### Inspection & Monitoring Plan

<table>
<thead>
<tr>
<th>Distress</th>
<th>Activity</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clogging</td>
<td>Vacuum sweep surface to remove sediment.</td>
<td>Annually (unless increase in sediment loading)</td>
</tr>
<tr>
<td>Clogged/Damaged Secondary Features</td>
<td>Clean out or repair secondary drainage features.</td>
<td>Annually, after major rain event</td>
</tr>
<tr>
<td>Depressions</td>
<td>Repair all paver surface depressions, exceeding 0.5 in.</td>
<td>Annually, repair as needed</td>
</tr>
<tr>
<td>Rutting</td>
<td>Repair all paver surface rutting, exceeding 0.6 in.</td>
<td>Annually, repair as needed</td>
</tr>
<tr>
<td>Faulting</td>
<td>Repair all paver surface faulting, exceeding 0.25 in.</td>
<td>Annually, repair as needed</td>
</tr>
<tr>
<td>Damage Paver Units</td>
<td>Replace medium to high severity cracked, spalled or chipped paver units.</td>
<td>Annually, repair as needed</td>
</tr>
<tr>
<td>Edge Restraint Damage</td>
<td>Repair pavers offset by more than 0.25 in. from adjacent units or curbs, inlets, etc.</td>
<td>Annually, repair as needed</td>
</tr>
<tr>
<td>Excessive Joint Width</td>
<td>Repair pavers exhibiting joint width exceeding 0.4 in.</td>
<td>Annually, repair as needed</td>
</tr>
<tr>
<td>Joint Filler Loss</td>
<td>Replenish aggregate in joints.</td>
<td>As needed</td>
</tr>
<tr>
<td>Horizontal Creep</td>
<td>Repair areas exhibiting horizontal creep exceeding 0.4 in.</td>
<td>Annually, repair as needed</td>
</tr>
<tr>
<td>Additional Distresses</td>
<td>Missing pavers shall be replaced. A geotechnical investigation is recommended for pavement heaves.</td>
<td>Annually, repair as needed</td>
</tr>
</tbody>
</table>
Site Design for Maintenance

Observation wells & cleanouts

Cleanouts for sediment removal

Exposed cap

Site Design for Maintenance

Factors Influencing Maintenance Intervals

#1 clogging factor: Sediment from contributing impervious drainage area

Sediment load from vehicles

Leaves, pine needles, mulch

Slope

Owner willingness to conduct routine surface cleaning that prevents expensive restorative cleaning

Back-up from inadequate drainage
What to Look For

Major sediment source:
Contributing Impervious Areas
Clogging ≠ Sealing

#1 Inspection Tool

Check Drainage

Clogged Drain!
ASTM C1781 Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems

1. Use stopwatch
2. in phone

ASTM C1781

Drain time & surface infiltration rate

Watching paint dry…

<table>
<thead>
<tr>
<th>Seconds to infiltrate 40 lbs (18kg) water</th>
<th>Minutes to Drain</th>
<th>Approximate surface infiltration Rate in./hr (mm/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0.5</td>
<td>1000 (25,400)</td>
</tr>
<tr>
<td>60</td>
<td>1</td>
<td>600 (15,240)</td>
</tr>
<tr>
<td>100</td>
<td>1.7</td>
<td>360 (9,144)</td>
</tr>
<tr>
<td>200</td>
<td>3.3</td>
<td>180 (4,572)</td>
</tr>
<tr>
<td>360</td>
<td>6</td>
<td>100 (2,540)</td>
</tr>
<tr>
<td>450</td>
<td>7.5</td>
<td>80 (2,032)</td>
</tr>
<tr>
<td>900</td>
<td>15</td>
<td>40 (1,016)</td>
</tr>
<tr>
<td>1800</td>
<td>30</td>
<td>20 (508)</td>
</tr>
<tr>
<td>3600</td>
<td>60</td>
<td>10 (254)</td>
</tr>
</tbody>
</table>

Note:

\[ I = \frac{(K \cdot M)}{(D^2 \cdot t)} \]

