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Technical Memorandum

Surface Water Design Manual Comparison

AltaTerra

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1. Introduction and Background

Surface water design regulations are intended to protect stream habitat and water quality, and to reduce the potential for flooding by requiring that new development and redevelopment projects control the flow and quality of water leaving their sites. The specifics of these regulations impact the degree of habitat protection and potential future restoration costs, the cost of construction for development projects, and the cost to the City of maintaining residential flow control facilities following construction.

The City was required to update existing stormwater design regulations by December 31, 2016 in order to maintain compliance with the Department of Ecology's Western Washington National Pollutant Discharge Elimination System Stormwater Permit (NPDES Permit). The City had the choice of adopting either the King County Surface Water Design Manual (KCSWDM), or the Washington State Department of Ecology's 2014 Stormwater Management Manual for Western Washington (Ecology Manual). The two manuals had been deemed equivalent by the Washington State Department of Ecology, but close reading by city staff revealed an important difference between the two manuals: The KCSWDM requires small short plats to provide flow control facilities, where the Ecology Manual does not. In other words, the KCSWDM went above and beyond Ecology's minimum requirements as noted in the Ecology Manual. City Council did choose to adopt the KCSWDM, but the vote was narrowly divided, and Council requested that staff conduct a study of the costs and benefits of this choice.

Potential benefits of increased flow control for small short plats as required by the KCSWDM include a greater degree of stream habitat protection. Although impacts from small short plat are diffuse, they are cumulative. Staff has heard from Ecology that future NPDES permits may require the addition of stormwater facilities to serve existing development. In other words, if developers are not required to provide flow control now, the City may be required to add flow control at a later date, though to what degree is unclear.

Potential costs of requiring additional flow control on a site-by-site basis for small short plats include additional construction costs and feasibility issues for development projects, and additional long-term maintenance costs for the City associated with a large number of small facilities: It is City policy to maintain flow control facilities that serve 2 or more residential lots.

The purpose of this study is to quantify to the degree possible these costs and benefits by looking at examples in Kirkland, both on a site-by-site and a cumulative basis. The work will help to inform Council as to whether they wish to consider changes to this provision of the KCSWDM as currently adopted.

1.1 Goals and Objectives

The specific project objectives include:

- Compare stormwater facility size and cost (flow control facilities) under different manual requirements for eight development projects in Kirkland.
- Evaluate cumulative impacts and costs of implementing design manual change from KCSWDM versus the Ecology manual.

- Provide alternatives for on-site versus City-implemented regional flow control for City Council consideration.

2. Data Sources

The methodology for conducting this study involved using the following data sources provided by the City:

- Development submittal information (i.e., design plans, stormwater technical information report, hydrologic model, and existing land use conditions spreadsheet) for eight approved development projects that range from 2-lot to 8-lot short plats and one commercial building,

- City geographic information system (GIS) shapefile showing parcels that have the potential to redevelop based on size, current zoning, and lot coverage,

- Cost information from private development experts, and

- Cost estimates for regional stormwater retrofit facilities being designed and planned by the City of Kirkland

3. Evaluation of Development Projects and Manual Comparison

Eight development projects submitted and approved for drainage review by the City were evaluated according to requirements of the KCSWDM and Ecology Manual to determine what size and types of sites would result in different outcomes for flow control requirements.

Development projects submitted for City drainage review were modeled according to requirements of Kirkland stormwater code under the KCSWDM, comparing flows for proposed developed conditions to flows on the site under forested conditions. Criteria for flow control under the Ecology Manual requires hydrologic modeling that compares flows under proposed developed conditions to flows under existing site conditions. This difference in how each manual requires development projects to model flows is what results in different flow control requirements. KCSWDM uses forested pre-existing conditions and the Ecology Manual uses existing site conditions as the standard for which developed conditions are compared.

For each of the development projects, the original models were re-run for proposed conditions, forested conditions, and existing conditions using the same modeling program used by the applicant (Western Washington Hydrologic Model [WWHM] or MGS Flood). 100-year peak flows were compared for proposed versus forested conditions to determine if criteria were met for flow control under the KCSWDM, and 100-year peak flows were compared for proposed versus existing conditions to determine if criteria were met for flow control under the Ecology manual. Table 1 presents a matrix of the results showing which development projects required flow control under both manuals, or just the KCSWDM. Modeling reports are provided in Attachment A.

The eight development projects evaluated ranged from 2-lot short plats to an 8-lot subdivision and included one commercial development. Each of the approved projects require flow control under Kirkland's current surface water design criteria following the KCSWDM. However, only one site (the commercial development) would require flow control under the Ecology criteria of evaluating the 100-

year peak flow increase for proposed versus existing predevelopment conditions. Ecology uses an additional criterion for determining which sites require flow control; sites that have greater than or equal to 10,000 square feet of new and proposed impervious surface also require flow control even if the project does not result in an increase of 0.15 cfs in the 100-year peak flow from existing predeveloped conditions to proposed conditions. Using the 10,000 square foot impervious surface threshold, only the two 2-lot short plat sites (Lola and Eva) would not require flow control if the Ecology manual methodology and 10,000 square foot threshold were used. Figure 1 shows a simplified schematic of Ecology Manual and KCSWDM flow control requirements.

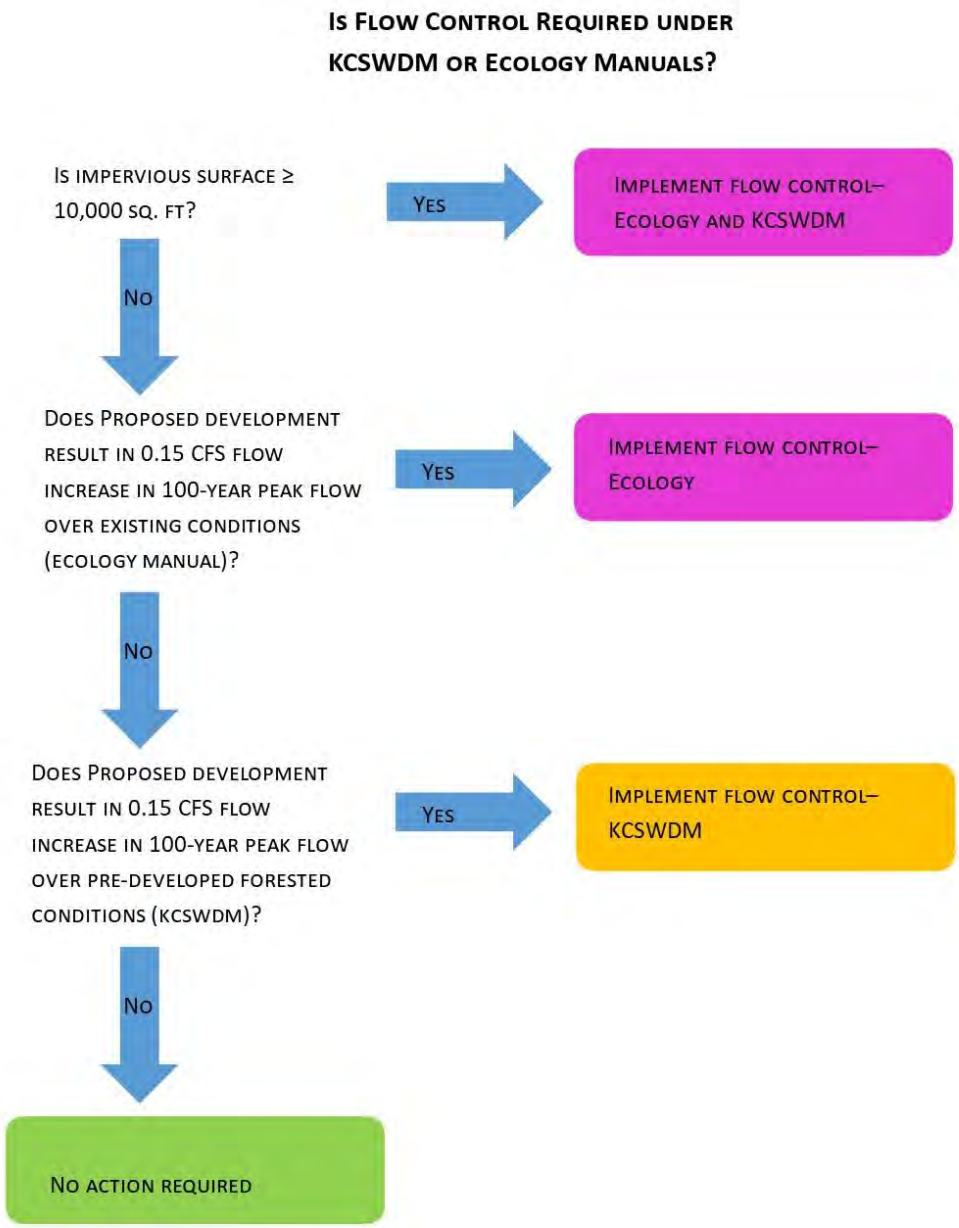


Figure 1. Flow chart of simplified flow control requirements under Ecology Manual and KCSWDM

Table 1. Matrix of surface water design manual comparison results

Project #	Project name	Modeling program used	Total site area (acres)	Total existing impervious area (acres)	Total proposed impervious area (acres)	100-YR peak flow increase from forested predeveloped conditions (KCSWDM) (cfs)	Flow control required under KCSWDM? (>0.15cfs increase)	100-YR peak flow increase from existing predeveloped conditions (Ecology) (cfs)	Flow control required under Ecology Manual? (>0.15cfs increase)	Flow control required with 10,000 sq. ft. impervious surface threshold?
1	Lola Short Plat (2 lots)	WWHM2012	0.43	0.12	0.21	0.1789	YES	0.0806	NO	NO
2	Eva Short Plat (2 lots)	WWHM2012	0.44	0.27	0.22	0.201	YES	-0.0202	NO	NO
3	Green Short Plat (3 lots)	WWHM2012	0.59	0.17	0.25	0.2528	YES	0.0219	NO	YES
4	Jorgenson Short Plat (3 lots)	WWHM2012	0.58	0.2	0.3	0.2125	YES	0.0193	NO	YES
5	Fahsholtz Short Plat (4 lots)	WWHM2012	0.85	0.2	0.56	0.3447	YES	0.1332	NO	YES
6	Lake Park II Short Plat (5 lots)	WWHM2012	1.12	0.09	0.61	0.5078	YES	0.1031	NO	YES
7A	NE 129TH ST (8 lots) (West Basin)	WWHM2012	1.32	0.1	0.45	0.3063	YES	0.1455	NO	YES
7B	NE 129TH ST (8 Lots) (East Basin)	WWHM2012	0.92	0	0.3	0.2073	YES	0.1081	NO	YES
8A	Hauge Commercial (no NGRA)	MGSFlood	0.62	0.1	0.5	0.5401	YES	0.216	YES	YES
8B	Hauge Commercial (w/ NGRA)	MGSFlood	0.91	0.1	0.5	0.5401	YES	0.123	NO	YES

Flow control facility sizes for each of the development projects evaluated were determined by the applicants. Costs for the facilities were estimated to evaluate potential cost savings to developers if flow control was not required (e.g., Ecology manual). Additionally, the estimated market values of homes for two of the development projects were assessed by a realtor based on comparable projects to assess the flow control facility costs as a percentage of estimated home sale price. The pricing analysis results for Lola Short Plat and Lake Park II Short Plat developments are provided in Attachment B.

Table 2. Estimated flow control facility sizes and costs

Project #	Project name	Flow control facility size and type	Estimated facility cost	Estimated market value of development	Facility cost as percentage of estimated home sale prices
1	Lola Short Plat (2 lots)	99' LONG X 8' DIAMETER PIPE	$63,000.00	$3,400,000.00	1.8%
2	Eva Short Plat (2 lots)	92' LONG X 12' WIDE X 5.5' DEEP VAULT	$175,000.00	Not estimated	Not estimated
3	Green Short Plat (3 lots)	462' LONG X 4.5' DIAMETER PIPE	$125,000.00	Not estimated	Not estimated
4	Jorgenson Short Plat (3 lots)	64' LONG X 14' WIDE X 7.5' DEEP VAULT	$145,000.00	Not estimated	Not estimated
5	Fahsholtz Short Plat (4 lots)	110' LONG X 14' WIDE X 8' DEEP VAULT	$246,000.00	Not estimated	Not estimated
6	Lake Park II Short Plat (5 lots)	140' LONG X 17.5' WIDE X 6.5' DEEP VAULT	$301,000.00	$10,000,000.00	3%
7A	NE 129TH ST (8 lots) (West Basin)	80' LONG X 30' WIDE X 7' DEEP VAULT	$326,000.00	Not estimated	Not estimated
7B	NE 129TH ST (8 Lots) (East Basin)	80' LONG X 30' WIDE X 7' DEEP VAULT	$326,000.00	Not estimated	Not estimated
8A	Hauge Commercial (no NGRA)	92' LONG X 34' WIDE X 7' DEEP VAULT	$388,000.00	Not estimated	Not estimated
8B	Hauge Commercial (w/ NGRA)	92' LONG X 34' WIDE X 7' DEEP VAULT	$388,000.00	Not estimated	Not estimated

If the Ecology manual criteria (0.15 cfs increase in 100-year peak flow for proposed conditions over existing predeveloped conditions and greater than or equal to 10,000 square feet of new and existing impervious surface) were used in Kirkland, only small short plats would likely not require flow control and result in a cost savings to developers. The Lola Short Plat is the best example of the type of development where this situation could occur. As shown in Table 2, the estimated cost of flow control facility compared to the estimated value of the Lola Short Plat homes is under 2%. Project summary sheets provide more detail for the Lola and Lake Park Short Plats and are provided in Attachment C.

