

## Permeable Pavement Facilities and Surfaces

This checklist is intended to highlight items critical to the performance of permeable pavement facilities and surfaces that need to be addressed in the design plans and verified by a City of Seattle (COS) Seattle Public Utilities (SPU) plan reviewer or a designated representative. Some items have detailed requirements that may not be explicitly stated; refer to the Stormwater Flow Control and Water Quality Treatment Technical Requirements Manual (Manual) and the Right-of-Way Improvements Manual (ROWIM) for specifics. Resources and their links are listed at the bottom of this checklist.

Items identified by a **FC** are GSI Engineering Design Feasibility Considerations as discussed in Appendix B of the “Requirements for Green Stormwater Infrastructure to the Maximum Extent Feasible” Director’s Rule that may prevent this technology from being implemented on the project site.

<b>Technology Description</b>
<p>Porous or permeable pavements allow for infiltration of stormwater while providing a stable surface suitable for pedestrian and traffic loads. These pavements contain sufficient void space to infiltrate runoff into the underlying reservoir base course and soil. Pavements include brick, concrete grids, unit pavers, porous asphalt or concrete, and plastic confinement systems with grass or gravel filler. See Figures 4.12, 4.13, and 4.14 of the Manual. Permeable pavement <b>facilities</b> may be designed to take run-on from adjacent impervious areas. Permeable pavement <b>surfaces</b> are designed to only manage the water which falls upon it directly.</p>

### **Infiltration Feasibility Requirements (Manual Volume 3, Section 4.3.4)**

	<b>Review Item</b>
	<b><i>Permeable Pavement Facilities only (infiltration occurs)</i></b>
<b>FC</b>	1. Facility is not within landslide-prone areas as defined by the Regulations for Environmental Critical Areas (SMC 25.09) and shown on the Critical Areas theme of GIS.
<b>FC</b>	2. Facility is not located in areas likely to have excessive sediment contamination (such as areas to be sanded) or high potential for concentrated pollutant spills.
<b>FC</b>	3. For projects located on arterial streets and/or in areas of dense underground infrastructure, the facility is limited to the sidewalk and planting strip area only and only receives sidewalk runoff, unless otherwise approved by SPU.
<b>FC</b>	4. Infiltration is typically not permitted within any of these specified setbacks:
	<ul style="list-style-type: none"> <li>▪ Within the top of steep sloped areas, as defined by the Regulations for Environmental Critical Areas (SMC 25.09) and shown on the Critical Areas theme of GIS, calculated as 10 times the slope rise (to a 500 foot maximum) unless demonstrated as feasible by geotechnical analysis</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Within 5 feet from property lines (excluding the property line abutting ROW)</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Within 5 feet from structure without basement, 10 feet from structure with basement when runoff from &lt; 5,000 square feet of new/replaced impervious area is infiltrated on site</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Within a 1H:1V slope between the bottom edge of an infiltration facility and</li> </ul>

	a building structure when runoff from = 5,000 square feet of new/replaced impervious area is infiltrated on site. The resulting setback is no less than 5 feet from structure without basement, 10 feet from structure with basement.
	<ul style="list-style-type: none"> <li>▪ Within 100 feet of a contaminated site or abandoned landfill</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Within 500 feet of a contaminated site or abandoned landfill for projects where runoff from 5,000 sf or more impervious area will be infiltrated on site, unless analysis and approval by a licensed hydrogeologist is provided.</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Within 10 feet of underground storage tank(s)</li> </ul>
	<ul style="list-style-type: none"> <li>▪ 100 feet of proposed or existing septic systems or drain fields</li> </ul>
<b>FC</b>	5. Minimum vertical separation requirements from the bottom of the facility (lowest elevation of the facility) to the underlying water table, bedrock, other impermeable layer or utility are met based on the following:
	<ul style="list-style-type: none"> <li>▪ A minimum of 3 feet if the area tributary to the facility meets or exceeds any of the following limitations: 5,000 square feet of pollution-generating impervious surface; 10,000 square feet of impervious surface; ¾ acres of lawn and landscaped areas</li> </ul>
	<ul style="list-style-type: none"> <li>▪ A minimum of 1 foot if the above criteria are not exceeded for the area tributary to the facility</li> </ul>
	6. Subsurface Characterization (information documented in the Technical Information Report (TIR) and/or geotechnical report)
	<ul style="list-style-type: none"> <li>▪ For sites with &lt; 5,000 square feet of impervious area to be infiltrated and that have not performed the modified PIT test, the design infiltration rate is assumed to be 0.25 inches per hour</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Design infiltration rate was determined by performing the modified PIT method (described in section 4.3.3 and Appendix E) with correction factors applied</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Test holes or pit explorations were performed during mid to late in the wet season (mid January through April) to provide accurate groundwater elevation information. At least one test pit or hole per 5,000 square feet of contributing area.</li> </ul>
	<ul style="list-style-type: none"> <li>▪ For sites where = 10,000 square feet of impervious area will be infiltrated on site, the infiltration receptor is characterized and groundwater level monitoring has been performed as described in section 4.3.4.6</li> </ul>
<b>FC</b>	<ul style="list-style-type: none"> <li>▪ If native soil infiltration rate as determined by the modified PIT method is less than 0.25 inches per hour, infiltration is not permitted</li> </ul>

