Draft 2012 LID Technical Guidance Manual Review Comments

Submitted 2-15-2012 by Tracy Tackett, GSI Program Manager, Seattle Public Utilities. Comments include Seattle Department of Planning & Development and Seattle Transportation Department staff comments.

#	Page Number	Comment	Reviewer
1.	General	There are numerous comments related to geotechnical investigation, specifically around determining design infiltration rate. Suggest WSU and DOE reconvene the subject matter experts (SME) DOE consulted with on 8/31/2011 to develop final infiltration guidance for infiltration and LID facilities; for reference in comments below I termed this the "Infiltration SMEs"	Tracy
2.	General	Note, all references to SMMWW are the most recent DOE Draft	
3.	General	Recommend the LID Manual state, "The Manual is technical guidance rather than a regulatory document and does not supersede the requirements of any NPDES permit, which governs in the event of any conflict between an NPDES permit and the LID Manual as its relevance or use." And any regulatory requirement pieces be moved directly into SMMWW.	Review team
	Chapter 1: Into		
4.	Page 4 Table 1.1	Not sure what is meant by: "Increased drainage *density..."*. Seems increase in impervious surface in the watershed is missing from table – is that what "increased drainage density" is alluding to or is it only attributable to "road networks, road crossings and stormwater outfalls" as noted? Please clarify.	Sherell
5.	Page 6 Section 1.3	Suggest adding language about effects on groundwater recharge associated with "Current Stormwater Management"	Sherell

#	Page Number	Comment	Reviewer
6.	Page 7 Section 1.3	Suggest moving last sentence in this section ("In this context...") to 1.4 LID as this addresses LID and not current stormwater management.	Sherell
7.	Page 8 Section 1.4.1	To match the LID definition used in the Permit, consider the following changes, "*emphasizing conservation, ~~and~~ use..." and make "stormwater" one word.*	Sherell
8.	Page 8 Section 1.4.2	Suggest deleting last sentence. The goal is as you defined in the first sentence. The goal is not to estimate and monitor etc.	Tracy/Sherell
9.	Page 8 Sections 1.4.3 & 1.4.4	Suggest changing titles from "Flow Control Objective" to "LID Objective" and change from "Flow Control Objective Discussion" to LID Objective Discussion"	
10.	Page 8 Section 1.4.3	For consistency and to avoid confusion, this objective should be changed to match Ecology's definition: "*Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 8% of the 2-year peak flow to 50% of the 2-year peak flow. Refer to the Standard Flow Control Requirement section in Minimum Requirement #7 for information about the assignment of the pre-developed condition. Project sites that must also meet the minimum requirement #7 – flow control – must match flow durations between 8% of the 2-year flow through the full 50-year flow.*"	
11.	Page 8-10 Sections 1.4.3.1 & 1.4.3.2	"1.4.3.1" & "1.4.3.2" should come after "1.4.4"	Sherell
12.	Page 9 Section 1.4.3.1	In the last paragraph, there seems to be a disconnect between 65% native soil/vegetation protection and the requirement to provide treatment when infiltrating stormwater on outwash soils from pollution generating surfaces.	Sherell

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13.	p. 10, 1.4.3.2:	Suggest modification to this sentence to make it not trigger legal mininterpretation. "In the higher density setting, where less forest protection area is possible, achieving hydrologic and water quality goals with LID requires a comprehensive application of LID practices. (see Chapter 3: Site Planning and Layout for design strategies).	tracy
14.	Page 11 Section 1.4.6	Last bullet of site planning. Suggest modifying. "minimize total impervious surfaces area and minimize or eliminate EIA"	Tracy
15.	Page 13 Section 1.4.6	Last bullet. "…., ~~and~~ recreation areas and core services (grocery, library, etc:	Tracy
16.	p. 10, 1.4.6:	Eliminating the roof water contribution through roof water harvesting systems may be ~~necessary~~ appropriate for achieving the LID flow objective where higher density projects are located on soils with low infiltration rates.	Theresa
17.	p. 13, 1.4.7:	To protect high quality, sensitive stream systems the following critical area designations and associated land use controls ~~are necessary~~ are indicated to be necessary(Horner, May, Livingston, Blaha, Scoggins, Tims, Maxted, 2001 and May et al., 1997): • Extensive and near continuous riparian buffer protection. • Floodplain protection. • Aggressive native forest and soil protection. • Limit EIA to approximately 10 percent.	Theresa
18.	p. 14, 1.4.8:	Implemented comprehensively, native soil and vegetation protection, soil improvement, and increased on-site storage and infiltration capacity at the site level ~~are necessary~~ would have the greatest impact on protection and enhancement ~~of to protect or enhance larger scale~~ hydrologic function and other watershed attributes.	Theresa

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	Chapter 2: Site Assessment		
19.	General Geotech/infiltration testing	Infiltration testing requirement for permeable pavements needs clarity. Suggest "infiltration SMEs" make recommendations. Consider varying requirements based on permeable pavement installation size, and degree of run-on from adjacent impervious surfaces. For small scale installations (patios, walkways, sidewalks, driveways) with no runon and no piped to reservoir flows, the intent is to have the 'hard' surface function like lawn. In this situation a minimal testing approach such as the Rain Garden Handbook seems appropriate. Larger scale applications (alleys, parking lots, etc) or sites with run-on, Seattle recommends infiltration testing with the small scale PIT test. It is unclear that large-scale PIT test would be considered appropriate for any LID projects, and currently it seems confusing to have the large scale PIT guidance in the LID manual. A suggestion for a table clarifying infiltration testing is provided at the end of this document.	Timothy
20.	Page 15 Introduction	In the first sentence the term *pre-disturbance* is used, however elsewhere in the document, such as in Chapter 1 and Chapt 2 (page 20), the term *pre-development* is used. *Be consistent in terms unless you are trying to reference something different, in which case that needs to be clarified, otherwise it is confusing to the reader. Seattle suggests using pre-disturbance to be consistent with the Permit language.*	Shanti
21.	Page 16 Introduction	Add a final bullet to the list of gathering site data for "Contaminated Sites"	Shanti

