Permeable Pavements – SR 234 Park and Ride Lot

Fall Asphalt Conference
Richmond, VA

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October 2, 2012

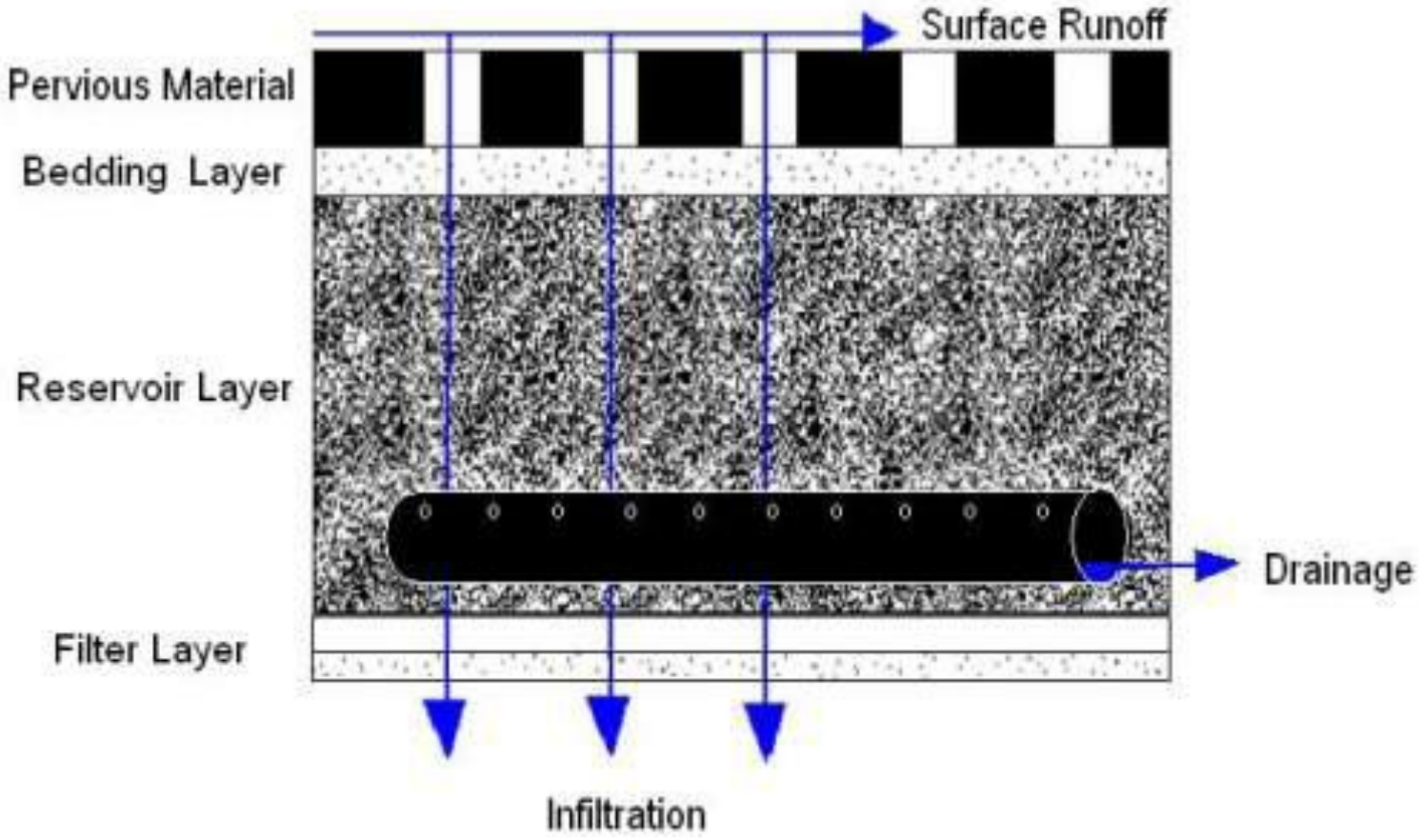
Too Much Water….

……is Not Good….

