



2022 Fall Conference at OC Fontainebleau Resort

Stormwater Management retrofit using permeable concrete blocks for pervious parking – Sligo Park Hills

Dan Sheridan, Montgomery County Department of Transportation

Dr. Aaron Fisher PhD, PaveDrain

Bill Park, Greenman Pedersen, Inc. (GPI)

September 30, 2022

1:00 PM to 2:00 PM

BIOGRAPHY

■ Dr. Aaron Fisher

- PhD in Chemical Engineering from the University of Maryland; B.S. in Chemistry from Duke University
- Vice President of Business Development for Ernest Maier
- U.S. Department of Energy (contractor); Water Research Foundation; GlaxoSmithKline
- Focused on sustainability and innovation around water, energy, manufacturing, and construction



■ Dan Sheridan, PE

- M.S. Civil Engineering - Virginia Tech; BS in Civil Engineering - University of Maryland
- Montgomery County DOT – Div. of Transportation Engineering – Design Section Chief



■ Bill Park

- B.S. in Environmental Analysis and Planning from Frostburg State University; Minor in Biology
- Vice President – Director of Environmental Services for Greenman Pedersen, Inc. (GPI)
- Project Manager for the planning, design, construction inspection and as-built certification for Sligo Park Hills Low Impact Development Project



OBJECTIVES

Pave Drain Installation – Sligo Park Hills stormwater management retrofit

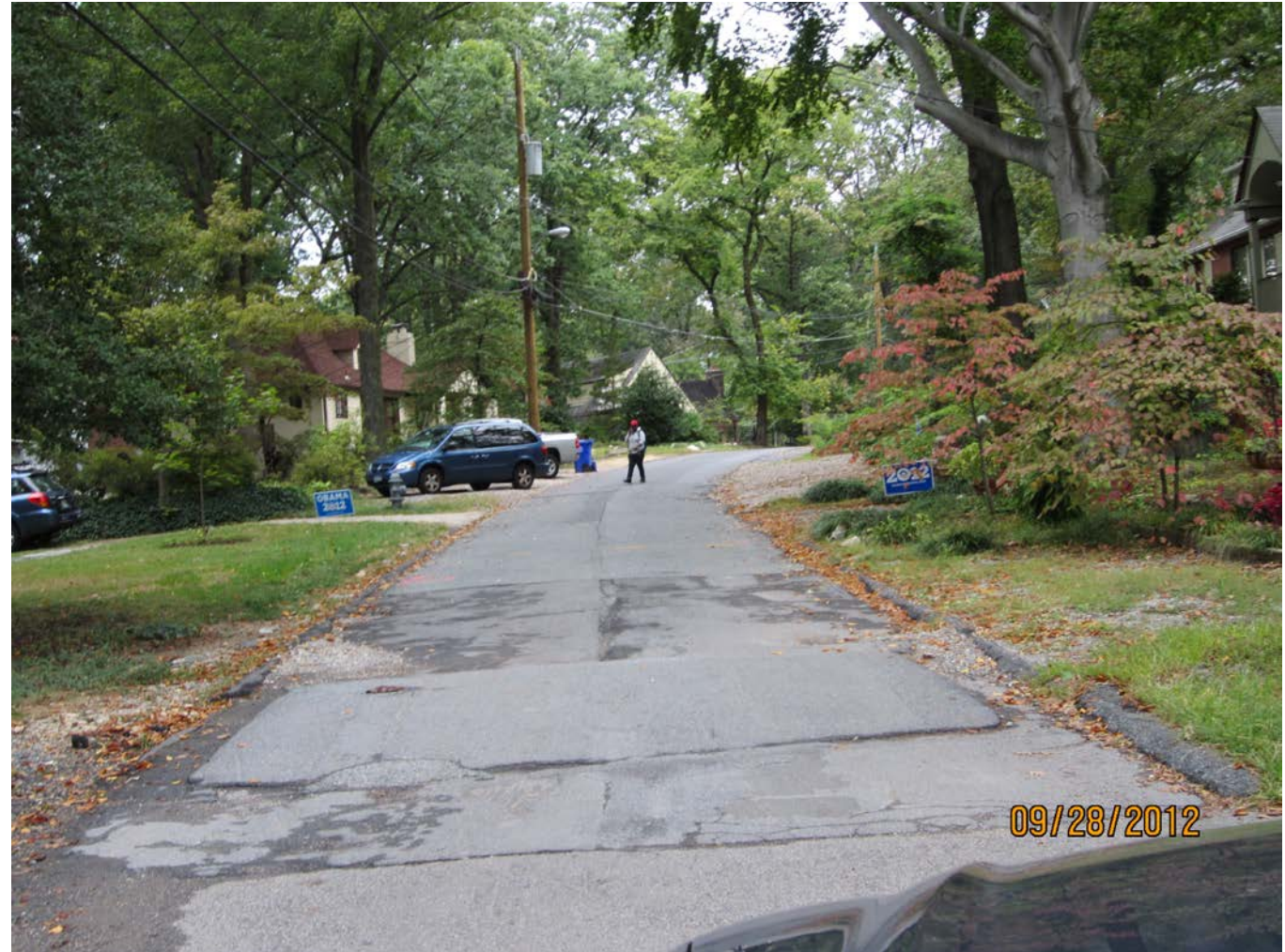
- Awareness of Permeable Articulating Concrete Block (P-ACB) systems: a heavy-duty, low-maintenance option for permeable pavement
- Better understand decentralized stormwater management at the source, how this performs under heavy rainfall events, and ancillary benefits throughout the community
- Challenges of the Sligo Park Hills neighborhood with stormwater and runoff
- Initial and Long-Term Performance from the implementation of a PaveDrain system in the Sligo Park Hills Neighborhood



Before: Steep and narrow street with parking

Sligo Park Hills

- 1928 and 1931 subdivision
- Approximately 240 single family houses on ¼ acres lots
- 1949 and 1950 – added 37 single family homes and two streets
- 12 County streets – narrow width, mature trees, steep slopes
- Very limited existing storm drain infrastructure
- Active community



Before: Narrow street, no curb and gutter and poor pavement

Project Objectives – MC DOT and MC DEP

- Neighborhood due for repaving
- Treat existing impervious streets for MS-4 credits
- Pilot projects for BMPs within the Right of Way
- Extensive community outreach
- Improve water quality in Sligo Creek
- Utilize existing parking pads for treatment



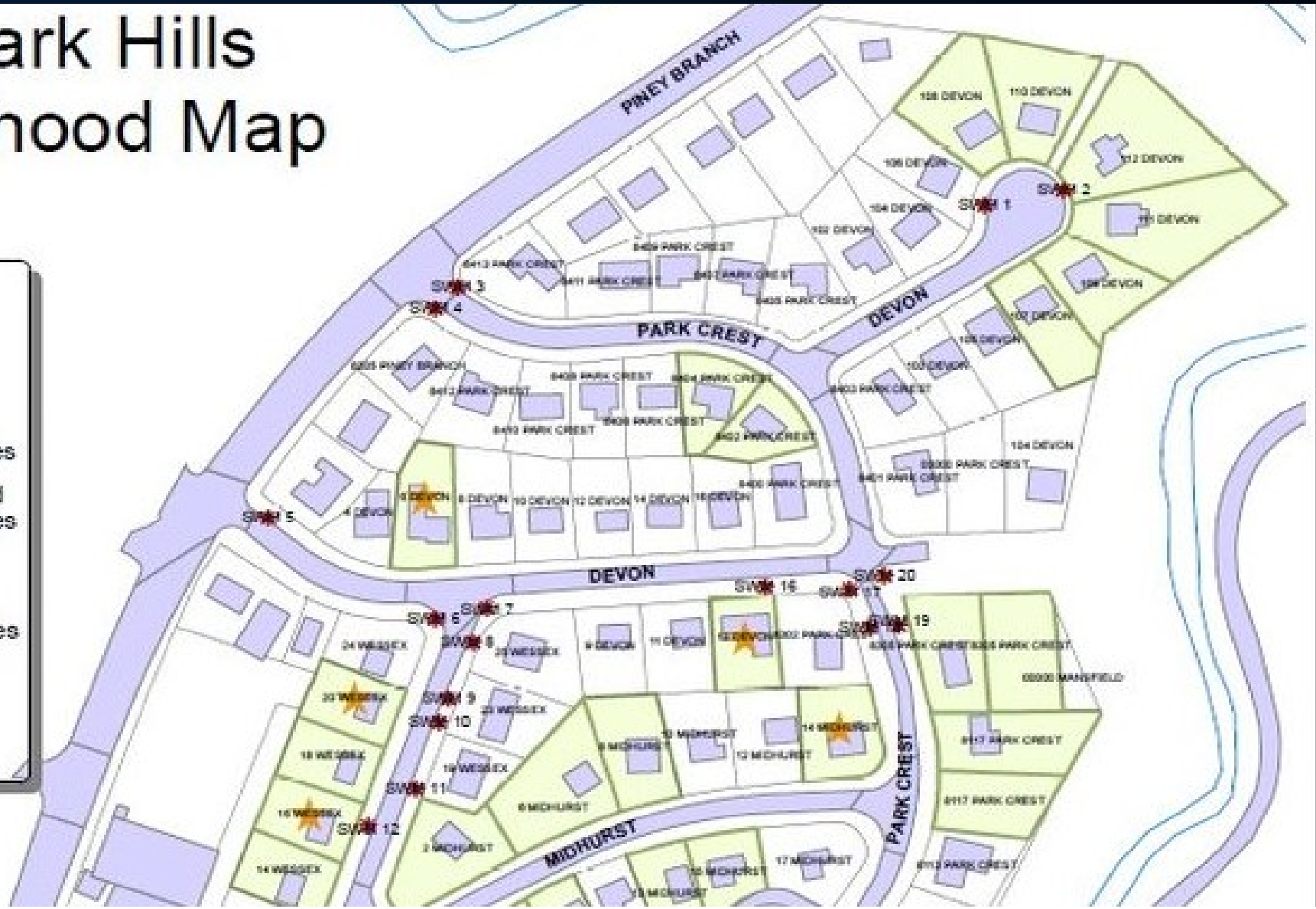
Sep. 2022 – 9 years after installation

Site Map

Sligo Park Hills Neighborhood Map

Legend

-  Impervious Surfaces - Roads & Rooftops
-  Properties Rating Good for Rainscapes Opportunities
-  Properties Rating in Top 3rd for Rainscapes Opportunities
-  County Stormdrain Inlets
-  County Stormdrain Manholes
-  County Stormdrain Pipes
-  Proposed Right of Way Retrofit Locations





PERMEABLE ARTICULATING CONCRETE BLOCKS (P-ACB) for Stormwater Management

What is an Articulating
Concrete Block?