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22.	Page 16-17 Section 2.1.1	The term *project proponent* is used, but does not seem appropriate or qualified to prepare the type of information being requested.	Shanti
23.	Page 16-17 Section 2.1.1	Site plans for projects required to meet Minimum Requirement 1-5 *Comment: Requiring surveys and soil reports for small projects is not in scale with the cost or impacts relative to the construction of 1-2 single-family residences. That level of detail for a small project site plan will have little benefit and should be at the jurisdictions discretion based on the site conditions. SMMWW has allowance for local administrator to waive these requirements.*	Michelle Macias/ Cris Horbelt
24.	Page 16 Section 2.1.1	Suggest modification of "Projects triggering Minimum Requirements 1-5 are generally smaller projects ranging from a single family residence and up to 2-3 homes." To "Projects triggering Minimum Requirements 1-5 per SMMWW are generally smaller projects ranging from a single family residence, multifamily residence and up to 2-3 single family homes." Unnecessary to include and not necessarily true; multifamily homes can be under this threshold.	Review team

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25.	Page 16 Section 2.1.1	Site plans for projects required to meet Minimum Requirements 1-5. This manual needs to clarify how it is to be used, and specifically how it intersects with Ecology's manual and requirements. According to Section 3.4.2 of Ecology's draft SMMWW, projects required to meet Minimum requirements 1-5 are referenced to the Rain Garden Handbook, which does not require this level of analysis or technical information. Since the SMMWW allows these smaller projects to just use the Rain Garden Handbook, it seems this manual should only provide guidance for bioretention on larger projects, those that are required to meet Minimum Requirements 1-9. Throughout this manual there are references to projects that only need to meet MRs 1-5, but it is very confusing since it seems those projects wouldn't be looking in this manual at all and only relying on the Rain Garden Handbook.	Review team
26.	Chapter 2 (Site Asessmt) page 17	4th solid bullet (bottom of page) Delete : "or project proponent"	Shane DeWald
27.	Page 17 Section 2.1.1 And page 18, Section 2.1.2	"Existing public and private, including utility infrastructure on and adjacent to the site." *Comment: Municipalities may not have legal authority to enter private property that is not included with the project. Is that the intent of this comment?*	Michelle Macias

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28.	Page 17 Section 2.1.1 Geotech/infiltration testing	"Infiltration rates of soil underlying rain gardens using the infiltration testing method outlined in the Rain Garden handbook for Western Washington Homeowners. For bioretention areas or permeable pavement use septic style pit tests, small-scale PIT or grain size analysis…" *Comment: Having the flexibility to use the septic style pit tests for small projects is desirable if supported by the infiltration SME. Also need clarity on testing requirement for permeable pavement that does not receive run-on*	Michelle Macias/ Tracy
29.	Page 17 Section 2.1.1	Define the difference between a rain garden and bioretention area, perhaps in a foot note or somewhere easily accessible so the reader doesn't have to go to the SMMWW to find it.	Shanti
30.	Page 17 Section 2.1.1	"Determine if depth to ground water under …" Change to "Determine if depth to ~~ground water~~ *hydraulic restriction layer* under…"	Shanti
31.	Page 17 Section 2.1.1	Add a bullet to the list of minimum analysis – "*Site evaluation the day after a large rain event to identify any undocumented surface seeps or other indicators of near surface groundwater."*	Shanti
32.	Page 18 Section 2.1.2	Site plans for projects triggering Minimum Requirements 1-9 Clarify how this section will merge with SMMWW Section 3.3.5	Review Team
33.	p. 18 2.1.2	"Projects triggering Minimum Requirements 1-9 are larger projects that must comply with Ecology's water quality treatment and/or flow control requirements." Use "may be required to" because some projects might exceed the threshold for MR #6-9, however there may not be a performance standard (i.e., flow control is not required for direct discharge to Designated Receiving Waters).	Cris Horbelt

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34.	p.19 2.1.2 Geotech/infiltration testing	Suggest change to "If seasonal high groundwater *or hydraulic restriction layer* cannot be confirmed to be greater than 5 feet below the bottom of the bioretention or permeable pavement facility monitoring wells should be placed strategically to assess depth to groundwater. This analysis should be performed for *one wet season* prior to construction ~~(including one full winter season) using a continuously logging sensor~~ and be performed by a licensed geotechnical engineer or licensed engineering geologist." Monitoring for one full year will make all but the largest projects financially infeasible. Permitting timelines for construction only projects are much shorter than what this would allow for. Seattle prefers the language in the SMMWW Volume III, Section 3.3.5, page 3-73 #4.	Cris Horbelt/ Review team
35.	Page 19 Section 2.1.2 Geotech/infiltration testing	"if on site infiltration may result in shallow lateral flow (interflow) the ..." This will likely require placement of groundwater monitoring wells to determine existing groundwater gradients and flow." If this is to be a requirement and not just guidance, this last sentence needs to be stronger. Seattle prefers the language in the SMMWW Volume III, Section 3.3.5, page 3-73 #4.	Review Team

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36.	Page 19 & 20 Section 2.1.2 Geotech/infiltration testing	"If a single bioretention facility serves a drainage area exceeding 1 acre..." Clarify what is meant by facility, is this one or many interconnected bioretention cells. A single cell serving a drainage area that big would be huge and doesn't meet the intent of LID of having small distributed systems. This threshold for requiring mounding analysis is too high, Seattle recommends > than 10,000 sf impervious drainage area.	Shanti
37.	Page 20 Section 2.2	"on sites with mixed soil types, the LID site plan should locate impervious areas over less permeable soils and preserve and utilize permeable soils for infiltration;" Add sentence acknowledging that on many infill and redevelopment projects, it is not possible to move these components as proposed due to locations of existing ROW, utilities, setbacks, etc.	Cris Horbelt
38.	Page 20 Section 2.2 Geotech/infiltration testing	"The initial or measured saturated hydraulic conductivity with no correction factor may be used as the design infiltration rate…" This statement appears to be inconsistent with the SWMMWW which does not allow for CF = 1 for site variability or test method. The LID manual also does not mention the CF for test method.	Claire Gibson
39.	Page 20 Section 2.2 Geotech/infiltration testing	The last paragraph of this chapter uses several terms for the same thing – short-term SHC, initial SHC, and measured SHC. It is confusing to keep using different terms for the same thing, pick one term for clarity and define (with ASTM designations as applicable).	Shanti
40.	Page 21 Section 2.2	This is the first time BSM is seen, need to define acronym	Review Team

