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MEMORANDUM

To: Kurt Triplett, City Manager

From: Kelli Jones, Surface Water Engineer
Jenny Gaus, Surface Water Engineering Supervisor
Kathy Brown, Public Works Director

Date: September 6, 2016

Subject: UPDATE OF SURFACE WATER DESIGN REGULATIONS TO MEET NPDES STORMWATER PERMIT REQUIREMENTS

RECOMMENDATION:

It is recommended that Council receives a second briefing on options for updating the surface water design requirements and provides feedback on any issues Council members would like staff to address during the update process.

BACKGROUND AND DISCUSSION:

1. Introduction

Staff provided background on the City's surface water design requirements at the July 5th regular Council meeting. In short, the City must adopt updated surface water design requirements by December 31, 2016 in order to comply with the NPDES Municipal Stormwater Permit (NPDES Permit). The updated requirements emphasize use of Low Impact Development facilities (LID), which help to reduce the flow and toxicity of stormwater. Use of LID complements other city efforts to manage stormwater for environmental and regulatory compliance purposes.

A study conducted since the July 5th Council meeting reveals that:

- Kirkland currently requires stormwater conveyance and flood protection measures that are not required per the NPDES Permit. The staff recommendation is that any package of surface water design requirements should continue to include these items.
- Based on review of approaches of neighboring cities and of Kirkland's needs (see above), staff have narrowed the choices to two packages that Kirkland could use to meet NPDES Permit requirements: the Ecology Manual plus separately adopted stormwater conveyance and flood protection measures (Ecology package), or the 2016 King County Surface Water Design Manual package (King County Package).
- Either package will provide significant stream protection and water quality benefits, and will increase the cost and complexity of surface water requirements. The difference between the packages is minor in comparison to the increased requirements caused by either package and necessary to comply with the NPDES permit.

- Either of these packages can be altered in certain ways to better meet Kirkland's needs

This study session will focus on the type of magnitude and impact of overall changes required regardless of the package chosen, as well as the differences between packages that comply with the NPDES Permit. The goal of the session is to gather Council feedback on the choice of package, so that staff can proceed with developing code changes and documentation for presentation for consideration at an October Council meeting.

This memo discusses the surface water design requirements only. There is significant interaction between update of surface water design requirements and update of the critical areas ordinance (CAO). An integrated view of the impacts of both of these updates to the city is presented in a 2017-2018 budget issue paper.

2. Options (Packages) for Updated Surface Water Design Requirements

The NPDES Permit requires that the City adopt a *package* of updated surface water design requirements equivalent to Appendix 1 of the Permit that includes:

- Minimum requirements for addressing
  - on-site runoff control (LID)
  - flow control
  - water quality treatment
- Requirements and guidance for pollution source control
- Project/Plan review and approval processes

Kirkland currently has requirements for stormwater conveyance and flood protection that are not required by the NPDES Permit, and staff assume that the City would not wish to relax these requirements. An example of such a requirement is that pipes conveying runoff from development/redevelopment be sized to contain runoff from the 25-year storm event. If the Council does not concur with this assumption, this study session would be the time to request the change in policy.

Based on the above requirements and assumptions, there are two packages presented for Council consideration:

<u>King County Package</u>

- 2016 King County Surface Water Design Manual
- 2016 King County Stormwater Pollution Prevention Manual
- Cross-reference and possible updates to Kirkland Code to match King County Code Chapter 9.04, 9.12 and 16.82.
- Kirkland Addendum that includes implementation details specific to the City

<u>Ecology Package</u>

- 2012/2014 Stormwater Management Manual for Western Washington (Ecology Manual) (includes a chapter on pollution source control)
- Creation and adoption of code and a technical notebook that details conveyance and flood protection requirements

- Comparison between Ecology Manual and Kirkland plan review/approval processes and possible alteration of Kirkland Code to resolve any conflicts
- Kirkland Addendum that includes implementation details specific to the City

The next two sections detail the general changes in requirements that occur with either of these packages, and the differences between the two packages.

3. Significant Changes with Either Package

Both of the packages presented above represent significant changes to the cost and complexity of surface water requirements relative to current City requirements. Differences between the two packages are small in relation to the magnitude of changes of either package relative to existing requirements.

The majority of the changes with either package result from the requirement that LID be considered and used to the maximum extent feasible. Every site that requires drainage review (generally those that create 2,000 sf of impervious surface) will need to evaluate soils, groundwater, slopes, and other information to determine feasibility. If conditions are favorable, installation of LID facilities such as rain gardens (bio retention), infiltration trenches, and permeable pavement will be required. In addition, soils must be amended with compost for most sites. Attachment A is an example of a typical design under the current manual compared to the new manual. Additional LID facilities, as well as larger LID facilities, will now be required and a traditional flow control facility, such as a vault or tank, will most likely still be required.

The size of flow control facilities will increase slightly under both packages. This increase results from new modelling software and the use of shorter time steps (15-minute vs. 1-hour). The change is likely a 10%-12% increase in volume for most projects. Depending on the size of the vault and efficiencies of scale, this will be a small increase in cost.

Both packages increase scrutiny of stormwater facilities that are proposed in landslide hazard areas. Additional requirements were added to determine feasibility of infiltration systems on or near steep slopes. This will prevent infiltration or dispersion from increasing landslide risk by being placed too close potential landslide hazard risk areas.

4. Impacts to Private Development and the City with Either Package

Types of impacts from updated surface water design requirements include alterations to construction cost, lifecycle cost, and maintenance costs. The impacts will affect both private development projects and city programs and operations. Balancing these impacts is an increased level of environmental protection that will assist in improving water quality and stream habitat.

Staff are still learning about these impacts, and what is presented here is our best educated guess. Both of the surface water design manuals are new, and only a small number of projects have been examined to evaluate potential impacts.

4A. Impacts to Private Development

Several examples that compare existing and proposed requirements for private development projects are presented in Attachments B and C. Private development projects will see the following impacts:

Increased study and design costs to evaluate the feasibility of LID, to develop more detailed erosion control plans, and to design many distributed LID facilities – this will have an especially large effect on small projects (2,000-10,000 sf of new and replaced impervious) that in the past would not have had to conduct a site evaluation or install LID facilities

Increased review time and cost - it may take longer to obtain permits for a given project, resulting in increased financing or opportunity costs. This delay will be longest when requirements are first adopted, as staff and design engineers will be learning the intricacies of the new design manual.

Increased construction cost – Because projects will need to provide LID facilities, often in addition to traditional flow control facilities such as tanks and vaults, construction costs will increase for most projects.

Potential increased lifecycle cost – If permeable pavement is used for driveways or parking areas, this may have a shorter life span than traditional paving materials. Other LID facility types may need to be reconstructed in fewer years than would a traditional tank or vault.

Increased maintenance cost – There will be more privately maintained facilities on private properties in residential projects: drywells and rain gardens in back yards, for example. The maintenance costs for these facilities vary from nothing (just make sure the facility is still there), to gardening (mulching, watering, weeding) for a rain garden, to vacuuming or sweeping of permeable pavement. Maintenance costs will increase for commercial multi-family projects that need to maintain both LID and traditional stormwater facilities.

4B. Impacts to City Projects and Programs

Update of surface water design requirements will impact City the cost and schedule of CIP projects, development review activities, and maintenance and inspection activities. There will also be long-term positive impact on water quality and stream habitat, which will assist with City efforts to protect and restore water resources. The size of this impact depends on the rate of development/redevelopment and on the long-term effectiveness of LID.

Transportation, Parks, and Public Safety (fire station) CIP projects are most likely to see changes to schedules and budgets with updated surface water design requirements. These projects are likely to add or replace impervious surface in quantities sufficient to trigger drainage review. Specific project examples are presented in Attachment D. Water and sewer projects generally do not create new impervious surfaces and/or are maintenance and so are exempt from surface water design requirements.

Transportation CIP projects such as sidewalks and street improvements (turn lanes, bike lines, etc.) are generally long and linear and are within existing rights of way. These projects will need to be evaluated for LID feasibility, to determine whether LID is infeasible due to soil conditions and drainage patterns. This will result in slightly increased study and design costs (these studies are often already done for CIP projects for other reasons so the difference may be minimal) and perhaps slightly lengthened project delivery periods. Requirements for evaluating flow control and water quality treatment remain unchanged. Flow control volumes

may increase by 10-20% due to new modelling methods and the construction cost difference will for those facilities will probably be slightly less then this because of efficiencies of scale.

Parks and fire stations are parcel-based projects. Impacts to the construction cost and schedule of these projects will be similar to what would be expected for a private development project. Small projects will be required to conduct an LID feasibility analysis, and to install LID facilities if feasible. Larger projects will also need to evaluate and install LID. Flow control and water quality treatment requirements are similar to existing (though there may be slight differences between the packages – see below). Parcel-based projects may have an increased review cost due to thresholds for types of drainage review, but currently pay for drainage review if triggered.

Surface water design review will be more complex and will need to be conducted for more projects under the new requirements. Service packages have been developed to add staff to work on both private development review and to coordinate and review CIP projects. These will be considered as part of the 2017-2018 budget process. The cost of these positions will be partially offset by increased design review revenue, as more projects will need to apply under a higher level of design review.

City maintenance needs will increase because of both facilities provided with CIP projects, and facilities provided with private residential projects (currently city policy is to maintain stormwater facilities associated with residential short plats and plats). Under both manuals, the number of LID facilities will increase. LID facilities provided with CIP projects will be publicly maintained unless agreements are negotiated with adjacent property owners. Staff will need to determine which if any LID facilities provided with private development projects will be publicly maintained. It may be possible, for example, to require that a homeowners' association be formed that will take responsibility for the gardening (weeding, mulching, plant replacement) of rain gardens in the right of way within a plat. A service package is being presented as part of the 2017-2018 budget to increase maintenance staff to accommodate this need plus work associated with maintenance of mitigation and restoration areas.

