21-7.3, 7.4, and 7.5 shall be deemed to meet this requirement.

4. At the intake to the outlet from the stormwater management basin, the orifice size shall be a minimum of two and one-half inches in diameter.

5. Stormwater management basins shall be designed to meet the minimum safety standards for stormwater management basins at Section 8.

B. Stormwater management measure guidelines are available in the New Jersey Stormwater Best Management Practices Manual. Other stormwater management measures may be utilized provided the design engineer demonstrates that the proposed measure and its design will accomplish the required water quantity, groundwater recharge and water quality design and performance standards established by Section 4 of this ordinance.

C. Manufactured treatment devices may be used to meet the requirements of Section 4 this ordinance, provided the pollutant removal rates are verified by the New Jersey Corporation for Advanced Technology and certified by the Department.

Section 7: Sources for Technical Guidance

A. Technical guidance for stormwater management measures can be found in the documents listed at 1 and 2 below, which are available from Maps and Publications, New Jersey Department of Environmental Protection, 428 East State Street, P.O. Box 420, Trenton, New Jersey, 08625; telephone (609) 777-1038.

1. Guidelines for stormwater management measures are contained in the New Jersey Stormwater Best Management Practices Manual, as amended. Information is provided on stormwater management measures such as: bioretention systems, constructed stormwater wetlands, dry wells, extended detention basins, infiltration structures, manufactured treatment devices, pervious paving, sand filters, vegetative filter strips, and wet ponds.

2. The New Jersey Department of Environmental Protection Stormwater Management Facilities Maintenance Manual, as amended.

B. Additional technical guidance for stormwater management measures can be obtained from the following:

1. The "Standards for Soil Erosion and Sediment Control in New Jersey" promulgated by the State Soil Conservation Committee and incorporated into N.J.A.C. 2:90. Copies of these standards may be obtained by contacting the State Soil Conservation Committee or any of the Soil Conservation Districts listed in N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number of each Soil Conservation District may be obtained from the State Soil Conservation Committee, P.O. Box 330, Trenton, New Jersey 08625; (609) 292-5540;

2. The Rutgers Cooperative Extension Service, 732-932-9306; and

3. The Soil Conservation Districts listed in N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number of each Soil Conservation District may be obtained from the State Soil Conservation Committee, P.O. Box 330, Trenton, New Jersey, 08625, (609) 292-5540.

Section 8: Safety Standards for Stormwater Management Basins

A. This section sets forth requirements to protect public safety through the proper design and operation of stormwater management basins. This section applies to any new stormwater management basin.

Note: The provisions of this section are not intended to preempt more stringent municipal or county safety requirements for new or existing stormwater management basins. Municipal and county stormwater management plans and ordinances may, pursuant to their authority, require existing stormwater management basins to be retrofitted to meet one or more of the safety standards in Sections 8.B.1, 8.B.2, and 8.B.3 for trash racks, overflow grates, and escape provisions at outlet structures.

B. Requirements for Trash Racks, Overflow Grates and Escape Provisions

1. A trash rack is a device designed to catch trash and debris and prevent the clogging of outlet structures. Trash racks shall be installed at the intake to the outlet from the stormwater management basin to ensure proper functioning of the basin outlets in accordance with the following:

   a. The trash rack shall have parallel bars, with no greater than six inch spacing between the bars.

   b. The trash rack shall be designed so as not to adversely affect the hydraulic performance of the outlet pipe or structure.

   c. The average velocity of flow through a clean trash rack is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocity is to be computed on the basis of the net area of opening through the rack.

   d. The trash rack shall be constructed and installed to be rigid, durable, and corrosion resistant, and shall be designed to withstand a perpendicular live loading of 300 lbs/ft sq.

2. An overflow grate is designed to prevent obstruction of the overflow structure. If an outlet structure has an overflow grate, such grate shall meet the following requirements:

   a. The overflow grate shall be secured to the outlet structure but removable for emergencies and maintenance.

   b. The overflow grate spacing shall be no less than two inches across the smallest dimension.

   c. The overflow grate shall be constructed and installed to be rigid, durable, and corrosion resistant, and shall be designed to withstand a perpendicular live loading of 300 lbs./ft sq.

3. For purposes of this paragraph 3, escape provisions means the permanent installation of ladders, steps, rungs, or other features that provide easily accessible means of egress from stormwater management basins. Stormwater management basins shall include escape provisions as follows:

   a. If a stormwater management basin has an outlet structure, escape provisions shall be incorporated in or on the structure. With the prior approval of the reviewing agency identified in Section 8.C a free-standing outlet structure may be exempted from this requirement.

   b. Safety ledges shall be constructed on the slopes of all new stormwater management basins having a permanent pool of water deeper than two and one-half feet. Such safety ledges shall be comprised of two steps. Each step shall be four to six feet in width. One step shall be located approximately two and one-half feet below the permanent water surface, and the second step shall be located one to

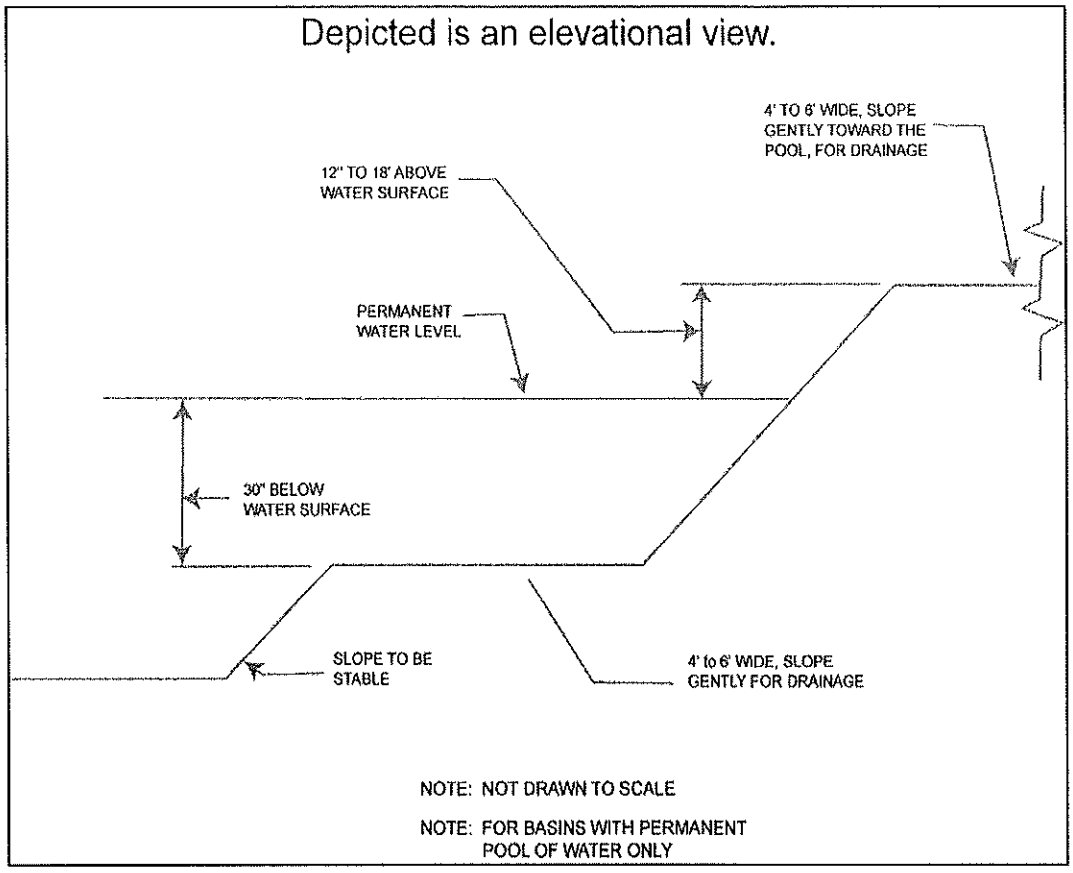
one and one-half feet above the permanent water surface. See Section 8.D for an illustration of safety ledges in a stormwater management basin.

c. In new stormwater management basins, the maximum interior slope for an earthen dam, embankment, or berm shall not be steeper than 3 horizontal to 1 vertical.

C. Variance or Exemption from Safety Standards

1. A variance or exemption from the safety standards for stormwater management basins may be granted only upon a written finding by the appropriate reviewing agency (municipality, county or Department) that the variance or exemption will not constitute a threat to public safety.

D. Illustration of Safety Ledges in a New Stormwater Management Basin



Section 9: Requirements for a Site Development Stormwater Plan

A. Submission of Site Development Stormwater Plan

1. Whenever an applicant seeks municipal approval of a development subject to this ordinance, the applicant shall submit all of the required components of the Checklist for the Site Development Stormwater Plan at Section 9.C below as part of the submission of the applicant's application for subdivision or site plan approval.

2. The applicant shall demonstrate that the project meets the standards set forth in this ordinance.

3. The applicant shall submit [*specify number*] copies of the materials listed in the checklist for site development stormwater plans in accordance with Section 9.C of this ordinance.

B. Site Development Stormwater Plan Approval

The applicant's Site Development project shall be reviewed as a part of the subdivision or site plan review process by the municipal board or official from which municipal approval is sought. That municipal board or official shall consult the engineer retained by the Planning and/or Zoning Board (as appropriate) to determine if all of the checklist requirements have been satisfied and to determine if the project meets the standards set forth in this ordinance.

C. Checklist Requirements

The following information shall be required:

1. Topographic Base Map

The reviewing engineer may require upstream tributary drainage system information as necessary. It is recommended that the topographic base map of the site be submitted which extends a minimum of 200 feet beyond the limits of the proposed development, at a scale of 1"=200' or greater, showing 2-foot contour intervals. The map as appropriate may indicate the following: existing surface water drainage, shorelines, steep slopes, soils, erodible soils, perennial or intermittent streams that drain into or upstream of the Category One waters, wetlands and flood plains along with their appropriate buffer strips, marshlands and other wetlands, pervious or vegetative surfaces, existing man-made structures, roads, bearing and distances of property lines, and significant natural and manmade features not otherwise shown.

2. Environmental Site Analysis

A written and graphic description of the natural and man-made features of the site and its environs. This description should include a discussion of soil conditions, slopes, wetlands, waterways and vegetation on the site. Particular attention should be given to unique, unusual, or environmentally sensitive features and to those that provide particular opportunities or constraints for development.

3. Project Description and Site Plan(s)

A map (or maps) at the scale of the topographical base map indicating the location of existing and proposed buildings, roads, parking areas, utilities, structural facilities for stormwater management and sediment control, and other permanent structures. The map(s) shall also clearly show areas where alterations occur in the natural terrain and cover, including lawns and other landscaping, and seasonal

high ground water elevations. A written description of the site plan and justification of proposed changes in natural conditions may also be provided.

4. Land Use Planning and Source Control Plan

   This plan shall provide a demonstration of how the goals and standards of Sections 3 through 6 are being met. The focus of this plan shall be to describe how the site is being developed to meet the objective of controlling groundwater recharge, stormwater quality and stormwater quantity problems at the source by land management and source controls whenever possible.

5. Stormwater Management Facilities Map

   The following information, illustrated on a map of the same scale as the topographic base map, shall be included:

   a. Total area to be paved or built upon, proposed surface contours, land area to be occupied by the stormwater management facilities and the type of vegetation thereon, and details of the proposed plan to control and dispose of stormwater.

   b. Details of all stormwater management facility designs, during and after construction, including discharge provisions, discharge capacity for each outlet at different levels of detention and emergency spillway provisions with maximum discharge capacity of each spillway.

6. Calculations

   a. Comprehensive hydrologic and hydraulic design calculations for the pre-development and post-development conditions for the design storms specified in Section 4 of this ordinance.

   b. When the proposed stormwater management control measures (e.g., infiltration basins) depends on the hydrologic properties of soils, then a soils report shall be submitted. The soils report shall be based on onsite boring logs or soil pit profiles. The number and location of required soil borings or soil pits shall be determined based on what is needed to determine the suitability and distribution of soils present at the location of the control measure.

7. Maintenance and Repair Plan

   The design and planning of the stormwater management facility shall meet the maintenance requirements of Section 10.

8. Waiver from Submission Requirements

   The municipal official or board reviewing an application under this ordinance may, in consultation with the municipal engineer, waive submission of any of the requirements in Sections 9.C.1 through 9.C.6 of this ordinance when it can be demonstrated that the information requested is impossible to obtain or it would create a hardship on the applicant to obtain and its absence will not materially affect the review process.

Section 10: Maintenance and Repair

A. Applicability

1. Projects subject to review as in Section 1.C of this ordinance shall comply with the requirements of Sections 10.B and 10.C.

B. General Maintenance

1. The design engineer shall prepare a maintenance plan for the stormwater management measures incorporated into the design of a major development.

2. The maintenance plan shall contain specific preventative maintenance tasks and schedules; cost estimates, including estimated cost of sediment, debris, or trash removal; and the name, address, and telephone number of the person or persons responsible for preventative and corrective maintenance (including replacement). Maintenance guidelines for stormwater management measures are available in the New Jersey Stormwater Best Management Practices Manual. If the maintenance plan identifies a person other than the developer (for example, a public agency or homeowners' association) as having the responsibility for maintenance, the plan shall include documentation of such person's agreement to assume this responsibility, or of the developer's obligation to dedicate a stormwater management facility to such person under an applicable ordinance or regulation.

3. Responsibility for maintenance shall not be assigned or transferred to the owner or tenant of an individual property in a residential development or project, unless such owner or tenant owns or leases the entire residential development or project.

4. If the person responsible for maintenance identified under Section 10.B.2 above is not a public agency, the maintenance plan and any future revisions based on Section 10.B.7 below shall be recorded upon the deed of record for each property on which the maintenance described in the maintenance plan must be undertaken.

5. Preventative and corrective maintenance shall be performed to maintain the function of the stormwater management measure, including repairs or replacement to the structure; removal of sediment, debris, or trash; restoration of eroded areas; snow and ice removal; fence repair or replacement; restoration of vegetation; and repair or replacement of nonvegetated linings.

6. The person responsible for maintenance identified under Section 10.B.2 above shall maintain a detailed log of all preventative and corrective maintenance for the structural stormwater management measures incorporated into the design of the development, including a record of all inspections and copies of all maintenance-related work orders.

7. The person responsible for maintenance identified under Section 10.B.2 above shall evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and the deed as needed.

8. The person responsible for maintenance identified under Section 10.B.2 above shall retain and make available, upon request by any public entity with administrative, health, environmental, or safety authority over the site, the maintenance plan and the documentation required by Sections 10.B.6 and 10.B.7 above.

9. The requirements of Sections 10.B.3 and 10.B.4 do not apply to stormwater management facilities that are dedicated to and accepted by the municipality or another governmental agency.