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41.	Page 21 Section 2.2 Geotech/infiltration testing	"Three infiltration tests are recommended for initial site assessment…" For a single, small bioretention cell, this is excessive. A threshold should be established for when this is required, such as sites required to meet minimum requirements #1-9 or three tests per 10,000 sf lot or 5 per acre. This sentence seems to be more appropriate for Section 2.1 where it is already generally touched on.	Shanti
42.	Page 21 Section 2.2	"The horizontal surface area of the bottom of the test pit should be 12 to 32 sf." This is too large for retrofit activities, or projects trying to fit in the planting strip. The range should start at 8 sf.	Shanti
43.	Page 21 Section 2.2	Last bullet, "Use a rigid diameter pipe…" Change to "Use a rigid ~~diameter~~ pipe…"	Review Team
44.	Page 22 Section 2.2 Small-scale PIT Geotech/infiltration testing	"Add water to the pit so that there is standing water for at least 6 hours." Define this as the pre-soak period for clarity, since it is then referred to in the next bullet. Since this test is generally performed within a working day, change pre-soak time to 4 hours from 6 hours unless there is specific data to support 6 hours. Specify how deep, or at least a range, the standing water needs to be during this period.	Shanti
45.	Page 22 Section 2.2 Soil grain size analysis	Define "soils unconsolidated by glacial advance" for the non-geologist	Review Team
46.	Page 23 Section 2.2	First bullet - Better define licensed professional, such as licensed geotechnical engineer or licensed engineering geologist.	Timothy Lowry

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47.	Page 23 Section 2.2	Second bullet – "Machinery or material stockpiles and associated compaction should not be allowed in infiltrating ~~bioretention~~ areas." "If compaction is unavoidable, the compaction shall be mitigated as determined by a licensed geotechnical engineer or engineering geologist."	Timothy/Tracy/
48.	Page 23 Section 2.2 Large-scale PIT Geotech/infiltration testing	Please clarify in what situations this test would be used for IMPs in the LID manual. Is there a threshold where there are enough small distributed systems that Large-scale pit is recommended? Seattle uses the small PIT. The large scale pit seems more appropriate to large retention ponds. Again, a discussion topic for the "infiltration SMEs"	Review Team
49.	Page 23 Section 2.2 Large-scale PIT Geotech/infiltration testing	"The horizontal surface area of the bottom of the test pit should be approximately 100 square feet." This size is very large when considering retrofit activities, such as permeable pavement in alleys. It would be very hard to put in test pit that would basically have to be equal to the width of the alley (10' by 10'). Alternatively, we would have to use a long trench (for example, 4' x 25'). Either way, this size PIT would result in considerable pavement restoration after the infiltration test is complete. Please consider whether this magnitude of surface area is necessary, or if it just adds considerable cost without great benefit.	Claire Gibson
50.	Page 23 Section 2.2 Large-scale PIT Geotech/infiltration testing	It is unclear why this is the preferred method for permeable pavement in general; it seems this should be more a function of drainage area. Smaller permeable pavement projects should be allowed to use the small-scale test. More discussion on when the large-scale test is appropriate for bioretention and permeable pavement would be helpful. Also clarify the last bullet on page 24 discussing correction factors for bioretention.	Shanti

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51.	Page 24 Section 2.2 Large-scale PIT Geotech/infiltration testing	"Add water to the pit at a rate that will maintain a water level in the range water height anticipated in the project design, usually 6 inches to 1 foot"	Review Team
52.	Page 24 Section 2.2 Large-scale PIT Geotech/infiltration testing	5th bullet: why is 17 hours stated as "usual"? Where is the reference for this? In Seattle's experience, the time to reach saturation depends on the soil type, density, and groundwater conditions at the time of testing.	Claire Gibson
53.	Page 24 Section 2.2 Large-scale PIT Geotech/infiltration testing	Data Analysis bullet - "Calculate and record the infiltration rate…" Change to "Calculate and record the saturated hydraulic conductivity…"	Claire Gibson
54.	Page 24 Section 2.2 Large-scale PIT Geotech/infiltration testing	Last paragraph, "the depth and number of test holes or test pits, and samples should be increased…" Increased from what, there is not a minimum number established.	Review Team
55.	Page 26 Section 2.2 Geotech/infiltration testing	"If the ground water in the area is known to be greater than 5 feet below the proposed facility, detailed investigation of the ground water regime is not necessary." It's unclear if this is true for all project sizes. If the drainage area is greater than the threshold for mounding analysis , then groundwater information would be needed as part of the mounding analysis	Claire Gibson

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56.	Page 27 Section 2.5	Wetlands - This section needs to be updated to match SMMWW.	Review Team
	Chapter 3: Site Planning and Layout		
57.	Section 3.1.1 Page 38	Third bullet references 'aggregate storage systems under the pavement.' This may be suitable for a parking lot application, but not for urban environments within the Right-of-Way due to the potential to undermine existing utilities and the potential to compromise existing adjacent impervious pavements that rely on subgrade strength for pavement performance. Suggest modification to 'aggregate storage systems under *parking lot* ~~the~~ pavement.' Additionally suggest adding: Infiltrating below pavement is considered infeasible where infiltrating would threaten existing underground structures, utilities, or adjacent pavements that rely on adjacent subgrade strength for pavement performance.	Corey
58.	Page 39 Section 3.1.1 Roads, Driveways and Parking	Add, "Permeable pavement sidewalks, trails and patios" to Section 3.1.	Timothy Lowry
59.	Page 39 Section 3.1.1 Roads, Driveways and Parking	"Permeable pavement with subsurface engineered soil systems surrounding newly planted trees, providing soil volume and sustain root development in a manner compatible with pavement and other subsurface infrastructure ~~associated subsurface planting soil structures~~"	Shane Dewald/ Timothy Lowry

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60.	Page 40 Section 3.1.1 Alleys	Bullet number 1 gives maximum alley widths. These are too general and should be specified by the local jurisdiction. City of Seattle Alley widths are specified based on the Land Use Codes and access requirements for emergency vehicles. Alley width should not be determined simply by available Right-of-Way widths and generally should be a maximum of 10 to 12 feet.	Corey
61.	Page 40 Section 3.1.2	Second paragraph "bioretention cells or planters adjacent to or attached to the building". Add clarity that this is appropriate when planter is lined or built in combination with building drainage system	Corey
62.	Page 40 Section 3.1.1 Roads, Driveways and Parking	"and **may** allow any surface flows to disperse and infiltrate to adjacent bioretention swales, shoulders or yards	Timothy Lowry
63.	Page 40Section 3.1.1 Roads, Driveways and Parking	Concern with Gravel paving bullet. To our knowledge gravel paving systems are not typically used on heavy load applications. Although use is stated on their website, it would be good to verify heavy load capacity; maybe have them provide local site example if there is one?	Timothy Lowry
64.	Page 40 Section 3.1.2 Lot and Building Design	Since Permeable pavements are not exclusively for ultra-urban setting suggest modification to "permeable paving systems are highly adaptable and can provide significant stormwater management benefits *in a variety of land use densities including,* an ultra-urban setting"	Timothy Lowry
65.	Page 50 Section 3.2.1	In the table under Street Type, the third example from the bottom for Olympia clarifies "local access" as 2-way, but none of the other "local access" cells have that note, does this mean they are on-way? Please clarify.	Shanti
66.	Page 50 Section 3.2.1	In the table, clarify under Parking what one side alternating means.	Shanti

