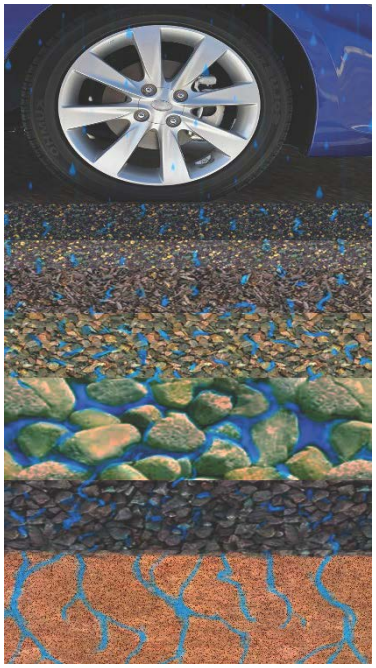


Practical Planning and Placement of Permeable Pavements to Maximize Benefits for Climate Change Resiliency Benefits and much much more…

Stormwater Quality, Storage, & Infiltration – a Diverse Green Infrastructure Option

Presented by
Bethany Eisenberg

April 4, 2016

Mainstreaming Permeable Pavement
A "Green Stormwater Infrastructure" Practice

Benefits all the way around
Institutional, Municipal, Private, Transportation, Residential, Recreation

- Stormwater Management
  - MS4 NPDES Permit Compliance
  - Flood Control – Resiliency – Infrastructure Protection
  - Water Quality Control
- Planning – Sustainable Design
- Roadway Design - Green Streets/Green Highways/ Complete Streets
- Site Design – Low Impact Development, Green Infrastructure
- Watershed - Water Quality/ Quantity - TMDLs – Pollutant Loading


Source: VHB


Source: VHB


Source: Andrew Potts

Pavement is a big deal…

Reduced Groundwater Recharge

- Reduced stream baseflow
- Reduced water for water supplies, aquifers, uses

Increased Flooding

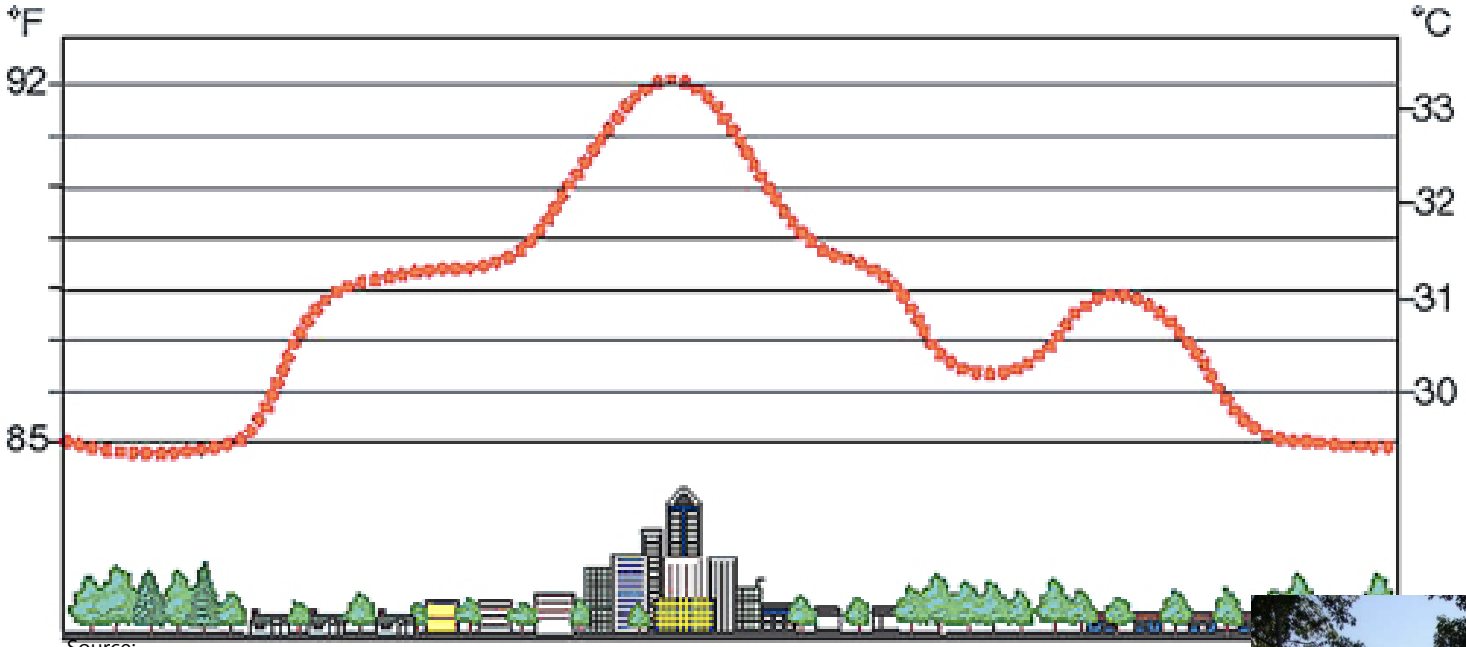
- It is no longer going in the ground, and…
- Increased frequency and volume of rain
- TP-40 Rainfall Data superseded, NOAA Atlas 14 – Fall 2015!

Impacts of Erosion and Sedimentation

- Destroys benthic environment
- Depth/temperature changes
- Species changes

Source: Cameron Paul

Thermal – Heat Island



Source:
http://apps.startribune.com/blogs/user_images/pauldouglas_1408655892_urbanheatisland.jpg

Bottom Line – If you Reduce the Impervious…

- Reduces the runoff volume
- Decrease flooding
- Reduces pollutant loads
- Increases recharge (treatment & baseflow)
- Reduces heat island effect

While we have gotten better in our designs, we still have a lot of pavement to work with…

Permeable Pavements & Pavement Systems

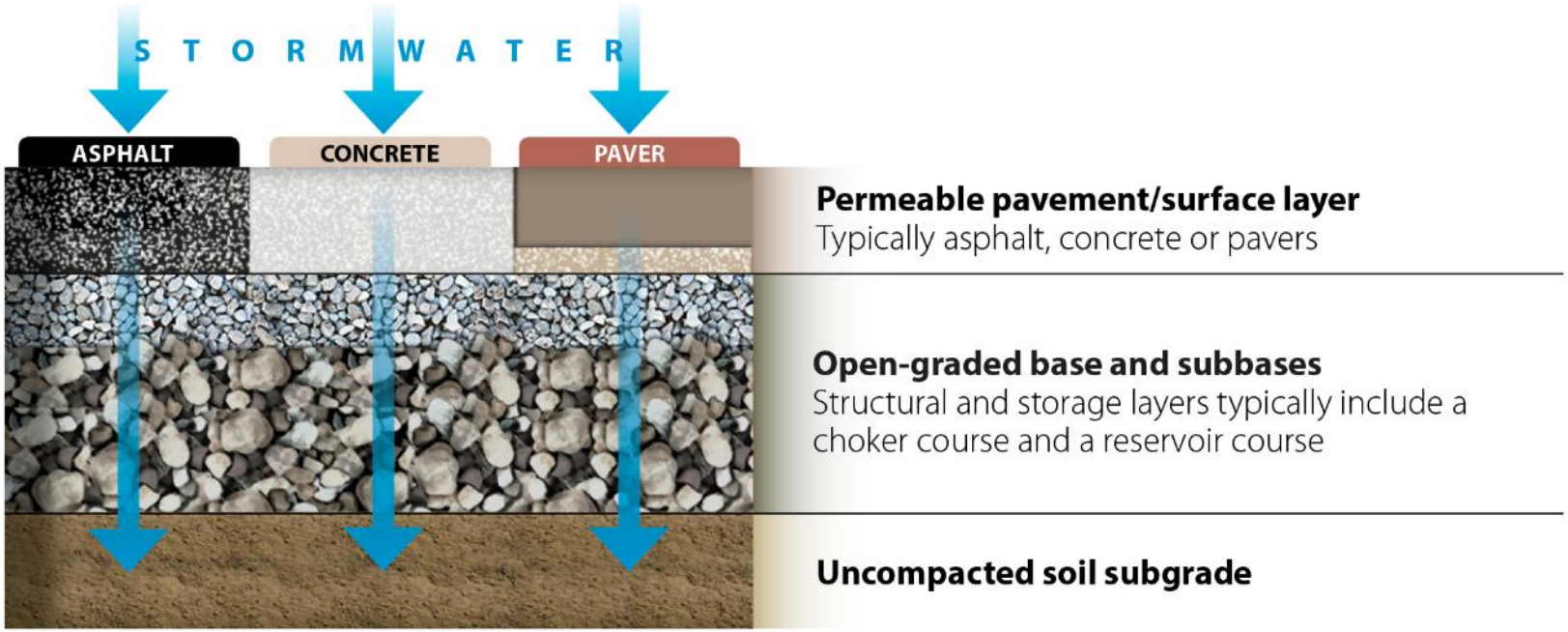


Figure 1-3
Generic permeable pavement cross-section
Source: © Vanasse Hangen Brustlin, Inc. (VHB)

Permeable Pavements are not just pavements…

- **Stormwater Quantity –**
  reduce flooding, stream erosion, CSOs
- **Stormwater Quality** –
  reduce stormwater runoff/pollutant loads
- **Groundwater Recharge**-
  baseflow, tree roots, water table
- **Reduce Thermal Impacts-**
  cools via filtering in ground
- **No Water on Surface-**
  reduce ponding, spray, hydroplaning, ice
- **Reduce Salt Use and Ice Build Up**
- **Preserve Land in Developments**
  instead of surface stormwater BMPs

Source: John Kevern, UMKC

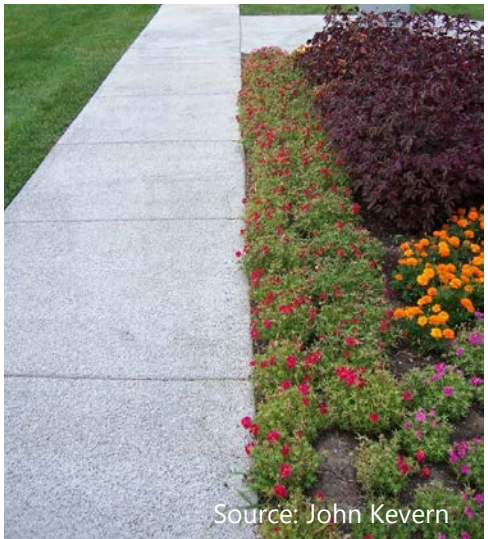
Permeable Pavements –Typical Applications

- Light use roadways, shoulders
- Driveways, sidewalks, bike paths
- Parking areas, boat ramps
- Recreational surfaces, patios
- Interior of greenhouses /other
- Pool decks, water parks


Source: Andrew Potts


Source: Hastings Pavement


Source: John Kevern


Source: John Kevern

Expanding Uses and Research

Incorporating pavements into landscape and streetscapes

Potential Transportation uses.. Roadway shoulders, park and rides

Porous Asphalt

Pervious Concrete

Permeable Pavers

Source ICPI

How do you select the location and type of pavement and pavement system?

