NATURAL•SYSTEMS ENGINEERING

A decade of improvements and lessons learned on porous asphalt installations in New York State

2019 Southeast New York Stormwater Conference and Trade Show

October 16, 2019

LHCCD
LOWER HUDSON COALITION OF CONSERVATION DISTRICTS

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Presentation Outline

- Learning Objectives
- Intro to asphalt pavements
  - Conventional
  - Porous
- Typical Pavement section(s)
- Design and Construction
- Case Studies
- Resources/Guidance
- Questions

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Learning Objectives

- Understand how porous asphalt differs from conventional asphalt pavement
- Understand how a porous asphalt system functions as a pavement and stormwater management system
- Understand construction of porous pavements and site considerations
- Understand application limitations and maintenance

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Asphalt Pavements – Latest/Greatest

- Recycling & Asphalt (RAP/RAS) – Most recycled product in the US
- Warm Mix Asphalt (WMA) – Another innovation that is finding acceptance
- ThinLift Asphalt – 6.3mm Mix
- SuperPave Asphalt – Design mixes to meet environmental and traffic needs
- Polymer – Asphalt on Steroids
- PaveXpress – Webbased Design Software

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Porous bituminous pavement

- Developed by the Franklin Institute – 1972
- Tested in pilot projects during 1970's
- Development of geotextiles in 1979
- Current design since 1980
- Numerous Projects built in Northeast over the last 10 years and New York State over the last 30 years
- You will hear about quite a few locally as well

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Porous Asphalt Pavement - Why ??

- **Groundwater Recharge, Runoff Reduction**
- **Effective pollutant treatment for solids, metals, nutrients, and hydrocarbons**
- **Little to No Closed Drainage System Needed**
- **Safety Improvements – Glare, Road Spray**
- **Hydroplaning – Friction Retention When Wet**
- **Little to no Black Ice - Reduced de-icing Materials**
- **Less Susceptible to Frost – No Capillary Action**
- **Noise Reduction – 1 dba to 3 dba**
- **Where space is limited, functions as pavement AND stormwater management system.**

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Porous Applications

- Parking Lots
- Roads

  -on a limited basis, but becoming more widely used
- Recreational Facilities

  -playgrounds, tennis courts, paths, etc.

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Porous Asphalt for Stormwater Management

- Green Infrastructure
  - High frequency, lower intensity events
  - e.g. 90% frequency, WQv event
  - Bypass volumes exceeding design capacity
  - High stormwater quantity management on an annual basis
  - Achieves WQv. Stormwater quantity depends on modeling.

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Pavement Section

Open-Graded HMA ~ 1 ½ - 2 ½”

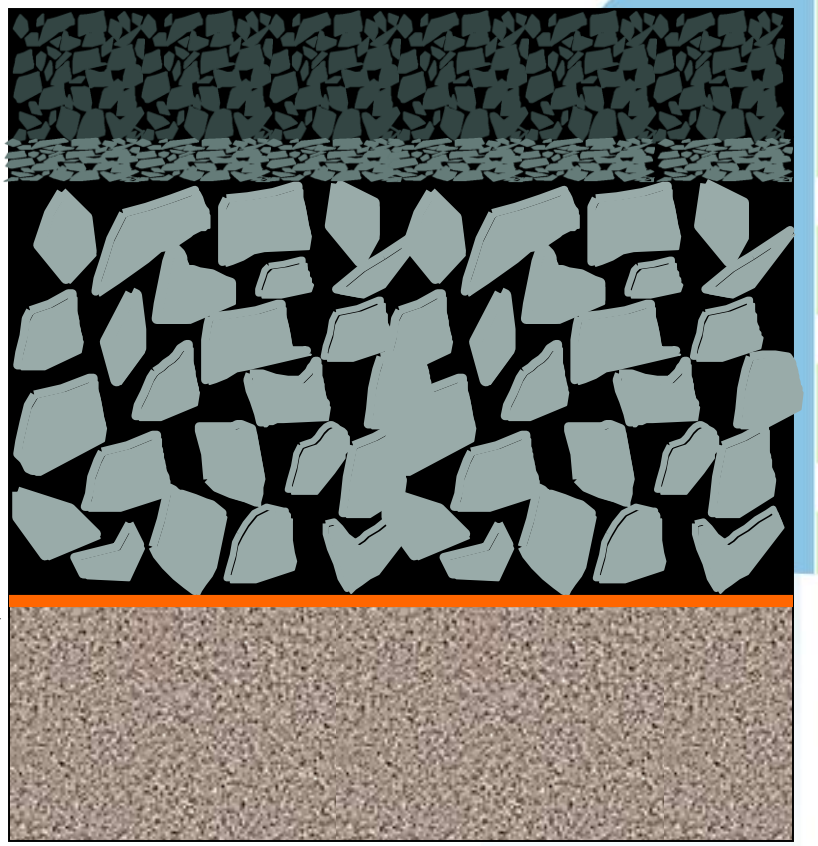
Optional Binder (e.g. ATPB) ~3”