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67.	Page 50 Table ???	Suggest adding row City of Seattle local residential street 25-feet width, parking 2 sides of street.	Tracy
68.	Page 51 Section 3.2.1	"Island cul-de-sacs" should be designed as bioretention or detention facilities" Add "… and the street should be graded accordingly to allow flow to reach the islands." Often the street slopes away from islands.	Shanti
69.	Page 52	Traffic calming strategies Insert 2nd Sentence: "The visual effect of street trees consistently placed are just one of many tools useful to visually confine and define the direction of travel and space available to drivers. "	Shane DeWald:
70.	Page 53, Section 3.2.1	Bullet at the bottom of the page: Minimum width for continuous sidewalk is 48", not 44" as stated. See 36 CFR Part 1190, Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way.	Corey
71.	Page 53, Section 3.2.1	Bullet at the bottom of the page, "Minimum width for continuous sidewalk is 44 inches". It is our understanding per 36 CFR Part 1190, Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way, that 48-inches is the minimum requirement.	Corey
72.	Chapter 3 (Site Planning) page 54	3rd solid bullet under **Sidewalks** Revise Sentence (add underlined text) : "Design a streetscape to accommodate bioretention swales or bioretention cells <u>along with street trees</u> between the sidewalk and the street to provide a visual break <u>and ensure adequate space for a varied palette of large scale deciduous and evergreen trees for optimum stormwater attenuation and transportation</u> safety."	From Shane DeWald:

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73.	Chapter 4 (Veg & Soil) page 68	Bold "vegetation and soil protection area" at first use (bottom of page 68) and add definition to glossary. Suggest the following as a short definition from Seattle's *CAM 531 – Post Construction Soil Management*: "Vegetation and Soil Protection Area Areas covered by vegetation that will not be subject to land disturbing activity or compaction (clearing, grading, storage, stockpiling, vehicles, etc.) that are fenced and continuously protected from impacts throughout the construction process."	David McDonald
	Chapter 5: Precision Site Preparation and Construction		
74.	Chapter 5 (Site prep) page 81	Third paragraph on page 81. Capitalize "Stormwater" in "National Menu of stormwater BMPs". Delete the phrase that follows (delete " are being developed at") and replace that phrase with "under the "Construction BMPs" heading at" (web URL is correct in draft). The compost blanket, berm and sock specifications are posted on that Construction sub-page along with the other more commonly known Construction Site BMPs.	David McDonald
75.	Page 81-82 Section 5.2.1	The first five bullets under this Section are all elements of MR #1and are described in Chapters 2 and 3. Section 5.2.1 describes design elements and it is confusing to have it in the Site Prep chapter, it seems better fitted for Chapter 3.	Cris Horbelt
76.			
77.	Page 82 Section 5.2.2	Add bullet: Maintain clear access path for construction deliveries throughout site to minimize construction impacts to LID IMPs. Augment with signage, visual boundaries, or TESC fencing to define special site conditions/constraints	Drena
78.	Page 83 Section 5.2.3	Second bullet: Along with equipment operators and project foreman, add contractors and or sub contractors doing work in the area of concern.	Drena

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79.	Page 85, first section, second bullet	Communication to "all contractors, *sub contractors, and personnel accessing site"*	Drena
80.	Page 86, Visit one, 3rd bullet	Add *inlets to catch basins* – this is a source of sediment sources to swales during construction.	Drena
81.	Page 86, Visit one	Include the following bullet: "Confirm BSM is protected from contamination and stormwater runoff if already on site."	Shanti
82.	Page 86, Visit one	Modify the following bullet: "Verify side slopes and other dimensions are per specification" to "Confirm depth is sufficient to accommodate required depths of bioretention soil, mulch and ponding."	Shanti
83.	Page 86, Visit one	This section specifies scarifying the subgrade to a minimum of 2 inches, but Section 6.1.2.3 requires a minimum of 6 inches. We recommend a minimum of 3 inches.	Shanti
84.	Page 86, Visit two	This visit is really bioretention placement, so the title should be changed to "Visit two (bioretention placement)".	Shanti
85.	Page 86, Visit two	Add bullet "verify side slopes and other dimensions are per specifications	
86.	Page 87, Visit three	Last bullet, "Verify that the finished BSM elevation is below sidewalks, curbs, driveways, and other pavement per plans (typically 1 inch)." Move under Visit 4 and change to "Verify that the finished *cell* elevation is below sidewalks, curbs, driveways, and other pavement per plans (typically 1 inch)."	Shanti
87.	Page 88, Visit four	Add: "verify all pipes, culverts, conveyance systems, flow control structures are free and clear of debris."	Drena

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88.	Page 88 Visit five	3rd bullet – "Verify BSM not clogged/infiltration rate adequate through visual assessment of sediment accumulation and post rain event duration of ponding. If concern that adequate procedures not followed and clogging resulted, infiltration tests may be necessary and can be implemented with spot checks using a double ring infiltrometer" .	Cris Horbelt/Tracy
89.	Page 88, Pre-Construction	Last bullet: Add "site, building and all other sub contractors who are doing installation work."	Drena/ Cris Horbelt
90.	Page 88, Pre-Construction	The pre-con for permeable pavement is the same as for bioretention, so these common tasks could be grouped together at the beginning of the chapter, and unique inspection criteria for each BMP called out later.	Cris Horbelt
91.	Page 92, second bullet at top	Add "equipment operators *and other responsible on site personnel* " Once the operator understands, the staff on the ground,out of the machine, also need to understand construction boundaries.	Drena
92.	Page 92, Section 5.4.1	"Minimizing sedimentation and removing sediment from bioretention areas when project is complete…" Change to "Minimizing sedimentation and removing sediment from bioretention areas *and replacing removed soil with new bioretention soil* when project is complete…"	Shanti
93.	Page 92, Section 5.4.1	Second bullet, "If bioretention area can be protected from compaction…" It is unclear what is being suggested here, please clarify.	Shanti