- Matrix of interconnected concrete block units
- Interlocking Mechanism
 - Geometry
 - Cables
 - Geofabrics
- Form a Hard, yet Pervious Surface via Open Joints

P-ACB and Pavers

Interlocking
Concrete Paver

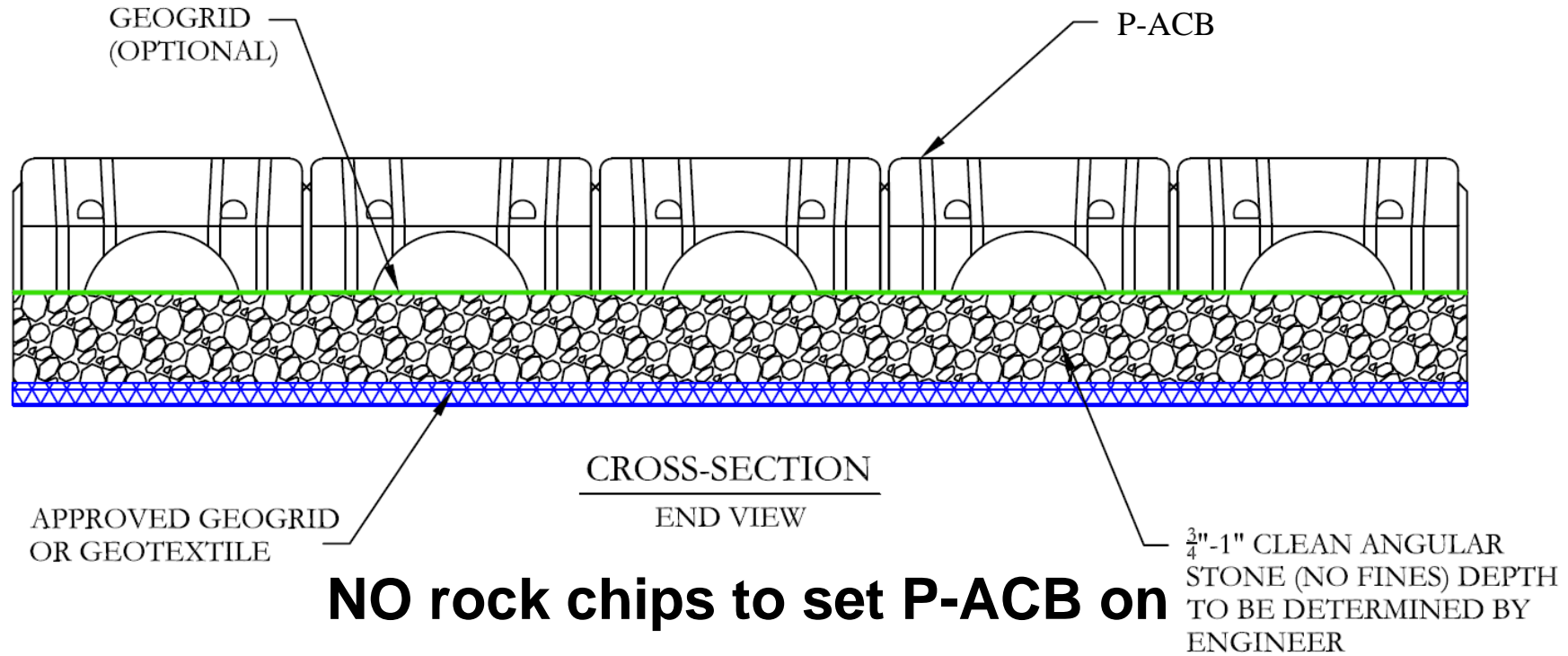


Articulating
Concrete Block

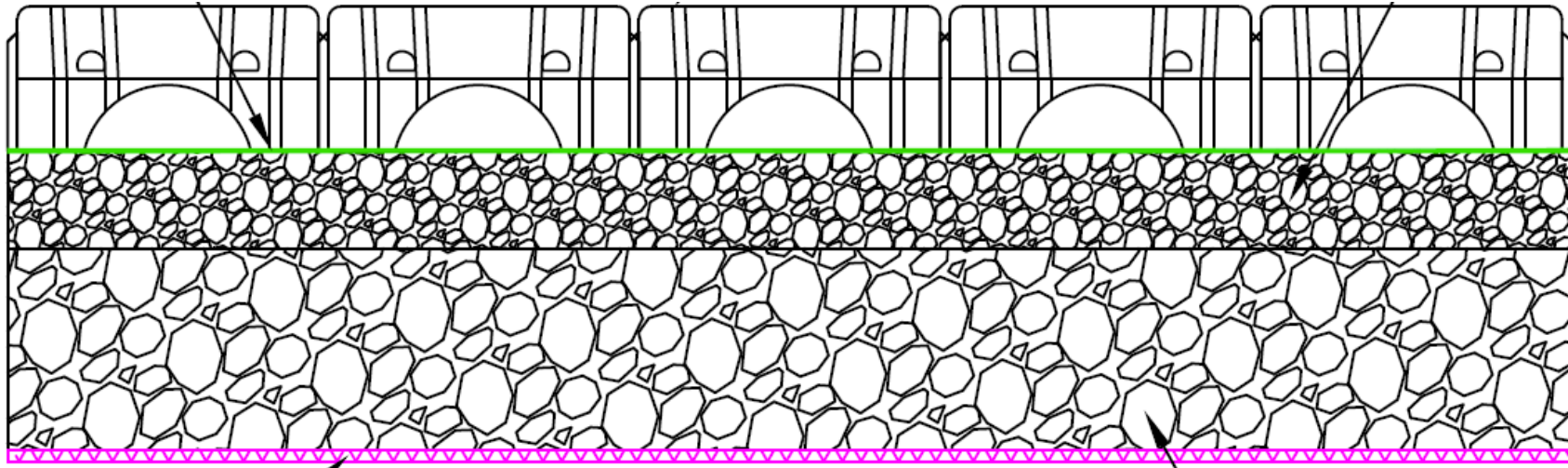
- **Bigger Blocks**
 - 12" x 12" x 5.65"
 - 45 – 48 lbs.
- **Open Joints**
- **Traffic Rated (Trucks)**

similar, but not the same

Typical P-ACB Cross- Section(s)



NO rock chips to set P-ACB on





The ACB Difference – HEAVY Applications



Permeable Roadway Options with ACBs



Installation

1. Plan out the system
2. Place and compact the base (including geofabrics)
3. Place the blocks
 - Blocks can be cut to fit curves
 - Use half blocks to create the edge of a form (recommended)
4. Place and pave asphalt/concrete
 - No need for ribbon curbs



