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Topics Covered

- **E&S Conveyance & Inlet Protection**
- **Soil Stabilization Requirements & Effectiveness**
- **Soil Compaction & Stormwater Issues**
- **PCSM Requirements and BMPs – common errors, problems and solutions**
- **N.O.T. - PCSM / Licensed Professional oversight / Closing out projects & permits**
- **Infiltration Basin Failure & Repair**

Inlet Protection or Not?





04/24/2006



07/06/2007



30

07/06/2007

Overloaded Inlet Protection!





Mud in infiltration
trench too!



Where's the berms?



04/24/2006

Silt fence failure resulted from concentrated bypass flows that did not enter the storm sewer & sediment basin



04/24/2006



When it works!

10/23/2012

Stabilization is always best - 4 days for temp stabilization



Notice slope tracking?

Straw at 3 tons/acre

**Straw at 2 tons per acre will reduce erosion by 98%
(per NRCS study)**

**Most sediment controls remove less than 50% of soils
from runoff, clays stay suspended**

**Rule of thumb: If you are seeing a lot of bare ground, there is not
enough straw.**

Hydroseed/Hydromulch Stabilization - Does this meet specs?



Fill Being Removed From NPDES Site

- ▶ Delivered to Agricultural Field....Farmer must have an Ag E&S Plan that covers incorporating the fill material into the farming operation (most Ag E&S plans cover farming only, not filling operations)
- ▶ Ag practices are not exempt from E&S requirements - Contact MCCD with any Agriculture questions
- ▶ Delivered to another construction site....The receiving site must have an approved E&S Plan, this is a permit requirement

Post-Construction Stormwater BMPs & NOTs

- ❖ **Very high rate of infiltrator failures and design issues!**
- ❖ **Must be working for permit termination.**
- ❖ **Developer/Contractor may remain responsible for long-term O&M!!**

102.8(m)(5)

A permittee or co-permittee that fails to transfer long-term operation and maintenance of the PCSM BMP or otherwise fails to comply with this requirement shall remain jointly and severally responsible with the landowner for long-term operation and maintenance of the PCSM BMPs located on the property.

PCSM Background

- ▶ Rate Control - traditional detention basins
- ▶ Water Quality - treats runoff to remove pollutants
- ▶ Volume Control - deals with extra volume of runoff created by land use change with infiltration BMPs, capture & reuse or evapotranspiration
- ▶ Volume control is generally the most difficult for designers to meet permit requirements for. Infiltration BMPs are used for volume credits but often fail to work properly.

Licensed Professional Oversight

- Required for observation of critical stages of PCSM BMP installation - be sure to invite them!
- Submit certified “Record Drawings” - As-builts
- Record PCSM Plans and Record Drawings with Recorder of Deeds
- Sign-off on construction and submit with N.O.T.

What if PCSM BMPs don't work?

NPDES Permit Condition 1. h. - Reduction, Loss or Failure of BMP: “Upon reduction, loss, or failure of any BMP, the permittee and co-permittee shall take immediate action to restore, repair, or replace the BMP or provide an alternative method of treatment.

Are the outlet structures leaking?

Did the Licensed Professional see sufficient stages of construction and sign off on the construction?

Are failures the result of design or construction??

Repairs and litigation can get very costly!

Could changes in soil be the biggest part of our stormwater problems?

- ▶ Compaction
- ▶ Lack of topsoil replacement depths
- ▶ Changes in root structures
- ▶ Changes in infiltration rates
- ▶ Inaccurate post-development curve numbers
- ▶ Lack of adequate seedbed preparation

