

## LID.08 Bioretention

This checklist reflects most, but not necessarily all of the items that will be reviewed by the Development Review. It is intended to be used as an aid by us to provide a consistent review of development work in Thurston County. All items may not be applicable in the review of each project and all items of concern to this office may not be covered on this checklist.

Y	N	
		<b>MODELING AND SIZING</b>
		<b>Minimum Requirement #5 (List #1 or List #2)</b>
		For compliance with Minimum Requirement #5 (List #1 or #2), the bioretention area has a horizontally projected surface area below the overflow which is at least 5% of the total impervious surface area draining to it.
		<b>Minimum Requirement #5 (Onsite Performance Standard Option), Minimum Requirement #6, and/or Minimum Requirement #7</b>
		For compliance with Minimum Requirement #5 (onsite performance standard component only), Minimum Requirement #6, and/or Minimum Requirement #7, the Western Washington Hydrology Model (WWHM), MGSFlood, or other approved continuous runoff model is used to size the bioretention area.
		For compliance with Minimum Requirement #6, at least 91% of the influent runoff file produced using a continuous simulation model is treated.
		The surface pool drawdown time (surface ponding volume) is not greater than 24 hours (drain time is calculated as a function of ponding depth and native soil design infiltration rate or bioretention soil mix infiltration rate, whichever is less).
		Infiltration rates of the native soil and bioretention soil mix rate are used when sizing and modeling bioretention areas. If using imported bioretention soil, the infiltration rate is 12 inches per hour before the correction factor. Refer to “Bioretention Soil Mix Infiltration Rates” section below for applicable correction factors.
		A computational time step of 15 minutes is used.
		Surface flow and interflow from drainage area are routed to facility.
		If the model does not apply precipitation and evaporation to facility, the facility area is included in the basin area.
		The value entered in the model for bioretention soil depth is at least 18 inches.
		If side slopes of the bioretention area are greater than 3H:1V, no infiltration is applied across the wetted surface. Bottom areas that are non-infiltrating are not included in sizing calculations or hydrologic modeling.
		The overflow elevation is set at the maximum ponding elevation and the overflow is modeled as weir flow over riser edge or a riser notch.
		<b>DESIGN CRITERIA</b>

Y	N	
		<b>Setbacks and Site Constraints</b> (Note: setback distances are measured from the bottom edge of the bioretention soil mix.)
		All bioretention area open water maximum surface elevations are at least 1 foot below the lowest floor elevation of any structures within 25 feet.
		All bioretention areas are a minimum of 10 feet away from any structure or property line, unless approved by the County.
		All bioretention areas are set back at least 50 feet from top of slopes steeper than 20% and greater than 10 feet high.
		All bioretention areas are a minimum of 5 feet from septic tanks and distribution boxes.
		Edge of design water surface is a minimum of 30 feet upgradient/10 feet downgradient of the drainfield primary and reserve areas. This requirement can be waived if site topography will clearly prohibit flows from intersecting the drainfield or where site conditions (soil permeability, distance between systems, etc.) indicate that this is unnecessary.
		Bioretention areas are setback at least 100 feet from drinking water wells and springs used for drinking water supplies.
		Bioretention areas are setback at least 300 feet from an erosion hazard or landslide hazard area (as defined by PCC Title 18E.80) <sup>1</sup> .
		All bioretention areas have at least 3 feet of vertical clearance from the lowest elevation of the bioretention soil (or any underlying gravel layer) to the seasonal high groundwater elevation or other impermeable layer if the area tributary to the facility meets or exceeds any of the following thresholds: <ul style="list-style-type: none"> <li>• 5,000 square feet of pollution-generating impervious surface (PGIS)</li> <li>• 10,000 square feet of impervious area</li> <li>• 0.75 acres of lawn and landscape</li> </ul>
		For bioretention areas with a contributing area less than the above thresholds, a minimum of 1 foot of clearance from seasonal high groundwater or other impermeable layer is provided.
		Water supply wells are identified and protected, and possible impacts of the proposed infiltration facility on groundwater quality are assessed.
		Bioretention soil mix does not contain composted materials if the bioretention area is located within 1/4 mile of phosphorus-sensitive waterbodies and if the underlying native soil does not meet the soil suitability criteria for treatment.

