DPD	Director's Rule 15-2012
SPU	Director's Rule DWW 201.1

Applicant: Dept. of Planning & Development (DPD) Seattle Public Utilities (SPU)	**Page** 1 of 33	**Supersedes:** NA
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Subject: Requirements for Green Stormwater Infrastructure to the Maximum Extent Feasible for Single-Family Residential and Parcel-Based Projects	**Code and Section Reference:** SMC 22.800-22.808	
Index: Title 22.800 – 22.808 Stormwater Code	**Type of Rule:** Code Interpretation	
	Ordinance Authority: SMC 3.06.040 and SMC 3.32.020	
	Approved **Date** /s/ (signature on file) February 25, 2013 Ray Hoffman Director, Seattle Public Utilities	
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Chapter 1 - Introduction

The purpose of this Directors' Rule is to state the City's interpretation of the requirement to implement "green stormwater infrastructure to the maximum extent feasible" (GSI to MEF), and to define steps for evaluating and reporting compliance with this requirement for **Single-Family Residential and Parcel-Based Projects**. According to Seattle Municipal Code (SMC) 22.805.020.F, the following types of projects are required to implement GSI to MEF:

- Any Single-Family Residential (SFR) Project
- All other projects (Parcel-Based, Roadway, Trail, and Sidewalk) with:
    - 7,000 square feet or more of land-disturbing activity, or
    - 2,000 square feet or more of new plus replaced impervious surface.

"Green stormwater infrastructure" means a drainage control facility that uses infiltration, evapotranspiration, or stormwater reuse. Examples of green stormwater infrastructure include permeable pavement, bioretention facilities, and green roofs. (SMC 22.801.080) Although infiltration basins, trenches, and drywells utilize infiltration for flow control, they are not considered green stormwater infrastructure per Section 4.4 of Stormwater Manual Volume 3.

Projects must implement GSI to MEF to infiltrate, disperse, and retain drainage water on site without causing flooding, landslide, or erosion impacts.

In addition to complying with this Directors' Rule, projects must also comply with the standards and requirements presented in the Stormwater Code (SMC 22.800-22.808) and Stormwater Manuals[1]. More detailed design information about GSI is available in Chapter 4 of Directors' Rule 2009-005 SPU / 17-2009 DPD (Stormwater Manual Volume 3).

Definitions relevant to this rule are provided in the Stormwater Code, in Appendix E to this Directors' Rule, and in Appendix A to Stormwater Manual Volume 3.

Note: This Directors' Rule is specific to Single-Family Residential and Parcel-Based Projects. Refer to Directors' Rule DWW-201.2 SPU / 16-2012 DPD for information on Roadway, Trail, and Sidewalk Projects and the GSI to MEF Requirement.

1 Vol. 1 - Source Control Technical Requirements Manual (2009-003 SPU / 15-2009 DPD Directors' Rule)
Vol. 2 - Construction Stormwater Control Technical Requirements Manual (2009-004 SPU / 16-2009 DPD Directors' Rule)
Vol. 3 - Stormwater Flow Control and Water Quality Treatment Technical Requirements Manual (2009-005 SPU / 17-2009 DPD Directors' Rule)
Vol. 4 - Stormwater Code Enforcement Manual (2009-006 SPU / 18-2009 DPD Directors' Rule)

Chapter 2 - GSI to MEF Rule

According to SMC 22.805.020.F, the following types of projects are required to meet the GSI to MEF requirement:

- All Single-Family residential (SFR) projects
- All other projects (Parcel-Based, Roadway, Trail, and Sidewalk[2]) with:
    - 7,000 square feet or more of land-disturbing activity, or
    - 2,000 square feet or more of new plus replaced impervious surface.

The City of Seattle interprets the GSI to MEF requirement (SMC 22.805.020.F) as follows:

- Mitigate the GSI to MEF target, constrained only by the:
    - physical limitations of the site,
    - practical considerations of engineering design, and
    - reasonable considerations of financial costs and environmental impacts.

The GSI to MEF target is defined as follows:

- For Single-Family Residential Projects only, all but 1,500 square feet of new plus replaced impervious surface.
- For all other projects (Parcel-Based, Roadway, Trail, and Sidewalk) requiring GSI to MEF, 100 percent of the new plus replaced impervious surface.

Applicants shall evaluate, select, and calculate sizing for GSI best management practices (BMPs), evaluate and determine feasibility, and provide the required documentation of compliance, all in accordance with this Directors' Rule.

The City recognizes that projects present variable opportunities and constraints and that, due to feasibility limitations, not all projects will be able to mitigate the entire GSI to MEF target. GSI reporting and feasibility analysis as described in this Directors' Rule allows the applicant to meet the GSI to MEF requirement by incorporating GSI to MEF into the project and documenting the specific opportunities and constraints that exist. This Directors' Rule is designed to provide appropriate flexibility for the applicant, with a required process and target to facilitate an evaluation. Ultimately, it is the responsibility of the applicant to use professional judgment and expertise to produce projects that meet the GSI to MEF requirement as explained in this Directors' Rule.

[2] If the total new plus replaced impervious surface **in the roadway** exceeds 5,000 square feet, the entire project is a Roadway Project and all of the requirements of SMC 22.805.060 apply.

Use Table 1 to evaluate GSI BMPs in the order shown. The applicant is solely responsible for selecting, designing, and constructing GSI BMPs that are appropriate to the project, considering all potential impacts on and off the site.

Table 1. Evaluating Green Stormwater Infrastructure BMPs

GSI Evaluation Category		GSI BMPs	Stormwater Manual Vol. 3 Section	
Category	Green Stormwater Infrastructure Type		Flow Control	Water Quality[3]
1	Runoff Reduction Methods	Retain Existing Trees	4.4.2	N/A
		Dispersion	4.4.3 / 4.4.4	N/A
		Plant New Trees	4.4.2	N/A
2	Infiltrating and Reuse Facilities	Bioretention Cells (without underdrain)	4.4.5	5.8.5
		Rainwater Harvesting	4.4.6	N/A
		Permeable Pavement Facilities (with storage reservoir / overflow)	4.4.7	5.8.5
3	Impervious Surface Reduction Methods	Green Roofs	4.4.8	N/A
		Permeable Pavement Surfaces Up to 2% slope	4.4.7	5.8.5
		Permeable Pavement Surfaces 2%-5% slope	4.4.7	NA
		Bioretention Cells (with detention)	4.4.5	NA
4	Non Infiltrating Facilities	Bioretention Planter	4.4.5	5.8.5
		Detention Cisterns for Single-Family Projects [a]	4.6.6	N/A

[a] Detention cisterns are considered green stormwater infrastructure for Single Family Residential Projects only.

The GSI to MEF requirement sizing factors and credits mitigate small storms (e.g., the 1-year recurrence interval storm). The basis for the GSI to MEF requirement sizing factors and credits are provided in Appendix D of this Directors' Rule.