Per the NPDES Permit, all public and private flow control and water quality treatment facilities must be inspected once per year unless data is provided showing that the inspection frequency can be reduced. The number of LID facilities on private property will increase though the exact numbers depends on the pace and type of development/redevelopment. In addition to inspection, staff must notify owners of required maintenance, and may need to follow up with enforcement if the required maintenance is not completed. The number of public LID and traditional facilities will continue to increase as well. Staff will watch inspection needs over the next 2 years, and then will make a determination as to whether additional staff or resources are needed for facility inspection.

5. Comparing Packages

Both packages represent a large change from existing surface water design requirements. This section details the differences between the packages, which are likely small in relation to the difference between existing requirements and either package.

Differences between the two packages result in environmental benefits, risks and costs. The major differences that would result from using the King County package as opposed to the Ecology Package are discussed below. Other considerations in choosing a package in addition to these technical differences include:

- Consistency for developers – If requirements are the same for all jurisdictions in a region (King County, for example), developers do not need to learn new requirements when building a project in a new jurisdiction.
- Consistency – the City currently follows the 2009 King County Surface Water Design Manual with a Kirkland addendum.
- Prescriptive vs. outcome-based – the King County package provides greater detail on requirements, as opposed to outcomes. Reviewers (and some design engineers) appreciate the details of the King County package because it is clear when a project is in compliance. Some developers appreciate the outcome-based approach because there are instances where this can provide more flexibility.
- Staff would need to develop supplemental code and guidance on flood protection as part of the Ecology package. The King County package includes these items.
- Technical support. King County provides detailed technical support. Ecology provides limited support on outcomes and implementation details due to staff limitations.

5A. Summary of Technical Differences Between Packages

Technical design differences between the two packages are summarized here. If a future study is funded (see below) staff would continue to analyze the number and type of properties that might be impacted by differences between the packages.

The King County package would result in slightly larger flow control facilities for projects on certain soil types (moderate soils in flat areas where LID is feasible). Initial staff estimates are that it would impact very few projects, as there are few areas with these type of soils in Kirkland. This difference in flow control requirements arises because King County staff are concerned about the long-term viability of LID for flood control. The King County package applies factors of safety and a credit system (as opposed to allowing modelling of actual soil conditions) that result in more conservative estimates of the flow control function of LID, which results in larger traditional flow control facilities. King County has seen LID failures as well as major flooding problems (not necessarily associated with LID) that have colored their viewpoint.

The King County package would require flow control facilities where the Ecology package would not for certain small residential projects. As Kirkland has many small residential projects, this is a significant issue for the City (Attachment E). In 2015, 13 of 31 projects that were 2-4 lot short plats would have been impacted by this difference and would have had to provide flow control facilities under the King County package but not under the Ecology package. The 2015 Capacity Analysis with potential direct discharge areas removed shows that there are 443 parcels that could be impacted by this difference (Attachment F). The City would have gained flow control volume that protects stormwater infrastructure and streams, but also would have needed to begin inspection and maintenance of an additional 13 facilities per year if rates of development are similar to 2015.

Both packages give an option of either using a list of pre-designed LID facilities, or conducting modeling and choosing and sizing a suite of facilities to meet an LID performance standard (Attachment G). The Ecology list must be followed in order and requires use of rain gardens to serve rooftops and permeable pavement to serve all other hard surfaces. In other words, this list would result in creation of quite a bit of permeable pavement, with associated lower lifecycle and increased maintenance costs. The King County list is more flexible in the allowed facility types and would likely result in less permeable pavement.

The overall impacts between either manual for the private development community and parcel based CIP projects are summarized below. The construction cost is estimated to be higher under the King County package due to the conservative LID approach and the need for flow control facilities for smaller projects where the Ecology package would not require a system. However, maintenance and life cycle costs are anticipated to be lower for the King County package due to less permeable pavement.

Private development and parcel-based CIP Projects

	Ecology Manual	King County Manual
Construction Cost	Base	Higher
Maintenance Cost	Base	Lower
Life Cycle Cost	Base	Lower

For the CIP Right of Way projects evaluated to date, the differences between the two manuals will not play a major factor in cost. Projects would likely be evaluated the same between both manuals. Projects that trigger a flow control facility (rare for Right of Way projects) would be slightly larger using the King County package rather than Ecology package, but otherwise, produce very similar LID options (meet LID performance standard instead of list approach).

CIP Projects in Right of Way

	Ecology Manual	King County Manual
Construction Cost	Base	Equal
Maintenance Cost	Base	Equal
Life Cycle Cost	Base	Equal

6. Potential Alterations to Packages

Either package may need to be altered to meet Kirkland's needs. In general, alterations that add or increase requirements are allowed, and implementation details such as plan review requirements can be changed to meet local processes. Below are groups of changes that staff would recommend that Council consider for each package.

6A. Potential Alterations to Ecology Package

The Ecology package is the base in terms of what is required by the NPDES Permit. It does not contain requirements regarding flood protection or stormwater system conveyance elements. As Kirkland already has these items in place via the 2009 King County Surface Water Design

Manual, staff recommends that these elements should be retained. If the Ecology package is adopted, staff would recommend that they develop a technical notebook and Municipal Code changes that adopt conveyance and flood protection items such as pipe sizing and peak flow control.

6B. Potential Alterations to King County Package

The King County package contains the base elements required per the NPDES Permit, and contains flood protection and conveyance system elements. There are also some places where requirements differ from those of Ecology, as noted above. Council could choose to modify certain requirements that could be considered to be above-and-beyond what is required by the NPDES Permit. As noted above, there are differences between the way that Ecology and King County packages determine whether flow control facilities are required. This has implications for small short plats, of which there are many in Kirkland (see above). Options for altering this requirement include:

> Option 1: Leave King County package as-is either permanently, or while staff investigate a fee-in-lieu program (see Option 3 below). This would result in construction of more flow control facilities to serve small short plats as described below.
>
> Option 2: Adopt the Ecology package method of determining whether flow control is required (allow use of existing conditions in determining whether flows exceed the 0.15 cfs exception). This would result in fewer flow control facilities provided by small projects. Based on 2015 development numbers, approximately 12 projects out of 61 LSM Permits issued would not trigger flow control, where they would trigger such control under the King County package. Ecology has indicated that this would be an acceptable alteration of the King County package.
>
> Option 3: Adopt a Fee-in-Lieu program for small projects that would require flow control under the King County package, but that would not require it using the Ecology package method. This program would give developers the option of paying a fee rather than installing a flow control facility for those projects. The fee would be used to conduct basin planning to determine the best location size and type of flow control facilities to meet flood and stream protection goals for the city's watersheds.

7. Recommendation – King County Package with Slight Alterations

Staff recommend adoption of the King County package as-is (Option 1). It is further recommended that staff evaluate a fee-in-lieu program for Council review and potential approval in the first half of 2017 (Option 3). This approach would require flow control facilities for certain small projects that would not be required under Ecology, but this would likely impact a small number of projects that complete review in the first portion of 2017. Staff could notify applicant of the potential for a fee-in-lieu program should they wish to wait to see if it is approved.

The King County package is more complete than the Ecology package as it includes conveyance and flood protection requirements. The King County package takes a slightly more cautious approach than the Ecology package to LID: it is required, but backup facilities are also required

in the event that LID fails due to non-maintenance, geologic conditions, or other conditions. The King County package also provides regional consistency and consistency with past City requirements, both of which are appreciated by developers. King County staff have provided, and continue to provide, excellent technical support for use of the King County package.

The study described above would be used to determine the costs and benefits of this choice, and would assist in identifying and developing tools to streamline the development review process.

8. Study of the Two Packages

The King County and Ecology packages are both new. Staff have spent considerable effort running sample projects through both packages, but will not truly start to see the full range differences unless project comparisons are continued as actual projects are reviewed. In addition, there may be tools and implementation methods that would streamline the design and review process for both private development and CIP projects in Kirkland. Therefore staff are proposing to conduct a study over the next two years that may include the following:

- LID feasibility tools: investigate whether groundwater and geologic maps can be used to inform LID feasibility in certain areas of the city, and whether calculators or other tools could help to streamline the process.
- Special zoning district and other ways of implementing LID on a watershed or regional basis: Investigate whether this would help to control the type and location of LID facilities in a way that would be beneficial for city maintenance costs and for our watersheds.
- Evaluation of flow control sizing under both manuals: Investigate the type and number of projects that are impacted by sizing and threshold differences between the manuals, and investigate whether further changes to the King County package should be considered.

This study is being proposed as a service package as part of the 2017-2018 budget process and grant opportunities are also being explored.

9. Outreach Process

Coordination and public outreach for adoption of updated surface water design requirements has the goal of informing city staff and elected officials, the development community, and the public about the upcoming changes. To date, the following outreach has occurred:

- Parks/Public Works/Human Resources Council Committee
- CIP Steering Committee
- Open House for the Community
- Open House for Developers and Design Engineers
- Council Briefing
- Project website

At these meetings, questions and concerns have been raised regarding the impact of the updated requirements on the cost, complexity, and environmental benefits of the proposed requirements.

Future outreach efforts will include a second public open house, training for internal staff, and handouts such as templates, flow charts and policies to help the development community understand the new requirements.

