

Don't Treat Your Soil Like Dirt! The Laws & Rules in NJ

Christine R. Raabe, District Director



2014



1935



"The nation that destroys its soil, destroys itself!" FDR, 1937

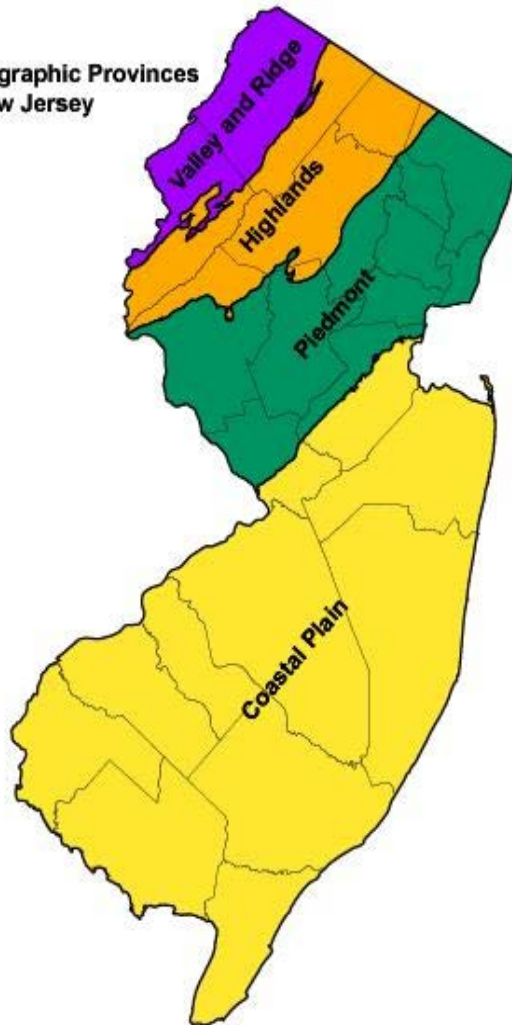


- Conservation districts in the United States trace their formation to the 1930s, when national attention was focused on the crisis of the Dust Bowl. Congress passed Public Law 46 in 1935, declaring soil and water conservation a national policy, and in 1937, President Franklin D. Roosevelt recommended that states allow landowners to form soil and water conservation districts. Today, there are close to 3000 conservation districts across the country.

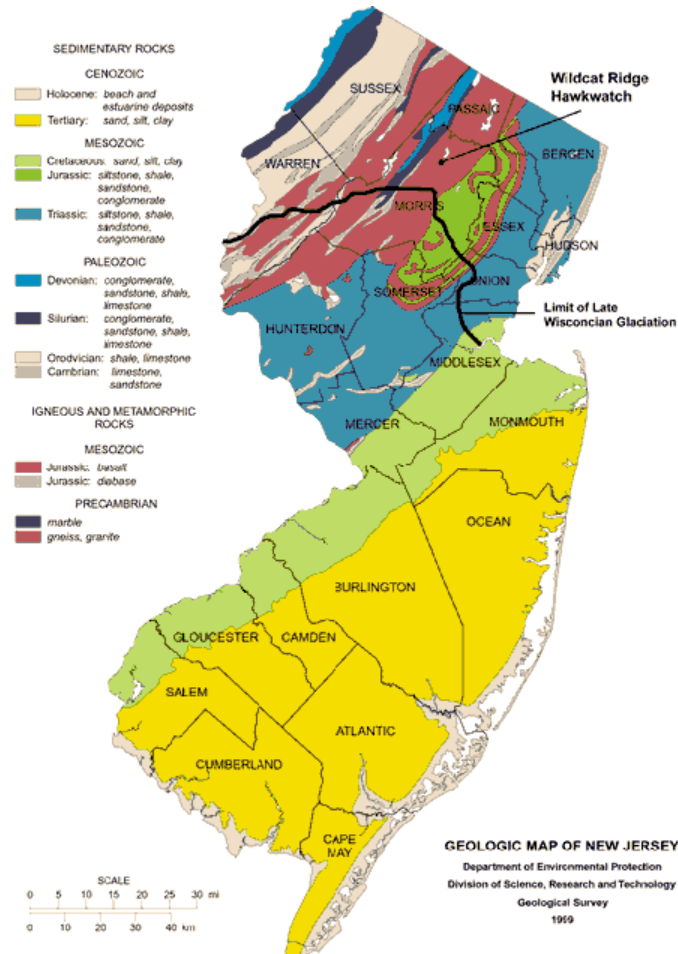
- Early 1930s – Great Depression rocked the country
- Dust Bowl – unparalleled ecologic and agricultural disaster that drove people from their homes
- In 1933, FDR summoned Hugh Hammond Bennett, a soil scientist, to the White House to see what could be done
- Bennett told FDR that 100 million acres had lost its topsoil, nearly half had been destroyed and could never be farmed again
- FDR gave Bennett \$5 million in relief funds to start the Soil Erosion Service, a temporary agency intended to provide relief & help people “heal their land.”

New Jersey is a Diverse Landscape - Land use decisions are (or should be) site specific

Physiographic Provinces
Of New Jersey



County boundaries for reference only.



History of Erosion and Sediment Control Regulations



- ▶ State Program Development - Soil Conservation Act - 1937
- ▶ EPA Clean Water Act/NPDES
- ▶ New Jersey's Erosion and Sediment Control Act of 1975 (Chapter 251) amended "to apply conservation practices to urban development" Threshold - 5000 square feet or more of soil disturbance
- ▶ Standards for Soil Erosion and Sediment Control - newest version 2014 & updates 2017
- ▶ New Jersey General Permit for Construction (stormwater discharge permit 1 acre or more)

Conservation Program in NJ

- 1937 1st legislation passed in response to Federal Soil Conservation Law
 - State Soil Conservation Committee (SSCC) formed
 - Primary emphasis on controlling soil erosion on farmland
- SSCC returned to Department of Agriculture in 1959
- 1976 expansion to include Soil Erosion and Sediment Control program (aka Chapter 251)
 - Primary emphasis on controlling soil erosion on construction activities (greater than 5,000 square feet)
 - Standards - Amended 8 times (most recently 2017)

<https://www.state.nj.us/agriculture/divisions/anr/nrc/njerosion.html>

History of the Act

- **Approved Nov 12, 1975; Ch 251, PL 1975, Effective Jan 1, 1976**
Regulated activities subject to Construction Permit, established Exemption for 1 SF Lot
- **Amended October 18, 1977; Ch 264, PL 1977**
Increased District Board to 5 Members; Aligned references to the State Uniform Construction Code
- **Amended Feb 27, 1980; Ch 459, PL 1979**
Expanded definition to virtually all land disturbances 5,000 sq/ft; provided for Legal Services; Required CO's subject to ROC's

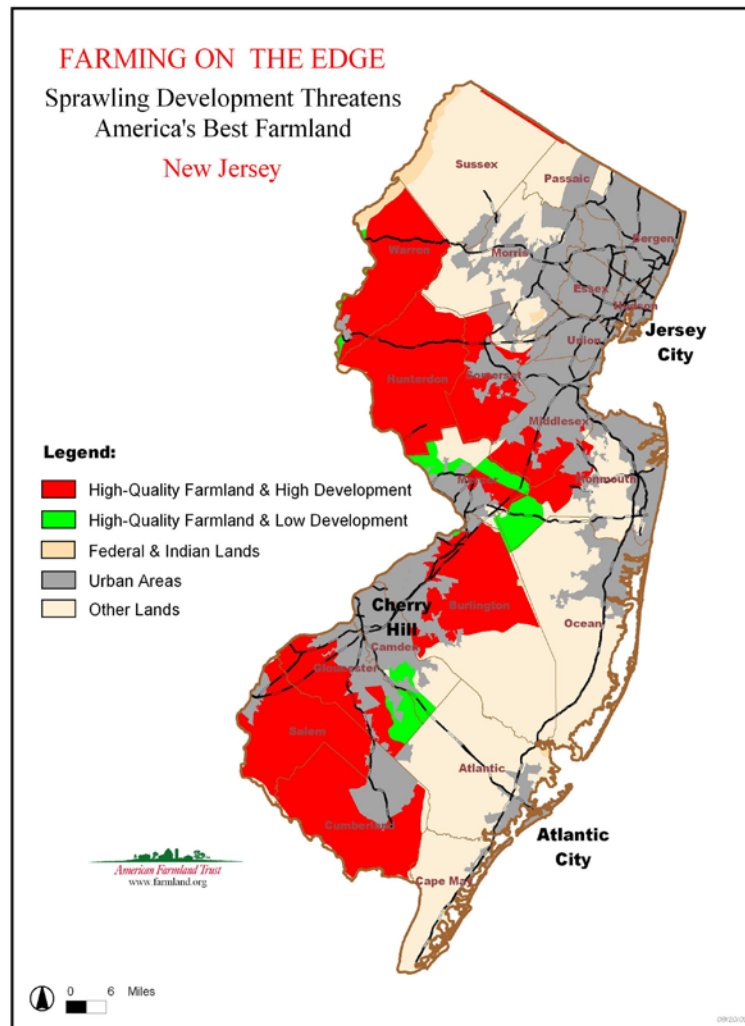
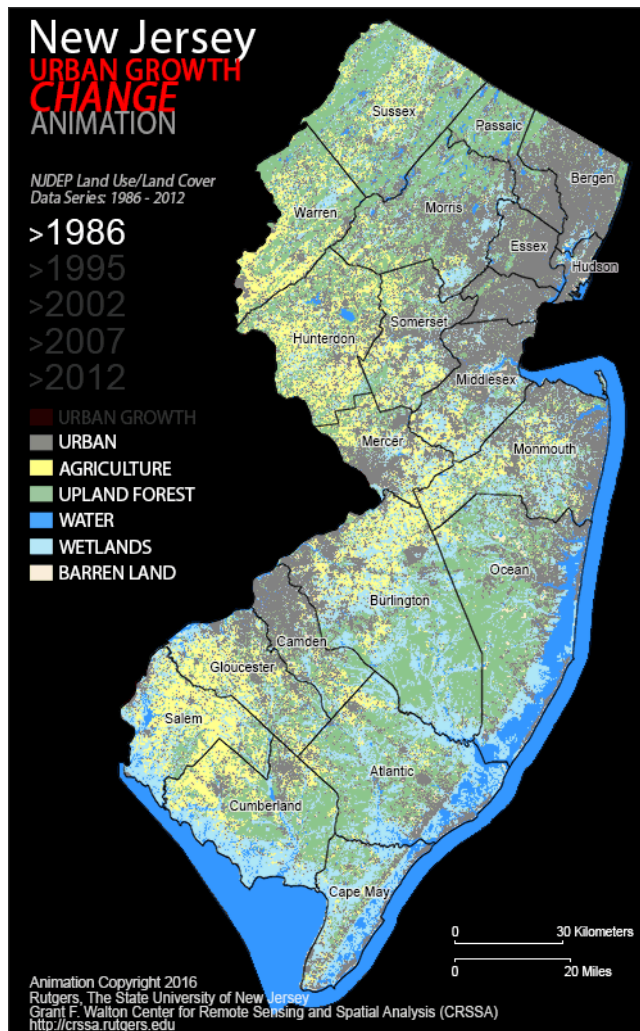
Administrative Rules

