



Appendix J
98-05 Manual Comparison

2005 King County Surface Water Design Manual Project Comparison

In anticipation of the City of Kirkland adopting the 2005 King County Stormwater Design Manual (KCSWDM) in 2006 the following comparison of projects designed under the 1998 KCSWDM was conducted. The projects were analyzed as submitted under the 1998 manual but with the design requirements, thresholds and standards of the 2005 KCSWDM.

Type	Name	'98 Detention Volume	'05 Detention Volume	% Increase
2-Lot Short Plat	Youngberg	Exempt – Small Site	Exempt – Small Site	n/a
3-Lot Short Plat	Pederson	1152 ft ³	5520 ft ³	479
4-Lot Short Plat	MacDonald	3066 ft ³	12,074 ft ³	393
Commercial	Lee Johnson Chevrolet	9,472 ft ³	136,222 ft ³	1438

2-Lot Short Plat

Project Name: Youngberg Short Plat

Location: 6311 111th Place NE

Description: 2-lot Short Plat with associated frontage improvements and NE 62nd Street widening. Existing residence to remain with downspouts connected to the public storm system.

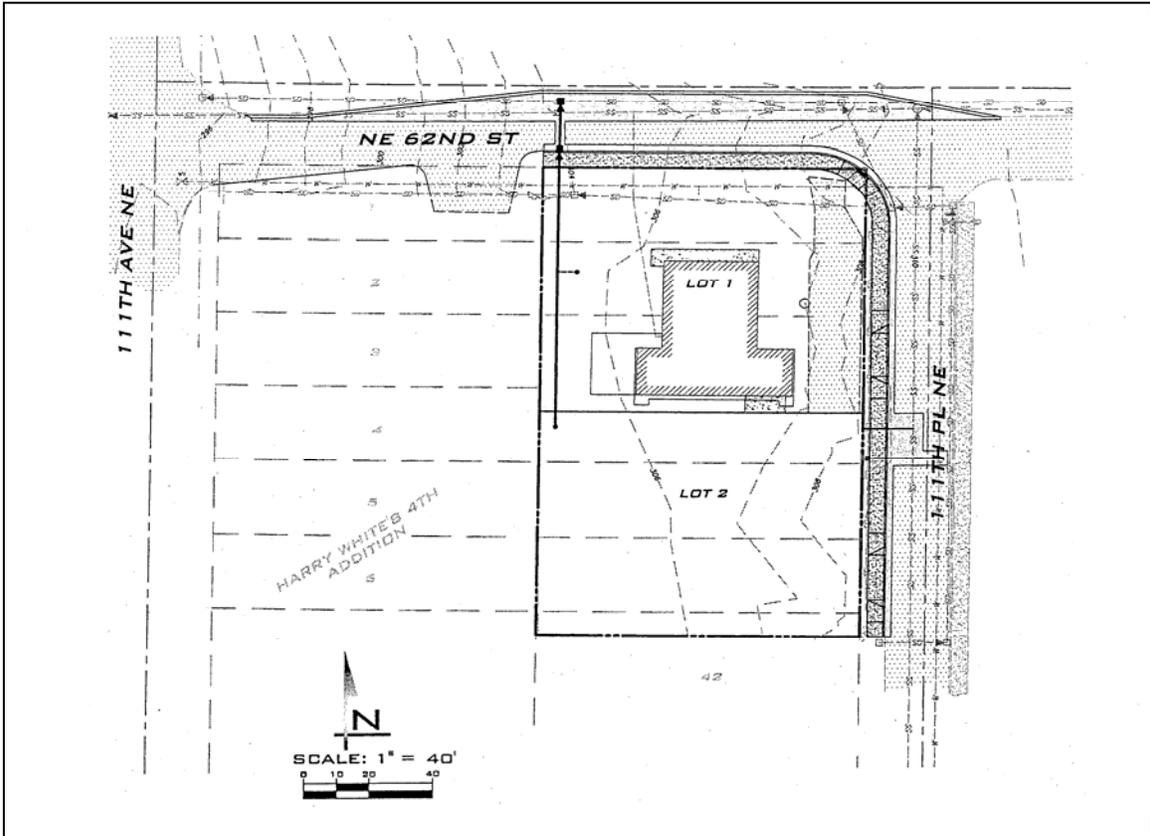
Project Area	Existing Conditions	Developed Conditions
Total Area: 17,212 ft ²	Impervious Area: 2,490 ft ²	Impervious Area: 6,355 ft ²
Onsite Area: 15,682 ft ²	Pervious Area: 13,192 ft ²	PGIS Area: 3,965 ft ²
Offsite Area: 1,530 ft ²		Pervious Area: 6,892 ft ²

