Stakeholders Meeting May 27, 2010

The Importance Of Functioning Soils In Low Impact Development Practices

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Ocean County Soil Conservation District

Water Movement in Soils

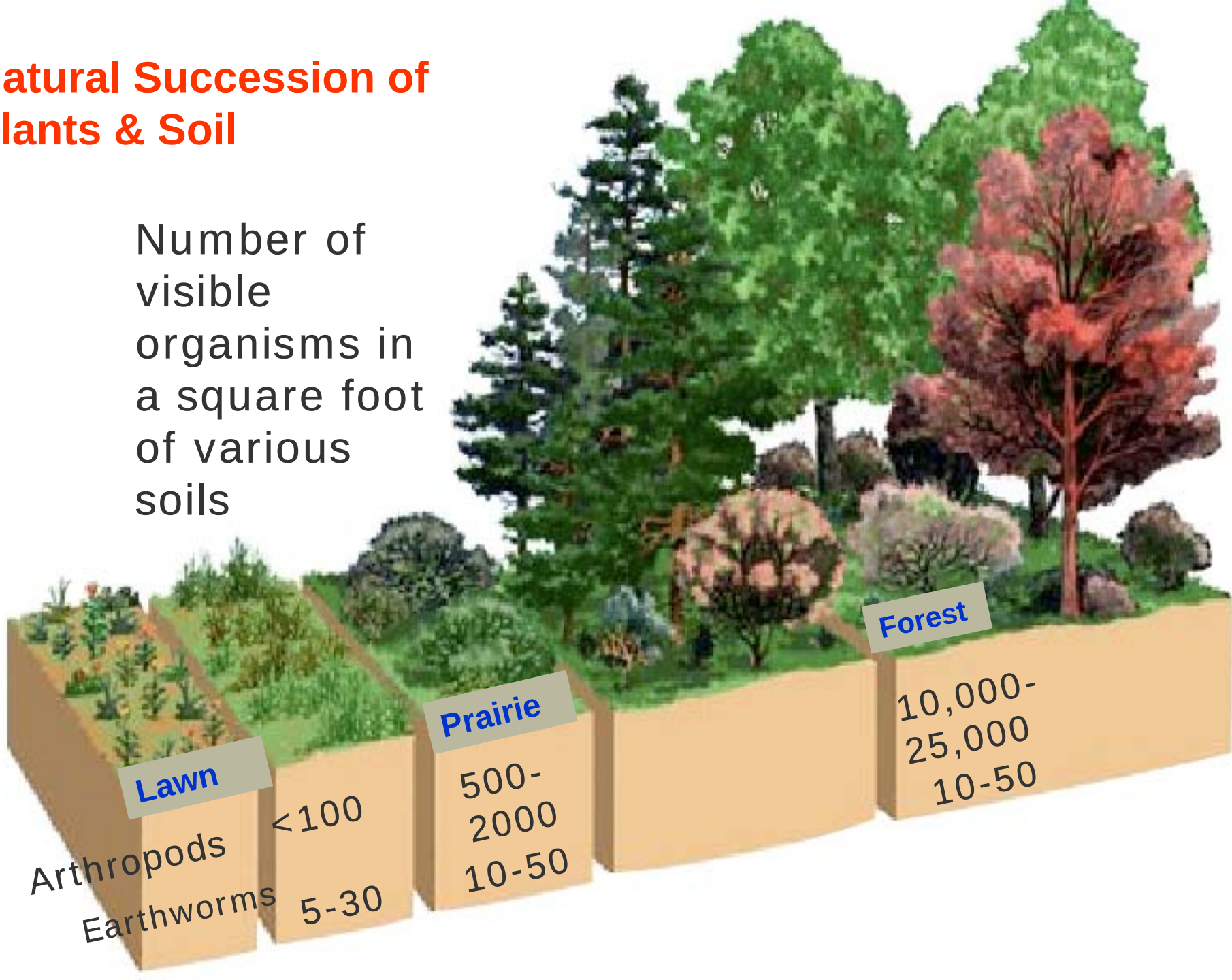
In natural forested soils water moves rapidly downward through root channels and large pores. US Forest Service report confirms little to no runoff from forest-covered soils.