- Structural – pedestrian, event, traffic
- Hydrologic – storage, infiltration quality treatment goals, peak reduction
- Aesthetic – use of the pavement, surroundings
- Protection – runoff, sediment/fine sources
- Practical – plowing, recreational uses, loads
- Costs – life cycle cost for intended use
- Constraints – curing time, utilities, loads, turning movements, soils, adjacent uses, discharge location, acceptance

Large Scale Planning and Site Specific Planning Critical

Cost

- System materials typically more expensive than traditional concrete or asphalt
  - Typ Costs for 2" Asphalt ($2-4/sf), Concrete ($3-5/sf)

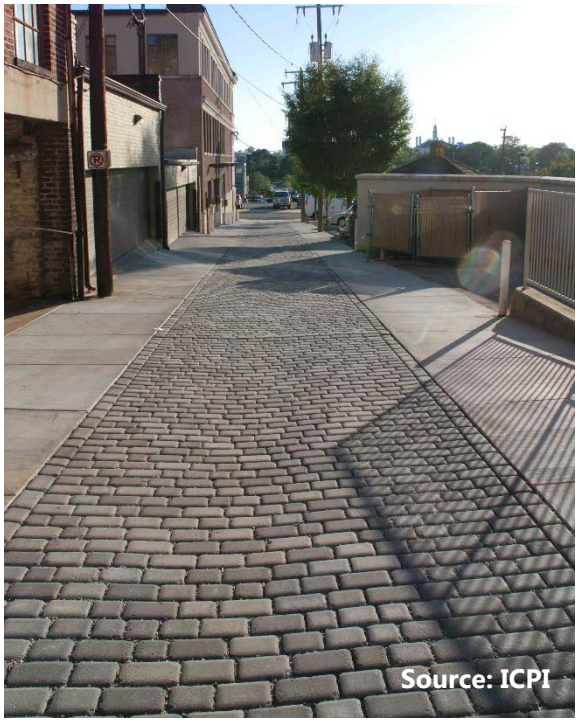
Table B-5 Permeable Pavements Surface Cost Comparison

POROUS PAVEMENT TYPE	TYPICAL INSTALLED COST ($/SF)	TYPICAL COST RANGE ($/SF)
Porous Asphalt (5 cm [2 in.] surface course, 7.62 cm [3 in.] ATPB)	$6.00	$4.00 – $8.00
Pervious Concrete (6 in.)	$8.00*	$6.00 – $10.00
Interlocking Permeable Pavers & Rigid Open Cell Pavers (including 5 cm [2 in.] bedding layer)	(small hand installation) $13.00	$10.00 – $20.00
	(large mechanical installation) $6.50	$5.00 – $10.00
Open Cell/Grid Paving Systems	$7.00	$5.00 – $9.00
Proprietary Porous Pavement Products	Vary by manufacturer	

Note: Based on 17 actual bids with unit materials costs for permeable pavements (excluding open celled/grid lattice) from projects 2011–2013. General Estimates for installed permeable pavement surfaces with no sub-surface storage. Prices vary greatly with pavement depth, base/subbase and drainage variations.
*Estimate provided by National Ready Mix Concrete Association 2013
Source: CH2M Hill, 2013

- Source: ASCE Permeable Pavements Book 2015
- Cost benefits may be realized through stormwater management savings

Select your materials based on your needs



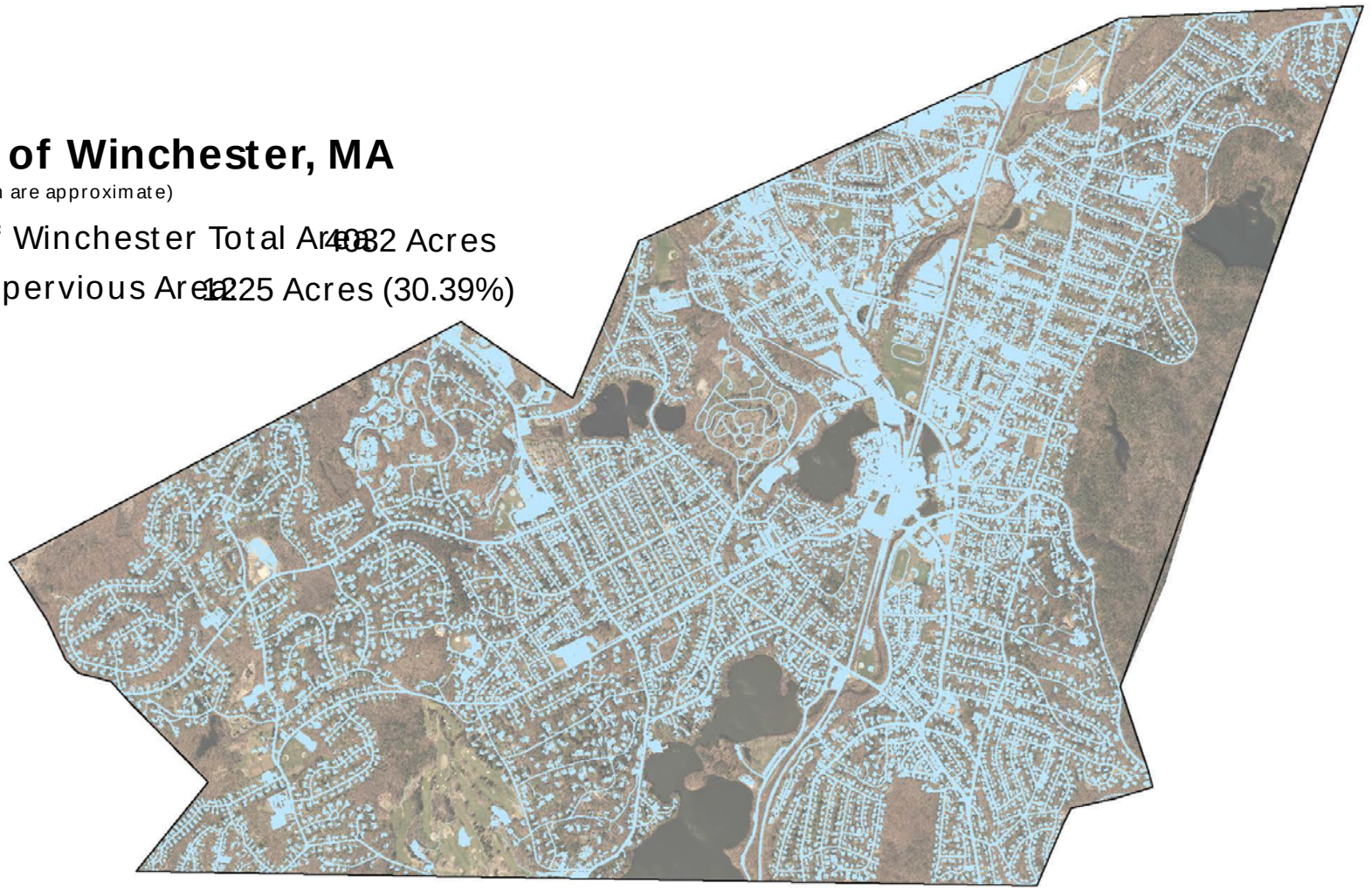
Town Example – Quick Analysis – Winchester, MA

Town of Winchester, MA

(Values Shown are approximate)

Town of Winchester Total Area 4032 Acres

Total Impervious Area 1225 Acres (30.39%)



Impervious Area

Town Example – Quick Analysis – Winchester, MA

Town of Winchester, MA

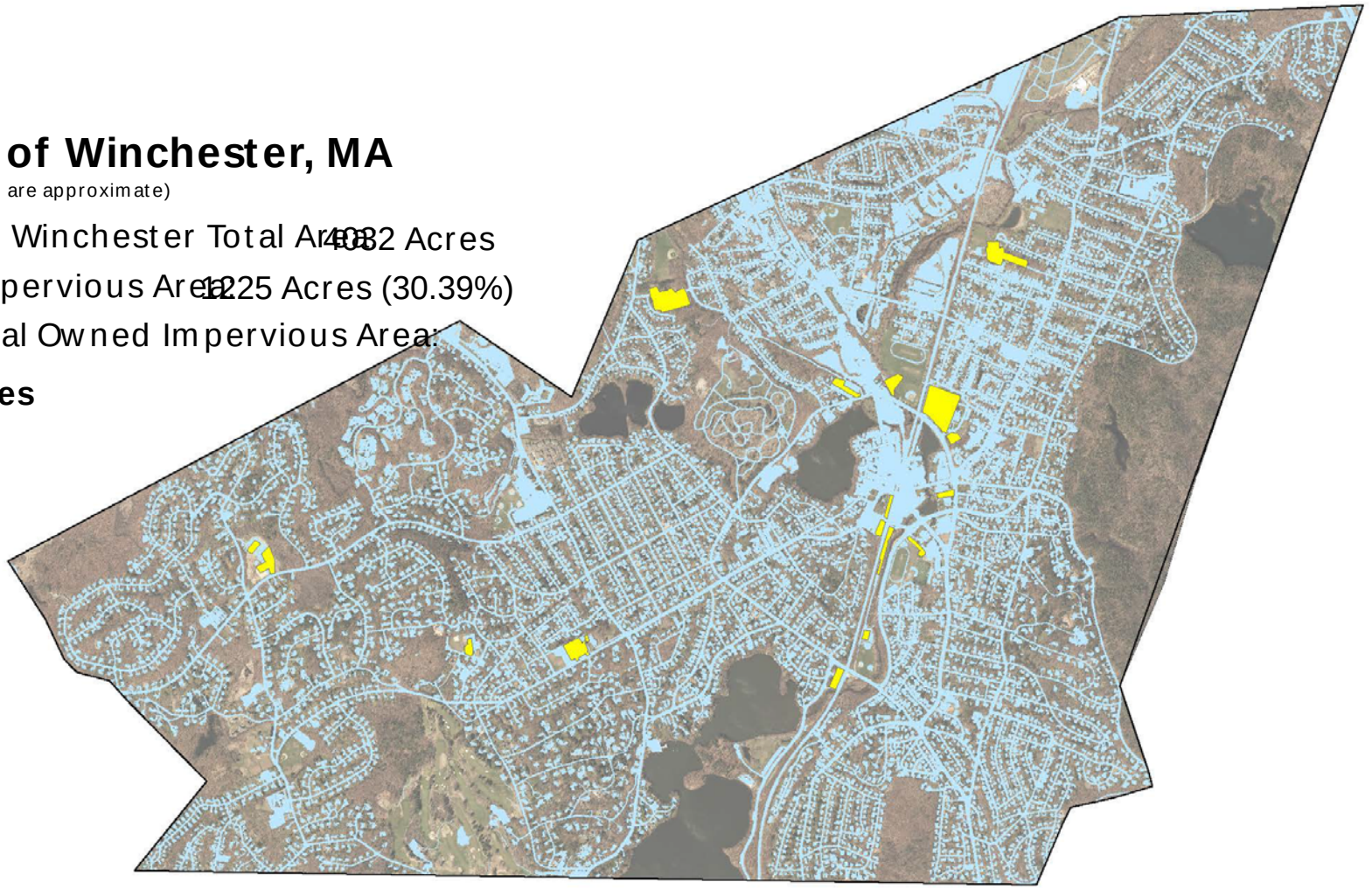
(Values shown are approximate)

