Directors' Rules
for
Seattle Municipal Code, Chapters 22.800 – 22.808

Stormwater Code

Requirements for Green Stormwater Infrastructure to the Maximum Extent Feasible for Roadway, Trail, and Sidewalk Projects

Directors' Rule:
DWW-201.2 (SPU) / 16-2011 (DPD)

City of Seattle
Seattle Public Utilities
Department of Planning and Development

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	Ray Hoffman Director, Seattle Public Utilities	
	Approved **Date**	
	Diane M. Sugimura Director, Planning & Development	

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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 **Roadway, Trail, and Sidewalk 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
- Any project with 7,000 square feet or more of land-disturbing activity
- Any project with 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.

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-.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). The provisions of this rule are adopted after considering the best available science set out in Clerk's File 310134.

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

Note: This Directors' Rule is specific to Roadway, Trail, and Sidewalk Projects. Refer to Directors' Rule SPU 2009-007 SPU / 19-2009 DPD for information on Single-Family Residential and Parcel-Based 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

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

- For Single-Family Residential Projects only, mitigate the GSI to MEF target of all but 1,500 square feet of new plus replaced impervious surface using GSI, constrained only by the physical limitations of the site, practical considerations of engineering design, and reasonable considerations of financial costs and environmental impacts.
- For all other projects requiring GSI, to MEF, mitigate the GSI to MEF target of 100 percent of the new plus replaced impervious surface using GSI, constrained only by the physical limitations of the site, practical considerations of engineering design, and reasonable considerations of financial costs and environmental impacts.

Projects 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 achieve the GSI to MEF target. GSI reporting and feasibility analysis as described in this Directors' Rule is intended to allow 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 that 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.

Projects shall use the sizing factors and credits in Appendix A, Tables A.1 – A.4, of this Directors' Rule to comply with the GSI to MEF requirement. Documentation required to confirm that the GSI to MEF requirement is met is outlined in Chapter 3, GSI to MEF Reporting, and in Appendix A of this Directors' Rule.

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 provided in Appendix A varies somewhat by GSI BMP as described below:

- 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 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.

Note: Roadway projects may be subject to numerical 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. Refer to Chapter 7 for more information on evaluating the GSI to MEF requirement with other performance standards.

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[2]:

1. A completed GSI to MEF Requirement Calculator (Appendix A, Figure A.1).

2. If the GSI to MEF target is not achieved (per Figure A.1), then additional submittal documentation regarding feasibility is required. The feasibility documentation shall provide substantial evidence sufficient to explain and justify the applicant's conclusion that including additional GSI in the project design is not feasible based on the physical limitations of the site, practical considerations of engineering design, and reasonable considerations of financial costs and environmental impacts. See Chapters 4-6 for additional reporting requirements.

3. If the GSI to MEF target is not achieved 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.

[2] The following land disturbing activities are not required to provide GSI to MEF installation or reporting because it has been determined that GSI installation for these projects is not considered feasible: 1) road maintenance practices including pothole and square cut patching, overlaying existing asphalt or concrete or brick pavement with asphalt or concrete without expanding the area of coverage, shoulder grading, reshaping or regrading drainage ditches, crack sealing, and vegetation maintenance; 2) maintenance, repair, or installation of underground or overhead utility facilities, such as, but not limited to, pipes, conduits and vaults, and that includes replacing the ground surface with in-kind material or materials with similar runoff characteristics.

In addition, for Roadway Projects that only disturb land between existing or proposed curbs, GSI to MEF is not considered feasible, and no GSI to MEF Requirement Calculator submittal is required. These Roadway Projects need only include a statement in the drainage report that GSI to MEF is not feasible for projects contained between the curbs.

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, include 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 in the project design 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[3]) 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 clearly document the additional engineering limitations that apply in the space provided in the Appendix B checklists, or provide additional supporting documentation.

[3] 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 intended public use of the right-of-way.

If the applicant determines that including additional GSI in the project design 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 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 infeasible based on physical limitations of the site.

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 in the project design 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, site paving, landscaping, and utilities, as applicable.
    - Itemization of the proposed GSI measures.
    - If permeable pavement is otherwise feasible without cost considerations, documentation of the difference in cost between the conventional surface and GSI approach (e.g., the difference in cost between permeable concrete relative to standard concrete).