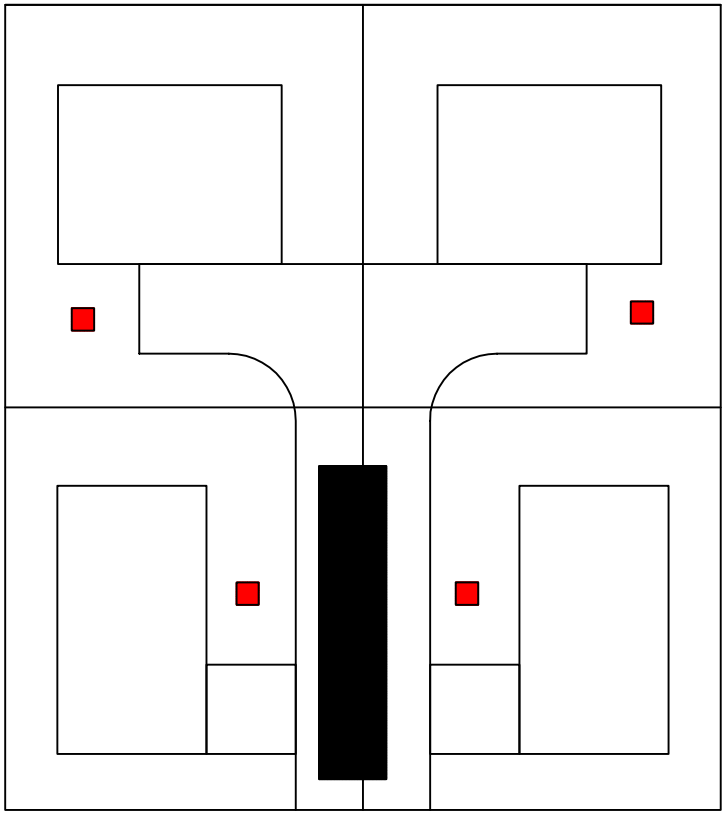
King County is planning on providing training on the 2016 KCSDM in October. If, however, King County does not provide training, the surface water group will develop training for design engineers and developers.

10. Timeline and Next Steps

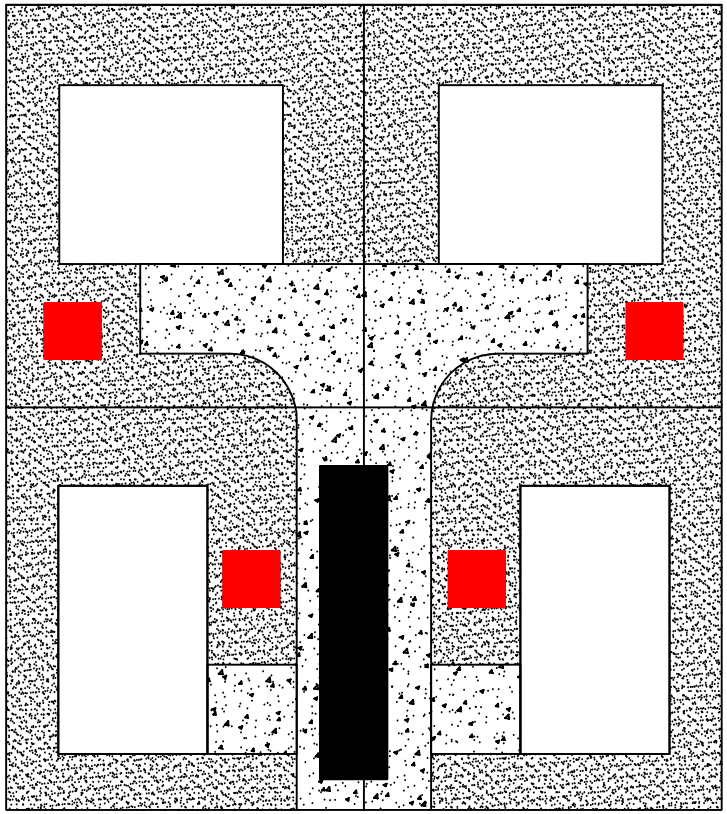
Staff will return to Council in October with an ordinance to adopt the Council's preferred package and to make any accompanying code changes. The effective date of whichever package is chosen will be set at January 1, 2017 in order to comply with the NPDES Permit. Staff will use the time between adoption and the effective date to provide and attend training, and to update the Pre-Approved plans with details and policies associated with the chosen package. Service packages are being proposed as part of the 2017-2018 budget for staff and consultant resources associated with adoption of either package.

Attachment A – Current Manual vs. New Manual Site Layout
Attachment B – Impacts to Projects by Size and Type from Adoption of the 2016 KCSDM
Attachment C – Sample Private Development Projects
Attachment D – Sample CIP Projects
Attachment E – Pie Chart for 2015 LSM Submittals
Attachment F – Properties between 15,000 and 20,000 Square Feet in Size Excluding Level 1 Flow Control Areas
Attachment G – LID lists in the Ecology and King County packages

Current Manual vs New Manual Site Layout



Current Manual
2009 King County Manual



New Manual
Either 2016 King County Manual
or 2012 Ecology Manual

Drywell

Soil Amendment

Pervious Pavement

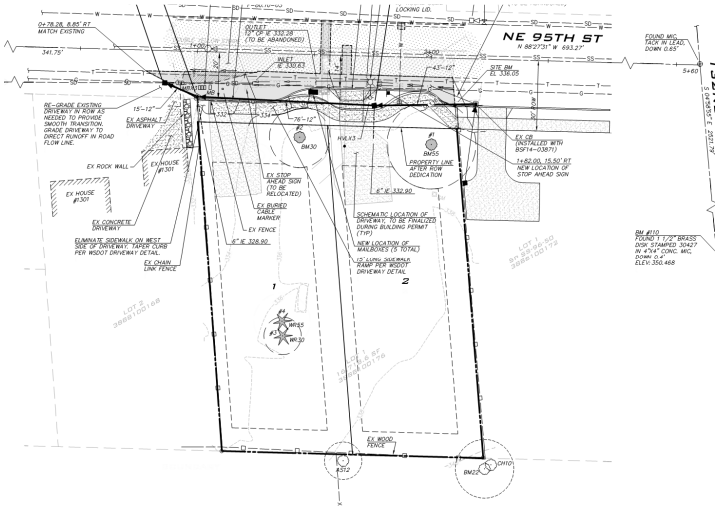
Detention Vault

Impacts to Projects by Size and Type from Updated Surface Water Design Requirements

Project Size	Typical Project	Change with New Manual	Change to Projects
< 500 sf of new plus replaced impervious surface	Addition of a patio or parking area to a single-family house	No change	No Change
Small - 500 - 1,999 sf of new plus replaced impervious surface	Addition to a single-family house	No change	No Change
Medium - 2,000 - 9,999 sf of new plus replaced impervious surface or < 5,000 sf of new impervious surface	2-4 lot shortplat, large single-family house	LID required to the maximum extent feasible, potentially full drainage review instead of small type II for projects	Potentially Large Change
Large - > 10,000 sf of new plus replaced impervious surface or > 5,000 sf of new impervious surface	Large commercial facility, plat of > 4 lots	LID required to the maximum extent feasible	Potentially Small Change because facilities are already required

Private Development Project – Beautiful Day Short Plat (2 Lots)

Background – Single lot subdividing into 2 lots. Total project size = 18,730 sf with existing impervious onsite = 4,200 sf.



Developed Conditions – This project would create 8,509 sf of new and replaced impervious surface and 10,221 sf of new pervious surface.

2009 KCSDM - This project would trigger a **Small Type II Drainage Review**. The project provided porous pavement and amended soil to meet minimum LID facility requirements. No flow control or water quality required.

2016 KCSDM – This project would trigger a **Full Drainage Review**. This project would need to evaluate flow control, water quality, and LID to the maximum extent feasible. This project would trigger a flow control facility (~4,700 CF), porous pavement for frontage improvements and driveways, and either infiltration trenches or rain gardens for the roofs. Water quality is not required.

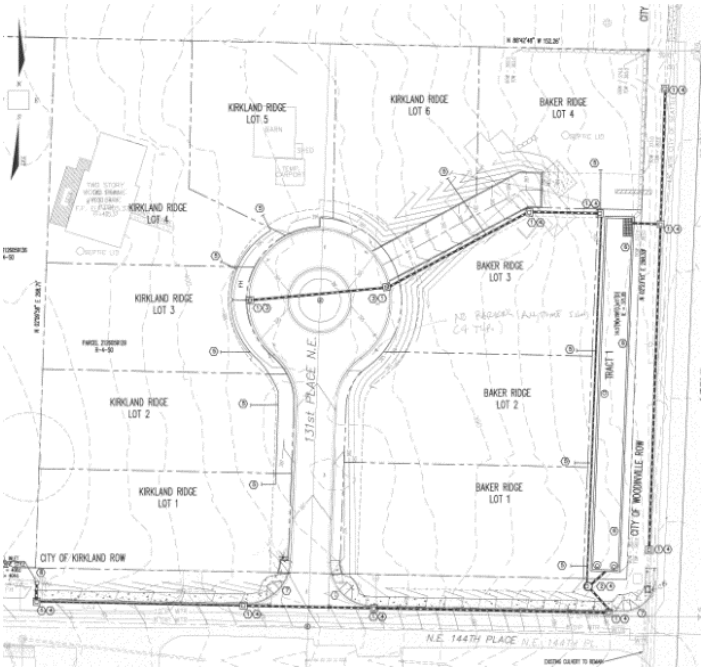
2014 Ecology Manual – This project would need to evaluate **Minimum Requirements 1 – 9** (similar to full drainage review). This project would need to evaluate flow control, water quality, and LID to the maximum extent feasible. This project would not require water quality treatment or a flow control facility. LID would be met using porous pavement for all hard surfaces and bioretention for each lot's roof tops.