Permeable Surface Infiltration Rate Comparison



1,640 in/hr

Open Joints = High Infiltration Rates

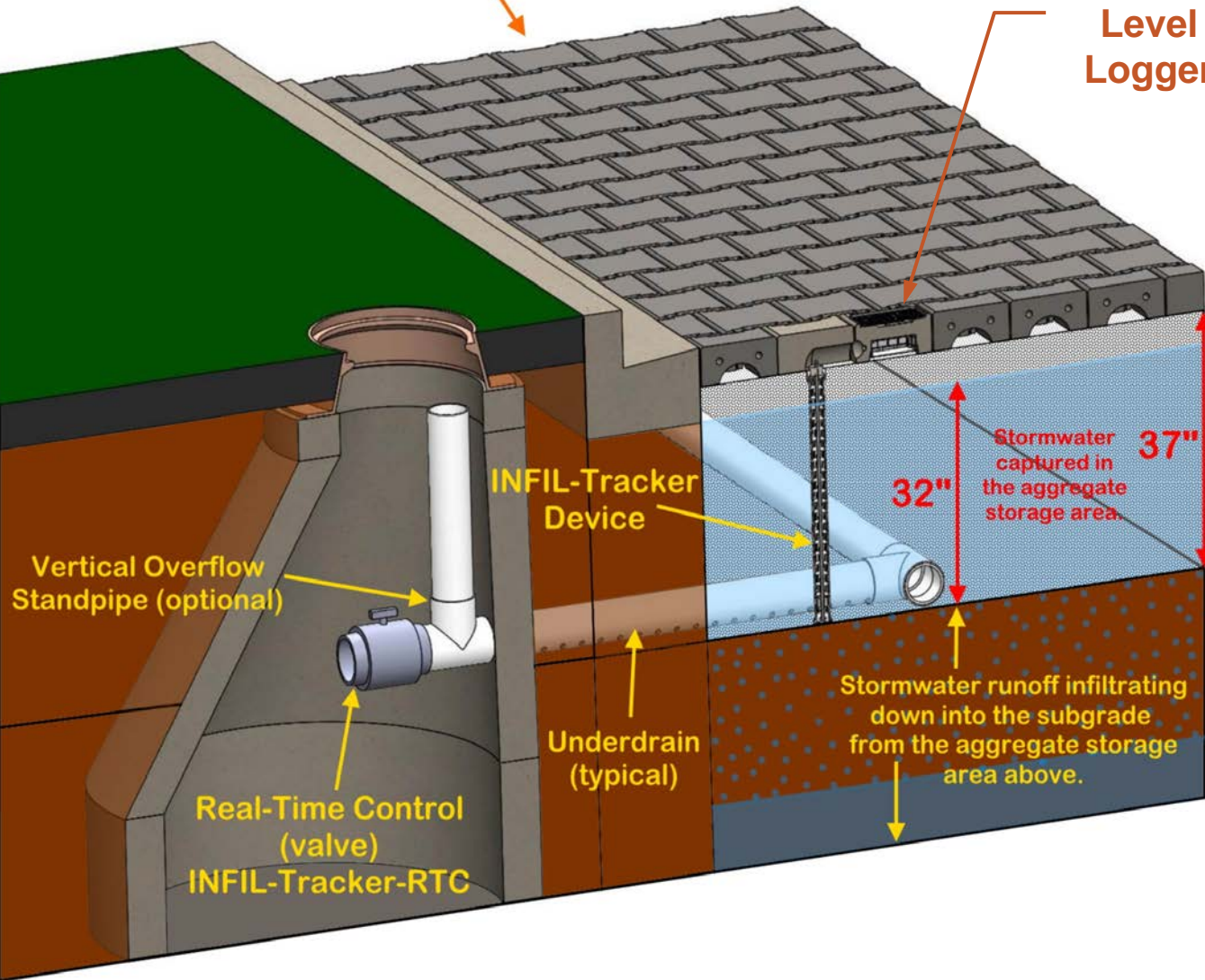
Table 1: Summary of Infiltration Rates Tested of Various Surfaces

Surface Material	Infiltration rate (in/hr)	Mass of infiltrated water (lb)	Diameter of infiltration ring (in)	Time (sec)
P-ACB	1,640	40.0	12.187	19.53/18.42/24.53
Porous pavers	3.2	2.54	12.187	683
Porous concrete	2.4	3.80	12.187	1,380
Porous asphalt	3.1	5.58	12.187	1,515

Soil Infiltration

P-ACB System

Water Level
Logger

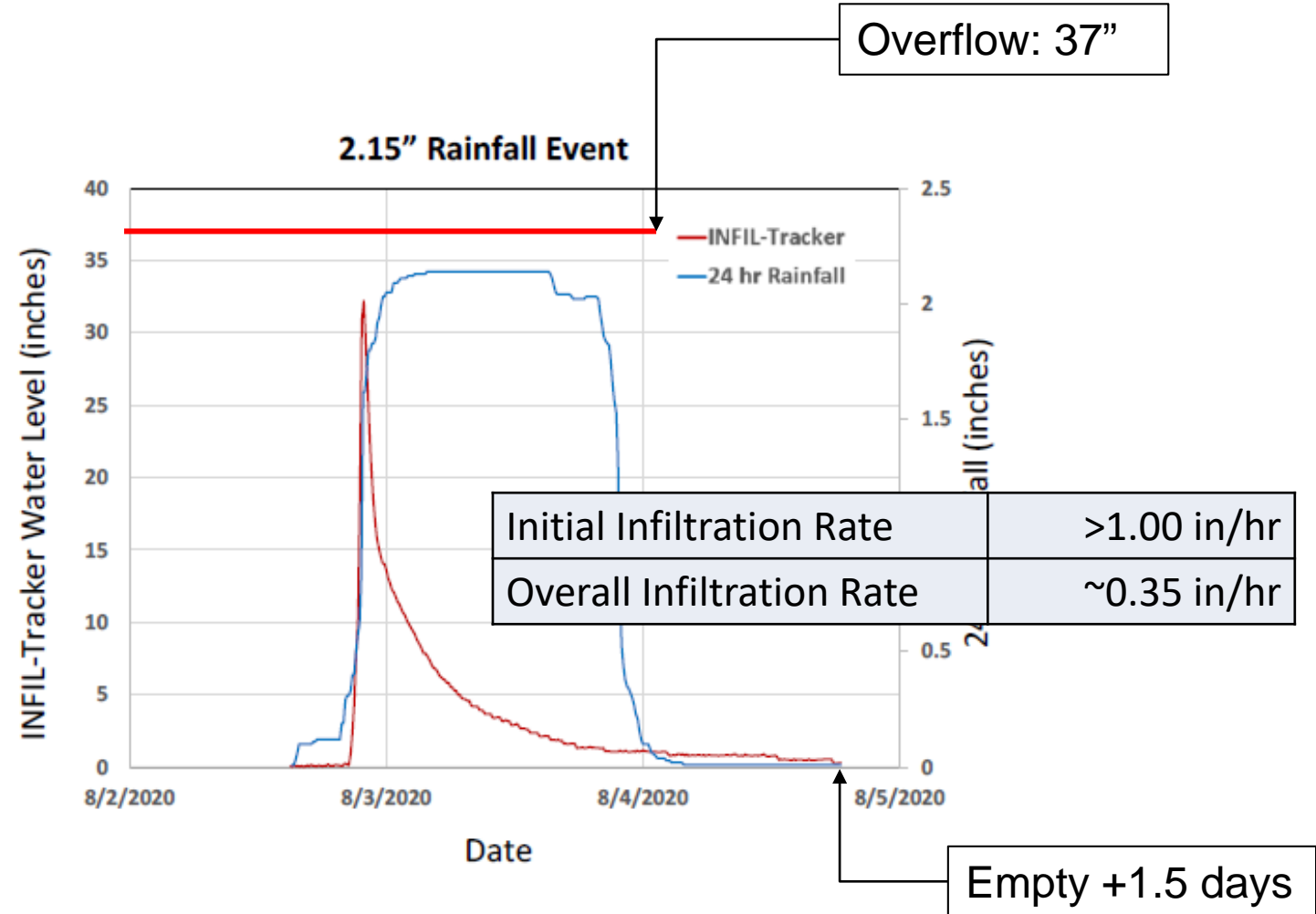


+Tipping Bucker Rain Gauge
Provides site-specific, time-stamped
rainfall data



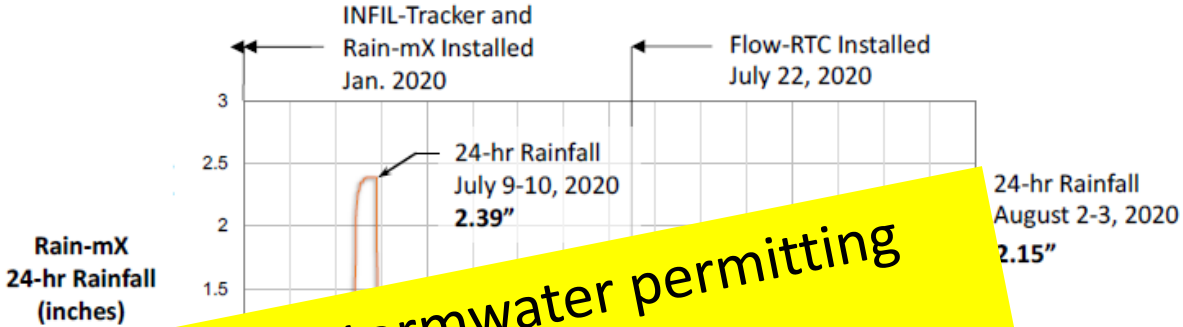
Van Norman Alley-Cudahy, WI

Impervious Cover	28,000 SF
P-ACB	850 SF
Run-On Ratio	33:1
Soil Infiltration Rate	0.04 in/hr



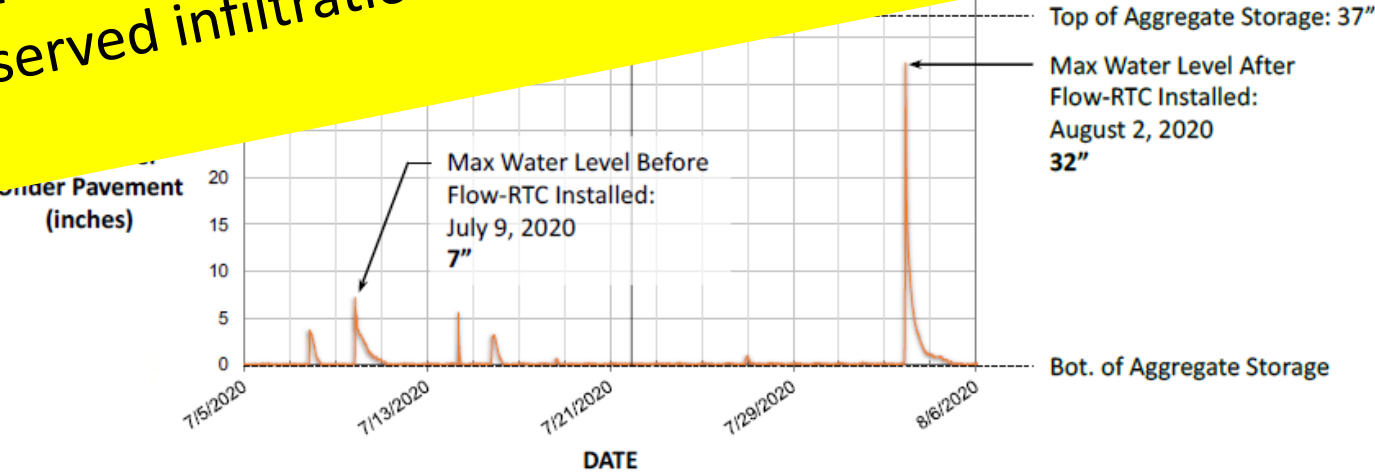
Van Norman Alley- Cudahy, WI

Impervious Cover	28,000 SF
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Overly conservative soil infiltration rates in our stormwater permitting
Real soil is a mixture with three dimensional channels and pathways that
result in higher observed infiltration rates

