Installing Porous Pavement

Waukesha County Dept. of Parks & Land Use
Storm Water BMP Design and Installation Workshop
March 11, 2009

Presented by
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SYMBIONT

Definition

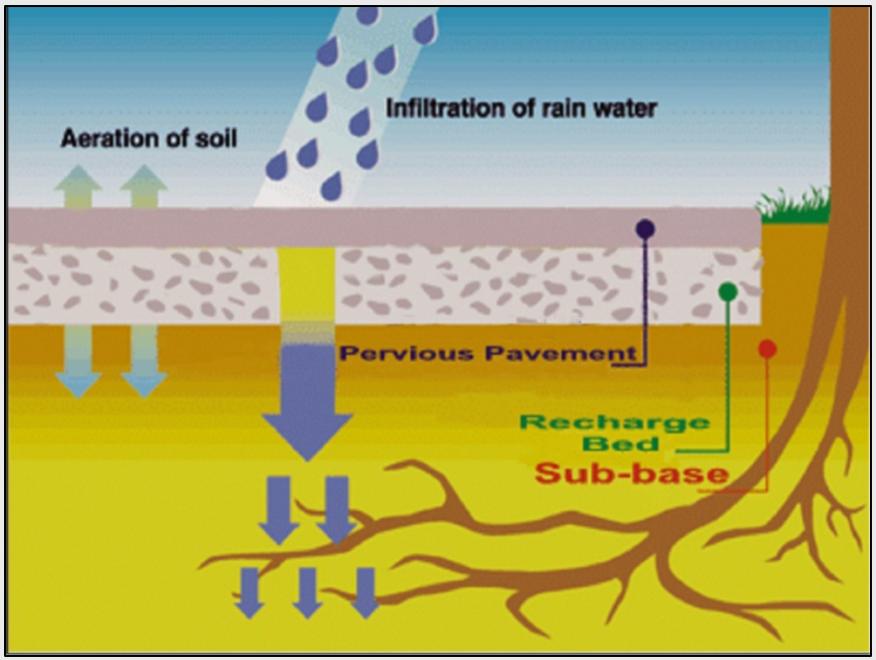
Porous Pavement

- A pavement is any treatment or covering of the earth surface that bears traffic
- A porous pavement is one with porosity and permeability high enough to significantly influence hydrology, rooting habitat, and other environmental effects

Ferguson, *Porous Pavements*

Benefits of Porous Pavement

- Reduce temperature of discharge to storm sewers
- Reduces pollutant loads to receiving waters
- Promote infiltration
- Promotes healthy trees
- Reduces runoff



Types of Porous Pavement

Pervious Concrete

Types of Porous Pavement

Pervious Asphalt

Types of Porous Pavement

Permeable Interlocking Concrete Pavements

Source: Interlocking Concrete Pavement Institute

Types of Porous Pavement
Open Cell Paving Grids and Geocells

Applicability

- Suitable for parking lots, residential areas, and low traffic volume roads
- Particularly suited for retrofit applications
- Not applicable for dirty areas or where spill/contamination hazards exist

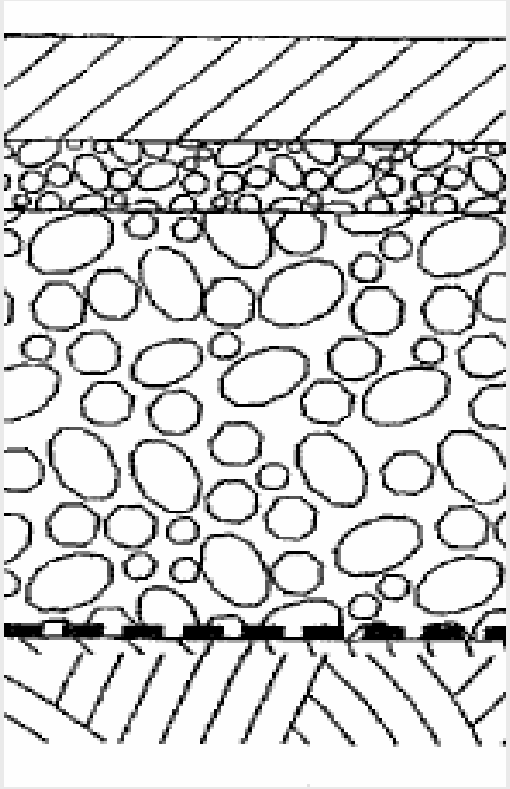
Planning Considerations

- What is the depth to groundwater?
- Which type of porous pavement is most suitable for the application?
- Are there potential sources of contamination?
- Is the site relatively flat?
- Who will care for the practice (vacuum sweep and jet wash)?
- Can appropriate snow plowing be performed?