4. Redevelopment Analysis and Cumulative Impacts

Potential cumulative impacts of using Ecology methodology for flow control requirements was evaluated by assessing potential redevelopment in two different basin areas; Champagne Creek, northwest of Juanita, and Forbes Creek in the north Rose Hill area. These two areas were chosen because of the extent of redevelopment predicted to occur in these basins and the proximity to sensitive receiving waters that could be impacted by flow control requirement modifications. The analysis of flow control requirements did not consider low impact development requirements that are separate and evaluated on a site-by-site basis. No changes are being considered to low impact development requirements for redevelopment. The redevelopment analysis methodology is described in Attachment D.

4.1 Champagne Creek Sub-Drainage Area Results

The area evaluated in the Champagne Creek drainage basin is approximately 184 acres and includes 65 parcels that have the potential to redevelop (Figure 1). Table 3 summarizes the estimated types of development based on maximum build-out, and number of parcels that would likely not need flow control using Ecology criteria. As shown in Table 3 and Figure 1 (depicted in orange), approximately 18% of the redevelopment parcels could avoid flow control using Ecology criteria; these are the parcels that have the potential to redevelop to small 2- and 3-lot short plats.

Table 3. Champagne Creek sub-area summary of parcel redevelopment potential and flow control requirements using Ecology methodology

Redevelopment Potential (Type of Plat)	Number of Parcels in Analysis Area	Number of parcels that likely would not need flow control using Ecology criteria
2-lot short plat	24	5
3-lot short plat	15	7
4-lot short plat	2	0
5-lot short plat	2	0
6-lot short plat	8	0
8-lot short plat	1	0
9- lot short plat	5	0
10-lot short plat	1	0
11-lot short plat	1	0
14-lot short plat	1	0
15-lot short plat	1	0
19-lots	1	0
20-lots	1	0
28-lots	1	0
47-lots	1	0
TOTAL	**65**	**12**

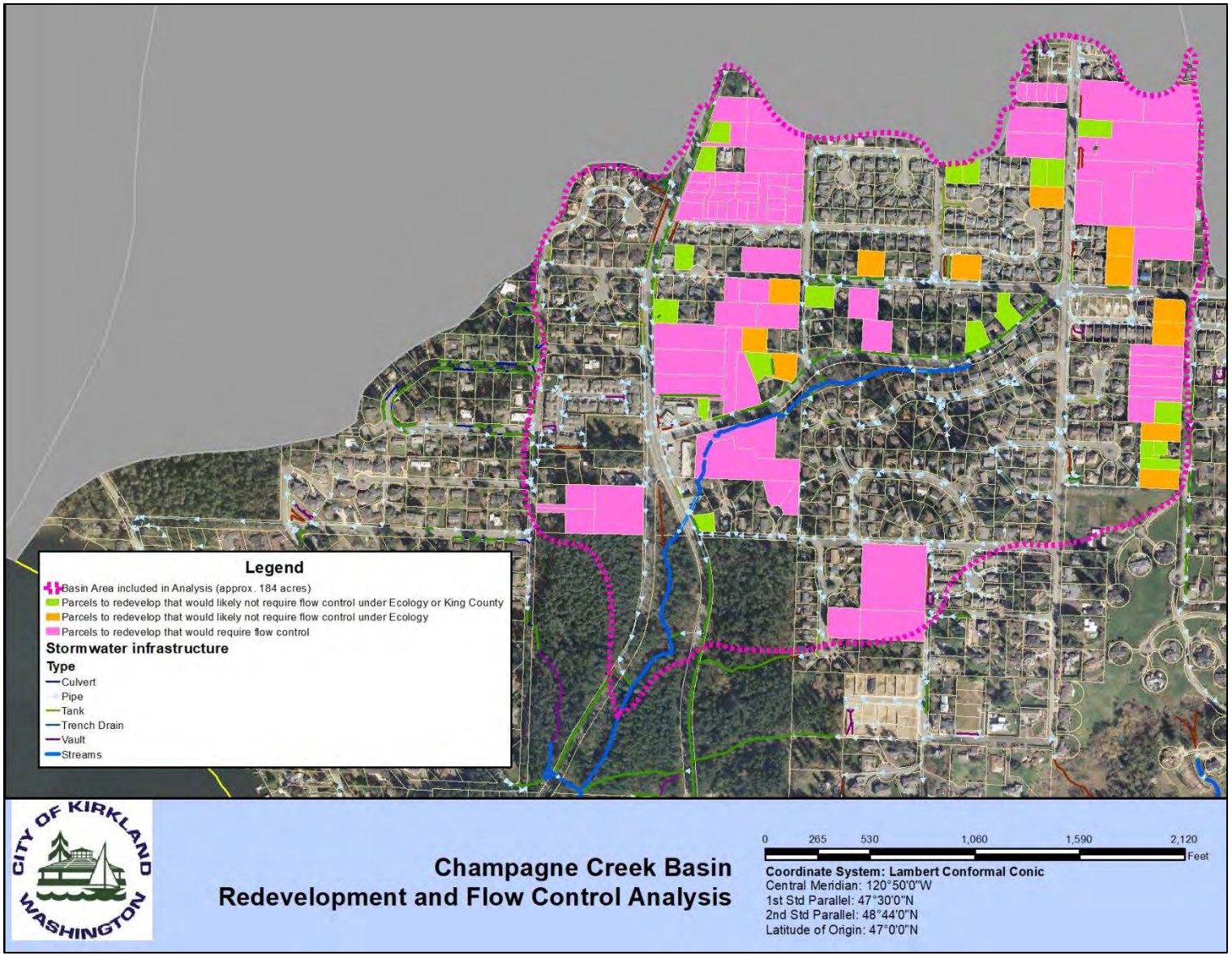


Figure 2. Champagne Creek subarea showing redevelopment parcels and estimated flow control requirements under Ecology or KCSWDM.

The 12 sites that are estimated to not need flow control under Ecology methodology would result in 1.7 ac-ft of lost flow control storage and detention if the Ecology provision were implemented. This is equivalent to approximately 1 football field filled with 2-feet of water. These 12 sites are shown in orange on Figure 1. These sites could be treated in a regional facility rather than on-site by developers (i.e., in a scenario where the City modified flow control requirements to use Ecology methodology but chose to provide flow control elsewhere for un-detained sites). In this case, the 1.7 acre-feet of flow control would be provided in a separate off-site facility. The savings to developers is approximately $1.25 million (through flow control avoidance), whereas the cost for regional flow control (by the City for retrofit) is at least $1.25 million plus $250,000 more for property acquisition.

4.2 Forbes Creek Sub-Drainage Area Results

The area evaluated in the Forbes Creek drainage basin is approximately 938 acres and includes 243 parcels that have the potential to redevelop (Figure 2). Table 4 summarizes the estimated types of development based on maximum build-out, and number of parcels that would likely not require flow control using Ecology criteria.

Table 4. Forbes Creek subarea summary of parcel redevelopment potential and flow control requirements using Ecology methodology

Redevelopment Potential (Type of Plat)	Number of Parcels in Analysis Area	Number of parcels that likely would not need flow control under Ecology but would under KCSWDM
Redevelopment - no increase in housing	29	1
Vacant to short plat	16	8
2-lot short plat	116	90
3-lot short plat	33	
4-lot short plat	20	
5-lot short plat	10	
6-lot short plat	5	1
7-lot short plat	4	
9- lot short plat	1	
13-lot short plat	1	
14-lot short plat	1	
16-lot short plat	1	
22 lots	1	
27-lots	1	
28-lots	1	
100 residences	1	
243 residences	1	
500 residences	1	
TOTAL	**243**	**100**

In the Forbes Creek drainage area example, over 40% of the redevelopment parcels would not require flow control under Ecology criteria.

The 100 sites that are estimated to not need flow control under Ecology methodology would result in 11.2 ac-ft of lost flow control storage and detention, if not mitigated. This is equivalent to approximately 2 football fields filled with 5.5 feet of water. The overall cost savings to developers would be approximately $8.3 million, however, the cost for the City to detain in regional facilities would be much greater due to property acquisition and conveyance costs. These sites are shown in orange on Figure 2.

An additional 47 sites (shown in green) in the area evaluated in the Forbes Creek drainage basin did not meet the flow increase threshold criteria for requiring flow control using the Ecology Manual but met the 10,000 square foot impervious surface threshold assuming maximum build-out. It is possible that some developers would choose to design some of these short-plats to fall under the 10,000 square foot impervious surface threshold to avoid providing stormwater flow control, resulting in additional lots that would not require flow control if the Ecology methodology was adopted. These 47 sites could result in an additional 8 ac-ft of lost flow control storage and detention, if not mitigated, depending on how the lots are developed.

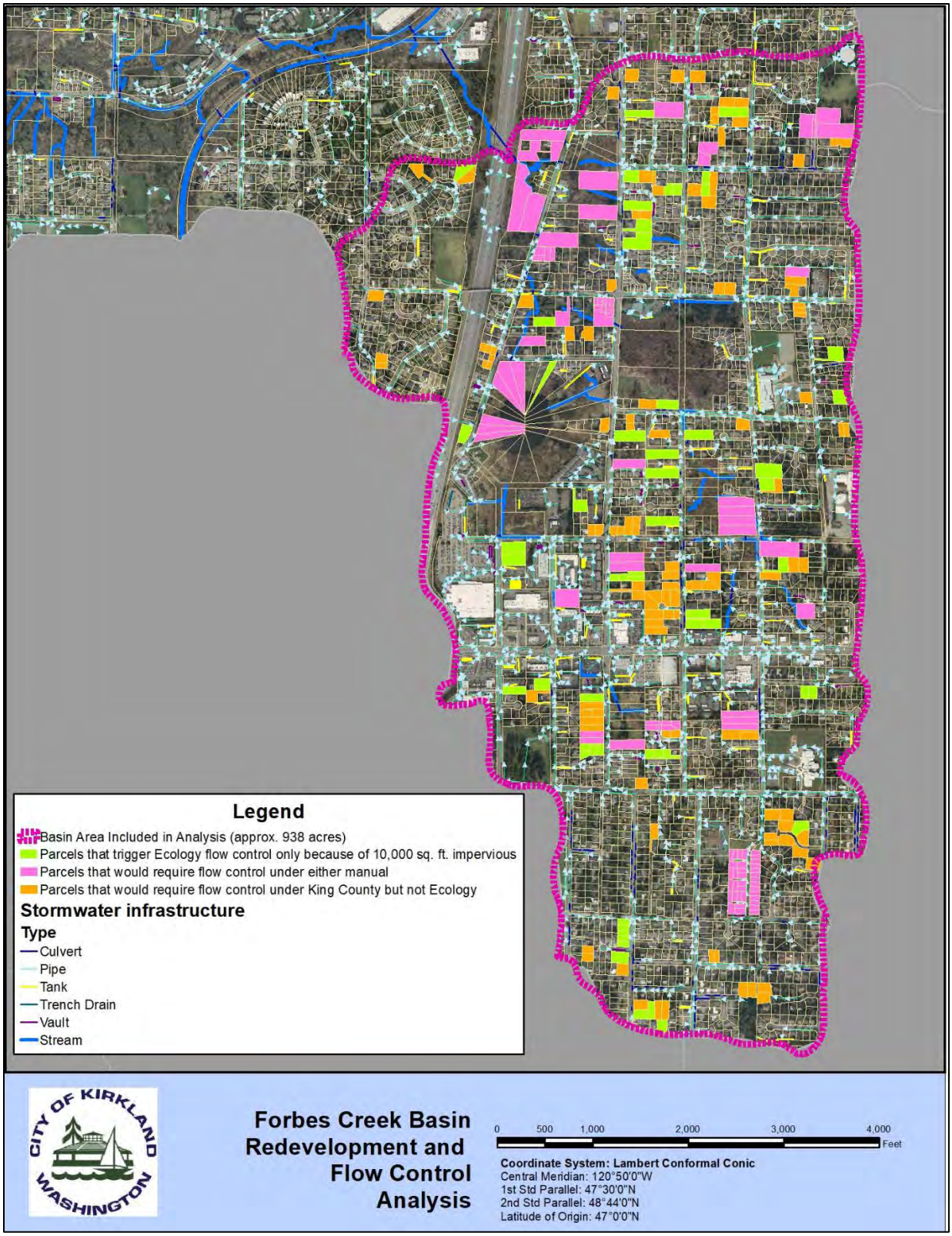


Figure 3.Forbes Creek subarea showing redevelopment parcels and estimated flow control requirements under Ecology or King County manuals.

