

Bioretention Cell without Underdrain

This checklist is intended to highlight items critical to the performance of a bioretention system 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. This checklist only addresses bioretention cells without underdrains. Bioretention cells with underdrains are addressed under bioretention planters. 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, which may prevent this technology from being implemented on the project site.

Technology Description
A bioretention cell is a shallow depression with a designed soil mix and plants, with or without an underdrain. See Figures 4.7 and 4.8 of the Manual. Bioretention cells may be connected in series, with the overflows of upstream cells directed to downstream cells.

Infiltration Feasibility Requirements (Manual Volume 3, Section 4.3.4)

	Review Item
FC	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.
FC	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.
FC	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.
FC	4. Infiltration is typically not permitted within any of these specified setbacks:
	<ul style="list-style-type: none"> ▪ 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
	<ul style="list-style-type: none"> ▪ Within 5 feet from property lines (excluding the property line abutting ROW)
	<ul style="list-style-type: none"> ▪ Within 5 feet from structure without basement, 10 feet from structure with basement when runoff from < 5,000 square feet of new/replaced impervious area is infiltrated on site
	<ul style="list-style-type: none"> ▪ Within a 1H:1V slope between the bottom edge of an infiltration facility and 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"> ▪ Within 100 feet of a contaminated site or abandoned landfill

	<ul style="list-style-type: none"> ▪ 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.
	<ul style="list-style-type: none"> ▪ Within 10 feet of underground storage tank(s)
	<ul style="list-style-type: none"> ▪ 100 feet of proposed or existing septic systems or drain fields
FC	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"> ▪ 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
	<ul style="list-style-type: none"> ▪ A minimum of 1 foot if the above criteria are not exceeded for the area tributary to the facility
	6. Subsurface Characterization (information documented in the Technical Information Report (TIR) and/or geotechnical report)
	<ul style="list-style-type: none"> ▪ For sites with < 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
	<ul style="list-style-type: none"> ▪ Design infiltration rate was determined by performing the modified PIT method (described in section 4.3.3 and Appendix E) with correction factors applied
	<ul style="list-style-type: none"> ▪ 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.
	<ul style="list-style-type: none"> ▪ 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
FC	<ul style="list-style-type: none"> ▪ If native soil infiltration rate as determined by the modified PIT method is less than 0.25 inches per hour, infiltration is not permitted

Design Requirements (Manual Volume 3, Section 4.4.1.2)

	Review Item
FC	1. ROWIM Requirements (ROWIM Ch. 6.4)
	<ul style="list-style-type: none"> ▪ Full street ROW NDS concepts allowed only on residential and low volume collector streets
	<ul style="list-style-type: none"> ▪ Street ROW is = 56 feet if full street ROW NDS concepts proposed. NDS full street concept may be allowed on street ROW < 56 feet if schedule allows time for development of design with City.
	<ul style="list-style-type: none"> ▪ Project area is zoned Single Family or L1 if full street ROW NDS concepts proposed. NDS full street concept may be allowed in different zoning areas if schedule allows time for development of design with City.
	<ul style="list-style-type: none"> ▪ Minimum culvert/pipe diameter is 6 inches
	<ul style="list-style-type: none"> ▪ Minimum culvert/pipe slope is 1.0%
	<ul style="list-style-type: none"> ▪ Standard details from ROWIM used

	2. Flow Entrance/Presettling
	<ul style="list-style-type: none"> ▪ If concentrated flows (such as through curb cuts or a culvert) are entering the cell, engineered flow energy dissipation (e.g., rock pad or flow dispersion weir) is incorporated
	<ul style="list-style-type: none"> ▪ A minimum 1-inch grade change between the edge of a contributing impervious surface and the vegetated flow entrance is required
	<ul style="list-style-type: none"> ▪ Plan sheet shows flow diversion and erosion control measures that will be installed until the upstream catchment area is thoroughly stabilized to protect the cell from sedimentation
	<ul style="list-style-type: none"> ▪ A presettling technique (e.g. variation on filter strip, presettling catch basin or vault) precedes the bioretention cell when the catchment area exceeds 2,000 square feet and flow is concentrated
FC	3. Site Considerations
	<ul style="list-style-type: none"> ▪ Slope is less than 7%
	4. Sizing
	<ul style="list-style-type: none"> ▪ GSI sizing based on Table A.3 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 was used and all of the following criteria were met: <ul style="list-style-type: none"> □ Project has < 10,000 square feet of new and replaced impervious area □ Bottom area was sized using the applicable sizing factor in Table 4.5 or 4.14 or 5.16 for water quality treatment only □ Bottom area is flat (0 percent slope) □ No underdrain included □ Side slopes within ponded area are no steeper than 3H:1V □ Imported bioretention soil per COS Soil Standard Specification is specified □ Bioretention soil depth is a minimum of 1.0 foot for flow control only, and 18 inches for water quality treatment □ Minimum ponding depth is set at the designated height (2, 6 or 12 inches). For intermediate ponding depths between 2 and 12 inches the sizing factor may be linearly interpolated. ▪ Continuous model was used and all of the following criteria were met: <ul style="list-style-type: none"> □ Assumptions listed in Table 4.16 were used
	5. Sizing for Bioretention Cell with Detention (additional requirements)
	<ul style="list-style-type: none"> ▪ The criteria under Section 8. Sizing and the criteria below are met: <ul style="list-style-type: none"> □ Contributing area is at least 1,500 square feet □ Bottom area was sized using the applicable sizing equation in Table A.4 of the GSI to the MEF Director's Rule, or if applicable, based on Table 4.15 or 4.14 or 5.16 for water quality treatment only □ The low flow orifice diameter is 0.5 inches □ The invert of the overflow is set at 12 inches above the invert of the low flow orifice
FC	6. Cell Ponding Area
	<ul style="list-style-type: none"> ▪ Maximum ponding depth of 12 inches measured from the top of mulch layer to invert of overflow; 6 inches in high density ROW areas ▪ Maximum surface pool drawdown time of 24 hours