Y	N	
		Bioretention areas with underdrains do not discharge to phosphorus-sensitive receiving waters unless Ecology's <i>Guidance on using new high performance bioretention soil mixes</i> is followed.
		<b>Flow Entrance / Presettling</b>
		One of the following four types of flow entrances is provided: <ol style="list-style-type: none"> <li>1. Dispersed, low velocity flow (less than 1 foot/sec) across a grass or landscape area</li> <li>2. Dispersed flow across pavement or gravel</li> <li>3. Drainage curb cuts for roadside, driveway, or parking lot areas (per Attachment Section A, Detail 26.1)</li> <li>4. Pipe flow entrance that includes rock or other erosion protection, via catch basins or trench drains</li> </ol>
		If concentrated flows are entering the facility, engineered flow dissipation (e.g., rock pad or flow dispersion weir) is incorporated.
		A minimum 2-inch grade change between the edge of a contributing impervious surface and the vegetated flow entrance, or 5% slope from the outer curb face extending to a minimum of 12 inches beyond the back of curb, is provided.
		Woody plants are not located in the entrance to the flow path.
		<b>Ponding Area</b>
		The ponding depth is not greater than 12 inches.
		The freeboard (measured from the invert of the overflow pipe or earthen channel to facility overtopping elevation) is at least 2 inches for drainage areas less than 1,000 square feet and 6 inches for drainage areas 1,000 square feet or greater.
		If berming is used, the slope of the berm is not greater than 3H:1V, and the top width of design berm is at least 1 foot.
		If berming is used, soil used for berming is imported bioretention soil or amended native soil and compacted to a minimum of 90% dry density.
		For sloped bioretention areas, check dams are included.
		<b>Bottom Area and Side Slopes</b>
		The planted side slope is not greater than 3H:1V.
		The bottom width is at least 2 feet.

Y	N																
		Where flush curbs are used, at least 12 inches is provided between the road edge and beginning of the bioretention side slope.															
		Shoulder is compacted to 90% proctor.															
		<b>Overflow</b>															
		The overflow route is sized to convey the 100-year recurrence interval developed peak flow to the downstream conveyance system or other acceptable discharge point without posing a health or safety risk or causing property damage.															
		Overflow is either: <ul style="list-style-type: none"> <li>• A vertical drain pipe installed at the designed maximum ponding elevation and connected to a downstream BMP or an approved discharge point, or</li> <li>• A curb cut at the down-gradient end of the bioretention area to direct overflows back to the street. See also Attachments Section A Detail 26.2</li> <li>• Emergency Overflow Spillway</li> </ul>															
		<b>Bioretention Soil Mix (BSM)</b>															
		The treatment soil is at least 18 inches deep.															
		<b>Compost Requirements</b> <i>Applies to Default and Custom Bioretention Soil Mixes.</i>															
		Meets the definition of “composted material” in WAC 173-350-100 and complies with testing parameters and other standards in WAC 173-350-220.															
		Composed of yard debris, crop residues, or bulking agents originated with a minimum of 65% by volume.															
		Composed of postconsumer food waste originated with a maximum of 35% by volume.															
		Water content: no visible free water or dust is produced when handling the material.															
		Tested in accordance with the U.S. Composting Council “Test Method for the Examination of Compost and Composting” (TMECC).															
		Meets the size gradations established in the U.S. Composting Council’s Seal of Testing Assurance (STA) program: <table border="1"> <thead> <tr> <th></th><th>Min.</th><th>Max.</th></tr> </thead> <tbody> <tr> <td>Percent passing 2"</td><td>100</td><td></td></tr> <tr> <td>Percent passing 1"</td><td>99</td><td>100</td></tr> <tr> <td>Percent passing 0.625"</td><td>90</td><td>100</td></tr> <tr> <td>Percent passing 0.25"</td><td>75</td><td>100</td></tr> </tbody> </table>		Min.	Max.	Percent passing 2"	100		Percent passing 1"	99	100	Percent passing 0.625"	90	100	Percent passing 0.25"	75	100
	Min.	Max.															
Percent passing 2"	100																
Percent passing 1"	99	100															
Percent passing 0.625"	90	100															
Percent passing 0.25"	75	100															