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94.	Page 92, Section 5.4.1	Fourth bullet, "Install robust construction barriers and signage…" It is unclear what is being suggested here, please reword, maybe something like "Install robust construction barriers and signage (e.g. chain link fencing) around bioretention areas where possible to prevent unwarranted equipment from entering and compacting those areas. Install robust sediment and erosion controls around bioretention cells to prevent the introduction of sediment into the cells (e.g sediment fence with compost sock).	Shanti
95.	Page 94, Section 5.4.2	Second bullet, Add *contractor/sub-contractor*	Drena
96.	Page 94 Section 5.4.2	Add bullet – no sandbags or if sandbags are used it is imperative they are maintained. (High Point, sand bags constantly broke open on pp sidewalks when used with TESC/sediment fencing	Drena
97.	Page 94 Fig 5-3	It is hard to see the wrapped sidewalks or tell that is what you are looking at. Fig. 5-2 is a little bit more zoomed in and it is easier to see that the sidewalk is wrapped.	Shanti
98.	Page 94 & 95 Section 5.4.2	Option 1& 2, first bullet – – " sediment fence with well maintained compost socks." Seattle experience with compost socks and sand bags is that they frequently broke and clogged up permeable pavement and we try to minimize their use.".	Drena
99.	Page 95 Section 5.4.2	First bullet, add *contractor* and change *homebuilder* to *builder*	Drena
100	Page 95 Section 5.4.2	Second bullet, add *contractor* and change *homebuilder* to *builder*	Drena
101	Page 95 Section 5.4.2	Last sentence, add by performing infiltration test.	Drena
102	Page 96 Section 5.4.2	Second bullet, add *contractor* and change *homebuilder* to *builder*	Drena
103	Page 96 Section 5.4.2	Option 1 & 2, First bullets. sediment fence with well maintained compost socks."	Drena

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104	Page 96 Section 5.4.2	Option 2, second bullet, add *contractor* and change *homebuilder* to *builder*	Drena
	Chapter 6.1: Bioretention Areas		
105	Page 98 Section 6.1	"Bioretention areas are:" Areas is too general a term, suggest *facilities* or *cells*	Review Team
106	Page 99 Section 6.1	"The terms bioretention and rain garden are sometimes.." This paragraph should move in front of the definition for bioretention areas. Also, suggest working with DOE for consistency in definitions in the SWMMWW for bioretention cells, swales, and planter boxes.	Review Team
107	Page 99 Section 6.1	"Planter-box designs also include patented or proprietary systems (usually using high flow media and placed subsurface along roads or in parking lots) for water quality treatment." This infers that Filterra will be considered LID. This is contradictory to conversation with DOE's LID task force. If a media cannot support trees, and system has no infiltration there is very little opportunity for influencing natural hydrology.	Tracy
108	Page 99 Section 6.1	It is hard to put all the variations of bioretention in a category. But we request defining planter-box designs as lined with underdrain designs - providing consistency with Seattle stormwater manual and Kitsap LID manuals.	Tracy
109	Page 101, Section 6.1.1	Last bullet, delete reference to *new construction* as oftentimes planters are the only thing feasible in an urban setting regardless if it is new construction or not.	Sherell Ehlers
110	Page 102 Section 6.1.1	Top bullet – this bullet seems to be referring to Filterra like systems. Again, conflicts with DOE's definition and causes confusion with LID definition.	Team Review/ tracy

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111	Page 103 Section 6.1.2	First bullet, "A minimum separation of 1 foot from the seasonal high water mark to the bottom…" Change to "A minimum separation of 1 foot from the ~~seasonal high water mark~~ *hydraulic restriction layer* to the bottom…"	Shanti
112	Page 103 Section 6.1.2	First bullet, "…Recommended separation distances for bioretention areas with small contributing areas are less than the new Department of Ecology recommendation…" This statement does not appear to be correct, the current draft Ecology SMMWW has the same recommendation.	Team Review
113	Page 103 Section 6.1.2	Second bullet, should be indented (like the one above). Also, "A minimum separation of 3 feet from the seasonal high water mark to the bottom…" Change to "A minimum separation of 3 feet from the ~~seasonal high water mark~~ *hydraulic restriction layer* to the bottom…"	Shanti
114	Page 103 Section 6.1.2	Last bullet – Setbacks Add "contaminated" sites to the list	Team Review
115	Page 104 Section 6.1.2	Transportation safety bullet – Add to end of paragraph, "*Some bioretention designs, such as extending the curb line into the roadway, can provide traffic calming functions. Work with local jurisdictions to determine restrictions.*"	Shanti
116	Page 105 Section 6.1.2.1	First bullet – Ecology uses SHC as the acronym for saturated hydraulic conductivity instead of Ksat. It would be helpful if the LID Manual and Ecology could use the same acronym.	Shanti
117	Page 106 Section 6.1.2.1	"If a single bioretention facility serves a drainage area exceeding 1 acre..." Clarify what is meant by facility, is this one or many bioretention cells. A single cell serving a drainage area that big would be huge and doesn't meet the intent of having small distributed systems. This threshold for requiring mounding analysis is too high.	Shanti

#	Page Number	Comment	Reviewer
118	Page 106 Section 6.1.2.1 Geotech/infiltration	Last paragraph – requiring a small-scale PIT every 50 feet for long, narrow bioretention facilities is excessive. Discuss with Infiltration SMEs, but recommend for linear projects greater than 200-feet, to change 50 feet to every 200 to 250 feet.	Shanti
119	Page 106 Section 6.1.2.1	Last paragraph – change seasonal high groundwater conditions to *hydraulic restriction layer*.	Shanti
120	Page 107 Section 6.1.2.1	A threshold on when a correction factor of 1 could be used should be established, applying no correction factor for large drainage areas seems risky. Suggest changing last sentence in first paragraph "Correction factors range from 0.33 to 1 (no correction) *as determined by a licensed geotechnical engineer or licensed engineering geologist."*	Shanti
121	Page 109 Section 6.1.2.2	Recommend addition of a table to defining minimum presetting requirements based on type of flow entrances. See end of document attached for suggested edits.	Tracy/Shanti
122	Page 109 Section 6.1.2.2	Flow Entrance and Presettling – 3rd bullet "Flow entrance should drop 2 to 3 inches from curb…" A better description or detail is needed here to aid in understanding what is being recommended. Seattle has a 1" drop from the curb to the top of finished grade at the curb cut, but then grades down to the bottom of the cell based on ponding depth.	Review Team
123	Page 109 Section 6.1.2.2	Third bullet, "special attention" replace with - *increased level of maintenance*	Drena
124	Page 109 Section 6.1.2.2	Curb cut width bullet – 18"recommended, 12" minimum	Shanti
125	Page 111 Section 6.1.2.2	Minimum bottom width 2ft- Seattle has reduced this criteria to 1' in the ROW to allow bioretention to fit within existing planting strips. Should allow local jurisdictions the ability to set a smaller width in the ROW otherwise bioretention may be deemed infeasible in those areas.	Drena/ Team Review