**Design Requirements (Manual Volume 3, Section 4.4.2)**

	Review Item
<b>FC</b>	1. ROWIM Requirements (ROWIM Ch. 6.4)
	<ul style="list-style-type: none"> <li>▪ Permeable pavements are located only on non-street surfaces, such as sidewalks, at this time.</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Permeable cement concrete approved in street ROW (sidewalk only at this time and must be at least 2000 sf contiguous or 1 block face, see ROWIM for updates). Required to follow COS specification</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Standard details from ROWIM used</li> </ul>

<b>FC</b>	2. Catchment area
	<ul style="list-style-type: none"> <li>▪ <b>Facility</b> - Catchment area tributary to facility shall be no larger than 3 times the permeable pavement facility area, unless otherwise approved</li> </ul>
	<ul style="list-style-type: none"> <li>▪ <b>Surface</b> – Surfaces cannot receive run-on from an impervious surface greater than 10% of the permeable pavement area</li> </ul>
<b>FC</b>	3. Site Considerations
	<ul style="list-style-type: none"> <li>▪ Slope is less than 5%</li> </ul>
	4. Flow Entrance/Presettling ( <b>Facilities only</b> )
	<ul style="list-style-type: none"> <li>▪ Plan sheet shows flow diversion and erosion control measures that will be installed until the upstream catchment area is thoroughly stabilized to protect the permeable pavement area from sedimentation</li> </ul>
	<ul style="list-style-type: none"> <li>▪ A presettling technique (e.g. variation on filter strip, presettling catch basin or vault) precedes the permeable pavement when the catchment area exceeds 2,000 square feet and flow is concentrated</li> </ul>
	<ul style="list-style-type: none"> <li>▪ If the catchment area for a flow entrance exceeds 1,000 sf and flow is concentrated, plans sheet shows how run-on shall be dispersed to permeable pavement. If subsurface delivery is used, primary settling is required followed by distribution to storage reservoir.</li> </ul>
	5. Sizing
	<ul style="list-style-type: none"> <li>▪ GSI sizing based on Table A.3 for <b>facilities</b> or GSI credit based on Table A.4 for <b>surfaces</b> of the GSI to the MEF Director’s Rule, or if a performance standard must be met the pre-sized approach shown in Table 4.7 or Sidewalk Project DR, as appropriate, was used and all of the following criteria were met:</li> </ul>
	<ul style="list-style-type: none"> <li>□ Project has &lt; 10,000 square feet of new and replaced impervious area</li> </ul>
	<ul style="list-style-type: none"> <li>□ Permeable pavement area was sized (<b>facilities</b>) or credit applied (<b>surfaces</b>) using the applicable sizing factor in Table 4.5, 4.18, or 4.20</li> </ul>
	<ul style="list-style-type: none"> <li>□ <b>Facility</b> – plans show, on average across the facility, the maximum subsurface water ponding depth in the storage reservoir before berm overtopping or overflow is at least 6 and no more than 12 inches. For intermediate ponding depths between 6 and 12 inches, the sizing factor may be interpolated</li> </ul>
	<ul style="list-style-type: none"> <li>□ No underdrain or impermeable liner included in design</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Continuous model was used and all of the following criteria were met:</li> </ul>
	<ul style="list-style-type: none"> <li>□ Assumptions listed in Table 4.19, Table 4.21, or Table 4.22, as appropriate, were used</li> </ul>
	6. Pervious Wearing Course
	<ul style="list-style-type: none"> <li>▪ Materials on the permeable pavement approved technology list (<a href="http://www.seattle.gov/util/greeninfrastructure">http://www.seattle.gov/util/greeninfrastructure</a>)</li> </ul>
	<ul style="list-style-type: none"> <li>▪ There is positive surface drainage, minimum surface slope of 1 percent</li> </ul>
	<ul style="list-style-type: none"> <li>▪ For a vegetated open-celled paving grid, specifications indicate that the topsoil has a minimum 4 percent organic matter by dry weight.</li> </ul>
	<ul style="list-style-type: none"> <li>▪ For a vegetated open-celled paving grid receiving run-on, calculations are provided that show run-on is infiltrated through the wearing course to the storage reservoir without ponding.</li> </ul>
	<ul style="list-style-type: none"> <li>▪ For porous cement concrete, plans specify use of COS specification</li> </ul>