N.J.A.C. 2:90-1 et seq.

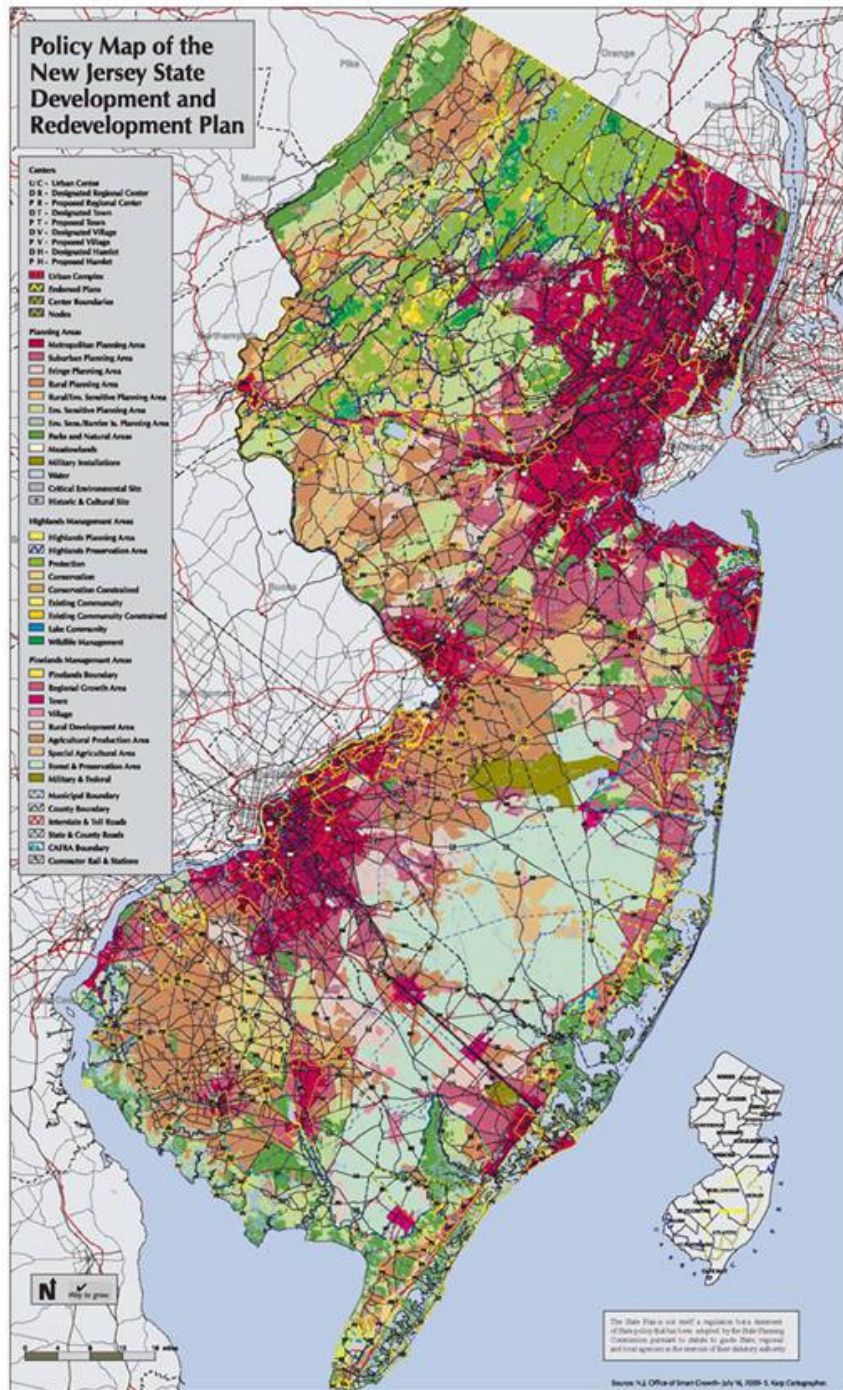
In 1975, due to serious erosion and sedimentation problems arising from urban development, the New Jersey State Legislature enacted Chapter 251, P.L. 1975, the Soil Erosion and Sediment Control Act.

This legislation mandated that a municipality cannot issue a construction permit unless the local soil conservation district has reviewed and certified a soil erosion and sediment control plan for that construction.

Urban Growth Animation: 1986-2012 and Results



http://www.crssa.rutgers.edu/projects/lc/NJUrbGrwoth8612_animation.html



Seeing “RED”

Urban Complex

Metropolitan
Planning Area

Regional Growth
Area

Towns

“Villages”

www.NJFuture.org

Soil Erosion and Sediment Control Act

N.J.S.A. 4:24-39 et seq.

The Ocean County Soil Conservation District (OCSCD) is one of fifteen districts in New Jersey established under Chapter 24, Title 4 of the revised statutes of 1937.

This legislation declared the policy of the Legislature through the State Soil Conservation Committee and local soil conservation districts, and provides for conservation of soil and water resources and the control and prevention of soil erosion in New Jersey.

Local districts are responsible for conservation programs within their geographic areas as covered by the political boundaries of their respective counties.

A Board of Supervisors, five local residents who are recommended by a local nominating committee and appointed by the State Soil Conservation Committee, administers each district.

The SESC Standards are a blend of agronomic science and state of the art engineering practices, embodied in 32 individual design chapters and detailed appendices that enable developers to successfully design erosion control practices for construction sites.

- *10 Vegetative Standards*
- *22 Engineering Standards*

Ch 251 and Rules Require

- ▶ “Application for Development” ...
- ▶ Approved by State, County, Municipality ...
- ▶ Shall be Conditioned upon District Certification of Plan for Soil Erosion and Sediment Control
- ▶ Projects Not Subject to State Uniform Construction Code Must Comply with Chapter 251
 - building, pipeline, highway, transmission line, etc.
- ▶ After January 1, 1976, Where a Project was not Required by the State, County or Municipality to Comply with Ch 251 is not Relieved of these Requirements

Exempt Activities

- ▶ Less than 5,000 sq/ft
- ▶ 1 Single-Family Lot not part of a Subdivision
- ▶ Additions to Existing Homes
- ▶ Hazardous Waste Sites
- ▶ Cultivation of Land for Agriculture/Horticultural Purposes
- ▶ Exemption is Subject to District Approval

Important Definitions and Acronyms



► Certification

- A written endorsement of a plan for soil erosion and sediment control by the local Soil Conservation District or DOT which indicates that the plan meets the standards promulgated by the State Soil Conservation Committee.

► Disturbance

- Any activity involving the clearing, excavating, storing, grading, filling or transporting of soil or any other activity which causes soil to be exposed to the danger of erosion.

► Project

- Any disturbance of more than 5000 square feet of the surface area of land for construction, demolition, mining, quarrying, clearing or grading other than for agricultural purposes.

► Soil Conservation District (SCD)

- An agency with responsibilities for the implementation of various elements of the statewide erosion and sediment control program

► Standards - Standards for Soil Erosion and Sediment Control

► BMP - Best Management Practice

► EPA - Environmental Protection Agency

► NJPDES - NJ Pollutant Discharge Elimination System

“Project” Definition

- ▶ Disturbance of more than 5,000 sq/ft/land...
- ▶ Demolition of 1 or more Structures
- ▶ Construction of Parking Lot
- ▶ Construction of Public Facility
- ▶ Mining/Quarrying Activities
- ▶ Clear/Grading Land-non Ag/Horticulture Purpose

Soil Restoration on Construction Sites in New Jersey

Implemented on 12/7/17

In accordance with P.L. 2010, Chpt. 113, The Soil Restoration Act, NJDA has modified its Top Soil and Land Grading Standards to address requirements for soil restoration on construction sites where soils may have become compacted.

