

PERMEABLE PAVEMENT MAINTENANCE

Washington Stormwater Center Technical Webinar on Permeable Pavement

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PRESENTERS:

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Agenda

- Considerations for frequency
- Identifying need
- Equipment
- Recommendation for periodic maintenance
- Case Studies in reactive maintenance



High Maintenance Sites

- High run-on ratio
- Leaves
- Pollen
- Unstable run-on areas (or other source control problems)

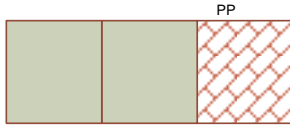


High Impervious Run-on Ratio

- Permeable Pavement
- Impervious Run-on Ratio

$$\frac{Area_{imp}}{Area_{pp}} \leq 2$$

Recommended to reduce maintenance frequency



2:1 impervious run-on ratio (maximum)



Identifying Maintenance Needs



- A high water mark in the curb and gutter or other evidence of ponding
- Sediment or pollen streaks on the surface of the pavement.
- Caked sediment
- low aggregate between pavers



PICP



"Black" sediment indicates migration of stormwater pollutants through pavement



Identifying Maintenance Needs



- Standing water during rainfall



Identifying Maintenance Needs



(Modified) ASTM C1701 or ASTM C1781 Infiltration Test
UDFCD "rule of thumb"
>20 inches/hr = OK
<20 inches/hr = needs maintenance



Identifying Maintenance Needs

Quick Inspection Method

- Pour 1 gallon of water over approximately 30 seconds. If the wetted area exceeds 10-feet, recommend maintenance and/or infiltration testing.



Types of Sweepers

- Broom (most common) – Not capable of removing silt from the pores of the surface.
 - A Combination sweeper is also a type of broom sweeper that includes a filtered vacuum system but this is just designed to control airborne dust and will not restore a clogged surface.



Proactive Maintenance



Types of Sweepers

- Regenerative Air Sweepers (2nd most common) – Appropriate for routine maintenance of permeable pavement but not enough to “restore” pavement.
 - Uses a blast of air the width of the sweeping head to dislodge material from the surface and lift it into an airstream



Periodic Maintenance



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Types of Sweepers

“Walk behind” vacuums can be used on small sites



Periodic Maintenance



Other Equipment

- "Vacuum Hydro Scrubber"
- Typically used for cleaning sidewalks



Periodic Maintenance

Reactive Maintenance



Types of Sweepers

- Pure Vacuum Sweepers (least common in the US) – Can be used to restore some clogged permeable pavements.
 - This is the only type of sweeper that uses air suction near the surface of the pavement.
 - Typically configured with side brooms that move debris into the 3-foot wide path of the vacuum.
 - May need to adjust the suction for the site. PICP restoration requires removal of the aggregate. NC State recommends 2000 rpm for this.

Reactive Maintenance



Recommended Periodic Maintenance

- Consider site specific factors
 - Run-on ratio
 - Tree cover
 - Stability of the tributary area
- Consider the type of pavement
- Start with regenerative air vacuum 2x per year. Adjust based on considerations and observations.

Periodic Maintenance



Case Studies of Reactive Maintenance

- Multiple PP installations in Colorado (5-10 years) old were not maintained
- Lack of maintenance = clogging/low infiltration rates
- UDFCD, CSU and City of Fort Collins experimented with several different methods for "restoring" the clogged PP sites
- Case Studies:
 - PICP – Denver Metro Wastewater Building
 - Porous Asphalt – Denver Metro Wastewater Building
 - PICP – Downtown Fort Collins
 - Porous Concrete – Commercial site in Fort Collins



PICP Reactive Maintenance

Regenerative Air Sweeper on Clogged PICP
(Not adequate for "restoration")

Results of CSU Testing (2013-2014)

- Pre-maintenance infiltration rate = 5 in/hr
- Post-maintenance infiltration rate = 5 in/hr



PICP Reactive Maintenance

Regenerative Air Sweeper on Clogged PICP
(Not adequate for "restoration")



Before



After



PICP and Pressure washing



Pressure washing
PICP is NOT
RECOMENDED



PICP Reactive Maintenance

"Vacuum" Hydro Scrubber on Clogged PICP
(Not adequate for "restoration")

Results of CSU
Testing (2013-2014)

- Pre-maintenance infiltration rate = 5 in/hr
- Post-maintenance infiltration rate = 5 in/hr



PICP Reactive Maintenance

Keeping PICP joints filled with washed 3/8" angular rock (ASTM No. 8, 89, or 9 Aggregate) will keep sediment closer to the surface



PICP Joint Fill



Use all-fractured face aggregate for backfill



PICP Reactive Maintenance



6 years of operation without maintenance

Infiltration rate < 2 inches/hr



Sediment accumulated throughout bedding layer (> 4 inches)



PICP Reactive Maintenance



- Solution:
- Removal all pavers manually
 - Remove/replace bedding layer
 - Replace pavers



Cost = \$1/SF

Pre-Maintenance: 2 in/hr
Post-Maintenance: 100 in/hr



Porous Concrete/Asphalt Reactive Maintenance



"Vacuum Hydro Scrubber"

- Angled nozzles
- 3500 psi hot wash
- 110 CFM suction

Fully clogged, Post-restoration
Infiltration rate = 24 in/hr

\$0.33/ SF as periodic maintenance



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Porous Concrete/Asphalt Reactive Maintenance



Porous Concrete Site

- Fully clogged due to water main break
- Pre-maintenance Infiltration rate < 3 inches/hr
- Post-maintenance infiltration rate = 34 in/hr



Porous Concrete/Asphalt Power washing



Power washing without suction can move sediment but also push it farther into the section.



Porous Concrete/Asphalt Reactive Maintenance

- Pure Vacuum Truck:
- successfully restored porous concrete
 - Slow and expensive
 - ~2 parking spaces/hour

Estimated Costs:
Restoration
\$0.60/ sf

Predictive Maintenance
\$0.05/ sf



Other PP Maintenance Considerations

- Make sure underdrains are protected



Weed Management and Stain Removal

- Flame or chemical spot treatment for weeds.
- Pulling weeds can move pavers
- Remove stains with a biodegradable degreaser – one that will sit on the surface and can be wiped off.



Snow Control

- No sand on ANY permeable pavement
- Don't store snow on the permeable pavement
- No chemical deicers on porous concrete
- Use rubber snow plow blades



Rubber "cutting edge"



Questions

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Additional Resources:
www.udfcd.org
stormwatercenter.colostate.edu