2. 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 maximizing the use of GSI.

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

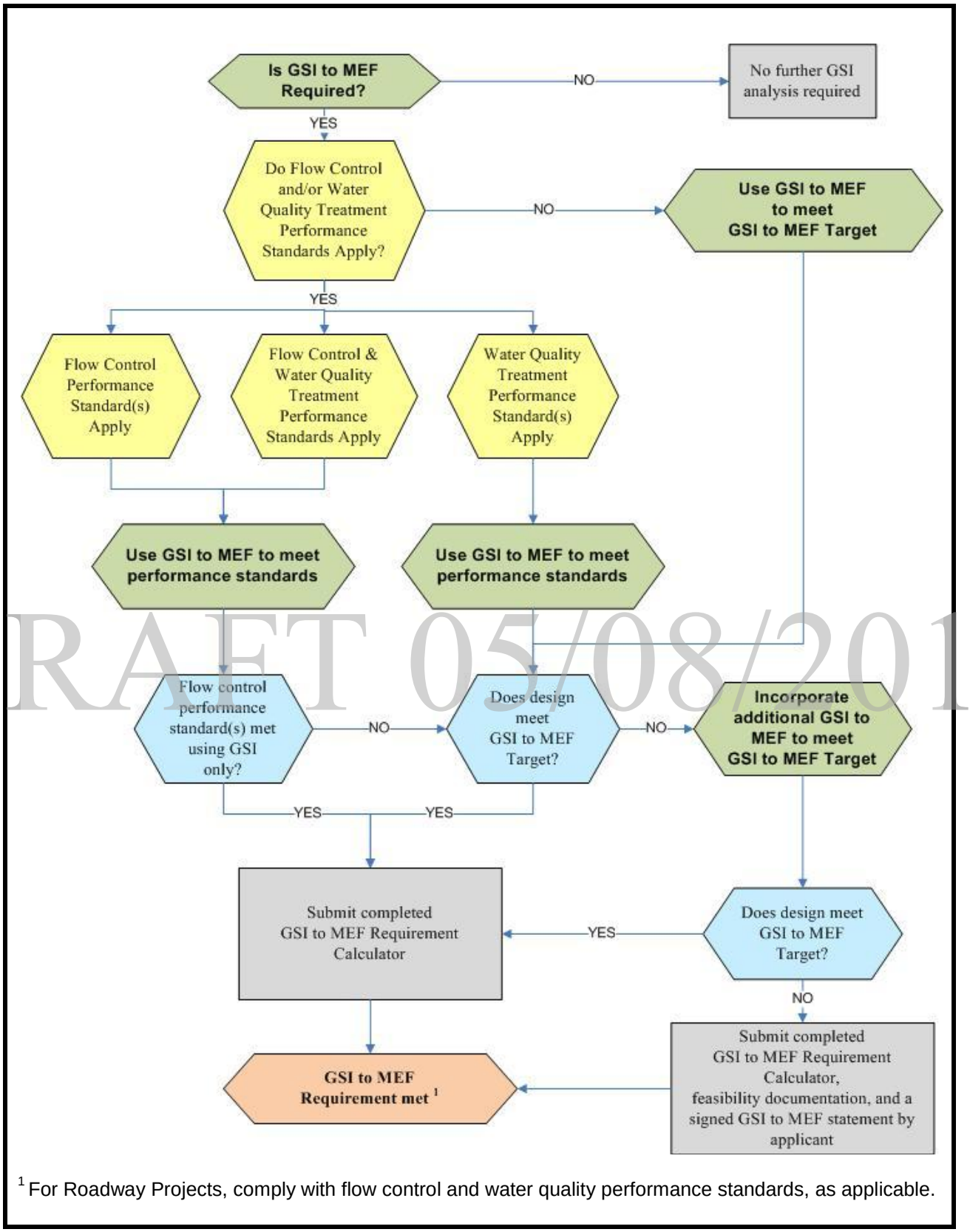
4. If applicable, building/project valuation construction cost as determined by DPD.

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

Roadway Projects may also be subject to numerical 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. The 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) must be met regardless of the amount of GSI that is feasible for a site. 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. Therefore, the applicant shall comply with the applicable flow control and water quality treatment performance standards and the GSI to MEF requirement.

