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A Municipal Stormwater Rule Primer

By George S. Hawkins, Executive Director,
Stony Brook-Millstone Watershed Association

New Jersey's new stormwater Rules offer the opportunity to preserve or improve the quality and quantity of New Jersey's waters. These Rules help to increase the recharge of fresh water into underground aquifers, decrease the amount of pollutants flowing into our water supplies from construction sites, new developments, public complexes and transportation agencies, and decrease the ferocity of storm surges that cause flooding and scour our stream banks. A sustainable supply of clean, fresh water is fundamental not only to people and all living organisms, but also to the economic well-being of our state.

These opportunities will be realized provided that the Rules are understood and followed. Are municipalities ready for the deadlines that will roll-out over the upcoming years? To help, this article is a primer about how the rules work for municipalities – its genesis, structure, language and schedule. Initially, we review five points.

1. Federal Law. New Jersey is required to develop a stormwater program under Phase Two requirements of Section 402 of the federal Clean Water Act. Although the NJ Department of Environmental Protection (NJDEP) has devised a program also based on New Jersey statutes and implementing federal provisions, the program is a non-negotiable federal mandate.
2. Two Rules. The new stormwater program is the product of two new regulations. One governs how municipalities will regulate new development with respect to stormwater (NJ Administrative Code Chapter 7, Subchapter 8; or Rule 7:8). The second requires municipalities to comply with new permits that control how municipalities manage municipal storm systems (NJ Administrative Code Chapter 7, Subchapter 14A; or Rule 7:14A).
3. General Permits. Every municipality must comply with a "New Jersey Pollutant Discharge Elimination System" (or NJPDES) General Permit. A General Permit (GP) means that each municipality must be authorized to discharge in compliance with a common set of obligations established for two categories pertaining to municipalities – Tier A and Tier B (Tier A is for larger municipalities, and covers most towns in New Jersey).
4. Five Year Phased Requirements. Obligations under these Rules and the associated GPs are phased over a five-year implementation schedule.
5. Models are available. NJDEP has created model documents that will satisfy requirements, many of which are appended to their Stormwater Best Management Practices Manual.

Overview. Rule 7:8 focuses on stormwater from new and re-development. In general, the Rule governs development that disturbs more than one acre, or increases impervious cover by ¼ acre – a "Major Development" – with some exemptions for developments with existing approvals. Rule 7:8 requires that non-structural management of stormwater be first used to attain applicable standards, including careful site plan design in concert with ecological conditions. If non-structural designs are not sufficient, the Rule requires specifications for stormwater retention ponds and associated structures. The Rule includes standards to increase groundwater infiltration and to decrease peak storm flows and suspended solids leaving the site. The Rule also includes special protections for "Special Water Resource Areas" – including a 300-foot buffer for streams with the highest water quality (C-1). Rule 7:8 is implemented through the application of the Residential Site Improvement Standards (RSIS), and through the adoption of a municipal stormwater plan, or regional stormwater plan.

Rule 7:14A creates a permit program that both requires the implementation of the stormwater measures for new development

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The Director's Chair

by Joan G. Ehrenfeld, Ph.D., Director, New Jersey Water Resources Research Institute
Rutgers, The State University of New Jersey

The management of stormwater is the most critical aspect of reducing non-point source pollution. The new rules promulgated by the NJ DEP present a major change in the way stormwater is managed. We present in this issue a series of articles on the subject, including an explanation of the rules, insights into research on BMPs for stormwater, and commentaries of several interest groups on the impacts of the rule on the state.

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A Municipal Stormwater Rule Primer (Cont.)

contained in Rule 7:8, and requires plans, ordinances and Best Management Practices (BMPs) to manage stormwater from lands owned and operated by the municipality, and the design, operation and maintenance of municipal storm sewer systems. This Rule requires municipalities and other public complexes and transportation agencies to adopt a range of practices to reduce the pollutants that are picked up in stormwater. These requirements include: management of wildlife feeding, litter and pet waste, maintenance of municipal yards, deicing and stormwater facilities, identification of stormwater outfalls and elimination of illicit connections, and regular education and outreach to the community. A municipal program is described in a Stormwater Pollution Prevention Plan.

Stormwater Plans and New Development (Rule 7:8)

The program establishes standards to govern stormwater from new and re-development in five categories:

- Nonstructural strategies: minimize disturbances and impervious cover, reduce lawn cover and implement pollution prevention steps.
- Groundwater recharge: retain 100% of pre-development groundwater recharge on-site or infiltrate the increase in the 2-year storm.
- Water quantity: reduce post development peak flows for the 2, 10 and 100-year storms by 50%, 75, and 80% respectively, or demonstrate no impact with full development in stream area.
- Water quality: reduce the total suspended solids by 80% and remove nutrients to the maximum extent possible in the post construction runoff.
- Special Resource Area: prohibit, with some narrow exceptions, development within a 300-foot buffer in the HUC (hydrologic unit code) 14 around C-1 waters.

These standards apply to new Major Developments and are implemented in four ways. 1) These standards are applicable to new residential development through application of the RSIS. 2) These standards will be reviewed by NJDEP when associated permits are required (Flood Hazard Area Control Act - Stream Encroachment, Freshwater Wetlands Protection Act, Coastal Area Facilities Review Act - CAFRA and the Waterfront and Harbor Facilities Act). 3) These standards will be reviewed by the municipality after it has an approved Stormwater Management Plan and associated Stormwater Ordinance(s). 4) These standards will be reviewed by the relevant agency after a Regional Stormwater Management Plan is adopted as part of the Water Quality Management Plan. The following schedule overlaps the permit schedule described below:

February 2, 2004: Municipalities must review new residential development that disturbs more than one acre to be consistent with new stormwater requirements, incorporated through RSIS.

One year from EDPA or Next Master Plan Reexamination, likely Spring 2005: Municipalities must adopt a Stormwater Management (SWM) Plan by the sooner of a) the deadline in the 7:14A General Permit or b) the next Master Plan Reexamination. (See summary of SWM Plan elements at the end of this article.) (Note: Under Rule 7:14A, most municipalities will need to complete a SWM Plan one year after being authorized by NJDEP –likely in the Spring of 2005).

One year from adoption of SWM Plan, likely Spring 2006: Municipalities must adopt municipal stormwater ordinance that implements the standards contained in Rule 7:8. The municipality must submit the plan and ordinances to the county review agency.

Sixty days from adoption of SWM Plan and Ordinance, likely Summer 2006: County must approve, conditionally approve or disapprove the municipal plan and ordinance. If the county does not act within 60 days, the plan and ordinances are deemed approved and effective immediately.

General Permits and Existing Development, Rule 7:14A

The stormwater program creates General Permits for Municipal Separate Storm Sewer Systems (MS4s), which include municipalities and public complexes and transportation agencies. Most municipalities requested authorization to discharge stormwater in compliance with the standardized terms of a Tier A or Tier B GP by submitting a Request for Authorization (RFA) to NJDEP on March 3, 2004.