4.3 Cumulative Impacts Discussion

The number of parcels that could potentially result in no stormwater flow control if the City adopted Ecology methodology depends on the types and sizes of lots available for redevelopment. As discussed above, LID requirements are separate from flow control requirements. LID is evaluated on a site-by-site basis and is required for all new development and redevelopment that meet the criteria. In the two example sub-areas evaluated in this study, there were a greater number of parcels expected to be redeveloped in the Forbes Creek basin, especially as small short-plats, compared to the Champagne Creek basin. Cumulative increases in flow from many small sites that wouldn't require flow control could be significant. Redevelopment is often looked at as an opportunity to achieve stormwater mitigation in areas where none was historically provided; minimizing or reversing effects of past stormwater impacts. Allowing development to avoid flow control is counter to this philosophy, especially when many millions of dollars are being spent to retrofit areas with new stormwater controls to minimize effects of ongoing stormwater discharges. The City's 132nd Square Park stormwater retrofit project is an example of a city-implemented project with a budget of ~$4.5 million to provide flow control and water quality treatment. This project will not meet current stormwater standards but will provide an improvement from existing conditions.

Cumulative impacts were assessed on a coarse scale without conducting hydrologic modeling or analysis to evaluate the potential timing and routing of flows from anticipated redevelopment under different flow scenarios. However, even at a coarse scale, the sum of the individual site flow increases from small lots could be significant; impacts such as flooding and erosion may be expected if development were allowed without mitigation. If the NPDES Phase II Permit were to require retrofit in the next permit cycle, as expected, it would be counter-intuitive to not require flow control that is commensurate with the impacts as development occurs.

5. Alternatives for Stormwater Fee-in-Lieu

Kirkland's stormwater management program has historically favored design standards based on best available science that result in more protection for natural resources. Adoption of the KCSWDM and its flow control requirements for small lots is an example of choosing design standards that provide more protection for the City's natural resources. As described in Section 4, the cumulative impact from flow control avoidance on smaller lots could be significant depending on the amount of redevelopment in a receiving water drainage area.

The City understands the challenges of siting flow control on small development sites. Developers deal with utility conflicts, site restrictions, and other factors that make siting flow control facilities difficult and expensive. City maintenance crews who are responsible for inspecting and maintaining the facilities after they are turned over to the City are challenged by difficult access, facility modifications made by home owners, and having to inspect and maintain so many small facilities throughout the City.

Stormwater fee-in-lieu alternatives were evaluated as a potential substitute for on-site flow control at the smaller short-plat sites. The alternatives for City-implemented regional flow control and developer buy-in through a stormwater fee-in-lieu program were evaluated in the Forbes Creek sub-drainage area. The factors considered in different alternative scenarios evaluated included:

- Establishment of criteria for fee-in-lieu participation
- Voluntary or compulsory buy-in from developers,
- Cost to City or developers,
- Location of facility relative to impacts,
- Types of development to target (i.e., all redevelopment, only short-plats that would not require flow control under Ecology methodology, etc.), and
- Potential for retrofit in addition to treatment of new or redeveloped parcels.

Criteria for fee-in-lieu participation

Based on the manual comparison and redevelopment analysis results, the sites that would be best targeted for participation in a stormwater fee-in-lieu program are those that would not require flow control if evaluated using Ecology Manual guidelines, and therefore would have less impact on the City's stormwater and natural resource system if flow control were to be provided off-site vs. on-site. Additionally, these are the sites that are the most challenging for developers to site facilities and most challenging for City crews to maintain. In this analysis it was assumed that criteria for participation in the fee-in-lieu program would be the following:

- Sites that are under 10,000 square feet impervious surface (Ecology Manual criteria), and
- Sites that do not result in greater than or equal to 0.15 cfs increase in the 100-year peak flow (15-minute time steps) from pre-developed existing site conditions to proposed developed site conditions (Ecology Manual criteria), and
- Sites that do result in greater than or equal to 0.15 cfs increase in the 100-year peak flow (15-minute time steps) from pre-developed forested site conditions to proposed developed site conditions (KCSWDM criteria).

However, in some cases, it might be worthwhile to allow all developers the option to purchase credits, particularly if a facility was designed to treat flow from a specific neighborhood and a minimum level of participation was needed to make implementation of the facility cost effective.

Voluntary or compulsory buy-in

If the City chooses to build a regional flow control facility for the purpose of providing off-site treatment in-lieu of developer provided on-site treatment, there are two possible developer participation scenarios; voluntary or compulsory. Voluntary participation would result in less certainty for the City to recoup costs for construction and implementation of the regional facility, however, the challenges and costs of on-site treatment may make voluntary participation an attractive option to developers if the cost for treatment mitigation credits was comparable to on-site treatment. Once the credits were expended in a facility through voluntary participation, the City would not necessarily need to provide additional facilities for regional in-lieu treatment. Compulsory developer participation would require participation unless the developer appeals and is granted a waiver according to special criteria outlined in the policy/fee-in-lieu program. One such exceptions to compulsory participation would be excellent site conditions for full on-site infiltration. Compulsory participation would provide greater certainty to the City that regional facility costs would be recovered by developer fees. However, the City would need to build a facility sized for the anticipated redevelopment that would buy credits in the facility or be prepared to build new facilities as credits were expended.

Cost to City and developers

Facility costs for the City include property acquisition, facility design and construction, and conveyance. Developer costs are the unit costs per mitigation credit that the City determines to be the fair market value for providing mitigation treatment in the facility in lieu of on-site treatment. The City's costs will vary depending on the location of the facility and whether the facility treats an equivalent off-site area in the same basin as the impacts or treats the actual impacted area downstream of the impacts. City owned land (i.e., parks, right-of-way, etc.) will reduce the need for property acquisition which in today's market could be as much or more than $900,000/acre depending on the location of property purchased and structures on the property.

Location of facility relative to impacts

Conveyance costs can be reduced if the facility treats an equivalent area of untreated right-of-way and existing impervious surfaces in the same basin, rather than attempting to convey stormwater from actual short-plats that buy-in to the facility. Additionally, it may be challenging and expensive to find available property in the right location near potential redevelopment to site a regional facility.

It was assumed that any regional facility would be located downstream of redevelopment, and upstream of existing or potential stream channel or stormwater infrastructure issues that could be impacted by changes in flow between the redevelopment impacts and the facility.

Redevelopment targets

Redevelopment that would require flow control under all circumstances was generally eliminated from consideration as a target for stormwater fee-in-lieu because inclusion of these sites in regional flow control facilities would limit flexibility for where the regional facilities could be located; the regional facilities would need to be connected to the actual sites that are purchasing credits. The smaller redevelopment sites that would not otherwise trigger flow control under Ecology Manual criteria, could purchase credits in a facility that is not directly connected to the immediate impact without having a significant impact.

Potential for retrofit

In the Forbes Creek drainage area example, much of the basin does not currently have adequate stormwater controls. Construction of facilities in most locations could serve to retrofit neighborhoods with stormwater flow control and/or water quality treatment on a temporary basis before all mitigation credits in the facility are sold, or permanently if the City wishes to set aside part of the facility solely for retrofit.

Table 5 provides a matrix of the alternatives evaluated.

Table 5. Matrix of alternatives

Alternative	Characteristics				
	Developer Buy-In?	Criteria for site participation	Location of facility	Property acquisition needed?	Cost to City
A	Voluntary or Compulsory	Exceeds KC flow control criteria, doesn't meet Ecology Manual flow control criteria	Anywhere in the defined basin area	No (City-owned land, such as a park)	Facility and conveyance
B	Voluntary or Compulsory	Exceeds KC and may or may not exceed Ecology Manual flow control criteria	Immediately downstream of impacts	Yes (City-purchased property)	Property acquisition, facility, and conveyance

5.1 Alternative A

Alternative A involves construction of a regional facility on City-owned property, such as a park, and treatment of impervious surfaces in the vicinity of the facility that currently do not have treatment. Developers of short plats that meet the criteria for participation would buy credits equivalent to the flow control that would otherwise need to be provided on-site or provide that flow control on-site according to Kirkland's code. The sites that buy-in would not need to be tributary to the facility but would need to be in the same basin. Figure 3 shows a schematic of how this alternative would be implemented conceptually. A detailed summary sheet of Alternative A is provided in Attachment F.

There are two options for participation in Alternative A; voluntary or compulsory. Voluntary participation is shown schematically in Figure 3, where developers opt to buy credits in the facility or choose to provide on-site detention.

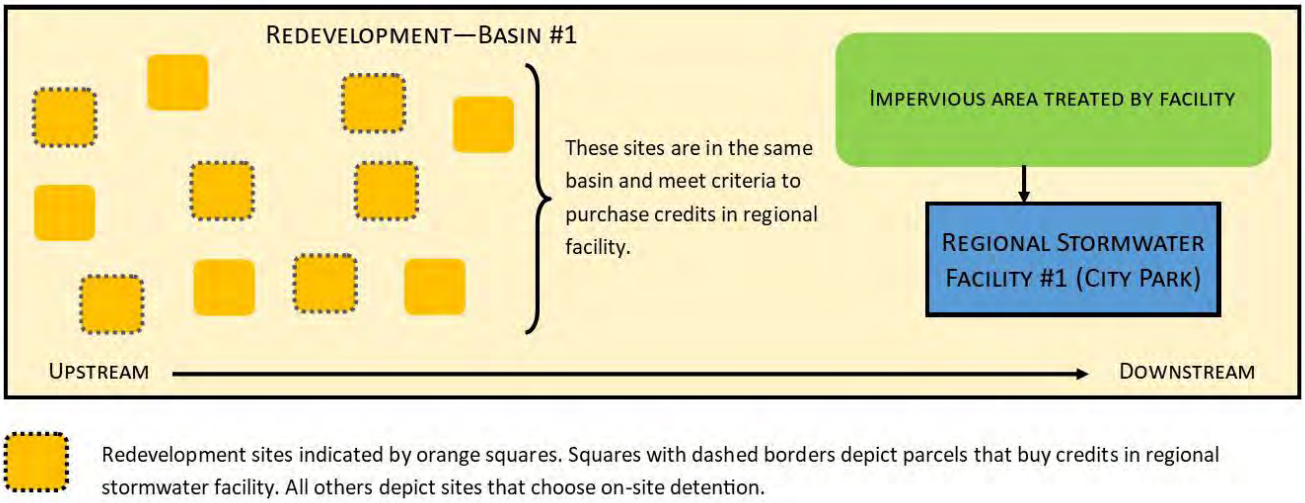


Figure 4. Conceptual schematic of voluntary participation for Alternative A

Compulsory participation would require all developers to buy credits in the facility unless granted a waiver. Figure 4 illustrates how compulsory participation may require the City to build additional treatment facilities in the future to accommodate new participants as credits in the original facility are expended. Alternatively, if the City chose not to build any additional facilities, once credits in the original stormwater facility are expended, future development would revert back to on-site treatment.