   (Note: It may be appropriate to delete requirements in the maintenance and repair plan that are not applicable if the ordinance requires the facility to be dedicated to the municipality. If the municipality does not want to take this responsibility, the ordinance should require the posting of a two year maintenance guarantee in accordance with N.J.S.A. 40:55D-53. Guidelines for developing a maintenance and inspection program are provided in the New Jersey Stormwater Best Management Practices Manual and the NJDEP Ocean County Demonstration Study, Stormwater Management Facilities Maintenance Manual, dated June 1989 available from the NJDEP, Watershed Management Program.)

10. In the event that the stormwater management facility becomes a danger to public safety or public health, or if it is in need of maintenance or repair, the municipality shall so notify the responsible person in writing. Upon receipt of that notice, the responsible person shall have fourteen (14) days to effect maintenance and repair of the facility in a manner that is approved by the municipal engineer or his designee. The municipality, in its discretion, may extend the time allowed for effecting maintenance and repair for good cause. If the responsible person fails or refuses to perform such maintenance and repair, the municipality or County may immediately proceed to do so and shall bill the cost thereof to the responsible person.

B. Nothing in this section shall preclude the municipality in which the major development is located from requiring the posting of a performance or maintenance guarantee in accordance with N.J.S.A. 40:55D-53.

Section 11: Penalties

Any person who erects, constructs, alters, repairs, converts, maintains, or uses any building, structure or land in violation of this ordinance shall be subject to the following penalties: {*Municipality to specify*}.

Section 12: Effective Date

This ordinance shall take effect immediately upon the approval by the county review agency, or sixty (60) days from the receipt of the ordinance by the county review agency if the county review agency should fail to act.

Section 13: Severability

If the provisions of any section, subsection, paragraph, subdivision, or clause of this ordinance shall be judged invalid by a court of competent jurisdiction, such order of judgment shall not affect or invalidate the remainder of any section, subsection, paragraph, subdivision, or clause of this ordinance.

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CHAPTER 7A
FRESHWATER WETLANDS PROTECTION ACT RULES

7:7A-4.3 Conditions that apply to all general permit authorizations

(a) (No change)

(b) The following conditions apply to all activities conducted under the authority of a general permit:

1.-9. (No change.)

10. If activities under the general permit meet the definition of "major development" at N.J.A.C. 7:8-1.2, the Stormwater Management Rules at N.J.A.C. 7:8 apply.

11.–16. (No change.)

(c)-(f) (No change.)

7:7A-5.11 General permit 11- Outfalls and intake structures

(a)-(e) (No change.)

(f) Stormwater discharged from an outfall authorized under general permit 11 shall be managed in accordance with the Stormwater Management Rules at N.J.A.C. 7:8.

(g)-(j) (No change.)

CHAPTER 7E
COASTAL ZONE MANAGEMENT

SUBCHAPTER 8. RESOURCE RULES

7:7E-8.7 Stormwater management

If a project or activity meets the definition of "major development" at N.J.A.C. 7:8-1.2, then the project or activity shall comply with the Stormwater Management rules at N.J.A.C. 7:8.

CHAPTER 8
STORMWATER MANAGEMENT

SUBCHAPTER 1. GENERAL PROVISIONS

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7:8-1.1 Scope and purpose

(a) This chapter establishes general requirements for stormwater management plans and stormwater control ordinances, as well as content requirements and procedures for the adoption and implementation of regional stormwater management plans and municipal stormwater management plans under the Municipal Land Use Law N.J.S.A. 40:55D-1 et seq.; the Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq.: the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq.; and the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.; and implementing rules.

(b) This chapter establishes design and performance standards for stormwater management measures required by rules pursuant to the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.; the Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq.; the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq.; the Waterfront Development Law, N.J.S.A. 12:5-3; the Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.; and the Dam Safety Act, N.J.S.A. 58:4-1 et seq.

(c) This chapter establishes safety standards for stormwater management basins pursuant to N.J.S.A. 40:55D-95.1.

7:8-1.2 Definitions

The following words and terms, when used in this chapter, shall have the following meanings unless the context clearly indicates otherwise.

"CAFRA Planning Map" means the geographic depiction of the boundaries for Coastal Planning Areas, CAFRA Centers, CAFRA Cores and CAFRA Nodes pursuant to N.J.A.C. 7:7E-5B.3.

"CAFRA Centers, Cores or Nodes" means those areas within boundaries accepted by the Department pursuant to N.J.A.C. 7:8E-5B.

"Compaction" means the increase in soil bulk density.

"Core" means a pedestrian-oriented area of commercial and civic uses serving the surrounding municipality, generally including housing and access to public transportation.

"County review agency" means an agency designated by the County Board of Chosen Freeholders to review municipal stormwater management plans and implementing ordinance(s). The county review agency may either be:

1. A county planning agency; or

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2. A county water resources association created under N.J.S.A. 58:16A-55.5, if the ordinance or resolution delegates authority to approve, conditionally approve, or disapprove municipal stormwater management plans and implementing ordinances.

"Department" means the Department of Environmental Protection.

"Designated Center" means a State Development and Redevelopment Plan Center as designated by the State Planning Commission such as urban, regional, town, village, or hamlet.

"Design engineer" means a person professionally qualified and duly licensed in New Jersey to perform engineering services that may include, but not necessarily be limited to, development of project requirements, creation and development of project design and preparation of drawings and specifications.

"Development" means the division of a parcel of land into two or more parcels, the construction, reconstruction, conversion, structural alteration, relocation or enlargement of any building or structure, any mining excavation or landfill, and any use or change in the use of any building or other structure, or land or extension of use of land, for which permission is required under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq.

In the case of development on agricultural land, development means: any activity that requires a State permit; any activity reviewed by the County Agricultural Boards (CAB) and the State Agricultural Development Committee (SADC), and municipal review of any activity not exempted by the Right to Farm Act, N.J.S.A. 4:1C-1 et seq.

"Drainage area" means a geographic area within which stormwater runoff, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

"Environmentally constrained area" means the following areas where the physical alteration of the land is in some way restricted, either through regulation, easement, deed restriction or ownership such as: wetlands, floodplains, threatened and endangered species sites or designated habitats, and parks and preserves. Habitats of endangered or threatened species are identified using the Department's Landscape Project as approved by the Department's Endangered and Nongame Species Program.

"Environmentally critical area" means an area or feature which is of significant environmental value, including but not limited to: stream corridors; natural heritage priority sites; habitats of endangered or threatened species; large areas of contiguous open space or upland forest; steep slopes; and well head protection and groundwater recharge areas. Habitats of endangered or threatened species are identified using the Department's

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Landscape Project as approved by the Department's Endangered and Nongame Species Program.

"Empowerment Neighborhoods" means neighborhoods designated by the Urban Coordinating Council "in consultation and conjunction with" the New Jersey Redevelopment Authority pursuant to N.J.S.A. 55:19-69.

"Erosion" means the detachment and movement of soil or rock fragments by water, wind, ice or gravity.

"Impervious surface" means a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water.

"Infiltration" is the process by which water seeps into the soil from precipitation.

"Lead planning agency" means one or more public entities having stormwater management planning authority designated by the regional stormwater management planning committee pursuant to N.J.A.C. 7:8-3.2, that serves as the primary representative of the committee.

"Major development" means any "development" that provides for ultimately disturbing one or more acres of land or increasing impervious surface by one-quarter acre or more. Disturbance for the purpose of this rule is the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation. Projects undertaken by any government agency which otherwise meet the definition of "major development" but which do not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., are also considered "major development."

"Municipality" means any city, borough, town, township, or village.

"Node" means an area designated by the State Planning Commission concentrating facilities and activities which are not organized in a compact form.

"Nutrient" means a chemical element or compound, such as nitrogen or phosphorus, which is essential to and promotes the development of organisms.

"Person" means any individual, corporation, company, partnership, firm, association, political subdivision of this State and any state, interstate or Federal agency.

"Pollutant" means any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, refuse, oil, grease, sewage sludge, munitions, chemical wastes, biological materials, medical wastes, radioactive substance (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. §§2011 et seq.)), thermal waste,

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wrecked or discarded equipment, rock, sand, cellar dirt, industrial, municipal, agricultural, and construction waste or runoff or other residue discharged directly or indirectly to the land, ground waters or surface waters of the State, or to a domestic treatment works. "Pollutant" includes both hazardous and nonhazardous pollutants.

"Recharge" means the amount of water from precipitation that infiltrates into the ground and is not evapotranspired.

"Sediment" means solid material, mineral or organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

"Site" means the lot or lots upon which a major development is to occur or has occurred.

"Soil" means all unconsolidated mineral and organic material of any origin.

"State Development and Redevelopment Plan Metropolitan Planning Area (PA1)" means an area delineated on the State Plan Policy Map and adopted by the State Planning Commission that is intended to be the focus for much of the State's future redevelopment and revitalization efforts.

"State Plan Policy Map" is defined as the geographic application of the State Development and Redevelopment Plan's goals and Statewide policies, and the official map of these goals and policies.

"Stormwater" means water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, or is captured by separate storm sewers or other sewage or drainage facilities or conveyed by snow removal equipment.

"Stormwater runoff" means water flow on the surface of the ground or in storm sewers, resulting from precipitation.

"Stormwater management basin" means an excavation or embankment and related areas designed to retain stormwater runoff. A stormwater management basin may either be normally dry (that is, a detention basin or infiltration basin), retain water in a permanent pool (a retention basin), or be planted mainly with wetland vegetation (most constructed stormwater wetlands).

"Stormwater management measure" means any structural or nonstructural strategy, practice, technology, process, program, or other method intended to control or reduce stormwater runoff and associated pollutants, or to induce or control the infiltration or groundwater recharge of stormwater or to eliminate illicit or illegal nonstormwater discharges into stormwater conveyances.

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"Stormwater management planning agency" means a public body authorized by legislation to prepare stormwater management plans.

"Stormwater management planning area" means the geographic area for which a stormwater management planning agency is authorized to prepare stormwater management plans, or a specific portion of that area identified in a stormwater management plan prepared by that agency.

"Tidal Flood Hazard Area" means a flood hazard area, which may be influenced by stormwater runoff from inland areas, but which is primarily caused by the Atlantic Ocean.

"Urban Coordinating Council Empowerment Neighborhood" means a neighborhood given priority access to State resources through the New Jersey Redevelopment Authority.

"Urban Enterprise Zones" means a zone designated by the New Jersey Urban Enterprise Zone Authority pursuant to the New Jersey Urban Enterprise Zones Act, N.J.S.A. 52:27H-60 et seq.

"Urban Redevelopment Area" is defined as previously developed portions of areas:
1. Delineated on the State Plan Policy Map (SPPM) as the Metropolitan Planning Area (PA1), Designated Centers, Cores or Nodes;
2. Designated as CAFRA Centers, Cores or Nodes;
3. Designated as Urban Enterprise Zones; and
4. Designated as Urban Coordinating Council Empowerment Neighborhoods.

"Waters of the State" means the ocean and its estuaries, all springs, streams, wetlands, and bodies of surface or ground water, whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

"Wetlands" or "wetland" means an area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

7:8-1.3 Program information

Questions or submissions regarding this chapter should be directed to the Division of Watershed Management, New Jersey Department of Environmental Protection, P.O. Box 418, Trenton, New Jersey 08625.

7:8-1.4 Severability

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If the provisions of any section, subsection, paragraph, or clause of this chapter shall be judged invalid by a court of competent jurisdiction, such order or judgment shall not affect or invalidate the remainder of any section, subsection, paragraph, or clause of this chapter.

7:8-1.5 Relationship to other regulatory programs

(a) Nothing in this chapter shall be construed as preventing the Department or other agencies or entities from imposing additional or more stringent stormwater management requirements necessary to implement the purposes of any enabling legislation including those measures necessary to achieve the Surface Water Quality Standards at N.J.A.C. 7:9B.

(b) If a stormwater management measure is used as a soil erosion or sediment control measure, the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., shall also apply.

(c) These stormwater requirements are the Department's standards referenced by the stormwater management provisions of the Residential Site Improvement Standards at N.J.A.C 5:21-7.

7:8-1.6 Applicability to Major Development

(a) Except as provided in (b) below, all major development shall comply with the requirements of this chapter.

(b) The following major development shall be subject to the stormwater management requirements in effect on February 1, 2004, copies of which are available from the Department at the address specified in N.J.A.C. 7:8-1.3:

1. Major development which does not require any of the Department permits listed in (c) below and which has received one of the following approvals pursuant to the Municipal Land Use Law (N.J.S.A. 40:55D-1 et seq.) prior to February 2, 2004:

i. Preliminary or final site plan approval;

ii. Final municipal building or construction permit;

iii. Minor subdivision approval where no subsequent site plan approval is required;

iv. Final subdivision approval where no subsequent site plan approval is required; or

v. Preliminary subdivision approval where no subsequent site plan approval is required;

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2. Major development which has received one of the approvals pursuant to the Municipal Land Use Law (N.J.S.A. 40:55D-1 et seq.) in (1) above prior to February 2, 2004 and has secured at least one of the applicable permits listed in (c) below from the Department by February 2, 2004, and provided that the permit included a stormwater management review component.

3. Major development undertaken by any government agency, which does not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., provided the project has secured at least one of the applicable Department permits listed in (c) below prior to February 2, 2004, and provided that the permit included a stormwater management review component.

(c) For the purposes of this section, the term "permit" shall include transition area waivers under the Freshwater Wetlands Protection Act. In order to qualify under (b)2 or 3 above, the major development must have obtained at least one Department permit granted under the following statutes and, provided that the permit included a stormwater management review component, prior to February 2, 2004:

1. Flood Hazard Area Control Act, N.J.S.A. 58-16A-50 et seq.;

2. Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.;

3. Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq.;

4. Waterfront and Harbor Facilities Act, N.J.S.A. 12:5-3;

(d) An exemption provided by (b) above shall expire with the expiration, termination or other loss of duration or effect of either of the qualifying local approval or Department permit, whichever comes first. The expiration of local approvals under (b)1 above shall be governed by local ordinance. In the event there are multiple qualifying Department permits under (c) above, the expiration date is governed by that permit which expires last provided that the permit is still in effect. Once the exemption expires, the major development shall be subject to all requirements of this chapter upon reapplication for that permit and all subsequent permits or local approval(s) under the Municipal Land Use Law.

(e) An exemption under (b) above is limited to the land area and the scope of the project addressed by the qualifying approval(s) and permit(s). Exemptions under this section shall be deemed void if revisions are made to the qualifying approval or permit in (b) above, including approvals under the Municipal Land Use Law, unless upon application, the Department determines that each revision would have a de minims impact on water resources. In making this determination, the Department shall consider the extent of any impacts on water resources resulting from the revision, including, but not limited to:

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1) increases in stormwater generated;

2) increases in impervious surface;

3) increases in stormwater pollutant loading;

4) changes in land use;

5) new encroachments in special water resource protection areas; and,

6) changes in vegetative cover.