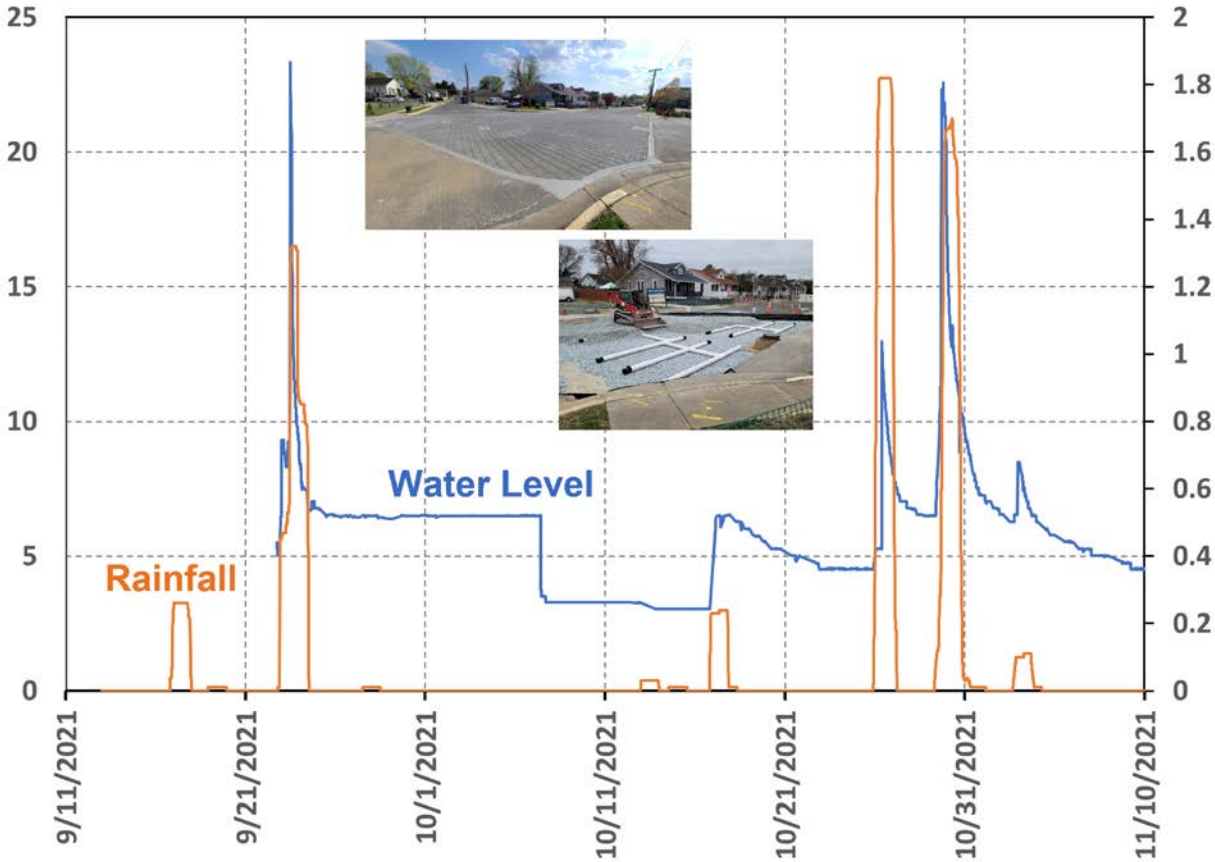
Rainfall			
2.15"			
0.75"			0.006
0.52"		1.2	0.003
Annual	0.2289	286	0.654



Right-of-Way in PG County

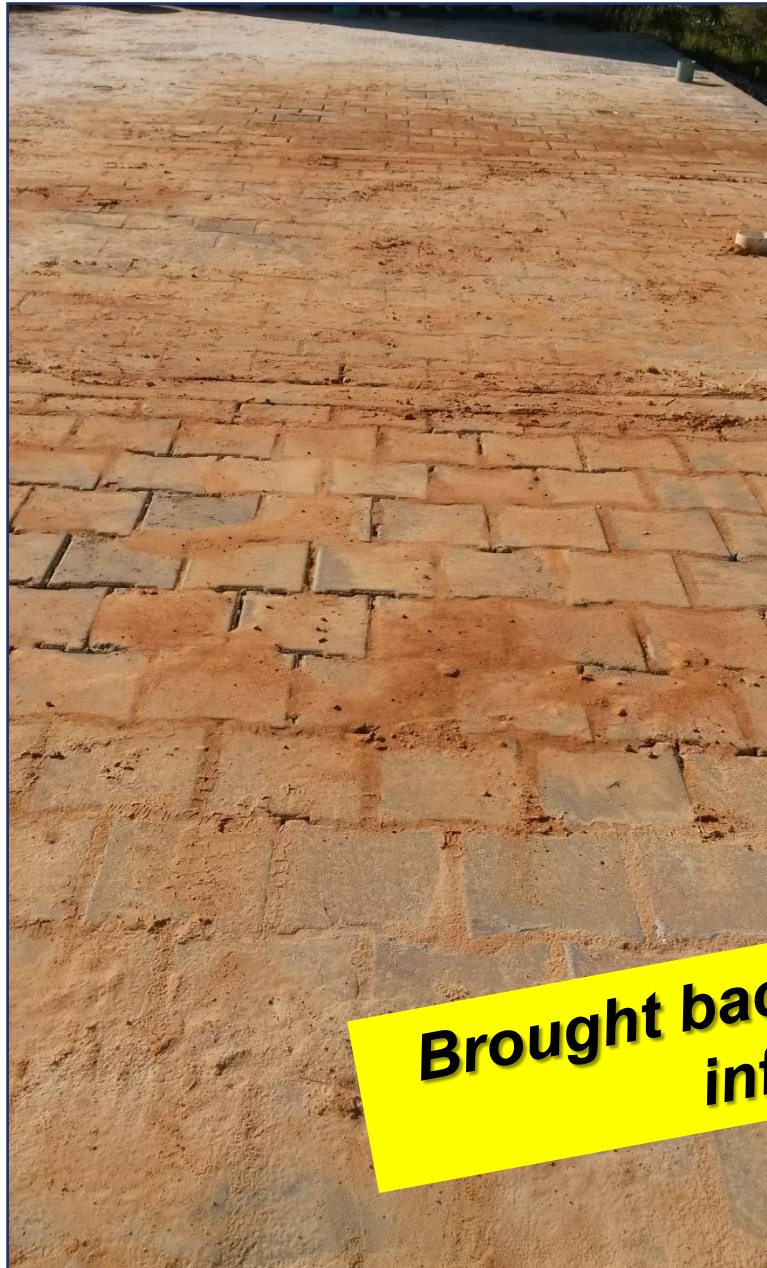
- 2,350 SF intersection (ROW)
- Soil tests confirmed D soils (clay)
- Elevated water table

	Expected	Actual
ESD Volume (ft ³)	376	1645
Soil Infiltration Rate (in/hr)	0.04	>1.00- initial ~0.40- overall