Town of Winchester Total Area: 4032 Acres

Total Impervious Area: 1225 Acres (30.39%)

Municipal Owned Impervious Area:

25.3 Acres

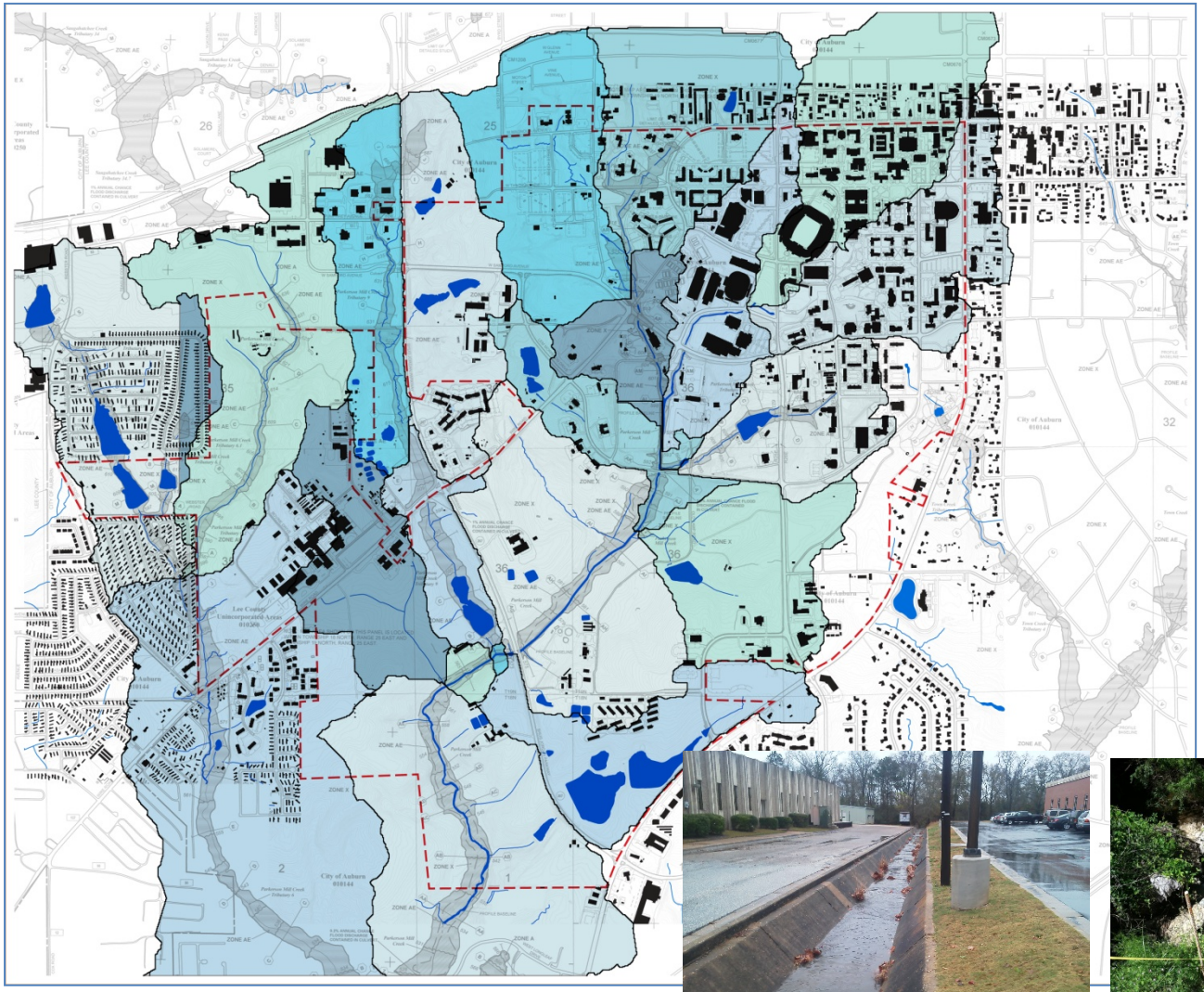


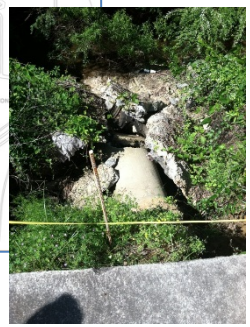
Percent of Impervious Area Municipally Owned: **2.1%**

Impervious Area

Municipal Owned

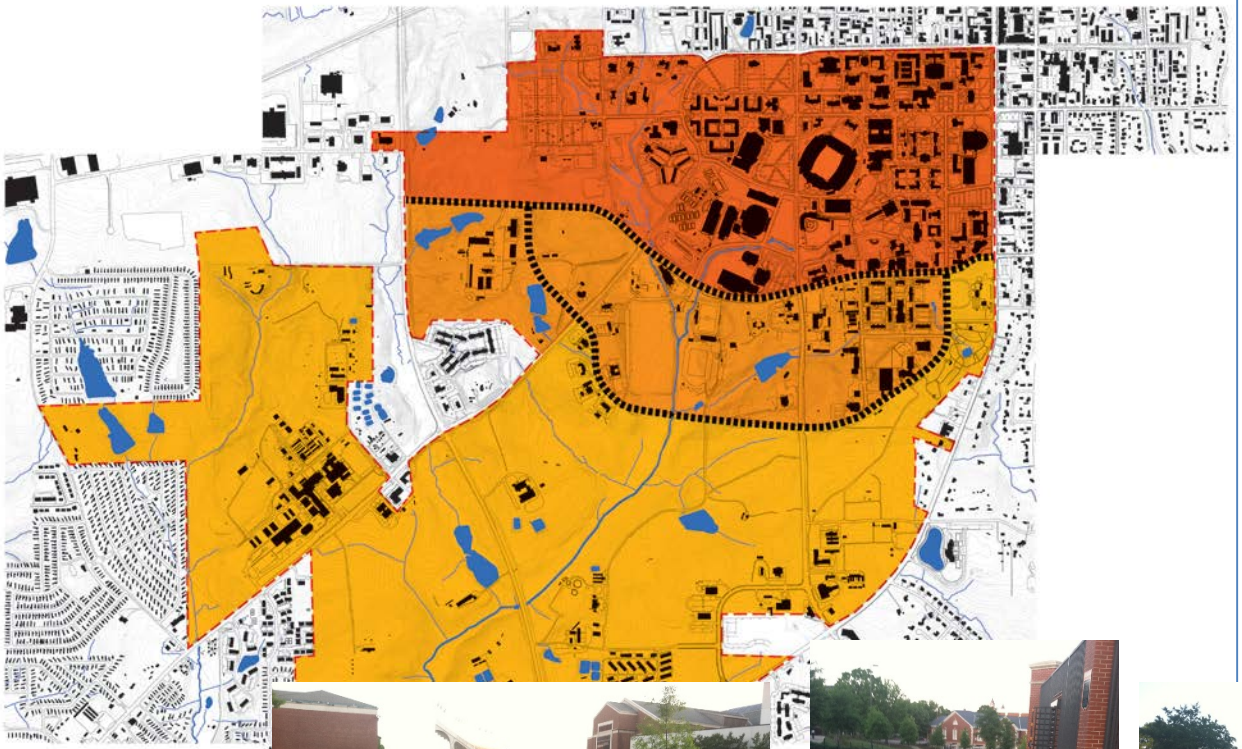
Campus Example – Auburn University Watersheds