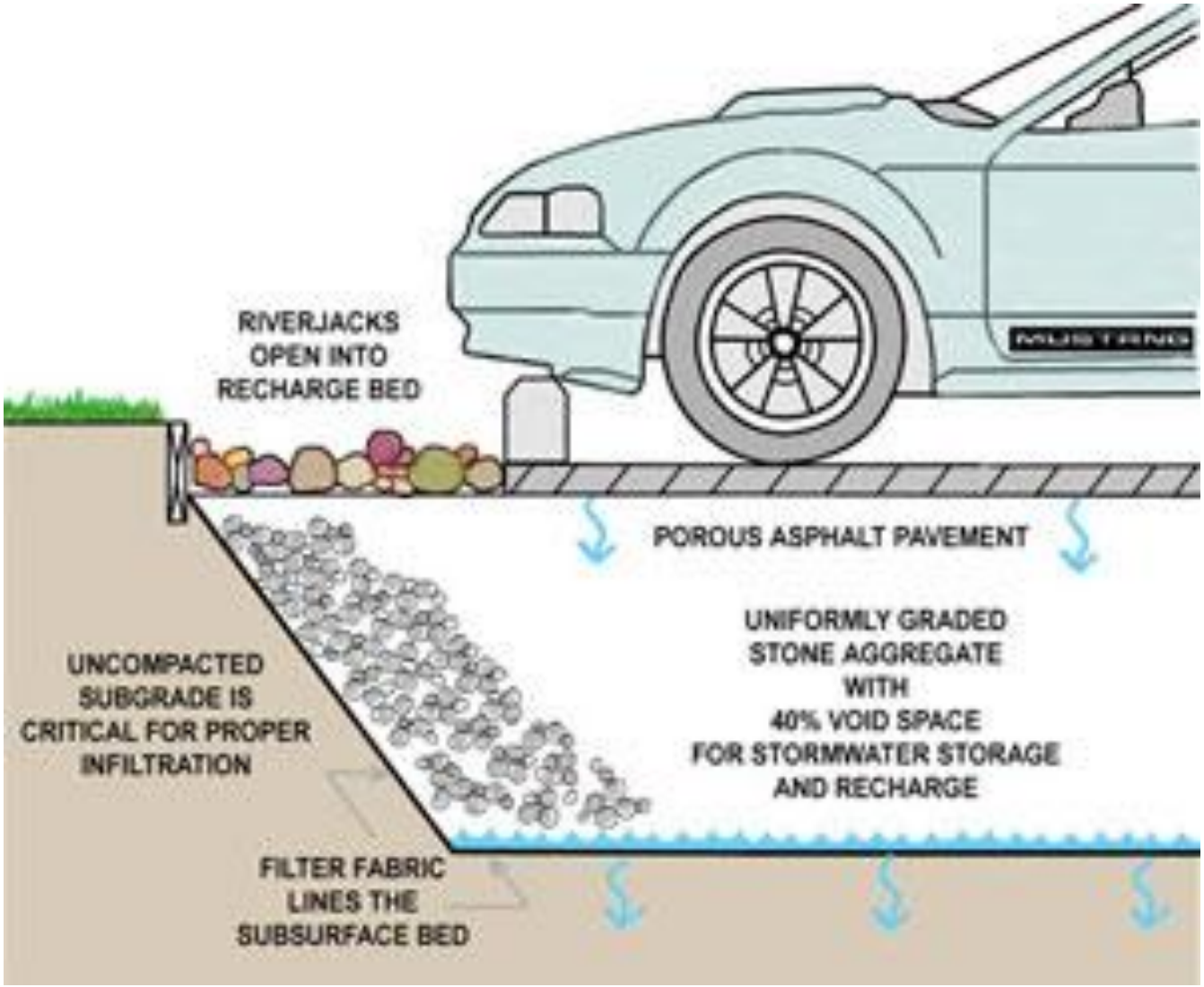
….for Pavements !

So Why Design Permeable Pavements ?

Infiltration and/or Storage



Infiltration Reduces Run-Off and Removes Pollutants



New DCR Regulations

Effective October 1, 2012 (VDOT SWPA 12-01)

- **Affects design-bid-build projects that have not begun pre-advertisement process**
- **Affects design-build projects that have not begun the request for proposals (RFP)**
- **Must evaluate total post development impervious area rather than net increase in impermeable area for storm water treatment**

DCR Design Spec. No. 7

VIRGINIA DCR STORMWATER DESIGN SPECIFICATION No. 7

PERMEABLE PAVEMENT

VERSION 1.8
March 1, 2011

SECTION 1: DESCRIPTION

Permeable pavements are alternative paving surfaces that allow stormwater runoff to filter through voids in the pavement surface into an underlying stone reservoir, where it is temporarily stored and/or infiltrated. A variety of permeable pavement surfaces are available, including **pervious concrete**, **porous asphalt** and permeable **interlocking concrete pavers**. While the specific design may vary, all permeable pavements have a similar structure, consisting of a surface pavement layer, an underlying stone aggregate reservoir layer and a filter layer or fabric installed on the bottom (See **Figure 7.1** below).