Changes from Current to Either Manual – This biggest change is the evaluation is from a small drainage review to a full drainage review. In a full drainage review, water quality and flow control are required to be evaluated. This causes this project to need a flow control facility in the 2016 KCSDM.

Change Between 2016 KCSDM and 2014 Ecology Manual – The biggest difference between the manuals is the need for a detention system in the KCSDM and no detention system in the Ecology manual.

Private Development Project – Baker / Kirkland Ridge Plat (10 Lots)

Background – Two lots subdividing into 10 lots. Total project size = 111,078 sf with existing impervious onsite = 7,000 sf.



Developed Conditions – This project would create 62,675 sf of new and replaced impervious surface and 48,403 sf of new pervious surface.

2009 KCSDM - This project would trigger a **Full Drainage Review**. This project would need to evaluate flow control, water quality, and LID for a portion of their project. Flow control was provided through a detention vault, water quality through a wetvault, and a reduction in lot coverage to meet LID.

2016 KCSDM – This project would trigger a **Full Drainage Review**. This project would need to evaluate flow control, water quality, and LID to the maximum extent feasible. A detention vault would be provided and water quality through a wetvault. LID was found to be infeasible for lots 1 – 6, but feasible for lots 7 – 10 and the ROW improvements. ROW improvements used an infiltration trench under the planter strip to meet LID requirements.

2014 Ecology Manual – This project would need to evaluate **Minimum Requirements 1 – 9** (similar to full drainage review). This project would need to evaluate flow control, water quality, and LID to the maximum extent feasible. A detention vault would be provided and water quality through a wetvault. LID was found to be infeasible for lots 1 – 6, but feasible for lots 7 – 10 and the ROW improvements. ROW improvements would be a permeable pavement road and sidewalks.

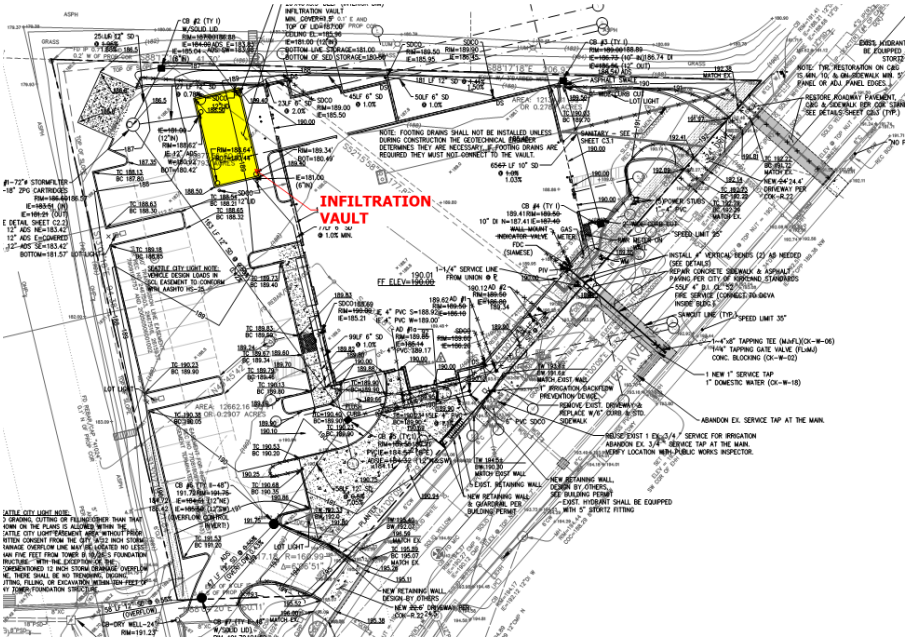
Changes from Current to Either Manual – This biggest change is LID to the maximum extent feasible. LID is only required for 10 – 20% of the lot size, rather than maximum extent feasible.

Change Between 2016 KCSDM and 2014 Ecology Manual – There are two major differences between the manuals: 1) how LID is implemented and 2) detention sizing.

1) With the 2016 KCSDM, options are allowed in the ROW using the list approach, which is why infiltration trenches are allowed under planter strips. 2014 Ecology Manual would require a permeable pavement road as the first LID alternative if feasible.
2) Detention sizing is significantly larger with the above design, due to credits in 2016 KCSDM (detention size of ~ 33,250 CF) vs allowance of modeling in 2014 Ecology Manual (detention size of ~16,200 CF).

Private Development Project – Commercial Project

Background – Hyundai car dealership was reviewed in 2013 under the King County 2009 Manual. The total parcel size was 45,700 square feet. Existing impervious on site was approximately 20,000 sf.



Developed Conditions – This project proposed to remove all existing impervious onsite and build a new dealership. New and replaced impervious on site totaled 38,000 sf.

2009 KCSDM – This project triggered a **Full Drainage Review**. Flow control, water quality, and LID for 20% of the site needed to be evaluated. This project met the requirements by providing an infiltration vault for full infiltration. Water quality was met through a soil exemption with infiltration.

2016 KCSWM – This project would trigger a **Full Drainage Review**. This project would need to evaluate flow control, water quality, and LID to the maximum extent feasible. This project proposed an infiltration vault for full infiltration to meet all requirements.

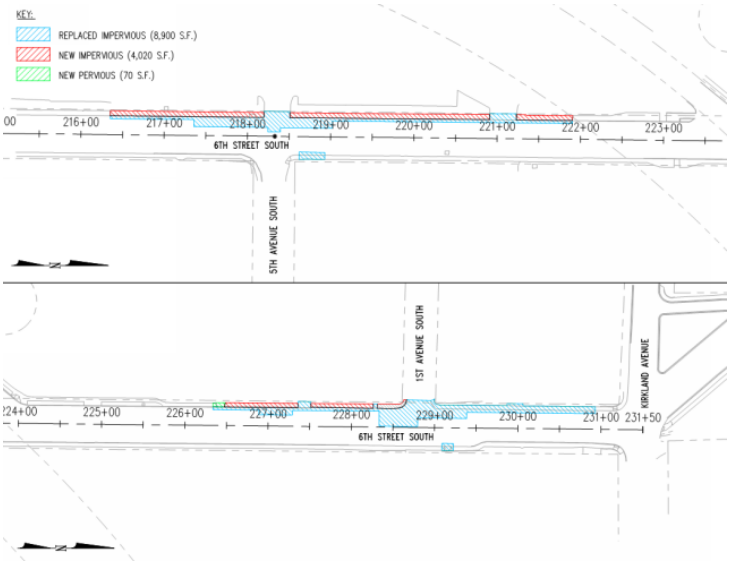
2014 Ecology Manual – This project would trigger **Minimum Requirements 1 – 9.** This project would need to evaluate flow control, water quality, and LID to the maximum extent feasible. This project proposed an infiltration vault for full infiltration to meet all requirements.

Changes from Current to Either Manual – This biggest change is the evaluation of LID to the maximum extent feasible. However, this project meets the LID requirement for the new manual by providing full infiltration. Design would not change.

Change Between 2016 KCSDM and 2014 Ecology Manual – Either manual would provide the same design using full infiltration to meet all three requirements. The design would be the same.

CIP Project – 6th Street Sidewalk

Background – Add new and replace existing sidewalk along 6th St S.



Developed Conditions – This project added 4,020 sf of new impervious area and replaced 8,900 sf of sidewalk.

2009 KCSDM – This project would fall under Full Drainage Review. It would meet the transportation exemption (<5,000 sf of new), so flow control would not be required. It would not trigger water quality requirements because sidewalk is not considered a pollution generating impervious surface. LID is recommended, not required for ROW projects.

2016 KCSDM – This project would fall under a Full Drainage Review. Flow Control would need to be evaluated, but would meet the 0.15 cfs exception, so no facility would be required. It would not trigger water quality requirements because sidewalk is not considered a pollution generating impervious surface. LID would be required to the maximum extent feasible.

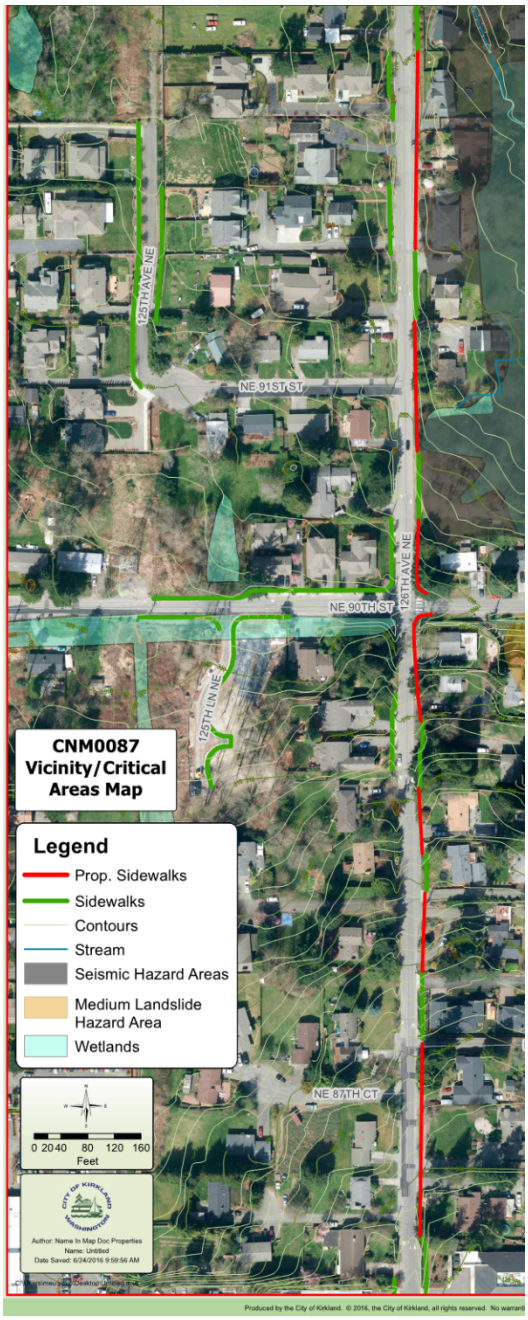
2014 Ecology Manual – This project would need to evaluate Minimum Requirements (MR) # 1 – 5, which include feasibility of LID to the maximum extent feasible. No evaluation of flow control is required.