Location

- 10’ separation from foundation
- Requires flat bottom or terraces

Typical Porous Pavement Section



Pervious Pavement

Choker Course

Reservoir Course

Filter Fabric or Filter Course

Native Soil

Features: Porous Concrete

- Helpful research published by National Concrete Pavement Technology Center, *Mix Design Development for pervious Concrete in Cold Weather Climates* February 2006, Iowa State University
- Tradeoffs between void ratio, permeability, and compressive strength
- 15% to 19% void ratio give 7-day strength of 3000 psi with permeability of 135 to 240 iph
- Field control Unit Weight from 127 to 132 pcf.

Features: Porous Concrete

- Design & installation guidelines *Pervious Concrete* ACI 522R-06
- Cement content 630 lbs/cu.yd
- Voids 13% to 25%
- Aggregates: Single sized coarse or graded between 3/8 and ¾ inch
- w/c between 0.30 to 0.40
- Admixtures: hydration stabilizer, viscosity modifier, water reducer

Features: Porous Concrete

- Use NRMCA trained and certified contractors with strict installation requirements
- Use specialized tools to speed installation

Installations: Porous Concrete

- SE Wisconsin Applications have seen failures
  - MSOE
  - South side coffee shop
  - Hart Park
  - UW Madison demo

Features: Porous Asphalt

- Design & installation guidelines *Porous Asphalt Pavements* NAPA Information Series 131, 2003
- Asphalt binder generally two grades stiffer (high temperature designation) than normally used for local climate
- May use fibers to prevent draindown,
- Target Voids > 18%

Features: Porous Asphalt

Aggregate Gradation

Size	Percent Passing
0.75”	100
0.50”	85-100
0.375”	55-75
No. 4	10-25
No. 8	5-10
No. 200	2-4

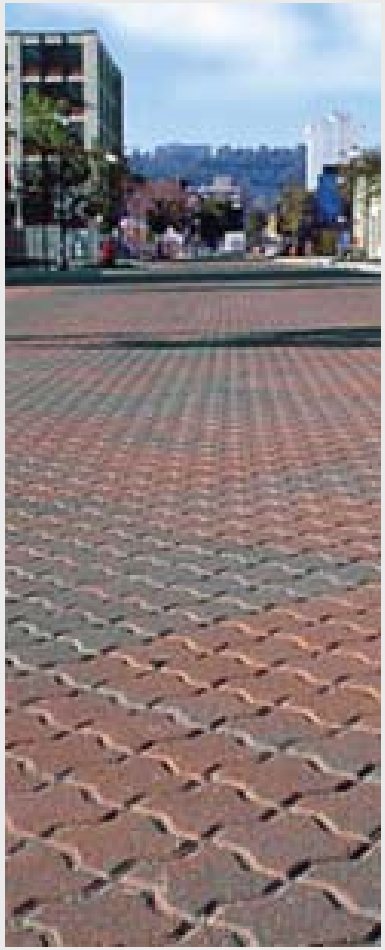
Installations: Porous Asphalt

- MSOE (Highland & Broadway)
- Milwaukee Ward St. Parking Lot (just east of KK)
- Good performance to date

Features: Permeable Interlocking Concrete Pavements

- Open jointed paving plocks
  - Drainstone, Ecoloc, Eco-Logic, Eco-Stone,SF-Rima
  - ¼ inch or wider joints
  - 3-6 iph infiltration rate 2-5 years after construction
  - Requires edge restraint
  - Many colors, shapes, styles

Features: Permeable Interlocking Concrete Pavements



Features: Permeable Interlocking Concrete Pavements

- Design guidelines available from Interlocking Concrete Pavement Institute
- Surface durability not an issue as with porous concrete
- Improved aesthetics
- Can snowplow normally
- Suitable for small jobs

Features: Open-Celled Paving Grids and Plastic Geocells

- Open-Celled Paving Grids
  - Porous area cast within each unit in addition to any provided between joints
- Plastic Geocells
  - 1” to 2” thick lattices with 88% to 98% open area
- Filled with porous aggregate or vegetated soil

Features: Open-Celled Paving Grids

- Open-Celled Paving Grids
  - Grasscrete, Monoslab, Turfstone, etc.

