# Asking the Right Questions in Stormwater Review

Rutgers Cooperative Extension (RCE) Water Resources Program
and
Association of New Jersey Environmental Commissions (ANJEC)

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# Rutgers Cooperative Extension

Rutgers Cooperative Extension (RCE) helps the diverse population of New Jersey adapt to a rapidly changing society and improves their lives through an educational process that uses science-based knowledge.

# Water Resources Program


The Water Resources Program is one of many specialty programs under Rutgers Cooperative Extension.

Our Mission is to identify and address community water resources issues using sustainable and practical science-based solutions.

The Water Resources Program serves all of New Jersey, working closely with the County Extension Offices.

# Environmental County Agents

The Environmental County Agents teach people new skills and information so they can make better informed decisions and improvements to their businesses and personal lives.

- Michele Bakacs, Middlesex and Union
- Pat Rector, Morris and Somerset
- Amy Rowe, Essex and Passaic
- Mike Haberland, Camden and Burlington
- Sal Mangiafico, Salem and Cumberland

# Association of NJ Environmental Commissions (ANJEC)

ANJEC's mission is to achieve responsible and sustainable use of New Jersey's natural resources through leadership, education, and support of environmental commissions and other local boards, public officials, environmental organizations and concerned citizens.

# Why are we here?

The approval of a developer's stormwater management plans lies **solely** with the municipality.

Since 2004, municipalities have been **required** under their *Municipal Stormwater General Permit* to enforce statewide basic requirements for post-construction stormwater management in new development and redevelopment.

# Purpose of Workshop

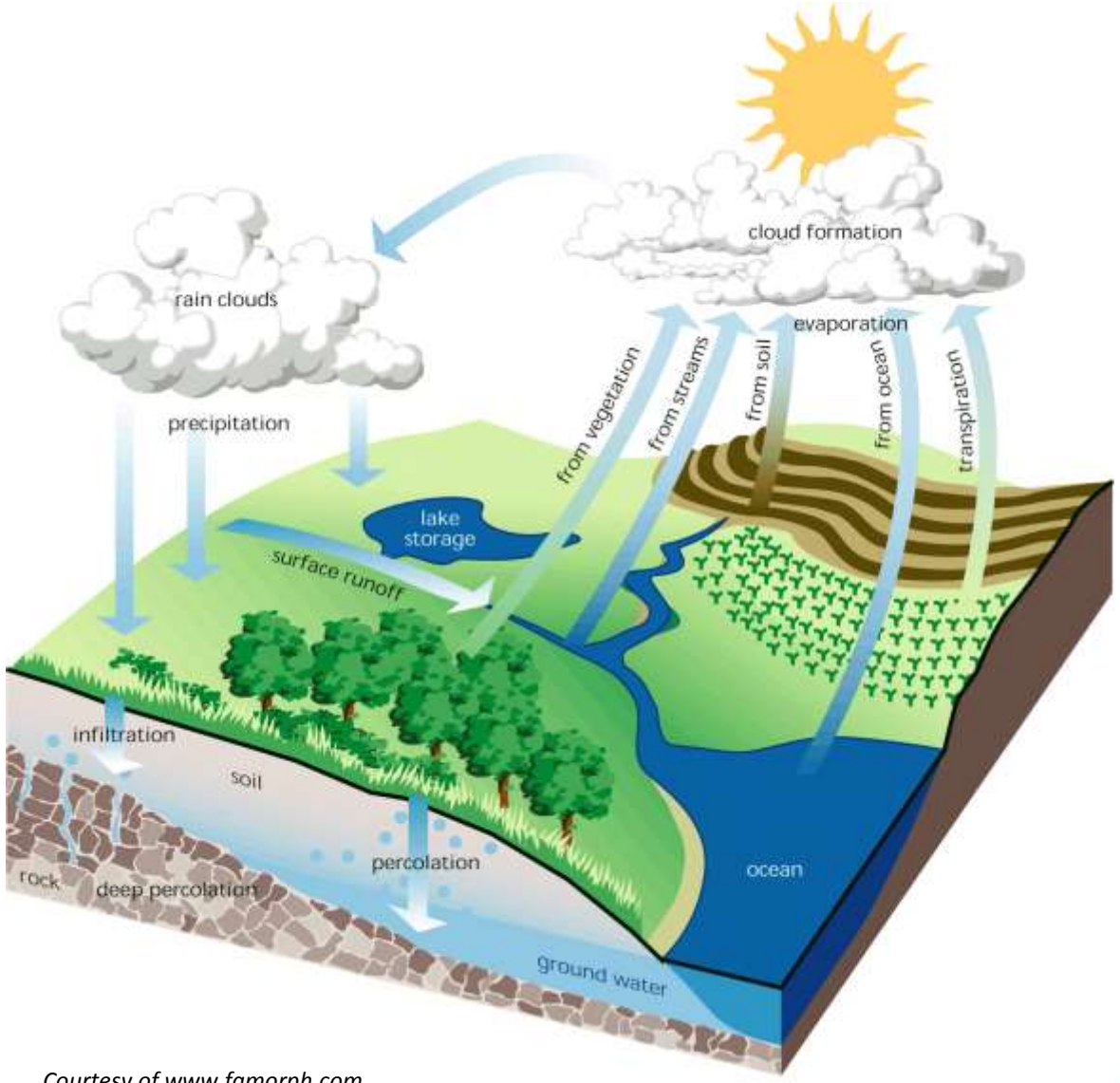
This workshop is intended to help you understand if a developer is in compliance with the NJ Stormwater Management Regulations so you can be comfortable in approving or rejecting the developer's plan.

# What happens to the rain?

# What is stormwater?

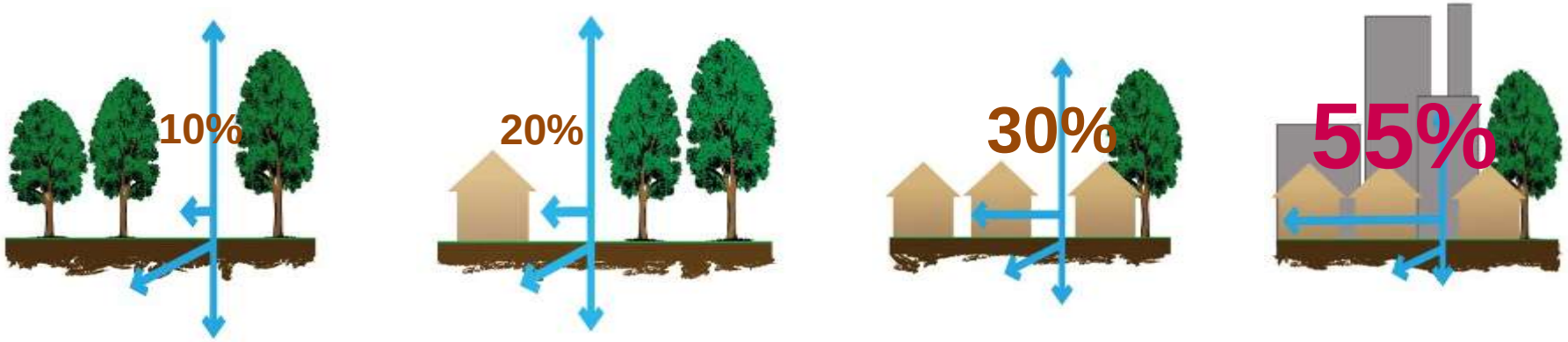
Stormwater is the water from rain or melting snows that can become “runoff,” flowing over the ground surface and returning to lakes and streams.