Team: jB+a inc.; Nelson, Byrd, Woltz L.A., VHB. Krebs

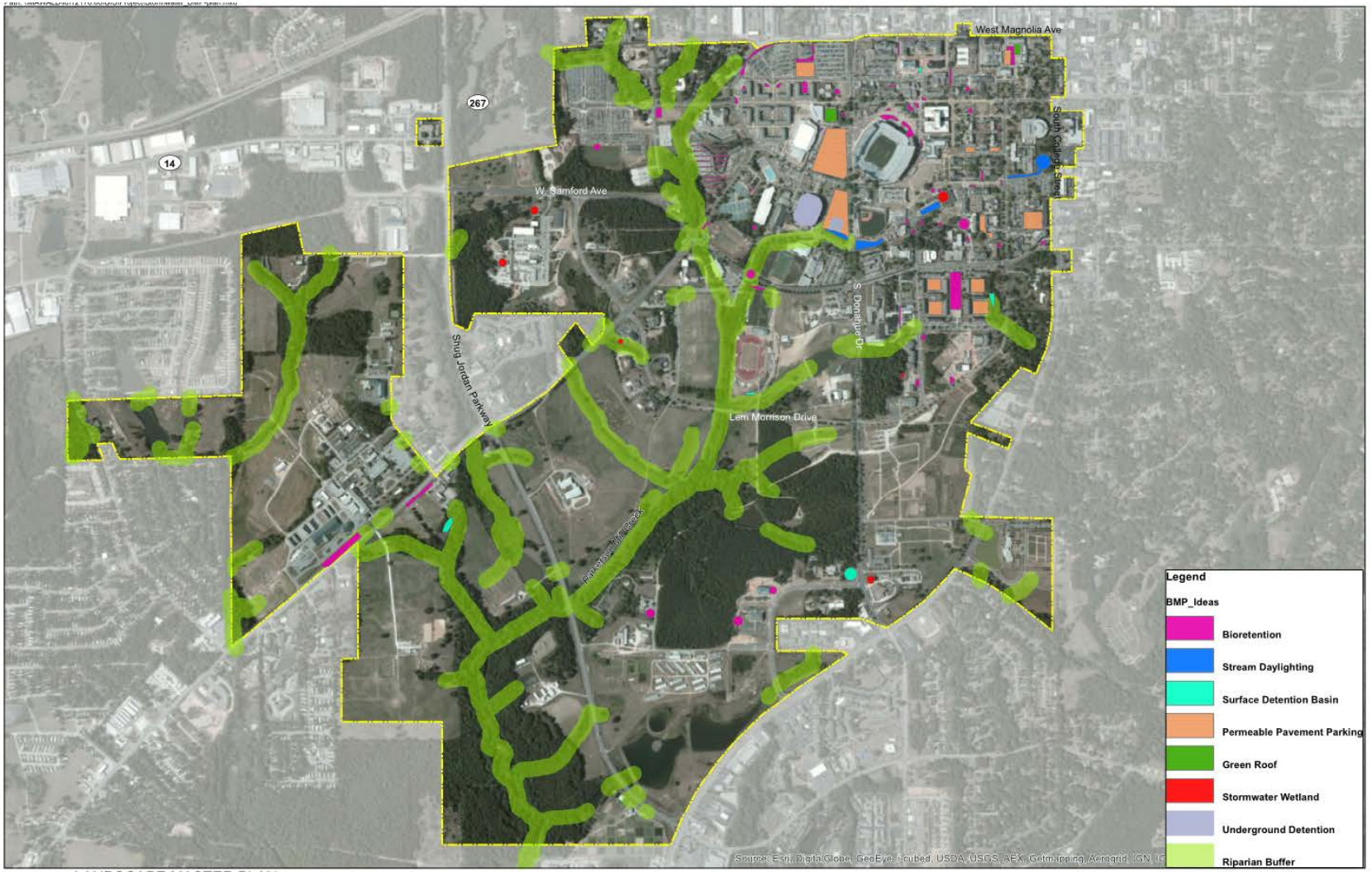
Auburn University
Zones of Density, Imperviousness and Uses



Team: jB+a inc.; Nelson, Byrd, Woltz L.A., VHB. Krebs

Auburn University Landscape Master Plan

Stormwater Management Component – Water Quantity & Quality



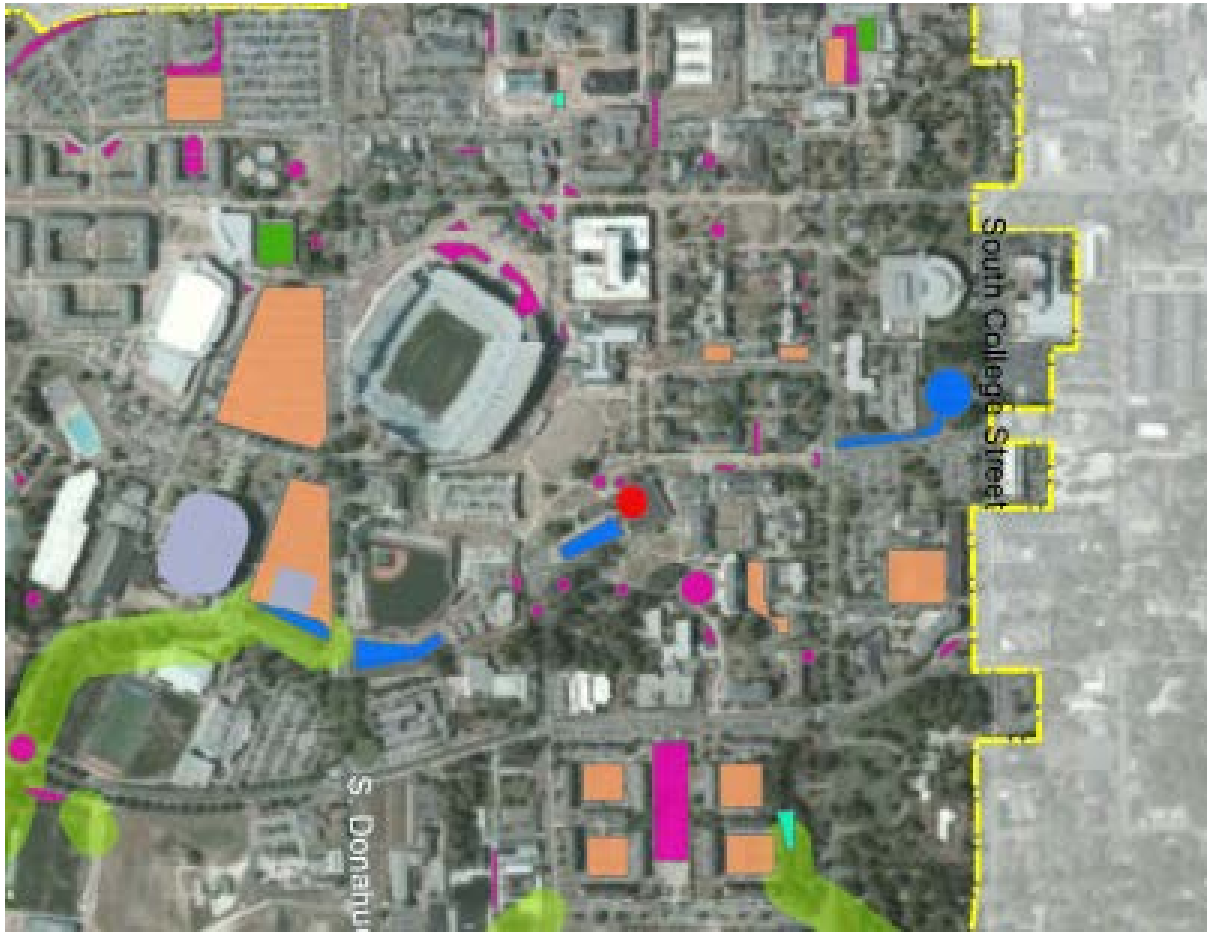
LANDSCAPE MASTER PLAN
AUBURN UNIVERSITY, ALABAMA

STORMWATER MANAGEMENT- PRELIMINARY BEST MANAGEMENT PRACTICE IDEAS

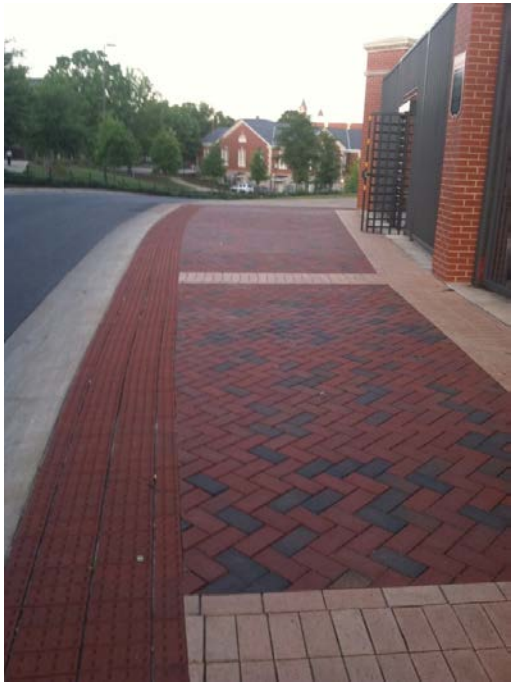
October 25, 2013

Team: jB+a inc.; Nelson, Byrd, Woltz L.A., VHB. Krebs

Permeable Pavement Potential Locations – Large Applications in Orange



Team: jB+a inc.; Nelson, Byrd, Woltz L.A., VHB. Krebs



Turner Field Atlanta :ICPI

Permeable Pavement Potential Locations – Smaller Innovative Retrofits

Select Your Materials Considering Aesthetics -

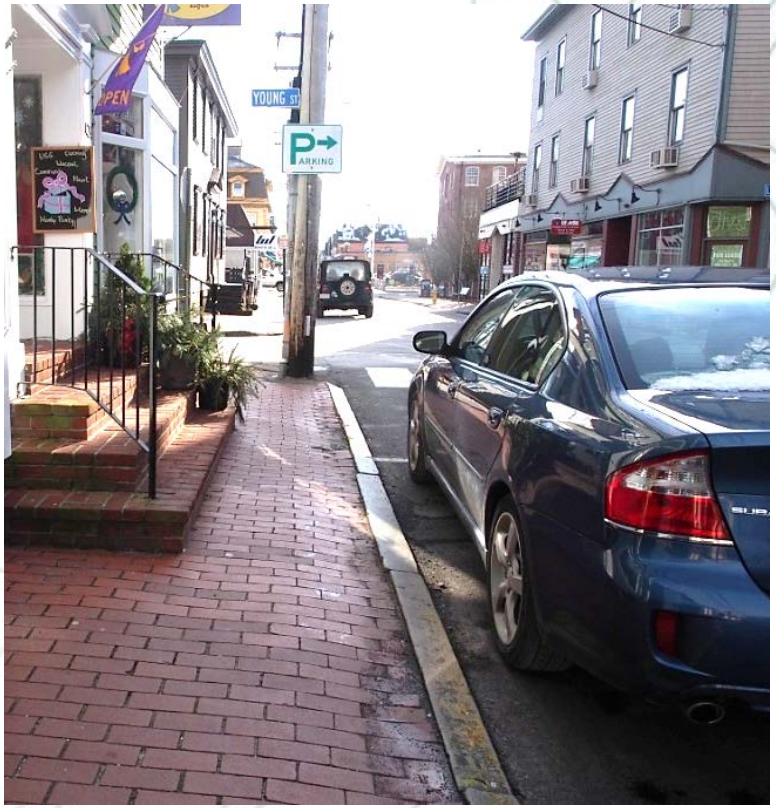
Elements of Newport into Green Infrastructure

Urban Streetscape Example
Planning - Thames Street, Newport, RI

Working Permeable Pavement /stormwater management into their Streetscape Concept

Goals

- Pedestrian safety
- Traffic calming
- Aesthetics
- Stormwater quality
- Stormwater quantity
- Historical