Features: Plastic Geocells

- Plastic Geocells
  - Grasspave, Geoblock, Grassy Pavers, etc.

Features: Open-Celled Paving Grids and Plastic Geocells

- Good for occasional parking
- Plastic grids lightweight and interlock
- Grass susceptible to droughts
- Excellent permeability
- Can shovel, plow, etc.
- Suitable for homeowner do it yourself project

Construction Sequencing

- Do not let construction runoff enter practice
- Suspend excavation during rain or snowmelt
- Avoid compaction, remediate compacted or smeared native soil
- Carefully plan landscaping activities

Operations & Maintenance

- Do not sand during winter
- Do not store any materials on porous pavement
- Do not allow high psi loads on porous asphalt
- Vacuum sweep 2 to 3 times per year
- Jet wash to restore permeability as needed
- Can patch with up to 10% impermeable material
- Never seal

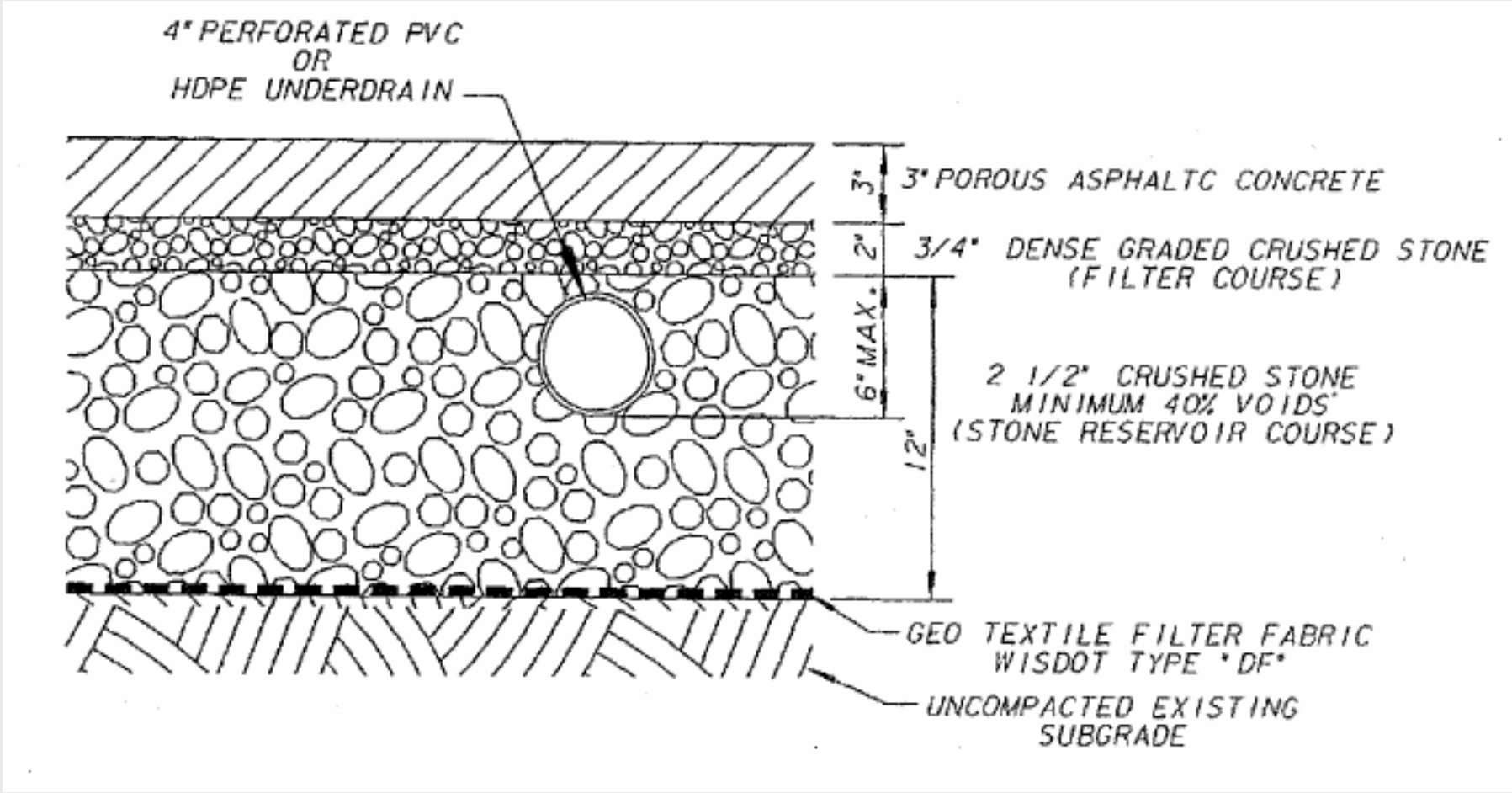
Cost

- Permeable Interlocking Concrete Pavements and Porous Concrete have comparable costs, $6 - $12 / SF for large jobs
- Porous Asphalt has lower installation costs, but a surcharge over standard asphalt because increased asphalt content, $3 - $6 / SF for large jobs
- Plastic geocell material costs $3 - $6 / SF for large jobs
- Cost is highly dependent upon size of job and depth of storage layer