1998 KCSWDM: Project falls within Small Site Drainage Requirements. Downspout Best Management Practices (BMPs) were utilized in the form of perforated pipe stub-outs. No water quality facility required.

2005 KCSWDM: Project is still exempt from formal flow control. Project would be required to apply selected Flow Control BMPs to at least 20% of the site per flow chart 5.2.1.A. These include Limited Infiltration, Basic Dispersion, Rain Garden, Permeable Pavement, Rainwater Harvesting, Vegetated Roof, Reduced Impervious Service Credit, Native Growth Retention Credit.

Conclusions: The project would still be feasible with only minor modifications to the site layout and stormwater engineering. These modifications could be accommodated onsite in the form of permeable pavement for access roads and driveways and/or limited infiltration and rain gardens on portions of Lot 1 and Lot 2.

Youngberg 2-Lot Short Plat



3-Lot Short Plat

Project Name: Pederson Short Plat

Location: 47XX 112th Avenue NE

Description: 3-lot Short Plat with associated frontage improvements and private access road.

Project Area	Existing Condition	Developed Conditions
Total Area: 37,461 ft ²	Impervious Area: 3,572 ft ² Pervious Area: 33,977 ft ²	Impervious Area: 16,368 ft ² PGIS Area: 3,768 ft ² Pervious Area: 21,093 ft ²

1998 KCSWDM: Total site impervious area is over 10,000 ft² therefore a Level 1 Flow Control Facility is required. A portion of the site has soil adequate for infiltration therefore 2-lots were infiltrated for storm events up to the 10-yr storm. The third lot is detained along with access road runoff.

Existing Condition (100% Pasture)

100-yr – 0.095 cfs
10-yr – 0.057 cfs
2-yr – 0.034 cfs

Developed Condition

100-yr – 0.186 cfs
10-yr – 0.090 cfs
2-yr – 0.065 cfs

Detention Sizing (Level 1)

Storage Volume – 1152 ft³
Depth – 6 ft
Width – 12 ft
Length – 18 ft

2005 KCSWDM: Infiltration still permitted, question arises as to overflow connection tight-lined to vault and how that would affect modeling of Level 2 facility. Possible solution would be to bypass overflows around facility. Level 2 flow control for remaining impervious area with historic land cover condition of forested results in a vault approximately 5 times as large as designed.

Existing Condition (100% Forested)