(f) In case of conflict with the Coastal Permit Program Rules at N.J.A.C. 7:7-4.4(a)4, the requirements of this chapter shall supersede.

SUBCHAPTER 2. GENERAL REQUIREMENTS FOR STORMWATER MANAGEMENT PLANNING

7:8-2.1 Scope

This subchapter provides general principles applicable to all stormwater management plans and stormwater control ordinances, including the goals of stormwater management planning, the process for identification of stormwater management planning agencies, and stormwater management plan requirements.

7:8-2.2 Goals of stormwater management planning

(a) All stormwater management plans and stormwater control ordinances shall be designed to:

1. Reduce flood damage, including damage to life and property;

2. Minimize, to the extent practical, any increase in stormwater runoff from any new development;

3. Reduce soil erosion from any development or construction project;

4. Assure the adequacy of existing and proposed culverts and bridges, and other in-stream structures;

5. Maintain groundwater recharge;

6. Prevent, to the greatest extent feasible, an increase in nonpoint pollution;

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7. Maintain the integrity of stream channels for their biological functions, as well as for drainage;

8. Minimize pollutants in stormwater runoff from new and existing development in order to restore, enhance and maintain the chemical, physical, and biological integrity of the waters of the State, to protect public health, to safeguard fish and aquatic life and scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial and other uses of water; and

9. Protect public safety through the proper design and operation of stormwater management basins.

7:8-2.3 Stormwater management planning agencies
(a) The following entities may be stormwater management planning agencies provided they are authorized under their enabling legislation to prepare stormwater management plans:
1. A municipality;
2. A county;
3. A county water resources agency or association;
4. A designated planning agency under N.J.A.C. 7:15;
5. A Soil Conservation District, in coordination with the State Soil Conservation Committee;
6. The Delaware River Basin Commission;
7. The Pinelands Commission;
8. The Delaware and Raritan Canal Commission;
9. The New Jersey Meadowlands Commission;
10. The Department; or
11. Other regional, State or interstate agencies.

7:8-2.4 Stormwater management plan requirements

(a) A stormwater management plan shall include structural and nonstructural stormwater management strategies necessary to meet the stormwater management goals of this chapter.

(b) A regional stormwater management plan shall comply with the requirements of this subchapter and N.J.A.C 7:8-3.

(c) A municipal stormwater management plan shall comply with the requirements of this subchapter and N.J.A.C 7:8-4.

(d) A stormwater management plan shall incorporate the safety standards for stormwater management basins at N.J.A.C. 7:8-6.

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(e) In developing a stormwater management plan and identifying appropriate stormwater management measures thereunder, each stormwater management planning agency shall consider the physical characteristics and ecological resources of the stormwater management planning area.

(f) A stormwater management plan and any stormwater management ordinance shall be coordinated with any other stormwater management plans related to the same river basin or drainage area.

7:8-2.5 Exemptions

A municipality or other entity conducting stormwater management planning under this chapter may petition the Department at the address provided at N.J.A.C. 7:8-1.3 for an exemption to the requirements of this chapter by submitting documentation to demonstrate that, if granted, the exemption will not result in an increase in flood damage, water pollution, including threats to the biological integrity, or constitute a threat to the public safety.

SUBCHAPTER 3. REGIONAL STORMWATER MANAGEMENT PLANNING

7:8-3.1 Scope

(a) This subchapter describes stormwater management planning and implementation at the regional level, including plan elements; planning process; characterization; development of drainage area-specific objectives and standards; selection of stormwater management measures; strategy for implementing the measures and evaluating the effectiveness of the regional stormwater management plan; plan review, adoption, amendment or revision; and implementation and periodic evaluation of the plan.

(b) A regional stormwater management plan shall address stormwater-related water quality, ground water recharge and/or water quantity impacts of new and existing land uses in a regional stormwater management planning area. A regional stormwater management planning area shall consist of one or more continuous drainage areas. For example, a drainage area could be an area defined by a hydrologic unit code 14 (HUC14) as defined by the United States Geological Survey.

7:8-3.2 Regional stormwater management planning committee and lead planning agency

(a) A regional stormwater management planning committee (the committee) shall be established for the purposes of creating a regional stormwater management plan.

(b) A person or entity seeking to establish a regional stormwater management committee shall solicit participation from municipalities, interstate agencies, regional agencies, counties, designated planning agencies under N.J.A.C. 7:15, Soil Conservation

Districts, regional environmental commissions, Pinelands Commission, mosquito control and extermination commissions, public water supply and wastewater treatment utilities and agencies, lake associations, watershed associations, the watershed management planning area public advisory committee, environmental organizations, businesses, the Department and other appropriate State and Federal agencies and, members of the general public in the drainage area(s) to be addressed by the proposed plan. The solicitation for members of the general public to be part of the regional stormwater management planning committee can be performed through notices in local paper.

(c) The regional stormwater management planning committee shall designate a lead planning agency, which shall be recognized as the primary contact for the committee. The regional stormwater management planning committee, through the lead planning agency, shall:

1. Prepare the regional stormwater management plan;

2. Coordinate the regional stormwater management planning process with any applicable watershed management area planning process;

3. Provide opportunities for public participation throughout the regional stormwater management planning process; and

4. Perform other activities appropriate to facilitate the regional stormwater management planning process, including mediation, public information, providing technical assistance, and seeking and providing grants or other financial assistance, as available, to municipalities and/or local or regional agencies pursuant to N.J.S.A. 40:55D-99 or other applicable authority.

(d) A request for recognition as a regional stormwater management planning committee shall be submitted to the Department at the address listed in N.J.A.C. 7:8-1.3 by the lead planning agency, and include the following information:

1. A draft work plan and schedule for completing a regional stormwater management plan;

2. A copy of the mailing list used to solicit participation, including the entities identified in (b) above;

3. A copy of the letter of invitation to participate in the committee;

4. A copy of each response to the letter of invitation; and

5. In cases where no response from a public entity to the letter of invitation is

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received within 60 days, the group shall send a follow-up request by certified mail, return receipt requested, and submit proof of such follow-up.

(e) The Department shall respond in writing within 45 days of the receipt of a complete request for recognition as a regional stormwater management planning committee. The Department shall either approve the application, request additional information or deny the request for recognition. Denials will include a justification for the decision.

The Department shall base approval or denial on the information submitted in the draft work plan and schedule for plan completion, completion of the requirements to involve and notify impacted parties, and whether there are other competing or overlapping requests for recognition for the same regional stormwater management planning area.

7:8-3.3 Regional stormwater management plan and elements

(a) A regional stormwater management plan shall incorporate, at a minimum, the following elements:

1. Identification of the lead planning agency and a description of the structure and members of the committee;

2. A statement of authority to develop and implement a stormwater management plan from public entities, as appropriate, represented on the regional stormwater management planning committee.

3. A characterization and assessment of the regional stormwater management planning area prepared in accordance with N.J.A.C. 7:8-3.4;

4. A statement of drainage area-specific water quality, groundwater recharge, and water quantity objectives established under N.J.A.C. 7:8-3.5;

5. The drainage area-specific stormwater-related water quality, groundwater recharge and water quantity design and performance standards established under N.J.A.C. 7:8-3.6;

6. The stormwater management measures selected in accordance with N.J.A.C. 7:8-3.7 and a summary of the rationale for the selection of each measure;

7. A description of the strategy for implementing the selected stormwater management measures for the regional stormwater management planning area and for evaluating the effectiveness of the regional stormwater management plan in accordance with N.J.A.C. 7:8-3.8, including a long-term monitoring program; and

8. To the extent elements of the plan do not represent the consensus of the committee, the plan shall identify and provide a discussion of the majority and minority positions.

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(b) The regional stormwater management plan may also include:

1. Innovative stormwater measures and strategies such as nonpoint source pollutant trading, mitigation strategies, or special protection measures; and

2. A stream corridor protection plan to address protection of areas adjacent to waterbodies. For waterbodies subject to N.J.A.C. 7:8-5.5(h), the plan shall provide, at a minimum, protections equivalent to those provided at N.J.A.C. 7:8-5.5(h) and demonstrate that the functional value and overall condition of the special water resource protection area will be maintained or enhanced.

7:8-3.4 Characterization and assessment of the regional stormwater management planning area

(a) The regional stormwater management plan shall include a characterization and assessment that addresses the following components, unless the committee determines that a component is not appropriate for the regional stormwater management planning area and provides a rationale for not including the component:

1. Maps showing the following information. Maps developed on a Geographical Information System shall meet the Digital Data standards in N.J.A.C. 7:1D unless a rationale for a different format is provided.

i. The regional stormwater management planning area boundary;

ii. Existing land uses;

iii. Projected land uses assuming full development under existing zoning;

iv. Soil mapping units based on the detailed soil maps in County Soil Surveys published by the U.S. Department of Agriculture or, in areas for which County Soil Surveys are not available, on information obtained from Soil Conservation Districts;

v. Topography based on the U.S. Geological Survey Topographic Map, 7.5 minute quadrangle series, or other sources of information depicting topography in similar or greater detail;

vi. Water bodies based on detailed map sheets in County Soil Surveys published by the U.S. Department of Agriculture; the U.S. Geological Survey Topographic Map, 7.5 minute quadrangle series; or other sources of information depicting water bodies in similar or greater detail;

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vii. Coastal wetlands based on maps prepared by the Department under the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq., and freshwater wetlands based on maps prepared by the Department under the Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.;

viii. Flood hazard areas based on delineations made by the Department under the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq. For a water body for which the Department has not delineated the flood hazard area, a map of the flood hazard area prepared in accordance with N.J.A.C. 7:13 is acceptable;

ix. Groundwater recharge areas and well head protection areas based on maps prepared by the Department or ordinances of an affected municipality;

x. Environmentally constrained areas and environmentally critical areas;

xi. River areas designated under the New Jersey Wild and Scenic Rivers Act, N.J.S.A. 13:8-45 et seq., or the Federal Wild and Scenic Rivers Act, 16 U.S.C. §§1278 et seq.;

xii. For each waterbody in the regional stormwater management planning area, identification of the waterbody or waterbody segment, the drainage area, and the classification of the waterbody pursuant to N.J.A.C. 7:9B-1.15;

xiii. Each waterbody designated as a water quality limited surface water pursuant to N.J.A.C. 7:15-6;

xiv. Man-made stormwater conveyance, storage and discharge systems, including municipal separate storm sewer outfall pipes and the drainage areas as appropriate for these outfall structures; and

xv. Source water areas of potable public surface water supply intakes and public water supply reservoirs available on the Departments webpage at www.nj.gov/dep/swap/;

2. A map showing jurisdictional boundaries within the regional stormwater management planning area of municipal, county, and other agencies with responsibility for implementing stormwater management;

3. Identification of the physical characteristics of the regional stormwater management planning area pertinent to stormwater management, such as slopes, swales and impoundment areas as necessary for completing the analysis in N.J.A.C. 7:8-3.4(a)4;

4. A water quality, groundwater recharge and water quantity hydrologic and hydraulic model or analysis of the regional stormwater management planning area which addresses existing land uses and projected land uses assuming full development under existing zoning and taking into account permanently preserved lands;

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5. An identification and evaluation of existing municipal, county, State, Federal, and other stormwater-related groundwater recharge, water quality and water quantity regulations and programs shall be conducted, including, where applicable, programs to develop total maximum daily loads (TMDLs) in accordance with N.J.A.C. 7:15-7; and

6. A summary of information that has been identified as useful for purposes of stormwater management planning but that is not available for technical, financial, or other reasons.

(b) The Department encourages the use of existing information to the extent that it is available to minimize the cost of data acquisition, such as information available on the Department's Geographical Information System web site (www.state.nj.us/dep/gis) or as developed through a watershed planning process.

(c) The characterization and assessment shall include information on locations and activities outside the regional stormwater management planning area that drain into the planning area (for example, stormwater originating in an adjacent drainage area that is transferred to the stormwater management planning area).

(d) Using the modeling or other information obtained under (a) through (c) above, the stormwater-related water quality impacts of existing land uses and projected land uses assuming full development under existing zoning shall be identified and ranked in accordance with the following process:

1. Inventory existing and potential stormwater-related pollutant sources and stormwater-related pollutants in the regional stormwater management planning area.

i. Stormwater-related pollutant sources include, for example, urban and suburban development, roads, storm sewers, agriculture, mining, and waterfront development.

ii. Stormwater-related pollutants include, for example, nutrients, pathogens, hydrocarbons, metals, pesticides, sediments, and suspended solids;

2. For surface water bodies and/or segments thereof and aquifers and/or portions thereof in the regional stormwater management planning area, identify and describe the existing or designated uses that are or may be adversely affected by stormwater-related pollutants, and to the extent feasible, identify the source(s) of the pollutant. The use of the report and list prepared by the Department to comply with Federal Clean Water Act, Section 303(d) and 305(b) (33 USC §§1313(d) and 1315(b)) and underlying data, including biological assessments, is encouraged; and

3. Identify and rank the most significant existing and potential stormwater-related pollutants and, for each pollutant, identify and rank the sources.

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(e) Using the modeling or other information obtained under (a) through (c) above for stormwater-related water quantity impacts and stormwater-related groundwater recharge impacts of existing and projected land uses assuming full development under existing zoning, the most significant existing and potential stormwater-related water quantity problems, including flooding, erosion, mosquitoes, base-flow reduction, ground water depletion, and associated ecosystem impacts, shall be identified and described. The problems shall be ranked based on consideration of threat to public health, safety, and welfare as evidenced by history of or potential for flood damage; risk of loss of or damage to water supplies; and risk of damage to the biological integrity of water bodies.

7:8-3.5 Drainage area-specific water quality, groundwater recharge and water quantity objectives

(a) The regional stormwater management plan shall identify drainage area-specific water quality, groundwater recharge and water quantity objectives that are consistent with the goals of stormwater management planning at N.J.A.C. 7:8-2.3, and address each of the stormwater-related pollutant sources and pollutants ranked under N.J.A.C. 7:8-3.4(d) and the water quantity and groundwater recharge problems ranked under N.J.A.C. 7:8-3.4(e). The objectives shall address the elimination, reduction, or minimization of stormwater-related impacts associated with new and existing land uses. The objectives developed for the regional stormwater management plan may take into consideration environmental, social, and economic factors.

(b) Notwithstanding (a) above, the drainage area -specific objectives for major development shall provide, at a minimum, the protection that would be achieved through the application of N.J.A.C. 7:8-5, Design and Performance Standards for Stormwater Management Measures.