US Forest Service, 1971:

"Nature and Extent of Macropores in Forest Soils and their influence on Subsurface Water Movement."

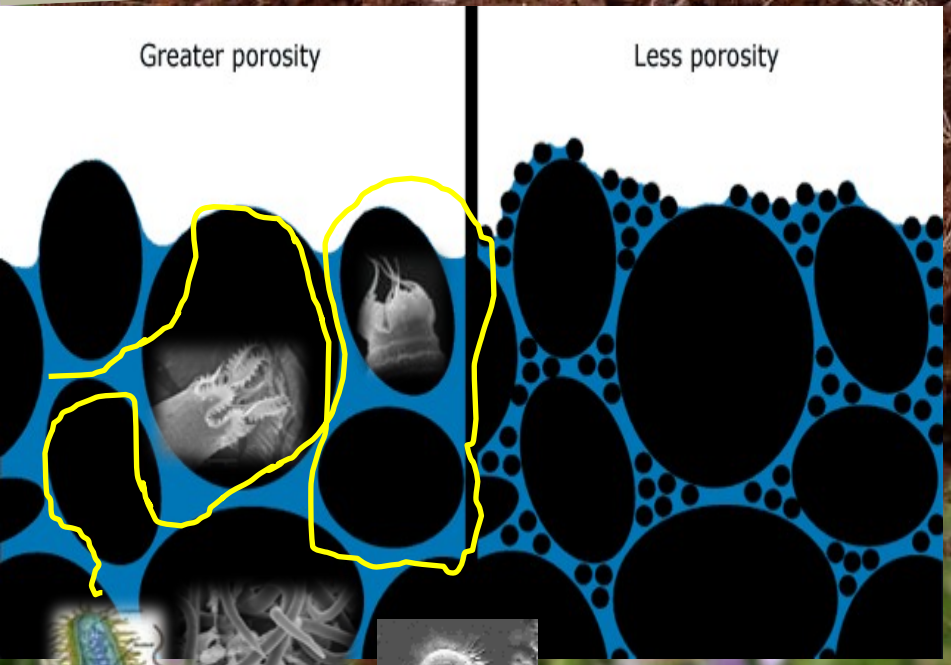
Natural Succession of Plants & Soil

Number of visible organisms in a square foot of various soils



Porosphere: All essential functions within soil pores

Primary an Aquatic Habitat (water films): for protozoa, bacteria, Mycorrhizae, and nematodes



The lungs and circulatory system of the soil:

- Regulates water and air flow
- Impacts N, P Mineralization
- Impacts soil organism bio-mass and diversity
- Site of nutrient exchange
- Site of mycorrhizal entanglement and sequestration of water and nutrients
- Root interface
- Part of the water cycle

M.H. Beare, D.C. Coleman, D.A. Crossley Jr., P.F. Hendrix and E.P. Odum (1995)

Where Do We See Effects of Disturbed Soils?

- Athletic fields, golf courses, lawns, stormwater basins
- National Park Service Study 1989 showed that several years of deep core aeration and organic matter were necessary to begin to provide growing conditions for turf.

Native soils have about 50% pore space. Water moves through these pores at rates of 6-20 in/hr.

Soil pores serve as natural stormwater utilities.

Table of 24 hr. rainfall depths O

1 yr	2.8"	in 24 hrs.
2 yr.	3.5"	in 24 hrs.
5 yr.	4.5"	in 24 hrs.

(Nearly 75% of annual rainfall events are less than 1.5" in 24 hours.)

What is an urban soil?

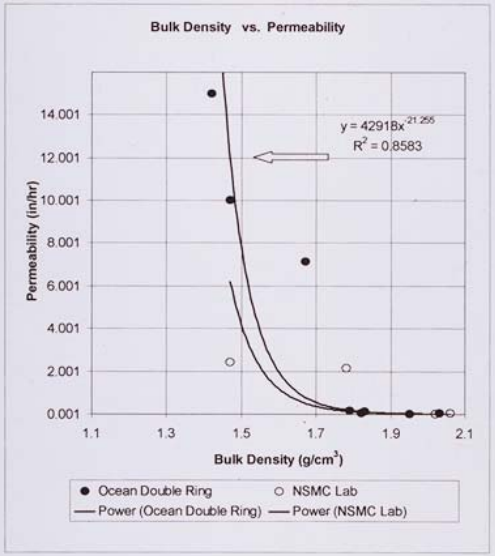
A non-agricultural, man-made surface layer more than 50-cm thick that has been produced by mixing, filling, or by contamination of land surface in urban and suburban areas.