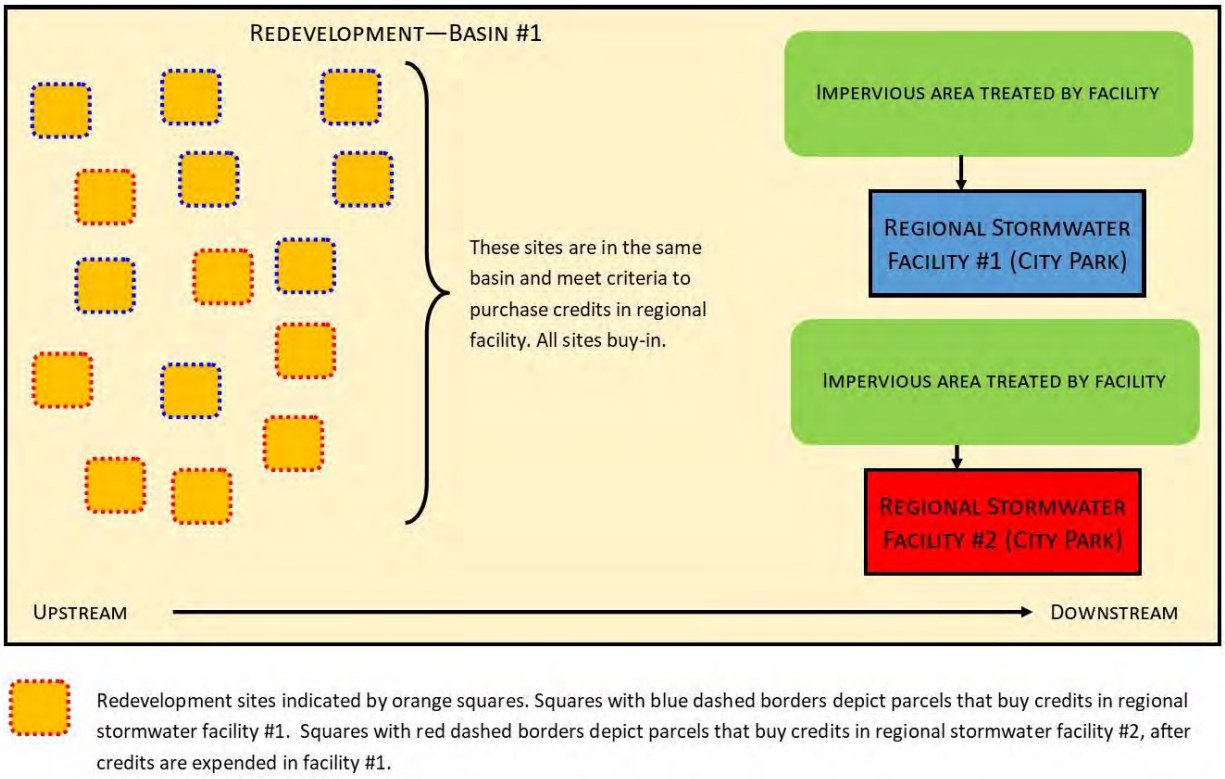


Figure 5. Conceptual schematic of compulsory participation for Alternative A

5.2 Alternative B

Alternative B involves construction of a regional facility on property purchased by the City on a site designed to capture an area anticipated for redevelopment. Participation could be limited to sites that meet the criteria described above, or all redevelopment sites could have the option to buy credits equivalent to the flow control that would otherwise need to be provided on-site or provide that flow control on-site according to Kirkland's code for this alternative. Alternative B could include voluntary or compulsory participation however, compulsory participation may make more sense for this alternative since the facility would be built specifically for a targeted area of redevelopment that is tributary to the facility. The outlay of cash for property acquisition would make this alternative less favorable for the City in terms of recouping its costs, unless it had certainty that credits would be purchased by developers, therefore compulsory or more flexible criteria for participation should be considered. Figure 4 shows a schematic of how this alternative would be implemented conceptually. A detailed summary sheet of Alternative B is provided in Attachment F.

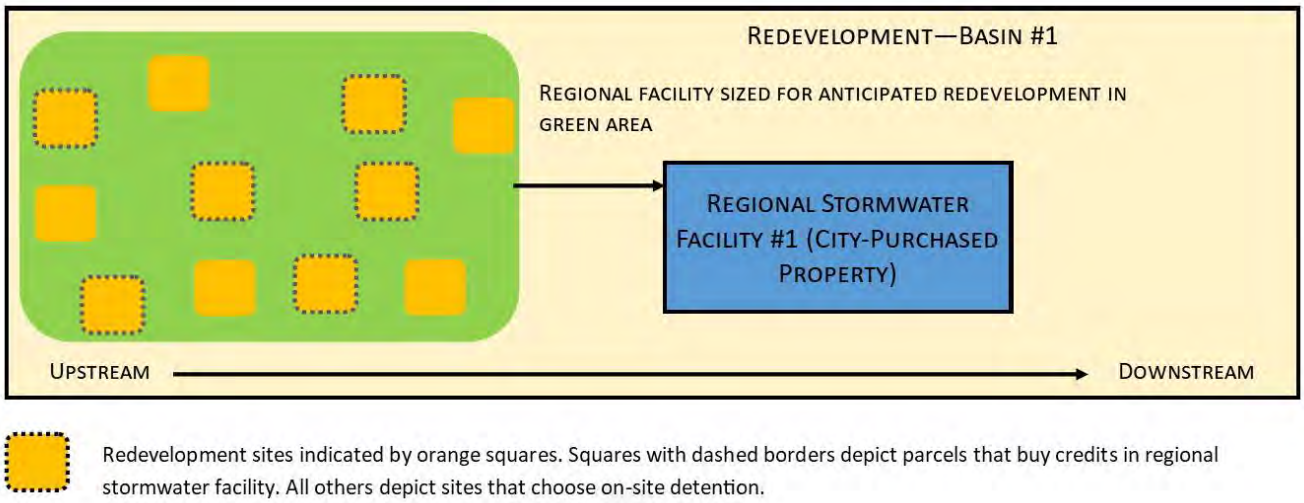


Figure 6. Conceptual schematic of Alternative B

5.3 Potential Regulatory Implications

The City's NPDES Phase II Municipal Separated Storm Sewer (MS4) Permit (Permit) authorizes the City to discharge stormwater from its system to receiving waters if it complies with conditions of the permit. As allowed by the Permit, the City adopted the KCSWDM to address runoff from new development, redevelopment and construction sites, rather than the Ecology Manual. Kirkland staff has demonstrated, and it has further been confirmed in this study, that the KCSWDM is more stringent than the Ecology Manual for small site flow control requirements. As such, Kirkland is providing greater environmental protection than otherwise would be required by the Permit, because the KCSWDM was adopted. Because the Permit is tied to the minimum requirements in the manual followed by Kirkland (i.e., KCSWDM), any changes to minimum requirements may require an adjustment to the City's adopted minimum requirements and Permit. This situation would not apply for Alternative B because the facility would in the immediate receiving area of the impacts, however, Alternative A may require an adjustment because these alternatives represent an in-basin area for area treatment trade. Attachment G outlines implementation steps that the City may need to take for Alternative A.

6. Findings and Recommendations

This study confirms the assumption that certain small short plats would be required to provide flow control under KCSWDM but not under the Ecology Manual. In the two sub-areas evaluated in the Champagne and Forbes Creek basins, if Kirkland adopted Ecology Manual methodology, over 100 parcels would avoid flow control if they were redeveloped to their full build-out conditions under current zoning. The cumulative impact from such a change could cause increased flooding and erosion, depending on the density of redevelopment. The City has invested a lot of money and resources toward stormwater retrofit to reduce impacts from untreated impervious surfaces, so making a change that potentially increases impacts is not recommended.

There are many challenges with implementing flow control on small residential redevelopment sites for developers and City staff. The City recognizes these challenges and desires to find a solution that benefits the City and the development community, while not making matters worse for the City's receiving waters and natural resources. Stormwater fee-in-lieu Alternative A is recommended as an option to alleviate some of these challenges. Alternative A provides the most flexibility, best cost, and least amount of risk for the City. Developers would likely find this option attractive, depending on the cost because it eliminates the site challenges confronted by many. Additionally, because it would be attractive to developers, compulsory participation would likely not be a problem if the City chooses to require developers to buy-in rather than provide flow control on-site. Careful siting of the regional facilities upstream of receiving waters that could experience flooding or erosion will alleviate concern for allowing treatment trades within the same basin. Conditions such as regional facility siting, credit availability and purchasing, credit tracking, and program management would need to be carefully developed and approved by City Council before implementation.

Attachment G
Implementation Steps for Stormwater Fee-in-lieu
Alternative A

AltaTerra

Attachment A
Modeling Reports

AltaTerra

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Peak Flows Ex Cond
Site Name:	Lola Short Plat
Site Address:	
City:	
Report Date:	7/2/2018
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2017/04/14
Version:	4.2.13

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.126
C, Lawn, Flat	0.178
Pervious Total	0.304
Impervious Land Use	acre
ROOF TOPS FLAT	0.044
DRIVEWAYS FLAT	0.03
Impervious Total	0.074
Basin Total	0.378

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.173
Pervious Total	0.173
Impervious Land Use	acre
ROADS FLAT	0.205
Impervious Total	0.205
Basin Total	0.378

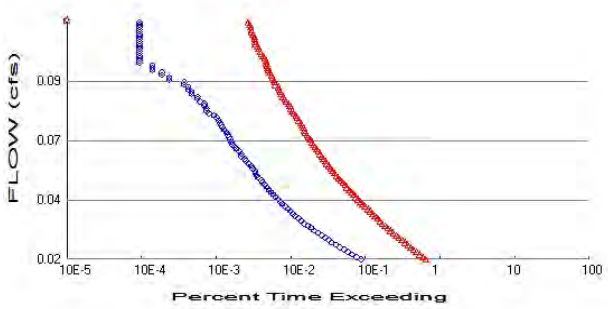
Element Flows To:

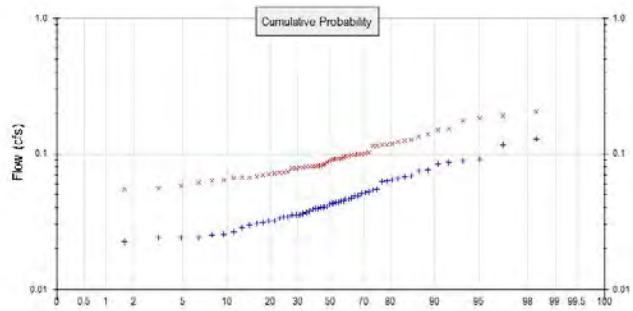
Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.304
Total Impervious Area: 0.074

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.173
Total Impervious Area: 0.205

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.042613
5 year	0.061133
10 year	0.075007
25 year	0.094443
50 year	0.110357
100 year	0.127543

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.089616
5 year	0.118258
10 year	0.138383
25 year	0.165188
50 year	0.186185
100 year	0.208087

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.066	0.126
1950	0.067	0.116
1951	0.043	0.078
1952	0.027	0.058
1953	0.024	0.063
1954	0.034	0.073
1955	0.035	0.080
1956	0.035	0.079
1957	0.049	0.097
1958	0.031	0.071

1959	0.024	0.066
1960	0.046	0.082
1961	0.040	0.081
1962	0.025	0.064
1963	0.038	0.078
1964	0.033	0.072
1965	0.051	0.102
1966	0.028	0.062
1967	0.068	0.117
1968	0.055	0.124
1969	0.045	0.092
1970	0.039	0.084
1971	0.047	0.100
1972	0.064	0.117
1973	0.025	0.054
1974	0.046	0.095
1975	0.052	0.098
1976	0.037	0.073
1977	0.032	0.069
1978	0.039	0.087
1979	0.043	0.114
1980	0.075	0.134
1981	0.041	0.092
1982	0.075	0.140
1983	0.040	0.100
1984	0.031	0.067
1985	0.041	0.092
1986	0.044	0.079
1987	0.045	0.115
1988	0.024	0.066
1989	0.030	0.083
1990	0.129	0.204
1991	0.088	0.152
1992	0.032	0.067
1993	0.022	0.054
1994	0.020	0.055
1995	0.035	0.080
1996	0.062	0.098
1997	0.049	0.092
1998	0.036	0.081
1999	0.091	0.190
2000	0.043	0.090
2001	0.034	0.088
2002	0.064	0.125
2003	0.053	0.097
2004	0.083	0.175
2005	0.042	0.081
2006	0.040	0.074
2007	0.115	0.184
2008	0.087	0.149
2009	0.054	0.101

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1291	0.2043
2	0.1153	0.1896
3	0.0915	0.1835

4	0.0883	0.1748
5	0.0865	0.1519
6	0.0833	0.1490
7	0.0755	0.1402
8	0.0747	0.1345
9	0.0684	0.1263
10	0.0674	0.1250
11	0.0660	0.1236
12	0.0636	0.1173
13	0.0635	0.1169
14	0.0619	0.1160
15	0.0546	0.1145
16	0.0537	0.1145
17	0.0527	0.1017
18	0.0516	0.1015
19	0.0511	0.1000
20	0.0491	0.0998
21	0.0487	0.0984
22	0.0467	0.0979
23	0.0462	0.0972
24	0.0459	0.0970
25	0.0451	0.0946
26	0.0450	0.0923
27	0.0436	0.0922
28	0.0435	0.0916
29	0.0430	0.0916
30	0.0428	0.0899
31	0.0423	0.0882
32	0.0406	0.0865
33	0.0406	0.0836
34	0.0403	0.0827
35	0.0403	0.0818
36	0.0395	0.0815
37	0.0395	0.0808
38	0.0390	0.0806
39	0.0381	0.0802
40	0.0371	0.0800
41	0.0363	0.0794
42	0.0354	0.0792
43	0.0353	0.0784
44	0.0350	0.0783
45	0.0345	0.0735
46	0.0341	0.0731
47	0.0332	0.0729
48	0.0321	0.0721
49	0.0319	0.0710
50	0.0310	0.0694
51	0.0308	0.0673
52	0.0299	0.0667
53	0.0283	0.0663
54	0.0266	0.0661
55	0.0255	0.0636
56	0.0250	0.0629
57	0.0242	0.0615
58	0.0240	0.0582
59	0.0239	0.0552
60	0.0224	0.0545
61	0.0199	0.0544

