Pervious Pavers: Where is the Perviousness?

Elizabeth (Betsy) Pappas

Research Hydraulic Engineer

Chi-hua Huang

Soil Scientist

United States Department of Agriculture
Agricultural Research Service
National Soil Erosion Research Laboratory
West Lafayette, IN USA

USEPA Stormwater Phase II Post-Construction Runoff Control Minimum Control Measure

BMPS Include:

- Non-structural
  - Planning / zoning around sensitive areas
  - Site-based minimization of disturbance
- Structural
  - Retention / detention
  - Infiltration
  - Vegetative

Pervious Pavement Types

- Porous concrete
- Grass pavers
- Gravel pavers
- Permeable interlocking concrete pavers
- Bricks
- Concrete grid pavers
- Recycled chipped tire surface…

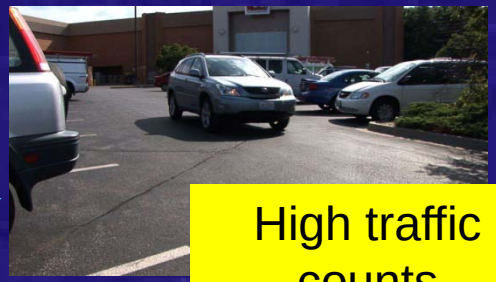
Causes of Decreased Infiltration Rates in Pervious Paver Systems

Clogging by:

- Silt and clay
- Organic matter
- Oil and grease
- Wear of paver

Proximity to erodible surfaces

Proximity to landscaping

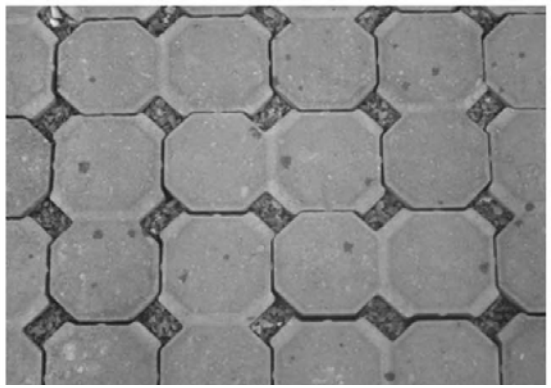


High traffic counts

Improper material

Previous Research

- Infiltration rates of permeable paver systems may be significantly improved by performing maintenance (Bean et al., 2007)
- In some cases, maintenance can return paver system to original infiltration rate. (Balades et al., 1995;)
  - Removal of top 15-25 mm and backfill with clean sand to original grade. (Gerrits and James, 2002)



Permeable Interlocking Concrete Pavers*

Single Ring Infiltrometer Test *

*Used with Permission: Bean, E.Z., Hunt, W.F., and Bidelspach, D.A. (2007) Field survey of permeable pavement surface infiltration rates. *J. Irrigation and Drainage Engr.* 133(3), 249-255.