(c) If a TMDL has been established pursuant to N.J.A.C. 7:15 for a waterbody or waterbody segment in the regional stormwater management planning area, drainage area-specific objectives shall incorporate the loading reductions established in the TMDL for stormwater sources of pollution. In addition, if a waterbody or waterbody segment in the regional stormwater management planning area is on the Department's list prepared to comply with Federal Clean Water Act, Section 303(d) (33 USC §§1313(d)) for one or more designated uses by stormwater runoff, then drainage area objectives shall be included that address the pollutants or pollution for which the waterbody is threatened or impaired.

7:8-3.6 Drainage area-specific design and performance standards

(a) The regional stormwater management plan shall identify drainage area-specific design and performance standards in order to meet the drainage area-specific water quality, groundwater recharge and water quantity objectives identified under N.J.A.C. 7:8-3.5.

(b) Drainage area-specific design and performance standards may include performance standards for control of stormwater quantity, erosion, groundwater recharge and stormwater quality, as well as design standards for particular structural and nonstructural stormwater management strategies.

(c) The design and performance standards for stormwater management measures for major development described in N.J.A.C. 7:8-5 shall be incorporated into the regional stormwater management plan. Alternative drainage area-specific design and performance standards may be developed provided the alternative standard is at least as protective as would be achieved under N.J.A.C. 7:8-5 when considered on a regional stormwater management planning area basis.

(d) For structural stormwater management measures, drainage area-specific design and performance standards shall conform to the general standards at N.J.A.C. 7:8-5.7.

(e) Drainage area-specific design and performance standards do not have to be uniform throughout a drainage area provided the drainage area, when considered in its entirety, satisfies N.J.A.C. 7:8-5.

7:8-3.7 Selection of stormwater management measures

(a) The regional stormwater management plan shall identify stormwater management measures necessary to achieve the drainage area-specific water quality, groundwater recharge and water quantity objectives developed in accordance with N.J.A.C. 7:8-3.5, and design and performance standards developed in accordance with N.J.A.C. 7:8-3.6.

(b) Stormwater management measures in the following categories shall be considered and selected, as appropriate:

1. Stormwater management measures for new land uses;

2. Stormwater management measures for existing land uses, including, for example, retrofit measures for the modification of existing structural stormwater management measures or other structures affecting stormwater runoff; elimination of illicit or illegal discharges; prevention or minimization of the exposure of pollutants to stormwater; and control of floatables;

3. Stormwater management measures that enhance, protect, and/or preserve land or water areas possessing characteristics or features that provide for flood control, maintenance or improvement of water quality, or conservation of natural resources (for example, land use controls, local and regional open space plans and taxes, buffer zones, redirecting, recharging or minimizing stormwater discharges, pretreatment and/or end-of-pipe treatment); and

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4. Public education programs that address stormwater quantity and quality.

(c) A written rationale shall be provided for each selected stormwater management measure, including an analysis of feasibility, benefits and costs, estimated percent pollutant load reduction and anticipated performance longevity;

(d) Each selected stormwater management measure shall include, as appropriate, a program for preventative and corrective maintenance, including a long-term implementation schedule and identification of the entity responsible for implementation and maintenance.

7:8-3.8 Strategy for implementing and evaluating effectiveness of stormwater management measures

(a) The regional stormwater management plan shall include a strategy for implementing the stormwater management measures. The lead planning agency or another entity designated by the committee shall be responsible for coordination and tracking of the implementation of the regional stormwater management plan, including the long-term monitoring program.

(b) The implementation strategy shall:

1. Identify agencies and/or entities necessary to implement the measures and conduct the long-term monitoring program;

2. Identify the respective measures and/or monitoring each agency and/or entity will implement and the enabling mechanisms by which the measures will be implemented, including, for example, new or amended municipal ordinances or interagency agreements;

3. Establish a schedule for the implementation of the measures based on priority, including specific milestones for all mechanisms identified under (b)2 above;

4. Provide an estimate of short term and long term implementation costs to be incurred; and

5. Identify existing and potential private, local, State, and Federal funding sources to implement the regional stormwater management plan.

(c) The implementation strategy shall include a long-term monitoring program that will provide information about land use, water quality, water quantity, groundwater resources and riparian and aquatic habitat condition, as appropriate. Information for the monitoring program may include data obtained through watershed management, local, county, State, interstate, and/or Federal monitoring programs, including volunteer monitoring programs.

(d) The implementation strategy shall include a procedure for evaluating and then updating as necessary, at least every five years, the effectiveness of the implemented measures in achieving the objectives and design and performance standards established in the regional stormwater management plan.

7:8-3.9 Regional stormwater management plan review, adoption, and amendment and/or revision

(a) Upon completion of a regional stormwater management plan, the lead planning agency shall submit the plan to the Department and, if applicable, to the designated water quality management planning agency as an amendment to the areawide water quality management plan(s) in accordance with the Water Quality Management Planning Rules at N.J.A.C. 7:15.

(b) In reviewing a regional stormwater management plan submitted under (a) above, the Department shall determine whether the plan conforms to the requirements of this chapter. The Department will disapprove, return for additional information or proceed with a proposed amendment in accordance with N.J.A.C. 7:15-3.4(g).

(c) Modifications to an adopted regional stormwater management plan shall be processed as an amendment or revision in accordance with N.J.A.C. 7:15-3.4(b)5 or 3.5(b)5, as applicable.

7:8-3.10 Implementation of adopted regional stormwater management plan

(a) Once the regional stormwater management plan has been adopted pursuant to N.J.A.C. 7:8-3.9, implementation responsibilities are as follows:

1. The Department will use the adopted regional stormwater management plan as the basis for reviewing the stormwater management aspects of projects or activities regulated pursuant to Coastal Permit Program rules, N.J.A.C. 7:7; the Freshwater Wetland Protection Act rules, N.J.A.C. 7:7A; the Coastal Zone Management rules, N.J.A.C. 7:7E; the Flood Hazard Area Control Act rules, N.J.A.C. 7:13; the New Jersey Pollutant Discharge Elimination System rules, N.J.A.C 7:14A; and the Dam Safety Standards, N.J.A.C. 7:20. The requirements of this chapter are considered to be the minimum stormwater standards. Additional requirements may be imposed as necessary under the respective programs.

2. Each municipality in the regional stormwater management planning area shall incorporate the applicable provisions of the regional stormwater management plan into a new or amended municipal stormwater management plan and ordinances.

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3. In accordance with the Residential Site Improvement Standards at N.J.A.C. 5:21-7, if a stormwater management plan for the region has been approved by the Department, stormwater management systems must conform with that plan.

4. The Department shall not issue a permit for a project or activity that conflicts with an Areawide Water Quality Management Plan pursuant to N.J.A.C. 7:15-3.1.

SUBCHAPTER 4. MUNICIPAL STORMWATER MANAGEMENT PLANNING

7:8-4.1 Scope

This subchapter describes stormwater management planning and implementation at the municipal level, including plan elements, county review and technical assistance, the schedule for adoption of the plan and ordinances, and variance or exemption from design and performance standards for stormwater management measures.

7:8-4.2 Municipal stormwater management plan and elements

(a) A municipal stormwater management plan shall address stormwater-related water quality, groundwater recharge and water quantity impacts of major development, and may also address stormwater-related water quality, water quantity and groundwater recharge impacts of existing land uses. For purposes of this subchapter, major development is limited to projects that ultimately disturb one or more acres of land.

(b) A municipal stormwater management plan and stormwater control ordinance(s) shall conform with applicable regional stormwater management plan(s).

(c) A municipal stormwater management plan shall, at a minimum:

1. Describe how the municipal stormwater management plan will achieve the goals of stormwater management planning set forth at N.J.A.C. 7:8-2.3;

2. Include maps showing water bodies based on Soil Surveys published by the U.S. Department of Agriculture; the U.S. Geological Survey Topographic Map, 7.5 minute quadrangle series; or other sources of information depicting water bodies in similar or greater detail;

3. Map groundwater recharge areas and well head protection areas based on maps prepared by the Department under N.J.S.A. 58:11A-13 or a municipal ordinance;

4. Describe how the municipal stormwater management plan incorporates design and performance standards in N.J.A.C.7: 8-5 or alternative design and performance standards adopted as a part of a regional stormwater management plan or water quality management plan;

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5. Describe how adequate long-term operation as well as preventative and corrective maintenance (including replacement) of the selected stormwater management measures will be ensured;

6. Describe how the plan will ensure compliance with Safety Standards for Stormwater Management Basins at N.J.A.C. 7:8-6;

7. Describe how the municipal stormwater management plan is coordinated with the appropriate Soil Conservation District and any other stormwater management plans, including any adopted regional stormwater management plan, prepared by any stormwater management planning agency related to the river basins or drainage areas to which the plans and/or ordinances apply;

8. Evaluate the extent to which the municipality's entire master plan (including the land use plan element), official map and development regulations (including the zoning ordinance) implement the principles expressed in N.J.A.C. 7:8-5.3(b). This evaluation shall also be included (with updating as appropriate) in the reexamination report adopted under N.J.S.A. 40:55D-89;

9. Include a map of the municipality showing:

i. Projected land uses assuming full development under existing zoning, and

ii. The hydrologic unit code 14 (HUC14) drainage areas as defined by the United States Geological Survey; and an estimate, for each HUC14 drainage area, of the total acreage in the municipality of impervious surface and associated future nonpoint source pollutant load assuming full build out of the projected land uses.

10. At the option of the municipality, document that it has a combined total of less than one square mile of vacant or agricultural lands rather than provide the information required in (c)8 and 9 above. Agricultural lands may be excluded if the development rights to these lands have been permanently purchased or restricted by covenant, easement or deed. Vacant or agricultural lands in environmentally constrained areas may be excluded if the documentation also includes an overlay map of these areas at the same scale as the map under (c)10i below.

i. Documentation shall include an existing land use map at an appropriate scale to display the land uses of each parcel within the municipality. Such a map shall display the following land uses: residential (which may be divided into single family, two-to-four family, and other multi-family), commercial, industrial, agricultural, parkland, other public uses, semipublic uses, and vacant land;

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11. In order to grant a variance or exemption from the design and performance standards in N.J.A.C. 7:8-5, include a mitigation plan that identifies what measures are necessary to offset the deficit created by granting the variance or exemption. The mitigation plan shall ensure that mitigation is completed within the drainage area and for the performance standard for which the variance or exemption was granted;

12. Include a copy of the recommended implementing stormwater control ordinance(s) requiring stormwater management measures, and

13. The municipal stormwater management plan may also include a stream corridor protection plan to address protection of areas adjacent to waterbodies. For waterbodies subject to N.J.A.C. 7:8-5.5(h), the plan shall provide, at a minimum, protections equivalent to those provided at N.J.A.C. 7:8-5.5(h) and be approved by the Department.

7:8-4.3 Schedule for adoption of municipal stormwater management plan and ordinances

(a) A municipality shall adopt a municipal stormwater management plan as an integral part of its master plan and official map in accordance with the schedule in (a)1 or 2 below, whichever is sooner. The requirements in N.J.A.C. 7:8-4.2(c)8 and 9 are not operative until February 2, 2006.

1. By the deadline established in a New Jersey Pollutant Discharge Elimination System permit obtained by the municipality for a municipal separate storm sewer system under N.J.A.C. 7:14A; or

2. By the next reexamination of the master plan under N.J.S.A. 40:55D-89, if a grant for 90 percent of the costs for the preparation of the municipal stormwater management plan has been made available to a municipality by the Department;

(b) Within one year after the municipality adopts the municipal stormwater management plan, the municipality shall adopt stormwater control ordinance(s) to implement the adopted plan and shall submit the adopted municipal stormwater management plan and ordinance(s) to the county review agency for approval. The adopted municipal stormwater management plan and ordinance(s) shall not take effect without approval by the county review agency.

(c) The municipality shall amend the municipal stormwater management plan and stormwater control ordinance(s) as necessary and submit the amended plan and amended ordinance(s) to the county review agency for approval.

(d) The municipality shall reexamine the municipal stormwater management plan at each reexamination of the municipality's master plan in accordance with N.J.S.A. 40:55D-89.

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(e) Within one year of the adoption of a regional stormwater management plan as an amendment to the Areawide Water Quality Management Plan, or an amendment thereto, each municipality within the regional stormwater management planning area shall amend their respective municipal stormwater management plans and stormwater control ordinance(s) to implement the regional stormwater management plan.

7:8-4.4 County review process

(a) A municipality shall submit a copy of the adopted stormwater management plan and stormwater control ordinance(s) to the county review agency and the Department.

(b) In reviewing the adopted municipal stormwater management plan and ordinance(s), the county review agency shall consider whether the plan and ordinance(s) conform with the requirements of this chapter.

(c) In accordance with N.J.S.A. 40:55D-97, it is the county review agency's responsibility to review and approve, conditionally approve (specifying the necessary amendments to the plan and ordinance(s)) or disapprove the adopted municipal stormwater management plan and ordinance(s) within 60 calendar days of receipt of the plan and ordinance(s). If the county review agency does not approve, conditionally approve, or disapprove the plan or ordinance(s) within 60 calendar days, the plan and ordinance(s) shall be deemed approved. The county review agency shall issue a written decision to the municipality, with a copy to the Department.

(d) A municipal stormwater management plan and ordinance(s) approved under (c) above shall take effect immediately. A municipal stormwater management plan and ordinance(s) conditionally approved under (c) above shall take effect upon adoption by the municipality of the amendments specified by the county review agency.

(e) Within 30 days of the effective date of the municipal stormwater management plan and ordinance(s) under (d) above, the municipality shall place the plan and ordinance(s) on its website and notify the Department, the Soil Conservation District and State Soil Conservation Committee, or:

1. Submit a copy of the approved municipal stormwater management plan and ordinance(s) to the Department; and

2. Provide notice of such approval to the Soil Conservation District and the State Soil Conservation Committee and, upon request, submit a copy of the approved plan and ordinance(s).

7:8-4.5 Reservation of rights

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The Department reserves the right to review stormwater management plans and ordinances for compliance with this subchapter and make recommendations to correct any deficiencies.

7:8-4.6 Variance or exemption from the design and performance standards for stormwater management measures

A municipality may grant a variance or exemption from the design and performance standards for stormwater management measures set forth in its approved municipal stormwater management plan and stormwater control ordinance(s), provided the municipal plan includes a mitigation plan in accordance with N.J.A.C. 7:8-4.2(c)11 and the municipality submits a written report to the county review agency and the Department describing the variance or exemption and the required mitigation.

SUBCHAPTER 5 DESIGN AND PERFORMANCE STANDARDS FOR STORMWATER MANAGEMENT MEASURES

7:8-5.1 Scope

(a) This subchapter establishes design and performance standards for stormwater management measures for major development intended to minimize the adverse impact of stormwater runoff on water quality and water quantity and loss of groundwater recharge in receiving water bodies.