# Hydrologic Cycle




*Courtesy of www.fgmorph.com*

# The Impact of Development on Stormwater Runoff




*More development* → *More impervious surfaces* → *More stormwater runoff*

# What is impervious cover?

Roads, rooftops, parking lots, and other hard surfaces that do not allow stormwater to soak into the ground.

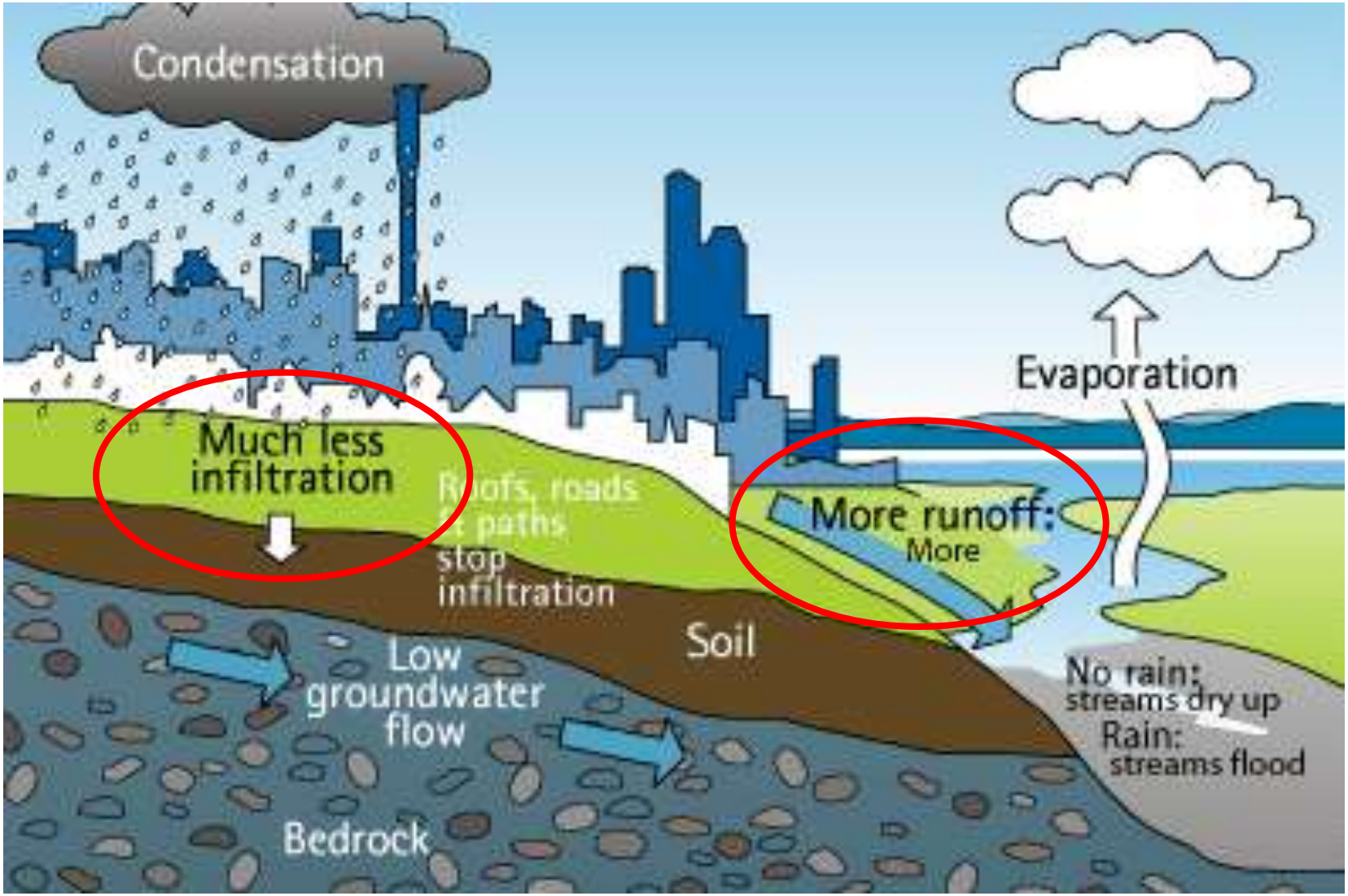
- provides a surface for accumulation of pollutants
- leads to increased polluted runoff and flooding
- inhibits recharge of groundwater