	7. Leveling Course, if required
	<ul style="list-style-type: none"> <li>▪ Often required for open-celled paving grids, interlocking concrete pavers and porous asphalt concrete</li> </ul>
	<ul style="list-style-type: none"> <li>▪ For proprietary products, a leveling course shall be indicated on the plans as indicated per manufacturer recommendations.</li> </ul>
	8. Storage Reservoir Aggregate/Subbase
	<ul style="list-style-type: none"> <li>▪ <b>SFR</b> - a minimum 3-inch depth of aggregate is shown on plans; <b>ROW</b> - a minimum 6-inch depth of aggregate is shown on plans</li> </ul>
	<ul style="list-style-type: none"> <li>▪ For permeable pavement in the ROW (such as driveways), a licensed engineer determined the minimum aggregate base thickness and analyzed subsoil load bearing for the traffic loading.</li> </ul>
	<ul style="list-style-type: none"> <li>▪ <b>Facility</b> - If longitudinal slope &gt; 2%, elements such as check dams or infiltration trenches are included as part of design to create subsurface ponding. If longitudinal slope &lt; 2%, at least one low permeability check dam is shown on plans at the downslope end to contain water in the facility.</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Design shows the maximum ponding elevation below the bottom of the wearing coarse section to prevent it from becoming saturated to minimize risk of damage due to freeze/thaw</li> </ul>
	9. Overflow ( <b>Facilities only</b> )
	<ul style="list-style-type: none"> <li>▪ Shown on drawings unless designed to provide full infiltration and maximum subsurface ponding is demonstrated to be below the bottom of the wearing coarse section or designed as a surface only</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Flows are conveyed to an approved discharge point</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Pipe has appropriate cover and depth, is of sufficient strength, and can be easily maintained. See GSI website for recommended specification.</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Minimum diameter of 6 inches for ROW, 4 inches for Private Property</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Clean out included on plans</li> </ul>
	<ul style="list-style-type: none"> <li>▪ If overflow located at maximum ponding depth, the pipe or daylight invert is shown on plans as located below the bottom of the wearing coarse section</li> </ul>
	10. Underdrain with flow restrictor (optional) ( <b>Facilities only</b> )
	<ul style="list-style-type: none"> <li>▪ Located at bottom of storage reservoir</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Flows are conveyed to an approved discharge point</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Slotted or perforated, thick-walled plastic pipe is used</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Minimum diameter of 6 inches for ROW, 4 inches for Private Property</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Clean out or inspection chamber for underdrain included on plans with clearances per COS Standard Plans 270 and 272A. This requirement may be waived for SFR projects</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Minimum orifice diameter is 0.25 inches</li> </ul>
	11. Non-Woven Geotextile (if required)
	<ul style="list-style-type: none"> <li>▪ Plans specify non-woven geotextile between storage reservoir/aggregate subbase and prepared subgrade (or water quality treatment layer)</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Plans specify non-woven geotextile to wrap up and to the sides of the storage reservoir/aggregate subbase and be secured</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Information is provided to demonstrate that the non-woven geotextile passes water at a greater rate than the design infiltration rate for the existing</li> </ul>

	subgrade soils while at the same time preventing the migration of fines in to the storage reservoir
	<b>12. Water Quality Treatment Layer (optional) (Facilities only)</b>
	<ul style="list-style-type: none"> <li>▪ If designed for water quality treatment, geotechnical report submitted verifying that native underlying soils meet the treatment soil requirements:                     <ul style="list-style-type: none"> <li>□ SSC#1 – the short-term soil infiltration rate (field measured, before correction factor) is not more than 4.0 inches per hour to a depth of 2.5 times the maximum ponding depth, or a minimum of 6 feet below the base of the infiltration facility, whichever is greater. A long-term infiltration rate (design, after correction factor) of up to 2.0 inches per hour may be used as long as the facility is not located within a critical aquifer recharge area and the underlying soil characteristics are documented to be comparable to those specified below in SSC#2</li> <li>□ SSC#2 – The underlying soil to a depth of at least 18 inches has a CEC = 5 meq per 100 g of dry soil and the organic content is at least 1 %</li> <li>□ SSC#3 – Underlying soil is not made up of uncontrolled or non-engineered fill soils and does not contain waste materials</li> </ul> </li> <li>▪ A sand filter may also be added for water quality – see Manual Volume 3, Section 5.9 for requirements</li> </ul>
	<b>13. Native soil/subbase</b>
	<ul style="list-style-type: none"> <li>▪ The correction factor applied to the underlying soil infiltration rate was determined by a geotechnical engineer to account for compaction of the soil during construction</li> <li>▪ The plans show measures to protect the underlying soil from unnecessary compaction and clogging from sediment during construction</li> </ul>
	<b>14. Maintenance</b>
	<ul style="list-style-type: none"> <li>▪ An Operations and Maintenance Plan for all non-single family residential projects is submitted and identifies the responsible parties and their contact information for warranty period inspection reporting.</li> </ul>

**Resources:**

- Green Stormwater Infrastructure (GSI) website (specifications, CADD drawings, plant lists, links to other resources)  
<http://www.seattle.gov/util/greeninfrastructure>
- Seattle Right-of-Way Improvements Manual  
<http://www.seattle.gov/transportation/rowmanual/manual/>
- Stormwater Code, Director’s Rules (Manual and GSI to MEF), Client Assistance Memos (CAMs), GSI and flow control calculators for pre-sized facilities  
<http://www.seattle.gov/dpd/Codes/StormwaterCode/Overview/default.asp>
- Seattle Department of Transportation CAM 2215 “Permeable Pavement in the Right of Way”  
<http://www.seattle.gov/transportation/cams/CAM2215.pdf>