(Bockheim 1974)

Man-made soils create poor environment for roots, increase runoff, erosion and nutrient loading.

Impact of Soil Disturbance During Construction on Bulk Density and Infiltration in Ocean County, NJ , OCSCD and USDA-NRCS 2001

Graph 2.



There is general agreement in the shape and relative trends of the data from both the lab and *in-situ* tests. As soil bulk density increases to 1.65 g/cm^3, the infiltration rate decreases rapidly. When the bulk density increases above 1.65 g/cm^3, infiltration rate declines slowly, approaching zero. Unless the soil surface becomes crusted or covered with an impermeable surface such as concrete, this permeability becomes the limiting factor for infiltration into the soil profile. Thus the permeability measurements were used to develop the following technique to estimate infiltration rates of densities not specifically measured. For example, using the formula from the *in-situ* data above [Permeability = (42198)(Bulk Density)$^{-21.255}$] it can be estimated that soil with a bulk density of less than 1.75 g/cm^3 would be expected to have an infiltration rate of greater than 0.3 in/hr.

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Table 1.

Permeability Measurements of Sampled Layers within 20" of Soil Surface		
Site	Bulk Density (g/cm^3)	Permeability (in/hr)
Woods	1.42	15
Pasture	1.47	9.9
Single House	1.67	7.1
Subdivision Lawn 1	1.79	0.14
Garage Lawn	1.82	0.04
Cleared Woods	1.83	0.13
Subdivision Lawn 2	2.03	0.03
Athletic Field	1.95	0.01

Table 2.

Site	Level of Disturbance	Soil Series as shown in the soil survey	HSG in TR-55 as assigned by soil survey	Field Measured Permeability (in/hr)	Field Estimated HSG[2]
Woods	Undisturbed	Downer	B	15	A
Pasture	Somewhat Disturbed	Downer	B	9.9	A
Single House	Somewhat Disturbed	Downer	B	7.1	A
Subdivision Lawn 1	Disturbed	Lakewood	A	0.14	C
Garage Lawn	Disturbed	Urban land	A[1]	0.04	D
Cleared Woods	Disturbed	Downer	B	0.13	C
Subdivision Lawn 2	Disturbed	Downer	B	0.03	D
Athletic Field	Disturbed	Sand Pit	A[1]	0.01	D

[1] HSG assigned based on soil texture in conformance with Appendix A of TR-55.
[2] Based on water transmission rates for row crops in TR-55, Appendix A.

The following graphs summarize the sites sampled in Ocean County. Graph 1 shows the distribution of bulk density with depth in the sites sampled. In the graded condition, the soil is more dense in all layers, especially just below the topsoil that was applied after most grading activities and loosened during seedbed preparation. Graph 2 relates permeability rate to bulk density for the specific layers sampled in Table 1.

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Undisturbed Lands

Forests

&

Woodlands

1.03g/cm^3

(50% void space)

Lawns residential

1.69-1.97g/cm^3

Soils for sustaining vigorous plant growth should have a bulk density below 1.6g/cm^3; root extension becomes suppressed when air filed pore space is < 15% (Richards/Crockrott, 1974).

Golf Courses

Parks

Athletic Fields

1.69-1.97g/cm^3

CONCRETE

2.2g/cm^3

NJDEP 319h grant created partnership: OC Planning Board, OC Engineering, OC Road Department, NJDEP,USDA-NRCS, OC Soil Conservation District.

(Restoration of these basins is not a beautification project. Restoration, by definition is about restoring structure and function when the original function of the system has been degraded or lost. Soil restoration was undertaken because the physical, chemical, and biological properties had been impaired.)