(b) The standards specified in this subchapter do not apply to major development if alternative design and performance standards that are at least as protective as would be achieved through this subchapter when considered on a regional stormwater management area basis are applicable under a regional stormwater management plan adopted in accordance with this chapter or a water quality management plan adopted in accordance with N.J.A.C. 7:15.

7:8-5.2 Stormwater management measures for major development

(a) Stormwater management measures for major development shall be developed to meet the erosion control, groundwater recharge, stormwater runoff quantity, and stormwater runoff quality standards at N.J.A.C. 7:8-5.4 and 5.5. To the maximum extent practicable, these standards shall be met by incorporating nonstructural stormwater management strategies at N.J.A.C. 7:8-5.3 into the design. If these measures alone are not sufficient to meet these standards, structural stormwater management measures at N.J.A.C. 7:8-5.7 necessary to meet these standards shall be incorporated into the design.

(b) The development shall incorporate a maintenance plan under N.J.A.C. 7:8-5.8 for the stormwater management measures.

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(c) Stormwater management measures shall avoid adverse impacts of concentrated flow on habitat for threatened and endangered species as documented in the Department's Landscape Project or Natural Heritage Database established under N.J.S.A. 13:1B-15.147 through 15.150, particularly *Helonias bullata* (swamp pink) and/or *Clemmys muhlnebergi* (bog turtle).

(d) The following linear development projects are exempt from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements at N.J.A.C. 7:8-5.4 and 5.5:

1. The construction of an underground utility line provided that the disturbed areas are revegetated upon completion;

2. The construction of an aboveground utility line provided that the existing conditions are maintained to the maximum extent practicable; and

3. The construction of a public pedestrian access, such as a sidewalk or trail with a maximum width of 14 feet, provided that the access is made of permeable material.

(e) A waiver from strict compliance from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements at N.J.A.C. 7:8-5.4 and 5.5 may be obtained for the enlargement of an existing public roadway or railroad, or the construction or enlargement of a public pedestrian access, provided that the following conditions are met:

1. The applicant demonstrates that there is a public need for the project that cannot be accomplished by any other means;

2. The applicant demonstrates through an alternatives analysis, that through the use of nonstructural and structural stormwater management strategies and measures, the option selected complies with the requirements of N.J.A.C. 7:8-5.4 and 5.5 to the maximum extent practicable;

3. The applicant demonstrates that, in order to meet the requirements at N.J.A.C. 7:8-5.4 and 5.5 existing structures currently in use, such as homes and buildings would need to be condemned; and

4. The applicant demonstrates that it does not own or have other rights to areas, including the potential to obtain through condemnation lands not falling under (e)3 above within the upstream drainage area of the receiving stream, that would provide additional opportunities to mitigate for requirements of N.J.A.C. 7:8-5.4 and 5.5 that were not achievable on-site.

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7:8-5.3 Nonstructural stormwater management strategies

(a) To the maximum extent practicable, the standards in N.J.A.C. 7:8-5.4 and 5.5 shall be met by incorporating nonstructural stormwater management strategies at N.J.A.C. 7:8-5.3 into the design. The persons submitting an application for review shall identify the nonstructural strategies incorporated into the design of the project. If the applicant contends that it is not feasible for engineering, environmental, or safety reasons to incorporate any nonstructural stormwater management strategies identified in (b) below into the design of a particular project, the applicant shall identify the strategy and provide a basis for the contention.

(b) Nonstructural stormwater management strategies incorporated into site design shall:

1. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss;

2. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces;

3. Maximize the protection of natural drainage features and vegetation;

4. Minimize the decrease in the "time of concentration" from pre-construction to post-construction. "Time of Concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the drainage area to the point of interest within a watershed;

5. Minimize land disturbance including clearing and grading;

6. Minimize soil compaction;

7. Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides;

8. Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas; and

9. Provide other source controls to prevent or minimize the use or exposure of pollutants at the site in order to prevent or minimize the release of those pollutants into stormwater runoff. These source controls include, but are not limited to:

i. Site design features that help to prevent accumulation of trash and debris in drainage systems;

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ii. Site design features that help to prevent discharge of trash and debris from drainage systems;

iii. Site design features that help to prevent and/or contain spills or other harmful accumulations of pollutants at industrial or commercial developments; and

iv. When establishing vegetation after land disturbance, applying fertilizer in accordance with the requirements established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., and implementing rules.

(c) Any land area used as a non structural stormwater management measure to meet the performance standards in N.J.A.C. 7:8-5.4 and 5.5 shall be dedicated to a government agency, subjected to a conservation restriction filed with the County Clerk's office, or subject to Department approved or equivalent restriction that ensures that measure or an equivalent stormwater management measure approved by the reviewing agency is maintained in perpetuity.

(d) Guidance for nonstructural stormwater management strategies is available in the New Jersey Stormwater Best Management Practices Manual available from the Department through the address listed at N.J.A.C. 7:8-1.3.

7:8-5.4 Erosion control, groundwater recharge and runoff quantity standards

(a) This section contains minimum design and performance standards to control erosion, encourage and control infiltration and groundwater recharge, and control stormwater runoff quantity impacts of major development.

1. The minimum design and performance standards for erosion control are those established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. and implementing rules.

2. The minimum design and performance standards for groundwater recharge are as follows:

i. The design engineer shall, using the assumptions and factors for stormwater runoff and groundwater recharge calculations at N.J.A.C. 7:8-5.6, either:

(1) Demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures maintain 100 percent of the average annual pre-construction groundwater recharge volume for the site; or

(2) Demonstrate through hydrologic and hydraulic analysis that the increase of stormwater runoff volume from pre-construction to post-construction for the two-year storm is infiltrated.

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ii. This groundwater recharge requirement does not apply to projects within the "urban redevelopment area," or to projects subject to iii below.

iii.The following types of stormwater shall not be recharged:

(1) Stormwater from areas of high pollutant loading. High pollutant loading areas are areas in industrial and commercial developments where solvents and/or petroleum products are loaded/unloaded, stored, or applied, areas where pesticides are loaded/unloaded or stored; areas where hazardous materials are expected to be present in greater than 'reportable quantities' as defined by the United States Environmental Protection Agency (EPA) at 40 CFR 302.4; areas where recharge would be inconsistent with Department approved remedial action work plan or landfill closure plan and areas with high risks for spills of toxic materials, such as gas stations and vehicle maintenance facilities; and

(2) Industrial stormwater exposed to "source material." "Source material" means any material(s) or machinery, located at an industrial facility, that is directly or indirectly related to process, manufacturing or other industrial activities, which could be a source of pollutants in any industrial stormwater discharge to groundwater. Source materials include, but are not limited to, raw materials; intermediate products; final products; waste materials; by-products; industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

iv. The design engineer shall assess the hydraulic impact on the groundwater table and design the site so as to avoid adverse hydraulic impacts. Potential adverse hydraulic impacts include, but are not limited to, exacerbating a naturally or seasonally high water table so as to cause surficial ponding, flooding of basements, or interference with the proper operation of subsurface sewage disposal systems and other subsurface structures in the vicinity or downgradient of the groundwater recharge area.

3. In order to control stormwater runoff quantity impacts, the design engineer shall, using the assumptions and factors for stormwater runoff calculations at N.J.A.C. 7:8-5.6, complete one of the following:

i. Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the two, 10, and 100-year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events;

ii. Demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the two, 10, and 100-year storm events and that the increased volume

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or change in timing of stormwater runoff will not increase flood damage at or downstream of the site. This analysis shall include the analysis of impacts of existing land uses and projected land uses assuming full development under existing zoning and land use ordinances in the drainage area;

iii.Design stormwater management measures so that the post-construction peak runoff rates for the two, 10 and 100-year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates. The percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed; or

iv. In tidal flood hazard areas, stormwater runoff quantity analysis in accordance with i, ii, and iii above shall only be applied if the increased volume of stormwater runoff could increase flood damages below the point of discharge.

(b) Any application for a new agricultural development that meets the definition of major development at N.J.A.C. 7:8-1.2 shall be submitted to the Soil Conservation District for review and approval in accordance with the requirements of this section and any applicable Soil Conservation District guidelines for stormwater runoff quantity and erosion control. For purposes of this section, "agricultural development" means land uses normally associated with the production of food, fiber and livestock for sale. Such uses do not include the development of land for the processing or sale of food and the manufacture of agriculturally related products.

7:8-5.5 Stormwater runoff quality standards

Stormwater management measures shall be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff generated from the water quality design storm by 80 percent of the anticipated load from the developed site, expressed as an annual average. Stormwater management measures shall only be required for water quality control if an additional one-quarter acre of impervious surface is being proposed on a development site. The requirement to reduce TSS does not apply to any stormwater runoff in a discharge regulated under a numeric effluent limitation for TSS imposed under the New Jersey Pollutant Discharge Elimination System (NJPDES) rules, N.J.A.C. 7:14A, or in a discharge specifically exempt under a NJPDES permit from this requirement. The water quality design storm is 1.25 inches of rainfall in two hours. Water quality calculations shall take into account the distribution of rain from the water quality design storm, as reflected in Table 1 below. The calculation of the volume of runoff may take into account the implementation of non-structural and structural stormwater management measures.

Table 1: Water Quality Design Storm Distribution

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Time (Minutes)	Cumulative Rainfall (Inches)	Time (Minutes)	Cumulative Rainfall (Inches)
0	0.0000	65	0.8917
5	0.0083	70	0.9917
10	0.0166	75	1.0500
15	0.0250	80	1.0840
20	0.0500	85	1.1170
25	0.0750	90	1.1500
30	0.1000	95	1.1750
35	0.1330	100	1.2000
40	0.1660	105	1.2250
45	0.2000	110	1.2334
50	0.2583	115	1.2417
55	0.3583	120	1.2500
60	0.6250		

(b) For purposes of TSS reduction calculations, Table 2 below presents the presumed removal rates for certain BMPs designed in accordance with the New Jersey Stormwater Best Management Practices Manual. The BMP manual may be obtained from the address identified in N.J.A.C. 7:8-1.3 or found on the Department's website at www.njstormwater.org. The BMP manual and other sources of technical guidance are listed in N.J.A.C. 7:8-5.9(a). TSS reduction shall be calculated based on the removal rates for the BMPs in Table 2 below. Alternative removal rates and methods of calculating removal rates may be used if the design engineer provides documentation demonstrating the capability of these alternative rates and methods to the review agency. Where the Department is not the review agency, a copy of any approved alternative rate or method of calculating the removal rate shall be provided to the Department at the address at N.J.A.C. 7:8-1.3.

(c) If more than one BMP in series is necessary to achieve the required 80 percent TSS reduction for a site, the applicant shall utilize the following formula to calculate TSS reduction:

$R = A + B - (AXB)/100$

Where

R = total TSS percent load removal from application of both BMPs, and

A = the TSS percent removal rate applicable to the first BMP

B = the TSS percent removal rate applicable to the second BMP

Table 2: TSS Removal Rates for BMPs

Best Management Practice	TSS Percent Removal Rate
Bioretention Systems	90

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Constructed Stormwater Wetland	90
Extended Detention Basin	40-60
Infiltration Structure	80
Manufactured Treatment Device	See N.J.A.C. 7:8-5.7(d)
Sand Filter	80
Vegetative Filter Strip	60-80
Wet Pond	50-90

(d) If there is more than one onsite drainage area, the 80 percent TSS removal rate shall apply to each drainage area, unless the runoff from the subareas converge on site in which case the removal rate can be demonstrated through a calculation using a weighted average.

(e) Stormwater management measures shall also be designed to reduce, to the maximum extent feasible, the post-construction nutrient load of the anticipated load from the developed site in stormwater runoff generated from the water quality design storm. In achieving reduction of nutrients to the maximum extent feasible, the design of the site shall include nonstructural strategies and structural measures that optimize nutrient removal while still achieving the performance standards in N.J.A.C. 7:8-5.4 and 5.5.

(f) Additional information and examples are contained in the New Jersey Stormwater Best Management Practices Manual, which may be obtained from the address identified in N.J.A.C. 7:8-1.3.

(g) In accordance with the definition of FW1 at N.J.A.C. 7:9B-1.4, stormwater management measures shall be designed to prevent any increase in stormwater runoff to waters classified as FW1.

(h) Special water resource protection areas shall be established along all waters designated Category One at N.J.A.C. 7:9B and perennial or intermittent streams that drain into or upstream of the Category One waters as shown on the USGS Quadrangle Maps or in the County Soil Surveys, within the associated HUC 14 drainage. These areas shall be established for the protection of water quality, aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, and exceptional fisheries significance of those established Category One waters. These areas shall be designated and protected as follows:

1. The applicant shall preserve and maintain a special water resource protection area in accordance with one of the following:

i. A 300-foot special water resource protection area shall be provided on each side of the waterway, measured perpendicular to the waterway from the top of bank outwards, or from the centerline of the waterway where the bank is not defined, consisting of existing vegetation or vegetation allowed to follow natural succession is provided.

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ii. Encroachment within the designated special water resource protection area under (h)1i above shall only be allowed where previous development or disturbance has occurred (for example, active agricultural use, parking area or maintained lawn area). The encroachment shall only be allowed where applicant demonstrates that the functional value and overall condition of the special water resource protection area will be maintained to the maximum extent practicable. In no case shall the remaining special water resource protection area be reduced to less than 150 feet as measured perpendicular to the top of bank of the waterway or centerline of the waterway where the bank is undefined. All encroachments proposed under this subparagraph shall be subject to review and approval by the Department.

2. All stormwater shall be discharged outside of but may flow through the special water resource protection area and shall comply with the Standard For Off-Site Stability in the "Standards for Soil Erosion and Sediment Control in New Jersey," established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. (See N.J.A.C. 2:90-1.3).

3. If stormwater discharged outside of and flowing through the special water resource protection area cannot comply with the Standard For Off-Site Stability in the "Standards for Soil Erosion and Sediment Control in New Jersey," established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., (see N.J.A.C. 2:90-1.3), then the stabilization measures in accordance with the requirements of the above standards may be placed within the special water resource protection area, provided that:

i. Stabilization measures shall not be placed within 150 feet of the waterway;
ii. Stormwater associated with discharges allowed by this paragraph shall achieve a 95 percent TSS post construction removal rate;
iii. Temperature shall be addressed to ensure no impact on receiving waterway;
iv. The encroachment shall only be allowed where the applicant demonstrates that the functional value and overall condition of the special water resource protection area will be maintained to the maximum extent practicable;
v. A conceptual project design meeting shall be held with the appropriate Department staff and Soil Conservation District staff to identify necessary stabilization measures; and
vi. All encroachments proposed under this section shall be subject to review and approval by the Department.