(Optional) Choker Course

Infiltration Basin

Separation layer

Uncompacted Subgrade



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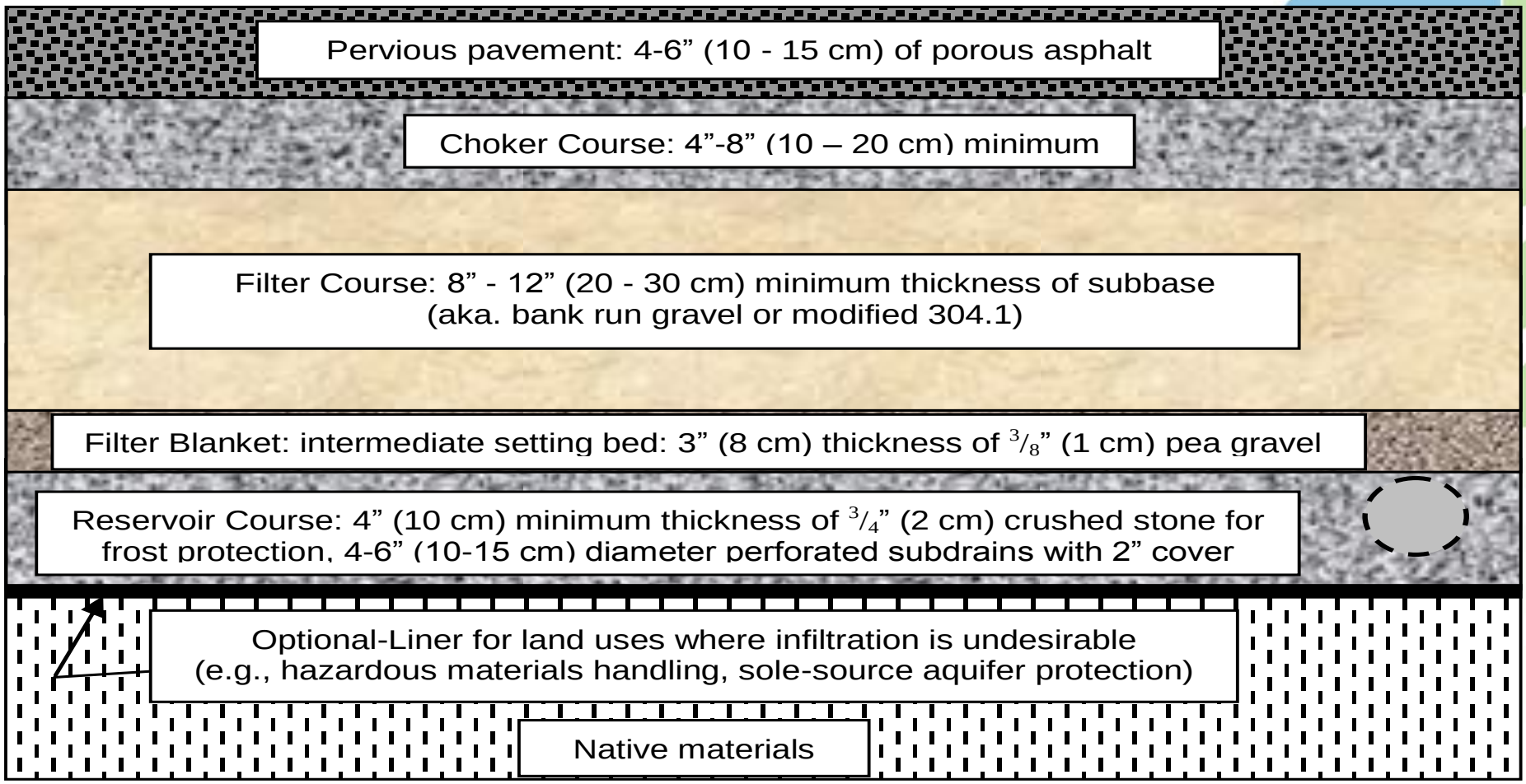
University of New Hampshire Model



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Pavement Section (cont'd)

- Subgrade
  - (Wet) strength
  - Infiltration rates
  - Uncompacted

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Keys to Success – Site Conditions

- Soil permeability/infiltration rate
  - DEC recommends 0.5”/hour; 0.1”/hour still OK
  - Key is dewatering rate – 72 hours
- Depth to bedrock > 2’
- Depth to high water > 3’
- Fill – not recommended
- Frost
  - Used to be Pavements should exceed frost, then 30% of frost depth, now. . .

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Pavement Section (cont'd)

- Separation Layer
  - Filter media
  - Geotextile

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Pavement Section (cont'd)

- Infiltration Basin
  - Clean Uniformly Graded Stone
  - Crushed Agg. (#3 or other)
  - 40% Voids (assumed)
  - Level bottom