Division Street Basins

Commonwealth Basin

Partnership Developing and Transferring New Tools

- To sustain high infiltration rates on turf areas construction must be overseen to minimize earthwork, and reduce compaction.
- Understand that an infiltration basin functions only as well as its least porous layer.
- Ocean County has completed soil health restoration in sixteen (16) basins.
- OC Planning Board adopted Section 624 Detention/Infiltration Basin specifications to provide guidelines on constructing basins. Applies to all plans submitted before the OC Planning Board. Includes planting specifications to ensure functionality and reduce maintenance.
- Rutgers, OCPB, OCSCD preparing a data base of basins.

Raingarden Demonstration
Freedom Fields-OC Parks Dept.

Incorporation of organic matter is key to drought resistant soil and sustaining infiltration.

Soil organic matter improves all essential soil properties providing biological diversity above and below the surface.

Healthy Soils → Healthy Landscapes → Healthy Water

Infiltration rates for turf are dependent on soil structural condition.

BMPs *are not* effective when soil functions have been impaired.

Don't judge a landscape by its cover.

BMPs must provide physical, chemical and biological soil functions.

Mimic natural forest (depression) hydrology to store, infiltrate and filter runoff.

Due to Poor Soil Health Many Basins Do NOT *Treat* Water - They Simply Convey Runoff

For further information see ***A Ground Breaking Partnership for the Barnegat Bay Estuary Program*, November 2003, Coastlines** www.epa.gov/nep/coastlines

OC Planning Board Report *Atlantic Coastal Watershed Grant Stormwater Basin/Storm Drain Retrofitting Projects, BB Watershed* RP03-036 funded by NJDEP.

CBT Long Swamp Creek (SWAP)

Developing Soil Health Indicators

- Training citizens to use tools and soil indicators to help evaluate soil conditions.
- Note the penetrometer (left) in woods and penetrometer (right) about six (6) ft into disturbed area.

Construction personnel need training in post-construction soil assessment to evaluate effectiveness of long term BMPs.

Once soil is loosened by subsoiling it will easily recompact with traffic. Organic matter helps to provide soil resiliency.

- Basin ponding water for several years due to poor soil structure. OCSCD installed a monitoring well confirming the natural water table 9 ft. below surface.

Soil Assessments
CBT Grant (SWAP) Longswamp Creek

- CBT Long Swamp Creek 2009 completed soil restoration in two basins; training for homeowners utilizing BB Soil Health Card and soil indicators to assess soil conditions; soil health fact sheets being prepared for citizen use; and restoration scheduled for two additional basins at local schools in the (SWAP) Long Swamp Creek watershed spring 2011.

NJDEP 319h Living Shoreline Demonstration (Longpoint-Island Hts.)

Coastal Stabilization (Beachwood)

Bowman Road Nonpoint Demonstration Project

Rain Gardens

Lavallette Elementary, Hugh J. Boyd Elementary, Central Regional HS, Central Regional MS, Frederic A. Priff Elementary, OCVTS-Jackson Center, New Egypt High School, Eagelswood Elementary, Lighthouse Center for Natural Resources, Jacques Cousteau National Estuarine Research Reserve, OCSCD Office, Crawford Rodriguez Elementary, Stafford Elementary, Berkeley Township Elementary, OCVTS/MATES-Mill Creek

Outdoor Classrooms

29 Completed in BB Watershed

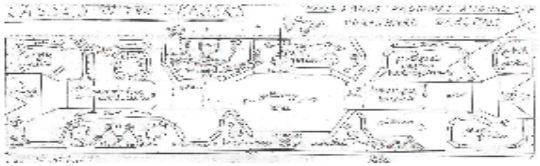
Ocean County Soil Conservation District– www.ocscd.org

Connecting to the Barnegat Bay Watershed— One School at a Time

OUTDOOR CLASSROOM CASE STUDY # 19

Pinelands Regional Middle School (Grades 7-8)
590 Nugentown Road, P.O. Box 248
Tuckerton, NJ 08087
609-296-3106 Lead teachers: Jane Hall & Anne Benoit n

Detailed Drawings Provide a Plan and a Visual Map of the Site



When designing this courtyard, consideration was given to provide hardy species; seasonal color and texture, wildlife value, accessibility, room for plants to grow & mature, sense of place and tranquility, & opportunities for multi-disciplinary curricular integration.