Permit Schedule and Requirements: NJDEP responded to most RFAs in the Spring of 2004. The response date from NJDEP is important because it sets the Effective Date of Permit Authorization (EDPA), which starts the clock on the State Basic Requirements (SBRs) mandated in the Rule and GPs. The GPs list SBRs in six categories:

- Stormwater Pollution Prevention Plan (SPPP): Prepare and implement a SPPP that outlines the program, an implementation schedule and measurable outcomes.
- Post-Construction Standards: Comply with RSIS standards and Stormwater plan and ordinances as required by Rule 7:8 for new and re-development projects, including operation and maintenance of best management practices and new storm drain inlets.
- Education: Conduct an annual event and distribute information that informs the public on topics such as over-fertilizing and pesticide use, and pet and waste disposal. Implement a program to stencil municipality operated stormwater drain inlets.
- Waste Disposal: Adopt ordinances to properly manage pet waste, litter, wildlife feeding, yard waste and to reduce other improper waste disposal, and implement programs to eliminate illicit connections to the municipal storm system.
- Floatables: Implement program to reduce solids and floatables in stormwater, including street sweeping in predominantly commercial areas, storm drain retrofitting, road erosion control maintenance, and remediation of stream scouring.
- Maintenance Yard: Implement pollution prevention techniques at maintenance yards including permanent structure for storage of de-icing materials, fueling, vehicle maintenance, and good housekeeping operating procedures.
- Employee Training: Implement appropriate employee training programs.

The GP may require Additional Measures (AM), which can include strategies to reduce a particular pollutant from stormwater in an impaired waterway (from a Total Maximum Daily Load), or requirements from an Areawide (or Statewide) Water Quality Management Plan, which addresses the extension of wastewater services on a regional basis. The GP also requires an Annual Report that outlines implementation, deliverables and outcomes. NJDEP will provide the format for the Annual Report. A chronological list of SBRs for Tier A municipalities follows:

Upon EDPA (in most cases, Spring 2004):

- Ensure compliance with RSIS requirements for new residential development for stormwater. This includes extensive

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Municipal Stormwater Permit Overview

By Bruce Friedman, Project Manager, Municipal Stormwater Regulation Program and *Kim Maxwell, Senior Environmental Specialist, NJ Dept. of Environmental Protection*

USEPA and the State of New Jersey realize the critical importance of substantially reducing stormwater/nonpoint pollution contributions into the waters of the State. Phase II of the Stormwater Permitting Program attempts to do just that, by addressing pollutants entering our waters from certain storm drainage systems owned or operated by local, county, state, interstate, or federal government agencies. These systems are called "municipal separate storm sewer systems" (MS4s).

It is now believed that stormwater/nonpoint sources are the remaining major sources of pollutants in our lakes, rivers, streams, bays, and oceans. It is estimated that up to 60% of our existing water pollution problems are attributable to stormwater/ nonpoint pollution problems, and 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 environmentally friendly alternatives available. Often there is a lack of public awareness. People are unaware that storm drain inlets often discharge directly to water bodies. When people allow motor oil, trash, or their pet's solid waste to enter the storm sewer in their street, they don't realize that it may end up in their local lakes, rivers, and streams. Individually these acts may seem insignificant, but the cumulative effects of these activities contribute to stormwater/ nonpoint source pollution and negatively impact water quality.

To implement the Municipal Stormwater Regulation Program, on February 2, 2004 the New Jersey Department of Environmental Protection published revisions to the New Jersey Pollutant Discharge Elimination System (NJPDES) rules at N.J.A.C. 7:14A-25 and issued as final, four general NJPDES permits: the Tier A, Tier B, Public Complex, and Highway Agency Stormwater Permits. The Municipal Stormwater Regulation Program has assigned New Jersey municipalities into two tiers (Tier A or Tier B). Tier A municipalities are generally located within more densely populated regions of the State or along or near the coast. Tier B municipalities are generally located in more rural areas and in non-coastal regions. In addition to municipalities, the Municipal Stormwater Regulation Program regulates certain large public complexes like colleges, universities, prisons and military bases and highway agencies like New Jersey Department of Transportation, New Jersey Turnpike Authority and other highways operated by county, state, iterstate, or federal government agencies.

The permits address stormwater quality issues related to new and existing development by requiring the preparation of a stormwater program and implementation of Statewide Basic Requirements (SBRs) and Best Management Practices (BMPs). Both Tier A and Tier B municipalities are required to address new development and redevelopment, in part, by adopting a municipal stormwater management plan and enforcing municipal stormwater ordinance in accordance with the Department's Stormwater Management Rules at N.J.A.C. 7:8 and educate residents by developing a local public education program. The local public education program includes an annual stormwater mailing, an annual educational event and storm drain inlet labeling. Tier A municipalities are also required to address existing development through broad topics including: Improper Disposal of Waste, Solid and Floatable Control, Maintenance Yard Operations and Employee Training. Tier A municipalities will be passing several new ordinances to address problems such as pet waste, litter, wildlife feeding, yard waste, improper disposal of waste, and illicit connections, and will be developing and implementing programs for street sweeping, stormwater facilities maintenance, road erosion control and outfall pipe scouring. Municipal maintenance yards will also be required to "clean up their act" by constructing a permanent structure for the storage of their deicing material, and by developing and implementing Standard Operating Procedures (SOPs) for vehicle and equipment fueling and maintenance, as well as implementing general good housekeeping practices.

At a glance the permit requirements may seem costly and time consuming. However, many municipalities already comply with many aspects of the permit and other municipal practices may only require minor changes. Additionally, the permit requirements are phased in over a five-year span. Governor McGreevey has made 6 million dollars in grants available to municipalities to assist with permit compliance. An additional 6 million dollars have been budgeted for next year as well. In addition the Department is committed to provide municipalities with compliance assistance and have developed extensive guidance materials and provided case managers for each municipality. The Department completed three regional training seminars in July as part of this compliance assistance and outreach effort.

On a larger perspective, the Municipal Stormwater Regulation Program is a critical component of the broader watershed management based initiatives being undertaken by the Department, as well as other States. These initiatives will protect drinking water quality, ensure that healthy ecosystems exist in the future, and ensure that the residents of New Jersey enjoy a sustained quality of life.