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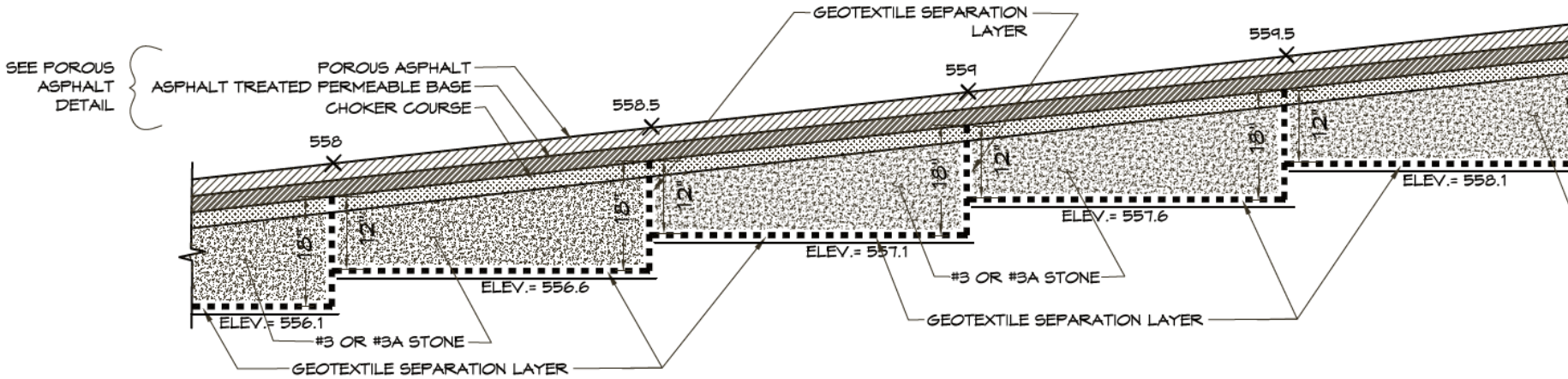
Pavement Section (cont'd)



SECTION B--B' POROUS ASPHALT PROFILE

SCALE: NONE

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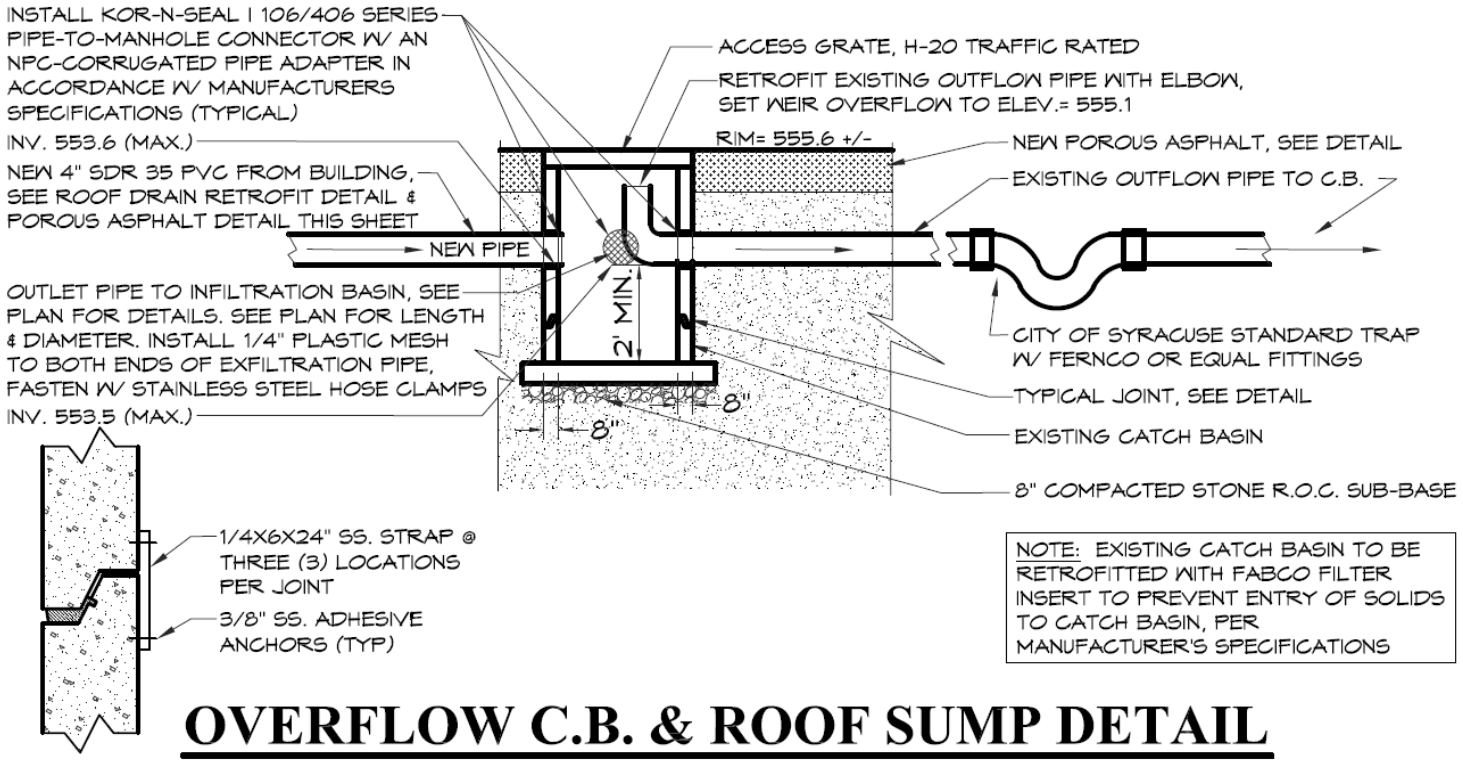
Pavement Section (cont'd)



OVERFLOW C.B. & ROOF SUMP DETAIL

SCALE: NONE

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Pavement Section (cont'd)

- Choker Course
  - ½" Agg. (#57) ~ 1 – 2" Thick
- Optional

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Pavement Section (cont'd)

- HMA Friction Course
- Binder (ATPB) (optional)

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Keys to Success – HMA Design

Materials Selection

- Aggregates
- Fine Aggregate Angularity
- Fractured Faces
- L.A. Abrasion

Binder

- Stiffness
- Polymer Modified - Yes
- Fibers???