The $ Thing

- Initial support came from the NJEA Frederick Hipp Foundation to create the courtyard gardens in 1999.
- In 2000, a $500 grant from OCSCD was awarded to expand the native plantings and to supply lumber for the construction of various bird feeders and nesting structures for placement

CLASSES IN THE GRASSES

This courtyard was designed to provide seven theme-based gardens:

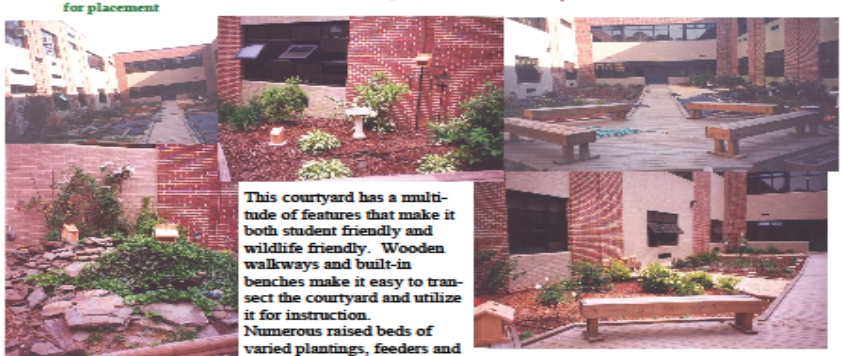
1. Butterfly
2. Native Plants
3. Water
4. Vegetable
5. Perennial Herb
6. Peace Garden
7. Roses

Newsletter Spotlight

In 1999, Mrs. Jane Hall & the courtyard project was featured on NJEA's "NJ Close-Up."

Approximately 350 seventh and eight grade students participated in the construction of the outdoor classrooms & was inclusive of the special education classes that Jane teaches.

The "Peace Garden," established by the English Department, remembers the victims of the Holocaust, and special education students developed a bird-friendly habitat.



This courtyard has a multitude of features that make it both student friendly and wildlife friendly. Wooden walkways and built-in benches make it easy to transect the courtyard and utilize it for instruction. Numerous raised beds of varied plantings, feeders and nest boxes built by the wood shop students, and a small pond, provide food, water & shelter for wildlife.

King County Construction Guidelines for Stormwater Management

- King County, Washington State adopted design, construction/ field inspection guidelines (*King County Surface Water Design Manual)* to sustain infiltration and protect water resources. County guidelines require restoration of soil functions including soil amendment specifications to sustain soil health for long term function of lawns and BMPs. Further information
  www. BuildingSoil.org
  www.seattle.gov/util/NaturalSystems/

Potential Applications for Barnegat Bay Watershed

- Understand when bulk density exceeds 1.6g/cm^3 soil is impaired.
- Construct BMPs to sustain soil properties to ensure function throughout the year.
- Develop/adopt assessment protocol to evaluate soils.
- Provide incentives to encourage effectual site layouts. Use undisturbed woods to infiltrate runoff (top photo). Basins with diverse biomass have greater ability to filter runoff.
- Decentralize the collection of runoff. Encourage healthy soils in all landscapes to infiltrate rainfall at the point of impact.
- Encourage County and State to adopt Standards/guidelines for construction/inspection to ensure that BMPs provide for post construction soil health.
- Facilitate permitting process to encourage infiltration, improve site layouts, reduce compaction and to ensure soil health in all BMPs.
- Science symposium "Impacts of Coastal Systems" in 2004 offered a four component strategy: (1) BMPs and construction practices minimize soil compaction, (2) utilize vegetative infiltration basins, (3) maintain natural vegetation on residential lots, (4) implement conservation zones.
- Application of any fertilizer must be predicated on the fact that the soil beneath the turf is fully functional.

Summary:

Healthy, functional soils work year-round sustaining our gardens and water quality in the bay.

When planning, designing and constructing BMPs we need to sustain soil functions to encourage infiltration, And when we reduce runoff volume through soil health practices we also reduce the load of pollutants entering the bay.