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0213	1884	13830	734	Fail
0.0222	1633	12540	767	Fail
0.0231	1437	11362	790	Fail
0.0240	1252	10376	828	Fail
0.0249	1120	9462	844	Fail
0.0258	973	8647	888	Fail
0.0267	863	7944	920	Fail
0.0276	754	7274	964	Fail
0.0285	682	6616	970	Fail
0.0294	624	6030	966	Fail
0.0303	553	5531	1000	Fail
0.0312	493	5067	1027	Fail
0.0321	444	4652	1047	Fail
0.0330	403	4276	1061	Fail
0.0339	363	3918	1079	Fail
0.0348	320	3610	1128	Fail
0.0357	294	3343	1137	Fail
0.0366	272	3133	1151	Fail
0.0375	245	2887	1178	Fail
0.0384	227	2656	1170	Fail
0.0393	212	2481	1170	Fail
0.0402	198	2310	1166	Fail
0.0411	179	2121	1184	Fail
0.0420	164	1984	1209	Fail
0.0429	156	1842	1180	Fail
0.0438	146	1708	1169	Fail
0.0447	134	1606	1198	Fail
0.0456	125	1493	1194	Fail
0.0465	116	1394	1201	Fail
0.0474	109	1305	1197	Fail
0.0483	104	1211	1164	Fail
0.0492	96	1145	1192	Fail
0.0501	90	1071	1190	Fail
0.0510	86	996	1158	Fail
0.0519	79	931	1178	Fail
0.0528	75	875	1166	Fail
0.0537	72	822	1141	Fail
0.0546	71	768	1081	Fail
0.0555	66	737	1116	Fail
0.0564	63	693	1100	Fail
0.0573	58	657	1132	Fail
0.0582	54	622	1151	Fail
0.0591	52	585	1125	Fail
0.0600	47	556	1182	Fail
0.0609	47	525	1117	Fail
0.0618	43	502	1167	Fail
0.0627	40	474	1185	Fail
0.0636	38	452	1189	Fail
0.0645	35	426	1217	Fail
0.0654	34	411	1208	Fail
0.0663	33	388	1175	Fail
0.0672	32	369	1153	Fail
0.0681	31	355	1145	Fail
0.0690	30	339	1130	Fail

0.0699	28	325	1160	Fail
0.0708	26	316	1215	Fail
0.0717	25	302	1208	Fail
0.0726	24	291	1212	Fail
0.0735	23	272	1182	Fail
0.0744	22	260	1181	Fail
0.0753	20	250	1250	Fail
0.0762	17	235	1382	Fail
0.0771	16	225	1406	Fail
0.0780	16	216	1350	Fail
0.0789	15	210	1400	Fail
0.0798	15	199	1326	Fail
0.0807	13	184	1415	Fail
0.0816	12	178	1483	Fail
0.0825	12	168	1400	Fail
0.0834	10	159	1590	Fail
0.0843	10	155	1550	Fail
0.0852	9	149	1655	Fail
0.0861	9	146	1622	Fail
0.0870	8	134	1675	Fail
0.0879	8	131	1637	Fail
0.0888	5	128	2560	Fail
0.0897	5	121	2420	Fail
0.0906	4	118	2950	Fail
0.0915	4	112	2800	Fail
0.0924	3	106	3533	Fail
0.0933	3	105	3500	Fail
0.0942	3	102	3400	Fail
0.0951	2	101	5050	Fail
0.0960	2	100	5000	Fail
0.0969	2	96	4800	Fail
0.0978	2	91	4550	Fail
0.0987	2	86	4300	Fail
0.0996	2	83	4150	Fail
0.1005	2	79	3950	Fail
0.1014	2	77	3850	Fail
0.1023	2	72	3600	Fail
0.1032	2	72	3600	Fail
0.1041	2	70	3500	Fail
0.1050	2	70	3500	Fail
0.1059	2	66	3300	Fail
0.1068	2	64	3200	Fail
0.1077	2	63	3150	Fail
0.1086	2	62	3100	Fail
0.1095	2	60	3000	Fail
0.1104	2	57	2850	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

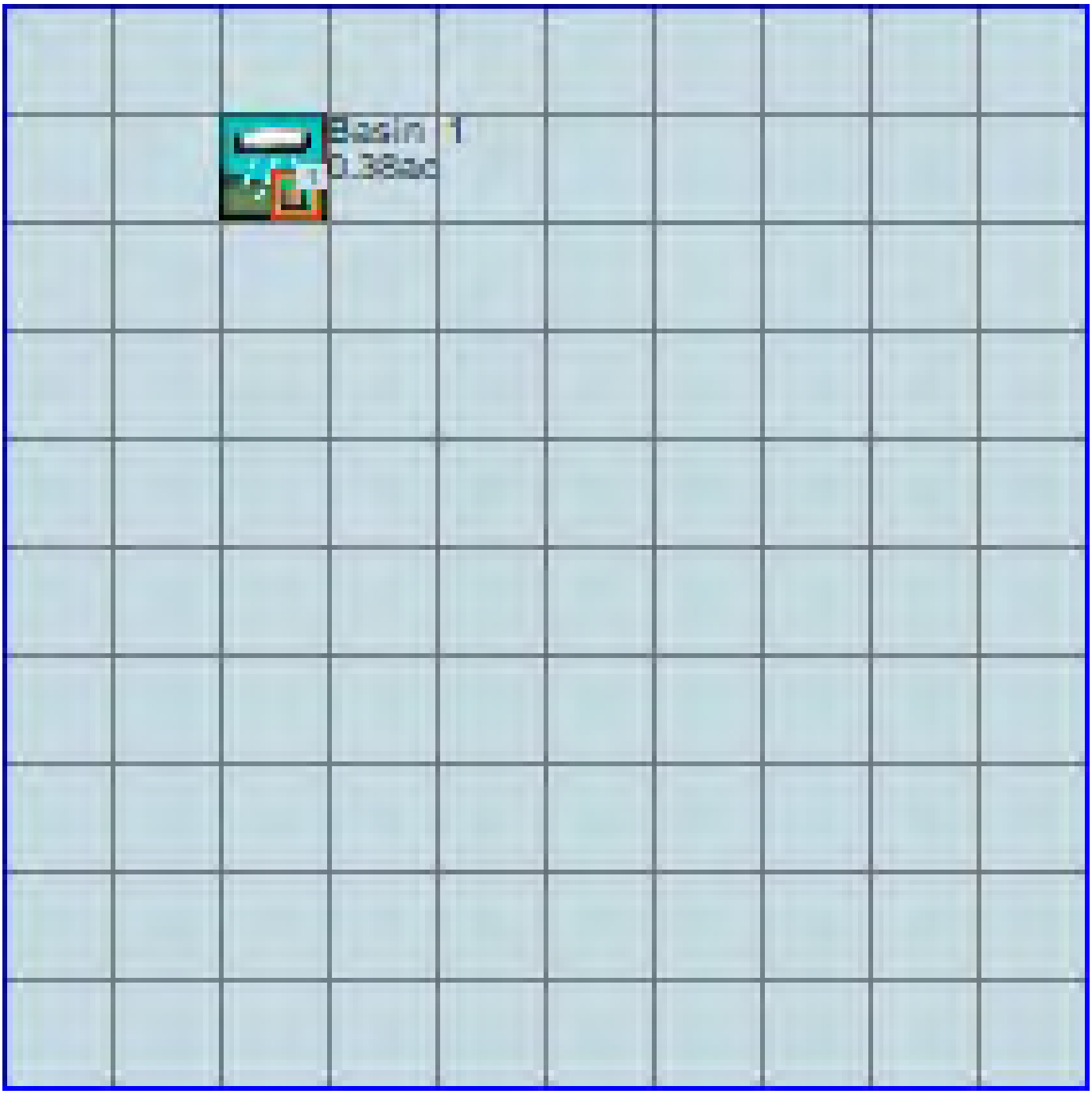
No PERLND changes have been made.

IMPLND Changes

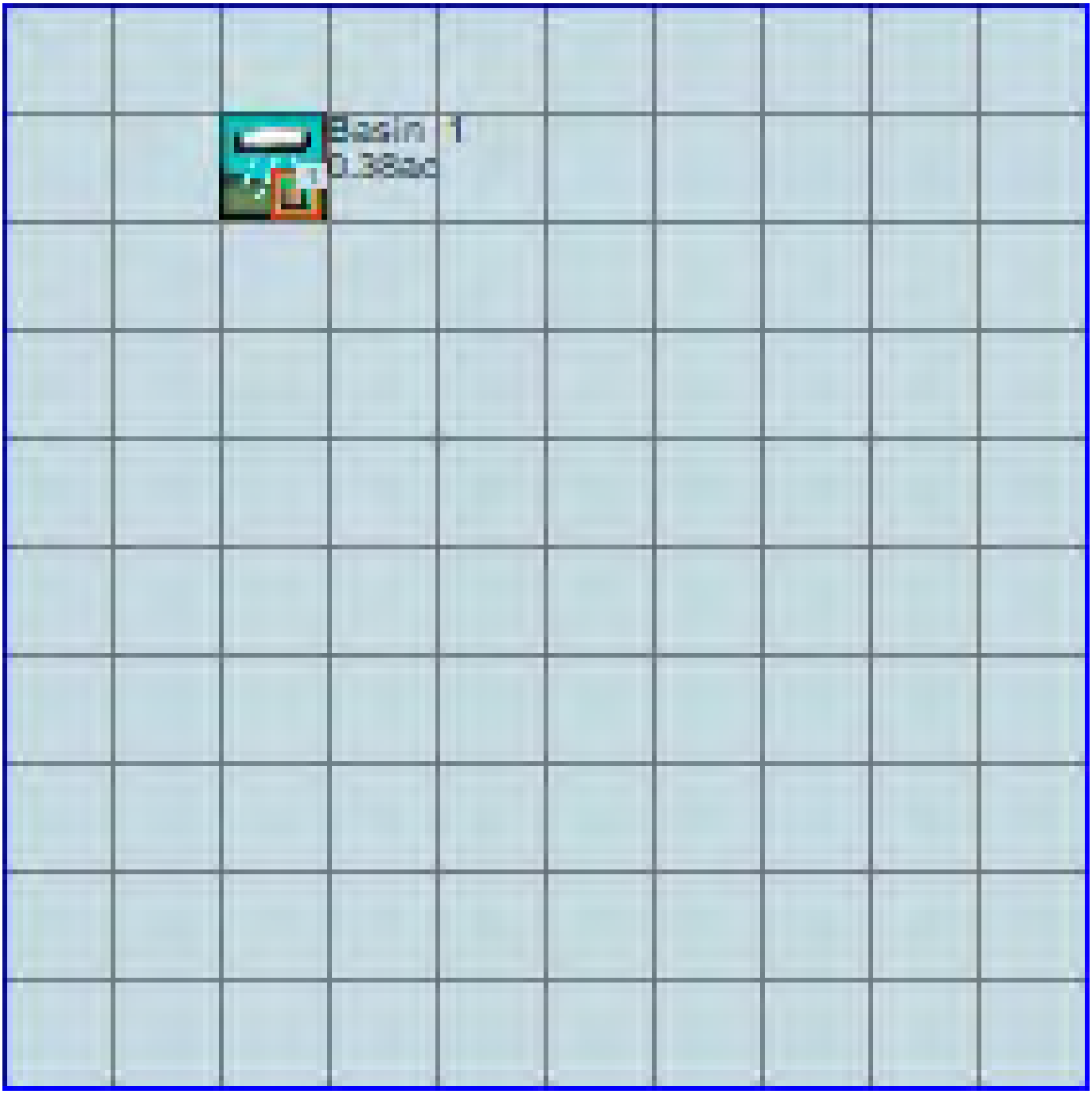
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   PrePeak Flows Ex Cond.MES
           27   PrePeak Flows Ex Cond.L61
           28   PrePeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      PERLND      16
      IMPLND       4
      IMPLND       5
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   10     C, Forest, Flat         1    1    1    1   27    0
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   10         0    0    1    0    0    0    0    0    0    0    0    0
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   10         0    0    0    0    0    0    0    0    0    0    0
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   10              0       4.5      0.08       400      0.05       0.5     0.996
   16              0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   10              0         0         2         2         0         0         0
   16              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                  ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   10            0.2       0.5      0.35         6       0.5       0.7
   16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   10              0         0         0         0       2.5         1         0
   16              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    5      DRIVEWAYS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
```

