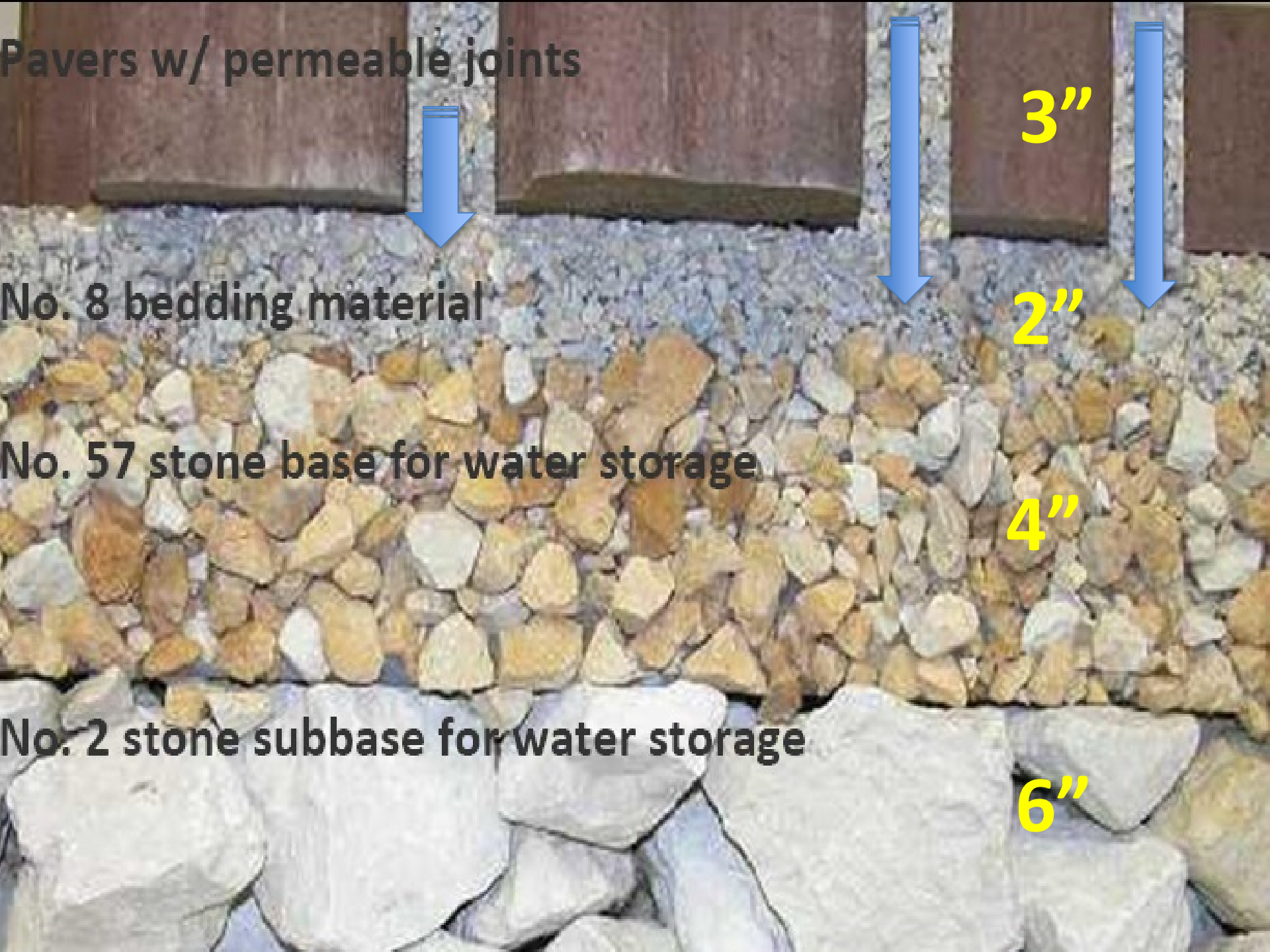
Maintenance Advances in Permeable Interlocking Concrete Pavement

Our Agenda

- **Permeable paver applications**
- **Inspecting & cleaning**
- **Maintenance options**
- **Maintenance research**


Pavers w/ permeable joints
3”
No. 8 bedding material
2”
No. 57 stone base for water storage
4”
No. 2 stone subbase for water storage
6”