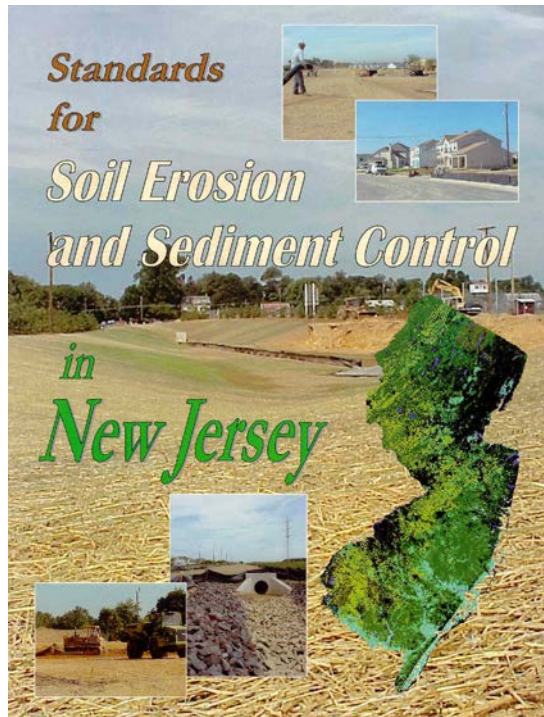
The goal of restoration as stated in the Act, is to enhance the establishment of vegetation used to provide permanent soil stabilization.





- ❖ Is 1 of 15 Soil Conservation Districts in NJ that work to implement the New Jersey Soil Erosion and Sediment Control Act by reviewing and certifying Soil Erosion and Sediment Control Plans for construction sites.
- ❖ Education & Outreach - to heighten awareness about the importance of natural resources and their conservation, and to promote environmental stewardship throughout the Barnegat Bay Watershed.

Standards for Soil Erosion and Sediment Control in N.J. - Updated 2017



- ▶ 10 Vegetative Standards
- ▶ 22 Engineering Standards
- ▶ 11 Technical Appendices
- ▶ Based on Physical-Topo - Watersheds of the Areas
- ▶ 4 Engineering Bulletins
- ▶ State-of-the-Art in Soil Erosion and Sediment Control/Stormwater Mgt

How'd we get here?

- ▶ 2010 - NJ Legislature amended Chapter 251 to require the addition of 'soil restoration' practices to the Standards-

- ▶ What does “restoration” mean?

noun res-to-ra-tion \,res-tə-'rā-shən\

: the act or process of **returning something to its original condition** by repairing it, cleaning it, etc.

: the act of bringing back something that existed before

However, we are not actually “restoring” soil to a prior condition; we are attempting to improve its initial condition immediately after construction is completed.

“Less conducive to vegetative stabilization...”

What does that mean?

- ▶ Less than... what ?
- ▶ There is no reference provided to measure what “less” means.
- ▶ Left up to NJDA to determine factors which might be considered to affect the potential success of stabilization
 - ▶ Soil Organic Matter content (SOM)
 - ▶ Soil Bulk Density (gm/cc)
 - ▶ Soil Moisture holding capacity

Permanent Vegetative Standard:

“Pursuant to the requirements in Section 7 of the Standard for Permanent Vegetative Stabilization, the contractor is responsible to ensure that permanent vegetative cover becomes established on at least 80% of the soils to be stabilized with vegetation. Failure to achieve the minimum coverage may require additional work to be performed by the contractor to include some or all of the following: supplemental seeding, re-application of lime and fertilizers, and/or the addition of organic matter (i.e. compost) as a top dressing. Such additional measures shall be based on soil tests such as those offered by Rutgers Cooperative Extension Service or other approved laboratory facilities qualified to test soil samples for agronomic properties.”

Soil Restoration – Topsoil and Land Grading

- ▶ Topsoil – Chapter 8
 - ▶ 4-6 " depth required. (was 5" recommended)
 - ▶ Must be 'firmed in place' – cannot measure unconsolidated lift
 - ▶ Imported topsoil must have 2.75% OM (no change)
 - ▶ May pose a problem in rocky or sandy areas of NJ
 - ▶ X-ref to Permanent Vegetative Standard:
 - ▶ *"Pursuant to the requirements in Section 7 of the Standard for Permanent Vegetative Stabilization, the contractor is responsible to ensure that permanent vegetative cover becomes established on at least 80% of the soils to be stabilized with vegetation. Failure to achieve the minimum coverage may require additional work to be performed by the contractor to include some or all of the following: supplemental seeding, re-application of lime and fertilizers, and/or the addition of organic matter (i.e. compost) as a top dressing. Such additional measures shall be based on soil tests such as those offered by Rutgers Cooperative Extension Service or other approved laboratory facilities qualified to test soil samples for agronomic properties."*

Changes to Land Grading...

- ▶ List of “exclusion areas” -
 - ▶ 20' from basements, 12' from crawl spaces
 - ▶ Under pavement
 - ▶ Regulated by other design requirements
 - ▶ Septic systems
 - ▶ Golf courses, soccer fields, airports etc.
 - ▶ Site Remediation
 - ▶ Brownfields
 - ▶ Steep Slopes (i.e., where equipment cannot safely travel)
 - ▶ Shallow Bedrock
 - ▶ Not required if restoration area is 500 sq feet or less.

Land Grading Changes, cont.

- ▶ Added option to “test out” of doing compaction remediation
 - ▶ Simple wire probe test
 - ▶ Penetrometer
 - ▶ Tube Bulk Density test
 - ▶ Nuclear Densitometer (my personal favorite).
- ▶ Can start with a simple test, and if unsatisfactory, can move up to more complex and reliable tests.
- ▶ Tests performed by the applicant or their agent;
not the District
- ▶ **A minimum of two tests per acre** are required.

4 soil test method options

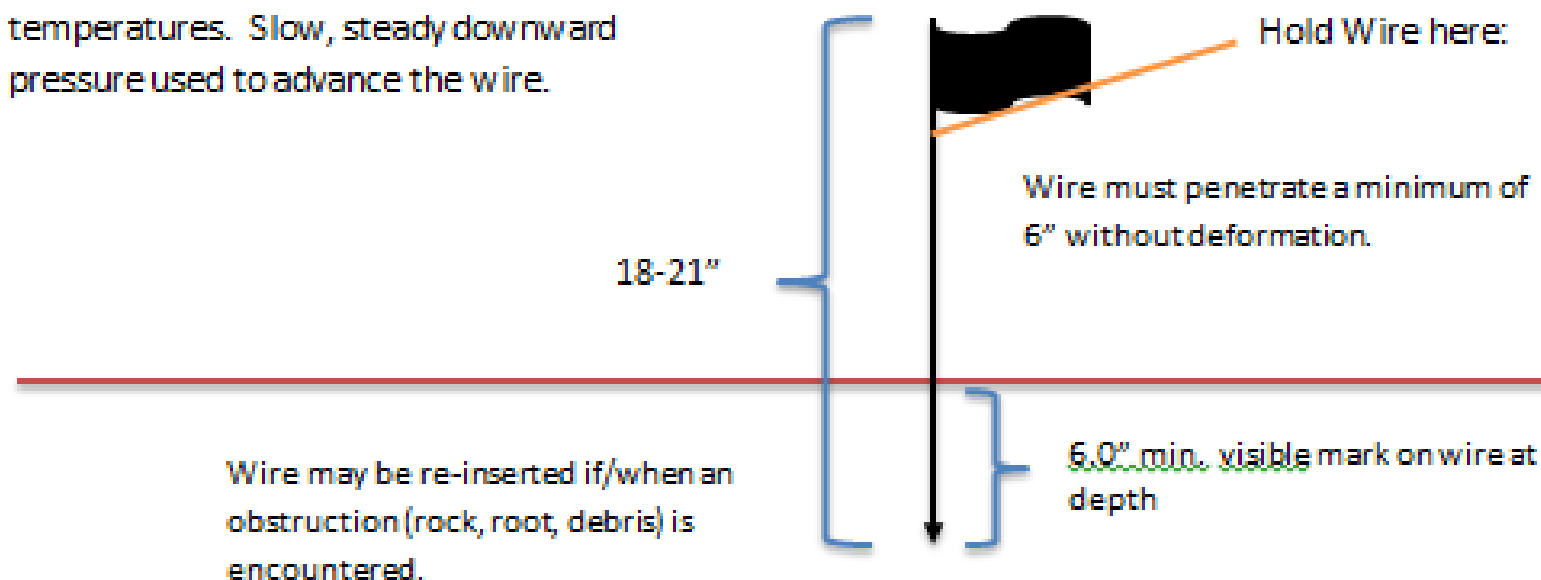
1. Probing Wire Test Method
2. Handheld Soil Penetrometer Test Method
3. Tube Bulk Density Test Method
4. Nuclear Density Test Method



1. Wire probe test

Probing Wire Test- 15.5 ga steel wire (survey flag)

Note: soil should be moist but not saturated. Do not test when soil is excessively dry or subject to freezing temperatures. Slow, steady downward pressure used to advance the wire.