Contact the authors at (609) 633-7021

Stormwater Guidance Available from NJDEP Online

To assist permittees in implementing the Municipal Stormwater Regulation Program, the Department of Environmental Protection is providing guidance information on CDs. The information includes Guidance Documents, Municipal Stormwater General Permits, education materials, example plans, model ordinances, forms, and other materials needed to develop and implement a stormwater program. The CDs are being mailed to all affected permittees. In addition, the Department is providing the content of the CDs online at a site, which may be accessed using the links at: ***www.njstormwater.org/sw_guidance.htm.*** The NJDEP hompage for Stormwater and Nonpoint Source Pollution can be found at: ***www.njstormwater.org***

Designing To Meet The New Jersey Stormwater Management Regulations

By Victorino B. Zabat, P.E., Najarian Associates

The long-awaited revisions to NJDEP's Stormwater Management Regulations (N.J.A.C. 7:8) were adopted on February 2, 2004. The Regulations now include explicit requirements for groundwater recharge, protection of Category 1 (C-1) waterways, and more stringent water quality requirements. The new Rules were designed to address non-point source pollution, both at the project level and, through Stormwater Management Planning, at the Municipal, County and regional levels. The new threshold for applying these regulations is the addition of ¼ acre of new impervious area to a project site, or a total land disturbance of 1 acre (or more).

Unfortunately, some requirements of the new Rules are not clearly specified or quantified. Thus, they posed a new challenge for the engineers at Najarian Associates as they designed a planned residential development in Woolwich Township, Gloucester County.

The first of these challenges involved satisfying new requirements regarding nonstructural stormwater management strategies (N.J.A.C.7:8-5.3). These requirements include: (a) separating and disconnecting impervious areas; (b) protecting natural drainage features and vegetation; and (c) minimizing land disturbance, clearing, grading and soil compaction. The Rules require these methods to be incorporated "*to the maximum extent practicable*." While the overall intent of these requirements is apparent, the Rules fail to provide clear (i.e., quantitative) guidance regarding the extent of their use. For example, how many acres of new impervious area should be disconnected? How does one protect a natural drainage path when natural runoff velocities are erosive? Addressing such vaguely defined parameters in the Rules was the first challenge to be met in this project.

The issue of which agency will hold ultimate jurisdiction in interpreting these Regulations is still undetermined. For example, residential projects are currently reviewed by the Municipal Engineer to ensure that they meet the RSIS standards (N.J.A.C. 5:21), and by NJDEP if Land Use permits are required. If this were to continue, would the Municipal Engineer and the NJDEP both have discretion over which non-structural measures are appropriate? In the subject project, the Najarian design team was fortunate to resolve these issues at joint meetings between the NJDEP and the Municipal Engineer. These meetings took considerable time to schedule, as the Municipal Engineer required authorization from the Municipality to attend them. This issue is foreseen as a major impediment to obtaining the necessary approvals.

Next, the Rules mandate 300-ft buffers around C-1 waterways and their tributaries, within the immediate Hydrologic Unit Code (HUC-14) drainage area delineated by the USGS. This task involved determining whether a G1 waterway was located within the HUC-14 drainage area of the project site, and whether the associated 300-ft. buffers fell within the site. To this end, a map of the project's HUC-14 drainage area was submitted to verify that the subject project did not encounter any of these buffers. Had the opposite been true, the design and permitting requirements for stormwater discharges into the buffer would have been quite restrictive and, ultimately, subject to the discretion of NJDEP.

The Rules now include an explicit requirement to either: (1) maintain the existing average annual recharge; or (2) infiltrate the increase in the 2-year runoff volume generated by the development. The design team selected the first option. The NJDEP provided a design aid in the form of an Excel™ spreadsheet for this option. Use of the spreadsheet calls for a leap of faith from the designer, since the scientific basis for some of the formulas is not fully documented in the spreadsheet's Users' Guide. In addition, while the spreadsheet calculations appear to be precise, the actual data may be in error by as much as 50%. Thus, the spreadsheet results should be viewed as approximate.

While the spreadsheet input may appear to be straightforward, a small amount of pre-processing saved much time in the overall design process. The design team found it helpful to set up a matrix of on-site soil types against existing land use / land cover (LULC) and another against developed LULC. The matrices were filled with measured areas of each combination of soil type and LULC.

The Rules contain a list of acceptable Best Management Practices (BMPs) for recharge and water quality purposes. A set of retention ponds with recharge afterbays was selected for the subject project. Once the size of each recharge afterbay was determined, the team had to verify that infiltration would be complete within 72 hours. Percolation test results were thus required. The recharge requirement in the new Rules now makes percolation testing essential.

The Rules waive the recharge requirements within urban redevelopment areas. This includes the Metropolitan Planning Area, as delineated on the State Plan Policy Map. However, this map states that the State Plan is not a regulation. Moreover, the boundaries on this map are described as varying up to 40 ft. from their actual location. Once again the Rules fail to provide clear guidance.

The previous water quality standard required 18-hour detention of either a 1-year storm or a 2-hour, 1.25-inch storm. The new Rules redefined the water quality standard as a TSS removal rate of 80%. Also, the Rules mandate use of a 2-hour, 1.25-inch storm, and require a 24-hour detention time. The volume of runoff generated by the design storm is usually too small to be detained for 24 hrs. A dry detention basin is now considered insufficient, according to the TSS removal rates assigned by the Rules to the various BMPs, even if the detention time is satisfied. It must be coupled to another BMP to meet the standard. The Rules do allow the use of sliding scales for TSS removal rates in dry detention basins and wet ponds, and recognize manufactured treatment devices. Although several treatment devices are available, only one was certified by the NJDEP. Thus, any project needing a manufactured device to meet the water quality standard would be forced to use the certified product.

Peak flow-reduction factors of 50%, 75% and 80% for the 2-, 10- and 100-year storm runoff, respectively, were retained in the new Rules. However, the method of calculation was modified. Separate calculation of impervious area runoff is now required for: (a) computing peak flows; and (b) conducting routing computations.

The new Rules require the design engineer to prepare a maintenance plan for the BMPs used on the project site. Recommendations for maintenance are found in the BMP Manual. For this project, the inspection requirements for the recharge afterbays were: (a) four inspections per year; and (b) inspections after every storm event exceeding 1-inch of rainfall. Monthly inspections were required for the bottom sand layer in the recharge afterbay, and semi-annual inspections were required

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Are The Stormwater Rules About Stormwater?

By Nancy Wittenberg, Director of Environmental Affairs, New Jersey Builder's Association

NEW JERSEY BUILDERS ASSOCIATION

The recently adopted Stormwater Management rules deal with highly technical and complex issues. The impacts on new development will be significant and in many instances prohibitive.

There are several significant new requirements in the Stormwater Management rules that became effective in February 2004. While the impact of these requirements is of concern, the rationale and justification for their inclusion in the rules is of equal concern.

Over the past few years it has become necessary to look at DEP initiatives in a different light. Three key questions are consistently raised. Is the proposal based on science? Is the proposal about environmental protection? Are the requirements achievable?

For the stormwater rule the answers to these questions are unfortunately mixed, as the rule is as much about the science of environmental protection as it is about the political science of limiting development.

There is no dispute that when stormwater leaves a site it can impact both the quality and quantity of the receiving water. What is in dispute is what is required to ensure that these impacts are minimized.

The most significant provision of the new rule is the imposition of a 300-foot buffer on Category 1 waters. These waters are those identified by the state as being of such importance that there can be no change to current water quality. Thus the 300-foot buffer is imposed to protect these waters.