SIERRA NEVADA


MURFREESBORO FIRE & RESCUE
9


3457


STOP

All SCMs Require Maintenance

Maintaining a Detention Basin

Permeable Pavements Need Maintenance

Contributory Run-on and Maintenance

Sedimentation is Biased

PICP Performance - Clogging

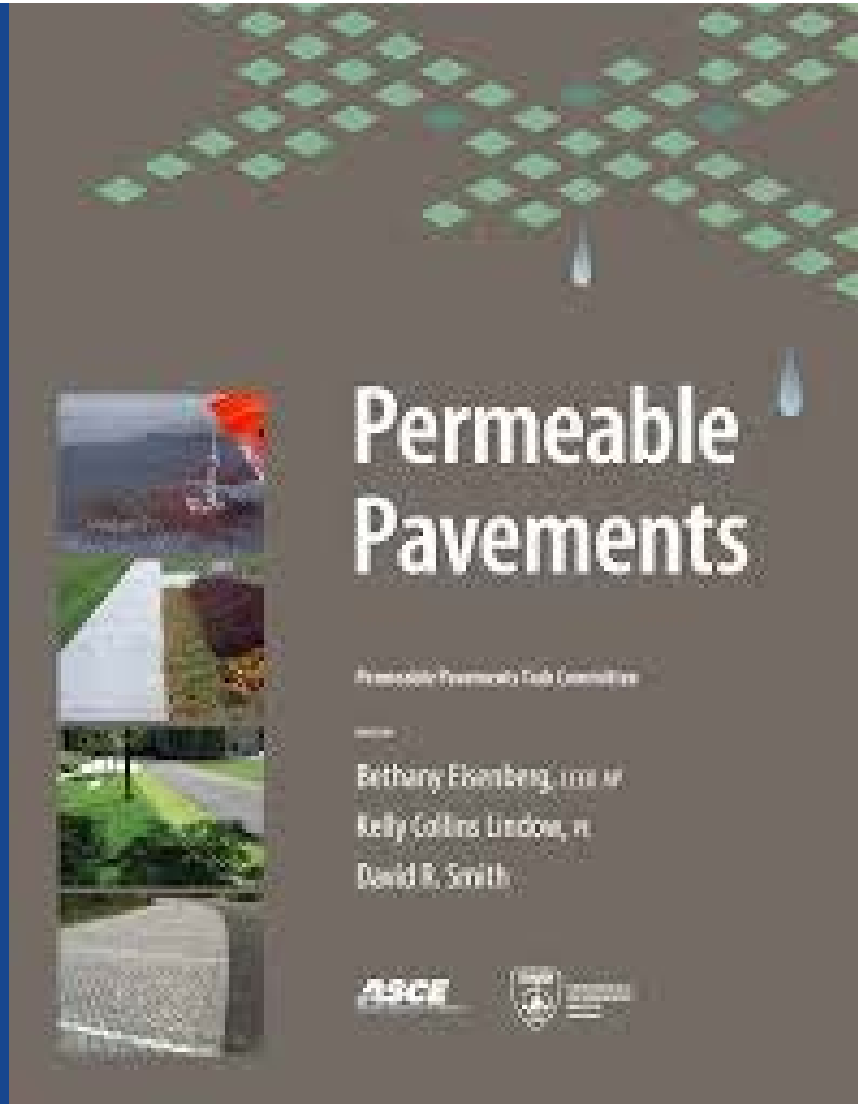
 # 1 Inspection Tool

<u>Clogging ≠ Sealing</u>

When is Remedial Maintenance Required?