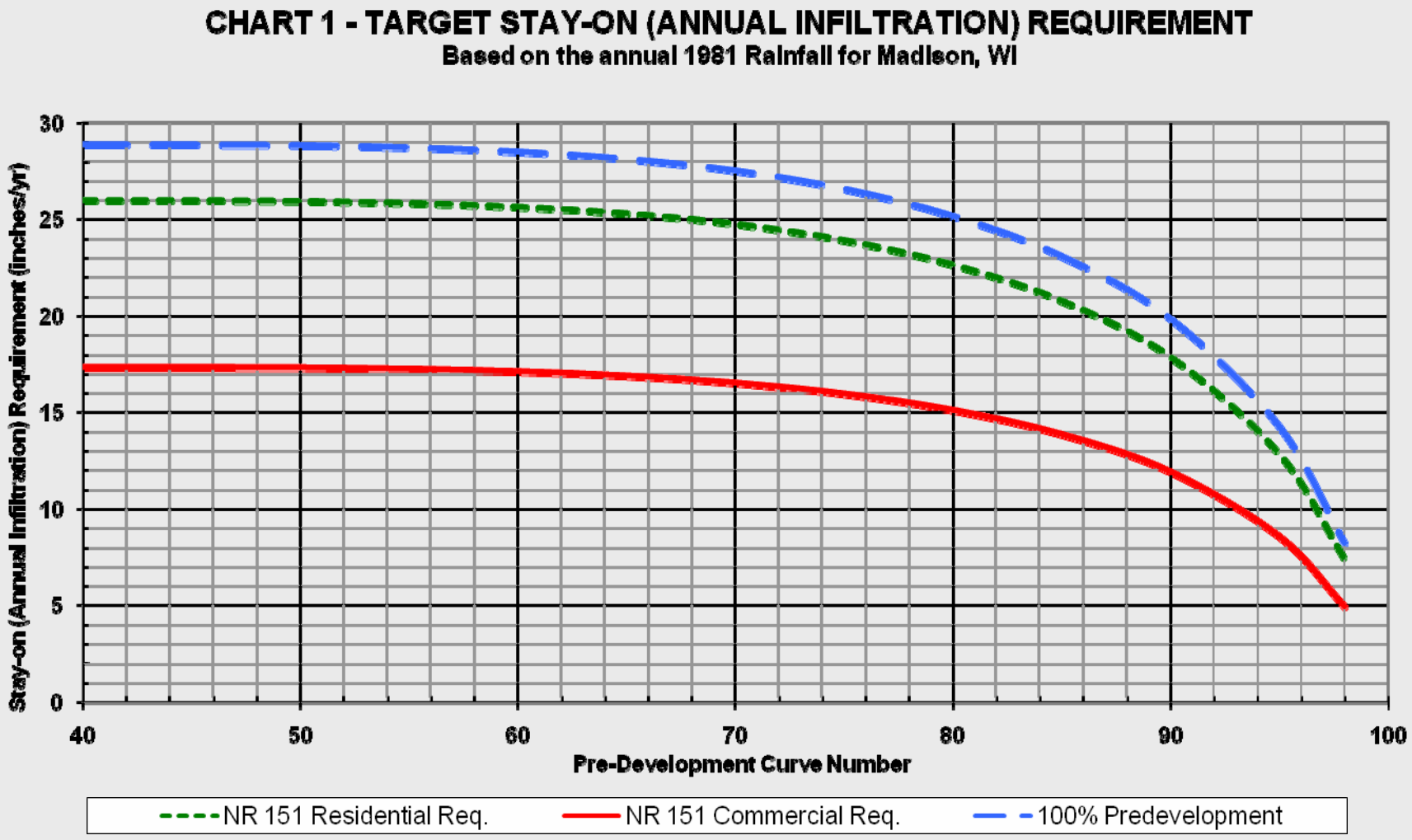
Research

- Bruce K. Ferguson (2005), *Porous Pavements*, CRS Press
  - Great reference and summary of research
- City of Milwaukee Ward St. Parking Lot
  - Infiltrate satisfies State of Wisconsin water quality requirements for infiltration systems
  - 8” storage course performs adequately
  - 100% runoff reduction and pollutant removal for up to 1- to 2-year event

Ward St. Cross-Section



Modeling/Sizing



RECARGA_2_3

Units English

RECARGA Version 2.3

Bioretention/Raingarden Sizing Program

Planview Data

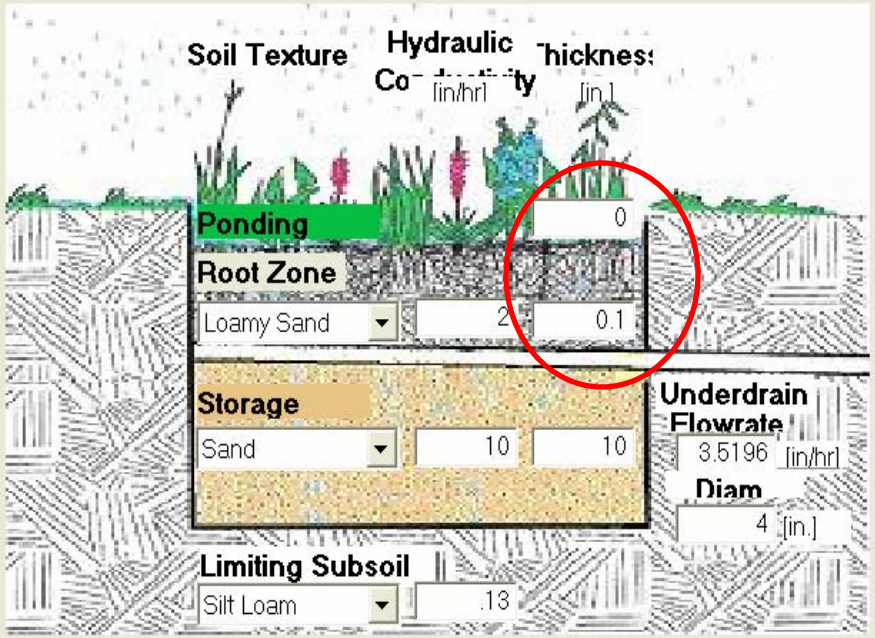
Facility Area	4356	[sf]
Tributary Area	0.1	[acre]
Percent Impervious	100	
Pervious CN	80	

Files

Regional Ave. ET	0	[in./day]
Simulation Type	Continuous	
Input File Length	266	days