**Perhaps our biggest
stormwater problem
is soil related!**

**Roots cannot penetrate
overly compacted soils
- this is from an area of
compost soil
amendments**



We use a Soil Probe to determine if soil amendments were actually done



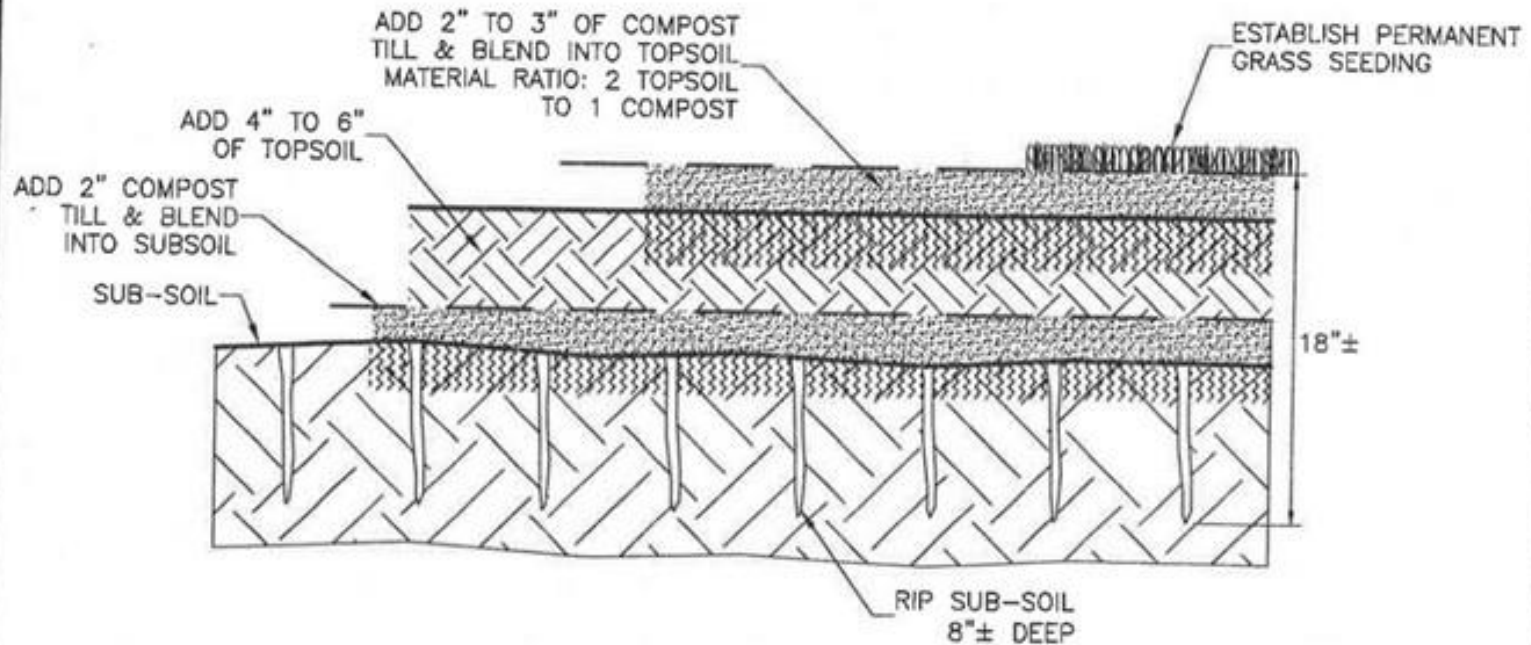


Notice the lack of roots and grass cover!

11/30/2015

Some effort made but not per plan requirements

Good Soil Amendment Detail - not just narrative



RIPPING SHOULD BE DONE WITH A SOLID SHANK RIP TEETH ON REAR OR TRACK MACHINE. DO NOT RIP SOIL IS WET. AVOID RIPPING EXISTING TREE ROOTS. SPACE RIP CHANNELS 12" TO 36" APART. TILLING AND BLENDING MAY BE DONE WITH ROTOTILLER, DISK HARROW, CHISEL PLOW, SPRING TOOTH HARROW, OR OTHER SUITABLE EQUIPMENT

SOIL RESTORATION MAINTENANCE:
WATER GRASS AS NEEDED FOR VIGOROUS HEALTH. APPLY ADDITIONAL COMPOST AS NEEDED FOR NOURISHMENT. AVOID COMMERCIAL FERTILIZER AND PESTICIDES.