Change from Current to Either Manual – The biggest change is the feasibility of LID to the maximum extent feasible for projects within the ROW. In the current manual, LID is recommended, not required in the ROW.

Change Between 2016 KCSDM and 2014 Ecology Manual – The primary change is how to evaluate LID. If the LID Performance Standard method is used, LID implementation would be very similar between the two manuals. If the list approach is used, Ecology would require permeable pavement or rain gardens as the first option to evaluate. King County's list could be met by either using porous pavement, or directing the flow into an infiltration trench, drywell, or rain garden.

CIP Project – School Walk Route: 126th Ave NE from NE 85th St to NE 94th Way

Background – Improve school walk routes by providing sidewalk where there currently is none. Install 1400 LF of sidewalk, including curb, gutter and storm drainage improvements



Developed Conditions – This project would add 7,000 sf of new impervious area.

2009 KCSDM – This project would trigger a Full Drainage Review. This project would need to evaluate flow control and water quality, but would not trip either requirement. LID is recommended, not required.

2016 KCSDM – This project would trigger a Full Drainage Review. This project would need to evaluate flow control and water quality, but would not trip either requirement. LID would need to be installed to the maximum extent feasible.

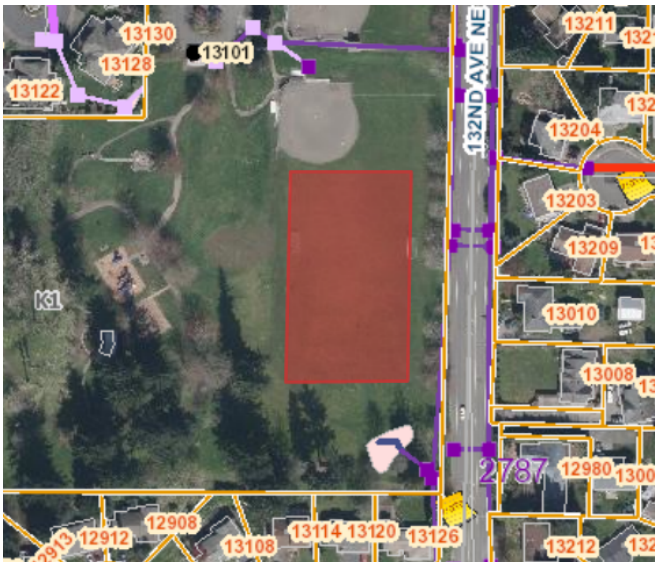
2014 Ecology Manual – This project would need to evaluate Minimum Requirements # 1 – 9. This project would need to evaluate flow control and water quality, but it would not trip either requirement. LID would need to be installed to the maximum extent feasible.

Changes from Current to Either Manual - The biggest change is the feasibility of LID to the maximum extent feasible for projects within the ROW. In the current manual, LID is recommended, not required in the ROW.

Change Between 2016 KCSDM and 2014 Ecology Manual – The primary change is how to evaluate LID. If the LID Performance Standard method is used, LID implementation would be very similar between the two manuals. If the list approach is used, Ecology would require permeable pavement or rain gardens as the first option to evaluate. King County's list could be met by either using porous pavement, or directing the flow into an infiltration trench, drywell, or rain garden.

CIP Project – 132nd Square Park Turf Field

Background – Parks is potentially looking at installing turf field at 132nd Square Park. The total project size is assumed to be 43,560 sf.



Developed Conditions – Assuming that the turf field did not have an underdrain but an overflow (providing storage beneath the pipe), there would be no new or replaced impervious surface. This project would create 43,560 sf of new pervious surface.

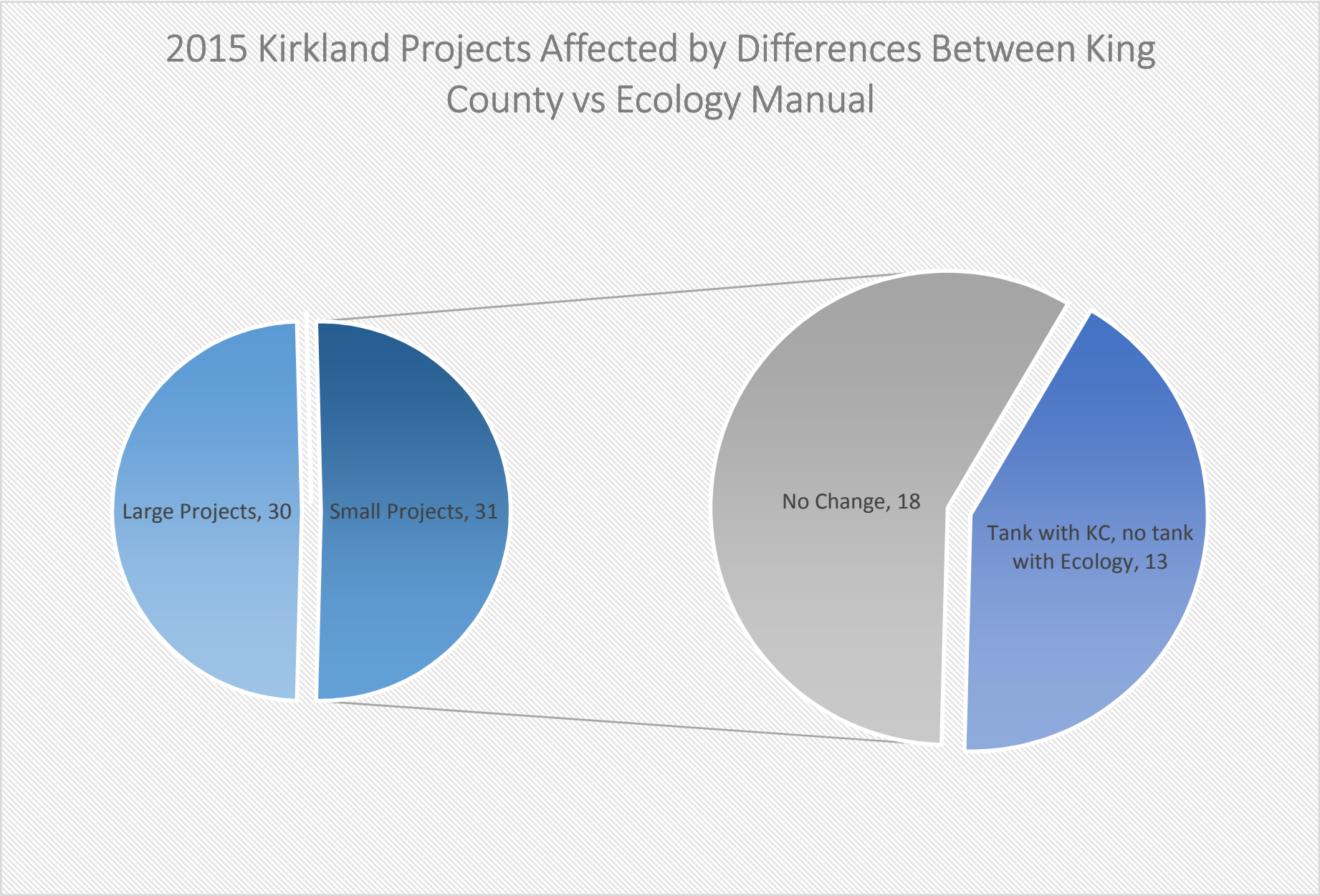
2009 KCSDM - This project would trigger a **Full Drainage Review**. This project would need to evaluate flow control, water quality, and LID for 10 – 20% of the disturbed area. All three of these would be met through infiltration under the turf field. 11" of rock storage would be provided below the field for full infiltration (assuming measured infiltration rate of 0.3 in/hr).