Figure 1 describes the general process for meeting the GSI to MEF requirement for a project to which flow control or water quality treatment performance standards, or both, apply.

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 A.1 - A.4 of Appendix A to this Directors' Rules 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 Stormwater Code and Directors' Rules, including but not limited to Stormwater Manual Volume 3, Sections 2.3 – 2.6.



[1] For Roadway Projects, comply with flow control and water quality performance standards, as applicable.

Figure 1. Evaluating the GSI to MEF Requirement with Flow Control and Water Quality Treatment Performance Standards.

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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 SDOT Street Improvement Plan website or DPD Stormwater website. If a project is a Joint Project, separate calculators shall be submitted for the Parcel-Based portion of the project and the Roadway[4] portion of the project. If the project is in the right-of-way, the Street Use Permit process will also require compliance with the design requirements of the Right-of-Way Improvement Manual (www.seattle.gov/transportation/rowmanual/). Where conflict exists, the ROWIM shall apply in conjunction with SMC 15 and SMC 22.800.

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 this appendix) are different from those presented in Volume 3. **Roadway projects must use the appropriate sizing 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 the GSI to MEF Requirement Calculator (Figure A.1) to identify BMP options for the project site as outlined in the subsequent steps. Use the electronic version of the calculator available on the SDOT Street Improvement Plan website or DPD Stormwater website.

Step B – Divide the project area into distinct project types, if applicable (e.g., Sidewalk[5], Trail, Roadway, Single-Family Residential, Parcel-Based).

Step C – Calculate and report total new plus replaced impervious surface[6] for each project type.

[4] See also Appendix B to this Directors' Rule, for exceptions to this requirement for Roadway Projects.

[5] SMC 22.801.200 – "Sidewalk Project" means a project conducted within the public right-of-way that exclusively involves the creation of a new or the replacement of an existing sidewalk, including any associated planting strip, curb, or gutter. Note – to provide clarity on the meaning of associated curb or gutter, a project involving a sidewalk with associated curb or gutter is considered a Sidewalk Project (as opposed to a Roadway Project) only if the sidewalk cannot be constructed without the new plus replaced impervious surface in the roadway. Additionally, if the total new plus replaced impervious surface in the roadway exceeds 5,000 square feet, the entire project is considered a Roadway Project.

[6] SMC 22.801.100 - "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,

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 and available space 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 A.1, to calculate and report the impervious area mitigated as a product of the BMP area and its GSI credit.

Step F – Identify opportunities and available space for GSI Category 2 "Infiltrating and Reuse Facilities" (bioretention cells without underdrain, permeable pavement facilities, and rainwater harvesting).

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

Step G – If there are remaining unmitigated impervious surfaces, identify opportunities and available space for GSI Category 3 "Impervious Surface Reduction Methods" (permeable pavement surfaces) followed by GSI Category 4 "non-infiltrating green stormwater infrastructure" (bioretention planter with underdrain).

For each BMP, use the electronic GSI to MEF Requirement Calculator, or alternatively Tables A.3 and A.4, 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 A.1 - A.4, to calculate and report the total impervious area mitigated with the selected GSI BMPs.

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

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.

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. GSI to MEF Requirement Calculator

Table A.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 total tree credit shall not exceed 25 percent of 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 A.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 [c]	Volume 3 Section providing Design Requirements
Bioretention Cell [b]	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 (may receive run-on)	6 inch storage reservoir depth	0.25	33.3% [d]	100%	4.4.7
		0.5	33.3% [d]		
		1.0	33.3% [d]		
Rainwater Harvesting [e]	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
Detention Cistern to Bioretention Cell for Single-Family Projects	Refer to Directors' Rule SPU 2009-007 SPU / 19-2009 DPD for information on Detention Cistern for Single-Family Residential Projects.				4.4.5 and 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 are based on infiltrating 91% of the total runoff volume (per Section 6.5.4.6 of the Stormwater Manual Volume 3).

[d] 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.

[e] Evaluation of rainwater harvesting not required for Roadway, Trail, or Sidewalk Projects.

Table A.3. 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 of green roofs not required for Roadway, Trail, or Sidewalk Projects.

Table A.4. 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	Refer to Directors' Rule SPU 2009-007 SPU / 19-2009 DPD for information on Detention Cistern for Single-Family Residential Projects.			4.6.6

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.