2. Penetrometer test

- ▶ Penetrometers are devices used to measure the resistance of a soil to penetration
- ▶ Not actually a bulk density test
- ▶ Really a screening tool
- ▶ Pass = Done
- ▶ Fail = “Real” testing or Compaction Mitigation



Photo : Steve Yergeau, Rutgers Cooperative Extension of Ocean & Atlantic Counties

3. Tube bulk density test

- ▶ This test shall be certified by a New Jersey Licensed Professional Engineer
- ▶ Utilizing only undisturbed samples (reconstitution of the sample not permitted)
- ▶ Procedure for Soil Bulk Density Tests as described in the USDA NRCS Soil Quality Test Kit Guide, Section I, Chapter 4, pp. 9 - 13
- ▶ Pass = A result at or below maximum dry bulk density in preceding table
- ▶ Fail = A result greater than the maximum dry bulk density permitted in preceding table and compaction mitigation is required



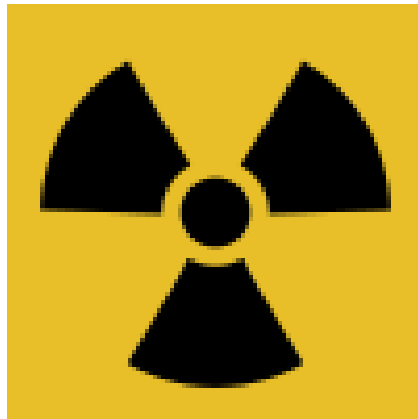
United States
Department of
Agriculture
Agricultural
Research Service
Natural Resources
Conservation Service
Soil Quality Institute
July 2004

Soil Quality Test Kit Guide



4. Nuclear density test

- ▶ This test shall be certified by a New Jersey Licensed Professional Engineer and conducted by a nuclear gauge certified inspector pursuant to ASTM D6938
- ▶ Pass = A result at or below maximum dry bulk density in preceding table
- ▶ Fail = A result greater than the maximum dry bulk density permitted in preceding table and compaction mitigation is required



Bulk Density – Maximum Limits

- Soil bulk density is actually measured in the Tube and Nuclear tests. Results must conform to the values below in order to “test out” of doing remediation:

Soil Type/Texture	Bulk Density (g/cc)
Coarse, Medium and Fine Sands and Loamy Sands	1.80
Very Fine Sand and Loamy Very Fine Sand	1.77
Sandy Loam	1.75
Loam, Sandy Clay Loam	1.70
Clay Loam	1.65
Sandy Clay	1.60
Silt, Silt Loam	1.55
Silty Clay Loam	1.50
Silty Clay	1.45
Clay	1.40

Note that these values are not “optimal” (typically lower) but are consistent with the intent of the definition in the statute.

“Optimum” values are logistically difficult to achieve and maintain in non-control conditions.

They represent the maximum density after which plant growth is restricted.

Table 19-1 – Maximum Dry Bulk Densities (grams/cubic centimeter) by soil type

Source: USDA Natural Resource Conservation Service,
Soil Quality Information Sheet, Soil Quality Resource Concerns: Compaction, April 1996

Soil compaction mitigation

- ▶ Mitigate excessive soil compaction prior to placement of topsoil and establishment of permanent vegetative cover
- ▶ Restoration of compacted soils shall be through deep scarification/tillage (6" minimum depth) where there is no danger to underground utilities (cables, irrigation systems, etc.) or in the alternative, another method as specified by a New Jersey Licensed Professional Engineer
- ▶ No need to retest after soil compaction mitigation
- ▶ Have the option to mitigate from the beginning to avoid testing altogether



CORRECT SIZE TIP
SOIL TYPE

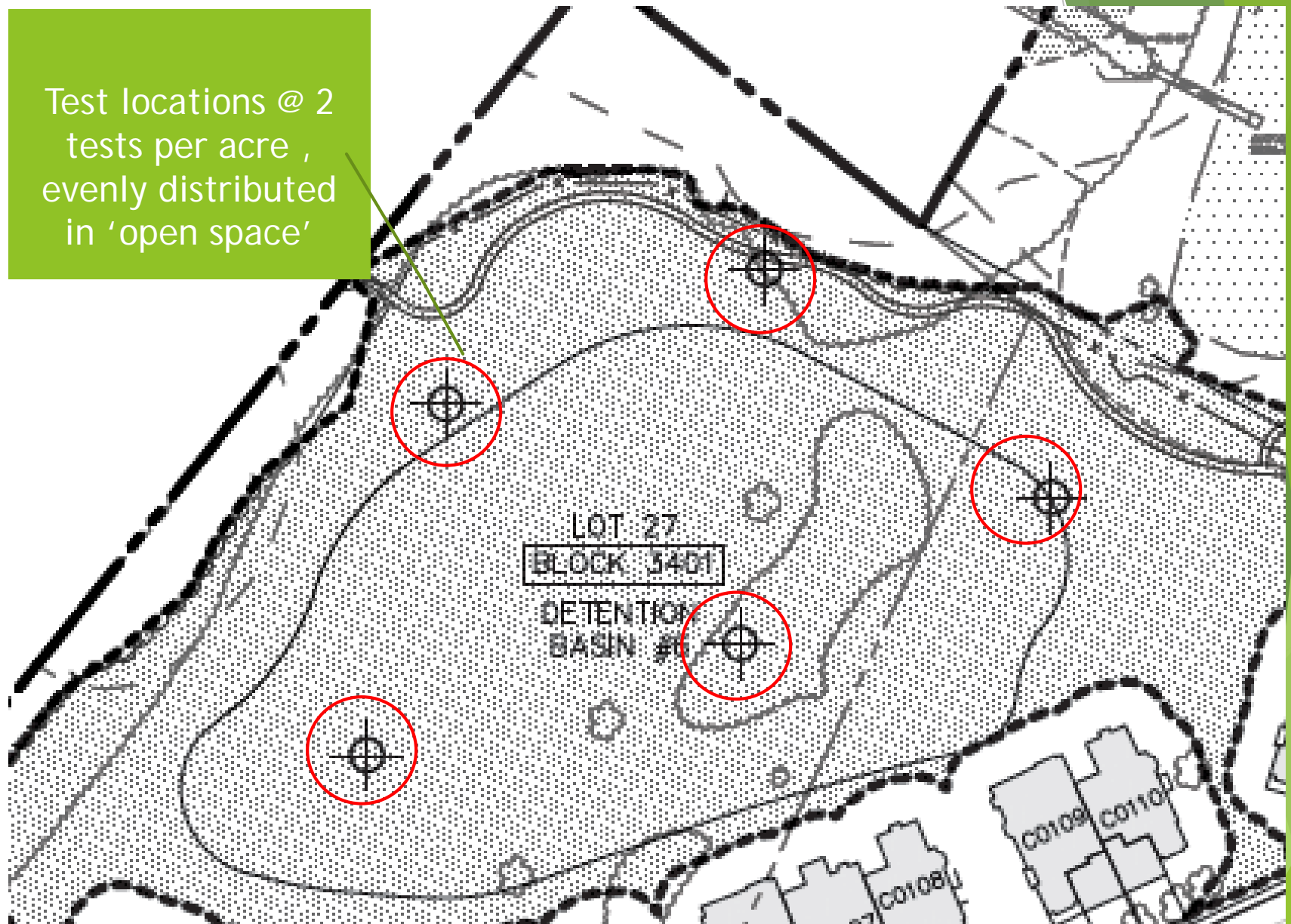
ER TEST

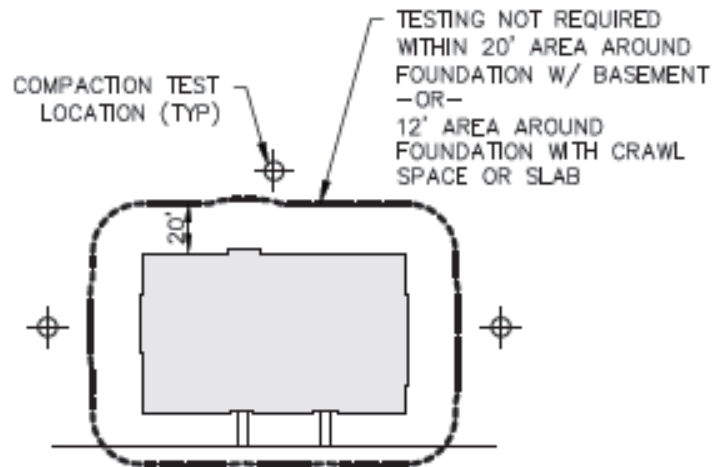
L.O.D.

Around
buildings 20'
basements, 12'
crawl spaces.



Test locations @ 2
tests per acre ,
evenly distributed
in 'open space'



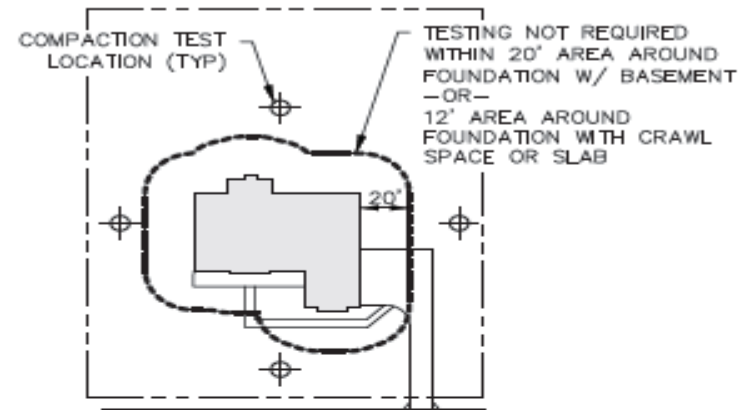


C. MULTIFAMILY HOUSING OR OTHER NON-RESIDENTIAL BUILDING/STRUCTURE

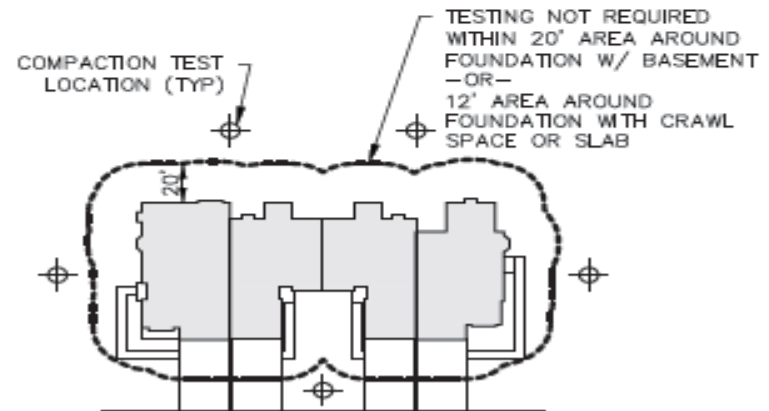
NOTE: SOIL COMPACTION TESTING LOCATIONS IDENTIFIED ARE RECOMMENDED LOCATIONS FOR GRADED/DISTURBED AREAS WITHIN THE VICINITY OF BUILDINGS AND STRUCTURES OR ON INDIVIDUAL LOTS. FOR GRADED/DISTURBED AREAS WITHIN OPEN OR COMMON SPACES, SOIL COMPACTION TESTING SHALL BE PERFORMED IN ACCORDANCE WITH THE FREQUENCY LISTED IN THE LEGEND (THIS SHEET).