```
    4         0    0    0    0    0
    5         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    5              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    5              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  10                       0.126     COPY   501     12
PERLND  10                       0.126     COPY   501     13
PERLND  16                       0.178     COPY   501     12
PERLND  16                       0.178     COPY   501     13
IMPLND   4                       0.044     COPY   501     15
IMPLND   5                        0.03     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                        in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO
```

```
  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   MitPeak Flows Ex Cond.MES
           27   MitPeak Flows Ex Cond.L61
           28   MitPeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16             0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1             0         0
```

```
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                      0.173     COPY   501     12
PERLND  16                      0.173     COPY   501     13
IMPLND   1                      0.205     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                               ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                      ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Peak Flows Ex Cond
Site Name:	Lake Park II
Site Address:	
City:	
Report Date:	7/2/2018
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2017/04/14
Version:	4.2.13

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.028
C, Lawn, Mod	1
Pervious Total	1.028
Impervious Land Use	acre
ROADS FLAT	0.043
DRIVEWAYS MOD	0.028
SIDEWALKS MOD	0.017
Impervious Total	0.088
Basin Total	1.116

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.5
Pervious Total	0.5
Impervious Land Use	acre
ROADS FLAT	0.062
ROOF TOPS FLAT	0.367
DRIVEWAYS FLAT	0.132
Impervious Total	0.561
Basin Total	1.061

Element Flows To:

Surface	Interflow	Groundwater

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.01
Pervious Total	0.01
Impervious Land Use	acre
ROADS FLAT	0.044
Impervious Total	0.044
Basin Total	0.054

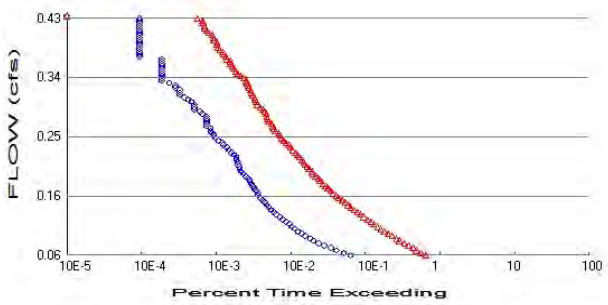
Element Flows To:

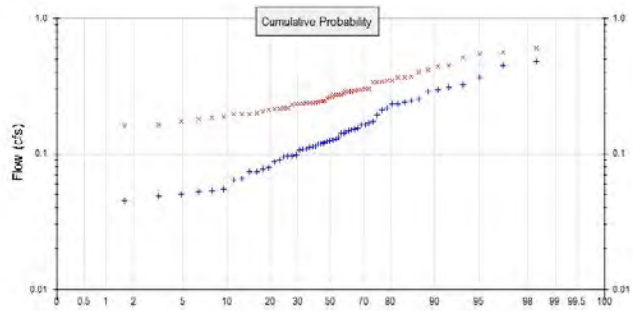
Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 1.028
Total Impervious Area: 0.088

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.51
Total Impervious Area: 0.605

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.127665
5 year	0.208285
10 year	0.270489
25 year	0.358902
50 year	0.431829
100 year	0.510791

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.264438
5 year	0.348933
10 year	0.408303
25 year	0.487375
50 year	0.549314
100 year	0.613919

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.232	0.373
1950	0.247	0.342
1951	0.131	0.231
1952	0.064	0.172
1953	0.051	0.186
1954	0.097	0.215
1955	0.095	0.236
1956	0.126	0.234
1957	0.152	0.286
1958	0.087	0.210

1959	0.073	0.196
1960	0.142	0.241
1961	0.108	0.238
1962	0.052	0.188
1963	0.117	0.231
1964	0.112	0.213
1965	0.162	0.300
1966	0.073	0.182
1967	0.240	0.345
1968	0.169	0.365
1969	0.145	0.272
1970	0.112	0.247
1971	0.149	0.295
1972	0.218	0.346
1973	0.055	0.160
1974	0.154	0.279
1975	0.163	0.290
1976	0.112	0.216
1977	0.098	0.205
1978	0.122	0.255
1979	0.077	0.338
1980	0.298	0.397
1981	0.107	0.270
1982	0.252	0.414
1983	0.142	0.295
1984	0.080	0.198
1985	0.108	0.272
1986	0.126	0.234
1987	0.118	0.338
1988	0.049	0.195
1989	0.045	0.244
1990	0.478	0.603
1991	0.323	0.448
1992	0.097	0.197
1993	0.053	0.161
1994	0.041	0.163
1995	0.090	0.237
1996	0.231	0.289
1997	0.150	0.270
1998	0.119	0.240
1999	0.368	0.560
2000	0.128	0.265
2001	0.066	0.260
2002	0.211	0.369
2003	0.192	0.287
2004	0.287	0.516
2005	0.121	0.238
2006	0.125	0.217
2007	0.445	0.541
2008	0.308	0.440
2009	0.174	0.300

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.4780	0.6028
2	0.4447	0.5595
3	0.3680	0.5415

4	0.3232	0.5158
5	0.3083	0.4481
6	0.2980	0.4397
7	0.2871	0.4137
8	0.2521	0.3968
9	0.2472	0.3728
10	0.2398	0.3690
11	0.2324	0.3646
12	0.2314	0.3462
13	0.2176	0.3450
14	0.2107	0.3421
15	0.1922	0.3380
16	0.1736	0.3379
17	0.1686	0.3000
18	0.1630	0.2995
19	0.1622	0.2950
20	0.1540	0.2946
21	0.1519	0.2903
22	0.1501	0.2889
23	0.1489	0.2869
24	0.1446	0.2861
25	0.1421	0.2793
26	0.1418	0.2723
27	0.1313	0.2721
28	0.1279	0.2704
29	0.1261	0.2704
30	0.1257	0.2652
31	0.1248	0.2603
32	0.1222	0.2553
33	0.1208	0.2466
34	0.1187	0.2441
35	0.1183	0.2412
36	0.1173	0.2405
37	0.1125	0.2384
38	0.1125	0.2377
39	0.1120	0.2367
40	0.1080	0.2360
41	0.1078	0.2344
42	0.1069	0.2336
43	0.0983	0.2313
44	0.0971	0.2309
45	0.0969	0.2169
46	0.0952	0.2157
47	0.0898	0.2150
48	0.0869	0.2127
49	0.0795	0.2096
50	0.0769	0.2048
51	0.0733	0.1985
52	0.0732	0.1967
53	0.0662	0.1957
54	0.0640	0.1952
55	0.0548	0.1875
56	0.0530	0.1857
57	0.0524	0.1816
58	0.0506	0.1717
59	0.0489	0.1629
60	0.0446	0.1608
61	0.0414	0.1604

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0638	1349	13757	1019	Fail
0.0675	1095	11877	1084	Fail
0.0713	872	10309	1182	Fail
0.0750	739	9289	1256	Fail
0.0787	600	8134	1355	Fail
0.0824	503	7137	1418	Fail
0.0861	432	6194	1433	Fail
0.0899	387	5604	1448	Fail
0.0936	334	4917	1472	Fail
0.0973	298	4327	1452	Fail
0.1010	267	3790	1419	Fail
0.1047	243	3469	1427	Fail
0.1084	219	3129	1428	Fail
0.1122	204	2757	1351	Fail
0.1159	185	2535	1370	Fail
0.1196	167	2282	1366	Fail
0.1233	153	2035	1330	Fail
0.1270	136	1820	1338	Fail
0.1307	127	1675	1318	Fail
0.1345	116	1521	1311	Fail
0.1382	108	1358	1257	Fail
0.1419	103	1254	1217	Fail
0.1456	95	1148	1208	Fail
0.1493	90	1046	1162	Fail
0.1530	83	934	1125	Fail
0.1568	78	867	1111	Fail
0.1605	78	788	1010	Fail
0.1642	73	729	998	Fail
0.1679	69	680	985	Fail
0.1716	65	629	967	Fail
0.1753	63	573	909	Fail
0.1791	60	534	889	Fail
0.1828	57	503	882	Fail
0.1865	54	462	855	Fail
0.1902	50	428	856	Fail
0.1939	46	411	893	Fail
0.1976	44	378	859	Fail
0.2014	43	355	825	Fail
0.2051	42	331	788	Fail
0.2088	42	319	759	Fail
0.2125	40	301	752	Fail
0.2162	40	278	695	Fail
0.2200	37	264	713	Fail
0.2237	34	246	723	Fail
0.2274	32	226	706	Fail
0.2311	30	212	706	Fail
0.2348	27	203	751	Fail
0.2385	26	184	707	Fail
0.2423	23	172	747	Fail
0.2460	21	161	766	Fail
0.2497	20	155	775	Fail
0.2534	19	147	773	Fail
0.2571	18	134	744	Fail
0.2608	18	129	716	Fail

0.2646	16	121	756	Fail
0.2683	16	117	731	Fail
0.2720	16	109	681	Fail
0.2757	16	105	656	Fail
0.2794	16	102	637	Fail
0.2831	14	100	714	Fail
0.2869	13	96	738	Fail
0.2906	11	90	818	Fail
0.2943	11	83	754	Fail
0.2980	11	77	700	Fail
0.3017	10	74	740	Fail
0.3054	9	71	788	Fail
0.3092	8	70	875	Fail
0.3129	7	66	942	Fail
0.3166	7	63	900	Fail
0.3203	7	62	885	Fail
0.3240	6	59	983	Fail
0.3277	6	57	950	Fail
0.3315	5	56	1120	Fail
0.3352	4	54	1350	Fail
0.3389	4	51	1275	Fail
0.3426	4	45	1125	Fail
0.3463	4	41	1025	Fail
0.3501	4	39	975	Fail
0.3538	4	37	925	Fail
0.3575	4	35	875	Fail
0.3612	4	33	825	Fail
0.3649	4	33	825	Fail
0.3686	4	30	750	Fail
0.3724	2	29	1450	Fail
0.3761	2	27	1350	Fail
0.3798	2	26	1300	Fail
0.3835	2	24	1200	Fail
0.3872	2	23	1150	Fail
0.3909	2	22	1100	Fail
0.3947	2	22	1100	Fail
0.3984	2	20	1000	Fail
0.4021	2	20	1000	Fail
0.4058	2	19	950	Fail
0.4095	2	17	850	Fail
0.4132	2	16	800	Fail
0.4170	2	15	750	Fail
0.4207	2	15	750	Fail
0.4244	2	14	700	Fail
0.4281	2	14	700	Fail
0.4318	2	12	600	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