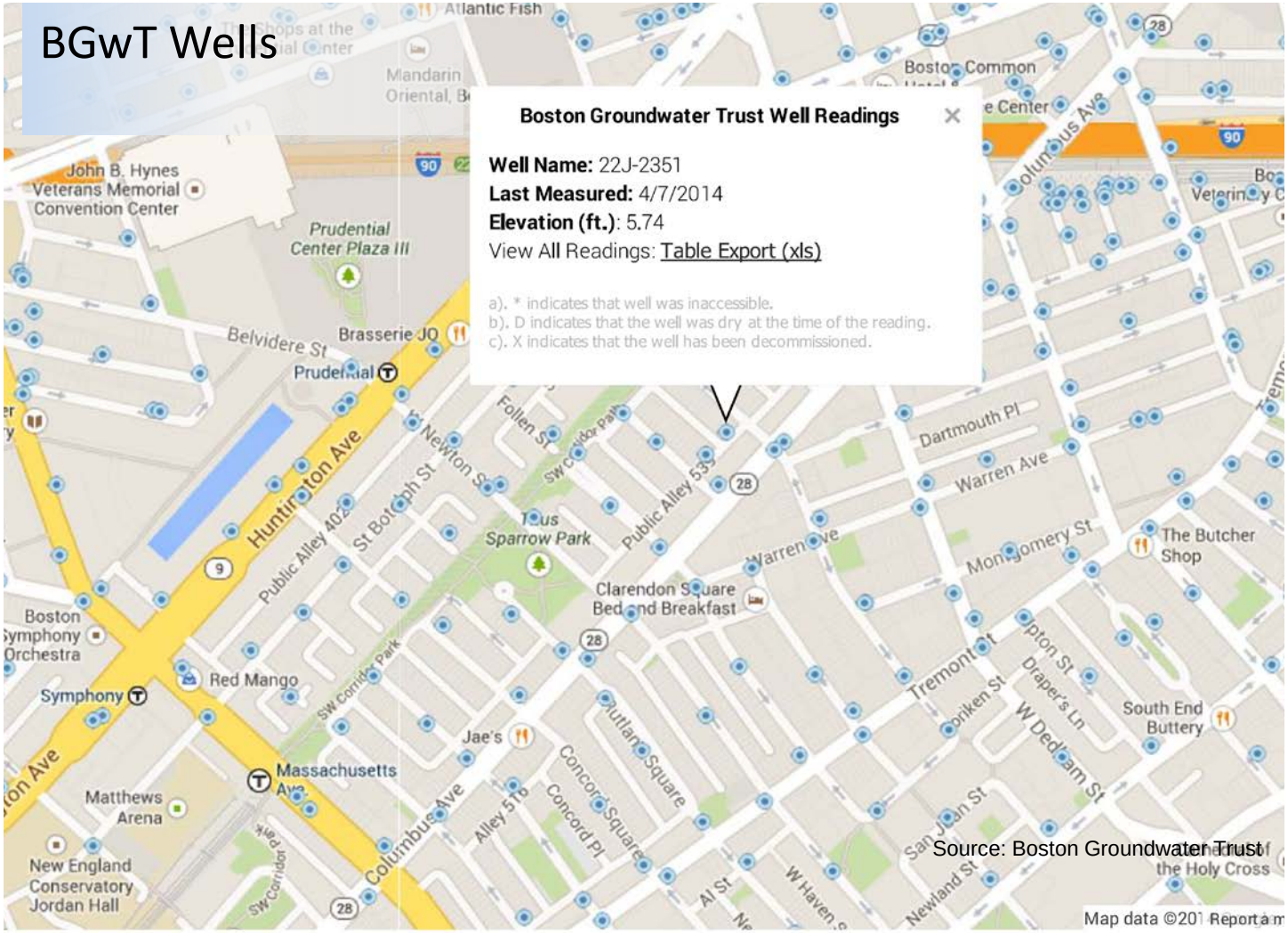
Tight Space Options

- Planters and window boxes
- Green walls (vines/arbors)
- Small Bioretention
- Permeable pavements
- Subsurface stormwater reservoirs


ANN
RICK OVEN PIZZERIA


RICK OVEN PIZZERIA
Loading Zone

Urban suitability?
Boston Porous Alley Demonstration Project



Team: VHB, Charles River Watershed Association,
City of Boston, Boston Groundwater Trust

Site Selection – Not so easy in Boston

Poor Existing Pavement

- Parking
- Basements
- Dumpster Access
- Sediment Control
- Materials Staging
- Safety
- Utilities
- Fine Grading
- Resident Access

Source: VHB, Inc.

Geotechnical Information
Borings and Permeability Information

BGwT — **OBSERVATION WELL INSTALLATION REPORT**

Section: 22J
Well No.: 2346

PROJECT	Summer 2013: 7 Well Installation	PROJECT MGR.	C. Simonelli
LOCATION	North End, Financial District, Fort Point Channel, Back Bay, South End, and Fenway	FIELD REP.	C. Simonelli
CLIENT	BOSTON GROUNDWATER TRUST (BGwT)	DATE INSTALLED	7/15/2013
CONTRACTOR	New Hampshire Boring, Inc.		
DRILLERS	Patrick and Jack		
Ground El. / El. Datum	14.03 ft / BCB	Location	In Alley No. 543, adjacent to 5 Holyoke St.

☐ Guard Pipe
☑ Roadway Box

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL
ASPHALT 0.2	CONCRETE 0.4
BOULDERS/ BRICK/ SANDS	BACKFILL 7.0
	BENTONITE 10.0
SANDS/GRAVELS 12.0	FILTER SAND
GRAVELS 17.0	
GRAVELS 20.0	
GRAVELS 23.0	24.0
ORGANICS 26.0	
(Bottom of Exploration) (Numbers refer to depth from ground surface in feet)	

(Not to Scale)

Type of protective cover/lock	Bolted Cover
Height of top of guard pipe/roadway box above ground surface	0.0 ft
Depth of top of riser pipe below ground surface	0.4 ft
Type of protective casing:	6" Cast Iron Roadway Box
Length	0.8 ft
Inside Diameter	6.0 in
Depth of bottom of guard pipe/roadway box	0.8 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	0.3
Bentonite Seal	7.0	3.0
Bentonite		

Type of riser pipe:	Sch 40 PVC Solid
Inside diameter of riser pipe	2.0 in
Type of backfill around riser	Filter Sand
Diameter of borehole	4.5 in
Depth to top of well screen	14.0 ft
Type of screen	Machine Slotted PVC
Screen gauge or size of openings	0.020 in
Diameter of screen	2.0 in
Type of backfill around screen	Filter Sand
Depth of bottom of well screen	24.0 ft
Bottom of Silt trap	24.3 ft
Depth of bottom of borehole	24.3 ft

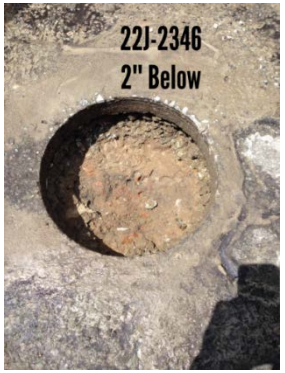
L1 = 14.00 ft (Riser Pay Length) + L2 = 10.0 ft (Length of screen) + L3 = 0.3 ft (Length of silt trap) = 24.30 ft (Pay length)

COMMENTS: Initally vac'ed to a depth of 6'-8" 7/15/2013

SAMPLE #1 (10'-12'): BLOWS/6" = 27 - 18 - 8 - 8

SAMPLE #2 (15'-17'): BLOWS/6" = 34 - 11 - 17 - 12

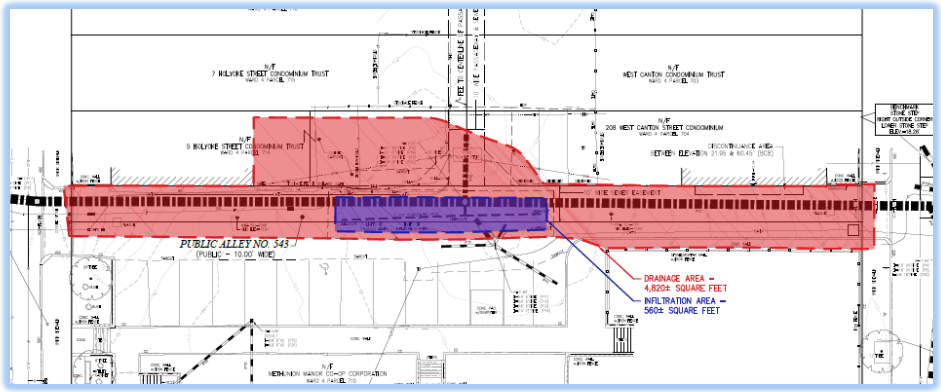
SAMPLE #3 (24'-26'): BLOWS/6" = W.H.- 12" - 1 - 1