# Impacts from a Changing Landscape -

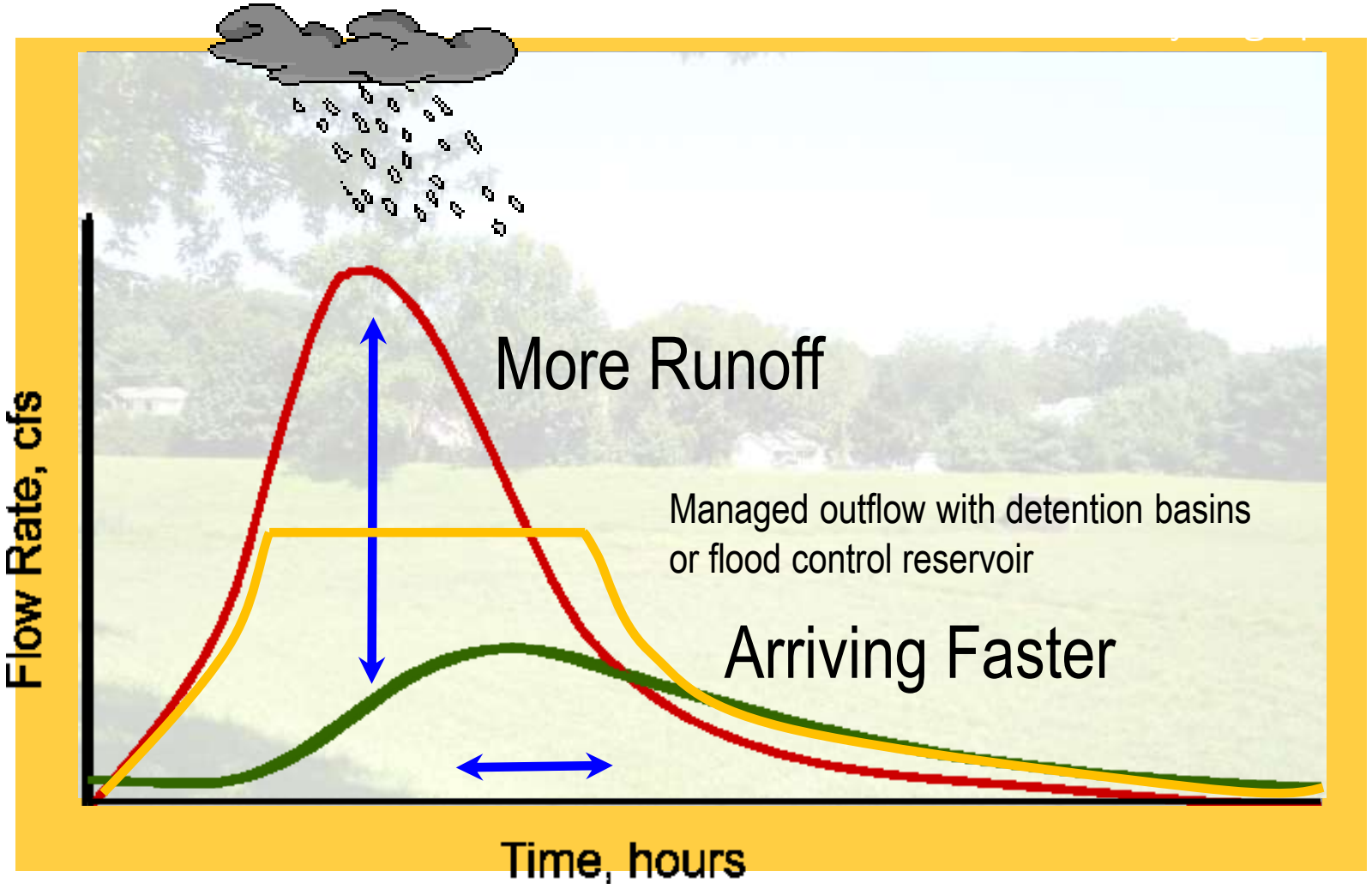
## *Increases in impervious cover leads to:*

- More stormwater runoff volume
- Higher peak stormwater runoff rates
- Increased nonpoint source pollution
- Less groundwater recharge

# The Urban Hydrologic Cycle



# The Science of Stormwater




Slide Courtesy of Bill Hunt, NEMO

# History of Stormwater Management

# 1st Attempt at Stormwater Management

***Capture all runoff, pipe it, and send it directly to the river . . .prior to mid 1970's***

# 2nd Iteration of Stormwater Management

***Capture runoff, detain it, release it slowly to the river…mid 1970's to 2004***

- Detain peak flow during large storm events
- Reduce downstream flooding during major storms
- Use concrete low flow channels to minimize erosion, reduce standing water, quickly discharge low flows
- Does not manage runoff from smaller storms
- Directly discharges stormwater runoff to nearby stream, waterway, or municipal storm sewer system (at a controlled/managed rate)

# 2004 NJ Stormwater Regulations

## Municipal "Phase II" NJPDES Stormwater Permitting Rules (N.J.A.C. 7:14a)

- Municipalities and large public complexes must obtain NJPDES permits for their storm sewer system
- Permittees must develop, implement, and enforce a stormwater program that protects water quality
- Permittees must prepare and implement a Stormwater Pollution Prevention Plan (SPPP):
  - Municipal stormwater management plan
  - stormwater control ordinance
  - public education program

## Stormwater Management Rules (N.J.A.C. 7:8)

- Sets forth stormwater management goals for new development:
  - Reduce flood damage
  - Reduce soil erosion
  - Protect public safety through proper design and operation of stormwater management basins
  - Minimize increases in peak runoff
  - Maintain groundwater recharge
  - Protect water quality
- Sets forth the required components of regional and municipal stormwater management plans

# 3rd Generation of Stormwater Management

- Reduce peak flows

**….and….**

- Maintain infiltration and groundwater recharge
- Reduce pollution discharged to local waterways

*abc Action News, August 27, 2012*

# How NJ's regulations change the way we manage stormwater

# QUESTIONS?

# Stormwater Management Key Objectives

- Use nonstructural management strategies
- Protect communities from increases in stormwater volume and peak flows as a result of new development
- Maintain groundwater recharge
- Protect waterways from pollution carried in stormwater runoff

*NJ.com, August 28, 2011*

# New Jersey Stormwater Management Rules

- Rules apply to any "Major Development" defined as a project disturbing more than 1 acre or increasing impervious surfaces by ¼ acre or more
- Design and Performance Standards established in NJAC 7:8-5, for:
  - Nonstructural Stormwater Management Strategies
  - Stormwater Quantity
  - Groundwater Recharge
  - Stormwater Quality
  - Stormwater Maintenance Plan

# Nonstructural Strategies

- Plan the project using Low Impact Development (LID) Principles
- Collect, infiltrate and where possible reuse stormwater near its source
- Capture runoff from small storm events in vegetated systems to protect water quality and promote recharge
- Minimize and disconnect impervious surfaces

# Stormwater Quantity Performance Standards

## *Stormwater Quantity*

- Demonstrate that post-development 2, 10, and 100-year storm event hydrographs do not exceed pre-development hydrographs

***or***

- Demonstrate that hydrograph peaks will not increase and that increase in volume or change in timing won't increase flood damage downstream

***or***

- Design stormwater management measures so that 2, 10, and 100-year pre-development hydrographs are reduced to 50%, 75%, and 80%, respectively
  - 2-year rainfall (3.3 inches)
  - 10-year rainfall (5.0 inches)
  - 100-year rainfall (8.3 inches)