100-yr – 0.068 cfs
10-yr – 0.041 cfs
2-yr – 0.021 cfs

Developed Condition

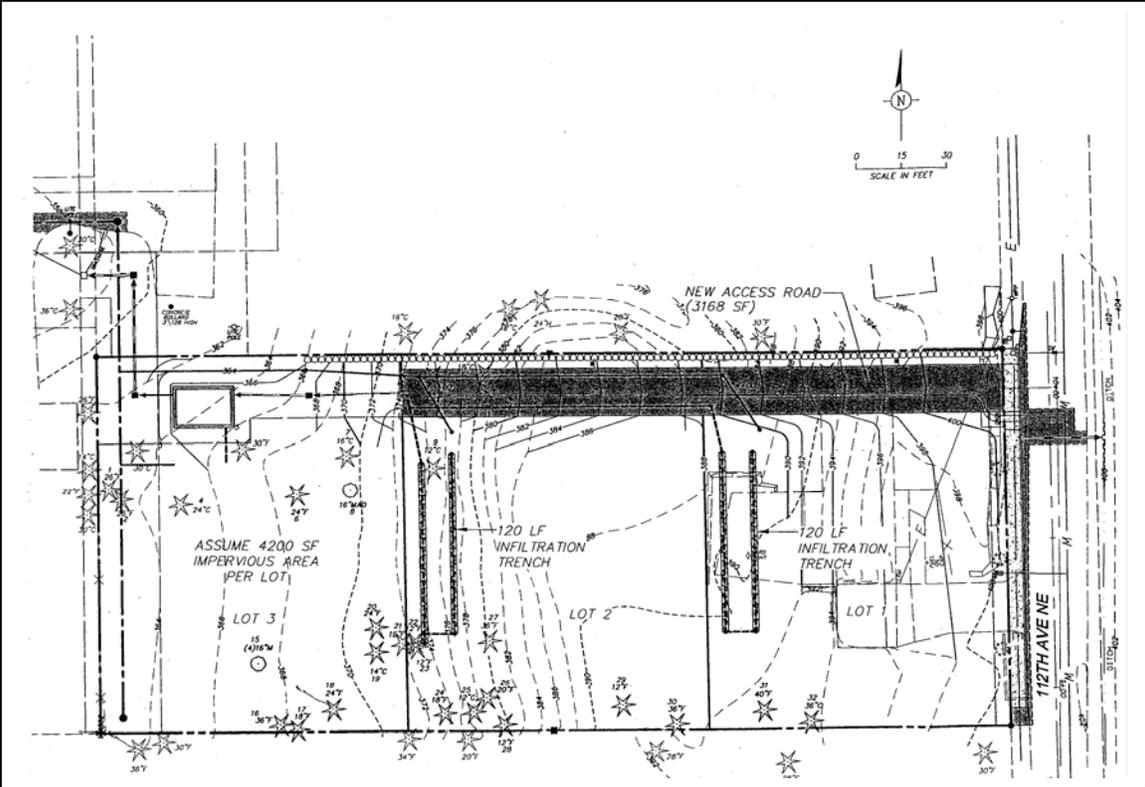
100-yr – 0.180 cfs
10-yr – 0.116 cfs
2-yr – 0.073 cfs

Detention Sizing (Level 2)

Storage Volume – 5520 ft³
Depth – 7.0 ft
Width – 20 ft
Length – 40 ft

Conclusions: The project would still be feasible with modifications to the infiltration system design such as sizing for full infiltration of 100-yr storm or overflow conveyance bypassing the detention vault. The detention vault although larger could still be accommodated onsite with minimum impacts to lot sizing. Low Impact Development (LID) approaches such as permeable pavement for driveways and access drive and/or limited infiltration for Lot 3 could be employed to reduce vault sizing.

Pederson 3-Lot Short Plat



4-Lot Short Plat

Project Name: MacDonald Short Plat

Location: 126XX NE 105th Place

Description: 4-lot Short Plat and half street improvement of NE 105th Place

Project Area	Existing Conditions	Developed Conditions
Total Area: 44,867 ft ²	Impervious Area: 9,148 ft ² Pervious Area: 35, 719 ft ²	Impervious Area: 16,117 ft ² PGIS Area: 6,534 ft ² Pervious Area: 22,216 ft ²

1998 KCSWDM: Total site impervious area is over 10,000 ft² therefore a Level 1 Flow Control Facility is required. The project provided flow control for the site in a detention tank providing 3066 ft³ of storage. Water quality treatment was provided by a 2 cartridge Stormfilter system.