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[7].

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 required level of GSI to meet the GSI to MEF target in the project design is not feasible. 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 shall evaluate, select, and calculate sizing for GSI BMPs to achieve the GSI to MEF requirement and comply with this rule. Use Table B.1 on the subsequent page to evaluate GSI BMPs in the order shown. For Roadway, Trail, and Sidewalk Projects, Table B.1 also identifies which BMPs shall be evaluated based on the project type, impervious surface type, and receiving water basin/drainage system into which the project discharges (refer to Chapter 2.3 of Stormwater Manual Volume 3 for further explanation of these terms). 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.

[7] Projects in the right-of-way also require compliance with the Right-of-Way Improvement Manual (www.seattle.gov/transportation/rowmanual/ to the extent applicable). Where conflict exists, the ROWIM shall apply in conjunction with SMC Title 15 and SMC 22.800.

Table B.1. Prioritizing Green Stormwater Infrastructure BMPs Roadway, Trail, and Sidewalk Projects Only

GSI Evaluation Category, in order of preference			Flow Control Basins [a]	Non-Flow Control Basins [b]	Non-Flow Control Basins [b]	Stormwater Manual Vol. 3 Section	
Category	Green Stormwater Infrastructure Type	GSI BMPs	All Impervious	PGIS [c]	Non-PGIS [c]	Flow Control	Water Quality [d]
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)	√ [e]	√ [e]	X	4.4.5	5.8.5
		Rainwater Harvesting	NA	NA	NA	4.4.6	N/A
		Permeable Pavement Facilities [f] (with storage reservoir / overflow)	√	√	X	4.4.7	5.8.5
3	Impervious Surface Reduction Methods	Green Roofs	NA	NA	NA	4.4.8	N/A
		Permeable Pavement Surfaces [f] Up to 2% slope	√	√	X	4.4.7	5.8.5
		Permeable Pavement Surfaces [f] 2%-5% slope	√	√ [g]	X	4.4.7	NA
		Bioretention Cells (with detention)	√	√	X	4.4.5	NA
4	Non Infiltrating Facilities	Bioretention Cell/Planter	√ [h]	√ [h]	X	4.4.5	5.8.5
		Detention Cisterns for Single-Family Projects	NA	NA	NA	4.6.6	N/A

√ Evaluation required for Roadway, Trail, and Sidewalk Projects except as noted below

X Evaluation not required for Roadway, Trail, or Sidewalk Projects

NA – Not applicable to Roadway, Trail, or Sidewalk Projects

[a] Flow Control Basins include: Wetland, Creek, Public Combined Sewer System, Small Lake, Capacity-Constrained System. Refer to Chapter 2.3 for of Stormwater Manual Volume 3 for further guidance.

[b] Non-Flow Control Basins include: Designated Receiving Water. Refer to Chapter 2.3 for of Stormwater Manual Volume 3 for further guidance.

[c] PGIS: Pollution generating impervious surface. Refer to SMC 22.801.170 for further guidance.

[d] For Roadway Projects subject to the minimum requirements for water quality treatment, Table B.1 identifies GSI BMPs that are also capable of meeting water quality treatment performance requirements in addition to flow control performance requirements.

[e] Minimum bioretention cell size top area in right-of-way is 500 sf. Evaluation only required when contributing area is sufficient to warrant minimum bioretention cell size in right-of-way.

[f] For use of permeable pavement in the right-of-way, refer to CAM #2215 for reference.

[g] Evaluation not required if project triggers water quality treatment as slopes greater than 2% do not meet the water quality treatment performance standard.

[h] Evaluation not required for Trail or Sidewalk projects.