# Groundwater Recharge Performance Standards

***Groundwater Recharge***

- Maintain 100% of average annual groundwater recharge volume

***or***

- Infiltrate increase in the post development runoff volume for the 2-year storm

# Stormwater Quality Performance Standards

***Water Quality***

- Install stormwater best management practices (BMPs) to reduce at least 80% of total suspended solids (TSS) loads
- Install BMPs to provide nutrient removal to maximum extent feasible

| BMP | TSS Removal Rate |
|---|---|
| **Bioretention** | **90%** |
| **Constructed Wetlands** | **90%** |
| **Forested Buffers** | **70%** |
| **Extended Detention Basin** | **40-60%** |
| **Infiltration Structure** | **80%** |
| **Sand Filter** | **80%** |
| **Vegetative Filter Strip** | **50%** |
| **Wet Pond** | **60-90%** |

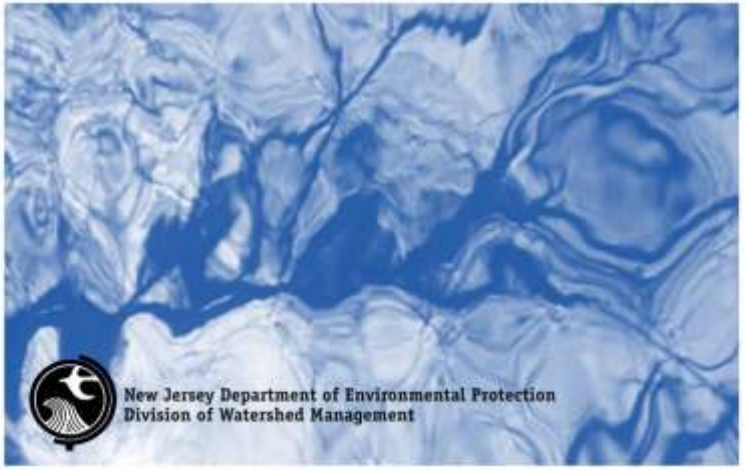
SOURCE: NJ Stormwater Management Rules and BMP Manual

# NJ Stormwater Guidance

**Tier A**

**Municipal Stormwater Guidance Document**
NJPDES General Permit No NJ0141852


New Jersey
**Stormwater**
**Best Management Practices Manual**




For more information, visit: [www.njstormwater.org](http://www.njstormwater.org)

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# QUESTIONS?

The approval of a developer's stormwater management plans lies **solely** with the municipality.

# As municipal officials…what is NOT your responsibility…

- You do **NOT** need to know how to meet required nonstructural management strategies
- You do **NOT** need to know how to design or use BMPs
- You do **NOT** need to know how to maintain BMPs

# The Role of Municipal Officials…

- You need to know how to ask the right questions of the professionals and the applicant
- Clearly understand that all applicants have to satisfy standards for:
  - Nonstructural Stormwater Management Strategies
  - Stormwater Quantity
  - Groundwater Recharge
  - Stormwater Quality
  - Stormwater Maintenance Plan
- Have confidence that your questions have been adequately answered by the professionals and the applicant so that approval can be given

# Who approves a developer's stormwater management plan?

The approval of a developer's stormwater management plans lies **solely** with the municipality.

A permit from NJDEP is **not** an approval of the applicant stormwater management plan.

ONLY the municipality can approve a developers stormwater management plan.

# Bottom line - what does the developer really need to do?

1. Maintain groundwater recharge on the site
2. Reduce sediment and nutrient runoff from the site
3. Reduce the peak stormwater runoff rates from the site

# How should a developer do this?

**1st** Use Nonstructural Strategies to achieve 1, 2, and 3

# Nine Nonstructural Strategies

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
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**
9. Provide other source controls to prevent or minimize the use or exposure of pollutants at the site to prevent or minimize the release of those pollutants into stormwater runoff

# 9 Strategies to 4 Categories

1. Vegetation and Landscaping
   - ✓ Preservation of natural areas (forested areas, riparian corridors, high recharge areas)
   - ✓ Native ground cover (limit turf grass areas)
   - ✓ Vegetative filters and buffers (protect them or plant new ones)

2. Minimizing Site Disturbance
   - ✓ Fit the development into the terrain
   - ✓ Minimize clearing and grading
   - ✓ Minimizing soil compaction
   - ✓ Build on low permeability soil areas

3. Impervious Area Management
   - ✓ Minimum street widths and sidewalks
   - ✓ Limit parking and driveway areas
   - ✓ Use pervious paving materials
   - ✓ Disconnect impervious surfaces from draining directly to waterways
   - ✓ Vegetated roofs

4. Time of Concentration Modifications (slow down runoff)
   - ✓ Surface roughness changes
   - ✓ Slope reduction
   - ✓ Vegetated conveyances

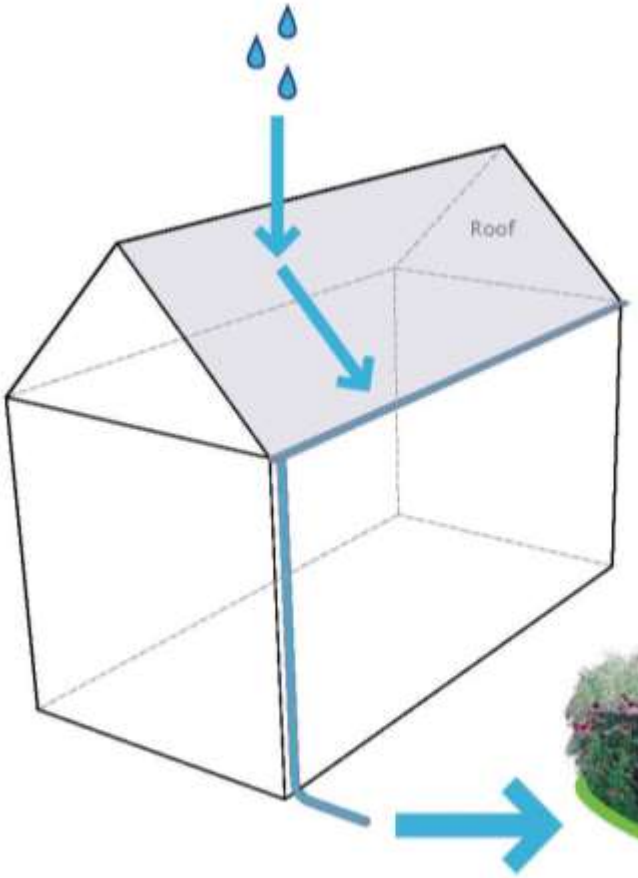
# #1 Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss


Vegetative Buffers

# #2: Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces

# Disconnected Impervious Surfaces

# The Solution…




PLACE A STORMWATER BEST MANAGEMENT PRACTICE (BMP) BETWEEN IMPERVIOUS AREAS AND THE STORM SEWER SYSTEM

REDUCE THE AMOUNT OF RUNOFF ENTERING STORM SEWERS


Rooftop runoff is now ***"disconnected"*** from flowing directly into the storm sewer system