SOIL AMENDMENT & RESTORATION DETAIL

NO SCALE

Bulk Densities in Soil

Bulk Density of Soils in New Jersey

Permeability Measurements of Sampled Layers within 20" of Soil Surface

Site	Bulk Density (g/cubic cm)	Permeability (in/hr)
Woods	1.42	15
Pasture	1.47	9.9
Single House	1.67	7.1
Subdivision Lawn	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

Reference: Bulk Density for Concrete is 2.2 g/ cubic cm

Topsoil Requirements

- 102.22(a) Permanent Stabilization – Includes reference to topsoil replacement
- E&S Manual requires minimum of 4”-8” of topsoil
- District may conduct soil probe to determine depths
- Source of many complaints
- Expect E&S plans to define topsoil in the future, this may cause the need to test topsoil for organics and fertilizer needs – should be doing this anyway.

E&S Manual - topsoil requirements

- **Requires scarification of subsoil 3” to 5” to permit bonding of the topsoil.**
- **Required soil “amendments” (lime, fertilizer) should be applied before seeding and worked into the soil to a depth of 4” to 6”.**
- **Maximum area at final grade before seeding and mulching is 15,000 square feet (1/4 acre).**

Seedbed Preparation

- ▶ This is a critical component that is not being done in most cases, resulting in poor grass establishment and lower seed germination percentages
- ▶ If you paid a subcontractor to follow the plan you may not be getting what you paid for!



Proactive Approach:

Used Sod

Watered Sod

*Inlet tops and all joints must
be sealed*

Bio-Retention / Rain Gardens



01/18/2006

Basin Stabilization - It's a problem

- ▶ Not much success in establishing specialty seed mixes
- ▶ Extended grow-in periods for some mixes
- ▶ Companion crop necessity?
- ▶ Concentrated flows washing seed away before establishment
- ▶ Planting trees/shrubs in ponding water?
- ▶ Still need ground cover with trees/shrubs planting plan

Rain Garden Seed Mix – Year 1



Is this what a new home buyer wants?

**Companion crop for stabilization – Spring Oats w/Ernst
Rain Garden Mix and plenty of straw mulch**



Earthen spillway - No leaky pipes for an overflow.



**Year 2 – Ernst Rain Garden Seed Mix
(2-3 year grow-in period)**



Year 3



Year 7 - Much of the original vegetation is gone, replaced by invasives (likely due to no seasonal mowing/maintenance). I do remove invasive vines like mile-a-minute and bindweed as necessary.

Cover the Soil!



- Mulch stabilization with containerized plantings is probably best**
- **wait to make sure it actually infiltrates before planting!**



Repair requires removing and reinstalling plantings



Untimely stabilization almost killed it!



Combination of seed mix and plantings

03.27.2012

A photograph showing a flooded area with a building in the background. A white callout box with a black border contains the text "Watertight joints" in green. A white arrow points from the box to a small, circular, blue-tinted structure in the water. The ground is covered in green grass and some small bushes. In the background, there is a large, multi-story building with a brown facade and a sign that says "SEARS". A parking lot with several cars is visible in front of the building. The sky is overcast.

Watertight joints

Soil mix is critical!

06/13/2013

Planting soils are extremely important!

1/3 - sand

1/3 - compost

1/3 - triple shredded bark mulch

Be careful with loose or unspecified onsite soil allowances

BMP Basin Soil Mix:

http://www.lowimpactdevelopment.org/raingarden_design/soil_amendments.htm

This mixture will create a very well drained, fairly low nutrient mix for a rain garden:

15% BY VOLUME DOUBLE SHREDDED HARDWOOD MULCH

50% BY VOLUME WASHED SHARP SAND – ASTM C-33

30% BY VOLUME TOPSOIL (be careful with this, could contain too much clay)

5% BY VOLUME PEATMOSS

It is important to note that the sand used in a rain garden should ALWAYS be a coarse, sharp sand. It should NEVER be a contractor building sand. In areas of high summer soil heat, the compost or peat moss components will decompose rapidly. The double shredded hardwood mulch will decompose slower and will maintain the desired coarse and well drained structure longer than some other amendments. In all cases, the quality of materials matters; topsoil should be weedfree and high in organic content and less than 10% clay.