#	Page Number	Comment	Reviewer
126	Page 112, Section 6.1.2.2	Top of the page, suggest adding to sentence ", overflow from bioretention can also be provided by a curb cut on the downstream end of the bioretention to direct overflows from the bioretention back to the street." This can help minimize the cost of bioretention retrofits in urban locations where there is already existing stormwater infrastructure that can be utilized in the streets.	Corey
127	Page 112 Section 6.1.2.2	Bioretention soil media – It is confusing to have this section following the description of how to measure the infiltration rate in the BSM.	Team Review
128	Page 113 Section 6.1.2.2	Infiltration rates, first bullet – "When using the approved BSM guidelines provided below enter 6 inches per hour in WWHM or MGSFlood." Change to "When using the approved BSM guidelines provided below enter *a Ksat (SHC) of* 6 inches per hour *with appropriate correction factor* in WWHM or MGSFlood."	Shanti
129	Page 113 Section 6.1.2.2	Infiltration rates, second bullet – Add to end of paragraph, "*Enter the Ksat (SHC) with the appropriate correction factor into WWHM or MGSFlood.*"	Shanti
130	Page 114 Section 6.1.2.2	Aggregate gradation – "Table <???> provides a gradation guideline for the mineral aggregate component of a BSM specification in western Washington." Change to "Table <???> provides a gradation guideline for the mineral aggregate component of a BSM specification in western Washington. *This is the preferred gradation, but if difficult for local suppliers to provide, defer to City of Seattle mineral aggregate specification for BSM*."	Shanti
131	Page 114 Section 6.1.2.2	Compost to Aggregate ratio – Provide a range for ratio; it is not realistic to have a single value.	Shanti

#	Page Number	Comment	Reviewer
132	Page 114 Section 6.1.2.2	Existing soils – "For small projects that do not trigger treatment requirements, the native soil…" This sentence seems like it should not be included here at all since this section is about bioretention and small projects have already been directed to the Rain Garden Handbook. Change to "For projects that do not trigger treatment requirements (MR #6), the native soil…" or delete sentence.	Team Review
133	Page 117 Section 6.1.2.2	Infiltration rates and water quality treatment considerations This paragraph is very difficult to understand so please reword to be clearer.	Team Review
134	Page 120 Section 6.1.2.2	Last bullet under Under-drain - change seasonal high groundwater table to *hydraulic restriction layer*.	Shanti
135	Page 121 Section 6.1.2.2	Third bullet - Seattle has slots along the top as well as backup.	Team Review
136	Page 121 Section 6.1.2.2	Add a final bullet for "Areas of contaminated groundwater and soil"	Team Review
137	Page 122 Section 6.1.2.2	Last paragraph – Change minimum orifice diameter from 0.25 inches to 0.5 inches. For underground systems, 0.5 is a better minimum to help ensure continued system performance.	Shanti
138	Page 123 Section 6.1.2.2	Figure 6-1-20 Detail should show the check dam/weir keyed into the subgrade on bottom and sides to prevent lateral flow around and underneath.	Team Review
139	Page 123 Section 6.1.2.2	"Filter fabric can be placed along vertical walls to reduce lateral flows." Filter fabric is designed to limit soil migration, not reduce water flow. While the fabric can sometimes become clogged with soil particles this is not a guaranteed method for blocking infiltration pathways. Recommend deleting this option.	Claire Gibson

#	Page Number	Comment	Reviewer
140	Page 124 Section 6.1.2.2	Add bullet to consider: *Shrubs should be located and sized appropriately to prevent mature shrubs from shading out swale bottom plants.*	Drena
141	Page 124 Section 6.1.2.2	Add to 7th bullet, *including line of site for safety*	Drena
142	Chapter 6.1 (Bioretention) page 125	Last paragraph ---sentence starts out "Native and hardy cultivar plant species…" Recommend this as an appropriate expansion of the plant selections wherever it is not critical to have strictly native plants!	From Shane DeWald
143	Page 127 Section 6.1.2.2	Add bullet to top section – "Mulch above ponding depth for systems with concentrated outlet locations such as flow control structures to prevent downstream flooding"	Drena
144	Page 128 Section 6.1.2.3	First paragraph, add "subcontractors"	Drena
145	Page 128 Section 6.1.2.3	City of Seattle requires only 3 inches of subgrade scarification, 6 inches may be excessive.	Shanti
146	Page 131 Section 6.1.2.4	Fourth bullet, add "Depending on aesthetic *and safety* requirements..."	Drena
147	Page 159 Section 6.2.3	After planting and end of project phase add bullet – "*Remove all filter socks, curb and inlet blocks."*	Drena
148	Page 163 Section 6.3 Permeable Pavement	"The paving units are intended for pedestrian use only." – *PICP are capable of carrying heavy loads.*	Cris Horbelt & Timothy Lowry SPU
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#	Page Number	Comment	Reviewer
1501	Page 164 Section 6.3.1 (Permeable Pavement) Applications	"Permeable paving systems have been designed with aggregate storage to function as infiltration facilities with low subgrade infiltration rates (as low as 0.008 cm/hour or 0.003 inch/hour) in the Puget Sound region." This data suggests that the infiltration testing as outlined in manual currently for small size permeable pavement systems not receiving any runoff from adjacent impervious surfaces is an unnecessary burden. Again suggest "infiltration SMEs" reconvene to develop procedures.	Timothy Lowry
151	Page 168 Section 6.3.2 Design and Construction	After point 4, add a fifth bullet. 5) Education and quality control is also critical for these new LID techniques. Without raising awareness throughout the many links in the project implementation chain, the chance of project success drops significantly.	Timothy Lowry
152	Page 168 Section 6.3.2 Design and Construction	Add sentenced. "If sand bags are used for TESC, inspect and replace sandbags as necessary to mimize them becoming a source of sediment loading." "If adjacent streets receive sanding during snow events minimize transport of sand to permeable pavement areas by vacuum sweeping after snow melt.	Drena
153	Pge 170 Section 6.3.2.1 Common Components, Design and Construction Criteria for Permeable Pavement	"final excavation then proceeds as machinery is pulling back and traveling on preliminary grade as final grade is excavated." – *This needs a diagram or additional text for clarification since it appears to be a non-standard construction practice.*	Cris Horbelt & Timothy Lowry SPU
154	Page 179 Section 6.3.2	"A. In-situ small-scale pilot infiltration test" This is inconsistent with Section 2.2, which states that a large scale PIT should be used for permeable pavement applications. Our recommendation is to modify Section 2.2	Claire Gibson