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Keys to Success – HMA Design

Gradation (NAPA Guide)

Aggregate Gradation: Sieve Size	Total Passing (% by weight)
(3/4″) 19 mm	100
(1/2″) 12.5 mm	85-100
(3/8″) 9.5 mm	55-75
(#4) 4.75 mm	10-25
(#8) 2.36 mm	5-10
(#200) 75 µm	2-4

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Sieve Size			19.0 mm	12.5mm	9.5mm	4.75 mm	2.36 mm	1.18 mm	0.60 mm	0.30 mm	0.15 mm	75 mm	Binder Content	Binder Grade
% Passing	1. General Limits		100	100	92 - 98	34 - 40	14 - 20	7 - 13				0 - 2	4.5 - 5.0	PG 64-22P
	2. JMF Range		100	94 - 100	87 - 97	34 - 44	12 - 22	6 - 16				0 - 2	4.5 - 4.7	
	3. Target Value		100	99	92	39	17	11				1	4.5	

475.10130101 - Top Course Porous Asphalt Pavement with Mineral Fiber F3
475.10190101 - Top Course Porous Asphalt Pavement with Mineral Fiber F9
475.01190101 - Binder Course Porous Asphalt Pavement F9

DESCRIPTION:

Furnish and place Porous Asphalt Pavement courses in accordance with the contract documents as directed by the Engineer-in-Charge. The top course mixture requires the use of Mineral Fibers as outlined in this specification. A Test Panel(s) will be required as outlined in this specification and other contract documents.

MATERIALS:

The materials and composition for the Porous Asphalt Pavement mixtures shall meet the requirements specified in §401-2 Materials, except as noted herein.

Formulate a job mix formula (JMF) that satisfies the design limits listed below and submit it to the Regional Materials Engineer (RME), at least one week prior to placement of the test section.

Porous Asphalt Pavement Mixtures Gradation Requirements

Screen Sizes	Top Course	Binder Course
	General Limits % Passing	General Limits % Passing
2 inch	---	100
1 ½ inch	---	75-100
1 inch	---	55-80
3/4 inch	100	---
1/2 inch	85-100	23-42
3/8 inch	55-75	5-20
No. 4	10-25	2-15
No. 8	5-10	---
No. 16	---	---
No. 30	---	---
No. 200	2-4	---

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Keys to Success – HMA Design

- Air Voids 18% - Compared to conventional mix of 4%
- Production Temperatures play a big factor in success of material
- Evaluate for Moisture Susceptibility
- Mix Design is required!!! Local Aggregates and Knowledge will dictate final gradation and Asphalt Content – Ask you Local Producer for Help!!!

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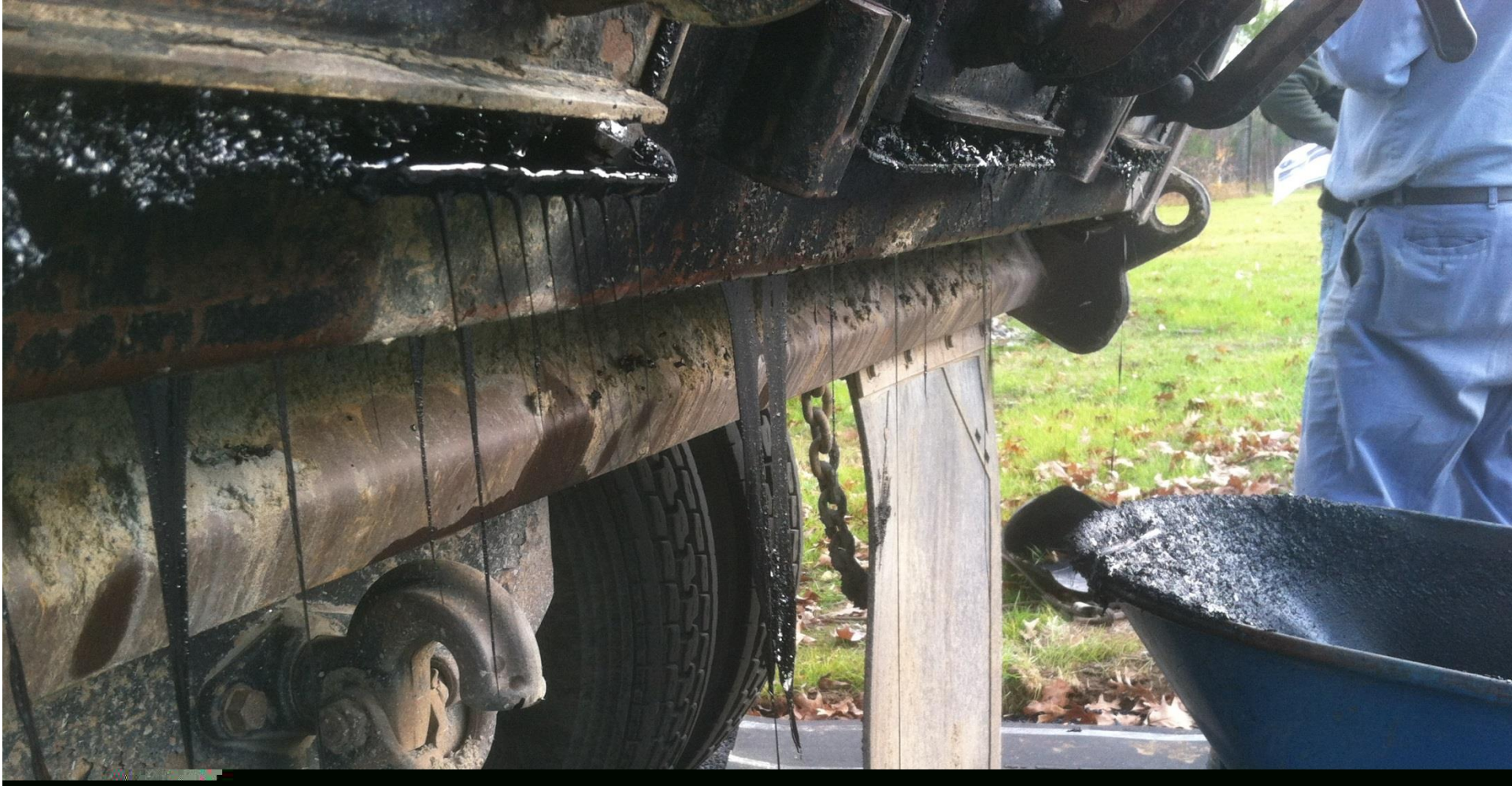