The original rule proposal included a long list of technical references in support of the 300-foot buffer. It is not typical of DEP to include such references in a rule proposal. The inference was that there was overwhelming science to support the need for a 300-foot buffer.

Unfortunately DEP neither had the cited references nor had correctly used them. What the references made quite clear was that there is no one-size-fits all buffer to address water quality or quantity concerns. Each study noted that the optimal buffer width would vary depending on the terrain, slope, soil type, pollutant loading, existing vegetation and other site-specific factors. In some instances 300 feet may be appropriate but in most instances smaller buffers will provide the same if not increased benefits.

Thus DEP chose 300 feet without adequate scientific justification. The buffer also will not achieve the stated environmental protection goals. The proposal prohibits any disturbance within the buffer including the discharge of the stormwater. Thus the stormwater must be discharged 300 feet away from the receiving stream. Water flowing over that distance will in most instances result in soil erosion and increased discharge of sediment into the stream. This is exactly what the rule is supposed to minimize. In fact the State Soil Conservation Districts prohibit discharges of stormwater closer than 300 feet due to the soil erosion issues.

Thus the buffer is not based on science and it does not accomplish the environmental protection goals. So what does it do? Well, it will keep development away from these waters and in many instances will prevent projects from going forward at all as the 300-foot buffers prohibit use of the site.

The facts show that there is no scientific justification for such a large buffer. The facts show that depending on site-specific factors there may be better ways to avoid impacts to the stream. Why doesn't the proposal allow any flexibility for protecting these water bodies? If the goal is to provide the maximum protection from stormwater impacts, applicants should be allowed to design the best way to achieve this. Yet the rule does not allow this.

There is increasing frustration in the regulated community over the trend in rulemaking that ignores science and imposes requirements that provide little to no environmental benefit. The imposition of the 300-foot buffer in the Stormwater Management rule is one example. There are other examples in this rule and other recent proposals as well. The bottom line is that environmental protection is being used to accomplish a different agenda and that serves no one well.

For more info, e-mail the author at ***nwittenberg@njba.org*** *or contact the author at (609) 587-5577*

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Designing to Meet NJ Regs (Cont.)

for vegetated areas. The responsibility for implementing the maintenance plan lies with the homeowners or homeowners' association.

Because of its recharge function, the recharge afterbays in this project may be subject to clogging due to mowing of the surrounding berm and other causes. Also, any compaction of the underlying soil would affect the recharge capacity. Such maintenance issues must be addressed by the homeowners' association to preserve BMP effectiveness.

The project design was submitted and deemed complete by NJDEP. The new Rules are not insurmountable. They only raise the bar a bit higher and make the gate a little narrower. The Najarian design team met this challenge and produced a successful design. In the end, the additional requirements in the Rules equated to additional time needed to conduct the necessary analyses.

The challenges of implementing the new Rules are quite taxing for design and review engineers alike. At a meeting with NJDEP staff, it was refreshing to hear the designated reviewer's candid question: "How shall we enforce these new regulations?" The road ahead appears to be bumpy and the regulated community will have to wait to see the benefits of the new regulations on the water quality of our receiving streams.

Contact the author at 732-389-0220

Bioretention Systems - Policy and Research Topics

By Gregory Rusciano, Bioresource Engineering, Rutgers University

Stormwater management in New Jersey has traditionally dealt with managing water quantity and peak runoff rates through engineered systems such as detention basins; however, the recently adopted New Jersey Stormwater Management Rule identifies the need for water quality improvement of stormwater through increased infiltration, groundwater recharge and retention of water. Bioretention systems, with the ability to effectively manage both water quantity and quality, are ideal for this effort.

Bioretention is a stormwater best management practice (BMP) commonly used in suburban settings, especially for the treatment of parking lot runoff. Typical design includes a sloped grass buffer strip, a ponding area with native vegetation (provides settling of suspended solids), a three-foot deep soil planting layer, a one-foot deep sand layer, and a gravel/under-drain layer.

The soil planting layer provides the following mechanisms: (1) act as a primary filter with attenuation of pollutants to soil particles, (2) provide rapid infiltration of stormwater runoff (NJ BMP requires complete infiltration within 72 hours), (3) sustain healthy vegetation at the surface. The soil planting bed consists of a high sand content to achieve infiltration requirements. The sand layer acts as a secondary filter and transition between the soil planting bed and the under-drain system. A thin mulch layer can be applied to the top of the soil planting bed to retain moisture and attenuate pollutants.

Plants in the bioretention system consist of a combination of native grasses, shrubs and trees which can adapt well to the soil and climate of the region as well as tolerate pollutants and varied depths of water. The plants are intended to uptake nutrient and water inputs into the system. The roots of the plants provide pore spaces within the planting soil bed which will provide a habitat for microorganisms, thus promoting biological degradation of pollutants (Davis et al., 2001).

When implemented properly, bioretention systems have the ability to remove a wide range of pollutants, such as suspended solids, nutrients, metals, hydrocarbons, and bacteria from stormwater runoff (NJDEP, 2004). In many cases, removal efficiencies have shown to be favorable for a variety of pollutants. However, if bioretention is intended to be used as a ***primary*** stormwater management tool in New Jersey, additional research is needed to optimize its effectiveness in practice and improve regulatory guidance for the future. Research will also help avoid possible problems with existing specifications for bioretention systems (NJDEP, 2004) when they are implemented on a large-scale basis throughout the State. For example, the NJDEP was forced to modify specifications for individual subsurface sewage disposal systems after many of the systems caused problems in practice. Preliminary in-state research on bioretention will ensure this problem will not be repeated for stormwater management projects. Furthermore, careful monitoring of systems already implemented in New Jersey according to accepted protocols such as *Urban Stormwater BMP Performance Monitoring* (ASCE, 2002), will help avoid problems and provide additional research.

Since much of the research on bioretention has been performed in other regions of the nation, these studies cannot fully describe the specific needs New Jersey. Research should be appropriate to the current water quality conditions of a state's waterways and focus on total daily maximum load (TDML), particularly in considering bioretention's efficiency in removing pathogens from polluted runoff. Many of New Jersey's waterways are impaired for pathogens (based on fecal coliform as an indicator) and have TMDLs in place for fecal coliform. However, past research on bioretention's ability to remove fecal coliform has been relatively inconclusive to date and not necessarily representative of New Jersey specifications.

Research on bioretention has many facets. In the laboratory, Davis et al. (2001) explored the efficiency (concentration reductions and pollutants) of bioretention at different depths within the system. Exploring different scenarios, experiments were repeated with different flow rates and chemical make-ups of synthetic stormwater. Overall, Davis noted high reduction of metals (lead, copper, and zinc), moderate reduction of total Kjeldahl nitrogen (TKN), ammonium, and phosphorus, and poor reduction of nitrates. In the case of metals, the majority (~90%) was reduced within the upper portion of the system. Phosphorus, TKN and ammonium were required to infiltrate to larger depths before significant reduction was achieved.