Preliminary data- Study with UMD

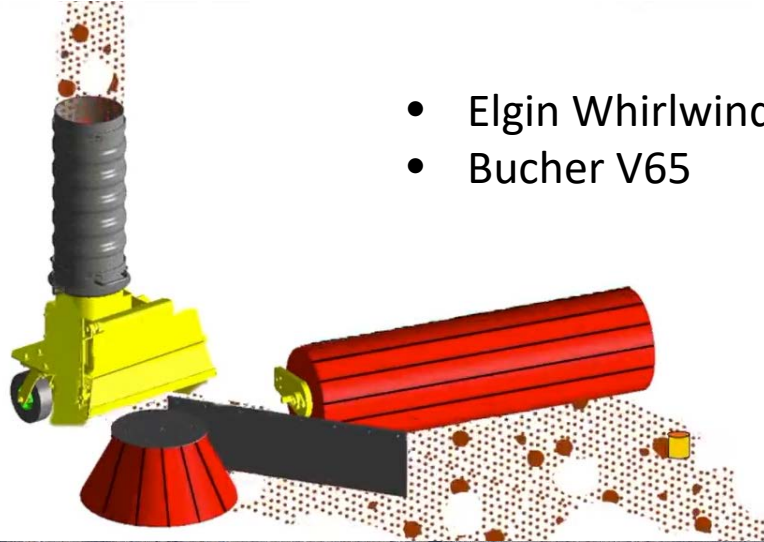
Abuse Test at Univ. of Central FL



**Brought back to 90+% of original
infiltration rate**



P-ACB Maintenance: True Vacuum Truck



- Elgin Whirlwind
- Bucher V65

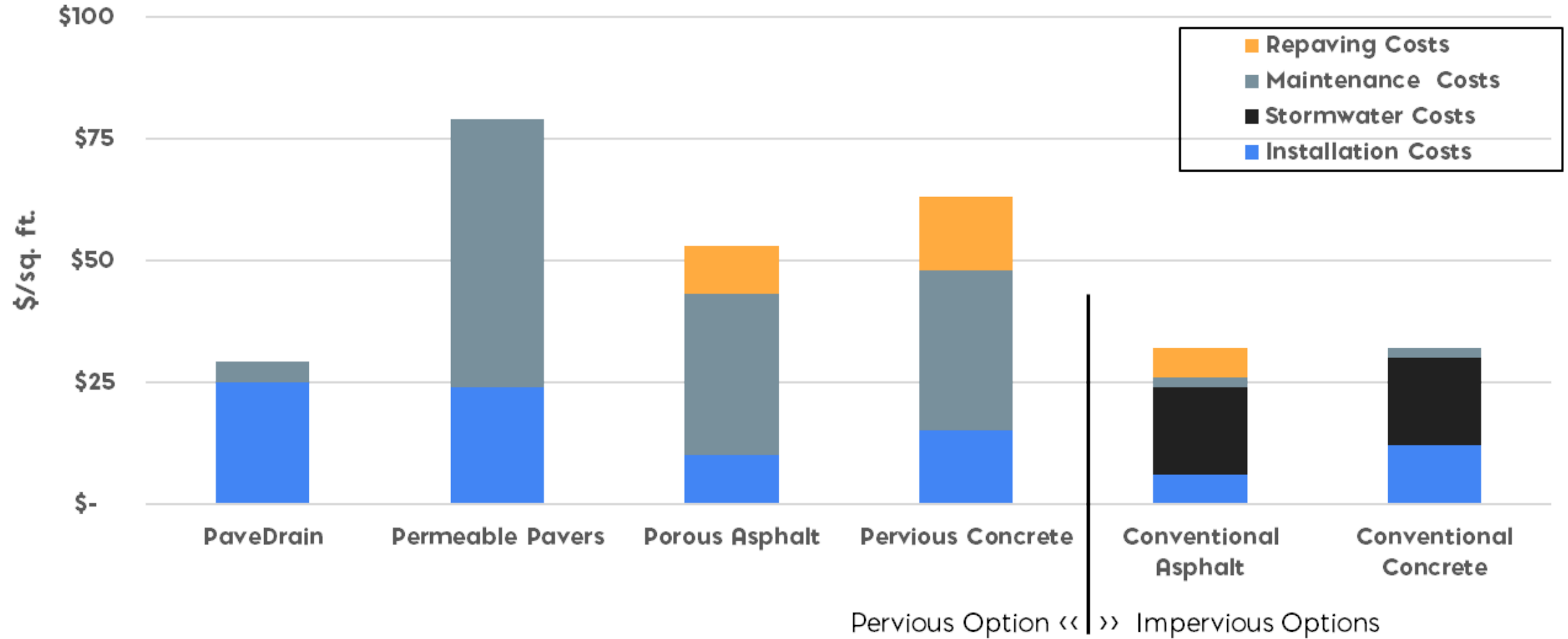


PRIOR TO CLEANING



First Pass

Total Costs @ 10 Years

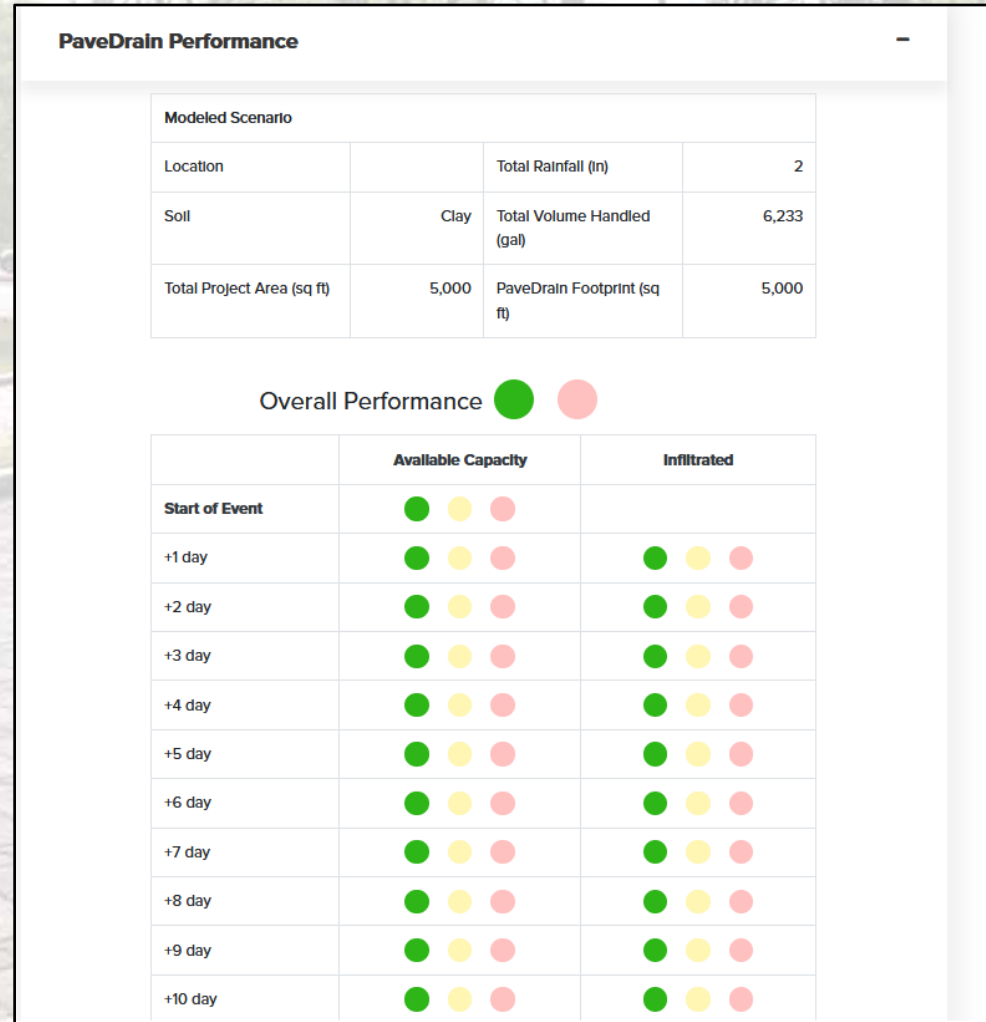


Infiltration Calculator

Model Your Scenario

- Rainfall via Location
 - 10-year event
 - 100-year event
 - 1,000-year event
 - Choose your own
- Area of permeable cover
- Area of impermeable cover (run-on)
- Soil
- Depth of Base

www.pavedrain.com/infiltrationcalculator



Manufacturer Warranty Example

- **3 years-500 in/hr (w/ maintenance)**
- **6 years-8 in/hr (w/o maintenance)**
- Restrictions
 - Proper installation
 - Voided if loose aggregate stored on surface
(sand, stone, soil, mulch, etc)
 - Other terms as specified

Other P-ACB Benefits

- Never have to replace joint filler (sand/stone dust)
- High void space avoids freeze-thaw and frost heaving challenges
- Can seal after installation to prevent salt damage
- Able to function in high water levels (e.g., sunny day flooding)
- Long lifetime of concrete (40 years)
- Single person can replace an ACB unit with a block extractor
- Increases resiliency of traditional paving surfaces

The P-ACB System: Multiple Installation Methods

Hand Placed Installation



Machine Lay



The P-ACB System: Machine Lay Installation



Sligo Park Hills Low Impact Development Project



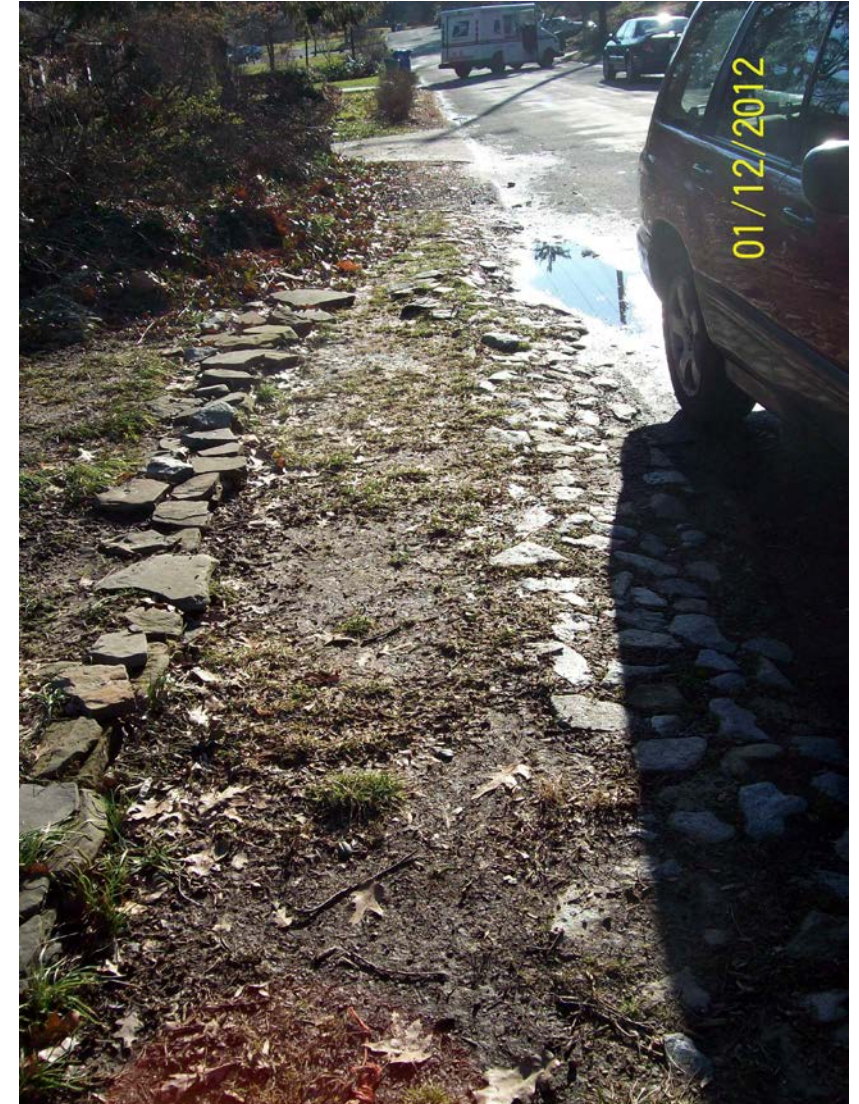
Engineering Design Development Process

- Preliminary Scoping
- Preliminary Site Assessment
- Field Data Collection
 - Utility Designation
 - Topographic Survey
 - Tree Inventory and Assessment