Maintenance of Pervious Paver Block Systems

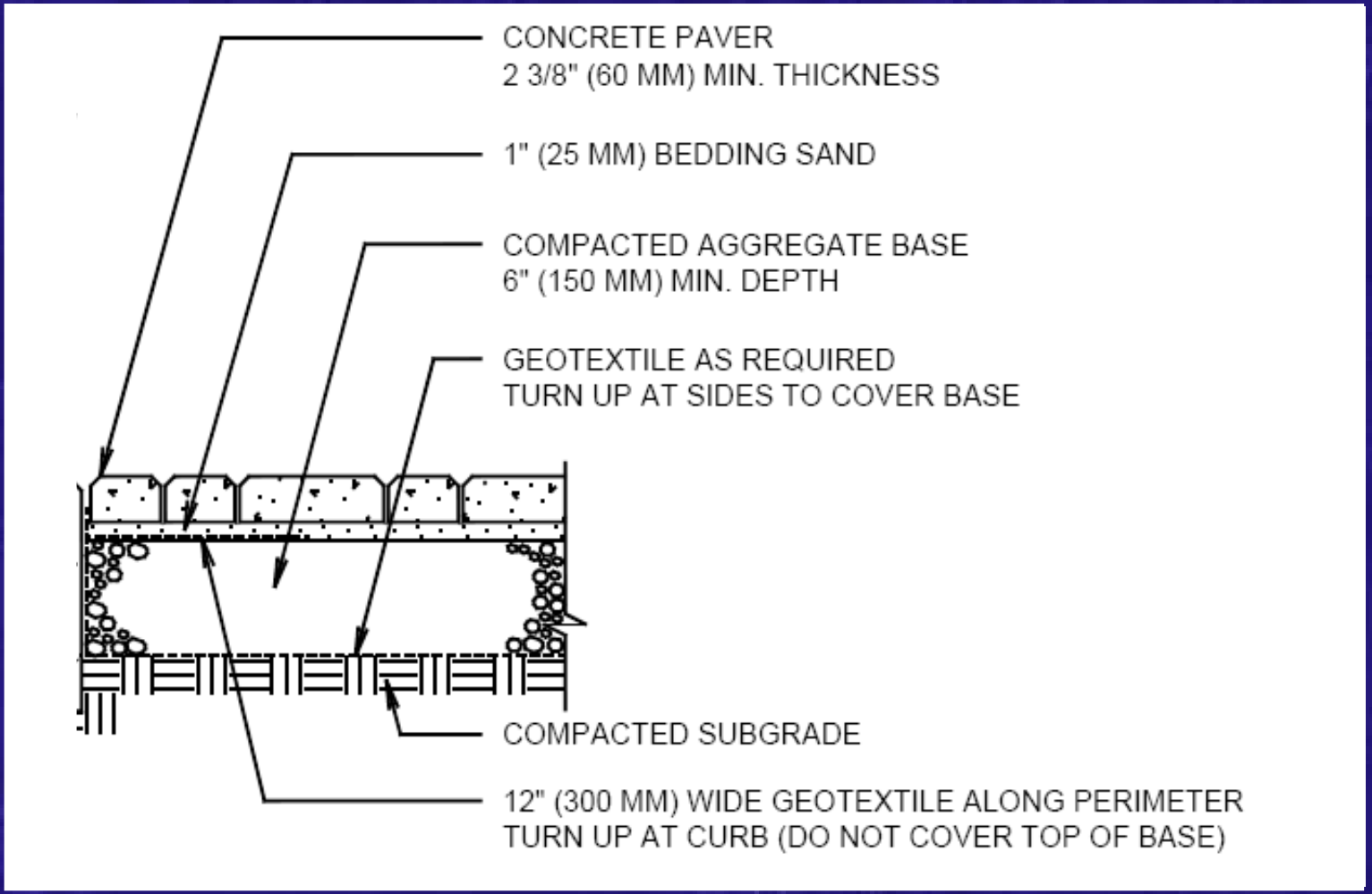
Maintenance Methods

- Vacuum
- Vacuum Sweep
- Sweep
- Powerwash
- Powerwash with Suction

Objectives

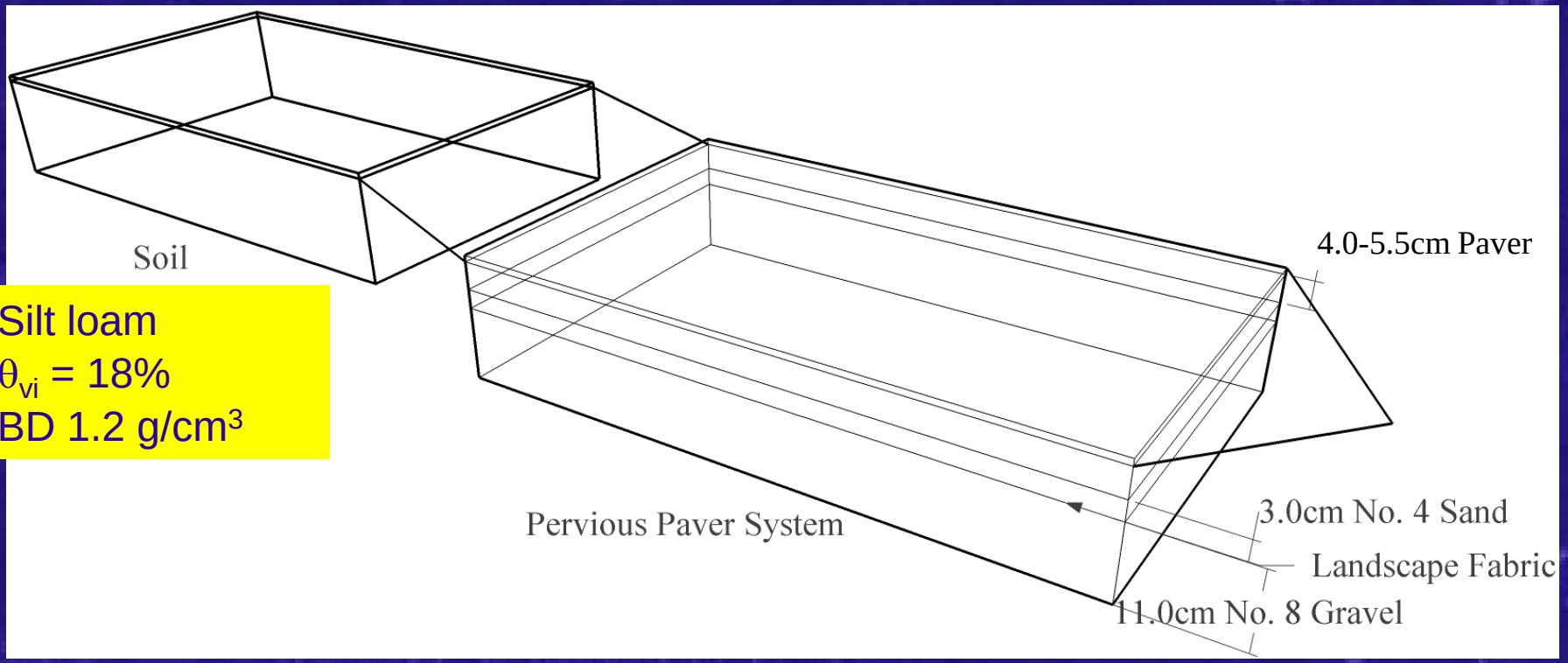
- Evaluate changes in runoff and infiltration rates from two paver block systems receiving runon from an erodible surface under repeated rainfall events.