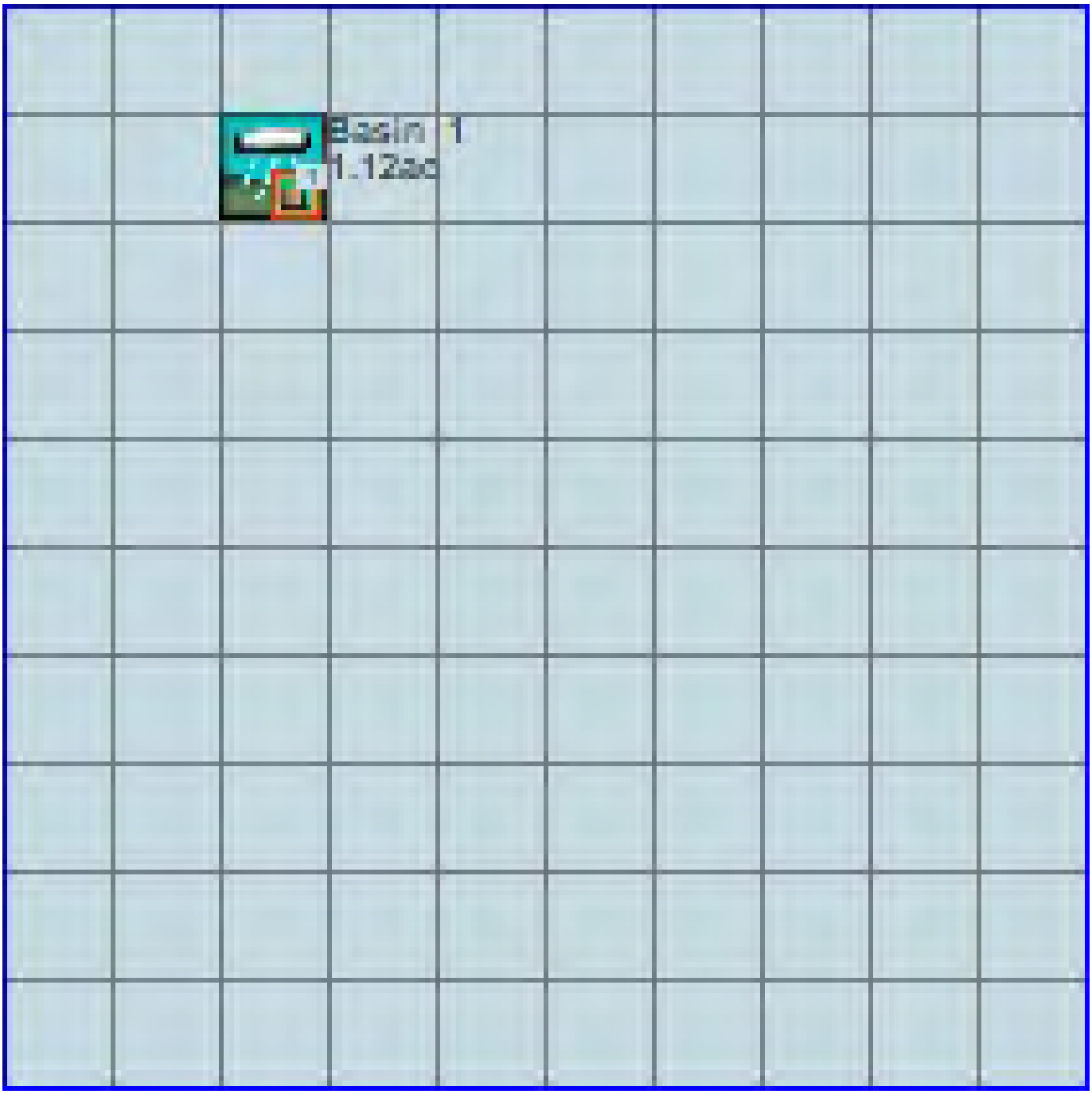
No PERLND changes have been made.

IMPLND Changes

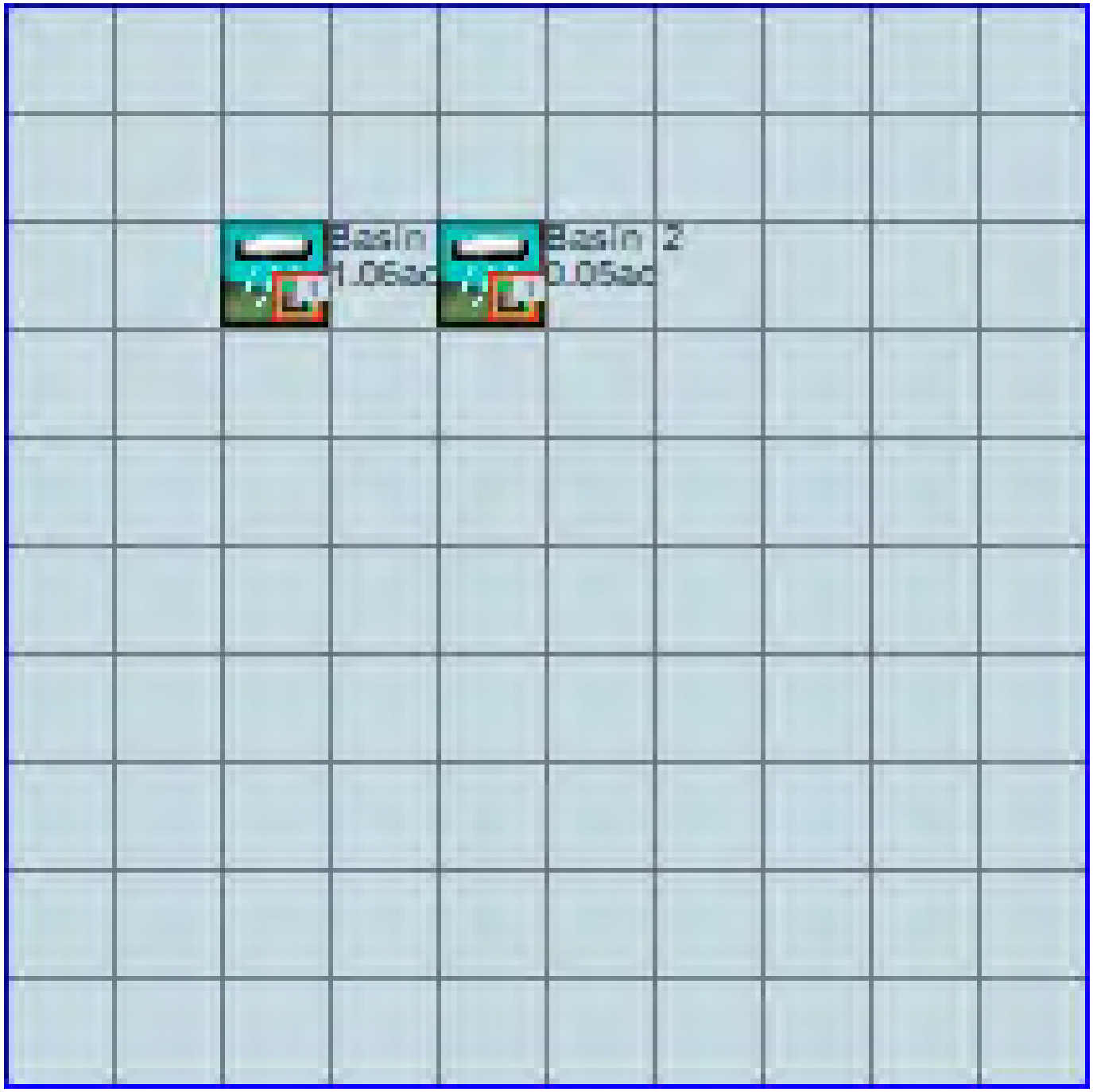
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   PrePeak Flows Ex Cond.MES
           27   PrePeak Flows Ex Cond.L61
           28   PrePeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      PERLND      17
      IMPLND       1
      IMPLND       6
      IMPLND       9
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                            in  out           ***
   11     C, Forest, Mod          1    1    1    1   27    0
   17     C, Lawn, Mod            1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   11         0    0    1    0    0    0    0    0    0    0    0    0
   17         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   11         0    0    0    0    0    0    0    0    0    0    0
   17         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   11              0       4.5      0.08       400       0.1       0.5     0.996
   17              0       4.5      0.03       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11              0         0         2         2         0         0         0
   17              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11            0.2       0.5      0.35         6       0.5       0.7
   17            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   11              0         0         0         0       2.5         1         0
   17              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    6      DRIVEWAYS/MOD          1    1    1   27    0
    9      SIDEWALKS/MOD          1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    6         0    0    1    0    0    0
    9         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
    6         0    0    4    0    0    0    1    9
    9         0    0    4    0    0    0    1    9
  END PRINT-INFO
```

```
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    6         0    0    0    0    0
    9         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    6            400      0.05       0.1      0.08
    9            400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    6              0         0
    9              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    6              0         0
    9              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  11                       0.028     COPY   501     12
PERLND  11                       0.028     COPY   501     13
PERLND  17                           1     COPY   501     12
PERLND  17                           1     COPY   501     13
IMPLND   1                       0.043     COPY   501     15
IMPLND   6                       0.028     COPY   501     15
IMPLND   9                       0.017     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                        in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
```

```
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   MitPeak Flows Ex Cond.MES
           27   MitPeak Flows Ex Cond.L61
           28   MitPeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       1
      IMPLND       4
      IMPLND       5
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
```

```
  16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  16             0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  16             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  16           0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  16             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
    5      DRIVEWAYS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
    4         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
    5         0    0    0    0    0
  END IWAT-PARM1
```

```
  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
    5              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
    5              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                        0.5     COPY   501     12
PERLND  16                        0.5     COPY   501     13
IMPLND   1                      0.062     COPY   501     15
IMPLND   4                      0.367     COPY   501     15
IMPLND   5                      0.132     COPY   501     15
Basin  2***
PERLND  16                       0.01     COPY   501     12
PERLND  16                       0.01     COPY   501     13
IMPLND   1                      0.044     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                               ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
```

```
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                      ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Peak Flows Ex Cond
Site Name:	Jorgensen Short Plat
Site Address:	
City:	
Report Date:	7/2/2018
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.833
Version Date:	2017/04/14
Version:	4.2.13

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.11
C, Lawn, Mod	0.392
Pervious Total	0.502
Impervious Land Use	acre
ROADS FLAT	0.06
DRIVEWAYS MOD	0.068
SIDEWALKS MOD	0.07
Impervious Total	0.198
Basin Total	0.7

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.03
C, Lawn, Mod	0.37
Pervious Total	0.4
Impervious Land Use	acre
DRIVEWAYS FLAT	0.3
Impervious Total	0.3
Basin Total	0.7

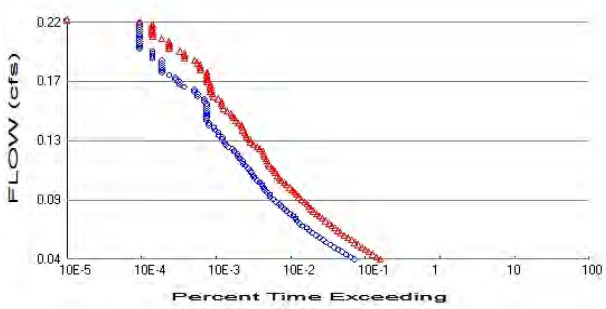
Element Flows To:

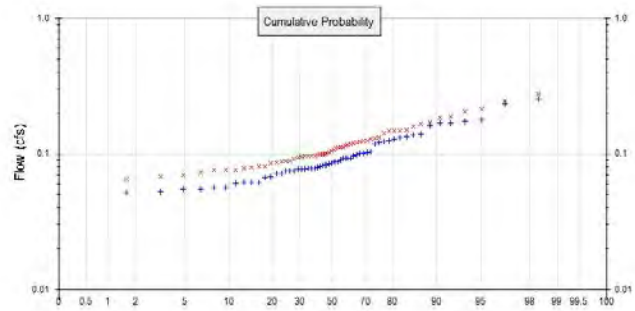
Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.502
Total Impervious Area: 0.198

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.4
Total Impervious Area: 0.3

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.08831
5 year	0.123021
10 year	0.148981
25 year	0.18534
50 year	0.215119
100 year	0.247304

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.107511
5 year	0.144017
10 year	0.170507
25 year	0.206717
50 year	0.235744
100 year	0.266588

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.138	0.159
1950	0.133	0.147
1951	0.081	0.098
1952	0.054	0.070
1953	0.055	0.073
1954	0.071	0.088
1955	0.078	0.097
1956	0.075	0.095
1957	0.092	0.116
1958	0.067	0.085

1959	0.060	0.076
1960	0.092	0.103
1961	0.075	0.097
1962	0.056	0.076
1963	0.079	0.094
1964	0.072	0.086
1965	0.102	0.125
1966	0.061	0.075
1967	0.133	0.150
1968	0.122	0.142
1969	0.090	0.111
1970	0.082	0.101
1971	0.098	0.119
1972	0.125	0.147
1973	0.052	0.067
1974	0.097	0.112
1975	0.101	0.123
1976	0.077	0.088
1977	0.061	0.078
1978	0.088	0.105
1979	0.101	0.130
1980	0.168	0.165
1981	0.085	0.111
1982	0.140	0.171
1983	0.087	0.117
1984	0.061	0.080
1985	0.077	0.107
1986	0.084	0.100
1987	0.093	0.131
1988	0.056	0.079
1989	0.082	0.087
1990	0.254	0.275
1991	0.168	0.188
1992	0.068	0.080
1993	0.052	0.064
1994	0.051	0.065
1995	0.075	0.096
1996	0.129	0.128
1997	0.093	0.114
1998	0.081	0.096
1999	0.178	0.214
2000	0.087	0.109
2001	0.078	0.099
2002	0.118	0.148
2003	0.121	0.124
2004	0.173	0.204
2005	0.078	0.099
2006	0.077	0.091
2007	0.233	0.246
2008	0.161	0.185
2009	0.104	0.122

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2543	0.2755
2	0.2329	0.2459
3	0.1781	0.2140