TYPICAL SOIL COMPACTION TESTING LOCATIONS

N.T.S.



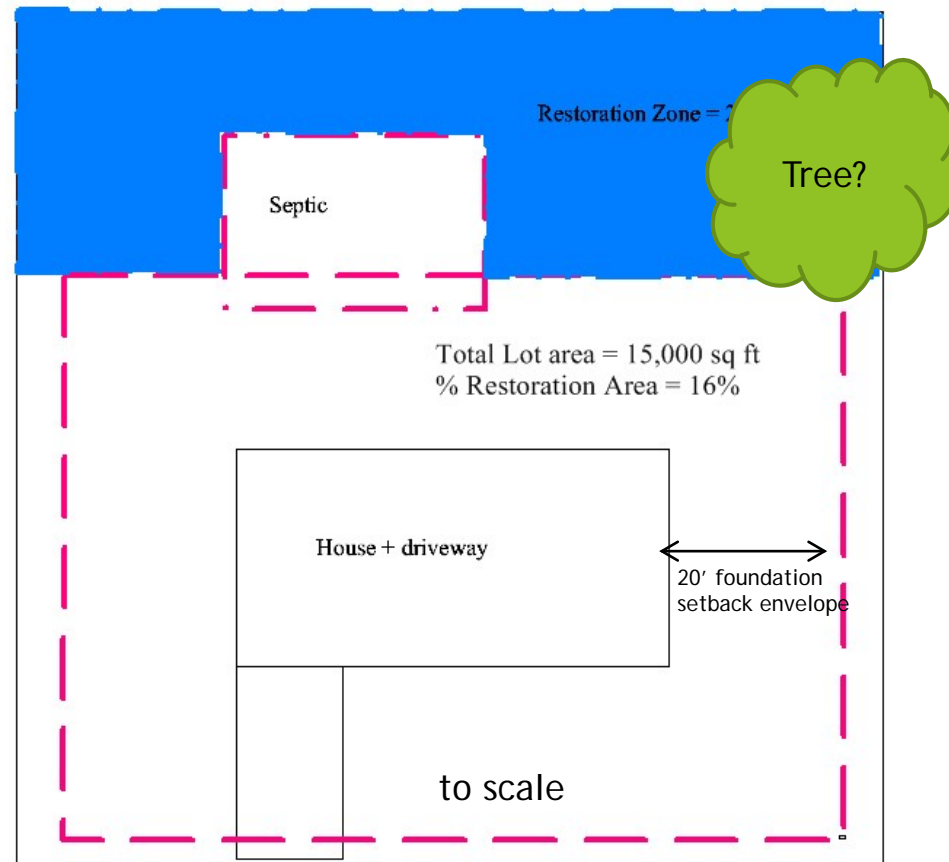
A. SINGLE FAMILY UNIT



B. TOWNHOUSE BUILDING

Note. For areas that are less than 1 acre, the test location density is a minimum of 2 tests.

Example Exclusion Area - Residential



Chapter 251: Protecting Soil Resources for Water Quality - Soil Restoration Standards

In accordance with P.L. 2010, Chapter 113, the State Soil Conservation Committee has revised its [Standards for Soil Erosion and Sediment Control in New Jersey](#) to include provisions for mitigating the negative impacts of soil compaction on construction sites subject to review and regulation by the New Jersey Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39, et seq. These provisions have been included within Sections 8 (Topsoiling) and 19 (Land Grading) of the Standards.

(<http://www.nj.gov/agriculture/divisions/anr/nrc/njerosion.html>)

Effective December 7th, 2017, any application submitted to a local Soil Conservation District for erosion and sediment control plan certification must include provisions to mitigate potential soil compaction in accordance with the revised Standards. Previously certified Soil Erosion and Sediment Control Plans, plans eligible for re-certification and minor revisions are not subject to the adopted amendments. There are 11 identified exceptions outlined on page 19-2 of the Land Grading Standard.

Click here for the State of New Jersey, Department of Agriculture, NJ Soil Erosion and Sediment Control Program website: (<http://www.nj.gov/agriculture/divisions/anr/nrc/njerosion.html>)

The following are useful documents associated with the new Soil Restoration Standards.

Forms and Helpful Information:

[Frequently Asked Questions](#)

[Topsoiling Standard \(Section 8\)](#)

[Land Grading Standard \(Section 19\)](#)

[Soil Restoration Notes Required on Plans for Soil De-Compaction and Testing Requirements](#)

[Soil Compaction Mitigation Verification Form](#)

[Sample Soil Restoration Plan Image](#)

[Guidelines for the Use of a Static Cone Penetrometer](#)

[Applicability of Soil Restoration to Urban Redevelopment 2018](#)

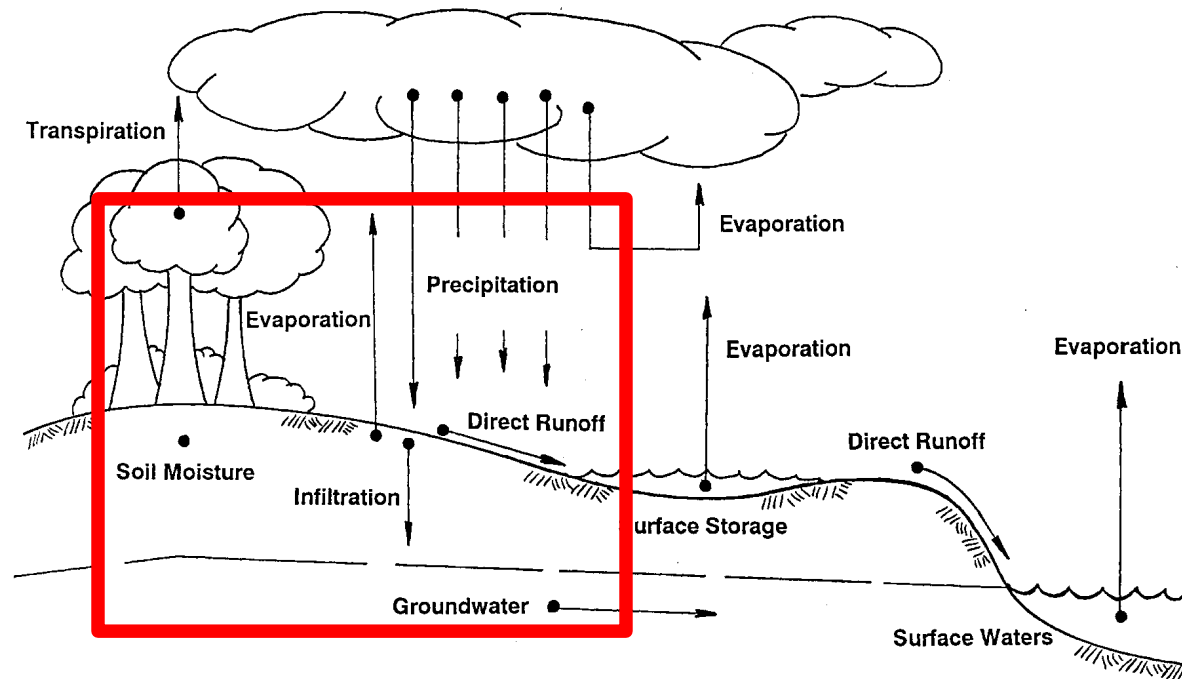
[Soil Restoration Inspection Verification Procedure](#)

[soil restoration applicability to SFH](#)

Link to Ocean County Soil Conservation District WebPage:

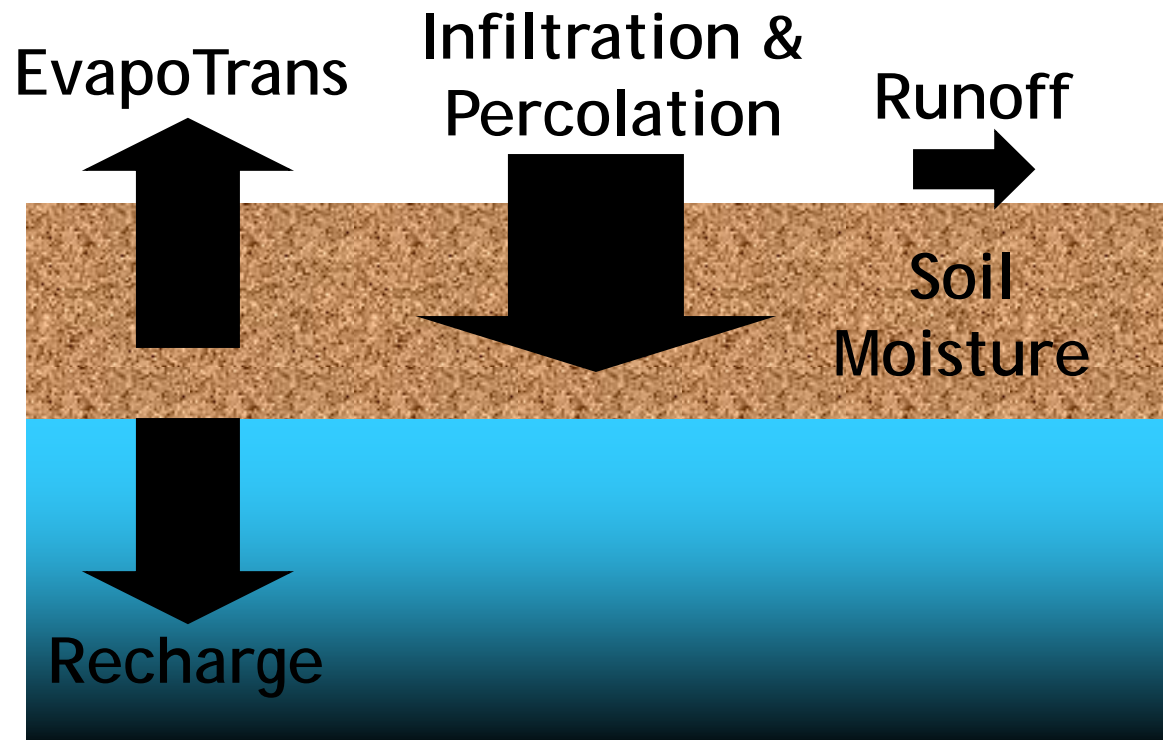
<http://www.soildistrict.org/soil-erosion-control/chapter-251/>

Hydrologic Cycle



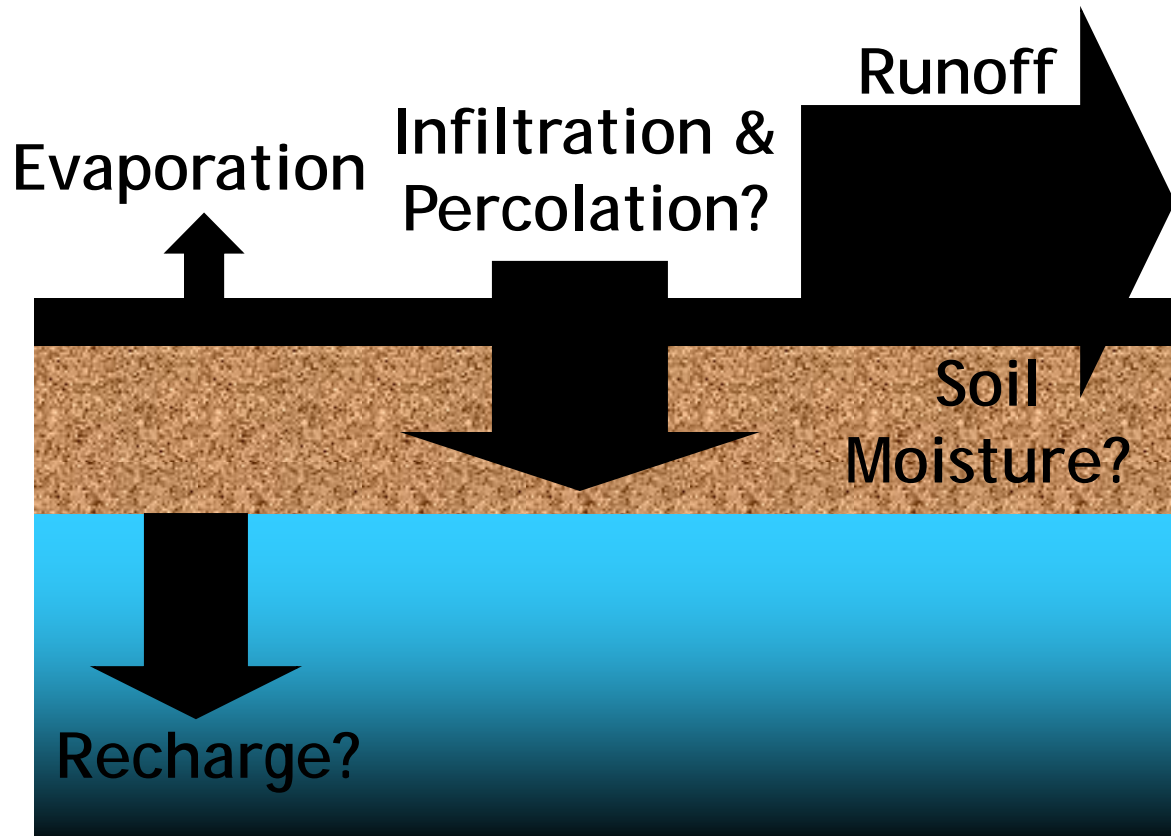
Source: NJDEP Stormwater BMP Manual

Pervious Soil Conditions



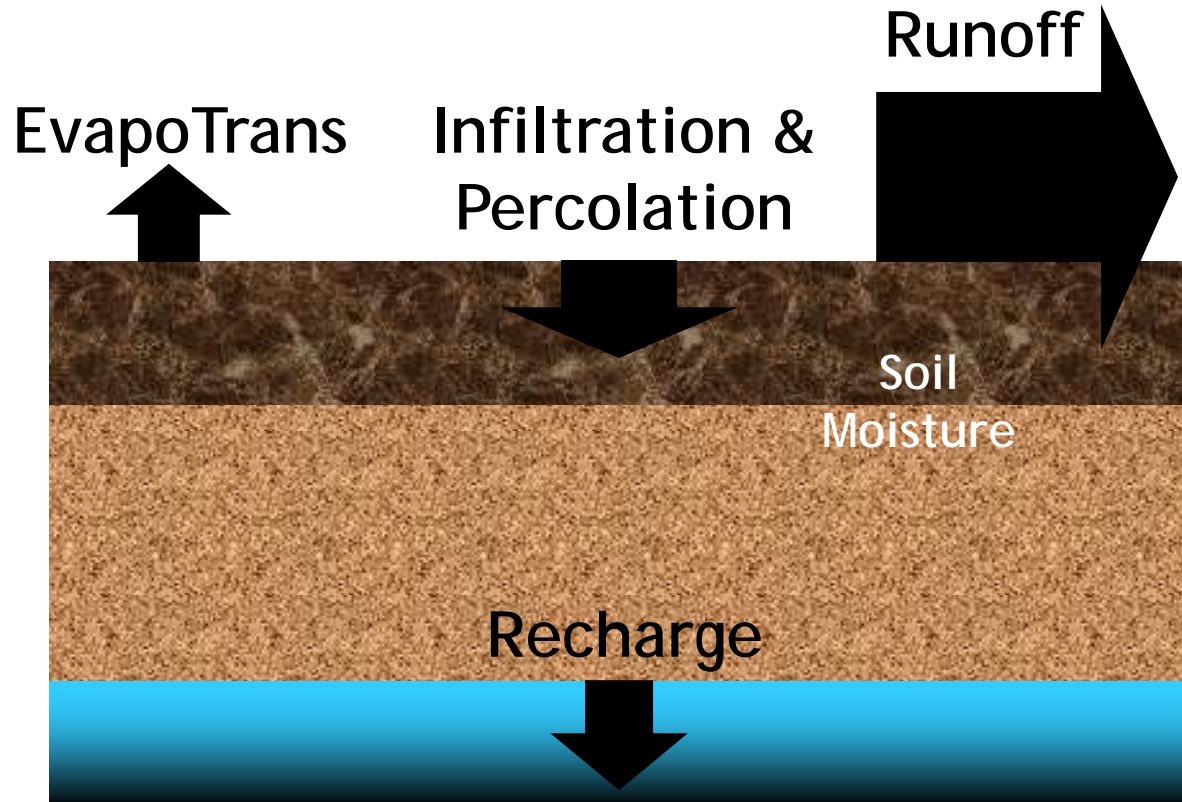
Joseph J. Skupien, President, Storm Water Management Consulting, LLC

Impervious Surface Conditions



Joseph J. Skupien, President, Storm Water Management Consulting, LLC

Compacted Soil Conditions



Joseph J. Skupien, President, Storm Water Management Consulting, LLC

Conclusions

- ▶ Healthy Soils have Greater Permeability than Unhealthy Soils
- ▶ Compaction Alters Healthy Structure and Reduces Permeability
- ▶ Reduced Permeability = Increased Runoff
- ▶ Increased Runoff = Increased Damage



Heavy Machinery Used to Shape Soils Causes Immeasurable Damage

- ▶ ATHLETIC FIELDS
- ▶ GOLF COURSES
- ▶ LAWNS
- ▶ STORMWATER BASINS



Compaction Affects Soil Ecosystem



- ▶ Disturbed soils have reduced capacity to absorb, filter and store rainwater



- ▶ Compaction restricts root systems, and plants of necessary organisms, air, water and nutrients

Using Your Senses To Detect Compacted Soil

Above the Surface

1. Iron-stained sidewalks
2. Water seeping along at the curbs, and it is not raining!
3. The lawn is sopping wet, but when you dig a hole, dry soil just below the wetness.
4. Sod is not attached to the soil
5. Can't dig/shovel is hard to push
6. "Walks Hard"
7. Grass is sparse or stunted
8. Trees are dead or dying
9. Iron-stained hard to push
10. When you pound a rod into the ground, the soil buckles and fractures.