#	Page Number	Comment	Reviewer
155	Page 180 Section 6.3.2	"Additionally, no correction factor may be necessary if the aggregate base is clean washed material…" Clarify to say "no correction factor *for quality of pavement base material aggregate* may be necessary…"	Claire Gibson
1564	Page 190 Section 6.3.2.2 Types of permeable paving (Portland cement pervious concrete / design and construction)	"ACI 522 is the current national standard …" . Suggest adding following sentence: "There is a concern that the ACI 522 specification does not provide adequate owner control since it currently allows for self-review by the concrete installer. For jurisdictions where low bid contracting is a requirement and the ACI 522 procedures are a concern, consider use of the City of Seattle standard for pervious concrete.	Timothy Lowry
1575	Page 206 Section 6.3.3 Maintenance	Add following bullets: "*Adaptive maintenance programs are encouraged to determine optimal cleaning of permeable pavements systems"*	Timothy Lowry
1584	Page 165, Section 6.3.1	'Permeable pavement should not be used or require additional engineering analysis and design considerations where:' These bulleted items do not match the infeasibility criteria for permeable that are listed in Volume 1 Minimal Technical Requirements and Site Planning of the Stormwater Management Manual for Western Washington. Add clarity on why some of the infeasibility criteria listed in Volume 1 are not listed, or list " additional considerations include and repeat the SMMWW list". The information should match to avoid confusion.	Corey
1595	Page 169, Section 6.3.2	Recommend allowing designed facilities to receive run-on. This can be a highly effective BMP depending on the site specific design considerations. City of Seattle allows up to 3:1 ratio of run-on to permeable pavement facilities that are engineered with an aggregate subbase storage layer.	Corey

#	Page Number	Comment	Reviewer
1606	Page 178, Section 6.3.2.1 Determining infiltration rate	There should be square footage thresholds that define small and large permeable pavement installations.	Corey
1618	Page 192 Section 6.3.2.2	Mix design should not necessarily be determined by the qualified concrete supplier. Permeable pavement of variable mix designs can be problematic for Right-of-Way applications. Suggest adding that Local jurisdictions should have the ability to develop their own specifications based on local practices, materials and lessons learned. City of Seattle already has a mix design in its Standard Specification for use in the Right-of-Way.	Corey
1629	Page 194 Section 6.3.2.2	How does Contractor demonstrate competence to install widths greater than 15' wide? Test panels? Suggest requiring contractor to provide method to show contractor competence.	Corey
1630	Page 195 Section 6.3.2.2	Minimum infiltration rate for newly placed pervious concrete is high. Use lower minimum infiltration rate. Seattle uses 100 inches per hour.	Corey
164	Page 229 Section 6.5	In the first paragraph, consider mentioning possibilities for urban agriculture.	SPU : April, Joel DPD: Dave LaClergue
165	Page 229 Section 6.5	At the end of paragraph 2, Green Roofs for Healthy Cities should have the industry growth data.	SPU : April, Joel DPD: Dave LaClergue

#	Page Number	Comment	Reviewer
166	Page 232 Section 6.5.2.1	A suggested addition to the first paragraph. After the sentence, "An additional design objective should be to incorporate fall protection and safety provisions both during construction and during regular maintenance." We would add, "*Providing easy roof access will result in, sometimes significantly, lower maintenance costs.*"	SPU : April, Joel DPD: Dave LaClergue
167	Page 233 Section 6.5.2.2	At the end of the third paragraph regarding steep slope green roofs, "…*and will have a lower flow control performance*."	SPU : April, Joel DPD: Dave LaClergue
168	Page 237 6.5.3.3	First paragraph, insert after the second sentence which states, "The role of filter fabric is to contain the fines and organics within the planted area." Consider adding something like, "*The fabric should have average opening size sufficient to retain the media and permissivity sufficient to allow anticipated peak rainfall to flow through when designed for flow control*."	SPU : April, Joel DPD: Dave LaClergue
169	Page 241	Response to third bullet point under "Irrigation". We have found that in this area, many extensive green roofs would have or have dried out when only water during plant establishment and drought periods – summers don't typically bring enough rain to sustain the plants. We have especially seen a high number of failures because of folks not wanting to water due to the LEED credit requirements. Consider: "*roofs should be designed for low-water use and this might include irrigation technologies that are highly efficient such as drip systems*."	SPU : April, Joel DPD: Dave LaClergue
170	Page 250	Add bullet: "*Another potential benefit is providing emergency water source in the event of natural or manmade disasters cutting off main water supply.*"	Timothy Lowry
171	Page 251 Section 6.7.1.1	Third paragraph, consider: "...a valuable *educational* tool..."	Bob Spencer

#	Page Number	Comment	Reviewer
172	Page 251 Section 6.7.1.1	Third paragraph, Edit to "(2000 to 10,000 gallons ~~typical~~) ~~is not available in rain barrels~~ cisterns are required…" Seems that the paragraph may have been intended to be about RWH for storm and significant water supply. But if you want to include the urban CSO reduction reference on the previous page, drop the low size down to 200 gallons. note we have modeling supporting stormwater benefit of 200 gallon size cistern if you would like the related data.	Bob Spencer
173	Page 251 Section 6.7.1.1	Suggest modification in text "The technology for rainwater harvesting is well developed and components readily available; however, system design and construction ~~is~~ *can be* relatively complex and should be provided by a qualified engineer or experienced designer."	Timothy Lowry
174	Page 252 Figure 6-7-2	Suggest also highlighting a small scale RWH system. Rainwater harvest for yard irrigation and peak flow reduction. You are welcome to the Seattle graphic for storm control in Rainwise design standards.	Bob Spencer
	6.7.2 Design	Clarify in intro paragraph Design elements are for systems intended for indoor water use. For simplistic peak flow cistern design suggest folks look to design guidance provided by Seattle RainWise program. Seattle.gov/util/rainwise (specifically this link but this is too long to reference!) http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/ResidentialRainwiseProgram/Incentives/index.htm	Tracy
175	Page 256 Section 6.7.2.1	"...multi reservoir applications can continue to operate if one of the tanks needs to be shut down..." Seems this would only be true if the multi tank systems had separate delivery systems, otherwise, most are in series so if one goes down, all the others downstream are affected.	Bob Spencer