Precip. File	Mad1981us	
Output File	PervPave	

☑ Summary ☐ Record

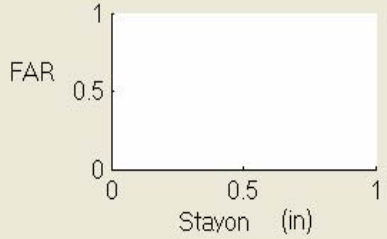
Facility Inputs



Target Stay-on 0 [in]

Facility Area Ratio Edit Text

Run FAR



Developed by the University of Wisconsin-Madison
Civil & Environmental Engineering Water Resources Group
(D. Atchison, A. Dussailliant, L. Severson)

Results

Plant Survivability
(Less than 48 hours max. ponding is desirable)

	max.	Total
Hrs. Ponded	0	0
Number of overflows		0

Tributary Runoff [in]

Precipitation	28.81
Impervious Runoff	20.821
Pervious Runoff	0

Raingarden Water Balance

	[in.]	%
Runon	20.8212	72.270
Runoff	3.1655	10.987
Recharge	17.806	61.806
Evaporation	0.0222	0.0772
Underdrain	0.4675	1.6227
Soil Moisture	-0.6405	-2.2233
Stay-on	25.177	87.389

RUN SIMULATION

CLEAR RESULTS