Existing Condition (75% Pasture, 25% Forest)	Developed Condition	Detention Sizing (Level 1)
100-yr – 0.188 cfs	100-yr – 0.354 cfs	Storage Volume – 3066 ft ³
10-yr – 0.100 cfs	10-yr – 0.202 cfs	Diameter – 6 ft
2-yr – 0.067 cfs	2-yr – 0.169 cfs	Length – 113 ft

2005 KCSWDM: Under the 2005 manual this project's existing condition would be required to be analyzed as forested and the level of Flow Control would be raised to Level 2. This would result in an increase to the volume of flow control storage. Water Quality treatment would remain as under 1998 conditions.

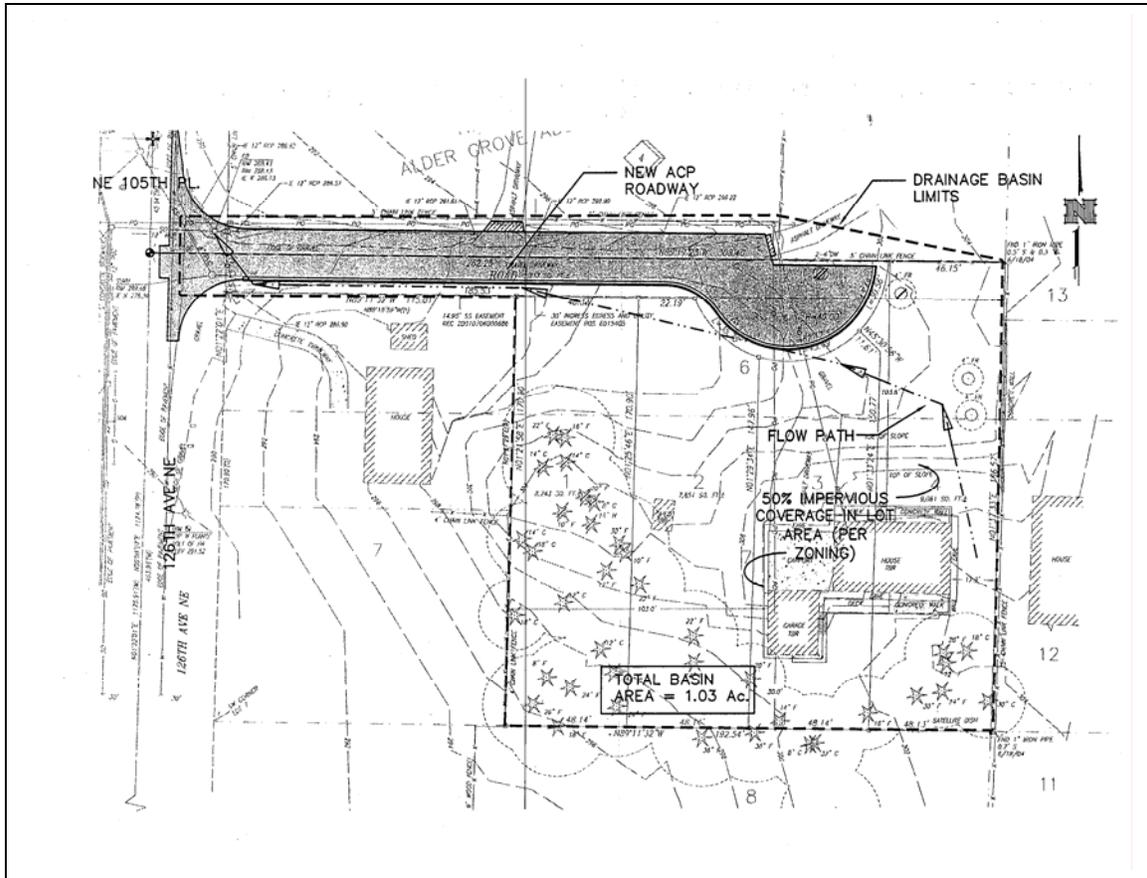
Existing Condition (100% Forested)	Developed Condition	Detention Sizing (Level 2)
100-yr – 0.082 cfs	100-yr – 0.333 cfs	Storage Volume – 12,074 ft ³
10-yr – 0.049 cfs	10-yr – 0.234 cfs	Diameter – 6 ft
2-yr – 0.025 cfs	2-yr – 0.161 cfs	Length – 445 ft