4. A stream corridor protection plan may be developed by a regional stormwater management planning committee as an element of a regional stormwater management plan, or by a municipality through an adopted municipal stormwater management plan. If a stream corridor protection plan for a waterway subject to this subsection has been approved by the Department, then the provisions of the plan shall be the applicable special water resource protection area requirements for that waterway. A stream corridor protection plan for a waterway subject to this subsection shall maintain or enhance the

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current functional value and overall condition of the special water resource protection area as defined above in (h)1i. In no case shall a stream corridor protection plan allow reduction of the Special Water Resource Protection Area to less than 150 feet as measured perpendicular to the waterway subject to this subsection.

5. This subsection does not apply to the construction of one individual single family dwelling that is not part of a larger development on a lot receiving preliminary or final subdivision approval on or before February 2, 2004, provided that the construction begins on or before February 2, 2009.

7:8-5.6 Calculation of stormwater runoff and groundwater recharge

(a) Stormwater runoff shall be calculated in accordance with the following:

1. The design engineer shall calculate runoff using one of the following methods:

i. The USDA Natural Resources Conservation Service (NRCS) methodology, including the NRCS Runoff Equation and Dimensionless Unit Hydrograph, as described in Section 4, National Engineering Handbook (NEH-4), dated July 2002, incorporated herein by reference as amended and supplemented. This methodology is additionally described in Technical Release 55 - Urban Hydrology for Small Watersheds (TR-55), dated June 1986, incorporated herein by reference as amended and supplemented. Information regarding the methodology is available from the Natural Resources Conservation Service website at http://www.wcc.nrcs.usda.gov/water/quality/common/neh630/4content.html or at Natural Resources Conservation Service, 220 Davidson Avenue, Somerset, New Jersey 08873; (732) 537-6040; or

ii. The Rational Method for peak flow and the Modified Rational Method for hydrograph computations. The rational and modified rational methods are described in "Appendix A-9 Modified Rational Method" in the Standards for Soil Erosion and Sediment Control in New Jersey, July 1999. This document is available from the State Soil Conservation Committee or any of the Soil Conservation Districts listed at N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number or each Soil Conservation District is available from the State Soil Conservation Committee, P.O. Box 330, Trenton, NJ 08625, 609-292-5540.

2. For the purpose of calculating runoff coefficients and groundwater recharge, there is a presumption that the pre-construction condition of a site or portion thereof is a wooded land use with good hydrologic condition. The term "runoff coefficient" applies to both the NRCS methodology at N.J.A.C. 7:8-5.6(a)1i and the Rational and Modified Rational Methods at N.J.A.C. 7:8-5.6(a)1i. A runoff coefficient or a groundwater recharge land cover for an existing condition may be used on all or a portion of the site if the design engineer verifies that the hydrologic condition has existed on the site or portion of the site for at least five years without interruption prior to the time of application. If more than

one land cover have existed on the site during the five years immediately prior to the time of application, the land cover with the lowest runoff potential shall be used for the computations. In addition, there is the presumption that the site is in good hydrologic condition (if the land use type is pasture, lawn, or park), with good cover (if the land use type is woods), or with good hydrologic condition and conservation treatment (if the land use type is cultivation.)

3. In computing pre-construction stormwater runoff, the design engineer shall account for all significant land features and structures, such as ponds, wetlands, depressions, hedgerows, or culverts, that may reduce pre-construction stormwater runoff rates and volumes.

4. In computing stormwater runoff from all design storms, the design engineer shall consider the relative stormwater runoff rates and/or volumes of pervious and impervious surfaces separately to accurately compute the rates and volume of stormwater runoff from the site. To calculate runoff from unconnected impervious cover, urban impervious area modifications as described in the NRCS Technical Release-55, Urban Hydrology for Small Watersheds or other methods may be employed.

5. If the invert of the outlet structure of a stormwater management measure is below the flood hazard design flood elevation as defined at N.J.A.C. 7:13, the design engineer shall take into account the effects of tailwater in the design of structural stormwater management measures.

(b) Groundwater recharge may be calculated in accordance with the following:

1. The New Jersey Geological Survey Geological Survey Report GSR-32 A Method for Evaluating Ground-Water-Recharge Areas in New Jersey, incorporated herein by reference as amended and supplemented. Information regarding the methodology is available from the New Jersey Stormwater Best Management Practices Manual; at New Jersey Geological Survey website at http://www.state.nj.us/dep/njgs/, or at New Jersey Geological Survey, 29 Arctic Parkway, P.O. Box 427, Trenton, NJ 08625-0427; (609) 984-6587.

7:8-5.7 Standards for structural stormwater management measures

(a) Standards for structural stormwater management measures are as follows:

1. Structural stormwater management measures shall be designed to take into account the existing site conditions, including, for example, environmentally critical areas; wetlands; flood-prone areas; slopes; depth to seasonal high water table; soil type, permeability and texture; drainage area and drainage patterns; and the presence of solution-prone carbonate rocks (limestone).

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2. Structural stormwater management measures shall be designed to minimize maintenance, facilitate maintenance and repairs, and ensure proper functioning. Trash racks shall be installed at the intake to the outlet structure as appropriate. The parallel bars at the outlet structure shall be spaced no greater than one-third the width of the diameter of the orifice or one-third the width of the weir, with a minimum spacing between bars of one-inch and a maximum spacing between bars of six inches. For outlets with a width or diameter less than three inches, the parallel bars shall be spaced one inch apart. In addition, the design of trash racks must comply with the requirements of N.J.A.C. 7:8-6.2(a).

3. Structural stormwater management measures shall be designed, constructed, and installed to be strong, durable, and corrosion resistant. Measures that are consistent with the relevant portions of the Residential Site Improvement Standards at N.J.A.C. 5:21-7.3, 7.4 and 7.5 shall be deemed to meet this requirement.

4. At the intake to the outlet from the stormwater management basin, the orifice size shall be a minimum of two and one-half inches in diameter.

5. Stormwater management basins shall be designed to meet the minimum safety standards for stormwater management basins at N.J.A.C. 7:8-6.

(b) Stormwater management measure guidelines are available in the New Jersey Stormwater Best Management Practices Manual. Other stormwater management measures may be utilized provided the design engineer demonstrates that the proposed measure and its design will accomplish the required water quantity, ground water recharge and water quality design and performance standards established by this subchapter.

(c) Manufactured treatment devices may be used to meet the requirements of this subchapter, provided the pollutant removal rates are verified by the New Jersey Corporation for Advanced Technology and certified by the Department.

7:8-5.8 Maintenance requirements

(a) The design engineer shall prepare a maintenance plan for the stormwater management measures incorporated into the design of a major development.

(b) The maintenance plan shall contain specific preventative maintenance tasks and schedules; cost estimates, including estimated cost of sediment, debris, or trash removal; and the name, address, and telephone number of the person or persons responsible for preventative and corrective maintenance (including replacement). Maintenance guidelines for stormwater management measures are available in the New Jersey Stormwater Best Management Practices Manual. If the maintenance plan identifies a person other than the developer (for example, a public agency or homeowners'

association) as having the responsibility for maintenance, the plan shall include documentation of such person's agreement to assume this responsibility, or of the developer's obligation to dedicate a stormwater management facility to such person under an applicable ordinance or regulation.

(c)Responsibility for maintenance shall not be assigned or transferred to the owner or tenant of an individual property in a residential development or project, unless such owner or tenant owns or leases the entire residential development or project.

(d) If the person responsible for maintenance identified under (b) above is not a public agency, the maintenance plan and any future revisions based on (h) below shall be recorded upon the deed of record for each property on which the maintenance described in the maintenance plan must be undertaken.

(e) Preventative and corrective maintenance shall be performed to maintain the function of the stormwater management measure, including repairs or replacement to the structure; removal of sediment, debris, or trash; restoration of eroded areas; snow and ice removal; fence repair or replacement; restoration of vegetation; and repair or replacement of nonvegetated linings.

(f) The person responsible for maintenance identified under (b) above shall maintain a detailed log of all preventative and corrective maintenance for the structural stormwater management measures incorporated into the design of the development, including a record of all inspections and copies of all maintenance-related work orders.

(g) The person responsible for maintenance identified under (b) above shall evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and the deed as needed.

(h) The person responsible for maintenance identified under (b) above shall retain and make available, upon request by any public entity with administrative, health, environmental or safety authority over the site, the maintenance plan and the documentation required by (f) and (g) above.

(i) Nothing in this section shall preclude the municipality in which the major development is located from requiring the posting of a performance or maintenance guarantee in accordance with N.J.S.A. 40:55D-53.

7:8-5.9 Sources for technical guidance

(a) Technical guidance for stormwater management measures can be found in the documents listed at (a)1 and 2 below, which are available from Maps and Publications, Department of Environmental Protection, 428 East State Street, P.O. Box 420, Trenton, New Jersey, 08625; telephone (609) 777-1038.

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1. Guidelines for stormwater management measures are contained in the New Jersey Stormwater Best Management Practices Manual, 2002 as amended. Information is provided on stormwater management measures such as:

i. Bioretention systems;
ii. Constructed stormwater wetlands;
iii. Dry wells;
iv. Extended detention basins;
v. Infiltration structures;
vi. Manufactured treatment devices;
vii. Pervious paving;
viii. Sand filters;
ix. Vegetative filter strip, and
x. Wet pond.

2. The New Jersey Department of Environmental Protection Stormwater Management Facilities Maintenance Manual, as amended.

(b) Additional technical guidance for stormwater management measures can be obtained from the following:

1. The "Standards for Soil Erosion and Sediment Control in New Jersey" promulgated by the State Soil Conservation Committee and incorporated into N.J.A.C. 2:90. Copies of these standards may be obtained by contacting the State Soil Conservation Committee or any of the Soil Conservation Districts listed in N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number of each Soil Conservation District may be obtained from the State Soil Conservation Committee, P.O. Box 330, Trenton, New Jersey 08625, 609-292-5540;

2. The Rutgers Cooperative Extension Service, 732-932-9306; and

3. The Soil Conservation Districts listed in N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number of each Soil Conservation District may be obtained from the State Soil Conservation Committee, P.O. Box 330, Trenton, New Jersey 08625, 609-292-5540.

SUBCHAPTER 6. SAFETY STANDARDS FOR STORMWATER MANAGEMENT BASINS

7:8-6.1 Scope

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(a) This subchapter sets forth requirements to protect public safety through the proper design and operation of stormwater management basins. This subchapter applies to any new stormwater management basin.

(b) The provisions of this subchapter are not intended to preempt more stringent municipal or county safety requirements for new or existing stormwater management basins. Municipal and county stormwater management plans and ordinances may, pursuant to their authority, require existing stormwater management basins to be retrofitted to meet one or more of the safety standards in N.J.A.C. 7:8-6.2(a), (b) and (c)1 for trash racks, overflow grates, and escape provisions at outlet structures.

7:8-6.2 Requirements for trash racks, overflow grates and escape provisions

(a) A trash rack is a device designed to catch trash and debris and prevent the clogging of outlet structures. Trash racks shall be installed at the intake to the outlet from the stormwater management basin to ensure proper functioning of the basin outlets in accordance with the following:

1. The trash rack shall have parallel bars, with no greater than six-inch spacing between the bars;

2. The trash rack shall be designed so as not to adversely affect the hydraulic performance of the outlet pipe or structure;

3. The average velocity of flow through a clean trash rack is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocity is to be computed on the basis of the net area of opening through the rack; and

4. The trash rack shall be constructed of rigid, durable, and corrosion resistant material and designed to withstand a perpendicular live loading of 300 lbs./ft sq.

(b) An overflow grate is designed to prevent obstruction of the overflow structure. If an outlet structure has an overflow grate, the grate shall comply with the following requirements:

1. The overflow grate shall be secured to the outlet structure but removable for emergencies and maintenance;

2. The overflow grate spacing shall be no greater than two inches across the smallest dimension; and

3. The overflow grate shall be constructed of rigid, durable, and corrosion resistant material and designed to withstand a perpendicular live loading of 300 lbs./ft sq.

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(c) Stormwater management basins shall include escape provisions as follows:

1. If a stormwater management basin has an outlet structure, escape provisions shall be incorporated in or on the structure. Escape provisions include the installation of permanent ladders, steps, rungs, or other features that provide easily accessible means of egress from stormwater management basins. With the prior approval of the reviewing agency pursuant to N.J.A.C. 7:8-6.3(a), a free-standing outlet structure may be exempted from this requirement;

2. Safety ledges shall be constructed on the slopes of all new stormwater management basins having a permanent pool of water deeper than two and one-half feet. Safety ledges shall be comprised of two steps. Each step shall be four to six feet in width. One step shall be located approximately two and one-half feet below the permanent water surface, and the second step shall be located one to one and one-half feet above the permanent water surface. See N.J.A.C. 7:8-6 Appendix A for an illustration of safety ledges in a stormwater management basin; and

3. In new stormwater management basins, the maximum interior slope for an earthen dam, embankment, or berm shall not be steeper than three horizontal to one vertical.

7:8-6.3 Variance or exemption from safety standards

A variance or exemption from the safety standards for stormwater management basins may be granted only upon a written finding by the appropriate reviewing agency (municipality, county or Department) that the variance or exemption will not constitute a threat to public safety.

Appendix A: Illustration of safety ledges in a new stormwater management basin. Depicted is an elevational view.

CHAPTER 13
FLOOD HAZARD AREA CONTROL

SUBCHAPTER 2. PROJECT STANDARDS

7:13-2.8 Stormwater management

If a project or activity meets the definition of "major development" at N.J.A.C. 7:8-1.2, then the project or activity shall comply with the Stormwater Management rules at N.J.A.C. 7:8.

CHAPTER 15
WATER QUALITY MANAGEMENT PLANNING

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SUBCHAPTER 3. PLAN ASSESSMENT, AMENDMENT AND ADOPTION

7:15-3.4 Water quality management plan amendment procedures

(a) (No change.)

(b) Procedures for amendment of the Statewide WQM Plan are as follows:

1. Water quality related provisions in present and future rules adopted by the Department shall be considered to be part of the Statewide WQM Plan. Such provisions may not be adopted, amended, or repealed through the WQM plan amendment process under (b) 6 below.

2. Priority systems, intended use plans and project priority lists for wastewater facilities that are developed by the Department and accepted by the United States Environmental Protection Agency (USEPA) pursuant to USEPA regulations, or that otherwise are developed by the Department under N.J.A.C. 7:22, shall be considered to be part of the Statewide WQM Plan. Such priority systems and project priority lists shall be adopted or revised in accordance with USEPA regulations and N.J.A.C. 7:22, as appropriate, and shall not be adopted or revised through the WQM plan amendment process under (b) 6 below.

3. Statewide Sludge Management Plans, District Sludge Management Plans and sludge management rules that are promulgated or approved by the Department pursuant to N.J.S.A. 13:1E-1 et seq. shall be considered to be part of the Statewide WQM Plan. Such plans and rules shall be promulgated, revised, updated or approved in accordance with N.J.S.A. 13:1E-1 et seq., and shall not be promulgated, revised, updated, or approved through the WQM plan amendment process under (b) 6 below.