- Determine the importance of infiltration in paver blocks themselves vs infiltration in the spaces between them.

Example Pervious Paver Schematic



Adapted from: Interlocking Concrete Pavement Institute
Residential Driveway
http://icpi.org

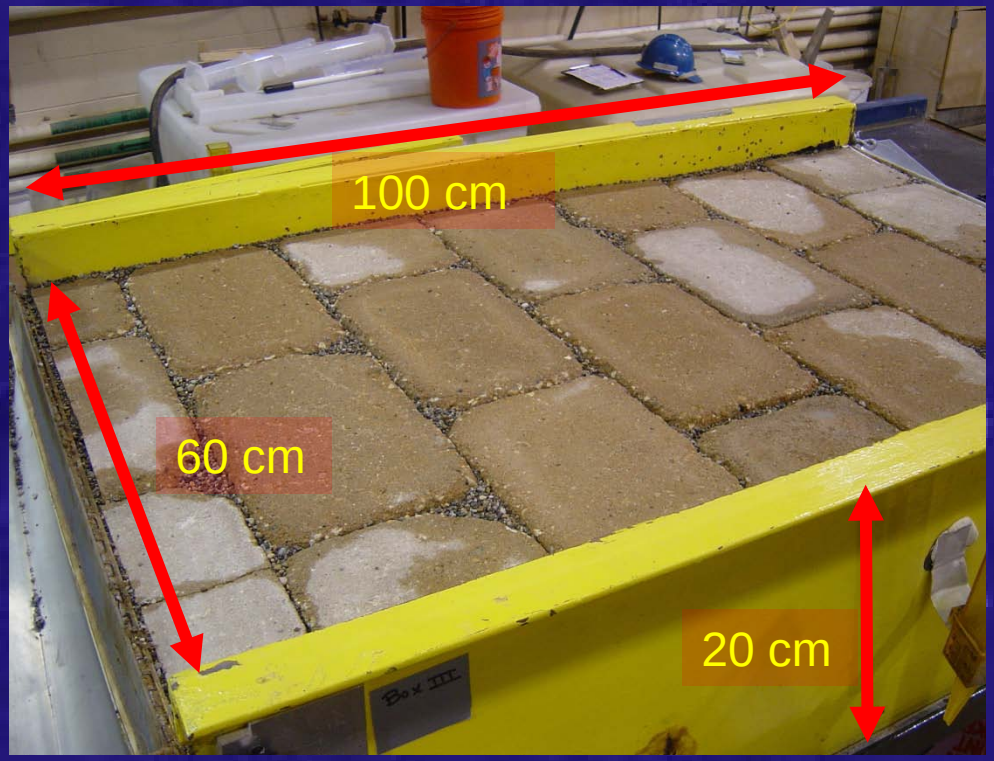
Schematic of Experimental Apparatus



Silt loam
θ_{vi} = 18%
BD 1.2 g/cm^3

Paver Boxes

Small Block (18.0 x 10.0 x 4.0 cm)