Asphalt Drain Down

Estimated Placement Temperature 350*F +

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Rolling Temperature – Critical !

- **Ambient Temperature 50 to 70 degrees F.**

- **Ideally - Wind – 0 to 3 mph**
- **Beware - Asphalt surface cooling to quick**
- **No Paving Top Course under 50 degrees F.**
  (Colder Weather Paving Process is Different)

- **Hot Weather and Cold Weather Rolling**
  - ❑ **Heavy Water Usage**

- **Cooling time to Finish Rolling = Approx. 4**

Rolling Temperature – Critical !

- Binder Course – 200 – 240 (260 F. Cooler air temps)
- Top Course – 200 - 240 F.
- Finish Rolling - 110 - 140 F. - Top,
  - 140 – 150 F. - Binder

- 4 to 6 Passes with 10 to 12 Ton Roller OK (Static)
- Increases in Density of 1 to 2 lbs/CF up to 5 - 6 passes
  - **Density Spike of 4 to 5 lbs/CF between 120 and 140 F.**
- 1 to 3 Passes with 3.5 to 5 Ton Roller to Finish

Rolling Temperature – Critical !

Must Make Two (2) Passes with 10 -12 Ton Roller Between 110 and 140 Degrees F.

Once Top Course is 100 Degrees F.

All Compaction, Jointing, and Line Removal Stops

Even if Vibrated

Rollers to be Operated SLOWLY

Annoyingly Slow

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Design and Construction

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Keys to Success – Design

- Slope – limit surface slope to 5%
- Terrace surface when necessary
- Terrace infiltration basin for flat bottom
- Use conventional HMA for steeper slopes
- Avoid piping water long distances
- Spread infiltration over largest area possible
- Loading: 2:1

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Keys to Success – Construction

- Build porous pavement last
  - Protect from construction debris
  - Protect from soil laden runoff
- Protect site from heavy equipment
  - Don't compact subgrade
- Excavate to subgrade (soft footprint)
- Place filter fabric

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Keys to Success – Construction

- Place reservoir course #2 or #3 stone – 40% voids (if granular source then 95% double fracture)

- Place 1-2 in layer of ½ in stone to stabilize the surface of the reservoir course – Choker Course - This is going away in some areas.

- Place porous asphalt course (2 to 4 in.) usually compacted with 2-3 passes with 10 ton roller.

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Construction Guidelines

- Post Construction
  - Inspect for design compliance during storm event.
  - Confirm vegetation is established before removing temporary storm water measures
  - Do not use sand or ash for snow or ice, liquid de-icing compounds may be used. Salt is fine
  - Sign for maintenance.
  - Reports say that ice mitigation budgets are decreased by 75% to 100%.

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Construction Guidelines

Construction

- Restrict traffic for 24 – 72 hrs.
- Protect porous pavement from contamination.
  - Runoff sediment
  - Construction debris

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Maintenance

- Inspect several time first few months during storm events.
- Inspect annually thereafter.
- Pavement surface may be flushed or jet washed. Most will sweep with a vacuum sweep at least once a year.
- Damage pavement can be repaired using dense hot mix provided <10% area.