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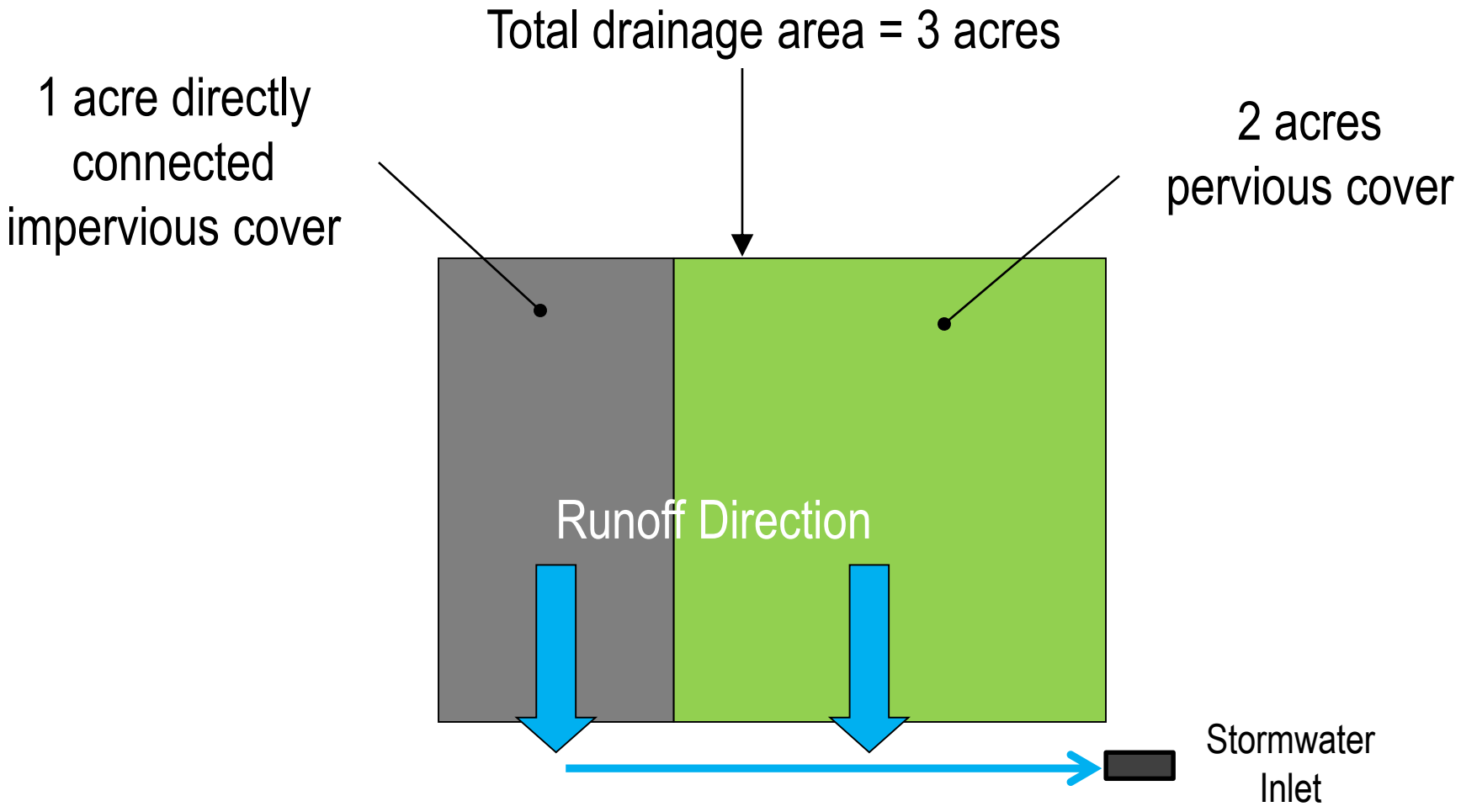
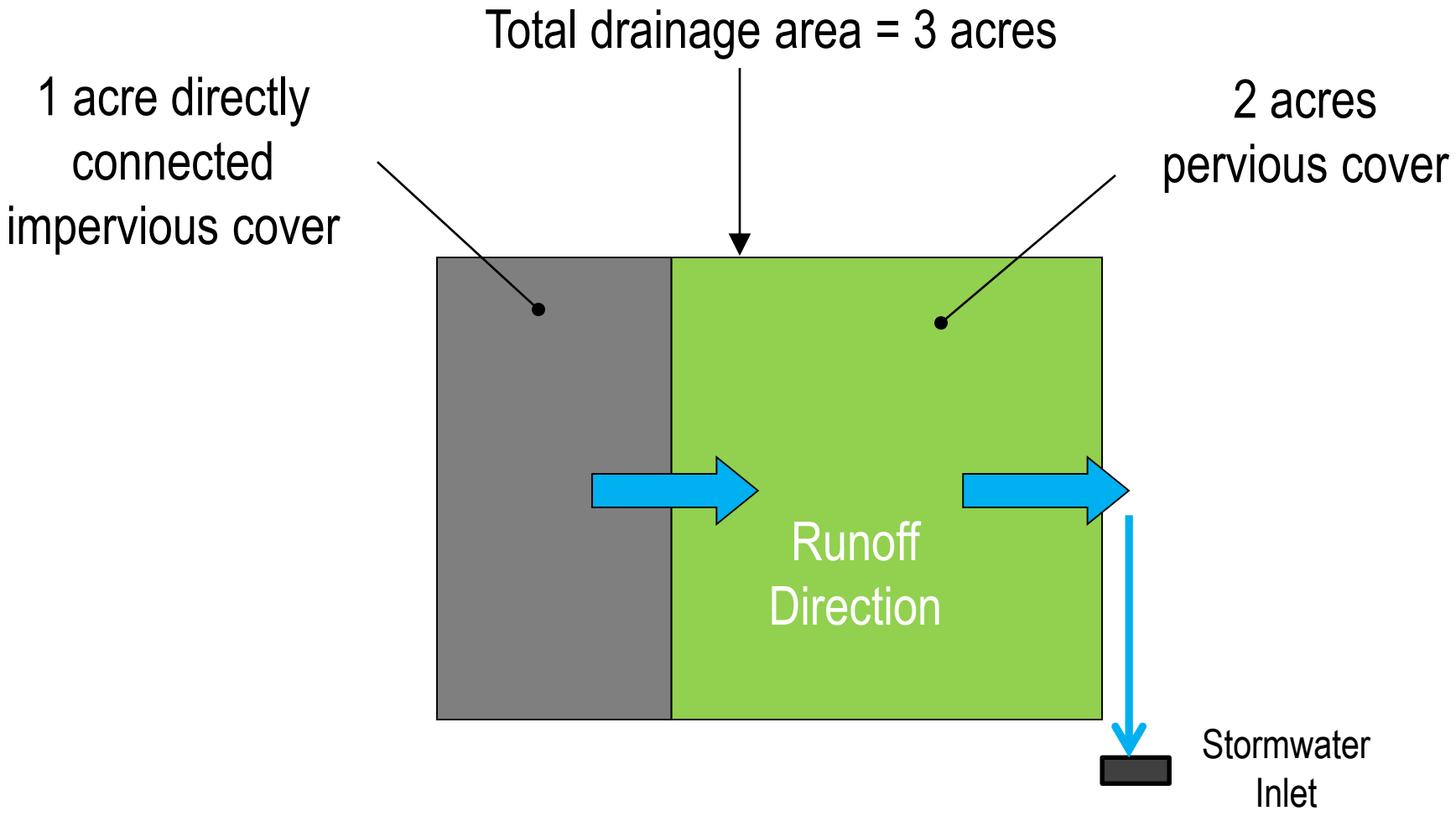
For 1.25 inch storm, 3,811 cubic feet of runoff = **28,500 gallons**