Note: Parcel-Based Projects may be subject to flow control and water quality performance standards in addition to the GSI to MEF requirement. Such projects shall use GSI to MEF to meet the minimum flow control and water quality treatment requirements per SMC 22.805.080.B and SMC 22.805.090.B. Refer to Chapter 7 of this Directors' Rule for more information on evaluating the GSI to MEF requirement with other performance standards.

[3] Note that for Parcel-Based Projects subject to the minimum requirements for water quality treatment, Table 1 identifies GSI BMPs that are also capable of meeting water quality treatment requirements in addition to flow control.

Chapter 3 - GSI to MEF Reporting

For projects required to install GSI to MEF, the applicant shall provide the following with the project application for drainage review and approval:

1. A completed GSI to MEF Requirement Calculator (Appendix A, Figure A.1) or alternatively, calculate and report the impervious surface mitigated using Tables D.1-D.5 in Appendix D to this Directors' Rule.

2. If the GSI to MEF target is not achieved (per Figure A.1), then additional submittal documentation regarding feasibility is required. See Chapters 4 - 6 of this Directors' Rule for additional reporting requirements.

Chapter 4 - Evaluating Feasibility: Engineering Limitations

Engineering design conditions may limit the type and amount of GSI that can be implemented for a project. Appendix B of this Directors' Rule, as well as the Stormwater Manual Volume 3, Sections 4.3 and 4.4, includes examples of engineering limitations to the implementation of GSI. Limitations on the use of GSI are based on the need to protect private and public property, protect infrastructure, and achieve facility effectiveness.

If the applicant determines that including additional GSI is not feasible due to practical engineering design limitations and therefore the project does not meet the GSI to MEF target, then the applicant shall provide, at a minimum in addition to the reporting requirements in Chapter 3, the following additional submittal documentation:

1. A completed GSI to MEF Requirement Feasibility Checklist (see the tables provided in Appendix B)[4] or a narrative description and rationale with substantial evidence sufficient to explain and justify the applicant's conclusion that the proposed GSI mitigation is the maximum extent feasible for the project and that additional GSI is infeasible based on engineering limitations. If the project encounters engineering limitations not specifically identified in Appendix B, the applicant must document the additional engineering limitations that apply in the space provided in the Appendix B checklists, or provide additional supporting documentation.
2. If the project does not achieve the GSI to MEF target and the project application is not signed and stamped by a professional engineer, a signed statement by the applicant certifying that the project design implements GSI to MEF is required

[4] Appendix B of this Directors' Rule summarizes limitations primarily derived from the Stormwater Manual Volume 3 that may limit applicability of each GSI BMP on a site. Refer to the appropriate sections in the Stormwater Manual Volume 3 for more detail on site considerations and for the design requirements for GSI. All sizing provided in this rule and Stormwater Manual Volume 3 assumes that an overflow conveyance system is included in the design.

Chapter 5 - Evaluating Feasibility: Physical Limitations of the Site

Urban environments present demands on space that may limit the type and amount of GSI that can be implemented for a project. Examples of physical site limitations that may restrict use of GSI include, but are not limited to: historical designation, vehicular and pedestrian access, utility conflicts, and usable open space requirements.

If the applicant determines that including additional GSI is not feasible due to physical site limitations and therefore the project does not meet the GSI to MEF target, then the applicant shall provide, at a minimum in addition to the reporting requirements in Chapter 3, the following additional submittal documentation:

1. A completed GSI to MEF Requirement Feasibility Checklist (see the tables provided in Appendix B) or a narrative description and rationale with substantial evidence sufficient to explain and justify the applicant's conclusion that the proposed GSI mitigation is the maximum extent feasible for the project and that additional GSI is infeasible based on physical site limitations. If the project encounters physical site limitations not specifically identified in Appendix B, the applicant must document the additional physical site limitations that apply in the space provided in the Appendix B checklists, or provide additional supporting documentation.
2. If the project does not achieve the GSI to MEF target and the project application is not signed and stamped by a professional engineer, a signed statement by the applicant certifying that the project design implements GSI to MEF is required.

Chapter 6 - Evaluating Feasibility: Financial Costs

The City has identified several project situations where specific GSI BMPs are not considered to be financially feasible. Those situations are included in the GSI to MEF Requirement Feasibility Checklist presented in Appendix B. For other situations, if the applicant determines that including additional GSI to meet the GSI to MEF requirement is not economically feasible using reasonable consideration of financial costs, even when engineering design limitations and physical limitations of the site would allow greater GSI use, then the applicant shall provide, at a minimum in addition to the reporting requirements in Chapter 3, the following additional submittal documentation:

1. A narrative description and rationale with substantial evidence sufficient to explain and justify the applicant's conclusion that the proposed GSI mitigation is the maximum extent feasible and that additional GSI is economically infeasible.

2. A detailed cost estimate of constructing the project as proposed (i.e., including the level of GSI that is considered cost feasible for the project). The detailed cost estimate must include the following:

    - Breakdown of project costs into subtotals for demolition, site preparation, building construction, site paving, landscaping, and utilities, as applicable.
    - Itemization of the proposed GSI measures.
    - If a green roof or permeable pavement would be feasible but for cost considerations, documentation of the difference in unit and total cost between the conventional surface and GSI approach (e.g., the difference in cost between permeable concrete relative to standard concrete).

3. A detailed cost estimate of constructing the project with additional GSI BMPs beyond what the applicant considers a feasible cost (i.e., beyond the proposed design itemized in item 2 above). That is, provide the additional cost the project would incur if the project were to use GSI to meet the GSI to MEF target.

4. Building/project valuation construction cost as determined by DPD.

5. If applicable, Street Improvement Plan or Utility Plan construction cost as determined by SDOT or capital improvement project cost as determined by applicable city department.

6. If the project does not achieve the GSI to MEF target and the project application is not signed and stamped by a professional engineer, a signed statement by the applicant certifying that the project design implements GSI to MEF is required.

Chapter 7 - Evaluating GSI to MEF Requirement with Other Performance Standards

Parcel-Based projects may be subject to flow control and water quality performance standards in addition to the GSI to MEF requirement. Such projects shall use GSI to MEF per SMC 22.805.080.B and SMC 22.805.090.B to meet the minimum flow control and water quality treatment requirements. And, if necessary after applying GSI to MEF, shall use additional non-GSI BMPs to meet the applicable minimum requirements for flow control and water quality treatment performance standards (SMC 22.805.080 and SMC 22.805.090, respectively, and Stormwater Manual Volume 3). A project that meets the GSI to MEF target does not necessarily also meet the applicable performance standards for flow control and water quality treatment.

Note that the GSI to MEF requirement sizing factors and credits for GSI BMPs differ from the sizing factors and credits for flow control and water quality treatment performance standards. Specifically, the GSI to MEF requirement sizing factors and credits in Tables D.1 – D.5 of Appendix D to this Directors' Rule are applicable to all sites subject to the GSI to MEF requirement. In contrast, the sizing factors and credits for flow control and water quality treatment vary depending on a given site's applicable performance standard (e.g., Pre-Developed Forest, Pasture, or Peak Flow Control Standards). See the Stormwater Code and Directors' Rules, including but not limited to Stormwater Manual Volume 3, Sections 2.3 – 2.6.