Other lab studies have monitored the pollutant removal efficiencies of different media, although not necessarily under the conditions of a bioretention system model. The poor reduction of nitrates discussed previously induced further research by Davis et al. (2003), namely the evaluation of solid-phase electron-donor substrates that may have the potential to be incorporated into bioretention systems. Barber et al. (1999) observed the hydraulic performance and the potential for several media types to remove cadmium, copper, lead, zinc, nitrate, orthophosphate, total suspended solids (TSS) and total petroleum hydrocarbons (TPH). The media, persolite, appeared to have the greatest potential for stormwater management applications. Tobiason et al. (2001) tested four filtration media as to their effectiveness in concurrent metals removal and toxicity abatement. Leaf compost and soybean hull material performed best in zinc removal and reducing toxicity.

Hutchinson (2004) investigated the effect of different native grass and shrub species on the removal efficiency of bioretention systems modeled in the laboratory. As a result of this study, switchgrass (*Panicum virgatum*) was determined to be very appropriate for use in bioretention systems. Claytor and Schueler (1997) provide information on other species that are potentially ideal for use in bioretention systems.

Field investigations are the next logical step in evaluating bioretention performance. Davis et al. (2003) implemented two field investigations in Maryland which generally supported previous laboratory studies, showing excellent reduction of metals. Again, the majority of metals were removed in the upper (top 20 cm) portion of the bioretention system. Bioretention monitoring projects conducted by USEPA (2000) in Maryland and Florida showed varied results in pollutant removal performance of nutrients and metals.

The *International Stormwater BMP Database* (***www.bmpdatabase.org***) has become an important tool in reporting the research and monitoring efforts of bioretention

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New Jersey's New Stormwater Rules…Do They Protect All Streams Equally?

By Mark Gallagher, Princeton Hydro, LLC.

As of February 2, 2004 the New Jersey Department of Environmental Protection enacted their long awaited revision to the Stormwater Management Act. One of the more controversial components of this legislation was the requirement for a 300-foot Special Waters Resource Protection Area or buffer adjacent to all Category One (C1) streams and their tributaries. Category One streams are special protection waters subject to the state's antidegradation policies. The protection of these waters has been an integral and well-advertised component of the new rules. Over the past few weeks, various newspaper articles made statements such as follows: "In total, the buffers will impact 6,093 stream miles - including the 3,307 miles of currently designated C1 rivers and streams and an additional 2,786 miles of non-C1 tributaries to C1 streams". Although the newspaper reports make this legislation seem comprehensive, there are gaps in the rules.

The revised rule stipulates the need for a buffer or Special Water Resource Protection Area (SWRPA) of as much as 300 feet on either side of C1 streams and mapped tributaries. In accordance with 7:8-5.5(h) *Special water resource protection areas shall be established along all perennial or intermittent streams 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 Survey Reports, within the associated HUC 14 drainage.*

This regulation identifies that SWRPA's are only required on mapped intermittent and perennial streams. The key point of this rule to remember is that it limits the buffer requirement to streams that are mapped. Thus, the protection of C1 watersheds is relying on the accuracy of these maps.

Recent studies by government agencies, academic institutions and private consulting firms indicate that many first and second order headwater streams are not indicated on United States Geologic Survey (USGS) maps; including both intermittent and perennial streams. Most of the missing stream segments are typically headwater streams. A study performed by the Ohio Environmental Protection Agency found that headwater streams, although generally absent from the USGS topographic maps, comprise more than 80% of the total length of the state's stream system. An article by Judy Myer and J. Bruce Wallace of the University of Georgia stated "it is humbling to recognize that the 185 ecological papers about streams that have been published in the past 25 years at Coweeta Hydrologic Laboratory (sponsored by the National Science Foundation) have been done on streams channels that do not exist according to most national accounting of stream networks".

Although the County Soil surveys may illustrate more of these headwater streams, especially intermittent streams, many of the streams indicated are drainage ditches. In accordance with the New Jersey Freshwater Wetlands Protection Act, a man-made ditch is considered a wetland of ordinary resource value that does not require a buffer and can be filled in accordance with the NJDEP's General Permit Program. In contrast to this rule, a ditch shown in the County Soil Survey that is tributary to a C1 stream will be required to have a 300-foot buffer. It should be interesting to see how the state resolves this conflict.

Another important aspect of the new rules also relates to the SWRPA requirement. The 300-foot buffer requirement that is so widely discussed will not always be 300 feet. These areas may be reduced from 300 feet to as little as 150 feet in previously disturbed areas and/or in areas under active cultivation.

This article was designed to comment on specific portions of the new regulations. However, as with all new regulations, there will likely be a variety of other issues that will emerge in the upcoming months and will need to be addressed by the NJDEP. Although there may be some problems with the new rules, they do provide for the possibility that many of the stated concerns can be addressed at the local level as part of a "stream corridor protection plan". For example, the omission of unmapped intermittent or perennial headwater streams, although clearly an oversight, can thus be managed at the local level. In addition, it is important to remember that the antidegradation standards of a C1 stream are still applicable and need to be considered in the management of unmapped elements of a C1 watershed.

However, the protection of certain mapped streams such as those indicated on County Soil surveys may be contrary to reducing downstream water quality impacts. For example, an eroding ditch may warrant elimination or modification as part of a proposed development as a means to better manage the water quality of a stream. It is clear that issues such as this need to be evaluated on a case-by-case basis. However, the preparation of a stream corridor management plan may be an important tool to better manage sensitive watersheds.

The protection of any important unmapped headwater streams that warrants additional protective measures would need to be done at the Municipal level. Protective measures such as buffers, re-vegetation programs for the SWRPA, as well as the identification of eroded streams or other channels can also be done as part of a local or regional Stream Riparian Corridor Protection Plan. In accordance with 7:8-5.5 "A Stream Corridor Protection Plan may be developed by a regional stormwater management planning committee, a municipality or the Department". A plan can also be part of an adopted municipal stormwater management plan. The Stream Corridor Protection Plan aspect of the new regulations could serve to provide management for those streams "overlooked" by the new regulations.

So do the new regulations protect all C1 streams equally? The answer is…no, and unless one looks beyond the headlines, your watershed may not be protected to the level that you have read.

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Contact the author at 908-237-5660

New Jersey Conservation Foundation

The 9th Annual New Jersey Land Conservation Rally, one of the nation's largest statewide conservation training events, will be held at the Marriott Lafayette Yard Conference Hotel on Saturday, March 12, 2005. The daylong event will feature nearly 30 workshops, plenary sessions, exhibits and networking opportunities. For more information, contact Doug Held at New Jersey Conservation Foundation, (908) 234-1225, ***Doug@njconservation.org***. A call for papers is listed on NJCF's website at ***www.njconservation.org***. Workshop proposals are due Oct. 7, 2004 and exhibitor applications are due Dec. 1, 2004.