STOP

Maintenance Resources



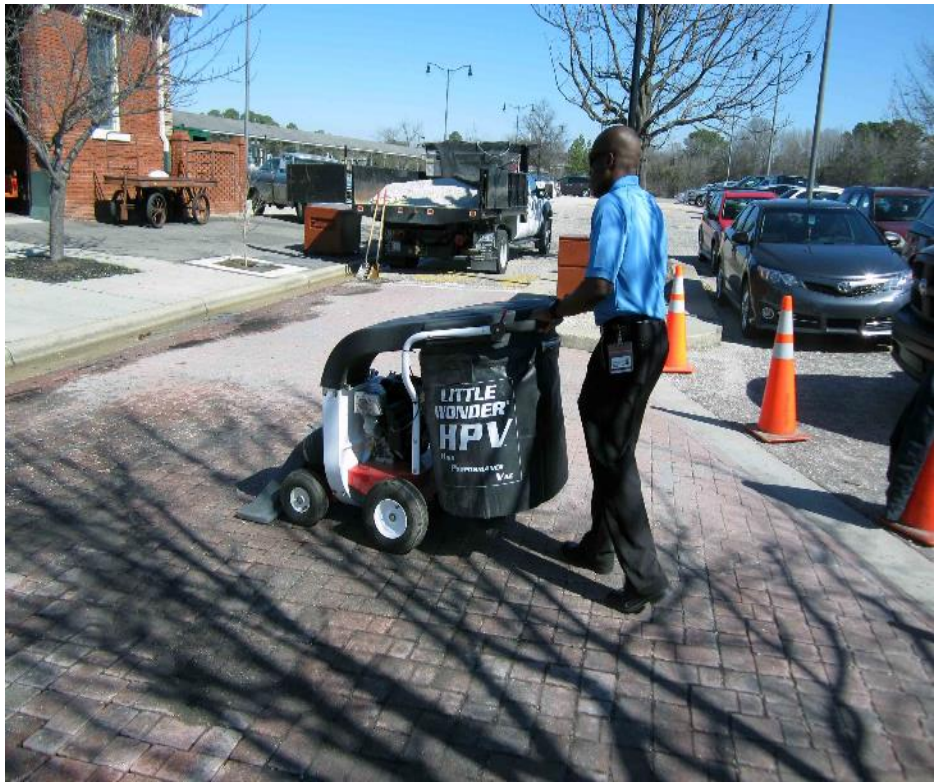
Industry Recommended Maintenance

- Inspect & clean annually
- Use appropriate equipment to remove surface sediment
- Adjust maintenance schedule based on sediment loading
- Check surface infiltration using ASTM C1781

PICP Maintenance – Starts with Inspection

- ❑ Evidence of ponding
- ❑ Check drains and outfalls
- ❑ Check observation wells
- ❑ Inspect pavers
- ❑ Inspect perimeter
- ❑ Confirm joints filled

This determines if seasonal or remedial maintenance is required



Important – Keep Joints Filled

Permeable Joint Fill Replacement

Easy to Repair/Replace/Adjust Pavers During Maintenance

PICP Performance in Winter

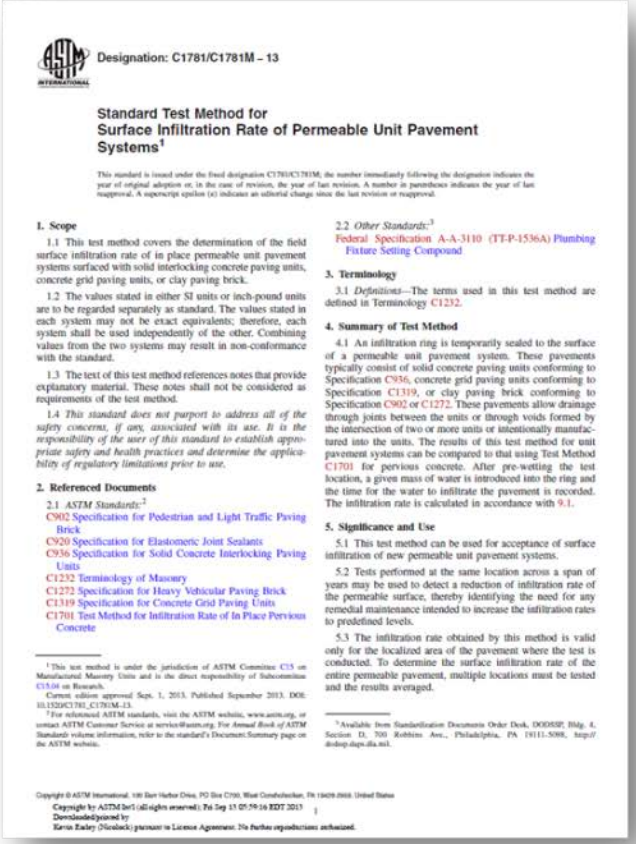
Toronto, Canada

- Eliminates black ice
- Aggregates not frost susceptible
- Surface does not heave
- Snow melts faster – deicing salts not needed

Snow Removal

Snow Removal

ASTM C 1781-Surface Infiltration Testing



Designation: C1781/C1781M – 13

Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems[1]

This standard is issued under the fixed designation C1781/C1781M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the field surface infiltration rate of in place permeable unit pavement systems surfaced with solid interlocking concrete paving units, concrete grid paving units, or clay paving brick.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 The test of this test method references notes that provide explanatory material. These notes shall not be considered as requirements of the test method.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C902 Specification for Pedestrian and Light Traffic Paving Brick
C920 Specification for Elastomeric Joint Sealants
C936 Specification for Solid Concrete Interlocking Paving Units
C1232 Terminology of Masonry
C1272 Specification for Heavy Vehicular Paving Brick
C1319 Specification for Concrete Grid Paving Units
C1701 Test Method for Infiltration Rate of In Place Pervious Concrete

2.2 *Other Standards:*[3]

Federal Specification A-A-3110 (TT-P-1536A) Plumbing Fixture Setting Compound

3. Terminology

3.1 *Definitions*—The terms used in this test method are defined in Terminology C1232.