Appendix A –

Documenting the GSI to MEF Requirement

APPENDIX A: Documenting the GSI to MEF Requirement

The GSI to MEF Requirement Calculator is presented as Figure A.1. Electronic versions are available on the DPD Stormwater Code website. If a project is a Joint Project, separate calculators shall be submitted for the Parcel-Based portion of the project and the Roadway portion of the project.

The applicant shall follow the steps presented below to document whether the GSI to MEF target has been met. These steps are in addition to steps required if other minimum requirements and performance standards apply.

Note that GSI facilities must meet the design considerations and requirements set forth in Stormwater Manual Volume 3. However, the sizing factors for meeting the GSI to MEF requirement (presented in Appendix D) are different from those presented in Volume 3. **Parcel-Based projects must use the appropriate factors and calculators defined in the Stormwater Manual Volume 3 when designing to meet the flow control and water quality treatment performance standards, not those outlined in this GSI to MEF rule**.

Documenting the GSI to MEF Requirement

Step A – Review Table 1 and the GSI to MEF Requirement Calculator (Figure A.1) to identify GSI BMP options for the project site as outlined in the subsequent steps. Use the electronic version of the calculator available on the DPD Stormwater Code website.

Note: Applicants that choose not to use the GSI to MEF calculator shall use the sizing factors and credits in Appendix D, Tables D.1 – D.5, of this Directors' Rule to comply with the GSI to MEF requirement.

Step B – Divide the project area into distinct project types, if applicable (e.g., Sidewalk, Trail, Roadway, Single-Family Residential, Parcel-Based).

Step C – Calculate and report total new plus replaced impervious surface (including permeable pavements) for each project type.

Step D – Check the feasibility of infiltration. See Appendix C and general requirements for infiltration facilities in Chapter 4.3 of Stormwater Manual Volume 3.

Step E – Identify opportunities for GSI Category 1 "GSI Runoff Reduction Methods" (retain existing trees, plant new trees, and dispersion). Note that dispersion is typically not feasible in an urban environment.

For each BMP, use the electronic GSI to MEF Requirement Calculator, or alternatively Table D.1, to calculate and report the

impervious area mitigated as a product of the BMP area and its GSI credit.

Step F – Identify opportunities for GSI Category 2 "Infiltrating and Reuse Facilities" (bioretention cells without underdrain, permeable pavement facilities, rainwater harvesting, and detention cisterns to bioretention cells). Note that detention cisterns are only GSI for Single-Family Residential Projects.

For each BMP, use the electronic GSI to MEF Requirement Calculator, or alternatively Tables D.2 and D.3, to calculate and report the impervious area mitigated with the selected BMPs.

Step G – If there are remaining unmitigated impervious surfaces, identify opportunities for GSI Category 3 "Impervious Surface Reduction Methods" (permeable pavement surfaces, green roofs, and bioretention with detention) followed by GSI Category 4 "non-infiltrating green stormwater infrastructure" (bioretention planter with underdrain, and detention cisterns with harvesting capacity). Note that detention cisterns are only GSI for Single-Family Residential projects.

For each BMP, use the electronic GSI to MEF Requirement Calculator, or alternatively Tables D.4 and D.5, to calculate and report the impervious area mitigated with the selected BMPs.

Step H – Use the electronic version of the GSI to MEF Requirement Calculator, or alternatively Tables D.1 - D.5, to calculate and report the total impervious area mitigated with the selected BMPs.

Step I – If the GSI to MEF target is not met, provide documentation as outlined in Chapters 4 - 6 of this Directors' Rule.

City of Seattle GSI to MEF Requirement Calculator (2012-05-01)

Building Permit No. →
Project Address →
Project Type →
Project Area → sf
New plus Replaced Impervious Area → sf
Area Requiring Mitigation → sf

Runoff Reduction Methods		Facility Size			Credit		Area Mitigated
Retained Trees							
Existing Evergreen	# Trees		Total Canopy Area of Trees	sf x	20% Canopy (or min 100 sf/tree) =		
Existing Deciduous	# Trees		Total Canopy Area of Trees	sf x	10% Canopy (or min 50 sf/tree) =		
New Trees							
New Evergreen			# Trees	x	50 sf/tree =		
New Deciduous			# Trees	x	20 sf/tree =		
					Total Area Mitigated by Trees	=	sf
Dispersion [1]							
Downspout or Sheet Flow Dispersion			Dispersed Impervious Area	sf x	100.0%	=	sf

Infiltration and Reuse Facilities			Facility Size			Sizing Factor		Area Mitigated
Infiltrating Facilities								
Bioretention Cell (without Underdrain)								
1 Contributing Area		sf	Bioretention Bottom Area	sf ÷		Select Project Type	=	sf
Ponding Depth		in						
Design Infiltration Rate		in/hr						
2 Contributing Area		sf	Bioretention Bottom Area	sf ÷		Select Project Type	=	sf
Ponding Depth		in						
Design Infiltration Rate		in/hr						
3 Contributing Area		sf	Bioretention Bottom Area	sf ÷		Select Project Type	=	sf
Ponding Depth		in						
Design Infiltration Rate		in/hr						
Detention Cistern to Bioretention Cell (BC) (without Underdrain) [2]								
Contributing Area		sf	Bioretention Bottom Area	sf ÷		Select Project Type	=	sf
Number Cisterns								
BC Ponding Depth		in						
BC Design Infilt Rate		in/hr						
Permeable Pavement Facility (may receive run-on) [3]								
Contributing Area		sf	Permeable Pavement Area	sf ÷		Enter Contributing Area	=	sf
Ponding Depth [4]		in				Plus Permeable Pavement Facility Area	=	sf
Design Infiltration Rate		in/hr						
Reuse Facilities [1]								
Rainwater Harvesting			Applicant must provide documentation of area mitigated by rainwater harvesting					sf

Impervious Surface Reduction Methods	Facility Size			Credit		Area Mitigated
Alternative Pavement Surfaces						
Permeable Pavement Surface (Subgrade Slope ≤2%)	Permeable Pavement Area	sf x	100.0%	=	sf
Permeable Pavement Surface (Subgrade Slope >2-5%)	Permeable Pavement Area	sf x	55.0%	=	sf
Alternative Roof Surfaces [1]					
Green Roof (Single/Multi-Course / 4" Growth Medium)	Green Roof Area	sf x	55.0%	=	sf
Green Roof (Multi-Course / 8" Growth Medium)	Green Roof Area	sf x	84.0%	=	sf
Partial Infiltration [1]					
Bioretention Cell with Detention (without Underdrain)					
Contributing Area		sf			
Ponding Depth		in	Bioretention Bottom Area	sf	Select Project Type	=	sf
Design Infiltration Rate		in/hr			

Non-Infiltrating Facilities			Facility Size			Credit		Area Mitigated
Non Infiltrating Facilities								
Bioretention Planter (with underdrain)								
Contributing Area		sf						
Ponding Depth		in	Bioretention Bottom Area	sf	÷	Select Project Type	=	sf
Detention Cistern with Harvesting Capacity [5, 6]								
Contributing Area		sf	Min Cistern Area	sf		Select Project Type	=	sf
			Min Live Cistern Volume	gal				

Total Area Mitigated → 0 sf
Area Requiring Mitigation → sf
% Impervious Area Mitigated → %
GSI to MEF Target Achieved? →

Notes:

GSI - Green Stormwater Infrastructure; sf - square feet; in - inch; eqn - equation; BC - bioretention cell
min - minimum; ft - feet; in/hr - inch per hour; gal - gallons; infilt - infiltration

1. Single family residential projects and trail/sidewalk projects are not required to evaluate this BMP.
2. Each above ground cistern must have 6.68 sf minimum bottom area, a 0.25 inch orifice and a minimum of 3 feet of live storage above the orifice. If using two cisterns they must be connected and have only one orifice. Flow from cistern orifice must be routed to bioretention cell.