Get it EARLY

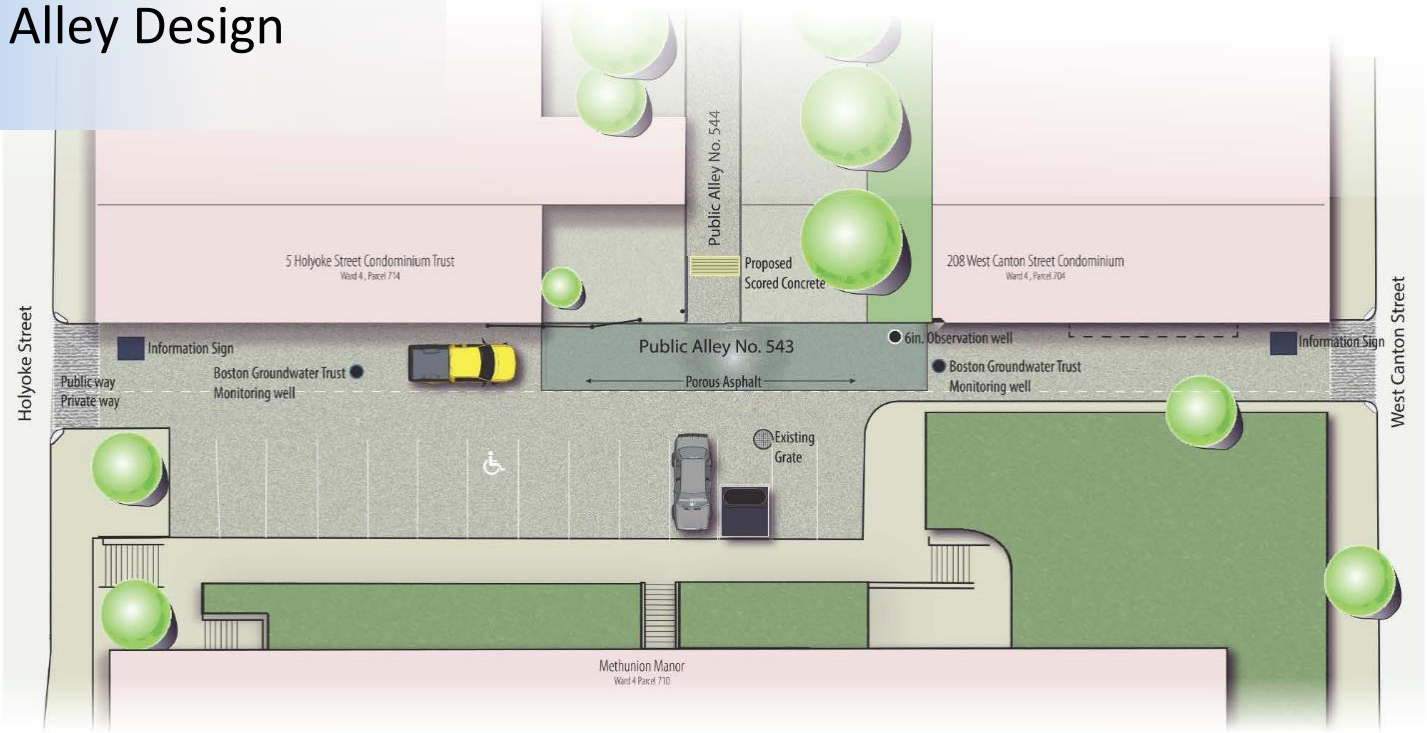
During Preliminary Design Phase
City of Boston & CRWA – Outreach to Community

- **Project Purpose** – reduce CSOs, recharge groundwater, reduce pollutant discharge
- **Project limits** – Porous alley is within the City owned Right of Way.
- **Parking** – City Effectively worked out Alternative parking plans
- **Dumpster** - Temporarily relocated to one end of alley
- **Dust Control** - the contractor was required to complete continual dust control with water during construction
- **Noise** – Construction activities weekdays 7:30 AM to 3 PM
- **Safety** - Contractor responsible for securing the entire site during work and non-work hours



4,820 s.f. drainage Area (100% IC)
560 s.f. permeable pavement section
425 cu.ft. storage
(1,064 cubic feet aggregate reservoir with void ratio of 0.4)

Alley Design



Source: VHB, Inc.

In the City…All about the Utilities

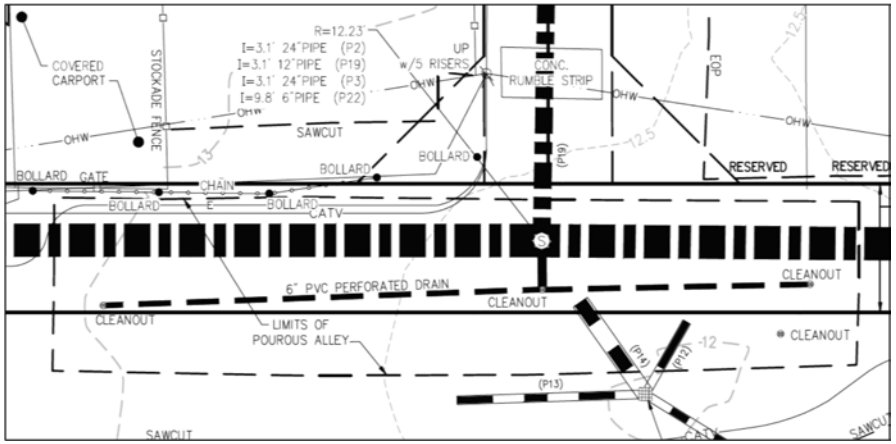
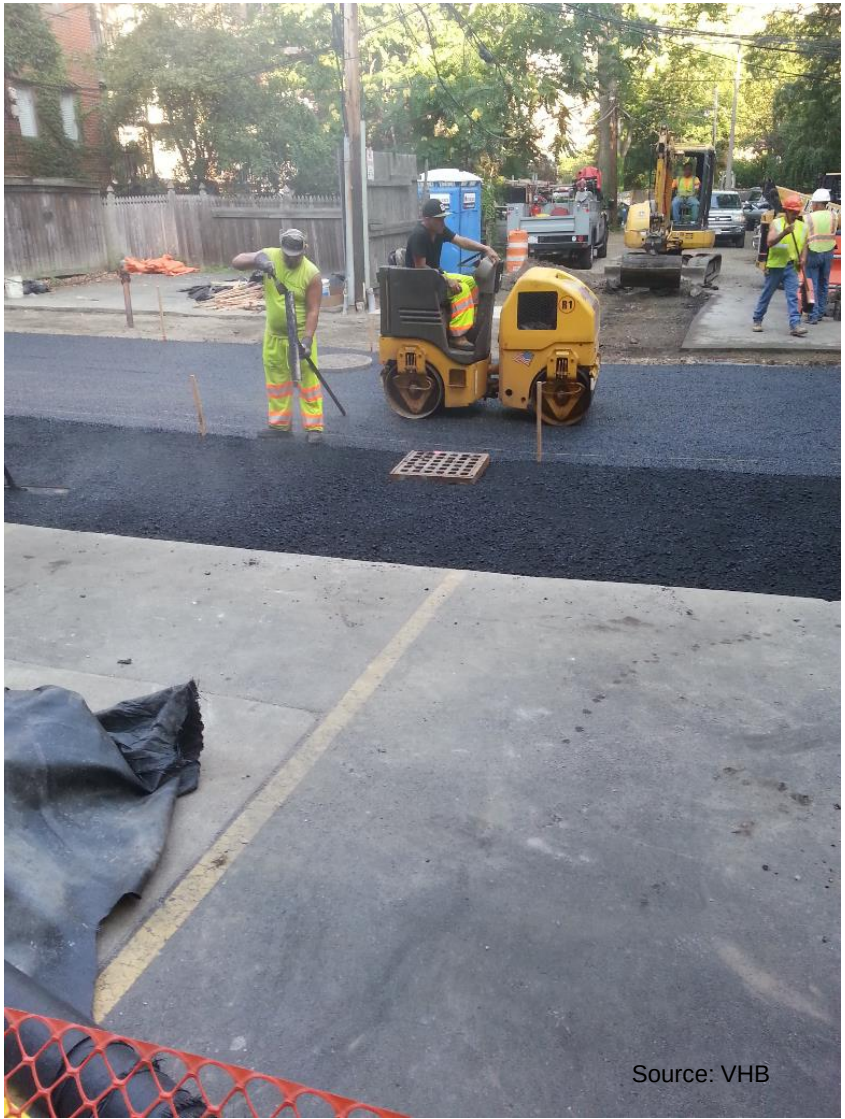


Photo source: Keville

First Lift

Top Lift



Source: VHB

Finish Day

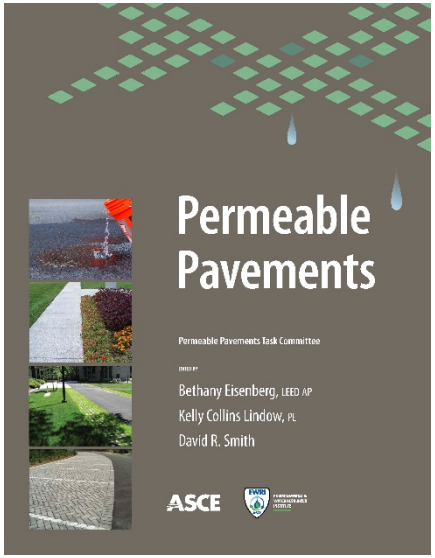
Source: Keville.

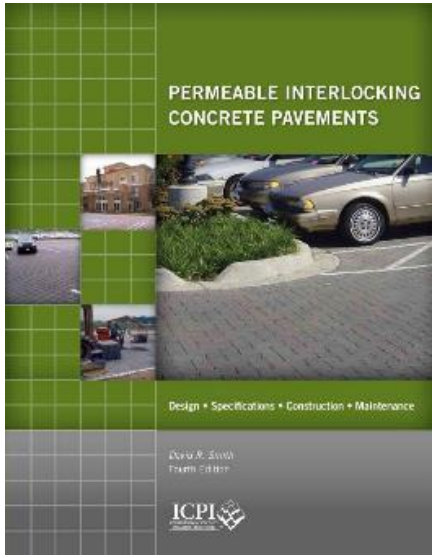
vhb

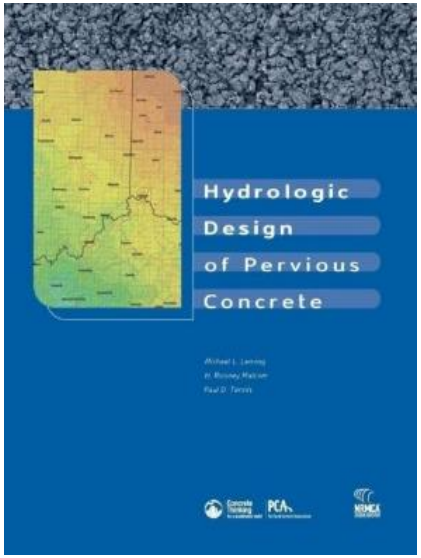
Offices located throughout the east coast

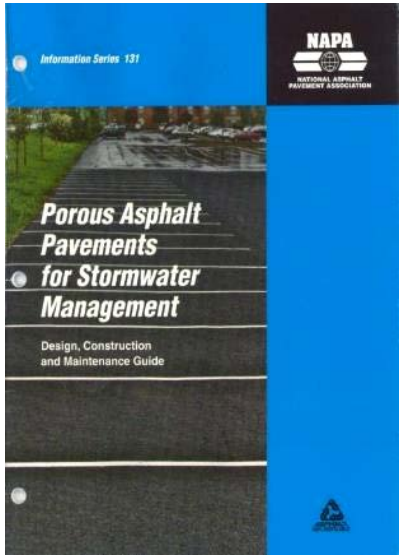
www.vhb.com

Permeable Pavements Book and Design and Construction Resources









vhb

Permeable Pavements Checklist

Recommendations for Permeable Pavement Construction Procedures

1 ☐ **Completed Soils Testing**

☐ a. Verify that soils tests indicated in the specifications have been completed. Note any changes to proposed use, materials or design that may have been made or need to be made as a result of the specified soils tests.