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Case Studies

- Morris Arboretum (BB)
- State Building Lot (KET)
- Beach Road (BB)
- Grace Church Lot (KET)
- Troy Lot (BB)
- Crest Acura (KET)

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Morris Arboretum
Philadelphia, PA

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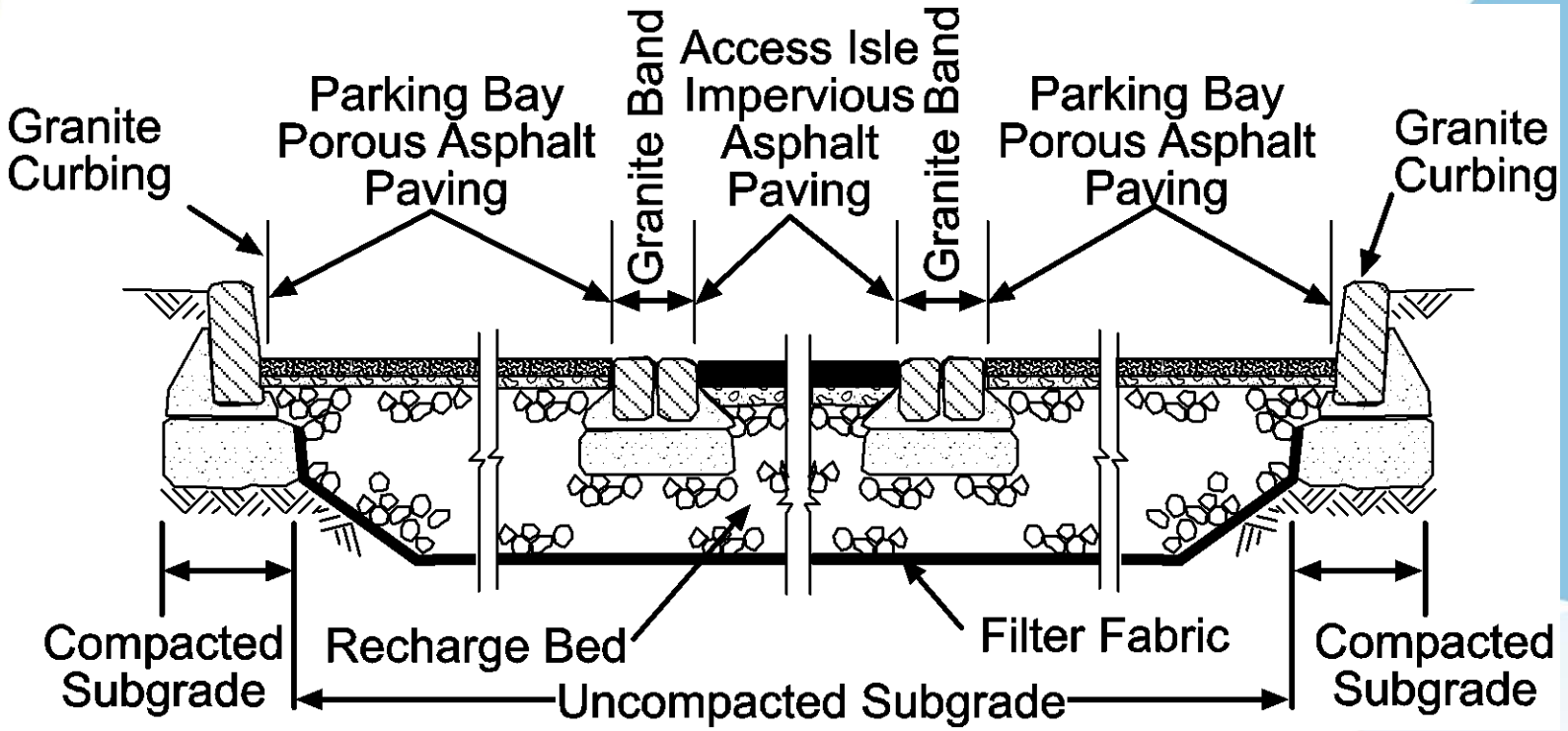

Diagram of infiltration bed at Morris Arboretum

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Crest Acura Leavenworth Lot
Syracuse, NY

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Beach Road
Lake George, NY

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Roads

- Challenges
  - Cuts and fills
  - Slope
  - Variable soil conditions
  - Utilities
- Limited use

If We Can …Where Can We Install Porous Pavement?