Table B.2. 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. ▪ SDOT Urban Forestry has required and/or approved street tree removal (Street Trees will not be required to be removed for the purpose of installing other GSI BMPs). ▪ New and/or replaced ground level impervious surface not proposed within 20 feet of existing tree (defer to SDOT Urban Forestry regarding Street Tree retention). ▪ For tree(s) with a diameter greater than or equal to 6", site design cannot avoid grading within the dripline or otherwise meet standards (per COS Standard Plans and Specifications) required for retention (defer to SDOT Urban Forestry regarding Street Tree retention). ▪ For tree(s) with a diameter between 4-6": site design cannot avoid grading within 5 feet of tree trunk or otherwise meet standards (per COS Standard Plans and Specifications) required for retention (defer to SDOT Urban Forestry regarding Street Tree retention).	
All Dispersion BMPs	▪ 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. ▪ Site design can only accommodate dispersion within steep slope setback. Applicable if geotechnical analysis shows that infiltration is allowable within this setback (attach geotechnical report).	
Sheet Flow Dispersion	▪ Site cannot be designed to sheet flow runoff. ▪ Impervious surface being dispersed cannot be graded to have less than a 15% slope. ▪ Site design cannot accommodate at least a 10-foot wide vegetation buffer for dispersion of the adjacent 20 feet of impervious surface.	
New Trees	▪ SDOT Urban Forestry does not allow installation of Street Trees. ▪ Site design cannot accommodate space necessary for the mature height, size, and/or rooting depth for tree planting per the current COS Recommended Tree List (defer to SDOT Urban Forestry regarding Street Tree installation).	

Table B.3. 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 due to reasonable concerns of erosion, slope failure, or down-gradient flooding (submit signed and stamped geotechnical report). ▪ 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). ▪ Minimum vertical and horizontal clearance from utilities cannot be achieved as required by utility owner.	
Bioretention Facilities (without impermeable liner)	▪ Bioretention facility evaluation is not required if the project site meets <u>all</u> of the following: 1. Discharges through a piped component of the public drainage system to a designated receiving water (SMC 22.801.050), and 2. Does not discharge to a capacity constrained system, and 3. Does not include new plus replaced PGIS areas. (Note: if the project meets criteria 1 and 2 above, but not criteria 3, bioretention facility evaluation is only required for the new plus replaced PGIS areas.) ▪ This is a right-of-way application and the project area does not have an approved location for bioretention facility use per the Right-of-Way Improvement Manual.	

Table B.3. GSI to MEF Requirement Feasibility Checklist Category 2: Infiltrating and Reuse Facilities (Continued).

BMP	Feasibility Consideration	Additional information from applicant
Bioretention Facilities (without impermeable liner) (Continued)	▪ Site design cannot accommodate bioretention areas because site's longitudinal surface slopes parallel to bioretention area cannot be graded to less than 7 percent. ▪ For projects within the right-of-way, total required bioretention surface area (top area including side slopes and bottom) is less than 500 sf. Minimum facility size cannot be met due to such examples as: encroachment within the critical root zone of an existing tree(s); minimum utility setbacks cannot be met; required pedestrian access; project limits are too small; directing runoff from impervious surfaces to meet minimum bioretention cell size in right-of-way not feasible due to longitudinal slope of project; amount of new plus replaced impervious surface area does not warrant installation of a bioretention cell with a 500 sf surface area.The minimum bottom cell width of the bioretention facility cannot be met due to site constraints (e.g. setbacks, planting strip width.)	
Permeable Pavement Facilities	▪ Permeable pavement facility evaluation is not required if the project site meets <u>all</u> of the following: 1. Discharges through a piped component of the public drainage system to a designated receiving water (SMC 22.801.050), and 2. Does not discharge to a capacity constrained system, and 3. Does not include new or replaced PGIS areas. (Note: if the project meets criteria 1 and 2 above, but not criteria 3, permeable pavement evaluation is only required for the new plus replaced PGIS areas.) ▪ This is a right-of-way application and the project area does not have an approved location for permeable pavement use per the Right-of-Way Improvement Manual. See CAM #2215 for reference. ▪ Site has high potential for concentrated pollutant spills. ▪ Site design cannot accommodate permeable pavement wearing course on surface slopes less than 5 percent. ▪ Site design cannot avoid a contributing tributary area more than 3 times larger than the permeable pavement facility.	
Rainwater Harvesting	▪ Rainwater harvesting evaluation is not required if project site is one of the following: 1. Trail or Sidewalk Project 2. Roadway Project	

Table B.4. GSI to MEF Requirement Feasibility Checklist
Category 3: Impervious Surface Reduction Methods