	<ul style="list-style-type: none"> Plans show that the cell bottom shall be scarified 3 inches deep prior to placement of the bioretention soil
	<ul style="list-style-type: none"> Maximum planted side slope is 2.5H:1V. If total cell depth exceeds 3 feet, the maximum planted side slope is 3.0H:1V. If steeper sides are necessary, rockery, concrete walls or steeper soil wraps may be used
	<ul style="list-style-type: none"> Bottom width is at least two feet
	<ul style="list-style-type: none"> Runoff from no more than 5,000 square feet of impervious area enters any single cell. Runoff from more than 5,000 square feet of impervious area may be directed to an interconnected series of cells. For SFR only, runoff from no more than 2,000 sf of impervious area enters any single cell.
	<ul style="list-style-type: none"> Bottom area of each individual cell is no larger than 800 square feet
	<ul style="list-style-type: none"> Minimum freeboard is 2 inches for drainage areas < 1,000 square feet and 6 inches for drainage areas = 1,000 square feet. Freeboard is measured from the invert or rim elevation of the overflow pipe (depending on configuration) or bottom of earthen channel to cell overtopping elevation
	<ul style="list-style-type: none"> Berming is sometimes used to achieve the minimum top cell elevation needed to meet ponding depth and freeboard needs. Maximum slope on berm is 2.5H:1V and maximum top width is 1 foot. Soil specified for berming is imported bioretention soil or amended native soil and compacted to a minimum of 90 percent dry density
	<ul style="list-style-type: none"> Plans show that there are no utility conflicts and that cells located adjacent to power poles have at least a 3-foot flat area around the poles before grading down.
	7. Bioretention Soil
	<ul style="list-style-type: none"> Plans indicate whether using imported bioretention soil per COS Standard Specification or compost amended native soil that meets the requirements of Section 4.4.1.2
	<ul style="list-style-type: none"> Minimum imported or amended soil depth is 12 inches
	<ul style="list-style-type: none"> Minimum imported soil depth is 18 inches for water quality treatment. Compost amended native soil is not approved for water quality treatment
	<ul style="list-style-type: none"> If proposing to amend native soil, geotechnical report demonstrates that native soil aggregate meets COS standard specification or the ponding depth is less than 3 inches and runoff from < 5000 sf impervious area will be infiltrated. For SFR only, for ponding depths of 2 inches or less, some of the native soil is removed and existing native soil amended with compost.
	8. Overflow
	<ul style="list-style-type: none"> Overflow is shown unless designed for full infiltration and surrounding grades slope toward street
	<ul style="list-style-type: none"> It conveys excess flows to approved discharge point
	<ul style="list-style-type: none"> ROW – see minimum pipe size under Section 1 ROWIM Requirements
	<ul style="list-style-type: none"> SFR – minimum pipe size is 4 inches
	9. Plant Materials
	<ul style="list-style-type: none"> Plans specify vegetation coverage of selected plants will be at least 90% within 2 years or additional plantings will be provided to meet 90%; for sites with = 5000 sf of new or replaced impervious surface, the plant size and

	spacing is certified by a landscape architect
	<ul style="list-style-type: none"> ▪ ROW – Plants meet requirements of the approved planting list (see GSI website)
	10. Mulch Layer
	<ul style="list-style-type: none"> ▪ A minimum of 2 inches and a maximum of 3 inches of compost is specified in the bottom of the cells
	<ul style="list-style-type: none"> ▪ A maximum of 4 inches of arborist wood chip mulch composed of shredded or chipped hardwood or softwood on cell slopes above ponding depth
	11. Maintenance
	<ul style="list-style-type: none"> ▪ A Landscape Management Plan for all non-single family residential projects is submitted and identifies the responsible parties and their contact information for warranty period inspection reporting.
	<ul style="list-style-type: none"> ▪ Plans include a note stating that adjacent property owner will provide long-term vegetation maintenance for facility

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>