Conclusions: The increase in required detention volume will be difficult if not unable to be accommodated without impacts to buildable lots. As designed the detention tank is located partially under the public street cul-de-sac and frontage of all four lots. The length of the existing tank could be somewhat increased but parallel tanks would be necessary to provide the required storage volume. The parallel tanks would most likely have to be located on the lot side of the existing tank due to utility conflicts in the right-of-way. A vault may be considered but this would elevate costs and impacts to the lots would not be fully avoided.

A significant portion of this project's runoff volume is generated by right-of-way improvements. Low Impact Development (LID) approaches such as permeable pavement/concrete or Street Edge Alternative (SEA) design could be employed to reduce detention sizing. Onsite LID techniques such as limited infiltration, basic dispersion, bioretention, or porous pavements could be utilized to

reduce detention sizing. Reducing onsite impervious area through footprint reduction may prove to be a viable alternative when balanced with increased detention volumes.

MacDonald 4-Lot Short Plat



Commercial/Retail Development

Project Name: Lee Johnson Chevrolet

Location: 11845 NE 85th Street

Description: Existing commercial auto showroom, service, and vehicle storage that will be remodeled and expanded. No associate right-of-way improvements.

Project Area	Existing Conditions	Developed Conditions
Total Area: 407,286 ft ²	Impervious Area: 241,758 ft ² Pervious Area: 165,528 ft ²	Impervious Area: 325,829 ft ² PGIS Area: 224,770 ft ² Pervious Area: 81,457 ft ²

1998 KCSWDM: Developed site contains 7.48ac (325,829 ft²) impervious. Increase of 84,071 ft² of impervious area, with a 9,472 ft³ detention vault. Water quality treatment was provided by a 29 cartridge Stormfilter system.

Existing Condition (100% Pasture)	Developed Condition	Detention Sizing (Level 1)
100-yr – 3.08 cfs	100-yr – 3.93 cfs	Storage Volume – 9,472 ft ³
10-yr – 1.83 cfs	10-yr – 2.37 cfs	Depth – 6.4 ft
2-yr – 1.55 cfs	2-yr – 1.98 cfs	Width – 20 ft
		Length – 74 ft

2005 KCSWDM: Under the 2005 manual this project’s existing condition would be required to be analyzed as forested and the level of Flow Control would be raised to Level 2. This would result in a large increase to the volume of flow control storage. Water Quality treatment would remain unchanged.

Existing Condition (100% Forested)	Developed Condition	Detention Sizing (Level 2)
100-yr – 0.745 cfs	100-yr – 3.79 cfs	Storage Volume – 136,222 ft ³
10-yr – 0.446 cfs	10-yr – 2.76 cfs	Depth – 6.4 ft
2-yr – 0.229 cfs	2-yr – 1.99 cfs	Width – 60 ft
		Length – 355 ft