Using Your Senses to Detect Compacted Soil

Below the Ground

1. Bright orange colored mottling in soil - The orange coloration represents oxidized (iron/rust) zone of "redox" mottling.
Gray colors are characteristic of the anaerobic (w/o oxygen) zone of mottling
2. Soil Stratification - Plates Structure
3. 6-8" below massive layer black strip (manganese) (oxidation/reduction)
4. Roots -
 - A Horizontal/near surface
 - B Shallow & Poor Root Development
 - C Trunk "circling" /Choking the Tree
 - D Underlying layer has no roots
5. Purple Worms - Lack of Oxygen
6. Sulfur Smell (hydrogen sulfide-rotten egg)
7. Buried Organic Matter that is Preserved



Water Movement in Soils



- ▶ *Soil profile only drains as well as the least restrictive layer*
- ▶ Compacted could be defined as a soil that is root restrictive and has a bulk density greater than 1.6 Mg/m^3 .
- ▶ *Soil compaction common to developed areas permanently reduces infiltration rates.*

**Impact of Soil Disturbance
During Construction
on
Bulk Density and Infiltration
in
Ocean County, New Jersey**

Prepared by:
Ocean County Soil Conservation District
Schnabel Engineering Associates, Inc.
USDA Natural Resources Conservation Service

March 2001 (Rev. 06/01/01)*

- ▶ In 2001, NRCS-NJ and Ocean SCD completed a study, *"The Impact of Soil Disturbance During Construction on Bulk Density and Infiltration in Ocean County, NJ."*
- ▶ Study demonstrates the significance of soil management in managing water resources. Highest infiltration rates were found in woods and oldest lawn areas free of grading.
- ▶ *The area of urban lawns represents the largest agricultural crop in the United States.*

Impact of Soil Compaction on Water Resources

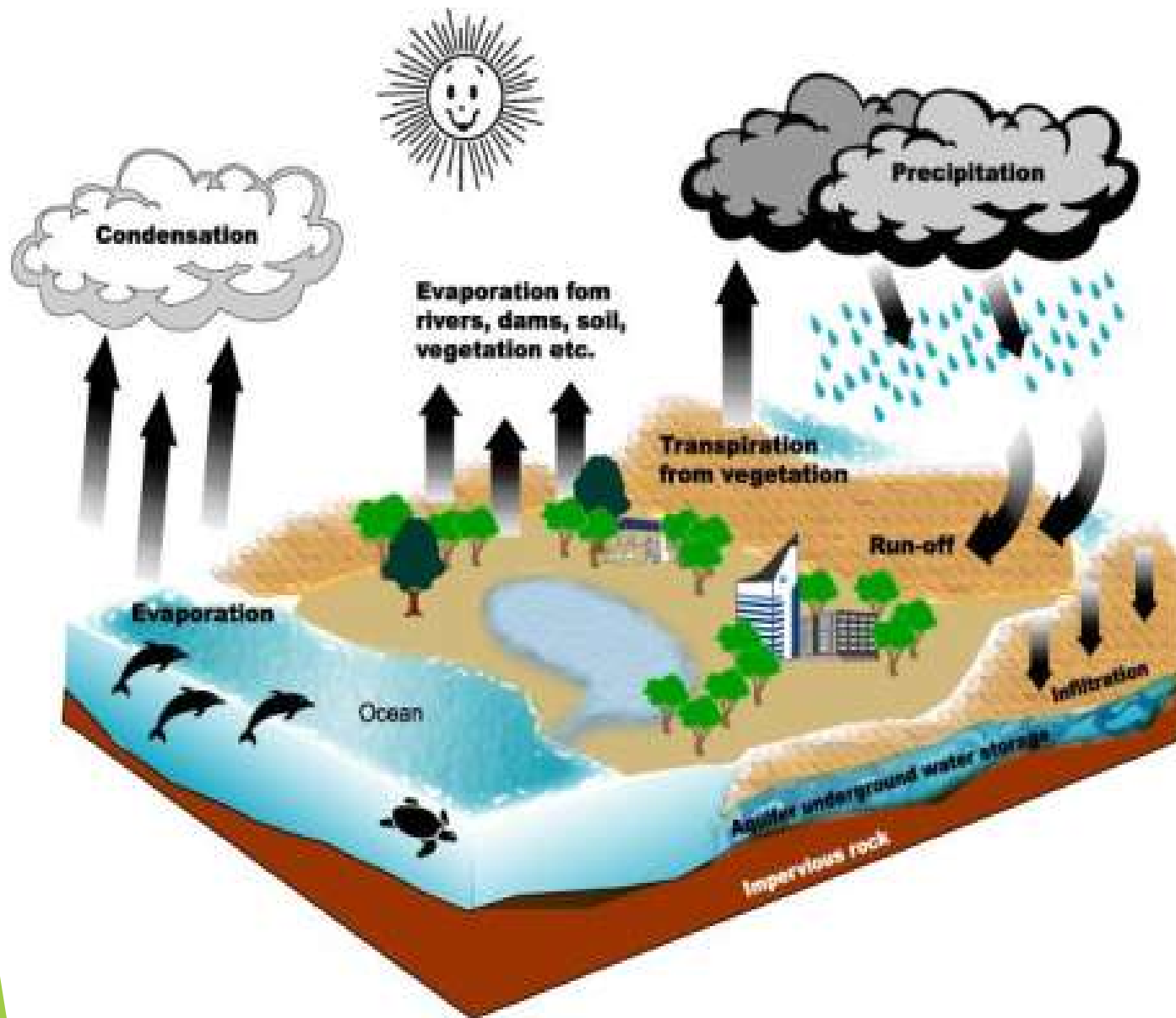
- ▶ Poor internal drainage
- ▶ Accelerated erosion and runoff
- ▶ Reduced recharge
- ▶ Increased demands on water resources
- ▶ Standing water creates mosquito habitat
(West Nile Virus)
- ▶ Increased growth of mold spores
(pulmonary impairments)
- ▶ Soil- bourn plant diseases
- ▶ Restricted root growth
- ▶ Poor Crop production
- ▶ Increased reliance on irrigation,
- ▶ Fertilizers, and harmful pesticides



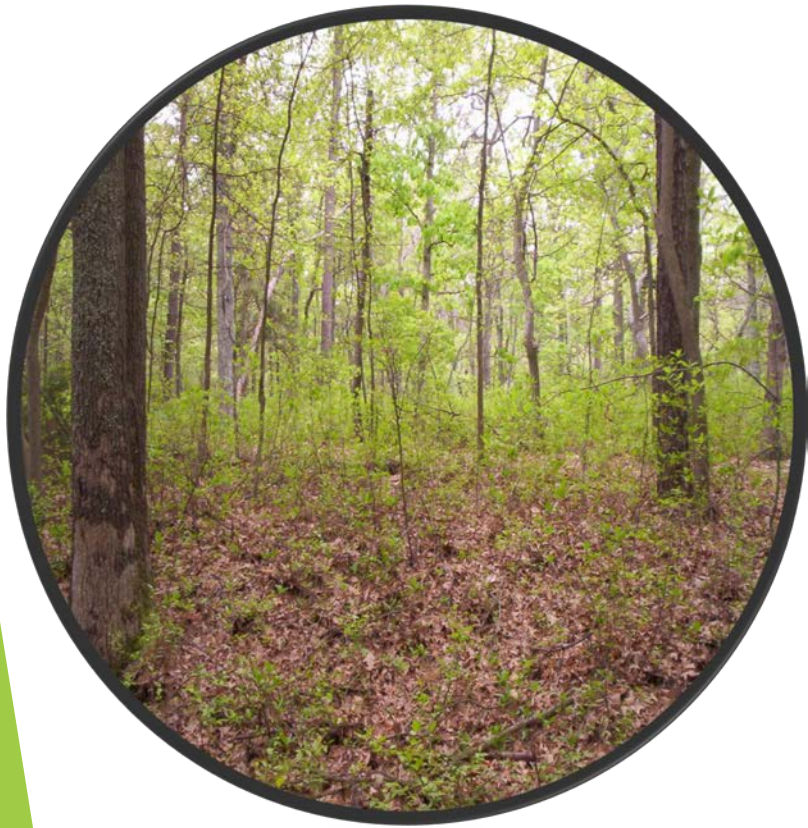
Rain Fall Begins In Soil

- ▶ Where we have healthy soils to sustain vegetation,
- ▶ water vapor rises
- ▶
- ▶ condenses into clouds and
- ▶
- ▶ falls back to earth as rain.





Water Movement in Undisturbed Soils



- ▶ Water moves downward through interconnected network of channels and macro-pores.
- ▶ This subsurface water is transmitted via paths of least resistance and explains why overland flow seldom, if ever, occurs on sloping forest-covered soils.

WATER STORAGE

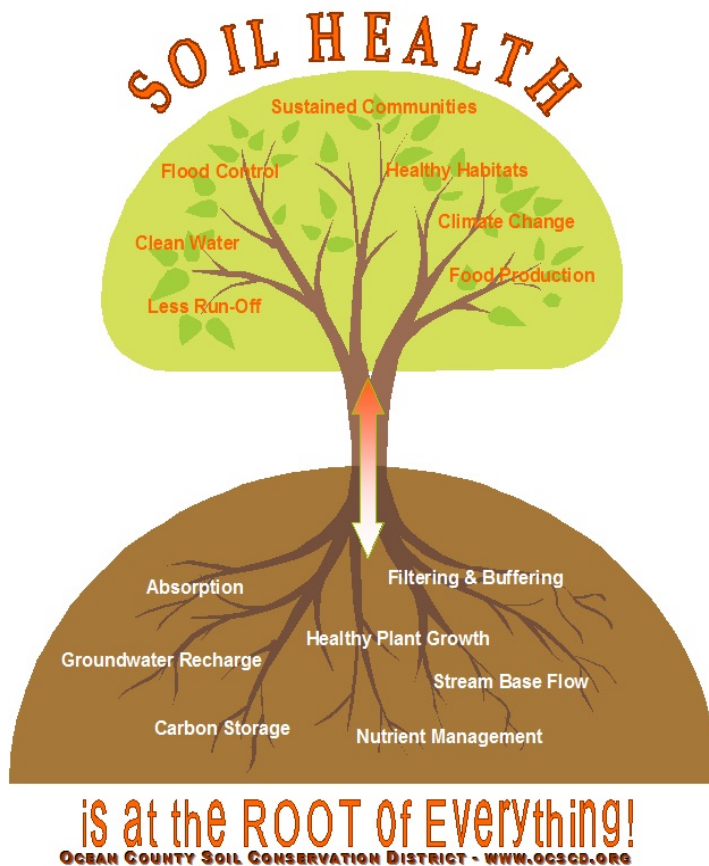


- ✗ Soil is also important to plants for water storage.
- ✗ Soil holds water and allows plants to get the moisture and nutrients they need.
- ✗ Soil also keeps water from running off or flowing elsewhere (flooding).