Engineering Design Development Process

- Concept Design
 - Design Build Approach
 - Concept Design Plans
 - Preliminary Treatment Calculations
- Subsurface Utility Locating
- Geotechnical / Infiltration Analysis



Engineering Design Development Process

- Final Design
 - MCDOT & MCDEP Standard Details
- Construction Inspection and Support Services
- As-Built Plan Certification
- Construction Landscaping Services



Types of Water Quality Improvement Facilities

- Tree Boxes w/ Stone Trench
- Bioswales
- Bioretention
- **Permeable Parking Pads with Pavedrain**
- Under Ground Storage with Rainstore
- Focal Point
- Internal Curb Storage
- Shoulder Stabilization



Project Results

- Overall Project:
 - 77 SWM Facilities were constructed
 - Drainage Area Treated = 41 acres
 - Impervious Drainage Area Treated = 14 acres
- Parking Pads Only (included Pavedrain, underground detention and Rainstore Products)
 - 37 SWM Facilities Constructed
 - Drainage Area Treated = 16.6 acres
 - Impervious Drainage Area Treated = 5.4 acres

Sources of Sediment



Sources of Sediment



Sources of Sediment



Origin of Concept



Project Goals

- Maintain Existing Parking Use
- Identify Additional Areas for Improvement
- Reduce Sedimentation
- Reduce Impervious Area
- No increase in Impervious Area
- Provide as much stormwater treatment as possible

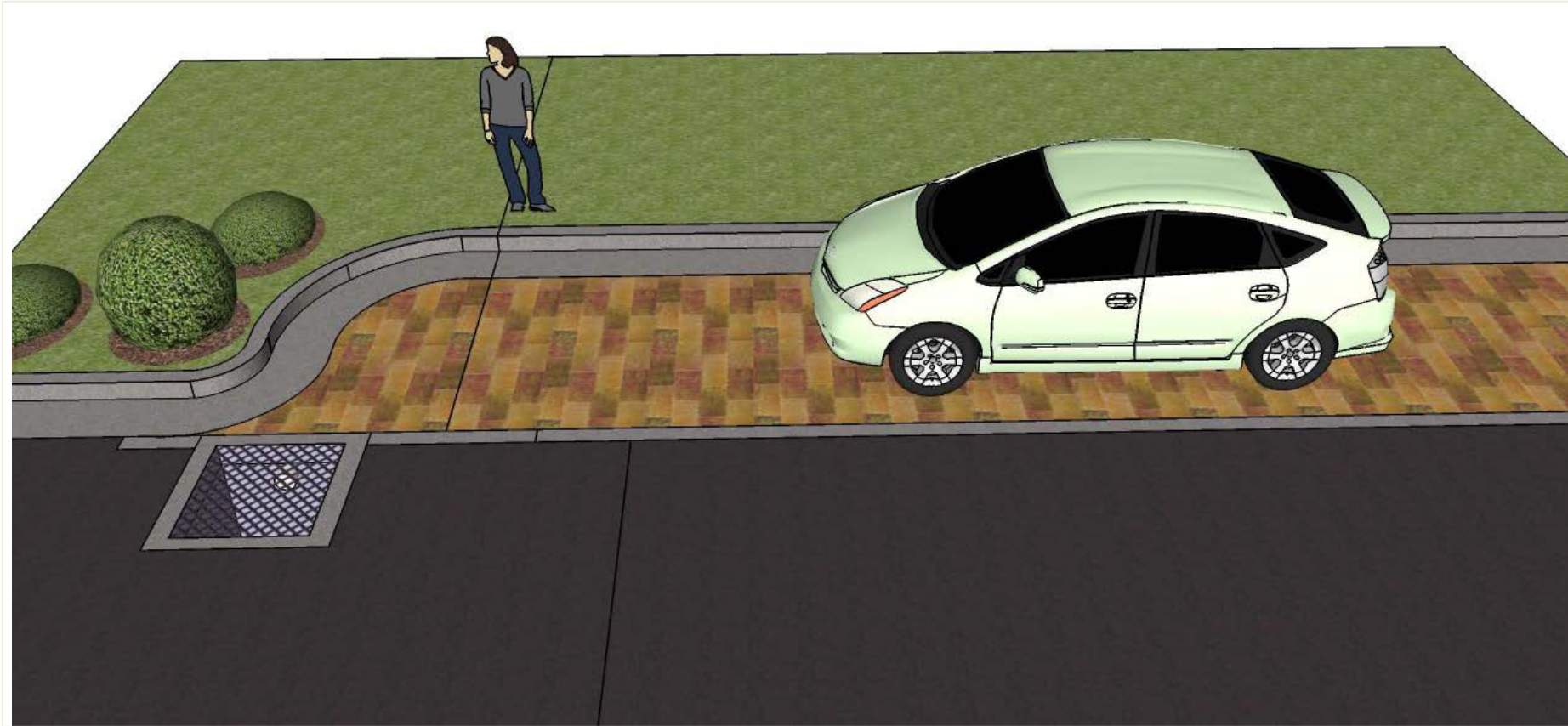


Product Research to Accomplish Goals

- Articulated Block



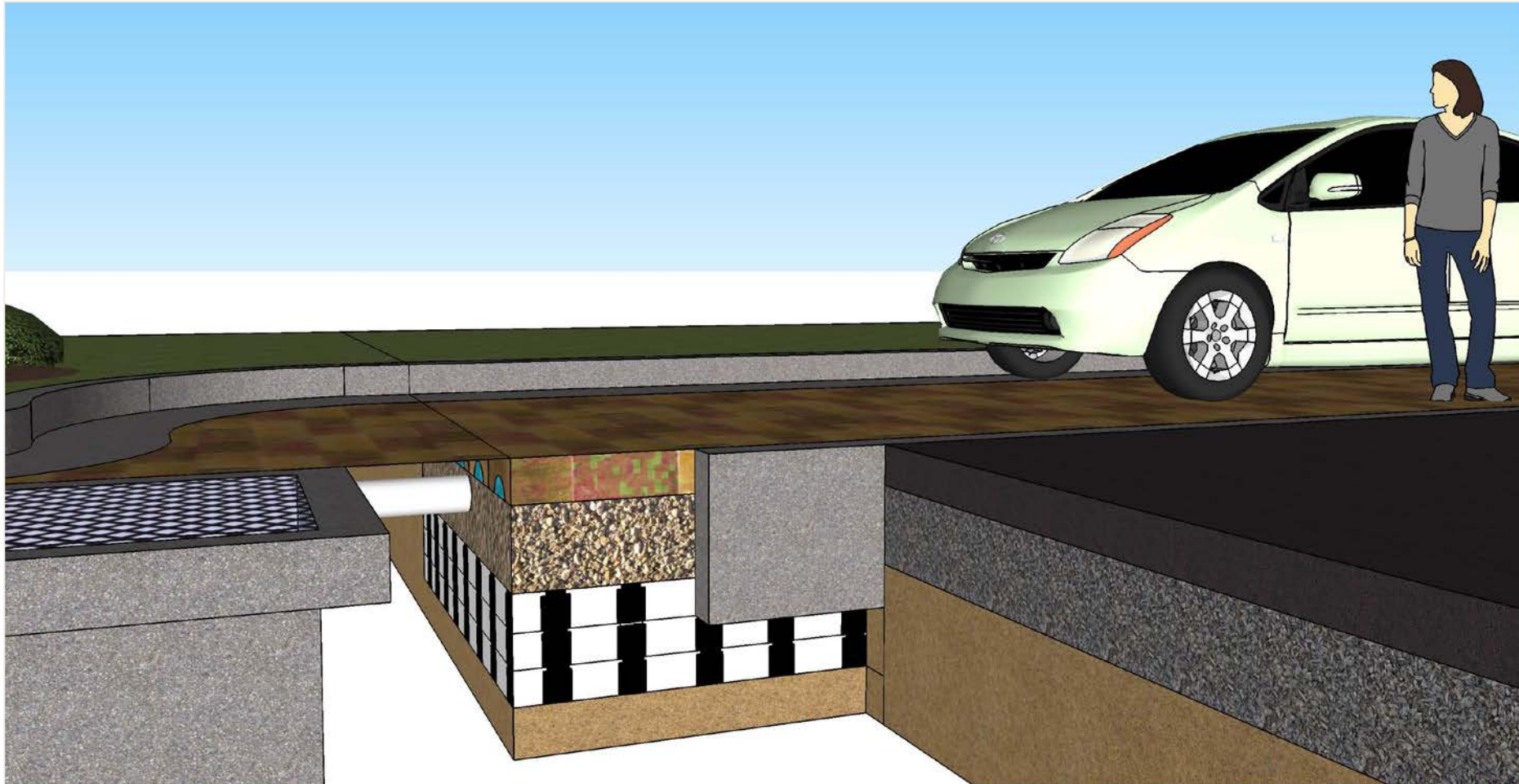
Permeable Parking Pad Rendering (Front View)