Saving Money By Complying With New Jersey's New Stormwater Rules

By James F. Cosgrove, Jr., P.E., President,
TRC Omni Environmental Corporation

New Jersey's new stringent stormwater rules provide very stringent requirements in terms of improving the quality and reducing the quantity of stormwater runoff as a result of development. Although the rules force design engineers to be more creative with site design and BMP design, the rules may not always result in more expensive stormwater management solutions. Yes, traditional detention basins with those beautiful concrete low flow channels may be a thing of the past since they do not meet the water quality requirements, but what is the alternative? An entrepreneur in the Princeton area recently found out that innovative stormwater designs can result in more aesthetically desirable and cost-effective solutions.

John Marshall, owner of the well know restaurant Main Street, was not satisfied with the stormwater management design he received from a traditional engineering firm for his renovation of a historic farmhouse into a banquet and catering facility. The design called for the construction of a very large wet detention basin that would not fit aesthetically with his vision of a historic farmhouse, and would cost over half a million dollars due in part to the need to blast through shallow bedrock.

TRC Omni Environmental Corporation developed an alternative stormwater design that cost less than half as much due to lower construction costs. Our design relies on bio-swales and an underground retention system instead of the originally proposed wet detention basin. The bio-swale (or bioretention swale) operates essentially as a long, narrow bioretention basin by using gently regraded areas planted with native vegetation such as tall grasses, a sandy soil mixture beneath the swale, and small check dams. These swales will collect road, parking lot, and landscaped area stormwater runoff. An underground retention system will be utilized to collect roof runoff. That water will then be utilized for landscape irrigation during the warm weather months. The newer design exceeds stringent state and local requirements through pollutant filtration, settling, and biological uptake during the infiltration process. These measures will substantially improve the water quality of the runoff events and also provide therequired peak rate controls to prevent downstream flooding. In addition, the BMPs will blend with the natural surroundings far better than a traditional basin approach.

Contact the author at 609-924-8821

The Watershed View

By George S. Hawkins, Executive Director,
Stony Brook-Millstone Watershed Association

Watershed groups and the dedicated people who give them vitality are delighted by New Jersey's new stormwater rules. The watershed ideal is based on several principles. First, water is a essential resource for life that must be protected. Rainwater is our principal source of this resource, and we must manage and protect it. For too long, rain – or stormwater – has been managed as a public nuisance, to be collected in ecologically barren basins and removed off-site as quickly as possible. The new emphasis in these rules to treat water as a valuable resource – by replenishing groundwater, by incorporating natural conditions, by reducing sedimentation, by protecting stream corridors – is a tremendous step. Second, water must be handled in a regional manner – a river will only be clean if protective measures are taken along its entire length, from headwaters to the ocean. The emphasis of this rule on regional stormwater planning will help us protect entire river ecosystems. Third, the health of a river is directly related to what we do on the land that surrounds the river (its "watershed"!). The emphasis in these rules requiring best management practices for new construction and development will improve the water quality that reaches our aquifers, reservoirs and rivers. Finally, our own behavior has a direct impact on the health of our streams. The elements of this rule that apply to our communities and homes remind us of our own responsibility. In short, watershed management and stormwater management go hand in hand. We believe that protection of our streams, rivers, reservoirs, and aquifers is critical to the vitality of nature, the economy, and ultimately, our lives. For all these reasons, we strongly support and applaud the approach and content of the stormwater program.

NJ Highlands Water Protection and Planning Act Information Online

A summary of the recent NJ Highlands Bill is now available on the Rutgers Cooperative Extension web site. This resource, a Cooperative Extension fact sheet in electronic form, is designed to introduce the main features of the bill to all interested citizens. The address is ***www.rce.rutgers.edu/Highlands***

Second Annual NJ Volunteer Monitoring Summit – Call for Papers

The New Jersey Department of Environmental Protection, in cooperation with Watershed Watch Network Advisory Council, will be hosting the Second Annual Volunteer Monitoring Summit on October 1st and 2nd at the Clarion Hotel and Towers in Edison, NJ. This conference is to bring together Volunteer Watershed Monitors from across the state. The deadline for the Call for Papers is August 9, for more information see ***www.nj.gov/dep/watershedmgt/volunteer_monitoring.htm*** or contact Danielle Donkersloot, Volunteer Monitoring Coordinator at 609-633-9241 or via email at ***Danielle.Donkersloot@dep.state.nj.us***.

Stormwater Best Management Practices For Small Horse Farms

By Chris C. Obropta, Ph.D., P.E., Water Resources Specialist, Rutgers Cooperative Extension, Dept. of Environmental Science

As New Jersey's Land Grant University, Rutgers is constantly attempting to integrate research, extension and education to address real world problems and develop solutions to these problems. To this end, a bioresource engineering senior design team addressed the problem of stormwater management at the Equine Center, of Rutgers, the State University of New Jersey. The site under consideration within the Equine Center will be a small horse farm, surrounded by agricultural fields and horse pastures. Upon preliminary inspection of the site and corresponding topographic maps, the student design team under the direction of Dr. Christopher Obropta identified the Equine Center as a candidate for improved stormwater management through Best Management Practices (BMPs). Several types of stormwater BMPs were designed to address the potential problem areas at the site. These BMPs included bioswales, infiltration trenches, bioretention basins, and dry wells. Currently, there are no stormwater management strategies in place at the Equine Center farm facility, and thus little control of non-point source pollution.

The project targeted several observed non-point pollution sources including roadways, paddocks, pastures, rooftops, and agricultural fields. During rainfall events, stormwater runoff carries nutrients, fecal matter, sediment, zinc, copper and petroleum hydrocarbons directly to the Lawrence Brook, and consequently into the Raritan River. Agricultural runoff consists of nitrogen and phosphorus that can degrade the health of water bodies by promoting algal growth, which can adversely affect the instream dissolved oxygen concentration. Fecal matter is also critical issue from both the horses and the geese that frequent the site. Not only does this fecal matter consume oxygen as it decays in the stream, it also can result in human health hazards as well as hazards to other animals due to potential bacteria and viruses associated with this material.

The final design was presented by the senior design team to a group of faculty at the end of the spring semester. The students produced designs for several stormwater management practices that will mitigate the identified problems. The BMPs were cost-effective solutions that can be implemented by the small horse owners across the State to help minimize the impact of their operations on local streams and lakes.

This project has proved very timely. New animal feed operation (AFO) regulations being created by the New Jersey Department of Agriculture (NJDA) will require many of the AFOs in New Jersey to address stormwater management on their farms. Due to these regulations, this project will have an immediate impact on New Jersey farmers. Funding is currently being solicited from the NJDA, New Jersey Department of Environmental Protection, and Unites States Environmental Protection Agency to construct these BMPs at the Rutgers Equine Science Center site, monitor the effectiveness of the BMPs, and establish an educational program where horse owners can visit the site and tour the various BMPs.