2 ☐ **Conducted Pre-construction Meeting**

☐ a. **As outlined in *Permeable Pavements Checklist: Design Considerations Common to All Permeable Pavements***, confirm that specifications are clear and review each of the items listed below with emphasis in materials testing, avoiding unspecified soil compaction to the subgrade, and proper installation of erosion and sediment control per Best Management Practices.

3 ☐ **Site Inspection Prior to Installation**

☐ a. **Site walk**—Walk through the site with project engineer, geotechnical engineer and builder/ contractor/subcontractor to review erosion and sediment control plan/stormwater pollution

ASCE Environmental Water Resources Institute – Permeable Pavements Technical Committee – Design Manual

- Academic
- Industry
- Private Sector
- Public Sector
- Designers, researchers, users, evaluators, vendors

Fact Sheet Examples

Porous Asphalt Fact Sheet

DESCRIPTIC
Porous asphal
surface underl
course and a r
allow for storm
as well as a str
bed depth is b
and frost dept
systems are us
to facilitate inf
and liner if nec

APPLICATIC

POTENTIAL A	
Overflow Parki	
Primary Parki (most heavily	
Sidewalks/Pat	
Drive/Aisles	
Roads/Highw	
Access Drives	
Loading Area	
Frequent Truc	

*Availability of he

Pervious Concrete Fact Sheet

DESCRIPTION
Pervious concrete consists of a hydraulic cementitious binding system combined with an open-grad
aggregate to produce a rigid, durable pavement. This pavement typically has a 15% to 25% intercon
void space that allows rapid infiltration of stormwater to the underlying soil and/or aggregate storag

Pervious concrete in San Diego County, CA
Source: Andrew Potts, CH2M HILL

Pervious concrete in Seattle, WA
Source: Amy Rowe

APPLICATIONS

POTENTIAL APPLICATION		NOTES
Overflow Parking	Yes	
Primary Parking Areas (most heavily used)	Yes	
Sidewalks/Pathways	Yes	
Drive/Aisles	Yes	
Roads/Highways	Limited	Not yet recommended for highway use in United States
Access Drives/Ring Roads	Yes	
Loading Areas	Limited	Tendency to ravel and deteriorate under turning loads
Frequent Truck Traffic	Limited	Tendency to ravel and deteriorate under turning loads

Grid Pavement Fact Sheet

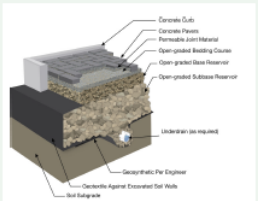
DESCRIPTION
Grid pavements ar
open-celled paving
penetrate their ent
accommodate agg
and plastic grids ar
loading applicatio
over a dense-grade
of grids are often u
and parking/drive l
a natural turf appe
as well as where hi
expected. In some
within the grid ope
base are used with
stormwater storag

APPLICATIONS

POTENTIAL APPLI	
Overflow Parking	
Primary Parking Ar (most heavily used	
Sidewalks/Pathway	
Drive/Aisles	
Roads/Highways	
Access Drives/Ring	
Loading Areas	
Frequent Truck Tra	

Permeable Interlocking Concrete Pavement (PICP) Fact Sheet

DESCRIPTION
Permeable interlocking concrete pavement (PICP) consists of manufactured concrete units that reduce stormwater runoff volume, rate, and pollutants. The impervious units are designed with small permeable joints. The openings typically comprise 5% to 15% of the paver surface area and are filled with highly permeable, small-sized aggregate. The joints allow stormwater to flow into a crushed stone aggregate bedding layer and base/subbase that support the pavers, while providing water storage as well as runoff quantity and quality treatment. PICP is visually attractive, durable, easily repaired, requires low maintenance, and can withstand heavy vehicle loads.



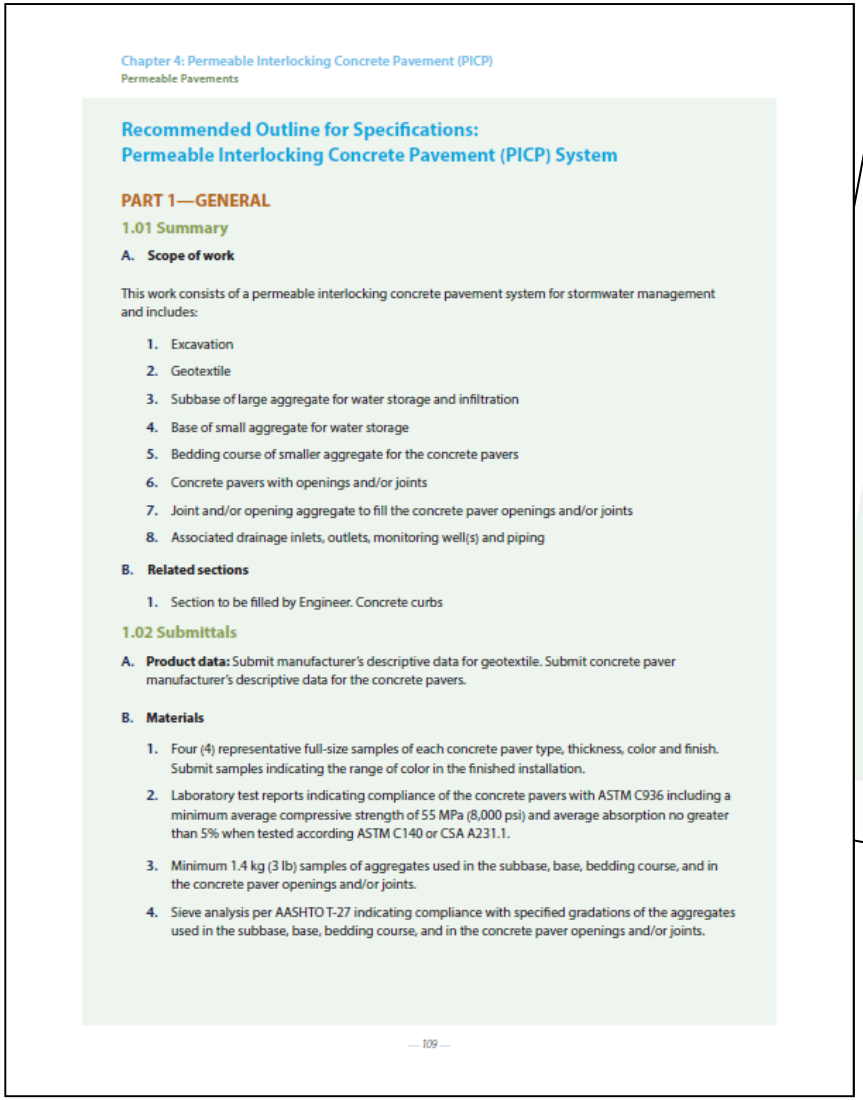
Source: ICPI 2012

APPLICATIONS

POTENTIAL APPLICATION		NOTES
Overflow Parking	Yes	
Primary Parking Areas (most heavily used)	Yes	
Sidewalks/Pathways	Yes	
Drive/Aisles	Yes	
Roads/Highways	Limited	Can be used for shoulders, rest areas, etc. up to design load repetition limitations
Access Drives/Ring Roads	Yes	Up to design load repetition limitations
Loading Areas	Yes	Up to design load repetition limitations
Frequent Truck Traffic	Yes	Up to design load repetition limitations

Source: VHB
Vanasse Hangen Brustlin, Inc. 2014

Chapters 2 to 6: Outlines for Specifications



Recommended Outline for Specifications: Permeable Interlocking Concrete Pavement (PICP) System

PART 1—GENERAL

1.01 Summary

A. Scope of work

This work consists of a permeable interlocking concrete pavement system for stormwater management and includes:

1. Excavation
2. Geotextile
3. Subbase of large aggregate for water storage and infiltration
4. Base of small aggregate for water storage
5. Bedding course of smaller aggregate for the concrete pavers
6. Concrete pavers with openings and/or joints
7. Joint and/or opening aggregate to fill the concrete paver openings and/or joints
8. Associated drainage inlets, outlets, monitoring well(s) and piping

B. Related sections

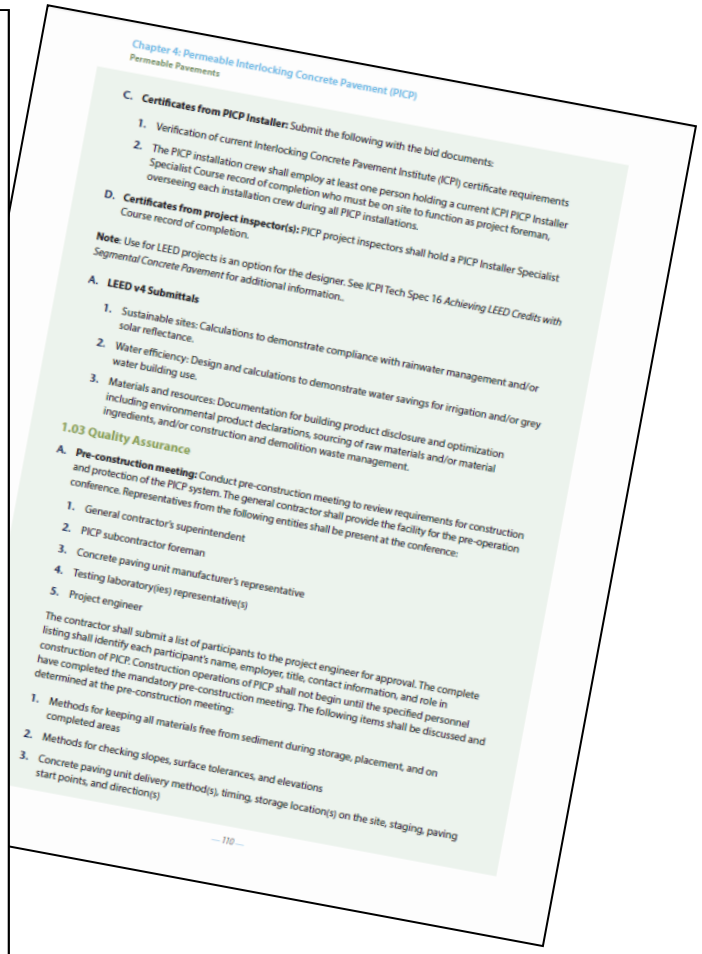
1. Section to be filled by Engineer. Concrete curbs

1.02 Submittals

A. Product data: Submit manufacturer's descriptive data for geotextile. Submit concrete paver manufacturer's descriptive data for the concrete pavers.