4. Lists of water quality limited segments, lists of segments where TMDLs will be developed, and project priority lists for TMDL development which are developed by the Department under N.J.A.C. 7:15-6 shall be adopted as amendments to the Statewide WQM Plan. TMDLs developed in accordance with N.J.A.C. 7:15-7 shall be adopted as amendments to the relevant Areawide WQM Plan(s). However, such lists, and TMDLs shall be adopted or revised in accordance with N.J.A.C. 7:15-6 or 7:15-7, as appropriate, and shall not be adopted or revised through the WQM plan amendment process under (b) 6 below. The Department may also publish a draft amendment as an Interested Party Review document or as a pre-proposal prior to formal proposal of the amendment.

5. A regional stormwater management plan prepared in accordance with N.J.A.C. 7:8-3 shall be submitted only by a lead planning agency as a proposed amendment to the applicable areawide WQM plan. In addition, the following changes to an adopted

regional stormwater management plan shall be processed as amendments to applicable areawide WQM Plans under this section:

i. The addition, deletion or modification to any of the drainage area-specific water quality, ground water recharge or water quantity objectives identified under N.J.A.C. 7:8-3.5;

ii. The addition, deletion or modification to any drainage area-specific design or performance standard developed under N.J.A.C. 7:8-3.6;

iii. Any modification to a regional stormwater management plan that the Department or designated planning agency determines is likely to have a significant environmental, social, or economic impact; or

iv. Any modification that the applicant requests be processed as an amendment.

6. Components of the Statewide WQM Plan other than (b)1 through 5 above may be amended by using the procedure specified in (g) below, except that the Commissioner shall render the final decision identified in (g)9 below.

(c)-(f) (No change.)

(g) Except as provided in (h) below, the Department procedure for amendment of areawide WQM plans is as follows:

1. – 2. (No change.)

3. The Department shall notify the applicant and the applicable designated planning agency, if any, in writing of its decision under (g)2 above. If the Department's decision is to proceed further with the amendment request under (g)2iii above, then this notification shall include the public notice that shall be given for the proposed amendment. If the proposed amendment is a regional stormwater management plan, the Department shall also notify the Department of Community Affairs and the Department of Agriculture. The applicant shall request written statements of consent under (g)4 below, and shall give public notice by publication in a newspaper of general circulation at the applicant's expense. The Department shall maintain a list identifying the newspaper that shall be used for this purpose in each planning area. The public notice shall also be published in the New Jersey Register. In cases where such Department decisions include a requirement for a non-adversarial public hearing, the public notice shall provide at least 30 days notice of the hearing.

4.-11. (No change.)

(h)-(l) (No change.)

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7:15-3.5 Water quality management plan review, revision, and certification

(a) (No change.)

(b) The Department and the designated planning agencies shall prepare revisions to Statewide and areawide WQM Plans under this section whenever such revisions are necessary to:

1. - 2. (No change.)

3. Revise schedules for submission of wastewater management plans under N.J.AC. 7:15-5.23(g);

4. Provide for the following substantive changes in Statewide and areawide WQM plans where the Department determines no significant individual or cumulative impacts will occur to environmentally sensitive areas or other natural resources (such as water supplies) due to the proposed revision (individually or in combination with past revisions in the area), that the changes are consistent with N.J.AC. 7:15-3.6 and 3.7, and that certain directly affected municipal and county agencies and other interests as identified by the Department have been provided an opportunity to review and comment on the proposed revision:

i. - iv. (No change.)

v. Expansion of a future sewer service area to contiguous lots, where the expansion involves less than 100 acres, contributes less than 8,000 gallons per day of additional wastewater flow, and does not create a significantly new pattern of sewered development such that a significant potential or incentive is created for additional revisions or amendments to open new areas to sewered development; or

5. Provide for any modification in an adopted regional stormwater management plan that does not require an amendment under N.J.A.C. 7:15-3.4(b)5.

(c) - (f) (No change.)

N.J.A.C. 7:14A

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SUBCHAPTER 25. MUNICIPAL STORMWATER REGULATION PROGRAM

7:14A-25.1 Scope

(a) This subchapter sets forth requirements applicable to the Municipal Stormwater Regulation Program, which regulates discharges to surface water and groundwater of stormwater from large, medium, and small municipal separate storm sewer systems.

(E)) RUSu

that is, any city, borough, town, township, or

7:14A-25.2 Identifying municipalities, public co
regulated under the small MS4 program

er discharges to surface water or groundwater identified in (a)1 through (a)4 below. The operating entities for those discharges shall apply for

1. Tier A municipalities: All stormwater discharges from small MS4s that are owned or operated by and located in a municipality that is assigned to Tier

from small MS4s that are owned or operated by
located entirely or partially in
a municipality that is assigned to Tier A under N. a municipality that
RI
single lot (or two or more lots that are conti
contains at least two buildings owned or operated by the same

ich Statewide has a combined

ii. Is at any other public fac se, hospital, prison, or general administration facility), and has a combined tota
or residents (including patients or prisoners) usually present

ater discharges from small MS4s that are
owned or operated by a county, Stat ency at a highway or other
thoroughfare (including a maintenance area for such a thoroughfare).
) RU RU

i. Any thoroughfare confined to the grounds of a single building, or of two or more buildings
(unless that building(s) is a

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maintenance or service facility for a highway or other thoroughfare not confined to such grounds);

ii. Any thoroughfare confined to the grounds of
instead considered part of the "public complex"); or

ormwater discharges fr

ii. All stormwater discharges that are from

iv. All stormwater discharges

to surface water or groundwater that

lity that is assigned to

Hunterdon County

Bethlehem Township
Bloomsbury Borough
East Amwell Township
Franklin Township
Lebanon Township
Tewksbury Township
West Amwell Township

Monmouth County

Interlaken Borough
Upper Freehold Township

Morris County

Harding Township

Salem County

Oldmans Township
Upper Pittsgrove Township

Somerset County

Far Hills Borough
Millstone Borough
Rocky Hill Borough

Sussex County

Andover Borough
Fredon Township

Warren County

Allamuchy Township
Harmony Township

(e) The waiver under (d) above is based on the fact that the small MS4s identified do not have any of the characteristics set forth in (e)1 or 2 below, and based on the presumption that those small MS4s are of such minimal extent and serve such a small population that none of their

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stormwater discharges have any of the characteristics set forth in (e)3i through iii below. An operating entity to which the waiver applies may subsequently be required to apply for a NJPDES permit under (a) above if circumstances change. The Department shall require any operating entity to which the waiver applies to apply for a NJPDES permit under (a) above for a

a reason other than the review under this

loadings of a physically

controls have been established as part of a

municipality is assigned to Ti
the operating entity in writing
instructions on how to apply for a NJPDES permit.

comment regarding the appropriateness of the initial determination may be received during the

reason for that determination was a decision

(a) All municipalities are assigned either to Tier A

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ii. Has a population density of at least 1,000 per square mile, and a population of at least 10,000 as determined by that Census;

iii. Has a stormwater sewer system discharging directly into the salt waters of Monmouth, Ocean, Atlantic, or Cape May counties (using the 1 .

it is determined in response to a petition under

termines that such identification warrants

consider the following with respect to the iden

any, operated by the munici
e quantity and nature of pollutants reaching the

e below, and shall mail notice of
ice under this paragraph
for informational purposes only.

shall identify the reason for the re
Any person may obtain the most current list of

Atlantic County

All municipalities not listed

All municipalities not listed

Burlington County	All municipalities not listed under Tier B	Bass River Township Fieldsboro Borough New Hanover Township North Hanover Township Springfield Township Washington Township Woodland Township Wrightstown Borough
Camden County	All municipalities not listed under Tier B	Pine Valley Borough Tavistock Borough
Cape May County	All municipalities not listed under Tier B	Woodbine Borough
Cumberland County	Bridgeton City Millville City Vineland City	All municipalities not listed under Tier A
Essex County	All municipalities	None
Gloucester County	All municipalities not listed under Tier B	Elk Township South Harrison Township Woolwich Township
Hudson County	All municipalities	None
Hunterdon County	Clinton Town Clinton Township Flemington Borough High Bridge Borough Lebanon Borough Raritan Township Readington Township Union Township	All municipalities not listed under Tier A

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Mercer County	All municipalities not listed under Tier B	Hopewell Borough
Middlesex County	All municipalities	None
Monmouth County	All municipalities not listed under Tier B	Interlaken Borough Roosevelt Borough Upper Freehold Township
Morris County	All municipalities not listed under Tier B	Harding Township
Ocean County	All municipalities not listed under Tier B	Plumsted Township
Passaic County	All municipalities	None
Salem County	Carneys Point Township Penns Grove Borough Pennsville Township Pittsgrove Township	All municipalities not listed under Tier A
Somerset County	All municipalities not listed under Tier B	Far Hills Borough Millstone Borough Rocky Hill Borough
Sussex County	Andover Township Byram Township Hopatcong Borough Newton Town Sparta Township Stanhope Borough	All municipalities not listed under Tier A

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Union County		
	All municipalities	None
Warren County		
	Alpha Borough Greenwich Township Hackettstown Town Independence Township Lopatcong Township Mansfield Township Phillipsburg Town Pohatcong Township	All municipalities not listed under Tier A

7:14A-25.4 Deadlines to apply for NJPDES permits for small MS4s

(a) The deadline to apply for a NJPDES permit for all stormwater discharges identified under N.J.A.C. 7:14A-25.2(a) is March 3, 2004, except as provided in (a)1 through (a)3 below.

1. If notice from the Department is received that a municipality has been reassigned from Tier B to Tier A, or that a special designation has been made under N.J.A.C. 7:14A-25.2(a)4, the deadline is 180 days after receipt of that notice, unless the Department approves a later date.

2. The following is applicable to entities proposing new facilities or activities (for example, new small MS4s, or increasing the number of employees or students) that would result in any stormwater discharges identified under N.J.A.C. 7:14A-25.2(a):

i. General permits for such discharges shall specify deadlines for submitting requests for authorization under such permits.

ii. Entities submitting an individual permit application for such discharges shall submit an application at least 180 days before the date on which the activity is proposed to commence (unless the Department approves a later date), or by March 3, 2004, whichever is later.

3. Any entity planning to continue discharging from a small MS4 after the expiration date of its NJPDES permit for that discharge shall comply with N.J.A.C. 7:14A-4.2(e)3. General permits for stormwater discharges from small MS4s shall provide for automatic renewal of authorization when those general permits are renewed (see N.J.A.C. 7:14A-4.2(e)3 and 6.13(d)9).

(b) The deadline for Tier B municipalities to apply for the Tier B Municipal Stormwater Permit is set forth in N.J.A.C. 7:14A-25.8(b).

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7:14A-25.5 Applying for a NJPDES permit for a small MS4

(a) All operating entities that are required under N.J.A.C. 7:14A-25.2(a) to apply for a NJPDES permit for stormwater discharges from small MS4s shall submit a request for authorization (RFA) under a general NJPDES permit in accordance with (a)1 below, or an application for an individual NJPDES permit under N.J.A.C. 7:14A-25.9.

1. An operating entity seeking authorization under a general NJPDES permit shall submit to the Department a written RFA. The RFA shall include a certification acknowledging the best management practices and measurable goals specified in the general permit and required by N.J.A.C. 7:14A-25.6, and shall also include information specified in the general permit in accordance with N.J.A.C. 7:14A-6.13(d)2.

(b) All Tier B municipalities that are required under N.J.A.C. 7:14A-25.2(b) to apply for the Tier B Municipal Stormwater Permit shall submit a request for authorization in accordance with N.J.A.C. 7:14A-25.8(d).

7:14A-25.6 Content of NJPDES permits for small MS4s

(a) The NJPDES small MS4 permit shall require at a minimum that the permittee develop, implement, and enforce a stormwater program designed to reduce the discharge of pollutants
tent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the Federal Act and the State Act. The stormwater program required under a general permit shall include the Statewide Basic Requirements (SBRs) that are listed under (b)1 and (b)3 through 8 below (and that may be set forth in more detail in the NJPDES permit). The stormwater program shall also include any additional measures (AMs) required under (e) below, and any other control or evaluation measures specified in the NJPDES permit.
program may also include optiona
provided in N.J.A.C. 7:14A-25.8(e)1 and (g), this section and N.J.A.C. 7:14A-25.7 do not apply to the Tier B Municipal Stormwater Permit.

1. Best management practice (BMP) requirements are generally the most appropriate form of effluent limitations when designed to satisfy technology-based requirements (including
practicable) and to protect water quality.
istent with the provisions of the stormwater program required pursuant to this section and the provisions of the NJPDES permit required pursuant to N.J.A.C. 7:14A-25.2(a) constitutes compliance with the standard of reducing

2. The NJPDES permit shall specify
five years from the date of notification of general permit authorization (or the date of individual permit issuance) for the permittee to fully develop and implement its stormwater program for SBRs, and for any other measures specified in the NJPDES permit. For an AM required under

(e) below, the areawide or Statewide water quality management plan will specify a time period for the permittee to fully develop and implement its stormwater program for that AM, and that time period will be listed in the permit when the permit is issued or in a minor modification to the permit.

3. The permittee shall prepare and implement a written stormwater pollution prevention plan (S program, and identifies the person or persons responsible for implementing or coordinating that Srogram (including, at the Sermittee's e responsibilities for implementing one or more Ms) with one or more other entit the permittee will implement, and identify the entity(ies) that will implement the other meas

assist permittees in the design and implementation of stormwater programs.

shall, at a minimum, comply with applicable State and local public notice requirements when providing for public participation in the

permit program to reduce pollutants in stormwat
activities that result in a land disturbance of
stormwater discharges from construction activity disturbing less than one acre shall be included in the program if the construction activity is part of a larger common plan of development or sale that would disturb one acre or more. This pr
stormwater discharges associated with constr

acts, the permittee shall develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment ss than one acre that are part of a

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larger common plan of development or sale, that

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(B) Set forth special area standards approved by the Site Improvement Advisory Board for residential development or redevelopment projects under N.J.A.C. 5:21-3.5.

4. Public education on stormwater impacts: The permittee shall implement a public education program about the impacts of stormwater discharges on surface water and groundwater, and about the steps that the public can take to reduce pollutants in stormwater runoff. As part of this education program, the permittee shall inform public employees, businesses, and the general public of hazards associated with illicit connections and improper disposal of waste.