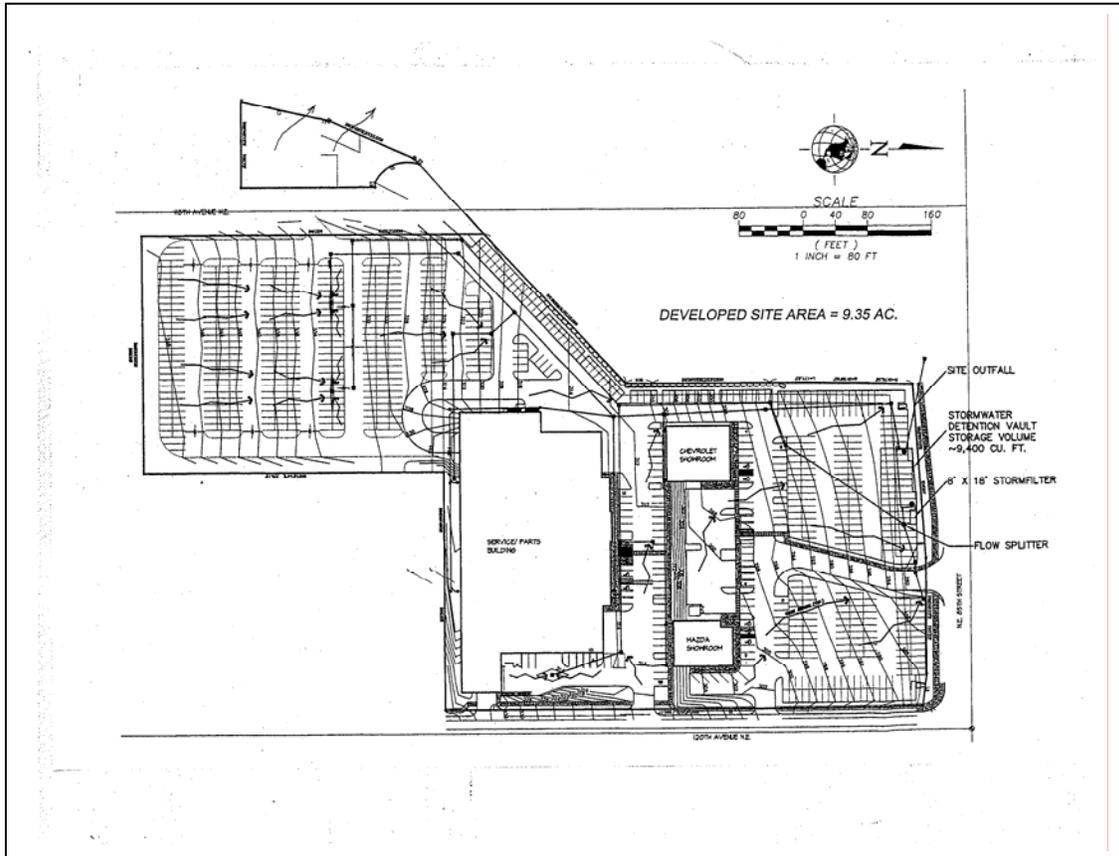
Conclusions: Although the increase in detention volume and vault size is significant the site plan includes large parking areas that could accommodate underground storage without impacting desired site use. The limiting factor due to increased storage volume would be cost of construction, approximately 14 times that of the vault designed under the 1998 KCSWDM.

To reduce costs and facility size the site could be detained through a sub-basin approach by creating several smaller detention vaults. This may reduce costs associated with a large excavation and construction.

A significant portion of this project’s runoff volume is generated by parking area for vehicle storage. Low Impact Development (LID) approaches such as permeable pavement/concrete could be used

as an alternative or in conjunction with traditional stormwater runoff control to reduce detention sizing.

Lee Johnson Chevrolet – Commercial Development



Transportation Capital Improvement Projects Sample Comparison of 1998 and 2005 Surface Water Design Requirements and Costs

The potential adoption of a new surface water design manual may have significant cost and design impacts on future capital improvement projects. To comply with the Federal Clean Water Act, the City is required to obtain coverage under the NPDES Phase II Municipal Separate Stormwater System General Permit, which is scheduled to be issued by the Washington State Department of Ecology in spring of 2006. The permit requires the City to adopt surface water design standards that are equivalent to the 2005 *Stormwater Management Manual for Western Washington* (Washington State Department of Ecology, February 2005, publication numbers 05-10-029 through 05-10-033). These standards are significantly different than those contained in the City's currently adopted standard, the 1998 *King County Surface Water Design Manual*.