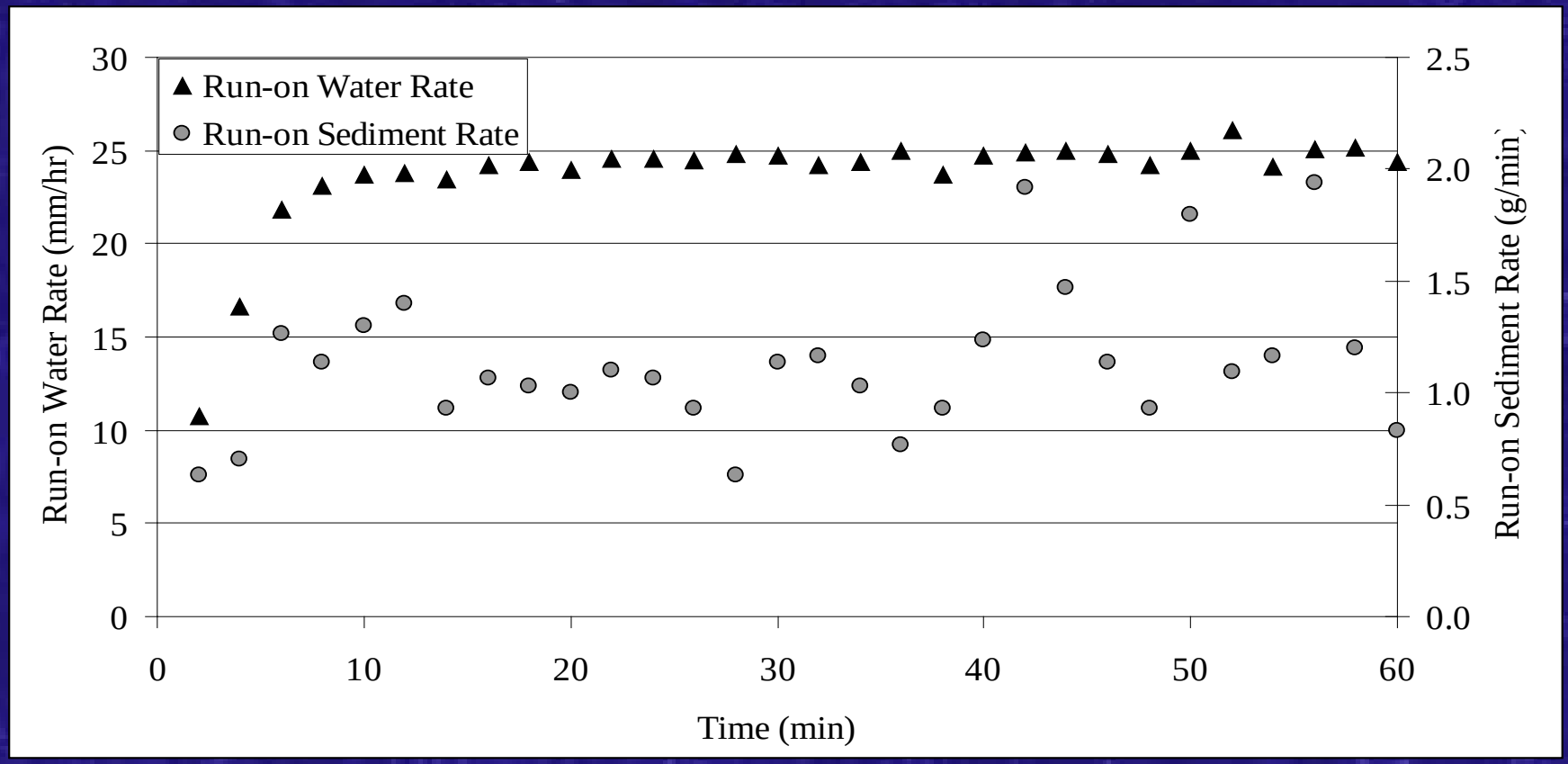


Large Block (22.5 x 15.0 x 5.5 cm)