What if you feel the specified soil mix wont work?

- ▶ Contact the plan designer for discussion before changing the mix and taking on liability
- ▶ **BE SURE TO HAVE THE DESIGNATED LICENSED PROFESSIONAL ONSITE TO VERIFY CONSTRUCTION OF THE BMP!**



Rain gardens can work in bad soils!

06/10/2015

Compost Soil Amendment Stormwater BMP



**Add compost or other products to topsoil and
relieve compaction of subsoil**



/2013

12/31/2013





Notice the lack of roots and grass cover!



11/30/2015

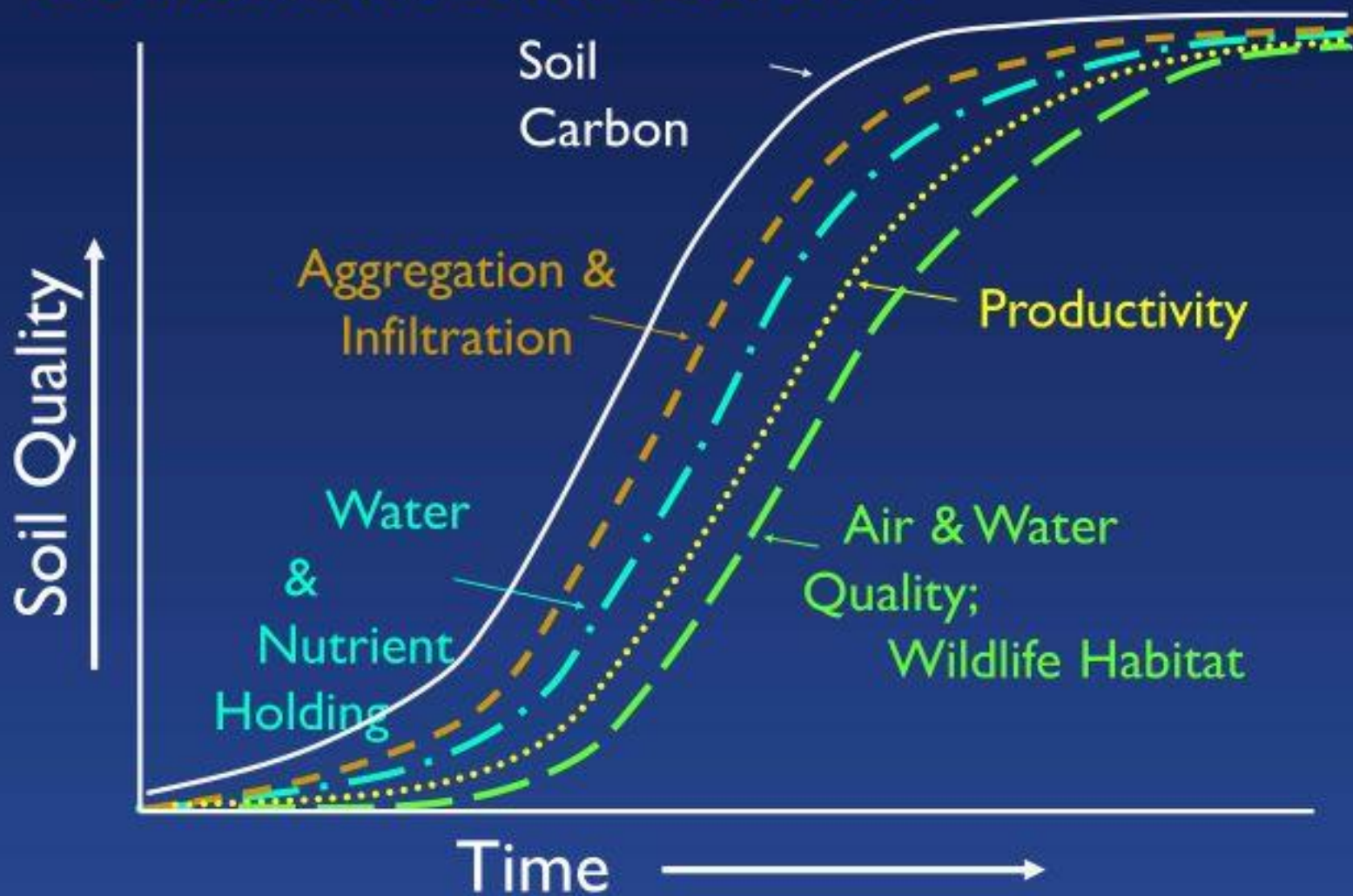
Some effort made but not per plan requirements