To determine impacts of the new design requirements, two city transportation projects were selected and evaluated under both manuals. The Slater Avenue NE Roadway Improvements project and the Juanita Drive NE Street Improvement projects were selected for comparison. Below is general information about each project and the drainage facilities required under the two different standards.

Slater Avenue NE Roadway Improvements

The project area contains four separate drainage basins, and creates 2.1 acres of new impervious surface area. Under both 1998 and 2005 standards, two out of the four drainage basins are exempt from detention. For the two basins requiring detention, additional detention volume is required under the 2005 standards (because a historic condition of 100% forested must be used for the pre-developed condition, instead of an existing condition containing a significant amount of impervious surface area).

Under the 1998 standards, water quality treatment is required for all four drainage basins. The 2005 standards offer an exemption that applies to two drainage basins (new exemption for transportation projects). But the level of water quality is increased in the remaining two basins that require water quality (sand filters are required).

The table below lists the requirements and facilities necessary to meet both standards.

Slater Ave NE	1998 KCSWDM	2005 KCSWDM
Flow Control		
<i>Requirement</i>	Drainage basins 1 and 4 are exempt. Level 1 Detention is required for basins 2 and 3, using existing impervious surface area in 2001 as the pre-developed condition.	Drainage basins 1 and 4 are exempt. Level 1 Detention is required for basins 2 and 3, using forested condition (with no impervious surface) as the pre-developed condition.
<i>Facility</i>	Minimum storage volume required is 17,434 cubic feet.	Minimum storage volume required is 46,249 cubic feet.
Water Quality		
<i>Requirement</i>	Basic Water Quality is required for all 4 drainage basins.	Drainage basins 1 and 4 are exempt. Enhanced Basic Water Quality is required for basins 2 and 3.
<i>Facility</i>	3 vaults containing 40 stormfilter cartridges, plus 1 swale (3.4' width x 100' length).	2 vaults containing 27 stormfilter cartridges, plus 2 sand filters.

The cost implications of the new standards will vary from project to project. Increased detention volumes can be translated to additional detention costs, but the increased level of water quality treatment required on some projects is more difficult to calculate. For the Slater Avenue NE project, the number of treatment vaults is reduced (because of the transportation exemption) so the direct cost is reduced by \$36,000. However this does not include the additional cost of two sand filters. Sand filters have not been widely used so their cost is difficult to estimate. When compared to the total project cost, the new standards would increase the project cost by approximately 4.8% (not including the cost of two sand filters).

Juanita Drive NE Street Improvements

The project area contains three drainage basins, and creates 0.97 acre of new impervious surface area. Under 1998 standards, only one of the three basins is exempt from detention. Using 2005 standards two out of three basins are exempt (new exemption for transportation projects), so less overall detention is required for the project.

Under the 1998 standards, water quality treatment is required for all three drainage basins, while under the 2005 standards two drainage basins are exempt. But the level of water quality is increased in the one remaining basin.

The table below lists the requirements and facilities necessary to meet both standards.

Juanita Drive	1998 KCSWDM	2005 KCSWDM
Flow Control		
<i>Requirement</i>	Drainage basin 3 is exempt. Level 2 Detention is required for basins 1 and 2, detaining 140% of new impervious surface area and using outwash soils for the pre-developed condition. ¹	Drainage basins 2 and 3 are exempt. Level 2 Detention is required for basin 1, using forested condition (with no impervious surface) and till soils for the pre-developed condition. ²
<i>Facility</i>	Minimum storage volume required is 11,676 cubic feet.	Minimum storage volume required is 7,049 cubic feet.
Water Quality		
<i>Requirement</i>	Basic Water Quality is required for all 3 drainage basins.	Drainage basins 2 and 3 are exempt. Enhanced Basic Water Quality is required for basins 1.
<i>Facility</i>	3 vaults containing 46 stormfilter cartridges.	1 vault containing 18 stormfilter cartridges, plus a sand filter.