Bioretention Systems (Cont.)

systems. A recent study by USGS (2002) reviewed this and other databases (data on 224 BMP studies) as to the pollutant removal effectiveness of bioretention systems. TSS, fecal coliform, total phosphorus and total lead removals ranged greatly among the studies with fecal coliform being the most far-reaching (3% average removal efficiency, which describes an addition of bacteria to the effluent). The variations in results from the databases reinforce the need to conduct additional research, especially in the area of fecal coliform.

A new study at the Department of Environmental Sciences at Rutgers, The State University of New Jersey, seeks to evaluate the pollutant removal capabilities and permeability rates of bioretention systems in the laboratory. Funded in part by the New Jersey Water Resources Research Institute, the study seeks to evaluate the ability of bioretention systems to effectively reduce fecal coliform colonies and concentrations of TKN, ammonium, nitrate, and total phosphorus.

Bioretention systems will be modeled in the laboratory as columns with representative depths of sand and soil. *Panicum virgatum*, typically used in bioretention systems, will also be integrated into the column studies. Various types of soil blends will be observed with the hope that an ideal blend can be recommended to the stormwater management community for future projects. Typical rainfall conditions for New Jersey will be mimicked in the laboratory with regard to rainfall intensity and frequency and stormwater composition (pollutant concentrations). New Jersey BMP specifications require bioretention systems to effectively treat 1¼" of rain over two (2) hours. The drainage areas received by a typical bioretention system will be estimated to determine the appropriate flow rate of water input into the system.

Phase I of the project investigates fecal coliform. The existing BMP specifications for the soil planting bed (for both New Jersey and Delaware) will be evaluated as to their potential to removed fecal coliform colonies from polluted stormwater. A mixture of concrete sand, compost and top soil will be used to evaluate New Jersey specifications, while a mixture of sphagnum peat moss, concrete sand and triple-shredded hardwood mulch will be used to evaluate Delaware specifications (Greer, 2004). Phase II will evaluate an innovative soil planting bed material and its ability to reduce concentrations of TKN, ammonium, nitrate and total phosphorus. While the material is still in development, it will likely incorporate the use of ion exchange resin into the soil planting bed.

With the initial development of the project nearly complete, experiments are expected to run throughout summer and fall of 2004. Collaborations have been made with previous researchers of bioretention systems, Rutgers faculty, engineering consultants,and the governmental agencies currently involved with watershed management oversight.

For more information on this article and references used, please contact Gregory Rusciano, Graduate Assistant in Bioresource Engineering: ***gruscian@eden.rutgers.edu*** *or Dr. Chris Obropta, Assistant Professor, Department of Environmental Sciences, Rutgers University:* ***obropta@envsci.rutgers.edu***

Spotlight on New Jersey Watersheds

Regional Stormwater Planning In Gloucester County

By Joseph Orlins, Ph.D., P.E., Associate Professor,
Civil and Environmental Engineering, Rowan University

Two watersheds in Gloucester County are the focus of Regional Stormwater Management Plans currently under development by a team of scientists, planners, and engineers from state and county agencies and a regional university. The Camden and Gloucester Soil Conservation Districts, the Gloucester County Planning Division, and Rowan University have received two grants for $637,174 and $526,809 from the New Jersey Department of Environmental Protection (NJDEP) to develop Regional Stormwater Management Plans (RSMPs) for the upper Raccoon Creek and upper Mantua Creek watersheds. The projects are funded through the 319(h) nonpoint source pollution control grant program.

What is a Regional Stormwater Management Plan?

An RSMP is a tool that can be used by municipalities and other stakeholders (such as watershed associations) to achieve water quality and quantity objectives on a watershed-scale basis. Creation of RSMPs involves a detailed characterization and assessment of the watershed, determination of stormwater concerns (such as flooding and streambank erosion), identification of stormwater management goals, proposed management strategies, creation of performance standards, and development of an implementation plan.

Targeted Watersheds

The Raccoon Creek drains a 50 square mile area that originates in Glassboro and travels northwest to the Delaware River. Land use in the watershed is a mix of agriculture and suburban development, with several small town centers. Development pressure in the watershed is intense, as farms and forests are converted to bedroom communities. The Upper Raccoon Creek RSMP encompasses the approximately half of the watershed, and affects the municipalities of Glassboro and Harrison, South Harrison, and Elk Townships. This region was selected for creation of an RSMP to address current (and prevent future) degradation of the watershed due to stormwater generated by development.

The Mantua Creek watershed borders the Raccoon Creek, draining an area of 50 square miles. The study area for this project includes the upper third of the watershed, affecting parts of Glassboro, Pitman, and Washington Township. The watershed is mostly developed, with several preserved farms. In this area, there are several dams, most of which are undersized for current hydrologic conditions. Two of these are considered "High Hazard" dams, and are candidates for removal. The Upper Mantua Creek RSMP will examine the effects of dam removal on regional stormwater management, and develop strategies for minimizing adverse impacts of dam removal.

Why Study Dam Removal?

There are over 1600 dams in New Jersey. The NJDEP Bureau of Dam Safety and Flood Control regulate all dams in the state, and classifies dams according to their hazard potential. *High Hazard* (or "Class I") dams pose the potential for loss of life and extreme property damage if they were to fail. *Significant Hazard* (Class II) dams may cause serious property damage in the event of failure, but are not likely to cause fatalities. If a *Low Hazard* (Class III) dam fails, flooding may result, but loss of life and extensive property damage are not likely.

Many of the dams in southern New Jersey were originally constructed in the late 19th and early 20th Centuries to provide power for local mills or irrigate agricultural lands. The mills are long gone, but the dams (and lakes they impound) remain, and land use upstream and downstream of the dams has changed with development. When the dams were originally built, they may have been adequate to withstand large rainfall events such as the 100-year storm. However, with development comes increased stormwater runoff. The changes in hydrology result in many dams being unable to handle the flows associated with current design storms. In addition, the settlement of areas downstream of dams increases the potential for property damage and loss of life, so the hazard classification of dams is increased.

This situation was highlighted in July, when 14 inches of rain fell on parts of southern and central New Jersey in a period of 12 hours. Dubbed the "1000-year storm," the deluge caused flooding in the Rancocas River watershed, and led to the failure of 14 dams in Burlington County. Some of these dams were being upgraded to handle increased design flows. However, even if all of the structures were built to current design standards, the intense rainfall event would likely have resulted in failure of some of the dams.

In the upper Mantua Creek watershed, the privately owned High Hazard dams are candidates for removal. Like many dams in the region, these structures are in need of repair and rehabilitation. Due to the high cost of repairing the structures, the owners are considering draining the lakes and removing the dams, to help prevent disasters such as those that occurred in Burlington County.

When dams are removed, the nature of hydrologic events in a watershed changes. Dams attenuate flows in the same manner as a stormwater detention basin, but on a much larger scale. The dams serve to regulate the flow of water leaving their reservoirs, and also act as sediment traps, catching silt that would otherwise be carried downstream. If a dam is totally removed, the flood control benefit and sediment trapping benefits may be lost.