For 1.25 inch storm, 581 cubic feet of runoff = **4,360 gallons**



| | Volume of Runoff | | |
|---|---|---|---|
| **Design Storm** | **Connected (gallons)** | **Disconnected (gallons)** | **Percent Difference** |
| 1.25 inches (water quality storm) | 28,500 | 4,360 | 85% |

Impervious area is now ***"disconnected"*** from flowing directly into the storm sewer system

# #5 Minimize land disturbance including clearing and grading

# Preserving Natural Lands

# Not Preserving Natural Lands

# #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


Vegetated Conveyances

| 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 | | |

**Explain why any one of these is "NO." Engineering, environmental and/or safety reasons are only acceptable.**

# NONSTRUCTURAL STORMWATER STRATEGIES (NJAC 7:8-5.3)

1. **Has the applicant identified the Nonstructural Stormwater Strategies which are incorporated into Project and where they are located on the plans?**

   If "YES" go to Question #2, If "NO" go to Question #3.

2. **Have the strategies been integrated into the design to the maximum extent practicable?**

   This can be determined if the applicant has submitted a completed Low Impact Development (LID) Checklist. Has the applicant submitted a completed LID Checklist? If yes, skip to question #4 . If no, the application is incomplete because we cannot determine if the applicant has satisfied the "maximum extent practicable" requirement at this time. Please resubmit at your earliest convenience with the completed LID Checklist.

# NONSTRUCTURAL STORMWATER STRATEGIES (NJAC 7:8-5.3)

3. **Has the applicant submitted justification to why none of the nine strategies can be incorporated into the site design (environmental, engineering, safety reasons)?**

   Has the applicant provided written justification as to why the site design cannot incorporate any of the ***nine*** nonstructural stormwater management strategies? If sufficient justification has not been submitted describing why the strategies could not be used, the application is incomplete at this time.

4. **If the applicant submitted the LID Checklist, does it indicate that "Proposed Nonstructural Measures are Adequate"?**

   If yes, the applicant should be asked to briefly describe what nonstructural stormwater strategies have been used to meet the requirement. Then go to Question #5.

   If no, the application is incomplete at this time.

# NONSTRUCTURAL STORMWATER STRATEGIES (NJAC 7:8-5.3)

5. **Has the applicant satisfied the deed restriction requirement for land that contains nonstructural management strategies?**

   If yes, the application is acceptable.

   If no, the application is incomplete at this time. It can be deemed acceptable contingent upon obtaining the appropriate deed restrictions.

# Bottom line - what does the developer really need to do?

1. Maintain groundwater recharge on the site
2. Reduce sediment and nutrients runoff from the site
3. Reduce the peak stormwater runoff from the site

# How should a developer do this?

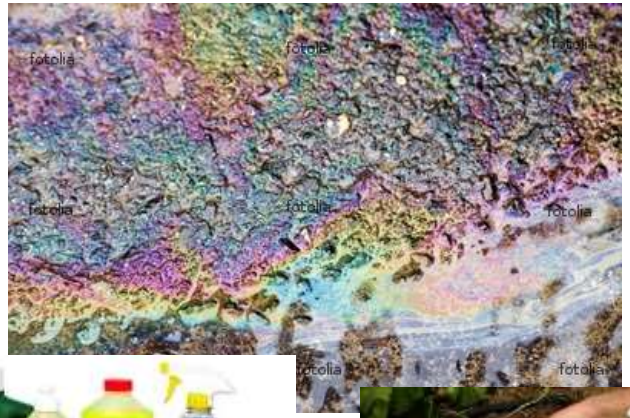
**2nd.** Focus on incorporating systems that address water quality and groundwater recharge

# Nonpoint Source Pollution

- Nonpoint Source (NPS) Pollution is pollution associated with stormwater runoff
- NPS occurs when runoff collects pollutants on its way to a collection system or water body
- NPS pollution cannot be traced to a direct discharge point such as a wastewater treatment facility

# Examples of NPS

- Oil and grease from cars
- Fertilizers
- Animal waste
- Grass clippings
- Septic systems
- Sewage leaks
- Household cleaning products
- Litter
- Agriculture
- Sediment