Rainfall Simulation

- 11 rainfall events
  - 30 mm/hr for 60 min
  - 5-yr return period
  - 24-72 hrs between events
- Timed Samples
  - Surface Run-on
  - Surface Runoff
  - Deep Infiltration (20cm)
  - Rainfall Rate

Run-on

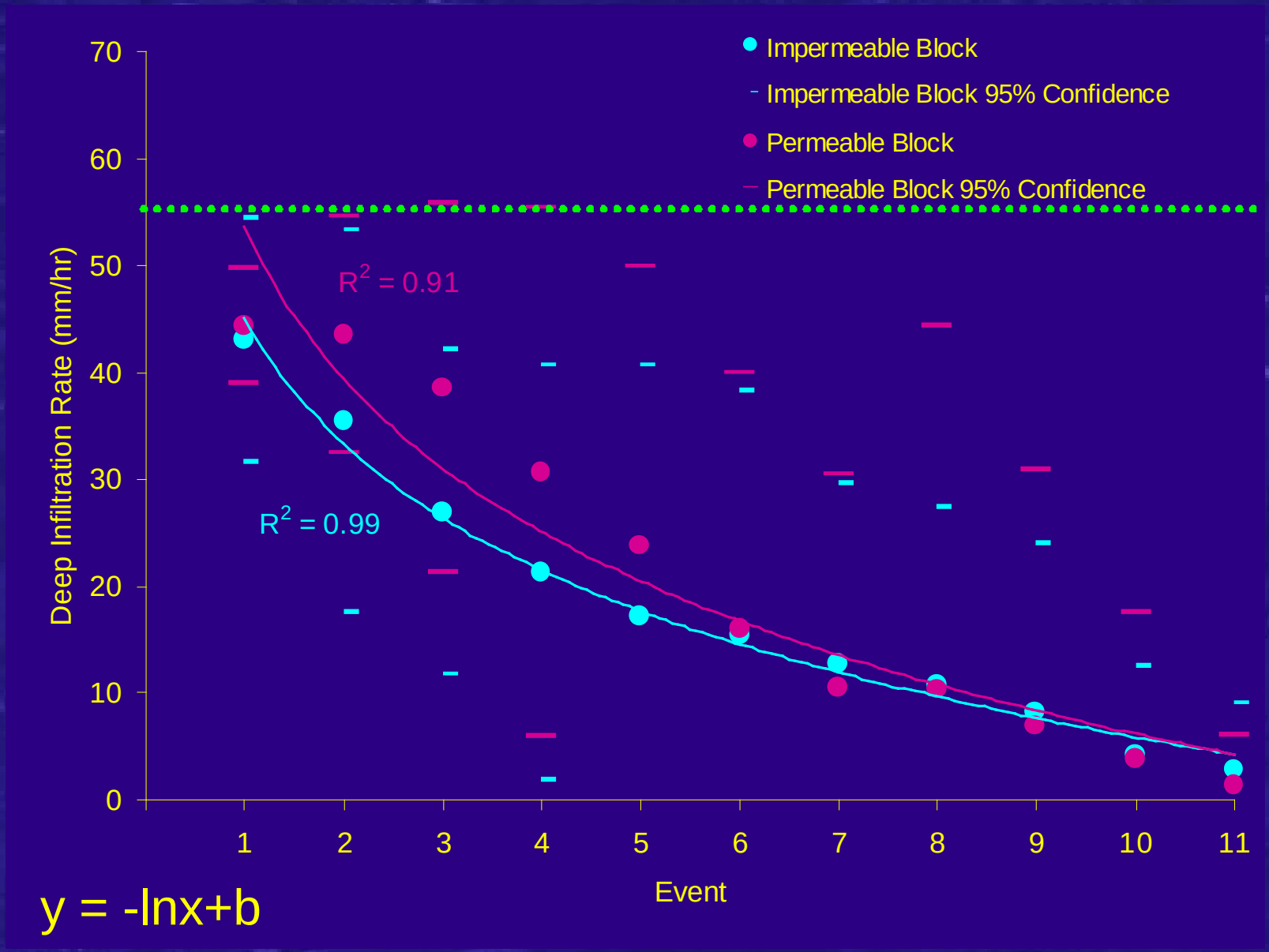

Run-on Water Rate
Run-on Sediment Rate
Run-on Water Rate (mm/hr)
Run-on Sediment Rate (g/min)
Time (min)
0
5
10
15
20
25
30
0.0
0.5
1.0
1.5
2.0
2.5
0
10
20
30
40
50
60