Soil Amendment as a PCSM BMP

- **Soil Amendment BMP Options vary widely**
- **Intent is to remove compaction of subsoil first**
- **Add topsoil/compost mixture (approx. 6"-10")**
- **Rake, seed, straw (use tack to prevent the straw from blowing away)**
- **Use low ground pressure equipment!**

It takes Mother Nature approximately 500 years to make 1" of topsoil so put it all back, it's a resource!

Benefits of Soil Carbon



*Are check dams really
a good idea?*



10.08.2012

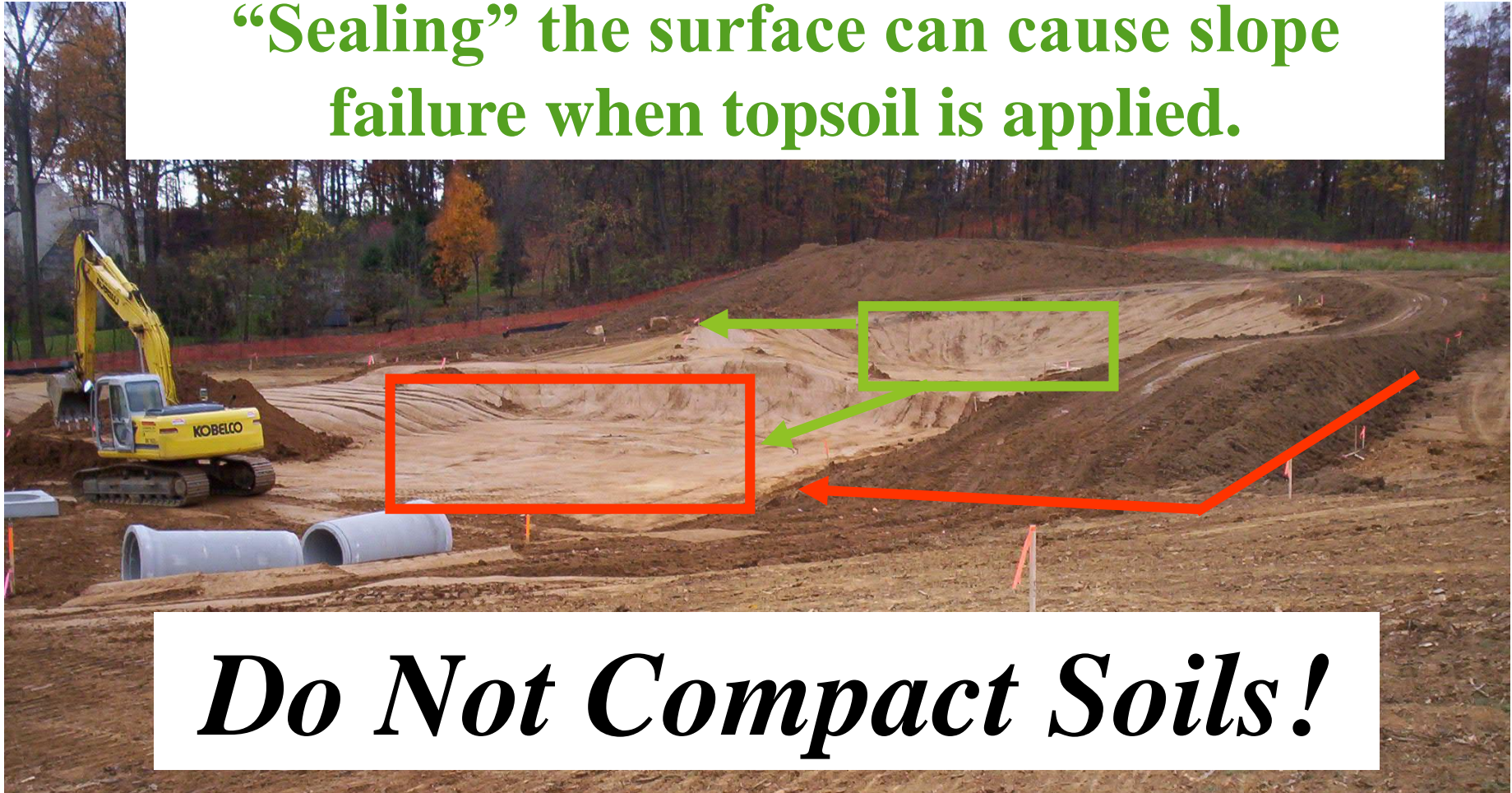


Infiltration Swale



Compacting and “sealing” soil surfaces increase erosion by approximately 30%

“Sealing” the surface can cause slope failure when topsoil is applied.





Infiltration area could have been built after all upslope disturbance areas were stabilized.

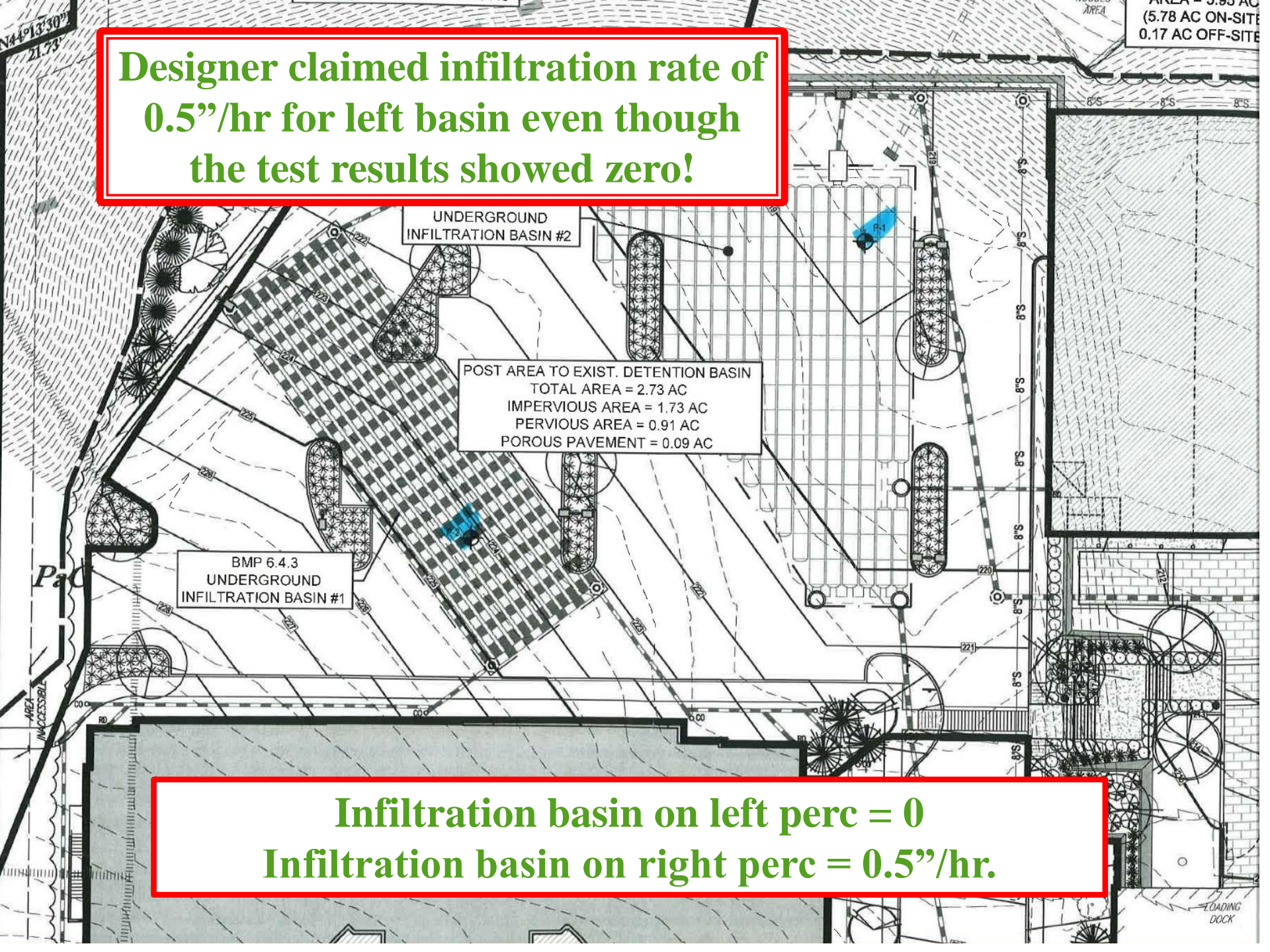
Infiltration basin bottom could have been left 1-2' higher until disturbance areas were stabilized.