The Upper Mantua Creek RSMP will address the issue of stormwater management changes resulting from dam removal in the watershed, and help develop strategies for minimizing adverse impacts.

The Gloucester and Camden County Soil Conservation Districts, Gloucester County Planning Division, and Rowan University have teamed together to develop the Regional Stormwater Management Plans for the Raccoon and Mantua Creeks. Over the next three years, the groups will conduct field assessments, stakeholder meetings, and modeling, and will prepare the RSMPs in consultation with the NJDEP.

For further information, contact Craig McGee, Project Director, at ***craig.mcgee@camdenscd.org***

A Municipal Stormwater Rule Primer (Cont.)

stormwater standards included in Rule 7:8.

- Comply with notice requirements for public participation in the program.
- Ensure operation and maintenance of Best Management Practices (BMPs) for stormwater from lands owned and operated by the municipality, and for stormwater BMPs installed in a new or redevelopment project.

12 Months from EDPA (Spring 2005):

- Prepare and implement a Stormwater Pollution Prevention Plan (SPPP), which describes how the SBRs will be implemented. SPPP requirements are in Rule 7:14A.
- Adopt a Stormwater Management (SWM) Plan in accordance with Rule 7:8, which describes how stormwater will be managed from new development
- Comply with new design standards for stormwater drain inlets installed by the municipality. Retrofit existing stormwater inlets during road repair, reconstruction and repaving.
- Initiate education program.
- Conduct monthly sweeping of roads in predominantly commercial areas, weather and road conditions permitting.
- Implement a stormwater facility maintenance program that includes yearly catch basin cleaning to ensure proper function of municipal stormwater facilities.
- Develop and implement comprehensive stormwater requirements for maintenance yards, including storage, vehicle fueling, vehicle maintenance and housekeeping.
- Develop and conduct employee training for appropriate employees covered by requirements in the general permit.

18 months from EDPA (Fall 2005):

- Adopt ordinances that provide for the control of pet waste, litter, improper waste disposal, wildlife feeding and yard waste. Adopt an ordinance that prohibits illicit connections to municipal stormwater systems.
- Develop a program to detect and eliminate illicit connections.
- Develop and implement programs to identify, stabilize and repair areas of roadside erosion, and to identify and remediate streambank scouring from outfall pipes.

24 months from EDPA or 12 months from adoption of the SWM Plan (Spring 2006):

- Adopt an ordinance to govern stormwater from new and re-development.
- Ensure operation and maintenance of BMPs for stormwater on non-municipal property.
- Ensure standards are met for storm drain inlets installed by non-municipal entities.

36 months from EDPA (roughly, April 2007):

- Implement a program to map all municipal stormwater outfall pipes to surface water in two phases. Complete first phase.
- Complete permanent structure to cover de-icing materials.

60 months from EDPA (roughly, April 2010):

- Map second phase of municipal stormwater outfall pipes to surface water.
- Complete labeling of all stormwater inlets near sidewalks, in plazas, parking areas and maintenance yards.

Additional Resources. Extensive additional information is available on the web to help municipalities and other regulated parties embrace and join in the effort to protect this precious resource. See: ***www.njstormwater.org***

George S. Hawkins, Esq. *is the Executive Director of the Stony Brook-Millstone Watershed Association and also teaches environmental law and policy at Princeton University. Since 1949, Stony Brook has provided a wide range of assistance on environmental issues to municipalities and citizens, and can be visited at* ***www.thewatershed.org****. This document is not intended to substitute for formal legal advice and municipalities should seek legal and technical counsel. This is an abridged version of a longer article that is available on the Association's website. You can reach George at* ***ghawkins@thewatershed.org***

A Word About Rain Gardens: Rain gardens, also known as ***bioretention systems***, originated in the Prince George's County, MD in 1990. Larry Coffman, head of the county environmental programs, was seeking cost effective, lower maintenance ways for improving infiltration for septic systems and for improving water quality in stormwater handling installations. In considering the concept of bioretention, or holding and filtering stormwater in plant systems, his team ultimately selected the term "rain gardens" to appeal to the public. Thus began a public movement to create garden areas imitating the function of natural filtering systems that development often removes. Plantings are selected for creation of an area where stormwater is stored to soak into the ground over time.

For more information on rain gardens see: Rain Gardens powerpoint tutorial at Rutgers Cooperative Extension website - click on "Stormwater Management Education Program" under hot topics *at* ***http://rwqp.rutgers.edu/univ/nj/*** as well as:
Information about raingardens with "Create a Garden" download and two raingarden designs: ***www.raingardens.org/Index.php***
Univ. of Wisconsin site featuring "Rain Gardens: A how-to manual for homeowners" ***http://clean-water.uwex.edu/pubs/raingarden/***
Gardening with Water Quality in Mind" ***www.mninter.net/~stack/rain/*** Raingarden Network ***www.raingardennetwork.com/***
The Bioretention Manual of Prince George's County, Maryland, is available at:
www.goprincegeorgescounty.com/Government/AgencyIndex/DER/PPD/LID/bioretention.asp?h=20&s=&n=50&n1=160

EPA Reference Materials Online

NPDES Stormwater Site - ***http://cfpub.epa.gov/npdes/home.cfm?program_id=6***
Green Landscaping with Native Plants for Municipal Officials - ***www.epa.gov/glnpo/greenacres/toolkit***
Stormwater Outreach Materials - ***http://cfpub.epa.gov/npdes/stormwatermonth.cfm***
Customizable Stormwater Brochures - ***http://cfpub.epa.gov/npdes/stormwatermonth.cfm#customize***
An Overview of Stormwater Modelling tools from EPA - ***http://www.forester.net/sw_0203_modeling.html***
Low-Impact Development and Polluted Runoff EPA Sites: ***www.epa.gov/owow/nps/lid/*** **and** ***www.epa.gov/owow/nps/urban.html***
Stormwater Program Overview - ***http://cfpub.epa.gov/npdes/home.cfm?program_id=6***
Graphic Presentations on Stormwater Management Slide shows can be found online at ***www.stormwatercenter.net/intro_slides.htm***

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New Jersey Flows

New Jersey Water Resources Research Institute

Dr. Joan G. Ehrenfeld,
Director
(732) 932-1081
ehrenfel@rci.rutgers.edu

Jeannine Der Bedrosian,
Editor
(732) 932-9632
NJWRRI@aesop.rutgers.edu

NJWRRI

NJAES
NEW JERSEY AGRICULTURAL EXPERIMENT STATION

IMPORTANT SUBSCRIPTION ANNOUNCEMENT
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NJ Water Resources Research Institute

Ecology, Evolution, and Natural Resources
Rutgers, The State University of New Jersey
Cook College
14 College Farm Road
New Brunswick, NJ 08901