4. Summary of Test Method

4.1 An infiltration ring is temporarily sealed to the surface of a permeable unit pavement system. These pavements typically consist of solid concrete paving units conforming to Specification C936, concrete grid paving units conforming to Specification C1319, or clay paving brick conforming to Specification C902 or C1272. These pavements allow drainage through joints between the units or through voids formed by the intersection of two or more units or intentionally manufactured into the units. The results of this test method for unit pavement systems can be compared to that using Test Method C1701 for pervious concrete. After pre-wetting the test location, a given mass of water is introduced into the ring and the time for the water to infiltrate the pavement is recorded. The infiltration rate is calculated in accordance with 9.1.

5. Significance and Use

5.1 This test method can be used for acceptance of surface infiltration of new permeable unit pavement systems.

5.2 Tests performed at the same location across a span of years may be used to detect a reduction of infiltration rate of the permeable surface, thereby identifying the need for any remedial maintenance intended to increase the infiltration rates to predefined levels.

5.3 The infiltration rate obtained by this method is valid only for the localized area of the pavement where the test is conducted. To determine the surface infiltration rate of the entire permeable pavement, multiple locations must be tested and the results averaged.

[1] This test method is under the jurisdiction of ASTM Committee C15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.04 on Research.

Current edition approved Sept. 1, 2013. Published September 2013. DOI: 10.1520/C1781_C1781M-13.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.

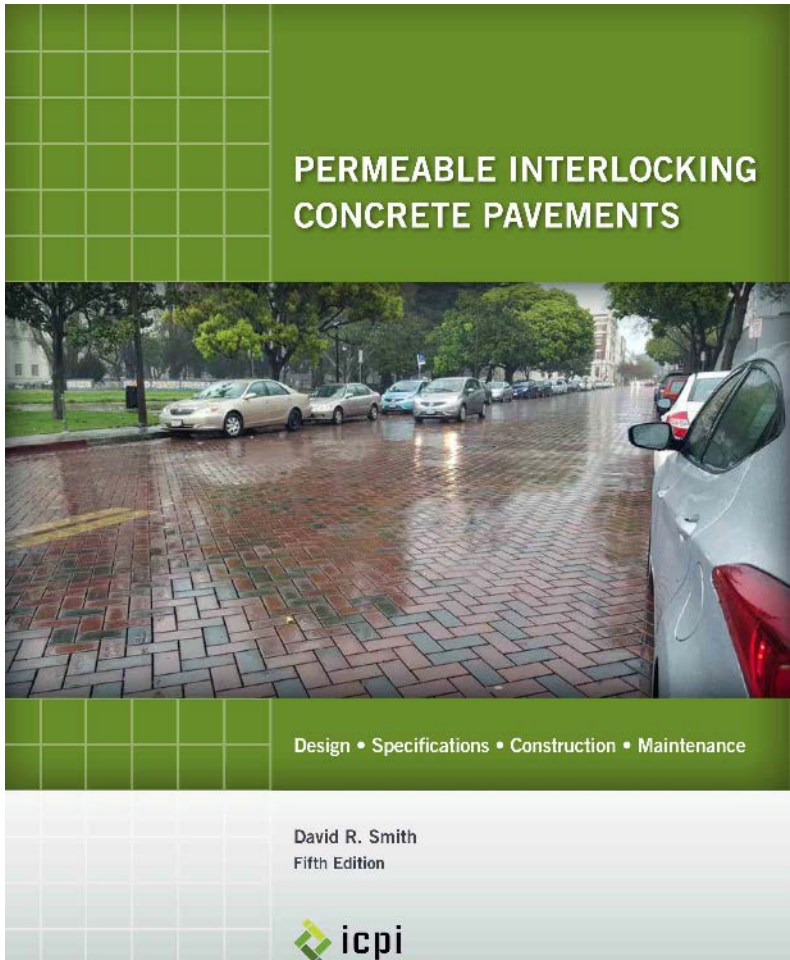
ASTM C1781 Measuring Surface Infiltration

ASTM C1781 – Ponding & Infiltration

Seconds to infiltrate 40 lbs water	Minutes to Drain	Approximate Surface Infiltration Rate inches/hr	
30	0.5	1000	OKAY
60	1	600	
100	1.7	360	
200	3.3	180	
360	6	100	Clean Before It Clogs
450	7.5	80	
900	15	40	
1800	30	20	Clean NOW
3600	60	10	

PICP Industry Recommendations

- **ASTM C1781**
  - **Acceptance testing, Min. 100 in./hr.**
  - **In-service, Min. 10 in./hr.**