Y	N	
		pH is between 6.0 and 8.5
		“Physical contaminants” (as defined in WAC 173-350-100) content is less than 1% by weight (TMECC 03.08-A) total, and does not exceed 0.25% film plastic by dry weight.
		Manufactured inert material (plastic, concrete, ceramics, metal, etc.) shall be less than 1.0% by weight (TMECC 04.10-A).
		Minimum organic matter content is 40% by dry weight basis (TMECC 04.10-A).
		Soluble salt contents are less than 4.0 dS/m (mmhos/cm) (TMECC 04.10-A).
		Maturity indicators from a cucumber bioassay shall be greater than 80% (TMECC 04.10-A) for both emergence and vigor.
		Stability is 7 mg CO <sub>2</sub> -C/g OM/day or less (TMECC 05.08-B).
		Carbon to nitrogen ratio is than 25:1 (TMECC 05.02A “Carbon to Nitrogen Ratio” which uses TMECC 04.01). A ratio of up to 35:1 may be allowed when only Puget Sound lowland native species are planted, and a ratio of up to 40:1 may be allowed for coarse compost to be used as a surface mulch.
		<b>Default Bioretention Soil Mix</b>
		Compost meets compost requirements above.
		Bioretention soil consists of two parts fine compost (approximately 35–40%) by volume and three parts mineral aggregate (approximately 60–65%), by volume.
		The mixture is well blended to produce a homogeneous mix.
		Mineral aggregate fines are not greater than 5% according to ASTM D422.
		Mineral aggregate is free of wood, waste, coating, or any other deleterious material.
		<p>The aggregate portion of the Bioretention Soil Mix (BSM) is well-graded according to ASTM D 2487-98:</p> <ul style="list-style-type: none"> <li>• Coefficient of Uniformity (<math>C_u = D_{60}/D_{10}</math>) is equal to or greater than 4, <b>and</b></li> <li>• Coefficient of Curve (<math>C_c = (D_{30})^2/D_{60} \times D_{10}</math>) is greater than or equal to 1 and less than or equal to 3.</li> </ul>

Y	N															
		<div>The mineral aggregate is analyzed by an accredited lab using the following sieves and gradation:</div> <table><tr><th>US Sieve Number</th><th>Percent Passing</th></tr><tr><td>0.375 inch</td><td>100</td></tr><tr><td>4</td><td>95-100</td></tr><tr><td>10</td><td>75-90</td></tr><tr><td>40</td><td>24-40</td></tr><tr><td>100</td><td>4-10</td></tr><tr><td>200</td><td>2-5</td></tr></table>	US Sieve Number	Percent Passing	0.375 inch	100	4	95-100	10	75-90	40	24-40	100	4-10	200	2-5
US Sieve Number	Percent Passing															
0.375 inch	100															
4	95-100															
10	75-90															
40	24-40															
100	4-10															
200	2-5															
		Compost is 60–65% mineral aggregate, 35–40% compost.														
		Organic matter content is 5–8% by weight.														
		Cation Exchange Capacity (CEC) is greater than 5 milliequivalents/100 g dry soil. Note: Soil mixes meeting the compost and mineral aggregate ratio and organic matter content specifications do not have to be tested for CEC.														
		Custom Bioretention Soil Mixes														
		Compost meets compost requirements above EXCEPT the gradation specification. An alternative gradation specification indicates the minimum percent passing for a range of similar particles.														
		Cation Exchange Capacity (CEC) is at least 5 milliequivalents /100 grams of dry soil; USEPA 9081														
		pH is between 5.5 and 7.0														
		Organic matter content is 5-8% before and after the saturated hydraulic conductivity test (ASTM D2974)														
		Mineral aggregate fines are between 2-5% passing the US #200 sieve (TMECC 04.11-A)														
		Bioretention Soil Mix Infiltration Rates														
		If using the default bioretention soil mix, the default infiltration rate is 12 inches per hour before a correction factor is applied. After the safety factor is applied, the infiltration rate is either 3 or 6 inches per hour, depending on contributing area (see row 73).														
		If using a custom bioretention soil mix, the measured (initial) infiltration rate is less than 12 inches per hour (ASTM D 2434) at 85% compaction (ASTM D 1557) before a correction factor is applied. The design (long-term) infiltration rate is greater than 1 inch per hour with the correction factor applied (see row 73).														

Y	N	
		<p>An appropriate bioretention soil mix design infiltration rate correction factor is applied:</p> <ul style="list-style-type: none"> <li>• A correction factor of 4 is applied to the initial infiltration rate if contributing area meets the following thresholds: <ul style="list-style-type: none"> <li>○ 10,000 square feet of impervious area, or</li> <li>○ 5,000 square feet of PGIS, or</li> <li>○ 0.75 acres of lawn and landscape</li> </ul> </li> <li>• A correction factor of 2 is applied if contributing area is less than the thresholds above.</li> </ul>
		<b>Underdrain (if included)</b>
		<p>The underdrain is slotted, thick-walled plastic pipe that meets the following specifications:</p> <ul style="list-style-type: none"> <li>• Minimum 4 inches diameter</li> <li>• Slotted subsurface drain PVC per ASTM D1785 SCH 40</li> <li>• Slots should be cut perpendicular to the long axis of the pipe and be 0.04 to 0.069 inches by 1 inch long and be spaced 0.25 inches apart (spaced longitudinally). Slots are arranged in four rows spaced on 45-degree centers and cover one-half of the circumference of the pipe.</li> </ul>
		Underdrain pipe slope is at least 0.5%.
		Pipe is placed in filter material and has a cover depth of at least 4 inches.
		Filter material meets the requirements of WSDOT Standard Specifications 9-03.12(4) (gravel backfill for drains).
		Geotextile fabric is used between the soil layer and underdrain.
		<p>If the bioretention area is used to meet Minimum Requirement #5, the underdrain meets the following additional requirements:</p> <ul style="list-style-type: none"> <li>• The invert of the underdrain is elevated at least 6 inches above the bottom of the aggregate bedding layer.</li> <li>• The distance from the bottom of the bioretention soil mix to the crown of the elevated underdrain pipe is between 6 and 12 inches.</li> <li>• The aggregate bedding layer runs the full length and the full width of the bottom of the bioretention area.</li> <li>• The facility is not underlain by a low permeability liner that prevents infiltration into the native soil.</li> </ul>
		<b>Planting</b>
		The design plans specify that vegetation coverage of selected plants will achieve 90% coverage within 2 years or additional plantings will be provided until this coverage requirement is met.