- I = Surface infiltration rate, in./hr (mm/hr)
- M = water mass, lbs (kg)
- D = ring diameter (12 in. or 300 mm)
- t = time for water to infiltrate in seconds

Okay
Clean before it clogs
Clean NOW
Cleaner Types, Applications & Performance

**Routine Maintenance**
- Removes *loose materials*

Mechanical Sweeper
- Least effective w/o vac
- Vac recommended

**Restorative Maintenance**
- Removes *Stuck sediment*

True vacuum sweeper

Regenerative air vacuum sweeper
- Elgin, Tymco, Schwartze, Stewart-Amos

Mechanical Sweeper – For Routine Cleaning

- Use with vacuum, not just sweeping
Regenerative Air Machine - For Routine Cleaning

Flat pavement surface for best vac performance
USE AT LEAST 2 TIMES/YEAR

True Vacuum Machine - For Restoring Clogged Surfaces
### Badger - For Restoring Clogged Surfaces

Badger – Water & vac
Cleaned out joints & pavers

### Badger Trials in Texas

<table>
<thead>
<tr>
<th>Location</th>
<th>Pre-cleaning Infiltration Rate (in./hr)</th>
<th>Post-cleaning Tymco Regen Air &amp; (dry) infiltration Rate (in./hr)</th>
<th>Post-cleaning Badger True Vacuum Infiltration Rate (in./hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East lot under Crepe Myrtle trees</td>
<td>6.5 (6/26/18)</td>
<td>17 (7/27/18)</td>
<td>381 (8/24/18)</td>
</tr>
<tr>
<td>East lot no tree cover</td>
<td>6.3 (7/27/18)</td>
<td>5 (7/27/18)</td>
<td>507 (8/25/18)</td>
</tr>
</tbody>
</table>
Typhoon - For Restoring Clogged Surfaces

12/3/2018

<table>
<thead>
<tr>
<th>St. Louis PICP Cleaning Trials Industrial Entrance</th>
<th>Pre-cleaning Infiltration Rate (in./hr)</th>
<th>Post-cleaning Typhoon True Vacuum Infiltration Rate (in./hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location 1:</td>
<td>&lt; 60</td>
<td>&gt; 270</td>
</tr>
<tr>
<td>Location 2:</td>
<td>&lt; 30</td>
<td>&gt; 270</td>
</tr>
</tbody>
</table>

Ditch Witch – For Restoring Clogged Surfaces
Ditch Witch

After

Cleaning Sidewalks & Residential Driveways

Billy Goat

Screen under inlet to block entry of small stones

Shop Vac
Utility Cuts & Restoration

Pervious concrete patch

Subgrade backfill:
Compacted DGA

Subbase/Base:
Compacted OGA &/or pervious concrete

PICP reinstatement

Winter Maintenance

• Snow melts faster – lower risk of ice & pedestrian slipping
• Surface does not heave when frozen
• Deicing salts okay – pervious concrete: wait a year
• Sand will clog surface – if used, vac in spring

Avoid

Steel blades scape all pavements
Use plows w/ rubber-edged blades
Maintenance Costs to Avoid the Bad & Ugly

10,000 sf area or larger...
• Vacuuming with a regenerative air machine: $0.02/sf or $800 - $1000/acre
• Rehabilitative/restorative true vac: $0.14/sf or $6,000/acre
• Top up PICP jointing stones & re-compact: $0.09/sf or $4000/acre
• Costs vary with project size, geographic region, labor & aggregates prices

• Modest sample of municipal maintenance costs
• Identifies cities collecting cost data
• Notes USEPA 2014 permeable pavement costs $0.05 to $0.30/sf/yr depending on activity


Free Resources  AEC Daily  https://aecdai.ly/icpi

+PICP Design & PICP Construction
www.icpi.org
Tech Spec Technical Bulletins
#18 PICP Construction
#23 PICP Maintenance

Questions?
dsmith@icpi.org

www.icpi.org
Maintenance Guide for Permeable Interlocking Concrete Pavements

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dsmith@icpi.org