The area contributing runoff to a facility shall be no larger than 3 times the permeable pavement facility area corresponding to a minimum sizing factor of 33.3%).

4. Average subsurface ponding depth in aggregate storage reservoir.
5. Cistern must be above ground. Cistern area must be rounded up to next commercially available product. Cistern need not have more than 3 feet of live storage volume above orifice.
6. Water collected using the detention cistern may be used for non-potable uses only (e.g., irrigation). For additional uses of harvested water consider the "Rainwater Harvesting" BMP.

This calculator does not provide conveyance flow calculations.
Applicant is responsible to ensure system overflow conveyance is provided per Section 4.2.5 of the Stormwater Manual Volume 3.

Figure A.1. Sample GSI to MEF Requirement Calculator

Appendix B –

GSI to MEF Requirement Feasibility Checklist

APPENDIX B: GSI to MEF Requirement Feasibility Checklist

The intent of this appendix is to help designers and reviewers evaluate feasibility of GSI BMPs in meeting the GSI to MEF requirement for a given site. The City has identified several project situations where specific GSI BMPs are not considered feasible based on engineering, site, or financial constraints, and has included these situations in the feasibility checklist. This checklist contains examples and is not an exclusive list of all possible feasibility limitations.

Applicants shall submit this feasibility checklist (or a narrative that provides the substantive equivalent information as the checklist) with permit applications as part of drainage review and approval if the applicant determines that including the level of GSI necessary to meet the GSI to MEF target is infeasible.

Feasibility shall be based upon practical engineering design limitations, physical limitations of the site, or reasonable considerations of financial costs as identified in the feasibility checklist or narrative. For BMPs selected, the applicant shall also use the information and design requirements presented in Chapter 4 of Stormwater Manual Volume 3.

The applicant is solely responsible for selecting, designing, and constructing GSI BMPs that are appropriate to the project, considering all potential impacts on and off the site.

Table B.1. GSI to MEF Requirement Feasibility Checklist
Category 1: Runoff Reduction Methods

BMP	Feasibility Considerations	Additional information from applicant
Retain Existing Trees	▪ No existing trees in project area. ▪ New and/or replaced ground level impervious surface not proposed within 20 feet of existing tree. ▪ For tree(s) with a diameter greater than or equal to 6", significant grading is unavoidable within the dripline or otherwise does not meet standards (per COS Standard Plans and Specifications) required for retention. ▪ For tree(s) with a diameter between 4-6": significant grading is unavoidable within 5 feet of tree trunk or otherwise does not meet standards (per COS Standard Plans and Specifications) required for retention.	
All Dispersion BMPs	▪ Dispersion evaluation is not required if site is Single-Family Residential Project. ▪ Design cannot accommodate dispersion due to infiltration restrictions and setbacks (identify from list below): 1. Geotechnical evaluation determines infiltration not be used anywhere within project area due to reasonable concerns of erosion, slope failure, or down-gradient flooding (submit a signed and stamped geotechnical report). 2. Project within a landslide hazard area defined by the Regulations for Environmental Critical Areas. 3. Project area in or within 100 feet of a known contaminated site or abandoned landfill.	
Downspout Dispersion - Splash Block	▪ There are no downspouts. ▪ A 50-foot minimum flow path for the dispersion area or a maximum of 700 sf drainage area to any dispersion area is unachievable.	
Downspout Dispersion- Gravel Filled Trench	▪ There are no downspouts. ▪ A minimum 10 ft length of trench for every 700 sf of drainage area followed by 25-foot minimum flow path (or 50-feet above a steep slope) is unachievable.	
Sheet Flow Dispersion	▪ Positive drainage for sheet flow runoff is unachievable. ▪ Dispersion area cannot be graded to have less than a 15% slope. ▪ At least a 10-foot wide vegetation buffer for dispersion of the adjacent 20 feet of impervious surface is unachievable.	
New Trees	▪ Space necessary for the mature height, size, and/or rooting depth for tree planting per the current COS Recommended Tree List is unachievable.	

Table B.2. GSI to MEF Requirement Feasibility Checklist
Category 2: Infiltrating and Reuse Facilities

BMP	Feasibility Consideration	Additional information from applicant
All Infiltrating Facilities (including permeable paving facilities bioretention without impermeable liner, and bioretention with detention.)	▪ Infiltration restrictions and setbacks per Stormwater Manual Vol. 3, Chapter 4.3 must be considered. "Infiltration Feasibility Flowchart" is provided in Appendix C for initial screening purposes. Infiltrating facilities may not be sited within: 1. Landslide prone critical areas 2. Setbacks from steep slope areas 3. 100 feet of a known contaminated site or abandoned landfill 4. Other setbacks presented in the Stormwater Manual Vol. 3 (e.g., setbacks from structures). ▪ The minimum vertical separation of three feet from the facility bottom to the seasonal high groundwater elevation, bedrock, or other impermeable layer cannot be achieved and where the area tributary to the facility to an individual facility meets or exceeds any of the following limitations: 1. 5,000 sf of pollution generating impervious surface (PGIS) 2. 10,000 sf of impervious area 3. 3/4 acres of lawn and landscaped area. ▪ The tributary area to an individual facility does not exceed the area limitations above but the minimum vertical separation of one foot from the facility bottom to the underlying water table, bedrock, or other impermeable layer cannot be achieved. ▪ Geotechnical evaluation determines infiltration not be used anywhere within the project area based on reasonable concerns of erosion, slope failure, or down-gradient flooding (submit a signed and stamped geotechnical report). ▪ Minimum vertical and horizontal clearance from utilities is unachievable as required by utility owner. ▪ Pilot infiltration test (PIT) results demonstrate that the design soil infiltration rate is less than 0.25 inches/hr (testing shall be per Appendix E of Stormwater Manual Vol. 3).	
Bioretention Facilities (without impermeable liner)	▪ Project site cannot accommodate bioretention areas because site's longitudinal surface slopes parallel to bioretention area cannot be graded to less than 7 percent. ▪ The minimum bottom cell width of the bioretention facility cannot be met due to site constraints (e.g. setbacks, planting strip width.) ▪ The minimum 1% fall from the building to the facility and from the facility to the point of connection to the public system is unachievable.	
Permeable Pavement Facilities	▪ Site has high potential for concentrated pollutant spills. ▪ A permeable pavement wearing course of 5 percent or less slope is unachievable. ▪ A contributing tributary of less than 3 times the permeable pavement facility area is unachievable.	