Sedimentation of Paver Surface

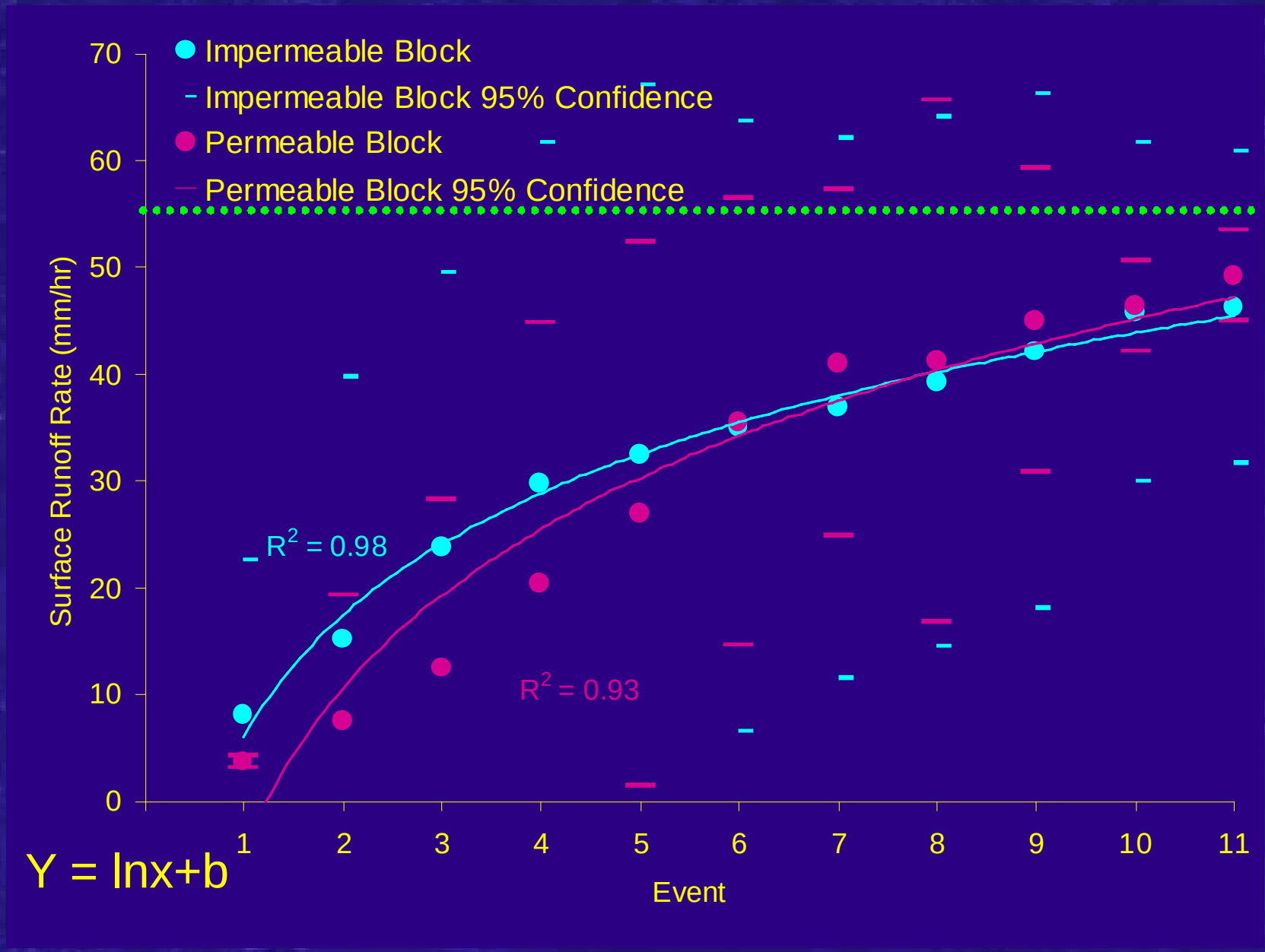
Before Rain

After Rain

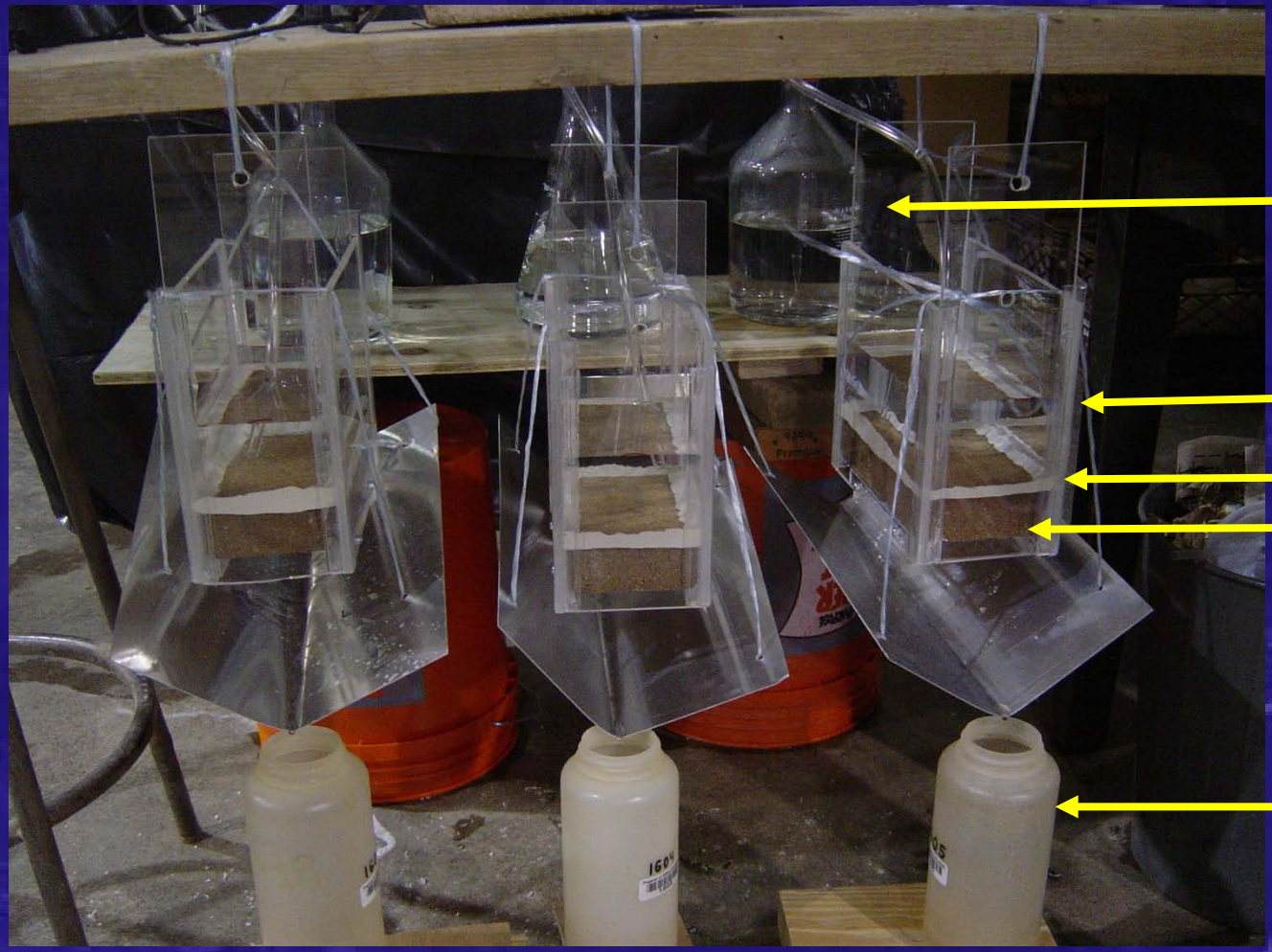
Steady State Deep Infiltration Rates



Steady State Runoff Rates



Paver Infiltration Tests



Paver Infiltration Tests

Paver Type	Average Steady State Infiltration Rate (cm/hr)
Permeable Block "Before Rain"	145.5
Permeable Block "After Rain and Sweeping"	1.4
Impermeable Block "Before Rain"	<0.01

Conclusions

- Measured deep infiltration rates of pervious paver block systems were shown to decrease from 87% to 3% of total water input when receiving precipitation and run-on from an erodible surface.
- Maintenance may not be effective in restoring infiltration rates of individual paver blocks.
  - Infiltration is most important in the open spaces between paver blocks.
  - The benefit of using a permeable paver block over using a more durable impermeable paver block is questionable.
  - There may be implications to applicability of porous concrete?

Thank You

betsy.pappas@ars.usda.gov