Many Variations of Pavement Cleaning Equipment

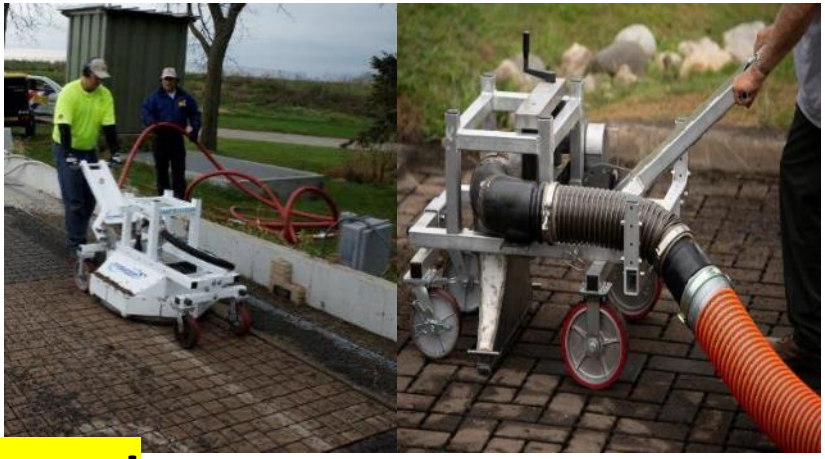
PICP Maintenance Equipment Options

Mechanical Sweeper

Regenerative Air

True Vacuum

Power Air & Vac Systems



Water-enhanced

True Vacuum Cleaning


STOP
dustless regenera

Ditch Witc Excavator

Regenerative Air Systems

Mechanical Sweepers