Table B.2. GSI to MEF Requirement Feasibility Checklist
Category 2: Infiltrating and Reuse Facilities (Continued)

BMP	Feasibility Consideration	Additional information from applicant
Rainwater Harvesting	▪ Rainwater harvesting evaluation is not required if project site is one of the following: 1. Single Family Residential Project. 2. Project discharges through a piped component of the public drainage system to a designated receiving water (SMC 22.801.050), and does not discharge to a capacity constrained system. 3. Parcel-Based project with less than 10,000 sf new plus replaced rooftop surface. 4. Non-potable water demand is insufficient to use the harvested rainwater. ▪ Project does not include a roof from which to harvest rainwater.	

Table B.3. GSI to MEF Requirement Feasibility Checklist
Category 3: Impervious Surface Reduction Methods

BMP	Feasibility Consideration	Additional information from applicant
Permeable Pavement Surface	▪ A permeable pavement wearing course of 2 percent or less slope is unachievable and the project includes greater than 5,000 sf of new plus replaced PGIS (Water Quality trigger). Rationale: permeable pavement surfaces with greater than 2 percent slope do not fully meet the treatment standard for water quality. ▪ Site has high potential for concentrated pollutant spills. ▪ A permeable pavement wearing course of 5 percent or less slope is unachievable. ▪ Run-on from an impervious area of 10 percent or less of the permeable pavement surface area is unachievable. ▪ Geotechnical evaluation recommends permeable pavement cannot be used anywhere within the project area due to reasonable concerns of erosion, slope failure, or down-gradient flooding (attach geotechnical report).	
Green Roof	▪ Green roof evaluation is not required if project site is one of the following: 1. Single-Family Residential Project 2. Parcel-Based Project with less than 5,000 sf new plus replaced rooftop surface. 3. Project discharges through a piped component of the public drainage system to a designated receiving water (SMC 22.801.050), and does not discharge to a capacity constrained system. ▪ Roof design has a slope greater than 2.5-inch:12-inch (20%). ▪ Building cannot feasibly be designed to accommodate structural load of green roofs. ▪ Project does not include a roof.	

Table B.3. GSI to MEF Requirement Feasibility Checklist
Category 3: Impervious Surface Reduction Methods (Continued)

BMP	Feasibility Consideration	Additional information from applicant
Bioretention with Detention	▪ Bioretention with detention evaluation is not required if project site is one of the following: 1. Project is a Single-Family Residential Project. 2. Project discharges through a piped component of the public drainage system to a designated receiving water (SMC 22.801.050), and does not discharge to a capacity constrained system. 3. Site does not have runoff concentrated from over 1,500 sf impervious surface. Rationale: for smaller contributing areas, bioretention cells without detention require less area. 4. Does not include new or replaced PGIS areas. (Note: if the project meets criteria 1 and 2 above, but not criteria 3, bioretention with detention evaluation is only required for the new plus replaced PGIS areas if the new plus replaced PGIS is over 1,500 sf.) ▪ Project site cannot accommodate bioretention areas because site's longitudinal surface slopes parallel to bioretention area cannot be graded to less than 7 percent. ▪ The minimum bottom cell width of the bioretention facility cannot be met due to site constraints (e.g. setbacks.)	

Table B.4. GSI to MEF Requirement Feasibility Checklist
Category 4: Non-Infiltrating BMPs

BMP	Feasibility Consideration	Additional information from applicant
Bioretention Planter	▪ Project site cannot accommodate bioretention areas because site's longitudinal surface slope parallel to bioretention area cannot be graded to less than 7 percent. ▪ The minimum bottom cell width of the bioretention facility cannot be met due to site constraints (e.g. setbacks.)	
Detention Cistern for Single-Family Residential Projects	▪ Detention cistern evaluation is not required (or allowed) because site is a Parcel-Based project. ▪ Project site cannot accommodate above ground detention cisterns. Below ground detention cisterns are not considered GSI.	