#	Page Number	Comment	Reviewer
176	Page 256 Section 6.7.2.1	WAC reference. Unclear if this is all cisterns or only those intended for indoor use. Does not seem applicable for <2000 gallon cisterns providing only supplemental irrigation.	Tracy
177	Bioretention plant list	City of Seattle staff and consultants have put our accumulated knowledge on best plants for bioretention into Seattle's recently updated Seattle Green Factor Plant List, available at http://www.seattle.gov/dpd/Permits/GreenFactor/GreenFactorTools/ And we encourage incorporation of those species and plant information into the LID manual's plant appendix.	

With reference to above comment Page 109, Section 6.1.2.2 Below are the draft City of Seattle Bioretention Flow Entrance/Pre-Settling Requirements (Call Shanti if you would like to discuss):

Flow Entrance/Presettling

Flow entrance design will depend upon topography, flow velocities, flow volume, and site constraints. Flows entering a bioretention facility should be less than 1.0 foot per second to minimize erosion potential. Vegetated buffer strips are the preferred entrance type because they slow incoming flows and provide initial settling of particulates.

Four primary types of flow entrances can be used for bioretention cells:

- *Dispersed, low velocity flow across a grass or landscape area*: This is the preferred method of delivering flows to the bioretention cell. This method can provide initial settling of particulates.
- *Sheet flow across pavement or gravel and past wheel stops for parking areas*
- *Drainage curb cuts for driveway or parking lot areas*: Curb cuts shall include rock or other erosion protection material in the channel entrance to dissipate energy.
- *Pipe flow entrance*: Piped entrances shall include rock or other erosion protection material in the channel entrance to dissipate energy and/or provide flow dispersion.

Woody plants should not be placed directly in the entrance flow path because they can restrict or concentrate flows and can be damaged by erosion around the root ball.

For all four primary types of flow entrances described above, the following minimum requirements apply:

- A minimum 1-inch grade change between the edge of a contributing impervious surface and the vegetated flow entrance is required
- Until the upstream catchment area is thoroughly stabilized, flow diversion and erosion control measures must be installed to protect the bioretention area from sedimentation

For drainage curb cuts and pipe flow entrances, the following additional minimum requirements apply:

- If concentrated flows are entering the cell, engineered flow energy dissipation (e.g., rock pad or flow dispersion weir) must be incorporated

Drainage to a single cell/entrance	**Presettling requirement**
Less than or equal to 2,000 sf	A 1'diameter rock pad at bottom of cell (continuation of required rock along slope from entrance)
Greater than 2,000 sf up to 10,000 sf	Presettling area* sized per the following: Arterials – 0.5% of drainage area Residential – 0.25% of drainage area
Greater than 10,000 sf	Follow pretreatment requirements in Chapter 5

* Presettling area is defined as an area specifically designed to capture and hold the flows as it first enters the cell. The bottom of the presettling area should be large rock (XX define size) or concrete with a porous weir that ponds the water to 12 inches in depth

With reference to above comments about clarity around permeable pavement infiltration testing a table with content similar to below is recommended. (This table created by Timothy Lowry, call if you would like to discuss)

Infiltration Testing Thresholds for Permeable Pavement Design

This table defines when infiltration tests are required, and if so, whether textural analysis, small-scale or large-scale PIT tests are appropriate.

In general, the complexity of infiltration testing increases with the greater the intensity/ size of the site development and performance goals (such as flow control or water quality). The infiltration testing should, "produce a soil profile characterization"(page 20) sufficient to assess soil infiltration capacity into the sub base soils given the magnitude/intensity of the permeable pavement facility goals; I.E. amount of water landing on, flowing onto or into a structural and/or reservoir aggregate base.

Design variables include, size of installation, depth/magnitude of aggregate base (with aggregate depths greater than 6 inches being considered a reservoir base), run-on ratio (either via surface flow or piped from roof or other impervious surface), sediment/pollutant load, characteristics and relative consistency of soils across the site.

This table below is presented for general guidance only. It proposes thresholds for infiltration testing correlated to:

- Permeable pavement size with **SMALL** defined as **patios, walkways, sidewalks, driveways**) and **LARGE** defined as **alleys, parking lots, roads**
- Aggregate reservoir defined as aggregate base is greater than 6 inches in depth
- Run-on ratios (which for this analysis should include runoff that is piped directly into the aggregate reservoir) threshold at 1:1.5 (onsite:offsite+onsite)
- Site intensity/size defined by minimum requirements – Low intensity defined as min reqt's 1-5 – High intensity defined as min reqt's 1-9

	<u>Small</u> permeable pavement installations (patios, walkways, sidewalks, driveways)	**<u>Large</u> permeable pavement installations. (alleys, parking lots, roads, etc)**	**<u>Large</u> permeable pavement installations. (alleys, parking lots, roads, etc)**	**<u>Large</u> permeable pavement installations. (alleys, parking lots, roads, etc)**

	with permeable pavement surface only (no aggregate reservoir storage)	**with reservoir storage and no run-on from surface or roof (Surface in COS manual)**	**with reservoir storage and run-on from surface or roof less than or equal to 1:1.5 (Facility in COS manual)**	**with reservoir storage and run-on from surface or roof greater than 1:1.5 (Facility in COS manual)**
Site Intensity - Low Minimum Requirements 1-5	No infiltration test or textural soil analysis since it acts like a lawn.	Small-scale PIT test if deemed appropriate by engineer.	Small-scale PIT test	Multiple small-scale PIT tests
Site Intensity – High Minimum Requirements 1-9	Small-scale PIT test(s) if deemed appropriate by engineer.	Multiple small-scale PIT tests if deemed appropriate by engineer.	Multiple small-scale PIT tests	Multiple small-scale PIT tests. Large-scale PIT tests if deemed appropriate by engineer.