The thickness of the reservoir layer is determined by both a structural and hydrologic design analysis. The reservoir layer serves to retain stormwater and also supports the design traffic loads for the pavement. In low-infiltration soils, some or all of the filtered runoff is collected in an underdrain and returned to the storm drain system. If infiltration rates in the native soils permit, permeable pavement can be designed without an underdrain, to enable full infiltration of runoff. A combination of these methods can be used to infiltrate a portion of the filtered runoff.

DCR Design Spec. No. 7

Level 1

- **Soil infiltration less than 0.5 ins./hr.**
- **Underdrain required**
- **45% run-off volume reduction**
- **Phosphorous and Nitrogen removal – 59%**

Level 2

- **Soil infiltration rate exceeds 0.5 ins./hr.**
- **Underdrain not required**
- **75% run-off volume reduction**
- **Phosphorous and Nitrogen removal – 81%**

Note: ground water table must be at least 2 feet below subgrade for both level 1 and level 2 designs

VDOT Special Provision

VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
POROUS ASPHALT PAVEMENT

July 10, 2012

I. DESCRIPTION

This work shall consist of furnishing and constructing a porous asphalt pavement on a prepared foundation using Porous Asphalt Mixtures (PAM) designed and placed in accordance with this Special Provision, Section 211 and Section 315 of the Specifications. The porous asphalt pavement shall be constructed within the specified tolerances of the lines, grades, thicknesses and cross sections shown on the plans or established by the Engineer.

II. POROUS ASPHALT MATERIALS

(a) **Coarse Aggregate:** Coarse aggregate shall conform to the following requirements:

PROPERTY	TEST	REQUIREMENT
1. Los Angeles Abrasion	AASHTO T96	40% max.
2. Flat and Elongated Particles	ASTM D4791	
Measured on No. 4 retained, max. to min.	VTM-121	
3:1 (Surface PAM-9.5 only)		25% max.
5:1		10% max.
3. Magnesium Sulfate Soundness Loss 5 cycles	AASHTO T104	15% max.
4. Particles retained on the No. 4 sieve shall have at least	ASTM D5821	
one fractured face		100% min.
two fractured faces		90% min.
5. Absorption	AASHTO T85	2% max.

The aggregate properties specified are for each stockpile of coarse aggregate material designated on the job mix form (TL-127). The material contained in each stockpile shall meet the minimum or maximum criteria specified, except that Flat and Elongated testing will be performed on Porous Friction Course Plant Sample and acceptance shall be in accordance with Section V. herein.

Use of slag will not be permitted.

(b) **Fine Aggregate** shall conform to the requirements of Section 202 of the Specifications, except for grading, which shall be tested according to AASHTO T 304 (Method A) with a value of not less than 40 percent and a sand equivalent value of not less than 45 (AASHTO T 176).

(c) **Asphalt Binder:** Asphalt binders shall be Performance Graded Binder (PG) 76-22 and 70-22. The supplier shall certify to the Department that the binder meets all the properties of that grade as shown in AASHTO M320-05 for Performance Graded Asphalt Binder. This certification shall be based on testing performed on samples of binder provided to the

VDOT Special Provision

Mix Design

- PAM-9.5 (5.75 to 7.25% AC)
- PAM-12.5 (5.0% AC)
- 16% min. air voids
- Min. 0.3% cellulose fibers

Acceptance

- Gradation and asphalt content

Placement

- Three passes of a steel wheel 8 to 10 ton roller
- No tack between layers (if placed within 24 hours)
- No construction traffic

VDOT Guidelines

Guidelines for the Use and Design of Porous Asphalt Pavement Structures

Porous asphalt pavement structures (PAPS) are becoming more popular across the United States. PAPS are being used to reduce or eliminate the need for storm water retention basins, to improve water quality, and to reduce the inflow to storm water systems.

The first PAPS were designed and constructed in the early 1970's. Since then, thousands of parking lots and low volume roads have been constructed. While the overall design philosophy of the structure has not changed, some of the materials used have changed. Originally, geotextile fabrics were not used between the soil subgrade and the rock layer – now the use of geotextiles is common practice. In addition, the asphalt material design and binders have evolved to last longer and withstand turning movements. Most asphalt materials use an open gradation with a polymer modified binder. Typically the total asphalt thickness ranges from 2 to 4 inches based on the traffic using the parking lot or road.