Don't rely on inefficient E&S Controls to protect the infiltration areas.

Was Licensed Professional onsite when infiltration area was compromised?

08/29/2006

Designer claimed infiltration rate of 0.5"/hr for left basin even though the test results showed zero!



POST AREA TO EXIST. DETENTION BASIN
TOTAL AREA = 2.73 AC
IMPERVIOUS AREA = 1.73 AC
PERVIOUS AREA = 0.91 AC
POROUS PAVEMENT = 0.09 AC

BMP 6.4.3
UNDERGROUND
INFILTRATION BASIN #1

UNDERGROUND
INFILTRATION BASIN #2

Infiltration basin on left perc = 0
Infiltration basin on right perc = 0.5"/hr.

LOADING DOCK

Infiltration Basin Conversion

- **Extremely High Rate of Failure!!**
- **When used as a sediment basin during construction the underlying clogged soils must be removed to restore infiltration capability. Permit requires re-testing soil perc.**
- **BMP Manual states over-excavation of at least 1 foot below the sediment basin bottom elevation**
- **Suggest excavating holes at 1', 2', & 3' and conducting soil investigation to determine depth of removal necessary.**
- **Replace with sandy soil mixture, suggest using pure 3"-6" sand on top for immediate stabilization and easy maintenance (BMP Manual suggests sand for slow percs).**
- **Was Licensed Professional onsite???**

Failing Infiltration Basins, Lots of them!



Sediment basin conversion to infiltration basin



Was muddy runoff from site or basin bottom itself?

08.10.2011



10.05.2011



10.05.2011

1' over-excavation would not have been enough



10.05.2011



- Stone on back of berm where topsoil slid off
- Sand for surface stabilization and easy maintenance
- Notice runoff color – site is mostly stable

10.14.2011

A photograph showing a muddy runoff pond. The water is a thick, brownish-red color, indicating high sediment content. The pond is situated next to a building with a blue door and a window with a metal grate. A rocky embankment runs along the left side of the pond. The surrounding area is covered in green grass and some small plants. The text "1-year later" is overlaid at the top, and "Why is the runoff still muddy?" is overlaid at the bottom. The date "09.19.2012" is in the bottom right corner.

1-year later

Why is the runoff still muddy?