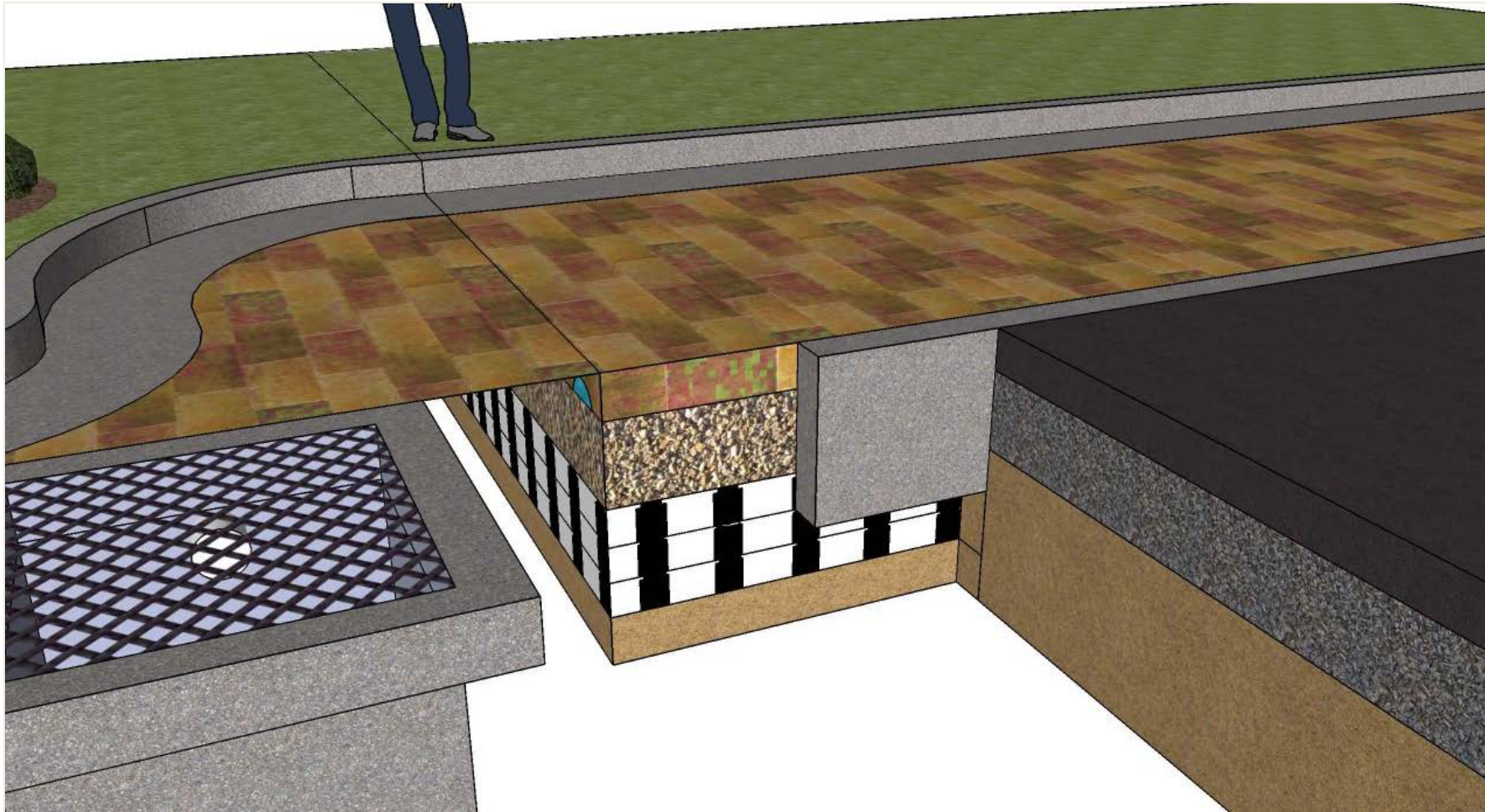
Permeable Parking Pad Rendering (Side View)



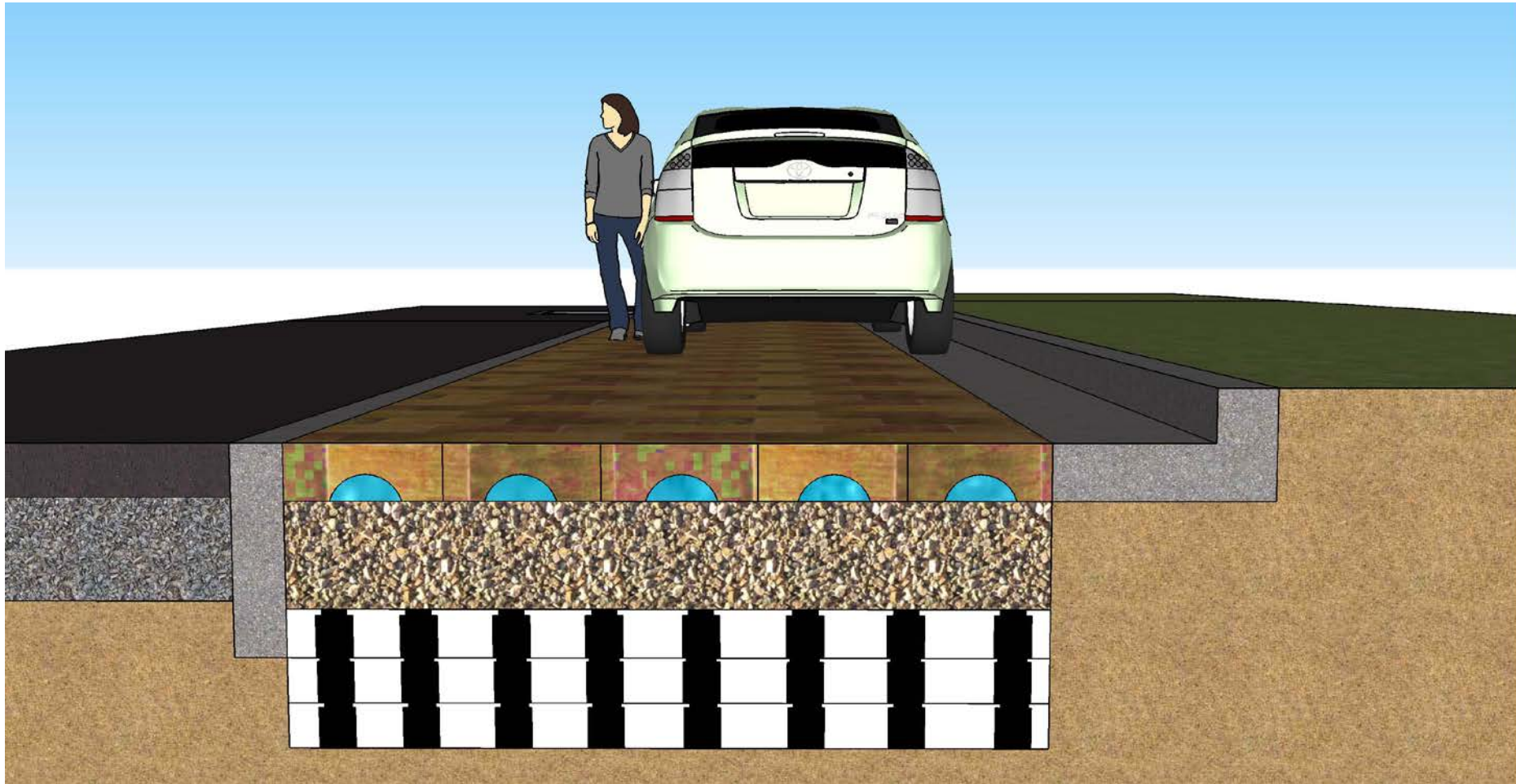
Permeable Parking Pad Rendering (Cross Section View)



Permeable Parking Pad Rendering (Cross Section View)