BMP	Feasibility Consideration	Additional information from applicant
Permeable Pavement Surface	▪ Permeable Pavement Surface evaluation is not required if the project site meets all of the following: 1. Discharges through a piped component of the public drainage system to a designated receiving water (SMC 22.801.050), and 2. Does not discharge to a capacity constrained system, and 3. Does not include new or replaced PGIS areas. (Note: if the project meets criteria 1 and 2 above, but not criteria 3, permeable pavement evaluation is only required for the new plus replaced PGIS areas.) ▪ This is a right-of-way application and the project area does not have an approved location for permeable pavement use per the Right-of-Way Improvement Manual. See CAM #2215 for reference. ▪ Area includes greater than 5,000 sf of new plus replaced PGIS (Water Quality trigger) and for those areas where the proposed pavement surface slope is greater than 2 percent (pavement surfaces greater than 2 percent do not fully meet the treatment standard for water quality). ▪ Site has high potential for concentrated pollutant spills. ▪ Site design cannot accommodate permeable pavement wearing course on surface slopes less than 5 percent. Site design cannot avoid run-on from an impervious surface area greater than 10 percent of the permeable pavement surface area.	
Green Roof	▪ Green roof evaluation is not required if project site is one of the following: 1. Trail or Sidewalk Project 2. Roadway Project	
Bioretention with Detention	▪ Bioretention with detention evaluation is not required if project site is one of the following: 1. Project is a Trail or Sidewalk 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 (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 over1,500 sf.) ▪ This is a right-of-way application and the project area does not have an approved location for bioretention facility use per the Right-of-Way Improvement Manual. ▪ Site design cannot accommodate bioretention areas because site's longitudinal surface slopes parallel to bioretention area cannot be graded to less than 7 percent.	

Table B.4. GSI to MEF Requirement Feasibility Checklist Category 3: Impervious Surface Reduction Methods (Continued).

BMP	Feasibility Consideration	Additional information from applicant
Bioretention with Detention	▪ For projects within the right-of-way, total required bioretention surface area (top area including side slopes and bottom) is less than 500 sf. Minimum facility size cannot be met due to such examples as: encroachment within the critical root zone of an existing tree(s); minimum utility setbacks cannot be met; required pedestrian access; project limits are too small; directing runoff from impervious surfaces to meet minimum bioretention cell size in right-of-way not feasible due to longitudinal slope of project; amount of new plus replaced impervious surface area does not warrant installation of a bioretention cell with a 500 sf surface area. ▪ The minimum bottom cell width of the bioretention facility cannot be met due to site constraints (e.g. setbacks, planting strip width.)	

Table B.5. GSI to MEF Requirement Feasibility Checklist Category 4: Non-Infiltrating BMPs.

BMP	Feasibility Consideration	Additional information from applicant
Bioretention Planter	▪ Bioretention Planter evaluation is not required if the project site meets all of the following: 1. Project is a Trail or Sidewalk Project. 2. Discharges through a piped component of the public drainage system to a designated receiving water (SMC 22.801.050), and 3. Does not discharge to a capacity constrained system, and 4. Does not include new or replaced PGIS areas. (Note: if the project meets criteria 1 and 2 above, but not criteria 3, bioretention planter evaluation is only required for the new plus replaced PGIS areas.) ▪ Site design cannot accommodate bioretention areas because site's longitudinal surface slopes parallel to bioretention area cannot be graded to less than 7 percent. ▪ For projects within the right-of-way, total required bioretention surface area (top area including side slopes and bottom) is less than 500 sf. Minimum facility size cannot be met due to such examples as: encroachment within the critical root zone of an existing tree(s); minimum utility setbacks cannot be met; required pedestrian access; project limits are too small; directing runoff from impervious surfaces to meet minimum bioretention cell size in right-of-way not feasible due to longitudinal slope of project; amount of new plus replaced impervious surface area does not warrant installation of a bioretention cell with a 500 sf surface area. ▪ The minimum bottom cell width of the bioretention facility cannot be met due to site constraints (e.g. setbacks, planting strip width.) ▪ This is a right-of-way application and the project area does not have an approved location for bioretention facility use per the Right-of-Way Improvement Manual.	