Appendix C –

Infiltration Feasibility Flowchart

APPENDIX C: Infiltration Feasibility Flowchart

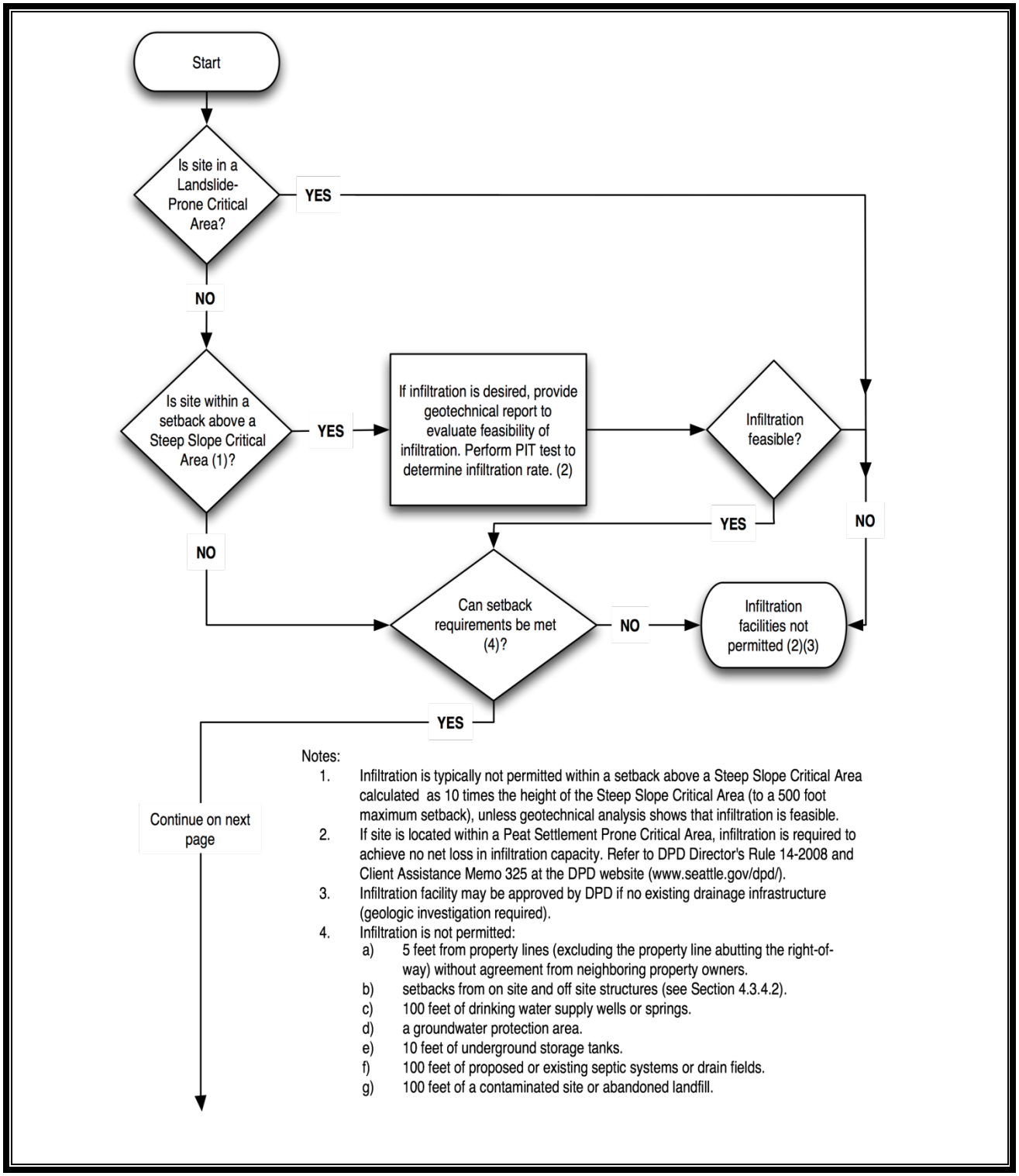

Figure C.1. From the Stormwater Manual Vol. 3, Chapter 4.3: Infiltration Feasibility

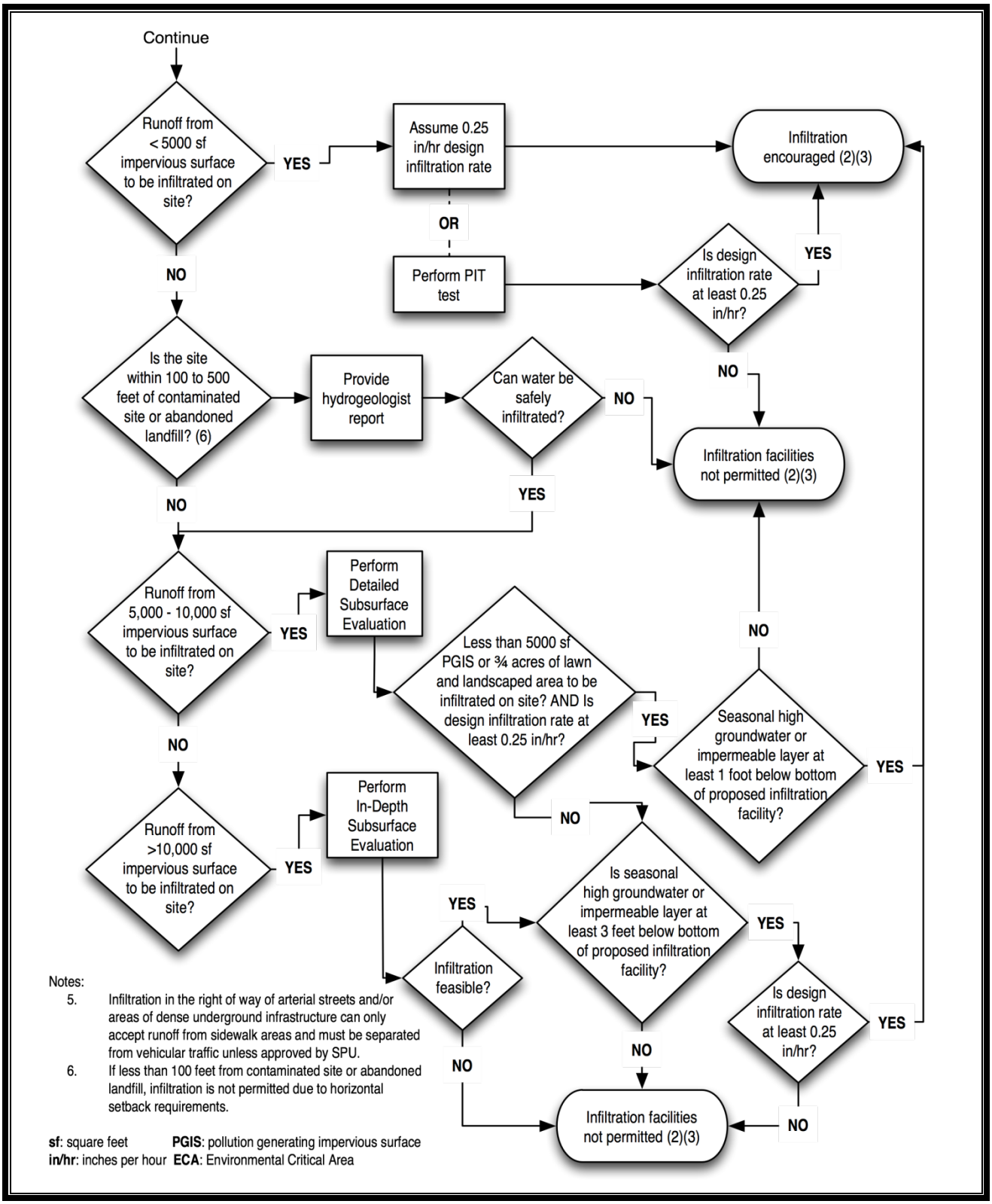

Figure C.2. From the Stormwater Manual Vol. 3, Chapter 4.3: Infiltration Feasibility (continued)

Appendix D –

GSI to MEF Sizing Factors & Credits

APPENDIX D: GSI to MEF Sizing Factors and Credits

The GSI to MEF requirement sizing factors and credits mitigate small storms (e.g., the 1-year recurrence interval storm). The basis for the GSI to MEF requirement sizing factors and credits vary somewhat by GSI BMP as described below:

- Credits for bioretention cells without an underdrain for Single Family Residential Projects are based on infiltrating 95% of the total runoff volume (per Section 6.5.4.6 of the Stormwater Manual Volume 3).
- Credits for bioretention cells without an underdrain (for non-Single Family Residential Projects), permeable pavement facilities, and rainwater harvesting facilities are based on managing 91% of the total stormwater runoff volume (per Section 4.4.6.3 of the Stormwater Manual Volume 3) or infiltrating 91% of the total stormwater runoff volume (per Section 6.5.4.6 of the Stormwater Manual Volume 3).
- Credits for green roofs, dispersion, permeable pavement surfaces, bioretention planters, and bioretention with detention are based on achieving a 91% reduction of the 1-year recurrence interval flow.
- Detention cistern credits (allowed for Single-Family Residential Projects only) are based on achieving a 95% reduction of the 1-year recurrence interval flow.
- Trees credits are as defined in Section 4.4.2.2 of the Stormwater Manual Volume 3.

Based on the sizing factors described above, Tables D.1 – D.5, define the specific factors and credits used in the GSI to MEF Calculator.