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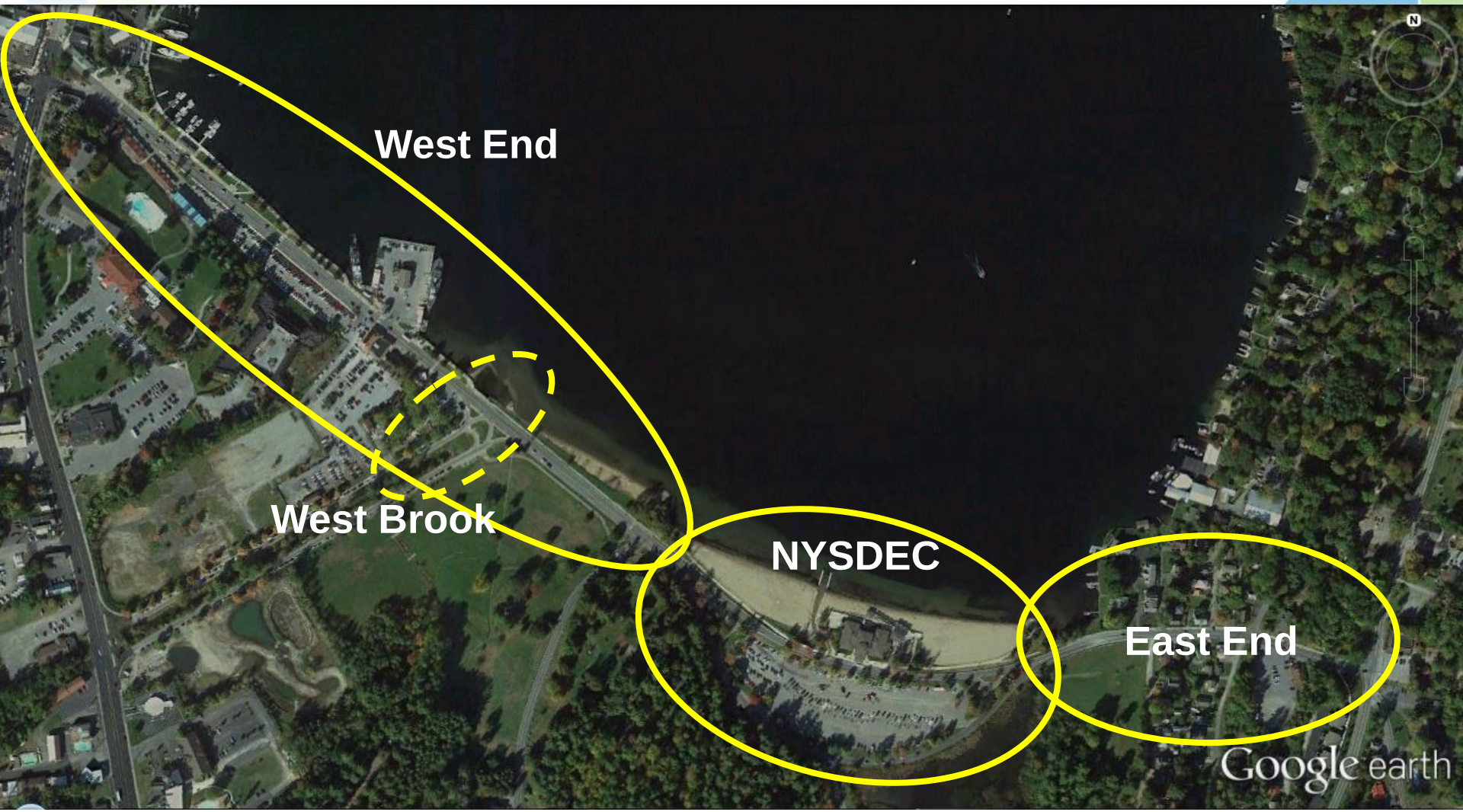

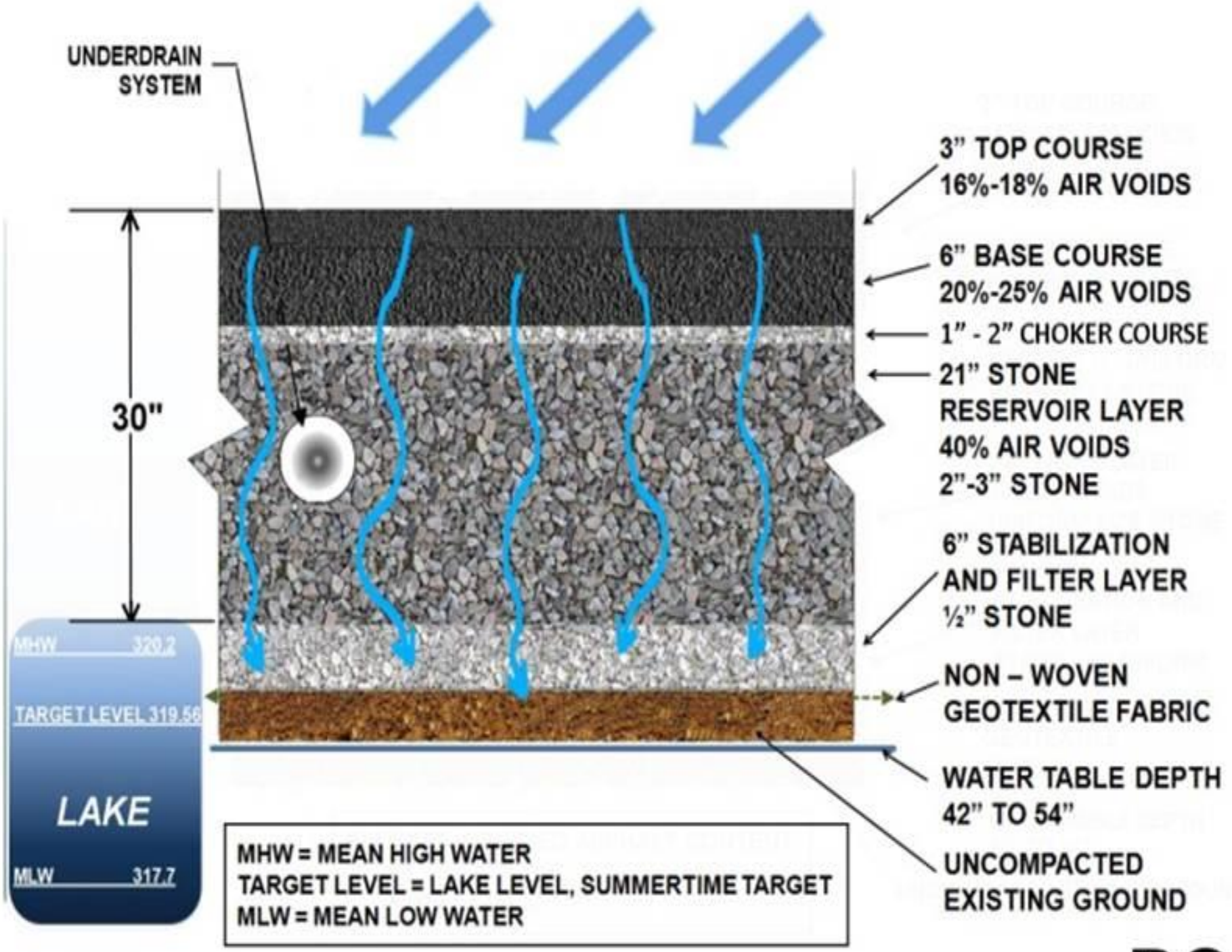
UNDERDRAIN SYSTEM
3" TOP COURSE
16%-18% AIR VOIDS
6" BASE COURSE
20%-25% AIR VOIDS
1" - 2" CHOKER COURSE
21" STONE
RESERVOIR LAYER
40% AIR VOIDS
2"-3" STONE
6" STABILIZATION
AND FILTER LAYER
½" STONE
NON – WOVEN
GEOTEXTILE FABRIC
WATER TABLE DEPTH
42" TO 54"
UNCOMPACTED
EXISTING GROUND
30"
MHW 320.2
TARGET LEVEL 319.56
LAKE
MLW 317.7
MHW = MEAN HIGH WATER
TARGET LEVEL = LAKE LEVEL, SUMMERTIME TARGET
MLW = MEAN LOW WATER