Appendix C –

Infiltration Feasibility Flowchart

APPENDIX C: Infiltration Feasibility Flowchart

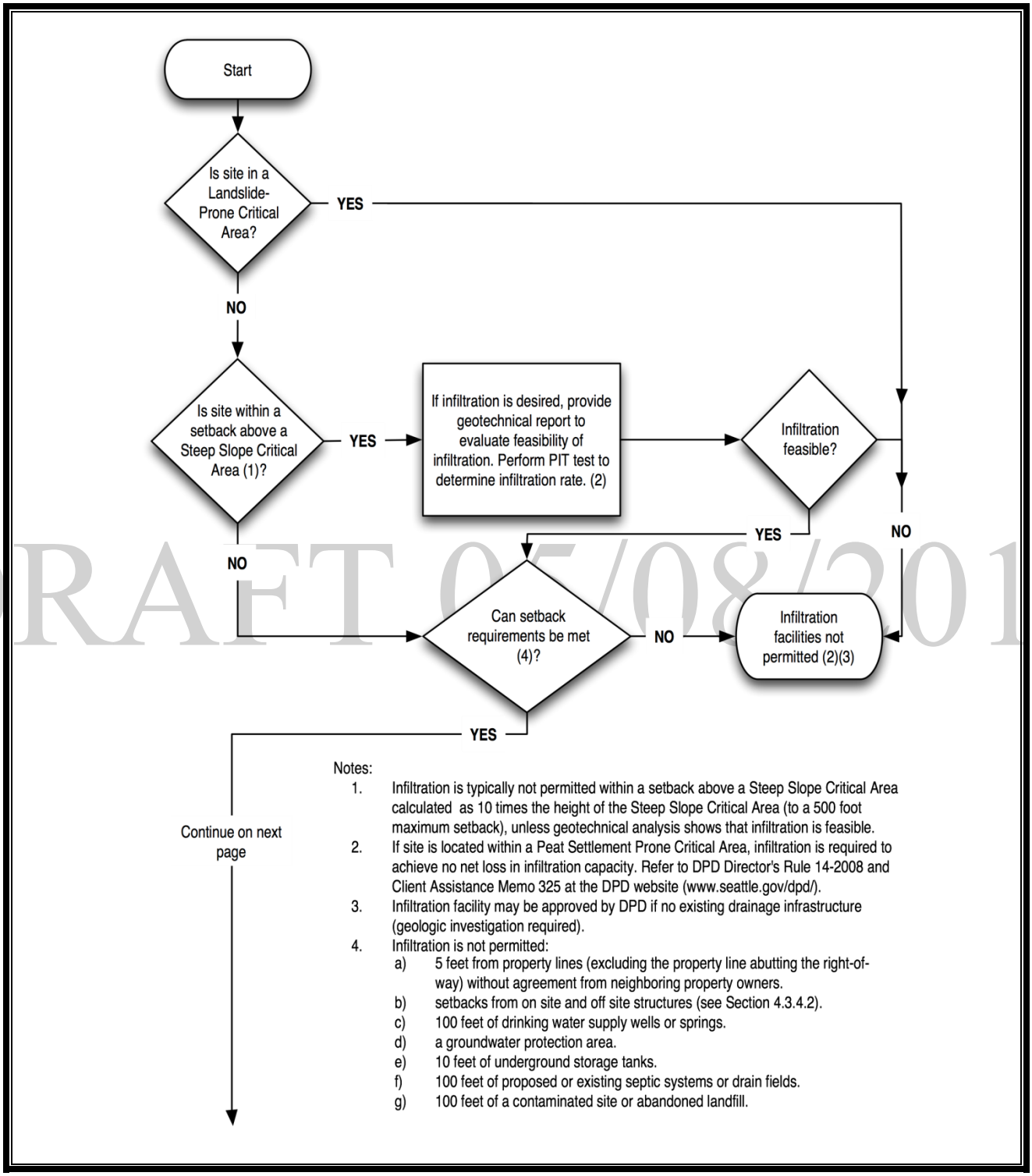

Figure C.1. From the Stormwater Manual Vol. 3, Chapter 4.3: Infiltration Feasibility.