B. Materials

1. Four (4) representative full-size samples of each concrete paver type, thickness, color and finish. Submit samples indicating the range of color in the finished installation.
2. Laboratory test reports indicating compliance of the concrete pavers with ASTM C936 including a minimum average compressive strength of 55 MPa (8,000 psi) and average absorption no greater than 5% when tested according ASTM C140 or CSA A231.1.
3. Minimum 1.4 kg (3 lb) samples of aggregates used in the subbase, base, bedding course, and in the concrete paver openings and/or joints.
4. Sieve analysis per AASHTO T-27 indicating compliance with specified gradations of the aggregates used in the subbase, base, bedding course, and in the concrete paver openings and/or joints.



C. Certificates from PICP Installer: Submit the following with the bid documents:

1. Verification of current Interlocking Concrete Pavement Institute (ICPI) certificate requirements
2. The PICP installation crew shall employ at least one person holding a current ICPI PICP Installer Specialist Course record of completion who must be on site to function as project foreman, overseeing each installation crew during all PICP installations.

D. Certificates from project inspector(s): PICP project inspectors shall hold a PICP Installer Specialist Course record of completion.

Note: Use for LEED projects is an option for the designer. See ICPI Tech Spec 16 *Achieving LEED Credits with Segmental Concrete Pavement* for additional information..

A. LEED v4 Submittals

1. Sustainable sites: Calculations to demonstrate compliance with rainwater management and/or solar reflectance.
2. Water efficiency: Design and calculations to demonstrate water savings for irrigation and/or grey water building use.
3. Materials and resources: Documentation for building product disclosure and optimization including environmental product declarations, sourcing of raw materials and/or material ingredients, and/or construction and demolition waste management.

1.03 Quality Assurance

A. Pre-construction meeting: Conduct pre-construction meeting to review requirements for construction and protection of the PICP system. The general contractor shall provide the facility for the pre-operation conference. Representatives from the following entities shall be present at the conference:

1. General contractor's superintendent
2. PICP subcontractor foreman
3. Concrete paving unit manufacturer's representative
4. Testing laboratory(ies) representative(s)
5. Project engineer

The contractor shall submit a list of participants to the project engineer for approval. The complete listing shall identify each participant's name, employer, title, contact information, and role in construction of PICP. Construction operations of PICP shall not begin until the specified personnel have completed the mandatory pre-construction meeting. The following items shall be discussed and determined at the pre-construction meeting:

1. Methods for keeping all materials free from sediment during storage, placement, and on completed areas
2. Methods for checking slopes, surface tolerances, and elevations
3. Concrete paving unit delivery method(s), timing, storage location(s) on the site, staging, paving start points, and direction(s)

Source: VHB
Vanasse Hangen Brustlin, Inc. 2014

Chapter 8: Maintenance Checklists

CHECKLIST 3 ☑

Annual Permeable Pavements Inspection

☐ 1. RUN-ON/TRACK-IN

Check all areas around permeable pavement perimeter for signs of sediment run-on or sediments tracked in from adjacent properties or roads.

☐ **Mitigation action**: Implement mitigation methods appropriate to reduce runoff or tracked in sediments.

☐ 2. VEGETATION/ SOILS/SLOPES

Inspect vegetation around permeable pavement perimeter for coverage, quality and soil stability, especially areas that slope towards the pavement.

☐ **Mitigation action**: Stabilize all soils and replant grass or groundcover as needed. Ground covers are typically preferred over mulch. Replace dead or unhealthy vegetation intended for stabilization. Incorporate compost amendments into soils that will be re-vegetated to assist with moisture retention, germination and/or long-term health. If possible, relocate soil stockpiles to impervious pavements. Otherwise, cover stockpile and place barrier between permeable pavements and stockpiles.

Inspect pavement for presence of unintended vegetation, which can affect infiltration and indicate excess sediment accumulation in voids.

☐ **Mitigation action**: Vegetation should be removed manually. Avoid use of herbicides, which can be transported into unintended environments (e.g., subsoil, groundwater or surface waters via discharge).

Inspect grid pavements for grass coverage, soil or aggregate erosion, scour and unwanted growth.

☐ **Mitigation action**: Replenish lost soil or aggregate. Re-seed bare soil areas as needed. Fertilize grass in the spring and fall. Limit applications if runoff may carry nutrients into nearby waters.

☐ 3. ORGANIC MATTER BUILD UP

Inspect for any excessive build up of organic materials or other debris (fallen tree leaves, mulch from adjacent areas, etc.)

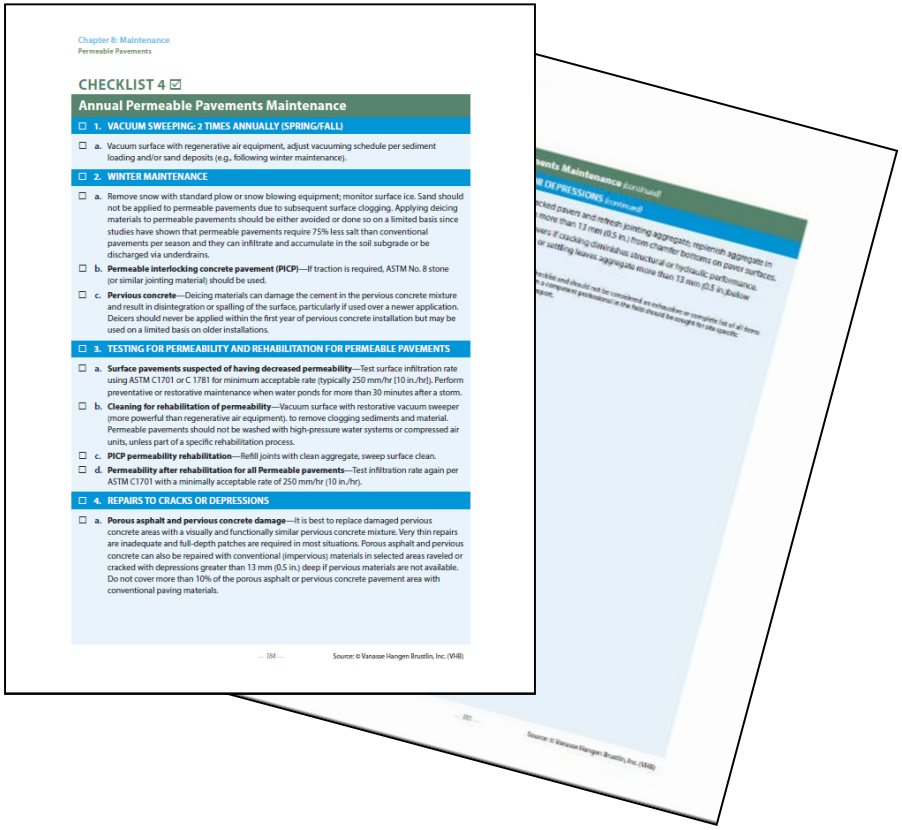
☐ **Mitigation action**: Sweep up affected areas and consider alternative methods of vegetated cover/ mulching, or adjust slopes to reduce pavement buildup.

☐ 4. UNDERDRAINS/OUTFALLS/MONITORING WELLS/CLEAN OUTS

Check that underdrains, outfalls and other flow paths allow for unobstructed water flow . Check monitoring wells (inspection ports) for standing water levels following a major storm.

☐ **Mitigation action**: Address clogged pipes via cleanouts. Clean outfalls and remove any obstructions. Recheck monitoring wells for adequate storage recovery.

*This information is a suggested framework for a checklist and should not be considered an exhaustive or complete list of all items that should be reviewed. Advice and direction from a competent professional in the field should be sought for site specific application of any and all material included in this report.



CHECKLIST 4 ☑

Annual Permeable Pavements Maintenance

☐ 1. VACUUM SWEEPING: 2 TIMES ANNUALLY (SPRING/FALL)

☐ a. Vacuum surface with regenerative air equipment, adjust vacuuming schedule per sediment loading and/or sand deposits (e.g., following winter maintenance).

☐ 2. WINTER MAINTENANCE

☐ a. Remove snow with standard plow or snow blowing equipment; monitor surface ice. Sand should not be applied to permeable pavements due to subsequent surface clogging. Applying deicing materials to permeable pavements should be either avoided or done so on a limited basis since studies have shown that permeable pavements require 75% less salt than conventional pavements per season and they can infiltrate and accumulate in the soil subgrade or be discharged via underdrains.

☐ b. **Permeable interlocking concrete pavement (PICP)**—If traction is required, ASTM No. 8 stone (or similar jointing material) should be used.

☐ c. **Pervious concrete**—Deicing materials can damage the cement in the pervious concrete mixture and result in disintegration or spalling of the surface, particularly if used over a newer application. Deicers should never be applied within the first year of pervious concrete installation but may be used on a limited basis on older installations.

☐ 3. TESTING FOR PERMEABILITY AND REHABILITATION FOR PERMEABLE PAVEMENTS

☐ a. **Surface pavements suspected of having decreased permeability**—Test surface infiltration rate using ASTM C1701 or C 1781 for minimum acceptable rate (typically 250 mm/hr [10 in./hr]). Perform preventative or restorative maintenance when water ponds for more than 30 minutes after a storm.

☐ b. **Cleaning for rehabilitation of permeability**—Vacuum surface with restorative vacuum sweeper (more powerful than regenerative air equipment). to remove clogging sediments and material. Permeable pavements should not be washed with high-pressure water systems or compressed air units, unless part of a specific rehabilitation process.

☐ c. **PICP permeability rehabilitation**—Refill joints with clean aggregate, sweep surface clean.

☐ d. **Permeability after rehabilitation for all Permeable pavements**—Test infiltration rate again per ASTM C1701 with a minimally acceptable rate of 250 mm/hr (10 in./hr).

☐ 4. REPAIRS TO CRACKS OR DEPRESSIONS

☐ a. **Porous asphalt and pervious concrete damage**—It is best to replace damaged pervious concrete areas with a visually and functionally similar pervious concrete mixture. Very thin repairs are inadequate and full-depth patches are required in most situations. Porous asphalt and pervious concrete can also be repaired with conventional (impervious) materials in selected areas raveled or cracked with depressions greater than 13 mm (0.5 in.) deep if pervious materials are not available. Do not cover more than 10% of the porous asphalt or pervious concrete pavement area with conventional paving materials.

Source: VHB
Vanasse Hangen Brustlin, Inc. 2014