The purpose of this document is to provide guidelines on where PAPS can be considered for construction and the PAPS design for that location.

Uses for Porous Asphalt Pavements

The most common use of porous asphalt pavements is in parking lots. These parking lots can be commuter lots, business lots, or other car dominated parking facilities. For any of these facilities that have channelized truck or bus traffic, conventional asphalt concrete mixes shall be used in-lieu of a porous asphalt material. The conventional AC can be placed directly on the aggregate reservoir layer. In the cases where additional AC thickness is needed for the truck/bus traffic, the aggregate reservoir thickness should be adjusted to accommodate. However, the remainder of the parking lot pavement structure should not be modified.

Porous Pavement Design

For VDOT projects, VDOT will have a standard porous asphalt thickness of 4 inches. The aggregate reservoir thickness will be designed per the Department of Conservation and Recreation Stormwater Design Specification No. 7 titled *Permeable Pavement Version 1.8* dated March 1, 2011.
Porous asphalt pavements should have the following structure:

1.5 inches PAM-9.5 (76-22)
2.5 inches PAM-19.0 (70-22)
#2 Aggregate Reservoir from 12" to 24" Per DCR Design Guide (Note 1)
Geotextile Filter Fabric Layer
Subgrade (Note 2)

Note 1 – For designs where the aggregate layer exceeds 24", the subgrade shall be stabilized and longitudinal underdrains installed.

Note 2 – For weak subgrade material (CBR <4), the subgrade shall be stabilized and longitudinal underdrains installed.

For the design of the truck/bus lanes, the current VDOT design guides shall be used.

VDOT Guidelines for Porous Pavement

Parking Lots Only

Reservoir Design

- Infiltration testing for subgrade
- Design capacity in accordance with SWM regulations
- No infiltration in fills

Site Considerations

- Generally not adjacent to cut slopes
- Limited cross-slope on subgrade

Typical Section

1.5” PAM-9.5 (76-22)

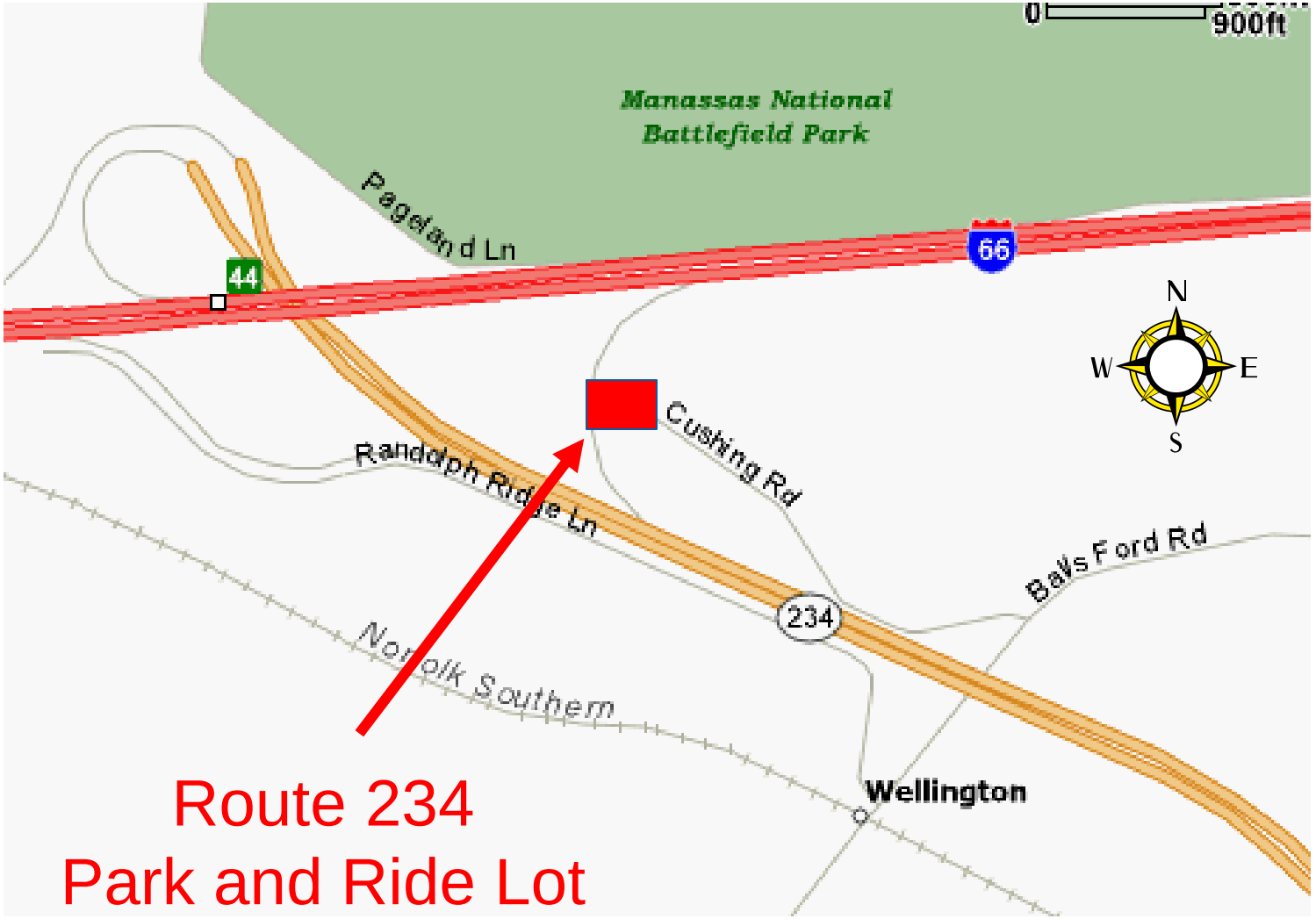
2.5” PAM-19.0 (70-22)