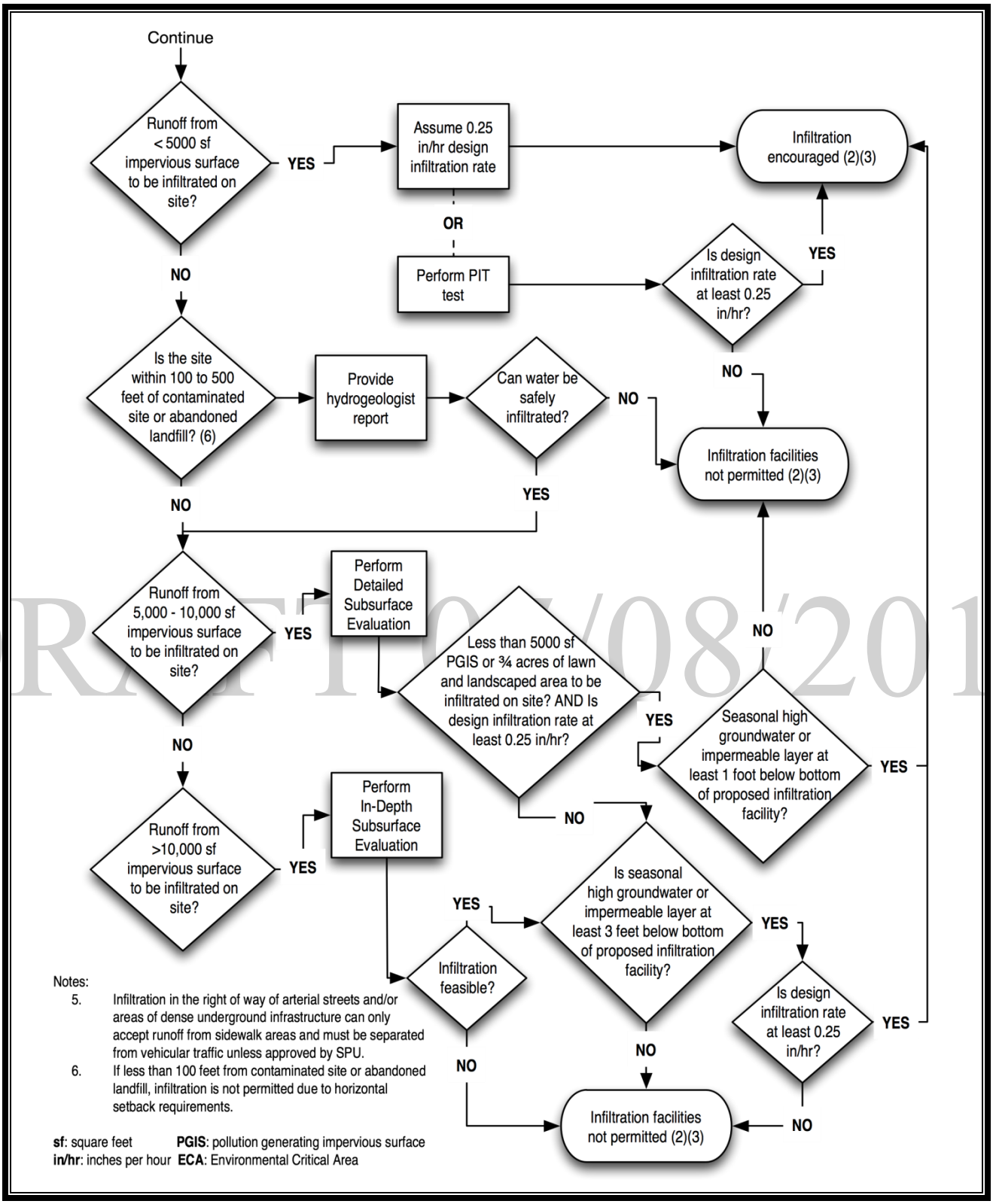

Figure C.2. From the Stormwater Manual Vol. 3, Chapter 4.3: Infiltration Feasibility (continued).

Appendix D –

Definitions

APPENDIX D: 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:
- For Single-Family Residential Projects only, mitigate the GSI to MEF target of all but 1,500 square feet of new plus replaced impervious surface using GSI, constrained only by the physical limitations of the site, practical considerations of engineering design, and reasonable considerations of financial costs and environmental impacts.
- For all other projects requiring GSI to MEF, mitigate the GSI to MEF target of 100 percent of the new plus replaced impervious surface using GSI, 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" means the following area:
- For Single-Family Residential Projects only, all but 1,500 square feet of new plus replaced impervious surface.
- For all other projects requiring GSI to MEF, 100 percent of the new plus replaced impervious surface.
- "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)