High Pressure Air/Vac System


Lakeville

Lancaster Brewery Demonstration


PAVEVAC
PAVEVAC

Badger – Super Sucker

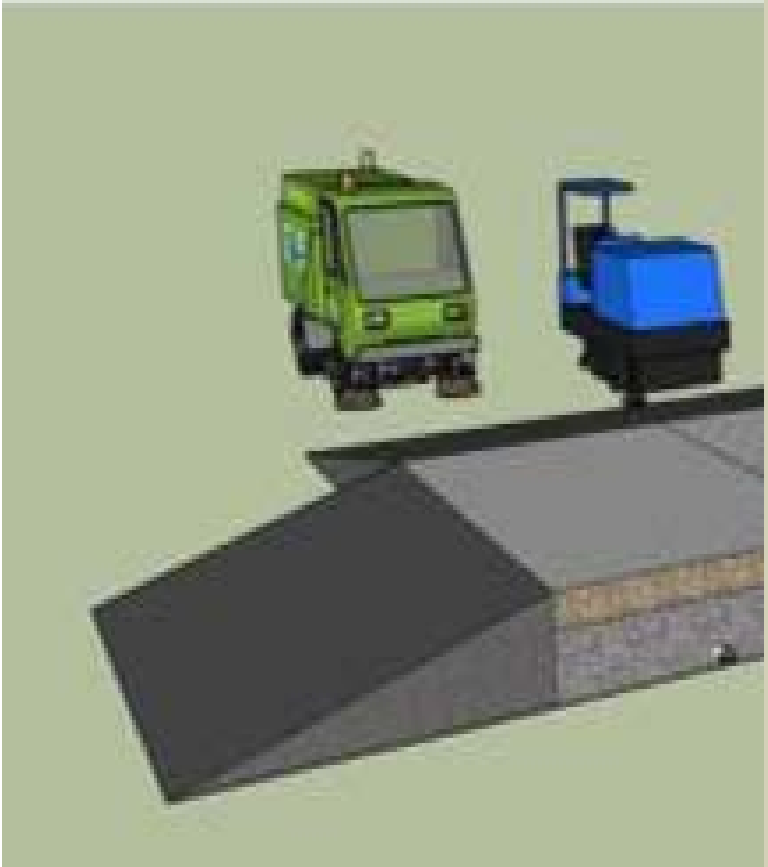
PICP Captures Sediment Near the Surface

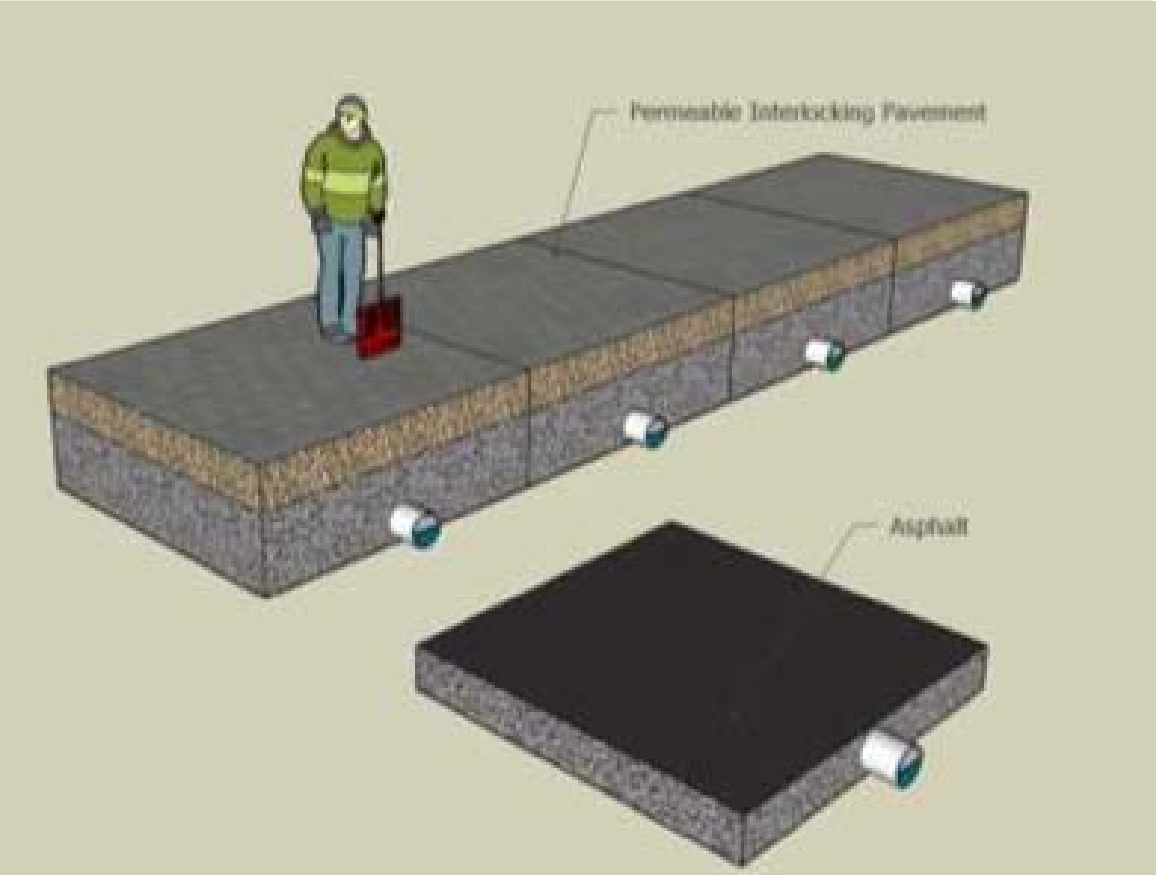
Sediment Capture Research

Morton Arboretum Workshop
Dr. Hunt-NCSU 2009

Most Sediment travel limited to upper top 1-2”