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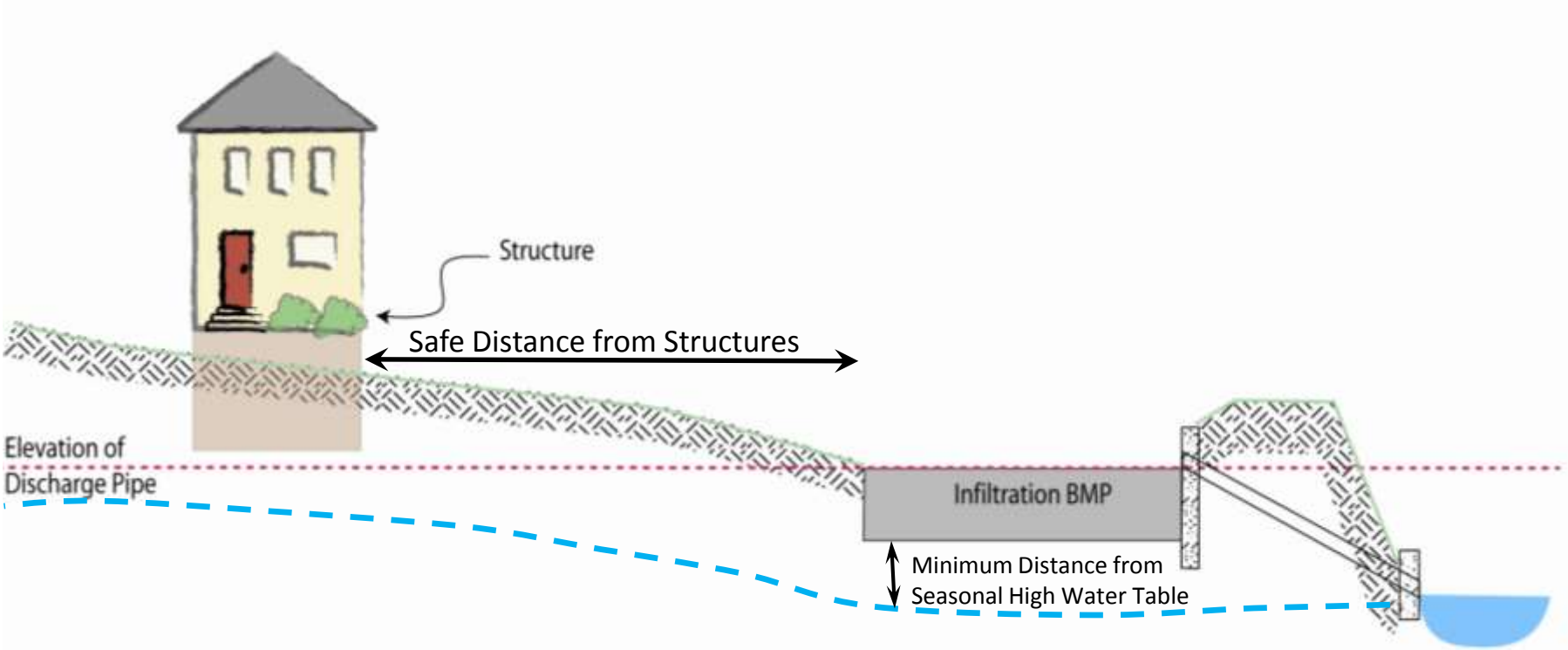
# Impact of NPS

- Fish and wildlife
- Recreational water activities
- Commercial fishing
- Tourism
- Drinking water quality

# Groundwater Recharge Requires…

- Healthy soils
  - Permeability
  - Hydraulic conductivity
- Vertical separation from seasonable high water table or groundwater table
- Suitable distance from foundations, basements and septic systems

# Groundwater Recharge…

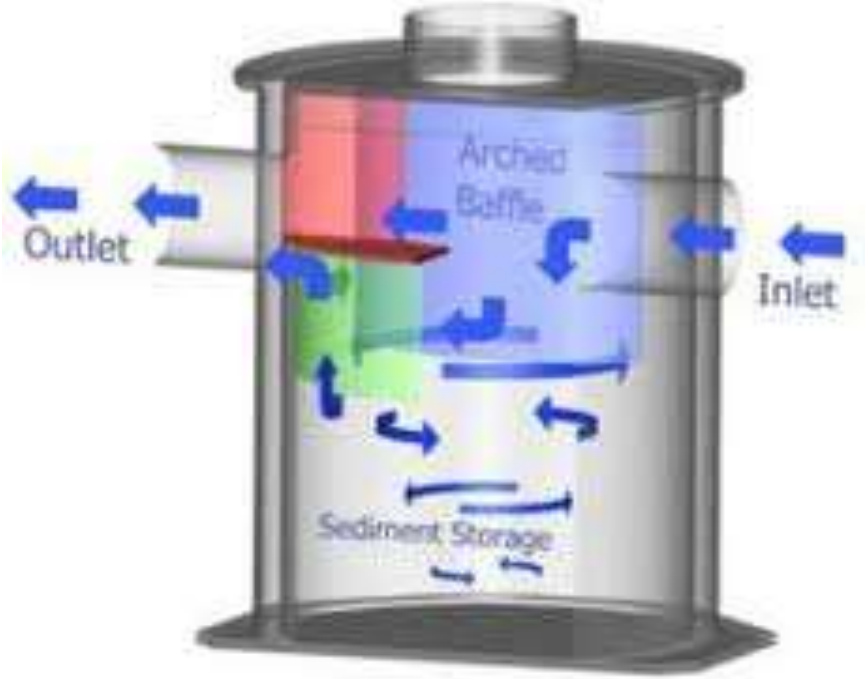


# Bioretention Systems

# 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 |
| Sand Filter | 80 |
| Vegetative Filter Strip | 60-80 |
| Wet Pond | 50-90 |
| Manufactured Treatment Device | See N.J.A.C. 7:8-5.7(d) |

# Manufactured Treatment Devices (off-line devices)




http://www.njstormwater.org/treatment.html

# GENERAL STORMWATER RUNOFF CALCULATION QUESTIONS

1. **Has the applicant demonstrated that the pre-construction conditions have been unchanged for at least the last five years?**
   If yes, go to Question #3. If no, go to Question #2.

2. **Has the applicant used wooded land use, good hydrologic condition in their pre-construction condition for stormwater runoff calculations?**
   If yes, go to Question #3. If no, application is incomplete at this time.

3. **Has the applicant calculated runoff from disconnected impervious cover, connected impervious cover, and pervious cover independently?**
   If yes, go to Question #4. If no, application is incomplete at this time.

4. **Has the applicant demonstrated compliance with the design and performance standards established under the Soil Erosion and Sediment Control Act?**
   If yes, go to next section. If no, application is incomplete at this time.

# WATER QUALITY (NJAC 7:8-5.5)

1. **Has the applicant used stormwater management measures to maintain or improve water quality?**
   If yes, go to Question #2. If no, application is incomplete at this time.

2. **Has the applicant used Best Management Practices to reduce the post-construction total suspended solids (TSS) load by 80%?**
   If yes, go to Question #3. If no, application is incomplete at this time.

3. **Has the applicant used the NJDEP approved protocols in calculating the pollutant load reductions?**
   If yes, go to Question #4. If no, application is incomplete at this time.

4. **Has the applicant used the NJDEP TSS Removal Rates from Table 2 of the regulations in calculating the pollutant load reductions?**
   If yes, go to Question #6. If no, go to Question #5.

# WATER QUALITY (N.J.A.C. 7:8-5.5)

5. **Has the applicant provided the sufficient documentation demonstrating the capability of these alternative removal rates and methods of calculating removal rates to achieve the required TSS pollutant load reduction?**
   If yes, go to Question #9. If no, application is incomplete at this time.

6. **Is the applicant using infiltration systems to achieve the required TSS pollutant load reductions?**
   If yes, go to Question #7. If no, go to Question #9.