12” -24” Aggregate No. 2

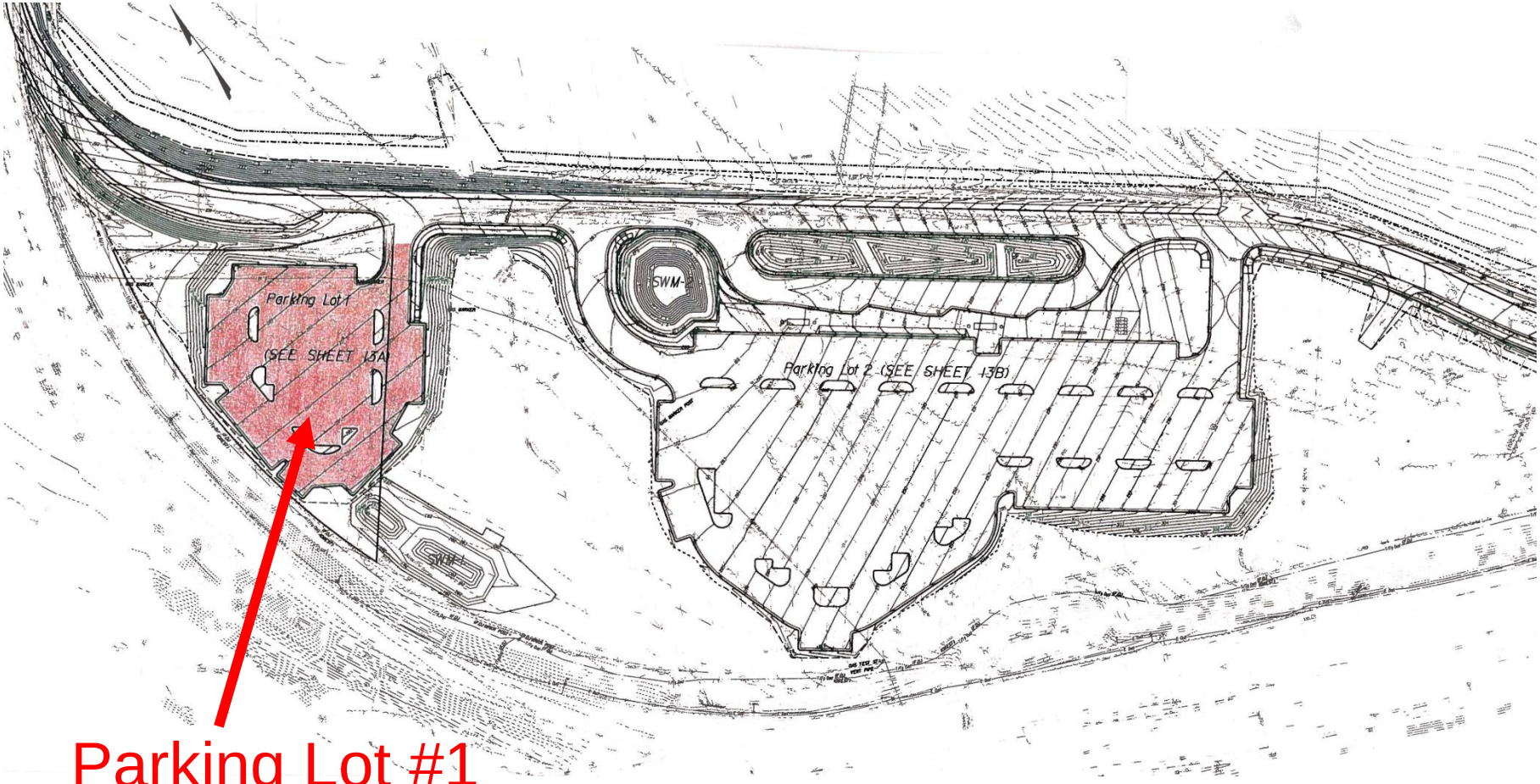
Needle-punch non-woven geotextile

Uncompacted soil subgrade

Pilot Project

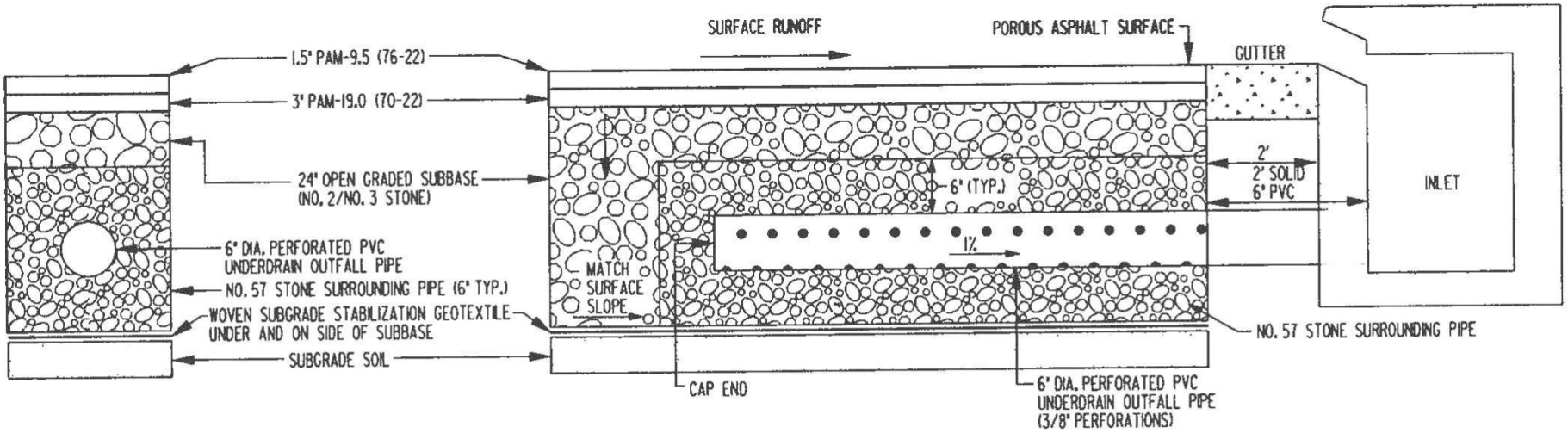


Parking Lot Layout



Parking Lot #1

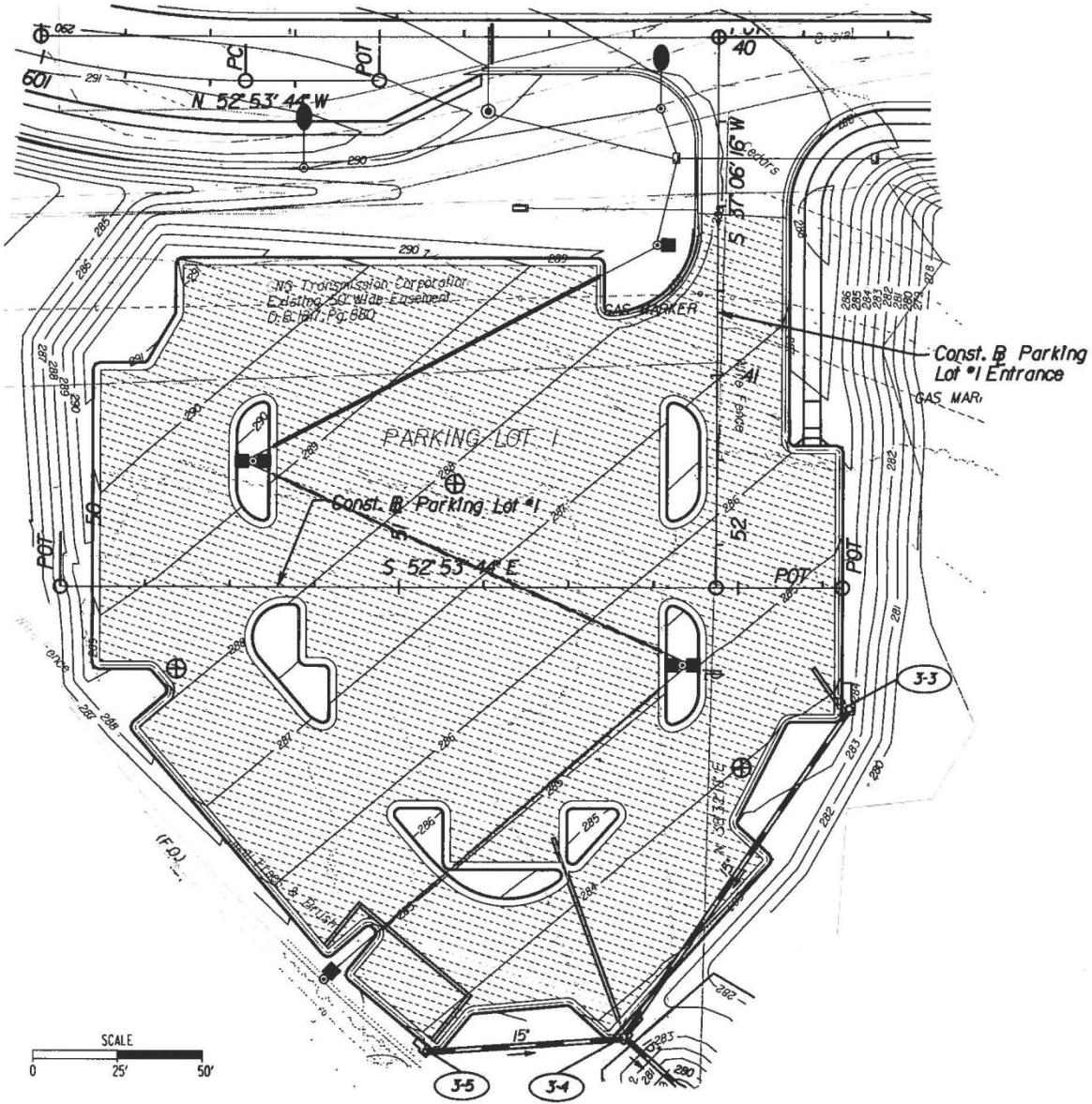
Typical Section



POROUS ASPHALT TYPICAL SECTION

N.T.S.

Parking Lot Layout



Pilot Project Objectives

Design Considerations

- Soil types/infiltration rates
- Depth of aggregate reservoir
- Thickness of porous asphalt layers

Cost

- Right-of-Way
- SWM facilities
- Construction costs
- Life cycle

Pilot Project Objectives

Material Properties

- Permeability of mixes
- Compaction in the field
- Field tests for permeability

Constructability

- Base aggregate type
- Installation of electrical conduit
- Concrete curb and planter islands
- Sequence of construction
- Type/thickness of pavement markings

Pilot Project Objectives

Maintenance

- Snow and ice treatment
- Removal of sand/salt/leaves, etc.
- Special vacuum trucks for cleaning/grit removal
- Disposal of debris in a sanitary landfill
- Future mill/overlay ?