Table D.1. GSI to MEF Requirement Credits
Category 1: Runoff Reduction Methods

BMP	Design Variable	Credit (%, or sf) [a]	Volume 3 Section providing Design Requirements
Retained Tree [b, c]	Evergreen	20% canopy area (min 100 sf / tree)	4.4.2
	Deciduous	10% canopy area (min 50 sf / tree)	
New Tree [b, c, d]	Evergreen	50 sf / tree	4.4.2
	Deciduous	20 sf / tree	
Dispersion [e]	Dispersion to compost amended lawn or landscape	100%	4.4.3 and 4.4.4

sf - square feet; % - percent; min - minimum

[a] Impervious area mitigated by a BMP is calculated as: [GSI Credit (%)/100] x [Existing Tree Canopy Area, Number New Trees Planted, or Impervious Area Dispersed].

[b] Trees must be within 20 feet of ground-level impervious surface. The maximum total tree credit is limited as follows:

- If at least one qualifying existing trees is retained then the total tree credit shall not exceed 25 percent of the total new plus replaced impervious surface.
- If no qualifying existing trees are retained, then the total tree credit shall not exceed 25 percent of the impervious area requiring mitigation

[c] GSI to MEF Credits for trees are the same as the credits presented in Section 4.4.2 of the Stormwater Manual Volume 3.

[d] Approved tree species are listed in the City of Seattle Tree List available via link from the SPU GSI website (http://www.seattle.gov/util/greeninfrastructure). Trees in the "small" category are not eligible for GSI to MEF credit. Tree species not included on the City of Seattle Tree List may be given credit with prior approval by the Director.

[e] GSI to MEF Credit for dispersion is based on achieving a 91% reduction of the 1-year recurrence interval flow.

Table D.2. GSI to MEF Requirement Sizing Factors and Credits
Category 2: Infiltrating and Reuse Facilities

BMP	Facility Overflow Depth	Native Soil Design Infiltration Rate (in/hr)	Sizing Factor (% of contributing impervious area)[a]	Credit	Volume 3 Section providing Design Requirements
Bioretention Cell without underdrain [b, c] (Single-Family Projects)	2 inch ponding depth	0.25	12.6%	100%	4.4.5
		0.5	7.8%		
		1.0	4.6%		
	6 inch ponding depth	0.25	7.4%		
		0.5	4.6%		
		1.0	2.8%		
	12 inch ponding depth	0.25	NA		
		0.5	2.8%		
		1.0	1.7%		
Bioretention Cell without underdrain [b, d] (Parcel-Based Projects)	2 inch ponding depth	0.25	9.3%	100%	4.4.5
		0.5	5.7%		
		1.0	3.3%		
	6 inch ponding depth	0.25	5.0%		
		0.5	2.9%		
		1.0	1.6%		
	12 inch ponding depth	0.25	NA		
		0.5	1.7%		
		1.0	0.9%		
Permeable Pavement Facility [d] (may receive run-on)	6 inch storage reservoir depth	0.25	33.3% [e]	100%	4.4.7
		0.5	33.3% [e]		
		1.0	33.3% [e]		
Rainwater Harvesting [f]	Facilities cannot be presized; applicant must provide water balance calculations demonstrating using 91% of the total runoff volume (per Section 4.4.6.3 of the Stormwater Manual Volume 3).			100%	4.4.6

sf – square feet; in/hr – inch per hour; % - percent

[a] BMP area is calculated as a function of impervious area draining to it: BMP Area = Contributing Impervious Area x Factor (%)/100

[b] Sizing factors are for bioretention facility bottom area. Total footprint will be larger and may be calculated by the designer based on total facility depth (ponding depth plus freeboard) and facility side slopes (3H:1V, typical).

[c] GSI to MEF Credits for bioretention cells on Single-Family Residential Projects are based on infiltrating 95% of the total runoff volume.

[d] GSI to MEF Credits for bioretention cells on Parcel-Based Projects and for permeable pavement facilities are based on infiltrating 91% of the total runoff volume (per Section 6.5.4.6 of the Stormwater Manual Volume 3).

[e] GSI to MEF Credits for permeable pavement facilities are 33.3% because the catchment area tributary to a facility is limited to 3 times the permeable pavement facility area.

[f] Evaluation of rainwater harvesting not required for Single-Family Projects.

Table D.3. GSI to MEF Requirement Sizing Factors and Credits
Category 2: Infiltrating and Reuse Facilities

BMP	Contributing Area (sf)	Number of Cisterns [a]	Bioretention Ponding Depth	Native Soil Design Infiltration Rate (in/hr)	Sizing Factor (% of contributing impervious area)[b,c]	Credit [d]
Detention Cistern to Bioretention Cell for Single-Family Projects [e]	200-500	1 cistern	6 inches	0.25	1.2%	100%
				0.5	0.1%	
				1.0	0.1%	
			12 inches	0.25	0.1%	
				0.5	0.1%	
				1.0	0.1%	
		2 cisterns	6 inches	0.25	1.1%	100%
				0.5	0.1%	
				1.0	0.1%	
			12 inches	0.25	0.1%	
				0.5	0.1%	
				1.0	0.1%	
	501-1,000	1 cistern	6 inches	0.25	2.3%	100%
				0.5	0.7%	
				1.0	0.1%	
			12 inches	0.25	0.7%	
				0.5	0.1%	
				1.0	0.1%	
		2 cisterns	6 inches	0.25	2.0%	100%
				0.5	0.5%	
				1.0	0.1%	
			12 inches	0.25	0.5%	
				0.5	0.1%	
				1.0	0.1%	
	1,001-1,500	1 cistern	6 inches	0.25	2.8%	100%
				0.5	1.1%	
				1.0	0.2%	
			12 inches	0.25	1.1%	
				0.5	0.2%	
				1.0	0.1%	
		2 cisterns	6 inches	0.25	2.6%	100%
				0.5	0.9%	
				1.0	0.1%	
			12 inches	0.25	1.0%	
				0.5	0.1%	
				1.0	0.1%	

Footnotes on following page.

Table D.3. GSI to MEF Requirement Sizing Factors and Credits
Category 2: Infiltrating and Reuse Facilities (Continued)

BMP	Contributing Area (sf)	Number of Cisterns [a]	Bioretention Ponding Depth	Native Soil Design Infiltration Rate (in/hr)	Sizing Factor (% of contributing impervious area)[b,c]	Credit [d]
Detention Cistern to Bioretention Cell for Single-Family Projects [e]	1501-2000	1 cistern	6 inches	0.25	3.4%	100%
				0.5	1.6%	
				1.0	0.5%	
			12 inches	0.25	1.5%	
				0.5	0.5%	
				1.0	0.1%	
		2 cisterns	6 inches	0.25	3.1%	100%
				0.5	1.3%	
				1.0	0.3%	
			12 inches	0.25	1.4%	
				0.5	0.3%	
				1.0	0.1%	

sf – square feet; in/hr – inch per hour; % - percent
[a] Each above ground cistern must have 6.68 sf minimum bottom area, a 0.25 inch orifice and a minimum of 3 feet of live storage above the orifice. If using two cisterns they must be connected and have only one orifice. Flow from cistern orifice must be routed to bioretention cell.
[b] Bioretention area is calculated as a function of impervious area draining to it: BMP Area = Contributing Impervious Area x Factor (%)/100
[c] Sizing factors are for bioretention facility bottom area. Total footprint will be larger and may be calculated by the designer based on total facility depth (ponding depth plus freeboard) and facility side slopes (3H:1V, typical).
[d] GSI Credits are based on infiltrating 95% of the total runoff volume (per Section 6.5.4.6 of the Stormwater Manual Volume 3).
[e] GSI to MEF credit for above ground detention cisterns not allowed for Parcel Projects.