7. **Does the infiltration system satisfy the design standards for the minimum depth to Seasonal High Water Table (SHWT) , infiltration rates, and 72-hour drain time?**
   If yes, go to Question #8. If no, application is incomplete at this time.

8. **Has the applicant followed the soil testing criteria as outlined in the NJDEP BMP Manual to collect information for the design of the infiltration system?**
   If yes, go to Question #9. If no, application is incomplete at this time.

# WATER QUALITY (N.J.A.C. 7:8-5.5)

9. **Have manufactured treatment devices (MTDs) been used to meet the water quality requirement?**
   If yes, go to Question #10. If no, go to Question #12.

10. **Have these devices' pollutant removal rates been: 1) verified by NJCAT and 2) certified by NJDEP?**
    If yes, go to Question #11. If no, application is incomplete at this time.

11. **Are these devices being proposed as off-line devices?**
    If yes, go to Question #12. If no, application is incomplete at this time unless the Department has issued a letter to indicate that the device can be used as an on-line water quality device.

12. **Are there special water resource protection areas that the developed site discharges to?**
    If yes, go to Question #13. If no, go to the next section.

13. **Has the applicant demonstrated compliance with the NJDEP requirements for the preservation and maintenance of these special water resource protection areas?**
    If yes, go to next section. If no, application is incomplete at this time.

# GROUNDWATER RECHARGE (NJAC 7:8-5.4(a)2) see also NJGS GSR-32 – guidance document

1. **Does the groundwater recharge requirement apply to this project?**

   If no, continue with Question #2. If yes, continue to Question #3.

2. **Has the applicant provided the required information to justify that they are exempt from this requirement?**

   If yes, skip groundwater recharge requirement, applicant is exempt from meeting this requirement. If no, the application is incomplete.

3. **Has the applicant demonstrated that the site and its stormwater management measures maintain 100% of the annual average pre-construction groundwater recharge volume?**

   If no, go to Question #4. If yes, go to Question #5.

# GROUNDWATER RECHARGE (NJAC 7:8-5.4(a)2) see also NJGS GSR-32 – guidance document

4. **Has the applicant demonstrated that the increase of stormwater runoff volume from pre- to post-construction condition for the 2-year storm is infiltrated?**

   If no, application is incomplete at this time. If yes, go to Question #5.

5. **Have the recharge calculations been performed in accordance with the NJDEP requirements outlined in the stormwater management regulations?**

   NJDEP has provided a spreadsheet for completing these calculations.

   If no, application is incomplete at this time. If yes, go to Question #6.

6. **Has the applicant demonstrated that the proposed infiltration stormwater management practices avoid adverse hydraulic impacts?**

   If no, application is incomplete at this time. If yes, go to next section.

# Bottom line - what does the developer really need to do?

1. Maintain groundwater recharge on the site
2. Reduce sediment and nutrients runoff from the site
3. Reduce the peak stormwater runoff from the site

# How should a developer do this?

**3rd.** Design systems that reduce peak stormwater runoff rates and meet water quantity requirements.

# WATER QUANTITY (NJAC 7.8-5.4(a)3)

1. **Has the applicant calculated stormwater runoff using NJDEP approved assumptions and factors?**

   These assumptions and factors can be found in the regulations under section NJAC 7:8-5.6. The Township Engineer or Review Engineer should be able to verify that the calculations were done correctly.

   If yes, go to Question #2. If no, application is incomplete at this time.

# WATER QUANTITY (NJAC 7.8-5.4(a)3)

2. **Has the applicant calculated the pre and post-construction peak runoff for the 2-year, 10-year, and 100-year storm events?**

   If yes, has the applicant demonstrated compliance with ONE of the following requirements?

   a. Has the applicant submitted adequate hydrologic and hydraulic analyses demonstrating the post-construction runoff hydrographs (2-yr, 10-yr, and 100-yr) do not exceed the corresponding pre-construction hydrographs?

   b. Has the applicant submitted adequate hydrologic and hydraulic analyses demonstrating that there is no increase as compared to the pre-construction condition in the peak runoff rates leaving the site (2-yr, 10-yr, and 100-yr) and that the increase volume or change in timing will not increase flood damage at or downstream of the project site.

   c. Has the applicant submitted adequate hydrologic and hydraulic analyses demonstrating that the post-construction peak runoff rates (2-yr, 10-yr, and 100-yr) are 50%, 75%, and 80% respectively of the pre-construction runoff rates.

   If the applicant has NOT demonstrated compliance with one of the requirements outlined above, the application is incomplete at this time.

# STRUCTURAL/MAINTENANCE

1. **Have all structural stormwater measures complied with minimum outlet orifice requirements?**

   A minimum 2.5” diameter is required.

   If yes, go to Question #2. If no, application is incomplete at this time.

2. **Has the applicant provided a maintenance plan for all stormwater management measures?**

   If yes, go to Question #3. If no, application is incomplete at this time.

3. **Does the maintenance plan include: tasks, schedules, cost estimates, and contact information for the responsible party?**

   If yes, go to Question #4. If no, application is incomplete at this time.

4. **If maintenance is identified as being required by an entity other than the developer is there a copy of agreement included with the application?**

   If yes, go to the next section. If no, application is incomplete at this time.

# SAFETY

1. **Are safety standards included in the Engineering Report?**

   If yes, go to Question #2.  If no, application is incompleteat this time.

2. **Has the trash rack on all outlet structures been designed in accordance with NJDEP requirements?**

   The average velocity is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocities greater than 2.5 feet per second are unacceptable.

   If yes, go to Question #3.  If no, application is incompleteat this time.

3. **Has the overflow grate in the outlet structure been designed in accordance with NJDEP requirements?**

   The perpendicular live loading on the grate must withstand 300 lbs per square foot. The overflow grate spacing should be not greater than 2 inches across the smallest dimension.

   If no, application is incompleteat this time.

# Summary

The best way for an applicant to meet the NJ Stormwater Management regulations is to:

1. Incorporate *nonstructural* strategies
2. Address water *quality* and groundwater *recharge* requirements
3. Ensure that proposed designs meet water *quantity* requirements

# One Last Question:

Who approves the developer's stormwater management plan?

**YOU DO!**

# How do we integrate these tools into the review process?

- All questions should be publicly available for all applicants, review engineers, and residents
- Members of the planning and/or zoning boards and/or environmental commission should be prepared to ask these questions of the Township's review engineer and applicant
- Understand that these questions outline the minimum requirements as defined in the NJ Stormwater Management Rules

# Questions?

Rutgers Cooperative Extension Water Resources Program

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