Healthy soils are fundamental to global recycling of water.

The greatest percentage of water in any watershed is in soil storage.

Infiltration is the most important of all the hydrological processes.



- ▶ A Healthy Soil is a Functioning Soil:

Biological - Physical -
Chemical Characteristics

A Healthy Soil Provides
Numerous Services

Healthy Soil is
at the Root of
EVERYTHING!

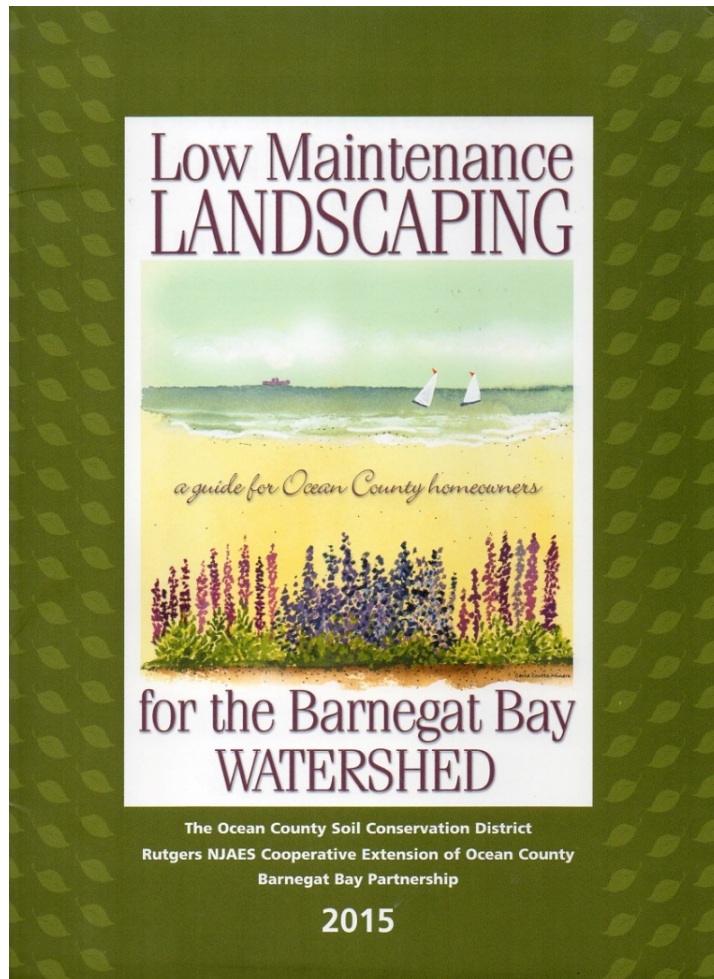
SHIP at Jakes Branch County Park

- ▶ This project seeks to develop simple, low cost and practical soil restoration techniques and procedures that are transferrable at the homeowner scale, one yard at a time. Including:
 - the improvement of soil function through de-compaction and organic matter addition to turf managed landscapes,
 - identification of characteristic microbial community profiles of healthy soil systems,
 - ▶
 - the demonstration of best management practices for soil restoration and native plantings, and a comprehensive education and outreach effort.
- Partners: *OCSCD, Rutgers Turf Management, Montclair Biology, American Littoral Society, Jacques Cousteau NERRS, NRCS*
- ▶ *Funded by Barnegat Bay Partnership*



<http://www.soildistrict.org/healthy-yards/jakes-branch-ship-project/>

Low Maintenance Landscaping for the Barnegat Bay Watershed



Jersey-Friendly Yard Website

www.jerseyyards.org



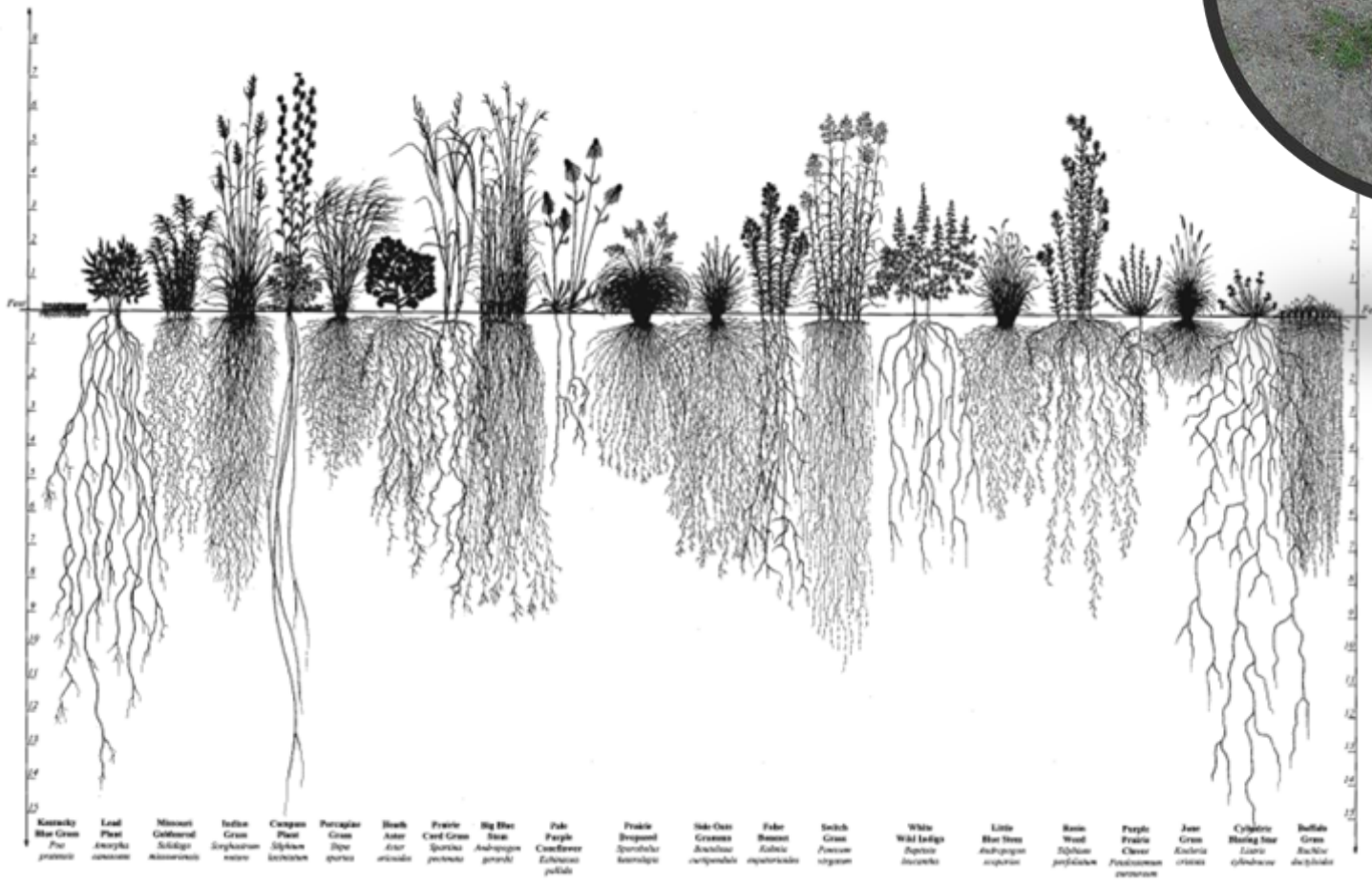
Make Your Yard a Sponge



and . . . keep your runoff to yourself!



Getting to the ROOT of the matter!





United States Department of Agriculture

Natural Resources Conservation Service



USDA Website Puts Soils Information, Tools at Your Fingertips

USDA has re-designed its [Soil Tools web page](#) to now serve as a one-stop source for new, leading-

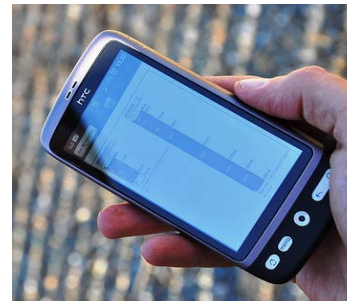




► Web Soil Survey

- The Web Soil Survey (WSS) provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world. NRCS has soil maps and data available online for more than 95 percent of the nation's counties and anticipates having 100 percent in the near future. The site is updated and maintained online as the single authoritative source of soil survey information

- A new smartphone application, or "app," is available as a free download for both iPhone and Android users to access soil survey information. The app, SoilWeb, combines online soil survey information with the GPS capabilities of smartphones.



- *NRCS Soil Scientist Dr. Dylan Beaudette developed the SoilWeb application for mobile devices while he was a graduate student at UC Davis. The app provides soil survey information in a mobile form and is particularly useful for those working in the field.*

<https://websoilsurvey.nrcs.usda.gov/app/>



Thank you!

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