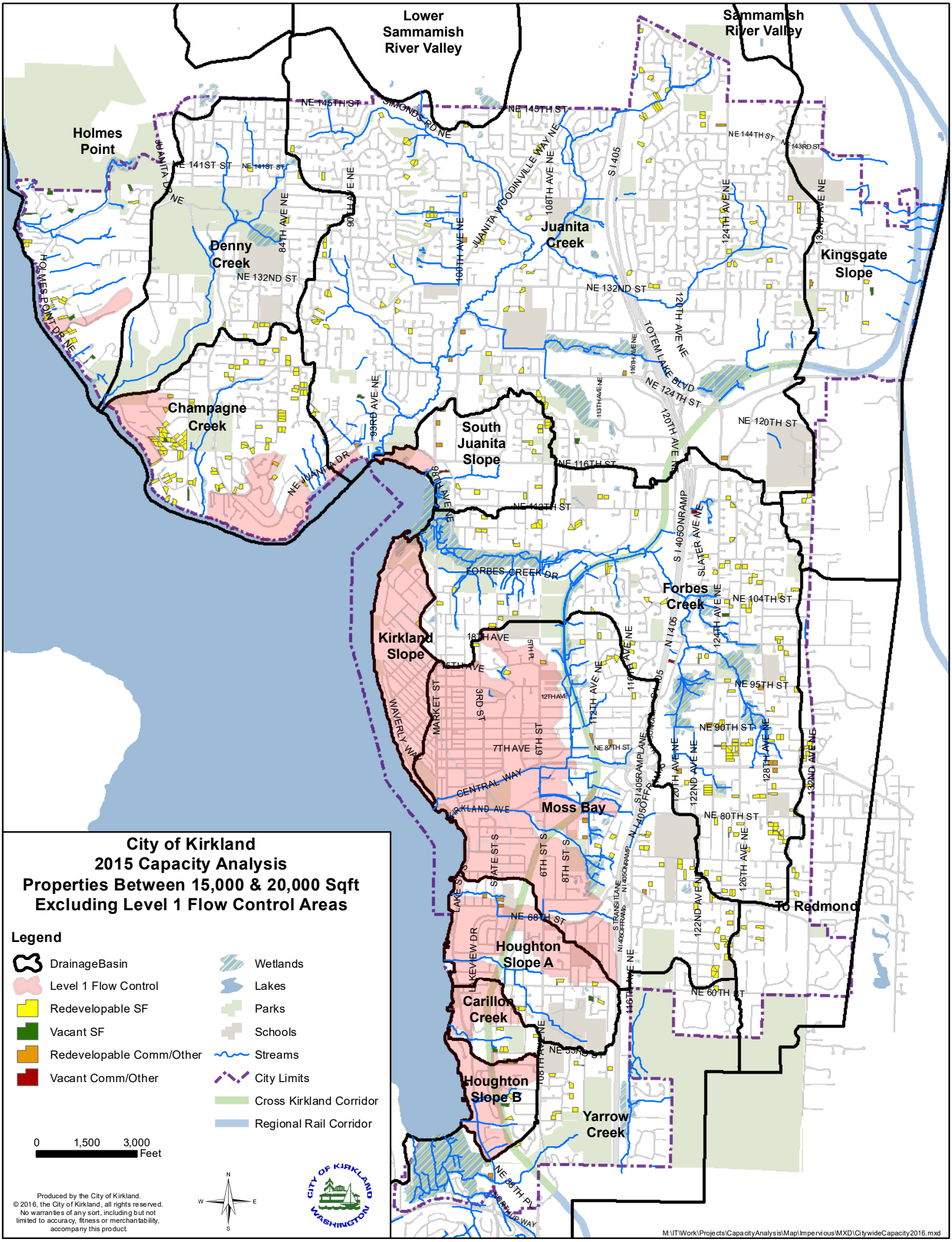
2016 KCSDM – This project would trigger a **Full Drainage Review**. This project would need to evaluate flow control, water quality, and LID for 10 – 20% of the disturbed area. All three of these would be met through infiltration under the turf field. 11" of rock storage would be provided below the field for full infiltration (assuming measured infiltration rate of 0.3 in/hr).

2014 Ecology Manual – This project would need to evaluate **Minimum Requirements 1 – 9** (similar to full drainage review). This project would need to evaluate flow control, water quality, and LID for 10 – 20% of the disturbed area. All three of these would be met through infiltration under the turf field. 11" of rock storage would be provided below the field for full infiltration (assuming measured infiltration rate of 0.3 in/hr).

Changes from Current to Either Manual – This biggest change is the evaluation of LID to the maximum extent feasible. However, this project meets the LID requirement for the new manual by providing full infiltration. Design would not change.

Change Between 2016 KCSDM and 2014 Ecology Manual – Either manual would provide the same design using full infiltration to meet all three requirements. The design would be the same.


2015 Kirkland Projects Affected by Differences Between King County vs Ecology Manual
Large Projects, 30
Small Projects, 31
No Change, 18
Tank with KC, no tank with Ecology, 13



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Basin	Redevelopable SF	Vacant SF	Redevelopable Comm/Other	Vacant Comm/Other	Total
Carillon Creek	5	2	0	0	7
Champagne Creek	82	2	0	0	84
Denny Creek	9	0	0	0	9
Forbes Creek	115	1	6	2	124
Holmes Point	15	6	0	0	21
Houghton Slope A	5	1	3	0	9
Houghton Slope B	3	1	0	0	4
Juanita Creek	82	3	7	0	92
Kingsgate Slope	6	1	1	0	8
Kirkland Slope	1	0	0	0	1
Lower Samm River Valley	0	0	0	0	0
Moss Bay	38	0	4	0	42
South Juanita Slope	12	0	3	1	16
To Redmond	15	0	0	0	15
Yarrow Creek	10	0	1	0	11
Totals	398	17	25	3	443

2014 Ecology List

List #1 & List #2: For each surface, consider the BMP's in the order listed for that type of surface. Use the first BMP that is considered feasible.

BMPs	***List #1 (Project triggers Minimum Requirements #1-5)***	***List #2 (Project triggers Minimum Requirements #1-9)***
Lawn & Landscaped Areas:	• Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 5 of Volume V of the *SWMMWW*	• Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 5 of Volume V of the *SWMMWW*
Roofs:	**1.** Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V of the *SWMMWW*, or Downspout Full Infiltration Systems in accordance with BMP T5.10A in Section 3.1.1 of Volume III of the *SWMMWW.*	**1.** Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V of the *SWMMWW*, or Downspout Full Infiltration Systems in accordance with BMP T5.10A in Section 3.1.1 of Volume III of the *SWMMWW.*
	2. Rain Gardens in accordance with the "Rain Garden Handbook for Western Washington," or Bioretention in accordance with Chapter 7 of Volume V of the *SWMMWW.* The rain garden or bioretention facility must have a minimum horizontal projected surface area below the overflow which is at least 5% of the area draining to it.	**2.** Bioretention (See Chapter 7 of Volume V of the *SWMMWW*) facilities that have a minimum horizontally projected surface area below the overflow which is at least 5% of the of the total surface area draining to it
	3. Downspout Dispersion Systems in accordance with BMP T5.10B in Section 3.1.2 of Volume III of the *SWMMWW.*	**3.** Downspout Dispersion Systems in accordance with BMP T5.10B in Section 3.1.2 of Volume III of the *SWMMWW.*
	4. Perforated Stub-out Connections in accordance with BMP T5.10C in Section 3.1.3 of Volume III of the *SWMMWW.*	**4.** Perforated Stub-out Connections in accordance with BMP T5.10C in Section 3.1.3 of Volume III of the *SWMMWW.*
Other Hard Surfaces:	**1.** Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V of the *SWMMWW.*	**1.** Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V of the *SWMMWW.*
	2. Permeable pavement[1] in accordance with BMP T5.15 in Chapter 5 of Volume V of the *SWMMWW,* or Rain Gardens in accordance with the "Rain Garden Handbook for Western Washington," or Bioretention in accordance with Chapter 7 of Volume V of the *SWMMWW.* The rain garden or bioretention facility must have a minimum horizontal projected surface area below the overflow which is at least 5% of the area draining to it.	**2.** Permeable pavement[1] in accordance with BMP T5.15 in Chapter 5 of Volume V of the *SWMMWW*
	3. Sheet Flow Dispersion in accordance with BMP T5.12, or Concentrated Flow Dispersion in accordance with BMP T5.11 in Chapter 5 of Volume V of the *SWMMWW.*	**3.** Bioretention (See Chapter 7, Volume V of the *SWMMWW*) facilities that have a minimum horizontally projected surface area below the overflow which is at least 5% of the of the total surface area draining to it**.**
		4. Sheet Flow Dispersion in accordance with BMP T5.12, or Concentrated Flow Dispersion in accordance with BMP T5.11 in Chapter 5 of Volume V of the *SWMMWW.*

Refer to your Municipal Stormwater Permit, 2012 Stormwater Management Manual for Western Washington, and/or your local jurisdiction for more information about these requirements and other requirements.

[1] This is not a requirement to pave these surfaces. Where pavement is proposed, it must be permeable to the extent feasible unless full dispersion is employed.

investigation, permeable soil and depth to seasonal high groundwater, determination of initial infiltration rates, calculation of design infiltration rates, and preparation of soils reports consistent with the larger size and risk associated with these systems.

Infiltration Testing Requirements

The testing procedure described below is for bioretention and permeable pavement serving a single lot, less than 10,000 square feet of impervious area, less than 5,000 square feet of pollution generating impervious surface, less than ¾ acre of pervious area, and less than 1 acre total tributary area.

Where required to determine feasibility/infeasibility based on native soil infiltration rates, the following test procedure is required:

Infiltration Testing Procedure

1. Excavations shall be made to the bottom elevation of the proposed infiltration BMP. The measured infiltration rate of the underlying soil shall be determined using one of the following: the **EPA falling head percolation test procedure** (*Onsite Wastewater Treatment and Disposal Systems*, EPA, 1980; see Reference Section 6-A), the **double ring infiltrometer test** (ASTM D3385), a **single ring percolation test** using a ring at least 3 feet in diameter (see Reference Section 6-A), or a small or large scale **Pilot Infiltration Test (PIT)** as described in the 2014 Stormwater Management Manual for Western Washington and Reference 6A of this manual. The larger PIT tests have been shown to more closely match actual full-scale facility performance than the single ring and smaller test methods.
2. The test hole or apparatus shall be filled with water and maintained at depths above the test elevation for the **saturation periods** specified for the appropriate test.
3. Following the saturation period, the rate shall be determined in accordance with the specified test procedures, with a **head** of 6 inches of water.
4. The design engineer shall perform sufficient tests at multiple locations in a proposed BMP footprint to determine a representative infiltration rate. At least two **tests** shall be performed (three if using the smaller-sized EPA falling head or ASTM D3385 double ring infiltrometer test methods) for each proposed bioretention BMP location. Proposed bioretention swales require 1 test per 200 linear feet of swale with a minimum of two tests (3 if using the smaller-sized EPA falling head or ASTM D3385 double ring infiltrometer test methods) performed. Proposed permeable pavement requires 1 test per 5,000 square feet of proposed footprint with a minimum of two tests (3 if using the smaller-sized EPA falling head or ASTM D3385 double ring infiltrometer test methods) performed.