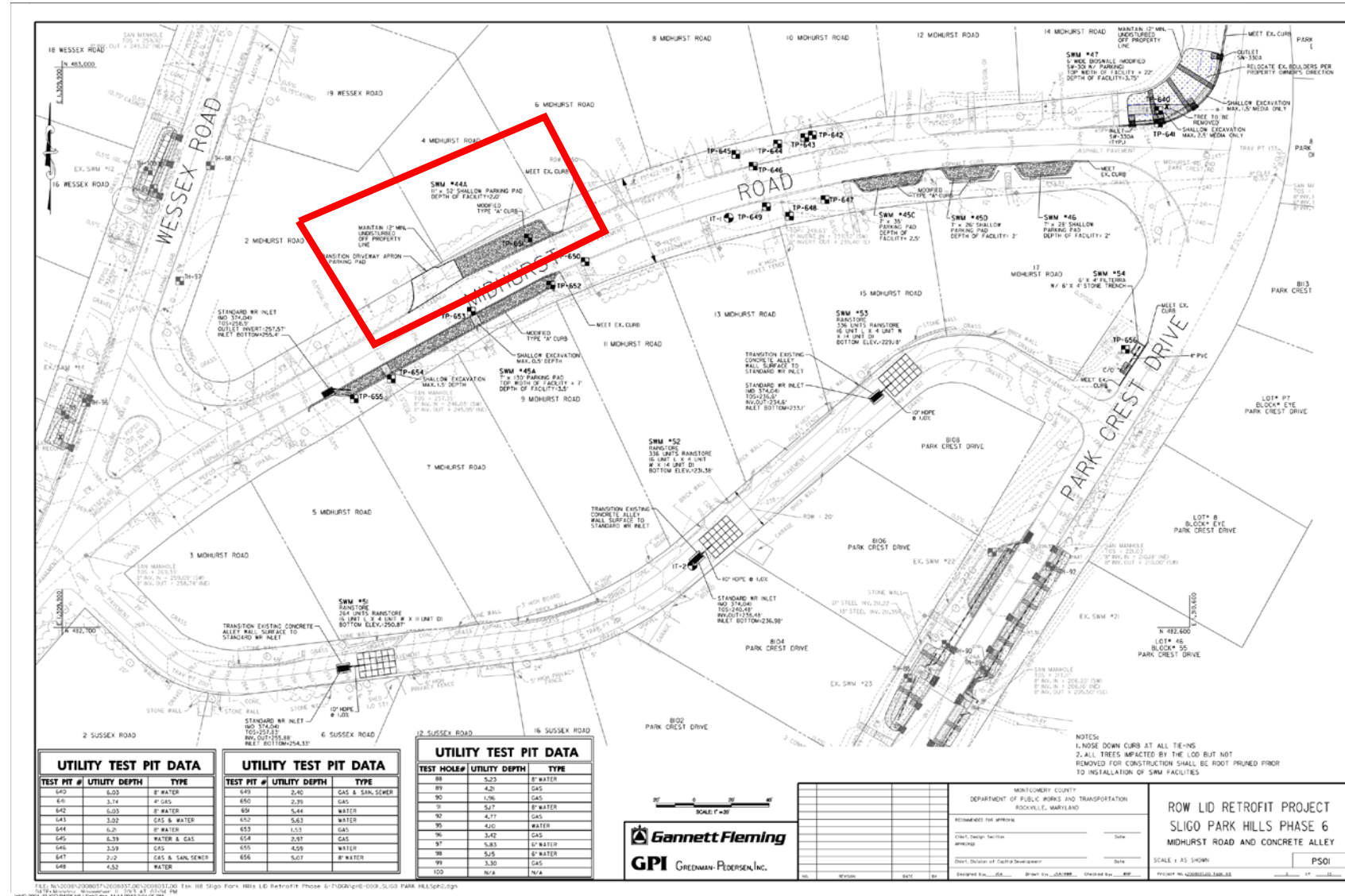


Permeable Parking Pad Rendering (Cross Section View)

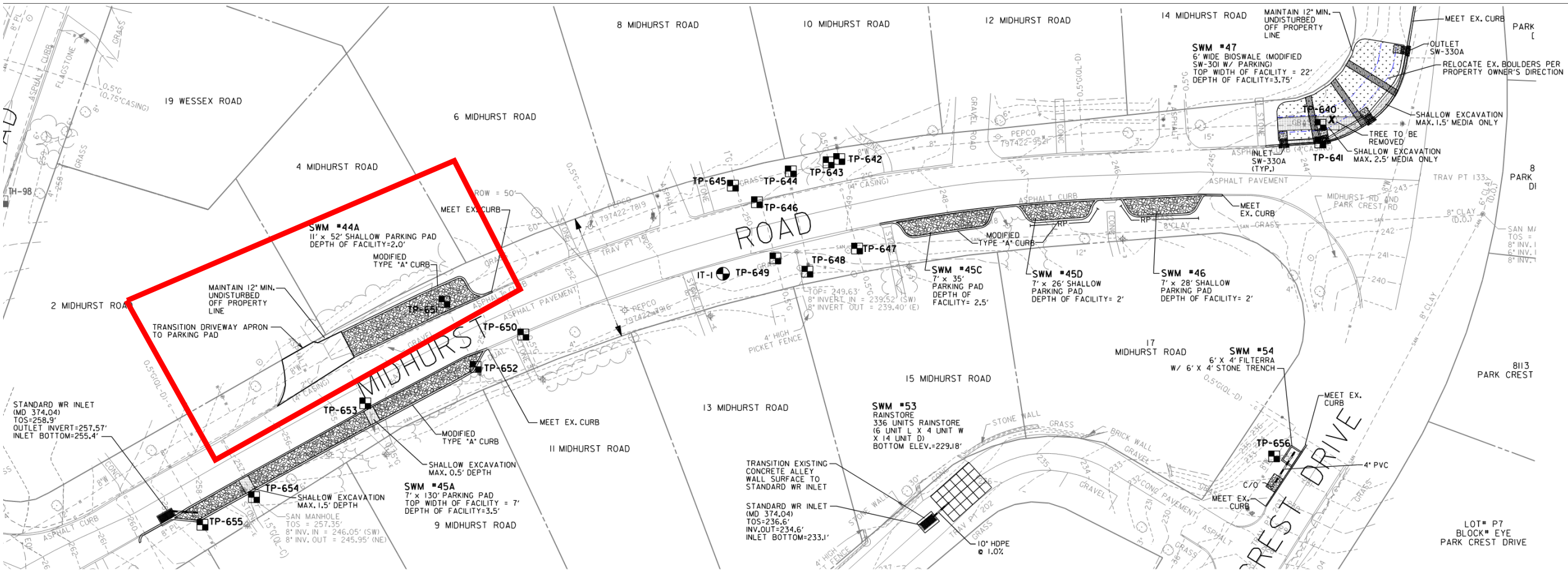


Typical Design Plans

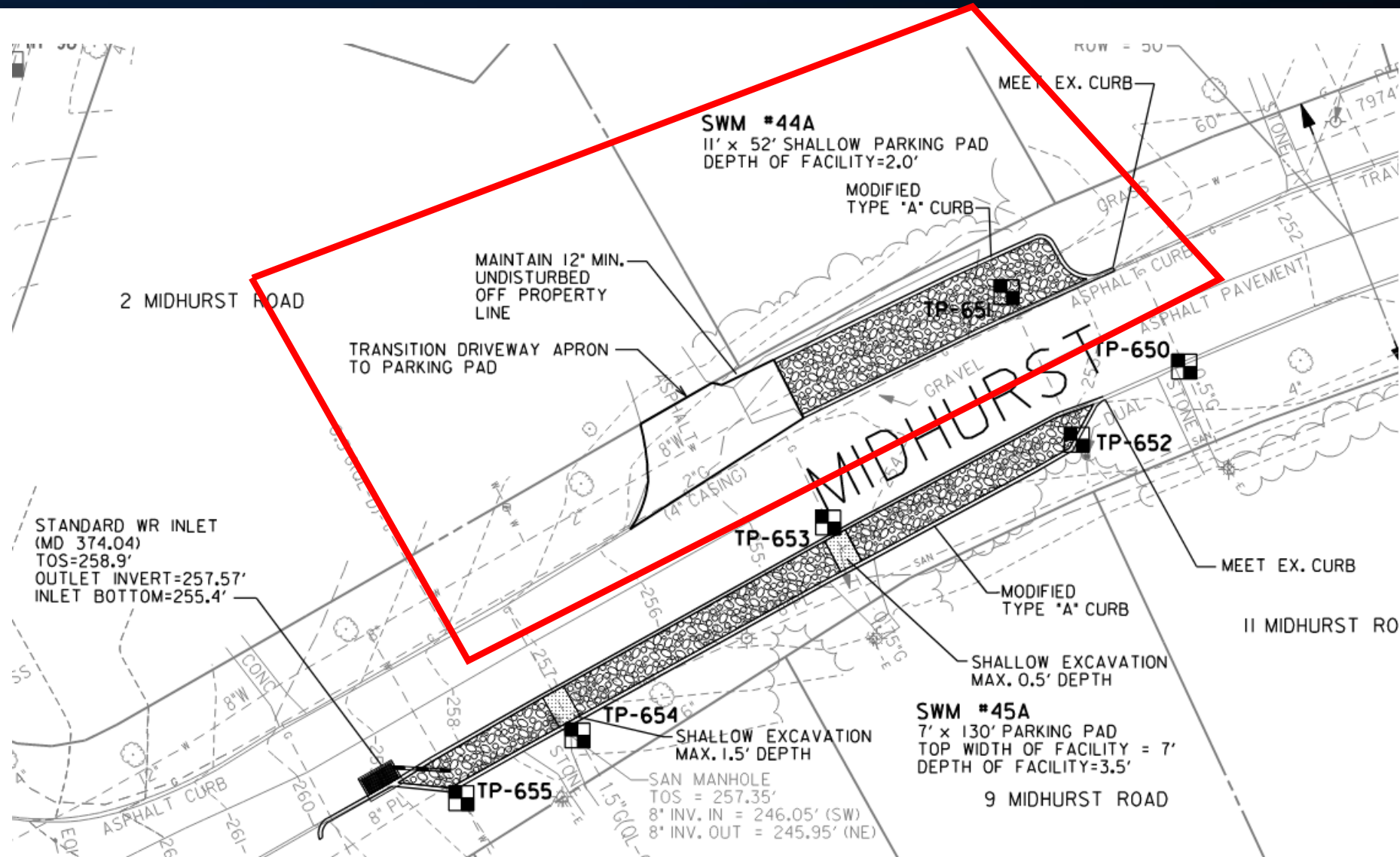
- Plans
- Details
- Profiles
- Treatment Tables
- Specifications
- Engineers Estimate



Proposed Midhurst Road LID Plan



Proposed SWM #44A – Parking Pad



Proposed SWM #44 – Parking Pad Existing Conditions



Completed SWM #44 - Parking Pad Post Construction Conditions



Other Examples of SWM Parking Pads



Other Examples of SWM Parking Pads



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Other Examples of SWM Parking Pads



QUESTIONS?

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