5. Prohibiting improper disposal of waste:

i. The permittee shall develop a map, showing the location of the end of all MS4 outfall pipes (if

surface water body (for example, a lake or pond, the Atlantic Ocean or one of its estuaries, or a river or stream including an intermittent stream). This map shall also show the location (and name, where known to the permittee) of all surface water bodies receiving discharges from those outfall pipes. The permittee shall submit a copy of this map to the Department if requested.

ii. The permittee shall develop, implement and enforce a program to detect and eliminate illicit
permittee shall, to the
ectively prohibit, through
ordinance or other regulatory mechanism, illicit
implement appropriate enforcement procedures and actions.

ordinance or other regulatory mechanism, other
improper disposal of waste into the perm
does not include any

iv. The permittee shall coordinate its programs under (b)5i, ii, and iii above with related

The permittee shall develop and implement an operation and maintenance program that prevents or reduces the discharge of solid and floatable

or operated by the permittee (including roads).

service areas: The permittee shall develop and implement an operation and maintenance program that prevents or reduces pollutant runoff from maintenance yards and highway service areas owned or operated by the permittee.

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8. Employee training: Using training materials that are available from USEPA, the Department or another State agency, or other organizations, the programs under (b)3, (b)5iii, (b)6 and (b)7 above shall include (where applicable) employee training to prevent and reduce stormwater-related pollution from activities such as park and open space maintenance, vehicle fleet and building maintenance, new construction and land disturbances, and stormwater system maintenance.

(c) For each of the SBRs listed under (b)1 and (b)3 through 8 above, BMPs and measurable goals shall be specified or identified as follows:

1. Any general NJPDES permit for small MS4s shall specify:

i. The BMPs that the permittee or another entity (see (a)3 above) will implement for each of those SBRs; and

ii. The measurable goals for each of those BMPs including, as appropriate, an implementation schedule specifying the month and year in which the permittee or another entity will undertake each required action, including interim milestones and the frequency of the action.

2. Individual NJPDES permit applications under N.J.A.C. 7:14A-25.9(d) shall identify the information in (c)1i and ii above. The individual NJPDES permit as issued may specify BMPs and measurable goals that are the same as or different from the BMPs and measurable goals identified in the application.

(d) If, at the time the NJPDES permit is issued, modified, revoked and reissued, or renewed, a qualifying State or local program requires the permittee to implement one or more of the SBRs (or SBR components) listed under (b) above, or of the AMs (or AM components) required under (e) below, the Department may include conditions in the NJPDES permit that direct the requirements rather than the corresponding requirements under (b) above or (e) below. For purposes of this subsection, a qualifying State or local program is a State or local municipal stormwater program that imposes, at a minimum, the relevant requirements under (b) above or (e) below. This subsection does not apply to the requirements in (b)2 above (construction site stormwater runoff control), or to the requirements in (b)3 above for compliance with the Stormwater Management Rules (N.J.A.C. 7:8) and the Residential Site Improvement Standards (N.J.A.C. 5:21).

(e) 7he SeUP ittee's stRUP wDteUSURJ UDP shDll inFlude Dny DdditiRnDl P eDsuUes (AMs) UeTuiUed under this subsection. AMs are non-numeric or numeric effluent limitations that are expressly required to be included in the stormwater program by an areawide or Statewide water quality management plan (WQM plan) adopted in accordance with N.J.A.C. 7:15. AMs may modify, or be in addition to, SBRs listed under (b) above.

1. AMs may be adopted in an areawide or Statewide WQM plan before or after the Department issues the NJPDES permit. The Department shall provide written notice of the adoption of the

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AM to each permittee whose stormwater program must include that AM, and shall list each adopted AM in the permit when the permit is issued or in a minor modification to the permit. For AMs other than numeric effluent limitations, the areawide or tatewide M plan shall specif the M s that the permittee or another entit see a a o e and . .A. . A . e will implement, and the measura le goals for each of those M s. AMs ma e re uired

i. A M appro ed or esta lished A, or an e ui alent anal sis that determines such AMs are needed to protect water ualit

ii. A regional stormwater management plan adopted under . .A. . or

iii. ther elements of areawide or tatewide M plans adopted in accordance with . .A. . .

f hene er a permit specifies measures other than s, AMs, or numeric effluent limitations, the permit shall specif the M s that the permittee or another entit see a a o e shall implement, and the measura le goals for each of those M s.

g ermittees shall meet measura le goals specified under c , e , or f a o e in order to demonstrate compliance with s, AMs, or other measures, respecti el . he epartment shall ma e guidance a aila le for those measures prior to March , for s , when AMs are adopted in M plans, or when the epartment issues the permit for other measures .

h he permittee shall compl with other applica le permit re uirements, standards and conditions esta lished in the indi idual or general permit.

( ) A he e ee's d sF e , d he ex ent allowa le under law, the stormwater program ma also include optional measures Ms , which are M s that are not implemented for s or AMs or for other measures specified in the permit , ut that pre ent or reduce the pollution of waters of the tate. he shall specificall identif such M s if an as Ms, and identif actions to implement those Ms. Failure to implement an M identified in the shall not e considered a iolation of the permit or this section.

j e uirements for e aluation, record eeping, and reporting are as follows

. he permittee shall e aluate compliance with permit conditions, including progress towards achie ing the measura le goals identified for M s under c , e , or f a o e.

. he permittee shall eep records re uired the permit for at least fi e ears from the date of the record. he epartment ma , at an time, extend this period through a written notice in accordance with . .A. . A 6.6 a . he permittee shall su mit these records to the epartment if re uested. he permittee shall ma e these records, including its , a aila le

to the public at reasonable times during regular business hours (see N.J.A.C. 7:14A-18 for confidentiality provisions).

3. The permittee shall submit an annual report to the Department unless the permittee is relying on another entity to satisfy all of its NJPDES permit obligations under N.J.A.C. 7:14A-25.7(a) (including its obligation to file the annual report required by this paragraph). The report, which shall be submitted on a form provided by the Department, shall include:

i. The status of compliance with NJPDES permit conditions, including progress towards achieving the measurable goals;

ii. For those SBRs or AMs (if any) that give the permittee a choice of BMPs, identification of the BMP(s) chosen by the permittee (including any change in any BMP identified in the previous annual report), and a summary of the actions that the permittee intends to undertake during the next twelve months to implement the chosen BMPs;

iii. A summary of the actions undertaken to implement OMs, if any; and

iv. Notice that the permittee is relying on another entity to satisfy some of its NJPDES permit obligations (if applicable).

7:14A-25.7 Sharing of responsibility to implement control measures for a small MS4

(a) A permittee may rely on another governmental, private, or nonprofit entity (for example, a wDershed DssRFiDiRn) NJPDES permit obligations to implement one or P Rr

1. The other entity, in fact, implements the measure(s), or component(s) thereof;

2. The particular measure(s), or component(s) thereof, is at least as stringent as the corresponding NJPDES permit requirement; and

3. The other entity agrees in writing (or is required by law) to implement the measure(s), or

if the other entity fails to implement the annual reports the permittee must submit under that it is relying on another entity to satisfy

obligations, including that perm ile annual reports required by N.J.A.C. nt of this reliance in writing, and shall

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(b) In some cases, the Department may recognize, either in an individual NJPDES permit or in a general NJPDES permit, that a governmental entity other than the permittee in question is responsible under a NJPDES permit for implementing one or more of the control measures, or

such recognition, the permittee in question is not required to include such measure(s), or comSonent(s) thereol, in thD SerP ittee's storP wDer measure(s), or component(s) thereof, but is responsible for the all other measure(s), or component(s) thereof, it may be reopened and modified to include the requirement to implement a measure(s), or component(s) thereof, if the other governmental

(a) Each municipality that is assigned to

ply for authorization under this general permit is

e Department that the municipality has been

operation is proposed to commence, or

shall submit to the Department a

and shall also include information specified in the general permit in partment shall notify the municipality in authorized to discharge under this general permit, or that the municipality is not authorized to discharge under this general permit because the municipality is

municipalities that are authorized to discharge under this
http://www.state.nj.us/dep/dwq).

(e) Each municipality that is authorized to discharge under the Tier B Permit shall develop, implement, and enforce a stormwater program that includes the Statewide Basic Requirements (SBRs) listed in (e)1 and 2 below (and that may be set forth in more detail in the general permit). The stormwater program shall also include any additional measures (AMs) required under (g) below. The municipality may share responsibilities for implementing any of these SBRs or AMs with one or more other entities. Nothing in this section shall be construed as preventing the municipality from also implementing other stormwater control measures as allowed by statute. Such control measures are not governed by the Tier B stormwater program. The SBRs are as follows:

1. Post-construction stormwater management in new development and redevelopment: To prevent or minimize water quality impacts, the municipality shall develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment projects. This program shall meet the requirements listed in N.J.A.C. 7:14A-25.6(b)3.

2. Public education on stormwater impacts: The municipality shall implement a local public education program about the impacts of stormwater discharges on surface water and groundwater, and about the steps that the public can take to reduce pollutants in stormwater runoff.

(f) The Tier B Permit shall specify:

1. The BMPs that the Tier B municipality or another entity will implement for each of the SBRs listed under (e) above; and

2. The measurable goals for each of those BMPs including, as appropriate, an implementation schedule specifying the month and year in which the municipality or another entity will undertake each required action, including interim milestones and the frequency of the action.

(g) The Tier B municipality's stormwater program shall include any additional measures (AMs) required under this subsection. AMs are non-numeric or numeric effluent limitations that are expressly required to be included in the stormwater program by an areawide or Statewide water quality management plan (WQM plan) adopted in accordance with N.J.A.C. 7:15. AMs may modify, or be in addition to, SBRs listed under (e)1 and 2 above. AMs required under this subsection are subject to N.J.A.C. 7:14A-25.6(e)1.

(h) Tier B municipalities shall meet measurable goals specified under (f) or (g) above. The Department shall make guidance available to assist municipalities in the design and implementation of Tier B stormwater programs.

1. The Tier B municipality shall keep records required by this general permit for at least five years from the date of the record. The municipality shall submit these records to the Department if requested.

2. The Tier B municipality shall submit an annual report to the Department. The report, which shall be submitted on a form provided by the Department, shall evaluate progress towards achieving the measurable goals specified for BMPs under (f) or (g) above.

7:14A-25.9 Individual NJPDES permit applications for small MS4s

(a) An operating entity that is subject to N.J.A.C. 7:14A-25.5(a) shall apply for an individual NJPDES permit under (c) or (d) below for stormwater discharges from small MS4s if:

1. An application is required pursuant to N.J.A.C. 7:14A-2.4(c) or 6.13(e), in which case the Department shall specify whether (c) and/or (d) below is applicable; or

2. A
available.

(b) An operating entity that is not required under (a) above to apply for an individual NJPDES permit may on its own initiative apply for an individual NJPDES permit under (c) below for stormwater discharges from small MS4s.

(c) The following is applicable to an operating ation to discharge under an individual NJPDES permit, and seeks to implement under the permit a stormwater program that is different from the stormwater program under N.J.A.C. 7:14A-25.6.

1. If the permit is for discharge to surface water, the operating entity shall submit to the Department a permit application that includes the information required by N.J.A.C. 7:14A-25.10(a). The entity does not need to submit the information required by 40 C.F.R. 122.26(d)(1)(ii) and (d)(2)(i) regardinJ the entity's leJD authority, unless the entity intends for the Department to take such information into account when developinJ the entity's SerP it conditions.

2. If the permit is for discharge to groundwater, the operating entity shall submit to the Department a permit application that includes:

i. The information required by N.J.A.C. 7:14A-4.3 (except 4.3(a)11 and 15 through 24) and 7.9. In accordance with N.J.A.C. 7:14A-7.9(a)1, the entity shall submit the information required pursuant to N.J.A.C. 7:14A-7.9(d), except when, after consultation with the Department during a pre-application conference, it is determined that the information is not necessary to develop permit conditions for the small MS4;

ii. An 8.5 inch x 11 inch copy of a portion of a U.S. Geological Survey Topographic Map(s), 7.5 minute Quadrangle Series extending one mile beyond the area served by the small MS4 that is the subject of the permit application. The boundaries of that area shall be marked on the copy; and

iii. Any information required by the Department under N.J.A.C. 7:14A-8.17 (if an individual UIC permit is sought).

(d) An operating entity that seeks to implement a stormwater program under N.J.A.C. 7:14A-25.6 may seek authorization to discharge under an individual NJPDES permit only if the Department requires that entity to submit an application under (a)1 above and this subsection, or if an application is required under (a)2 above. The operating entity shall submit to the Department an application that includes:

1. The information required under N.J.A.C. 7:14A-4.3(a)1, 2, 3, 6 and 9, and 25.6(c);

2. An estimate of the area,

3. A map, showing the location of the end of MS4 outfall pipes, that satisfies the requirement for such a map in N.J.A.C. 7:14A-25.6(b)5i (if the entity operates any MS4 outfall pipes);

4. Any information required under N.J.A.C. 7:14A-8.17 (if an individual UIC permit is sought); and

(e) If a small MS4 is in the same urbanized area as a medium or large MS4 with a NJPDES stormwater permit, and if the operating entity for the medium or large MS4 is willing to have the operating entity for that small MS4 participate in its stormwater program, both operating entities may jointly seek a modification of the medium or large MS4 permit to include the operating entity for the small MS4 as a limited co-permittee. As a limited co-permittee, the operating entity for the small MS4 will be responsible for compliance with the NJPDES permit conditions DSSlicDEle to thD eQity's MUsdiction. If an operating entity for a small MS4 chooses this option for discharge to surface water, the entity shall comply with N.J.A.C. 7:14A-25.10(a) rather than N.J.A.C. 7:14A-25.6, except that the entity does not need to comply with 40 C.F.R. 122.26(d)(1)(iii) and (iv) and (d)(2)(iii) (discharge characterization). The entity may satisfy the requirements in 40 C.F.R. 122.26(d)(1)(v) and (d)(2)(iv) (identification of a management program) by referring to the medium or lDJe 0 64's stoUP wDeUSUbJUP .

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7:14A-25.10 Requirements for large and medium municipal separate storm sewer discharges

(a) Application requirements for operating entities for discharges to surface water from large and medium municipal separate storm sewers are contained in 40 C.F.R. 122.26(d), which is incorporated into this chapter by reference. Also incorporated into this chapter by reference, for purposes of this subsection only, are the definitio
municipal separate storm sewer Rutfall" nd "m jRr Rutf ll." fe

indicates otherwise. References t
C.F.R. 122.26(d) shall be understood to mean an
7:14A-1.2. Any operating entity for a discharge under this subsection is exempt from the requirements of N.J.A.C. 7:14A-4.3(a)11 and 15 through 24, (c) through (e) and 4.4(a) and (b)3 through 7.

(b) The operating entity for a large or medium municipal separate storm sewer system that discharges to surface water shall submit an annual report by the anniversary of the date of the issuance of the N
required under 40 C.F.R. 122.42(c), which is incorporated into this chapter by reference.