University of Toronto Maintenance Research





University of Toronto Maintenance Research

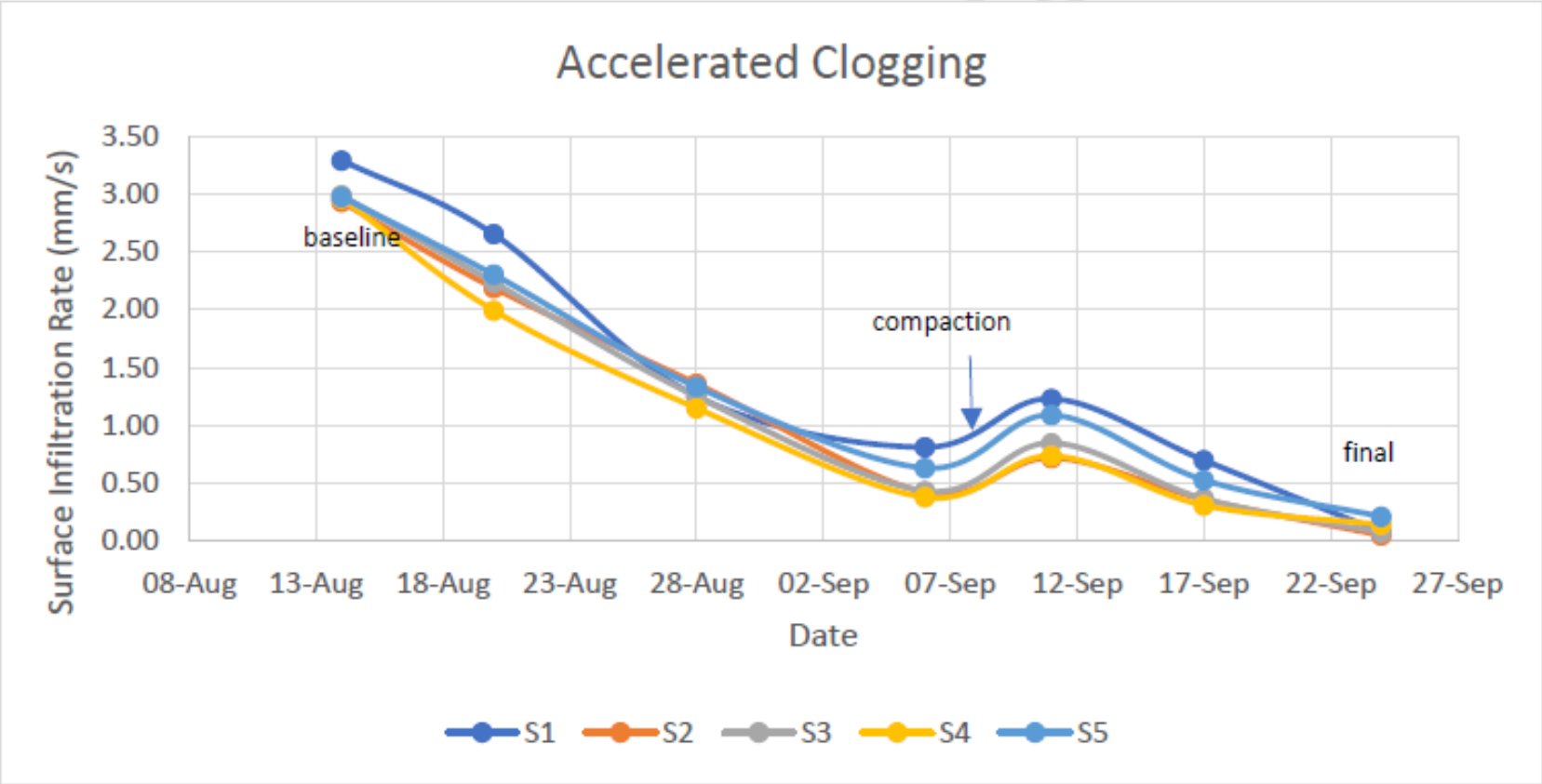


Figure 1: Measured Surface Infiltration Rates during Accelerated Clogging

Vacuum #1

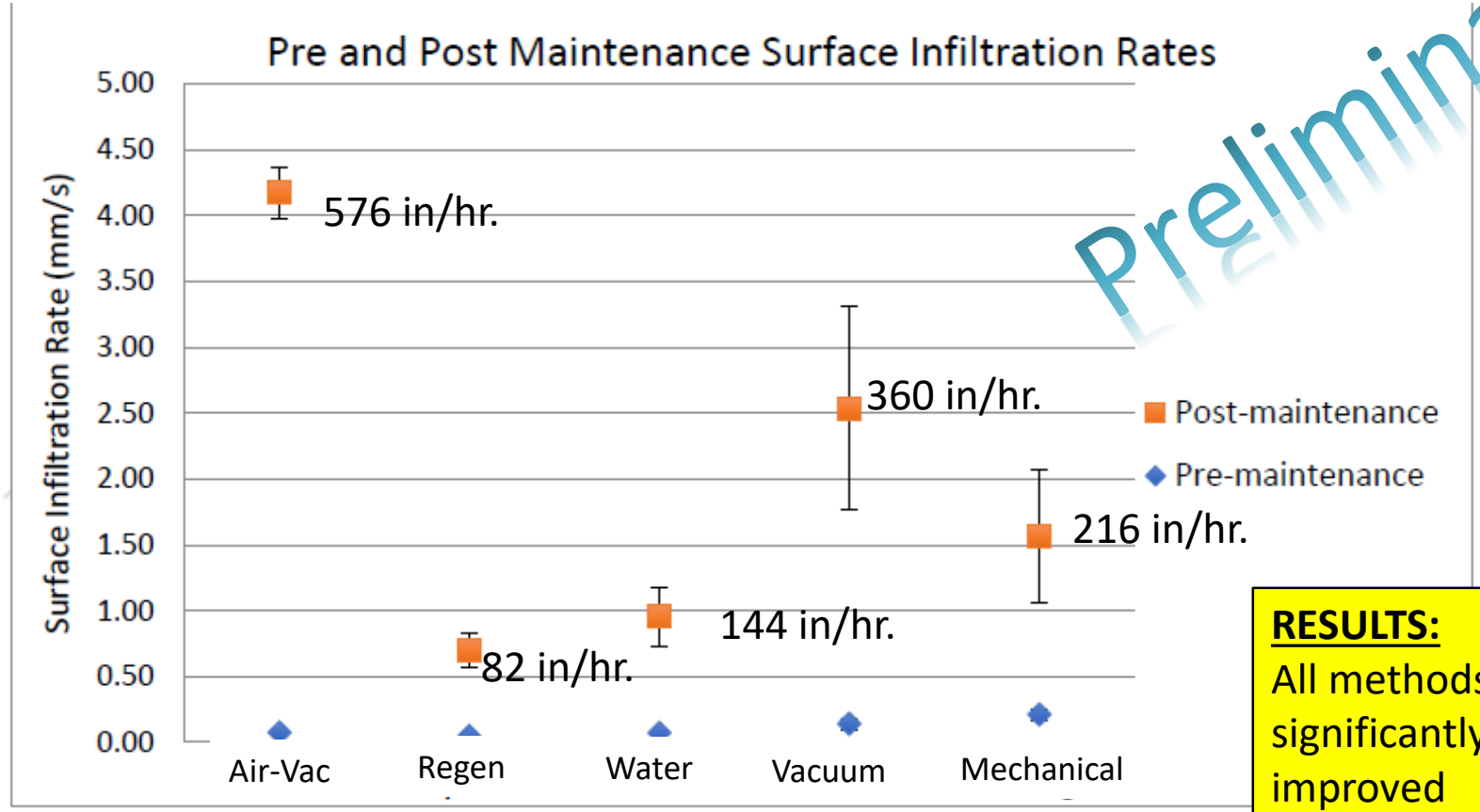
Regenerative Air #2

Mechanical Sweeper #3

Pressure Wash – Water Injection #4

High Pressure Air / Vacuum – Hybrid #5

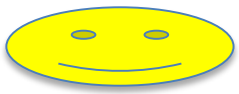
Maintenance Research Update



Preliminary

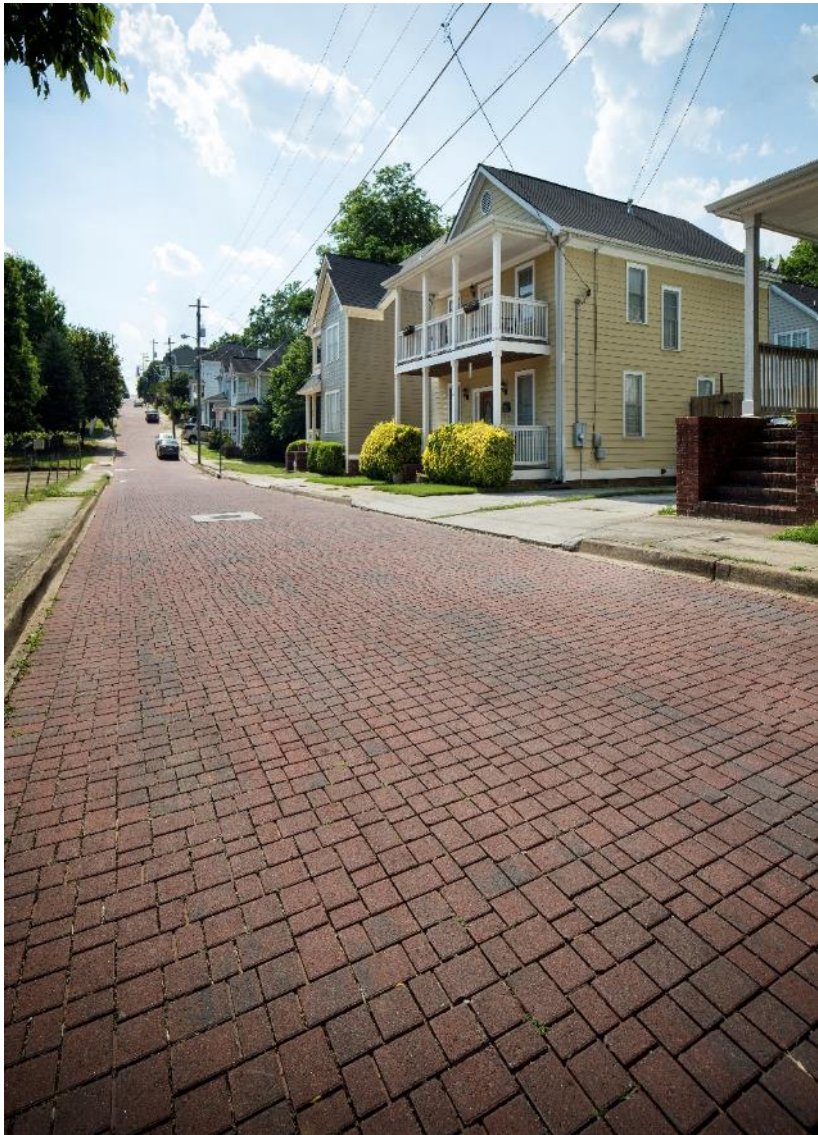
RESULTS:
All methods significantly improved infiltration rates!

#5 #2 #4 #1 #3



Permeable Pavers – Maintenance Summary

- Long-term surface infiltration rates can be maintained
- Distributive LID infiltration solution
- Safety – removes surface water
- Provides detention & water quality benefits
- 2 Functions in 1 – pavement & SCM
- **Sediment captured near surface allows for easy maintenance**



For More Information

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