Y	N	
		For facilities receiving runoff from 5,000 square feet or more impervious surface, plant spacing and plant size is designed to achieve specified coverage by a certified landscape architect.
		Plants are sited according to sun, soil, wind, and moisture requirements.
		Provisions are made for supplemental irrigation for at least the first two growing seasons following installation.
		<b>Mulch Layer</b>
		Compost is provided in the bottom of the bioretention area (wood chip mulch is not to be used in the bottom of the bioretention area).
		Wood chip mulch composed of shredded or chipped hardwood or softwood is provided on the bioretention cell slopes above the ponding elevation and rim area.
		Shredded construction wood debris or shredded wood with added preservatives are not used.
		The mulch layer is free of weed seeds, soil, roots and other material that is not trunk or branch wood and bark.
		The mulch layer is a maximum of 3 inches thick.
		If aggregate mulch is used, the area covered with aggregate mulch does not exceed 1/3 of the facility bottom area.
		<b>Hydraulic Restriction Layer</b>
		A hydraulic restriction layer is provided across the facility if it is necessary to prevent infiltration to underlying soils (e.g., contaminated soils or steep slope areas), or to prevent or restrict lateral infiltration pathways (for bioretention adjacent to roads, foundations or other sensitive infrastructure).
		The hydraulic restriction layer is either: <ul style="list-style-type: none"> <li>• A low permeability (e.g., concrete) container with a closed bottom and underdrain; or</li> <li>• A low permeability material (e.g., clay, geomembrane liner) and underdrain.</li> </ul>
		If a geomembrane liner is used, the liner has a minimum thickness of 30 mils and is ultraviolet (UV) resistant.
		<b>Signage</b>
		Signage is provided for bioretention used to meet Minimum Requirement #6 and/or #7. See Volume V, Appendix V-E.



Y	N	
		<b>CONSTRUCTION CRITERIA</b>
		A soil and vegetation management plan is provided showing areas to be protected and restoration methods for disturbed areas.
		Construction SWPPP outlines construction sequencing that will protect the bioretention area during construction and addresses the inspection requirements outlined below.
		Construction SWPPP BMPs and protection techniques are implemented as applicable. The upslope areas of construction areas are stabilized and overland flow distances are minimized.
		The infiltration area is clearly identified (e.g., using flagging or high visibility fencing) and protected prior to construction.
		Machinery is operated outside of bioretention area during construction. If machinery is operated in the bioretention area for excavation, lightweight, low ground-contact pressure equipment is utilized and the base soil is scarified to a minimum of 12 inches at completion.
		Bioretention area excavated to final grade only after all disturbed areas in the upgradient project drainage area have been permanently stabilized. If bioretention areas must be excavated before permanent site stabilization, initial excavation is conducted to no less than 6 inches of the final elevation of the facility floor.)
		No excavation of bioretention areas during wet or saturated conditions.
		No placement of bioretention soil mix during saturated or during wet conditions.
		Infiltration and interflow pathways are maintained in an unobstructed state during construction and post-construction.
		Clogging and over compaction of the subgrade and bioretention soils is prevented during construction.
		Area is inspected for compaction prior to planting. If compaction occurred during construction, the bioretention soil was aerated prior to planting.
		<b>INSPECTION CRITERIA</b>
		The bioretention area meets applicable design and construction criteria (see Design and Construction Criteria above).
		<b>Verification of Performance by Project Engineer (Engineer of Record)</b>
		Prior to placement of BSM, the subgrade is finished, scarified, and meets the design infiltration rate.
		At least two verification of performance tests were performed prior to the release of the financial guarantee. The type of test was approved by the county prior to testing.

Y	N	
		The County was notified of the scheduled infiltration testing at least 2 working days in advance.
		If tests indicated poor function, the County was informed.
		The bioretention mix was reviewed and certified by the engineer of record prior to submitting to Thurston County's Water Resources Technical Services Group for review, acceptance, and installation.