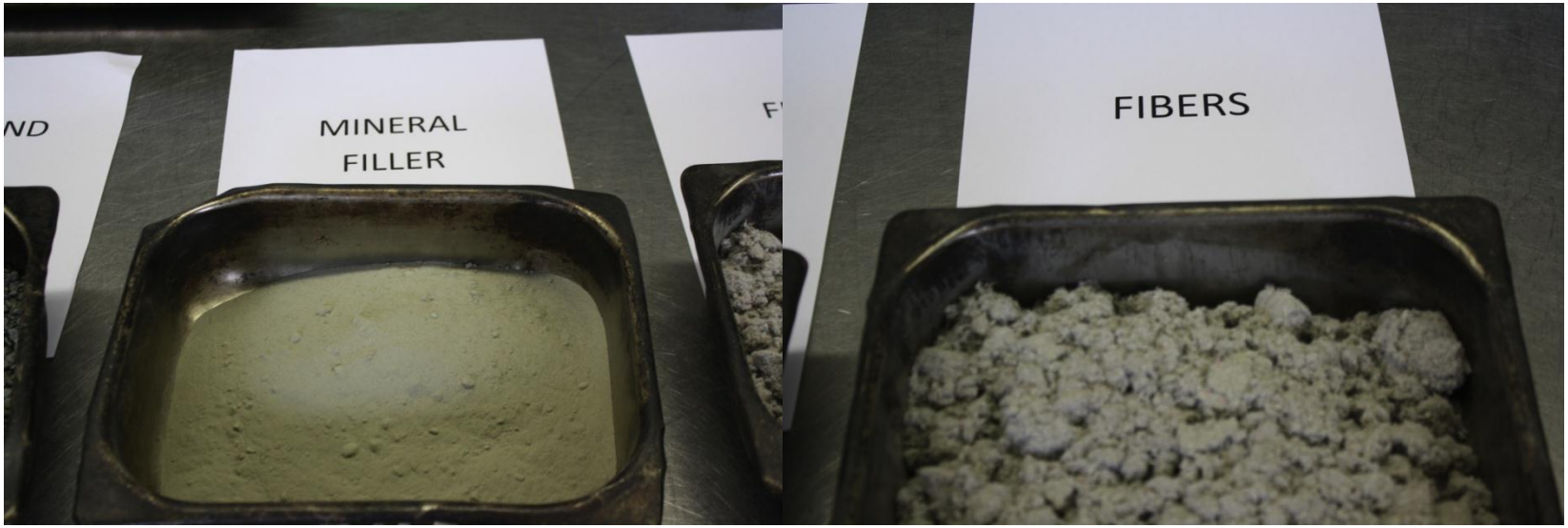
Pilot Project Progress

Current Project Status

- Mix designs complete
- Placement to occur late fall/early spring
- Update at Spring Meeting

Cost Considerations

- Use of RAP is ***NOT*** Permitted
- Air voids shall be calculated using CoreLok method. Cost of that machine approximately $9,000.
- PAM – 9.5 requires 76-22 A/C % range 5.75 – 7.25
- Fibers & Mineral Filler

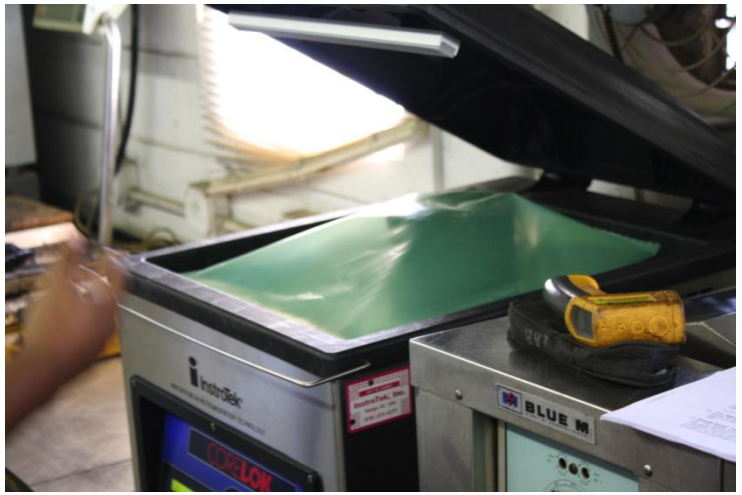


Some Additional Benefits

- Environmental Benefits
  - Reducing storm water run offs
  - Potentially reduce or even eliminate the need for storm water management ponds
- Commercial real estate in Nova can be up to and over $1 million per acre. This site has nearly 1 acre of SWMP.

CoreLok

- Weigh the bag
- Weigh dry sample
- Weigh in CoreLok bag in water – look for bubbles
- Weigh after – dry sample – that no water entered sample
- Use caution using bags – must sand paper edges of core
- 16% minimum air voids



PAM

- By using a high A/C content it makes PAM more durable than pervious concrete.
- Use by private sector for LEED certification and reduce the use of SWMP.
- Private projects require VDOT specifications.

A/C Content – 76-22

- Using 6.5 A/C content, which is middle of the range
- $700.00 PG 76.22 + 6.5% AC content = $45.50 per ton


Questions ?