❑ MITIGATION OF WATER QUALITY IMPACTS

For projects subject to Simplified Drainage review, most water quality impacts will be adequately addressed through proper application of flow control BMPs to impervious and pervious surface as specified below. Projects in Simplified Drainage Review are required to have less than 5,000 square feet targeted pollution generating impervious surfaces and less than ¾ acres of new pollution generating pervious surfaces-- therefore, water quality facilities are not required.

C.1.3.1 SMALL LOT BMP REQUIREMENTS

IF the proposed project is on a ***site*/lot smaller than 22,000 square feet**, THEN flow control BMPs must be applied as specified in the requirements below OR the project must demonstrate compliance with the LID Performance Standard (described in Section 1.2.9 of SWDM) using an approved continuous runoff model. Projects on small lots are typically single family residential improvements (e.g., homes, outbuildings, etc.) but could be a small commercial development.

1. The feasibility and applicability of full dispersion as detailed in Appendix C, Section C.2.1 must be evaluated for all target impervious surfaces. If feasible and applicable, **full dispersion** must be implemented as part of the proposed project. Typically, small lot full dispersion will be applicable

only in subdivisions where enough forest was preserved by tract, easement, or covenant to meet the minimum requirements for full dispersion in Appendix C, Section C.2.1.1

2. Where full dispersion of target impervious roof areas is not feasible or applicable, or will cause flooding or erosion impacts, the feasibility and applicability of full infiltration as detailed in Appendix C, Section C.2.2 must be evaluated (*note, this will require a soils report for the* ***site/lot***). If feasible and applicable, **full infiltration of roof runoff** must be implemented as part of the proposed project.

3. All target impervious surfaces not mitigated by Requirements 1 and 2 above, must be mitigated to the maximum extent feasible using one or more BMPs from the following list. Use of a given BMP is subject to evaluation of its feasibility and applicability as detailed in Appendix C. Feasible BMPs are required to be implemented. The BMPs listed below may be located anywhere on the ***site*/lot** subject to the limitations and design specifications for each BMP. These BMPs must be implemented as part of the proposed project.

   - **Full Infiltration** per Appendix C, Section C.2.2, or per Section 5.2, whichever is applicable
   - **Limited Infiltration** per Appendix C, Section C.2.3,
   - **Bioretention** per Appendix C, Section C.2.6, sized as follows:
     - <u>Inside the UGA (Rainfall region SeaTac 1.0 and less):</u> In till soils, provide bioretention volume based on 0.6 inches of equivalent storage depth; in outwash soils provide bioretention volume based on 0.1 inches of equivalent storage depth,
     - <u>Inside the UGA (Rainfall regions greater than SeaTac 1.0):</u> In till soils, provide bioretention volume based on 0.8 inches of equivalent storage depth; in outwash soils, provide bioretention volume based on 0.4 inches of equivalent storage depth,
     - <u>Outside the UGA</u>: In till soils, provide bioretention volume based on 1.9 inches of equivalent storage depth; in outwash soils provide bioretention volume based on 1.0 inches of equivalent storage depth,
   - **Permeable Pavement** per Appendix C, Section C.2.7,

4. All target impervious surfaces not mitigated by Requirements 1,2 and 3 above, must be mitigated to the maximum extent feasible using the Basic Dispersion BMP described below. Use of Basic Dispersion is subject to evaluation of its feasibility and applicability as detailed in Appendix C. Feasible BMPs are required to be implemented. Basic Dispersion BMPs may be located anywhere on the ***site*/lot** subject to the limitations and design specifications cited in Appendix C. The BMP must be implemented as part of the proposed project.

   - **Basic Dispersion** per Appendix C, Section C.2.4,

5. BMPs must be implemented, at minimum, for an impervious area equal to at least 10% of the ***site*/lot** for ***site*/lot sizes up to 11,000 square feet** and at least 20% of the ***site*/lot** for ***site*/lot sizes between 11,000 and 22,000 square feet**. For projects located in ***critical aquifer recharge areas***, these impervious area amounts must be doubled. Doubling of the minimum impervious area required for BMP implementation in a CARA is not required for projects located within 200 ft. of a **steep slope hazard**, **landslide hazard area**, or **erosion hazard area**. If these minimum areas are not mitigated using feasible BMPs from Requirements 1, 2, 3, and 4 above, either a fee in lieu of the required minimum BMPs must be paid (requires that King County Water and Land Resources Division has established a program for determining and utilizing the fees for stormwater focused retrofit projects) OR one or more BMPs from the following list are required to be implemented to achieve compliance. These BMPs must be implemented as part of the proposed project.

   - **Reduced Impervious Surface Credit** per Appendix C, Section C.2.9,
   - **Native Growth Retention Credit** per Appendix C, Section C.2.10.

6. The soil moisture holding capacity of **new pervious surfaces** must be protected in accordance with KCC 16.82.100 (F) and (G). KCC 16.82.100(F) requires that the duff layer or native topsoil be

retained to the maximum extent practicable. KCC 16.82.100(G) requires soil amendment to mitigate for lost moisture holding capacity where compaction or removal of some or all of the duff layer or underlying topsoil has occurred. The specifications for compost for soil amendment can be found in Reference 11-C.

7. Any proposed connection of roof downspouts to the *local drainage system* must be via a **perforated pipe connection** as detailed in Appendix C, Section C.2.11.

C.1.3.2 LARGE LOT BMP REQUIREMENTS

IF the proposed project is on a ***site*/lot** that is **22,000 square feet or larger, but is not a Large Rural Lot as defined in Section 1.3.3,** THEN flow control BMPs must be applied as specified in the requirements below OR the project must demonstrate compliance with the LID Performance Standard (described in Core Requirement #9, Section 1.2.9 of the SWDM) using an approved continuous runoff model.

1. The feasibility and applicability of **full dispersion** as detailed in Appendix C, Section C.2.1 must be evaluated for all ***target impervious surfaces***. If feasible and applicable for any such surface, then full dispersion must be applied to that surface and implemented as part of the proposed project. Typically, full dispersion will be applicable only on the largest ***sites*/lots** where there may be enough forest area available within a ***threshold discharge area*** to meet the 15% ratio of ***fully dispersed*** impervious area to ***native vegetated surface***.
2. Where full dispersion of target impervious roof areas is not feasible or applicable, or will cause flooding or erosion impacts, the feasibility and applicability of **full infiltration of roof runoff** must be evaluated in accordance with Appendix C, Section C.2.2, or Section 5.2 of the SWDM, whichever is applicable based on the type of project.[11] If feasible and applicable, full infiltration of roof runoff must be implemented as part of the proposed project.
3. All target impervious surfaces not mitigated by Requirements 1 and 2 above, must be mitigated to the maximum extent feasible using one or more BMPs from the following list. Use of a given BMP is subject to evaluation of its feasibility and applicability as detailed in Appendix C. Feasible BMPs are required to be implemented. The BMPs listed below may be located anywhere on the site/lot subject to the limitations and design specifications for each BMP. These BMPs must be implemented as part of the proposed project.

   - **Full Infiltration** per Appendix C, Section C.2.2, or per SWDM Section 5.2, whichever is applicable
   - **Limited Infiltration** per Appendix C, Section C.2.3,
   - **Bioretention** per Appendix C, Section C.2.6, sized as follows:
     - <u>Inside the UGA (Rainfall region SeaTac 1.0 and less):</u> In till soils, provide bioretention volume based on 0.6 inches of equivalent storage depth; in outwash soils provide bioretention volume based on 0.1 inches of equivalent storage depth
     - <u>Inside the UGA (Rainfall regions greater than SeaTac 1.0):</u> In till soils, provide bioretention volume based on 0.8 inches of equivalent storage depth; in outwash soils, provide bioretention volume based on 0.4 inches of equivalent storage depth,
     - <u>Outside the UGA</u>: In till soils, provide bioretention volume based on 1.9 inches of equivalent storage depth; in outwash soils provide bioretention volume based on 1.0 inches of equivalent storage depth,
   - **Permeable Pavement** per Appendix C, Section C.2.7,

[11] For projects subject to Simplified Drainage Review, and for any ***single family residential project*** subject to Full or Large Project Drainage Review, the design requirements and specifications in Appendix C, Section C.2.2 may be used for evaluation and design of full infiltration on individual lots. For all other projects, full infiltration must be evaluated and designed in accordance with the infiltration facility standards in Section 5.2.

4. All target impervious surfaces not mitigated by Requirements 1,2 and 3 above, must be mitigated to the maximum extent feasible using the Basic Dispersion BMP described below. Use of Basic Dispersion is subject to evaluation of its feasibility and applicability as detailed in Appendix C. Feasible BMPs are required to be implemented. Basic Dispersion BMPs may be located anywhere on the ***site*/lot** subject the limitations and design specifications cited in Appendix C. The BMP must be implemented as part of the proposed project.
   - **Basic Dispersion** per Appendix C, Section C.2.4,
5. BMPs must be implemented, at minimum, for impervious area amounts defined as follows:
   a) For projects that will result in an impervious surface coverage on the buildable portion of the site/lot of less than 45%, flow control BMPs must be applied to 50% of target impervious surfaces.
   b) For projects that will result in an impervious surface coverage of 45% to 65% on the buildable portion of the site/lot, flow control BMPs must be applied to 50% of target impervious surfaces reduced by 1.5% for each 1% of impervious surface coverage above 45% (e.g., impervious coverage of 55% results in a requirement of FCBMPs applied to 35% of target impervious surfaces).
   c) For projects that will result in an impervious surface coverage greater than 65% on the buildable portion of the site/lot, flow control BMPs must be applied to 20% of the target impervious surfaces or to an impervious area equal to at least 10% of the site/lot, whichever is less.