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Why is the Beach Road Project Significant ?

Higher Traffic and Traffic Loading Applications

Standardized Specifications – NYSDOT

Raise Awareness - Protect the Pavement

Opens up the Practice to Thousands of miles of Roadways & where HD Pavement is Needed

High Water Table Application Next to a Lake

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Grace Church
Syracuse, NY


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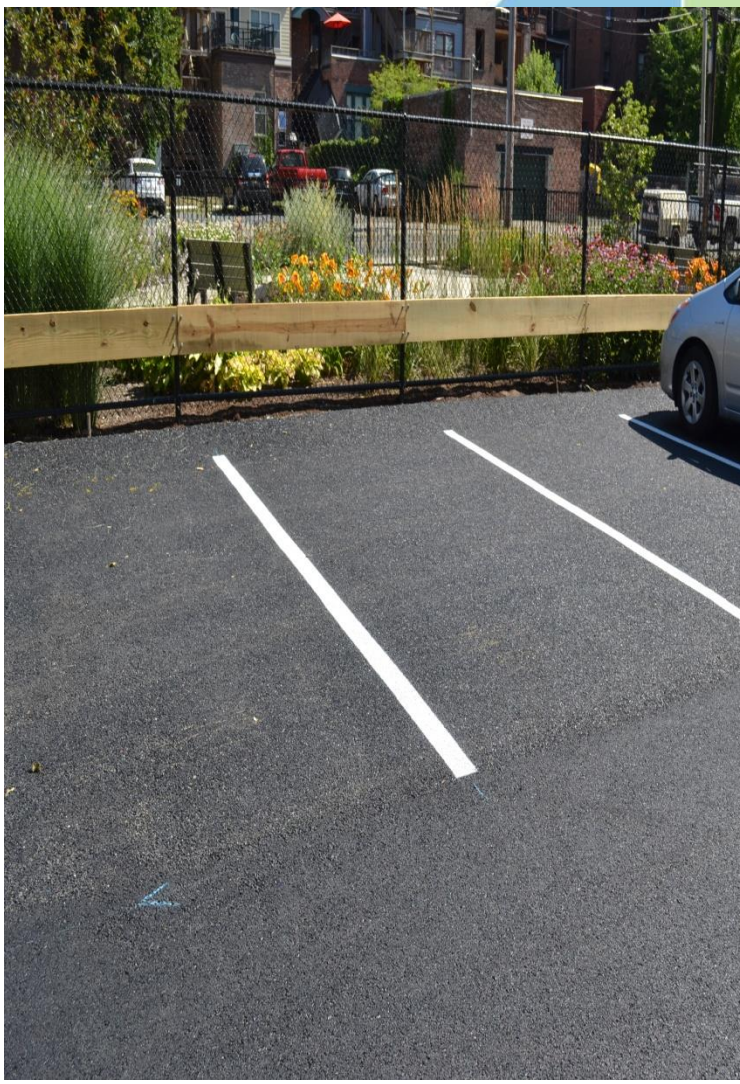
Troy Parking Lot



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Crest Acura
Syracuse, NY

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Porous asphalt guidance and standards

Source : Real World Ph

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Questions?

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Contact:

Kyle E. Thomas, P.E., LEED® AP_{BD+C}
Natural Systems Engineering, PLLC
120 E. Washington St., Ste. 813
Syracuse, New York 13202
kthomas@naturalsystemsengineering.com
www.naturalsystemsengineering.com

Bruce Barkevich, Vice President
New York Construction Materials Association
11 Century Hill Drive
Latham, NY 12110
(518) 783-0909