09.19.2012

1 ½ -years later



Costs to Convert & Repair

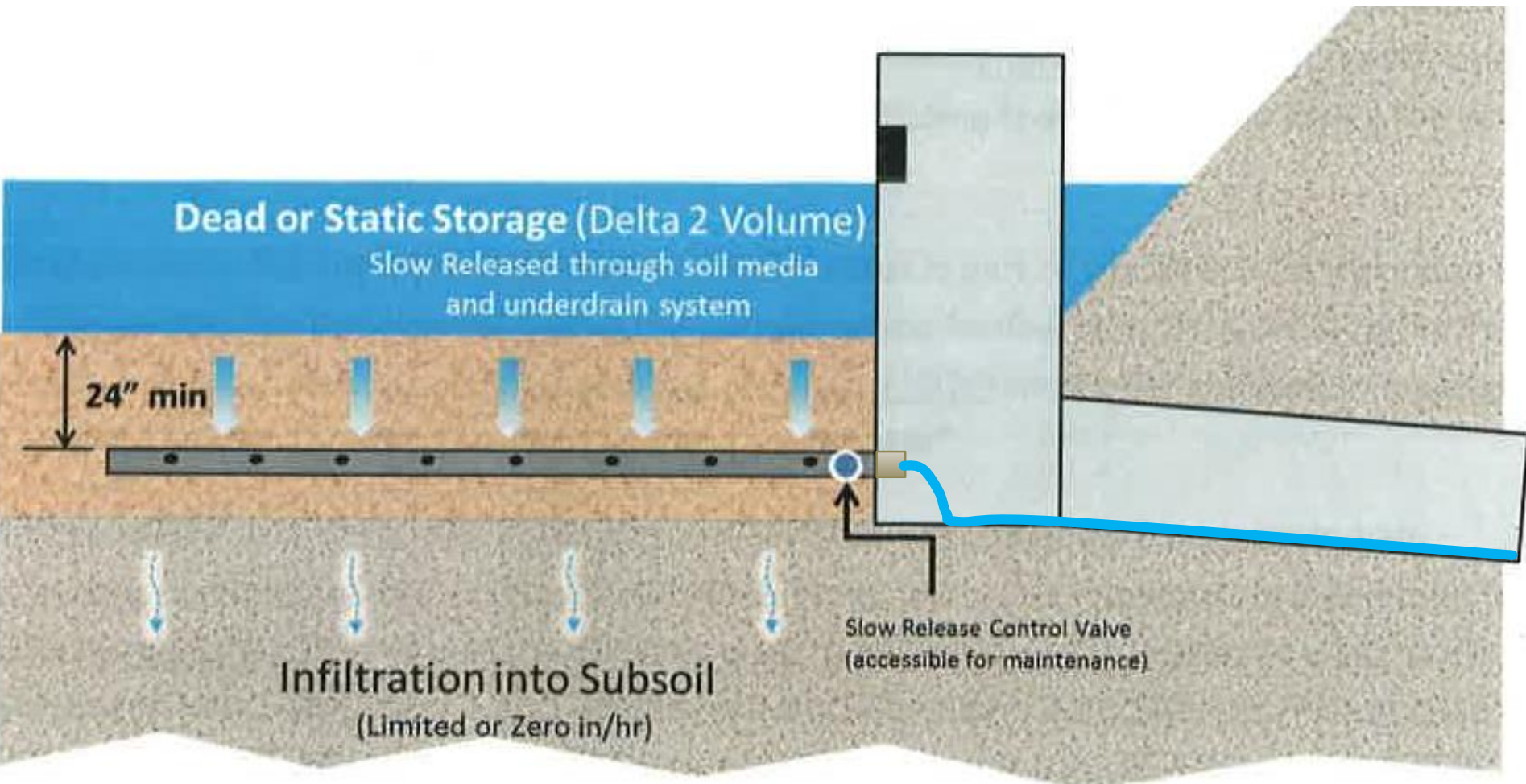
- **Initial Conversion per plans = \$6,932.87**
- **Resulted in failure to infiltrate and berm failure**

- **Subsequent Repair = \$7,812.50**
- **Over-excavation, soil replacement, berm repair**
- **Low cost since basin is small and onsite sand was used for most of the backfill**
- **Final cost more than double what client was expecting from original quotes – could have been much more!**

Under-drains & Valves

- ▶ Infiltration BMPs often have “back-up” under-drains to be used to dewater the basin for required maintenance
- ▶ Generally, if they are specified with a valve.....the valve is to remain closed!
- ▶ New slow-release concept has an under-drain but is designed for minimal flows (orifice cap)

Slow release concept BMP





QUESTIONS?