   The buildable portion of the site/lot is the total area of the site/lot minus any critical areas and minus 200 ft. buffer areas from **a steep slope hazard**, **landslide hazard area**, or **erosion hazard area**. If these minimum areas are not mitigated using feasible BMPs from Requirements 1, 2, 3, and 4 above, either a fee in lieu of the required minimum BMPs must be paid (requires that King County Water and Land Resources Division has established a program for determining and utilizing the fees for stormwater focused retrofit projects) OR one or more BMPs from the following list are required to be implemented to achieve compliance. These BMPs must be implemented as part of the proposed project.
   - **Reduced Impervious Surface Credit** per Appendix C, Section C.2.9,
   - **Native Growth Retention Credit** per Appendix C, Section C.2.10.
6. The soil moisture holding capacity of **new pervious surfaces** must be protected in accordance with KCC 16.82.100 (F) and (G). KCC 16.82.100(F) requires that the duff layer or native topsoil be retained to the maximum extent practicable. KCC 16.82.100(G) requires soil amendment to mitigate for lost moisture holding capacity where compaction or removal of some or all of the duff layer or underlying topsoil has occurred. The specifications for compost for soil amendment can be found in Reference 11-C.
7. Any proposed connection of roof downspouts to the drainage system must be via a **perforated pipe connection** as detailed in Appendix C, Section C.2.11.

C.1.3.3 LARGE RURAL LOT BMP REQUIREMENTS

IF the proposed project is on a ***site*/lot** that is **5 acres or larger and is located outside the Urban Growth Area (UGA),** THEN the project must demonstrate compliance with the LID Performance Standard (described in Section 1.2.9 of SWDM) using an approved continuous runoff model.

As an alternative to demonstrating compliance with the LID Performance Standard via modeling as described above, agricultural projects and single family residential projects (excluding subdivisions creating 10 lots or more) are given the option to apply flow control BMPs as specified in the requirements below.

1. The feasibility and applicability of full dispersion as detailed in Section C.2.1 must be evaluated for all target impervious surfaces. If feasible and applicable, **full dispersion** must be implemented as part of the proposed project. Typically, full dispersion will be applicable only to ***sites*/lots** or portions of ***sites*/lots** where enough forest is preserved by a clearing limit per KCC 16.82 or by recorded tract, easement, or covenant to meet the minimum requirements for full dispersion in Section C.2.1.1.
2. Where full dispersion of target impervious roof areas is not feasible or applicable, or will cause flooding or erosion impacts, the feasibility and applicability of **full infiltration of roof runoff** must be evaluated in accordance with Section C.2.2, or Section 5.2, whichever is applicable based on the type of project.[12] If feasible and applicable, full infiltration of roof runoff must be implemented as part of the proposed project.
3. All target impervious surfaces not mitigated by Requirements 1 and 2 above, must be mitigated using one or more BMPs from the following list. Use of a given BMP is subject to evaluation of its feasibility and applicability as detailed in Appendix C. The BMPs listed below may be located anywhere on the site/lot subject to the limitations and design specifications for each BMP. These BMPs must be implemented as part of the proposed project.
   - **Full Infiltration** per Appendix C, Section C.2.2, or per SWDM Section 5.2, whichever is applicable,
   - **Limited Infiltration** per Appendix C, Section C.2.3,
   - **Bioretention** per Appendix C, Section C.2.6, sized as follows: In till soils, provide bioretention volume based on 1.9 inches of equivalent storage depth; in outwash soils, provide bioretention volume based on 1.0 inches of equivalent storage depth,
   - **Basic Dispersion** per Appendix C, Section C.2.4 followed by **Bioretention** per Section C.2.6., with bioretention sized as follows: In till soils, provide bioretention volume based on 0.9 inches of equivalent storage depth; in outwash soils, provide bioretention volume based on 0.2 inches of equivalent storage depth,
   - **Permeable Pavement** per Appendix C, Section C.2.7
4. The soil moisture holding capacity of **new pervious surfaces** must be protected in accordance with KCC 16.82.100 (F) and (G). KCC 16.82.100(F) requires that the duff layer or native topsoil be retained to the maximum extent practicable. KCC 16.82.100(G) requires soil amendment to mitigate for lost moisture holding capacity where compaction or removal of some or all of the duff layer or underlying topsoil has occurred. The amendment must be such that the replaced topsoil is a minimum of 8 inches thick, unless the applicant demonstrates that a different thickness will provide conditions equivalent to the soil moisture holding capacity native to the site. The replaced topsoil must have an organic content of 5-10% dry weight and a pH suitable for the proposed surface vegetation (for most soils in King County, 4 inches of well-rotted compost tilled into the top 8 inches of soil is sufficient to achieve the organic content standard.) The amendment must take place between May 1 and October 1. The specifications for compost for soil amendment can be found in Reference 11-C.
5. BMPs must be applied to all new pervious surfaces according to the order of preference and extent of application specified in the following requirements:
   a) The feasibility and applicability of full dispersion as detailed in Section C.2.1 (p. C-32) must be evaluated for all new pervious surface. If feasible and applicable, full dispersion must be implemented as part of the proposed project. Typically, full dispersion will be applicable only to sites/lots or portions of sites/lots where enough forest is preserved by a clearing limit per KCC

[12] For projects subject to Simplified Drainage Review, and for any ***single family residential project*** subject to Full, Directed, or Large Project Drainage Review, the design requirements and specifications in Appendix C, Section C.2.2 may be used for evaluation and design of full infiltration on individual lots. For all other projects and any project proposing a full infiltration system serving more than one lot, full infiltration must be evaluated and designed in accordance with the infiltration facility standards in Section 5.2.

16.82 or by recorded tract, easement, or covenant to meet the minimum requirements for full dispersion in Section C.2.1.1 (p. C-32).

b) For that portion of new pervious surface not addressed in Requirement 5.a above, one or more of the following BMPs must be implemented as part of the proposed project.

- **Basic Dispersion** per Appendix C, Section C.2.4, onto native vegetated surfaces only,
- **Bioretention** per Appendix C, Section C.2.6, sized as follows: In till soils, provide bioretention volume based on 0.7 inches of equivalent storage depth; in outwash soils, provide bioretention volume based on 0.006 inches of equivalent storage depth.
- **Limited Infiltration** per Appendix C, Section C.2.3

C.1.3.4 FLOW CONTROL BMP IMPLEMENTATION REQUIREMENTS

The flow control BMPs required in Section C.1.3.1, C.1.3.2, and C.1.3.3 above must be implemented in accordance with the following requirements:

1. **Implementation Responsibility.** All flow control BMPs required for the ***site*/lot** must be implemented (installed) by the applicant as part of the proposed project unless they have already implemented as part of a subdivision project (e.g., plat or short plat) that created the lot.

2. **Maintenance Responsibility.** Maintenance of all required flow control BMPs is the responsibility of the owner of the ***site*/lot** served by these BMPs. The responsibility for such maintenance must be clearly assigned to the current and future owners of the ***site*/lot** through a "declaration of covenant and grant of easement" as described in Requirement 3 below.

3. **Declaration of Covenant and Grant of Easement.** A declaration of covenant and grant of easement must be recorded for each ***site*/lot** that contains flow control BMPs. A draft of the proposed covenant must be reviewed and approved by DPER prior to recording. All required covenants must be recorded prior to final construction approval for the proposed project. The covenant in Reference Section C.5.2, p. C-149, (or equivalent) must be used, and is designed to achieve the following:

   a) Provide **notice** to future owners of the presence of flow control BMPs on the lot and the responsibility of the owner to retain, uphold, and protect the flow control BMP devices, features, pathways, limits, and restrictions.

   b) Include as an **exhibit**, a *recordable version*[13] of the following drainage plan information:

   - The **flow control BMP site plan** showing all developed surfaces (impervious and pervious) and the location and dimensions of flow control BMP devices, features, flowpaths (if applicable), and limits of native growth retention areas (if applicable). This plan(s) must be to scale and include ***site*** topography in accordance with the specifications for such plans in Section C.4.2 (p. C-139). Also indicate any areas where County access is excluded (see paragraph 3.d below). *Note: DPER may waive this element if, for example, the only flow control BMP proposed is a limit on impervious surface (reduced footprint).*

   - The **flow control BMP design and maintenance details** for each flow control BMP per Section C.4.3 (p. C-143). This includes a diagram (if applicable) of each flow control BMP device or feature and written maintenance and operation instructions and restrictions for each device, feature, flowpath (if applicable), native growth retention area (if applicable) and impervious surface coverage (if applicable). See Reference M for prepared 8-1/2"x11" maintenance instruction sheets. See http://www.kingcounty.gov/environment/water-and-

[13] *Recordable version* means one that meets King County's "Standard Formatting Requirements for Recording Documents" pursuant to RCW 36.18.010 and 65.04.045, available online and from the King County Recorder's Office. These requirements include specifications for such things as page size ($8^1/_2$" x 14" or smaller), font size (at least 8-point), and margin width (1" on all sides of every page if there is a standard cover sheet).