¹WDFW required detention and a higher degree than the 1998 KCSWDM (outwash soils, and detention of 140% of new impervious surface area).

²Geotechnical report indicates till soils at the project site (not outwash). Assuming 100% forested condition on till soil produces conservative pre-developed flows. Using 100% forested outwash produces flows of 0.000cfs, which are unattainable.

For the Juanita Drive project, detention costs would be reduced by \$24,570, because the transportation exemption allows for reduced detention volume. Similarly, the treatment cost is reduced by \$58,000 (less vaults needed), however this does not include the cost of one sand filter. When compared to the total project cost, the new standards would reduce the project cost by approximately 4.0% (not including the cost of one sand filter).

Summary

The cost implications of the new regulations are difficult to assess because they will vary greatly between projects. The new transportation exemption will not apply to all projects (applicable if the total new impervious surface is less than 50% of existing impervious surface). Those transportation projects not meeting the requirements for exemption will require both additional detention volume and additional water quality treatment. A dollar value was

approximated for the change in detention and water quality costs in the projects above, but sand filters have not been widely used so their cost cannot be calculated with any surety. Low Impact Development (LID) techniques could be implemented to lessen the detention volume and the need for water quality. These techniques may require more area than is available within the road right-of-way, but may yield greater environmental benefits at the same cost as traditional constructed facilities.

Slater Ave NE - Roadway Improvement Project
 Surface Water Requirement Comparison - Flow Control

	Existing Impervious	Developed Impervious	New Impervious	New % of existing	1998 Exempt?	2005 Exempt?
Basin 1A	0.36	0	-0.36			
Basin 1B	0.45	0.95	0.5			
Basin 1C	0.22	0	-0.22			
Basin 1	1.03	0.95	-0.08	0%	Yes	Yes

	Existing Impervious	Developed Impervious	New Impervious	New % of existing	1998 Exempt?	2005 Exempt?
Basin 2A	0.28	1.85	1.57			
Basin 2B	0.22	0	-0.22			
Basin 2C	0.5	0.04	-0.46			
Basin 2D	0.01	0	-0.01			
Basin 2	1.01	1.89	0.88	87%	No	No

	Existing Impervious	Developed Impervious	New Impervious	New % of existing	1998 Exempt?	2005 Exempt?
Basin 3A	0.07	0.81	0.74			
Basin 3B	0.16	0.68	0.52			
Basin 3C	0.26	0.24	-0.02			
Basin 3	0.49	1.73	1.24	253%	No	No

	Existing Impervious	Developed Impervious	New Impervious	New % of existing	1998 Exempt?	2005 Exempt?
Basin 4	0.51	0.56	0.05	10%	Yes	Yes

Exemptions used:

1998 Peak Flow Exemption: 100 year increase in peak flow is less than 0.1 cfs

2005 Transportation Exemption: total new impervious surface is less than 50% of existing impervious surface.

Result:

Same Basins are exempt, but detention is based on forested condition, not existing conditions.

Volume of Detention is increased

Drainage Basin	Storage needed 1998	Storage needed 2005
1	Exempt	Exempt
2	5,264	46,249
3	12,170	
4	Exempt	Exempt
Total	17,434	46,249

combined basins
2 and 3

cubic feet

Detention Costs for Project

	Cubic ft	Project Cost	Cost/foot
1998	17,434	\$99,500	\$5.71
2005	46,249		\$5.71

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\$264,082	2005 Project cost
\$164,582	Difference in cost

**Summary Detention & Water Quality costs compared to total project cost
Slater Ave NE Roadway Improvements**

	Det	WQ	Total	Increase	Project cost	% of project
1998	99,500	96,500	196,000			
2005	264,082	60,500	324,582			
				128,582	2,684,638	4.8%