Table D.4. GSI to MEF Requirement Sizing Equations and Credits
Category 3: Impervious Surface Reduction Methods

BMP	Design Variable	Sizing Equation (% of contributing impervious area) [a]	Credit (%) [b, c]	Volume 3 Section providing Design Requirements
Permeable Pavement Surface (may not receive run-on)	Slope less than or equal to 2%	NA	100%	4.4.7
	Slope > 2%-5%	NA	55%	
Green Roofs [d]	4 inch depth growing medium	NA	55%	4.4.8
	8 inch depth growing medium	NA	84%	
Bioretention with Detention	0.25 in/hr	[0.0382xA] + 199	81%	4.4.5
	0.5 in/hr	[0.0297xA] + 129	81%	
	1.0 in/hr	[0.0208xA] + 97	81%	

sf – square feet; %-percent.
[a] Sizing factors are for bioretention facility bottom area.
[b] Impervious area mitigated by a BMP is calculated as: [GSI Credit (%)/100] x [Permeable Pavement Surface Area or Green Roof Area or impervious area directed to bioretention with detention]
[c] GSI to MEF Credits for impervious surface reduction methods are based on achieving a 91% reduction of the 1-year recurrence interval flow.
[d] Evaluation for green roof not required for Single-Family Projects.

Table D.5. GSI to MEF Requirement Sizing Factors and Credits
Category 4: Non-Infiltrating Facilities

BMP	Design Variable	Sizing Factor/Sizing Equation (% of contributing impervious area)[a]	Credit (%)[b]	Volume 3 Section providing Design Requirements
Bioretention Planter with Underdrain [c]	6 inch ponding depth	2.6%	46%	4.4.5
	12 inch ponding depth	2.0%	56%	
Detention Cistern for Single-Family Projects [d, f]	Contributing area 150-317 sf	6.7 sf [e]	59%	4.6.6
	Contributing area 317-399 sf	2.4%	64%	
	Contributing area 400-499 sf	2.7%	69%	
	Contributing area 500-599 sf	3.0%	73%	
	Contributing area 600-699 sf	3.3%	76%	
	Contributing area 700-799 sf	3.6%	79%	
	Contributing area 800-899 sf	3.8%	81%	
	Contributing area 900-999 sf	4.1%	83%	
	Contributing area 1,000-1,099 sf	4.3%	85%	
	Contributing area 1,100-1,199 sf	4.5%	87%	
	Contributing area 1,200-1,299 sf	4.7%	89%	
	Contributing area 1,300-1,399 sf	4.9%	90%	
	Contributing area 1,400-1,499 sf	5.1%	92%	
	Contributing area 1,500-1,599 sf	5.3%	93%	
	Contributing area 1,600-1,699 sf	5.5%	95%	
	Contributing area 1,700-1,799 sf	5.7%	96%	
	Contributing area 1,800-1,899 sf	5.8%	97%	
	Contributing area 1,900-1999 sf	6.0%	98%	
	Contributing area ≥2,000 sf	0.0008 x [A^1.57] (in square feet)	([0.212 x LN(A)] - 0.63) x 100 (as percent)	

sf – square feet; in/hr – inch per hour; % - percent; A – Contributing Area (sf); LN – natural log

[a] BMP bottom area is calculated as a function of impervious area draining to it: Bioretention Planter Area (square feet) = Contributing Impervious Area x Sizing Factor (%)/100 or Detention Cistern Area (square feet) = Factor x [A (square feet) ^Integer].

[b] Impervious area mitigated by a BMP is calculated as: [GSI Credit (%)/100] x [Impervious Area directed to Bioretention Planter]

[c] GSI to MEF Credits for bioretention planter with underdrain are based on achieving a 91% reduction of the 1-year recurrence interval flow.

[d] GSI to MEF Credits for above ground detention cisterns are based on achieving a 95% reduction of the 1-year recurrence interval flow.

[e] Instead of a sizing factor, a total cistern bottom area of 6.7 square feet must be used. This is a standard size for manufactured cisterns readily-available in the Seattle area.

[f] GSI to MEF credit for above ground detention cisterns not allowed for Parcel-Based Projects.

Appendix E –

Definitions

APPENDIX E: Definitions

The following definitions are relevant to this Directors' Rule. Additional definitions are contained in Chapter 22.801 of the Stormwater Code, and in Appendix A to Stormwater Manual Volume 3.

- "Green stormwater infrastructure" means a drainage control facility that uses infiltration, evapotranspiration, or stormwater reuse. Examples of green stormwater infrastructure include permeable pavement, bioretention facilities, and green roofs. (SMC 22.801.080) Although infiltration basins, trenches, and drywells utilize infiltration for flow control, they are not considered green stormwater infrastructure.
- "GSI to MEF requirement" means the SMC 22.805.020.F requirement, interpreted as follows:
    - Mitigate the GSI to MEF target, constrained only by the:
        - physical limitations of the site,
        - practical considerations of engineering design, and
        - reasonable considerations of financial costs and environmental impacts.
- "GSI to MEF target" is defined as follows:
    - For Single-Family Residential Projects only, all but 1,500 square feet of new plus replaced impervious surface.
    - For all other projects (Parcel-Based, Roadway, Trail, and Sidewalk) requiring GSI to MEF, 100 percent of the new plus replaced impervious surface.
- "Impervious surface" means any surface exposed to rainwater from which most water runs off. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, formal planters, parking lots or storage areas, concrete or asphalt paving, permeable paving, gravel surfaces subjected to vehicular traffic, compact gravel, packed earthen materials, and oiled macadam or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces for the purposes of determining whether the thresholds for application of minimum requirements are exceeded. Open, uncovered retention/detention facilities shall be considered impervious surfaces for purposes of stormwater modeling (SMC 22.801.100).
- "Joint Project" means a project that is both a Parcel-Based Project and a Roadway Project (SMC 22.01.110).

- "Maximum extent feasible" means the requirement is to be fully implemented, constrained only by the physical limitations of the site, practical considerations of engineering design, and reasonable considerations of financial costs and environmental impacts. (SMC 22.801.140).
- "Parcel-Based Project" means any project that is not a Roadway Project, Single-Family Residential Project, Sidewalk Project, or Trail Project (SMC 22.801.170).
- "Single-Family Residential Project" means a project, that constructs one Single-family Dwelling Unit per Section 23.44.006.A located in land classified as being Single-family Residential 9,600 (SF 9600), Single-family Residential 7,200 (SF 7200), or Single-family Residential 5,000 (SF 5000) per Section 23.30.010, and the total new plus replaced impervious surface is less than 10,000 square feet and the total new plus replaced pollution-generating impervious surface is less than 5,000 square feet(SMC 22.801.200).