4	0.1735	0.2039
5	0.1680	0.1878
6	0.1677	0.1850
7	0.1610	0.1709
8	0.1401	0.1649
9	0.1380	0.1594
10	0.1330	0.1497
11	0.1328	0.1480
12	0.1291	0.1474
13	0.1248	0.1472
14	0.1222	0.1421
15	0.1215	0.1313
16	0.1176	0.1302
17	0.1043	0.1283
18	0.1017	0.1251
19	0.1010	0.1239
20	0.1010	0.1230
21	0.0979	0.1220
22	0.0966	0.1194
23	0.0930	0.1171
24	0.0928	0.1164
25	0.0923	0.1137
26	0.0922	0.1118
27	0.0899	0.1112
28	0.0875	0.1111
29	0.0871	0.1095
30	0.0869	0.1066
31	0.0851	0.1046
32	0.0843	0.1028
33	0.0825	0.1013
34	0.0825	0.1000
35	0.0813	0.0994
36	0.0806	0.0992
37	0.0793	0.0978
38	0.0784	0.0969
39	0.0781	0.0968
40	0.0776	0.0964
41	0.0769	0.0960
42	0.0766	0.0953
43	0.0765	0.0940
44	0.0752	0.0909
45	0.0747	0.0885
46	0.0745	0.0885
47	0.0719	0.0872
48	0.0714	0.0863
49	0.0675	0.0850
50	0.0671	0.0800
51	0.0611	0.0797
52	0.0610	0.0791
53	0.0609	0.0778
54	0.0603	0.0763
55	0.0563	0.0757
56	0.0563	0.0754
57	0.0546	0.0729
58	0.0544	0.0699
59	0.0521	0.0674
60	0.0515	0.0649
61	0.0513	0.0641

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0442	1523	3403	223	Fail
0.0459	1348	3029	224	Fail
0.0476	1181	2693	228	Fail
0.0493	1036	2374	229	Fail
0.0511	920	2135	232	Fail
0.0528	810	1909	235	Fail
0.0545	724	1715	236	Fail
0.0562	641	1530	238	Fail
0.0580	576	1392	241	Fail
0.0597	526	1247	237	Fail
0.0614	466	1112	238	Fail
0.0632	417	1006	241	Fail
0.0649	383	916	239	Fail
0.0666	350	832	237	Fail
0.0683	307	758	246	Fail
0.0701	283	697	246	Fail
0.0718	264	626	237	Fail
0.0735	247	563	227	Fail
0.0752	231	517	223	Fail
0.0770	209	475	227	Fail
0.0787	188	431	229	Fail
0.0804	176	397	225	Fail
0.0821	158	372	235	Fail
0.0839	150	355	236	Fail
0.0856	137	331	241	Fail
0.0873	124	297	239	Fail
0.0891	114	272	238	Fail
0.0908	112	255	227	Fail
0.0925	104	242	232	Fail
0.0942	97	223	229	Fail
0.0960	92	208	226	Fail
0.0977	88	187	212	Fail
0.0994	82	175	213	Fail
0.1011	76	159	209	Fail
0.1029	71	150	211	Fail
0.1046	68	141	207	Fail
0.1063	63	134	212	Fail
0.1081	61	129	211	Fail
0.1098	57	120	210	Fail
0.1115	54	112	207	Fail
0.1132	49	108	220	Fail
0.1150	48	103	214	Fail
0.1167	44	100	227	Fail
0.1184	42	96	228	Fail
0.1201	41	93	226	Fail
0.1219	37	90	243	Fail
0.1236	35	81	231	Fail
0.1253	31	76	245	Fail
0.1270	29	68	234	Fail
0.1288	28	62	221	Fail
0.1305	26	60	230	Fail
0.1322	26	55	211	Fail
0.1340	23	54	234	Fail
0.1357	23	52	226	Fail

0.1374	21	49	233	Fail
0.1391	20	48	240	Fail
0.1409	17	47	276	Fail
0.1426	17	42	247	Fail
0.1443	16	39	243	Fail
0.1460	16	37	231	Fail
0.1478	16	35	218	Fail
0.1495	16	34	212	Fail
0.1512	16	30	187	Fail
0.1530	16	27	168	Fail
0.1547	16	26	162	Fail
0.1564	16	25	156	Fail
0.1581	15	25	166	Fail
0.1599	15	23	153	Fail
0.1616	12	20	166	Fail
0.1633	12	19	158	Fail
0.1650	11	18	163	Fail
0.1668	11	18	163	Fail
0.1685	8	18	225	Fail
0.1702	7	18	257	Fail
0.1719	7	16	228	Fail
0.1737	6	16	266	Fail
0.1754	6	16	266	Fail
0.1771	5	16	320	Fail
0.1789	4	16	400	Fail
0.1806	4	13	325	Fail
0.1823	4	13	325	Fail
0.1840	4	13	325	Fail
0.1858	4	12	300	Fail
0.1875	4	11	275	Fail
0.1892	3	8	266	Fail
0.1909	3	8	266	Fail
0.1927	3	8	266	Fail
0.1944	3	7	233	Fail
0.1961	2	5	250	Fail
0.1978	2	5	250	Fail
0.1996	2	5	250	Fail
0.2013	2	5	250	Fail
0.2030	2	4	200	Fail
0.2048	2	3	150	Fail
0.2065	2	3	150	Fail
0.2082	2	3	150	Fail
0.2099	2	3	150	Fail
0.2117	2	3	150	Fail
0.2134	2	3	150	Fail
0.2151	2	2	100	Pass

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

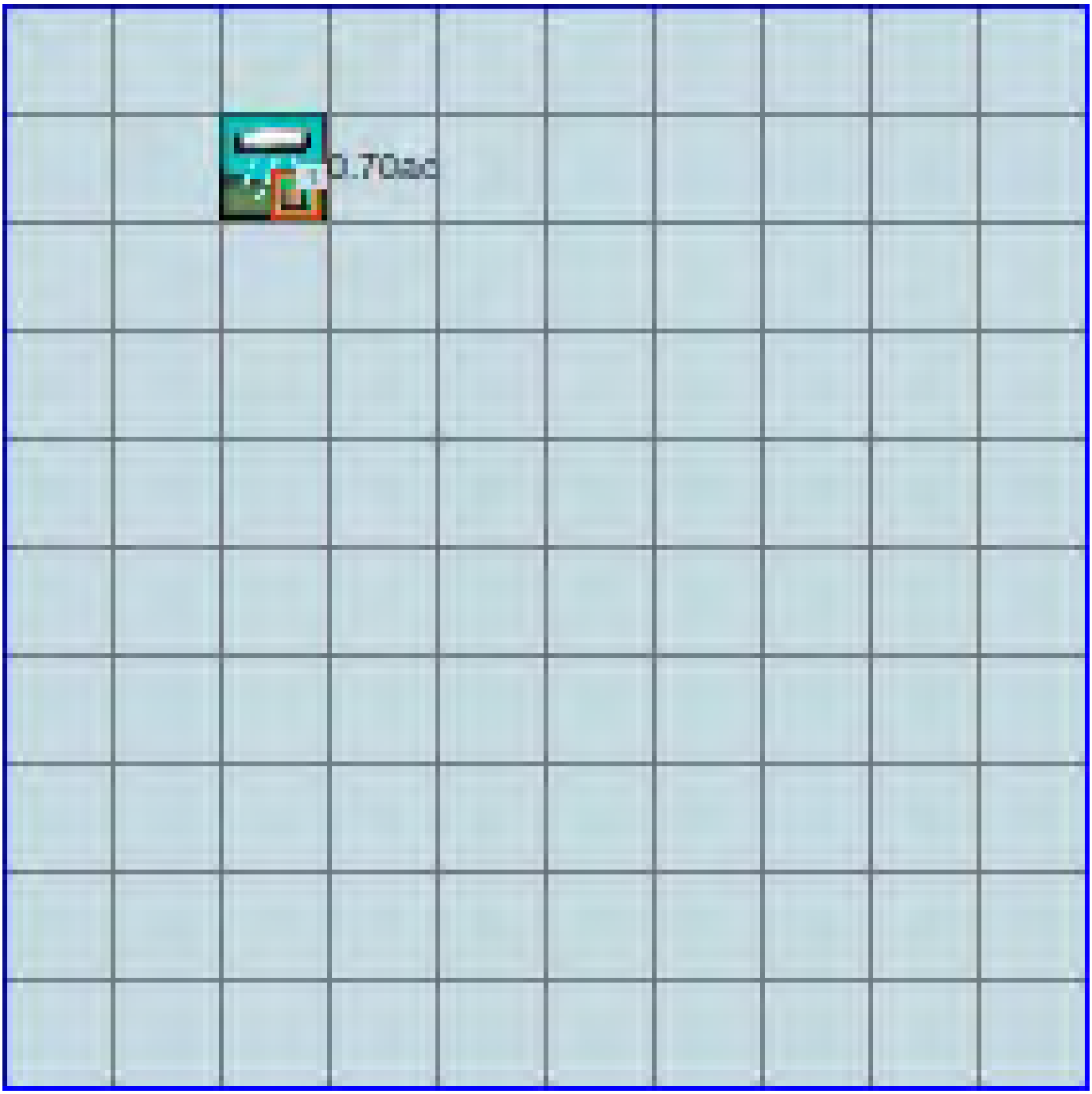
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   PrePeak Flows Ex Cond.MES
           27   PrePeak Flows Ex Cond.L61
           28   PrePeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      PERLND      17
      IMPLND       1
      IMPLND       6
      IMPLND       9
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1                                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                            in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
   17     C, Lawn, Mod            1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
   17         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
   17         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16              0       4.5      0.03       400      0.05       0.5     0.996
   17              0       4.5      0.03       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16              0         0         2         2         0         0         0
   17              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
   17            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16              0         0         0         0       2.5         1         0
   17              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    6      DRIVEWAYS/MOD          1    1    1   27    0
    9      SIDEWALKS/MOD          1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    6         0    0    1    0    0    0
    9         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
    6         0    0    4    0    0    0    1    9
    9         0    0    4    0    0    0    1    9
  END PRINT-INFO
```

```
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    6         0    0    0    0    0
    9         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    6            400      0.05       0.1      0.08
    9            400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    6              0         0
    9              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    6              0         0
    9              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
 ***
PERLND  16                        0.11     COPY   501     12
PERLND  16                        0.11     COPY   501     13
PERLND  17                       0.392     COPY   501     12
PERLND  17                       0.392     COPY   501     13
IMPLND   1                        0.06     COPY   501     15
IMPLND   6                       0.068     COPY   501     15
IMPLND   9                        0.07     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                        in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
```

```
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.833          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.833          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   MitPeak Flows Ex Cond.MES
           27   MitPeak Flows Ex Cond.L61
           28   MitPeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      PERLND      17
      IMPLND       5
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   11     C, Forest, Mod          1    1    1    1   27    0
   17     C, Lawn, Mod            1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   11         0    0    1    0    0    0    0    0    0    0    0    0
   17         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   11         0    0    0    0    0    0    0    0    0    0    0
   17         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   11              0       4.5      0.08       400       0.1       0.5     0.996
   17              0       4.5      0.03       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11              0         0         2         2         0         0         0
   17              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                  ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11            0.2       0.5      0.35         6       0.5       0.7
   17            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   11              0         0         0         0       2.5         1         0
   17              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    5      DRIVEWAYS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    5         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    5         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    5         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
```

```
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    5            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    5               0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    5               0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  11                        0.03     COPY   501     12
PERLND  11                        0.03     COPY   501     13
PERLND  17                        0.37     COPY   501     12
PERLND  17                        0.37     COPY   501     13
IMPLND   5                         0.3     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                               ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
```

```
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.833          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.833          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Peak Flows Ex Cond
Site Name:	Green Short Plat
Site Address:	
City:	
Report Date:	7/2/2018
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2017/04/14
Version:	4.2.13

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.418
Pervious Total	0.418
Impervious Land Use	acre
ROOF TOPS FLAT	0.107
DRIVEWAYS MOD	0.057
SIDEWALKS MOD	0.002
Impervious Total	0.166
Basin Total	0.584

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.332
Pervious Total	0.332
Impervious Land Use	acre
ROADS FLAT	0.1075
ROOF TOPS FLAT	0.1445
Impervious Total	0.252
Basin Total	0.584

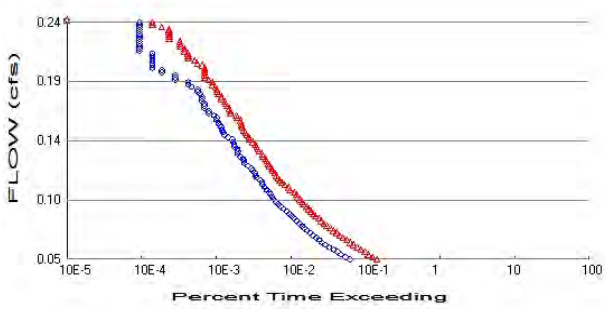
Element Flows To:

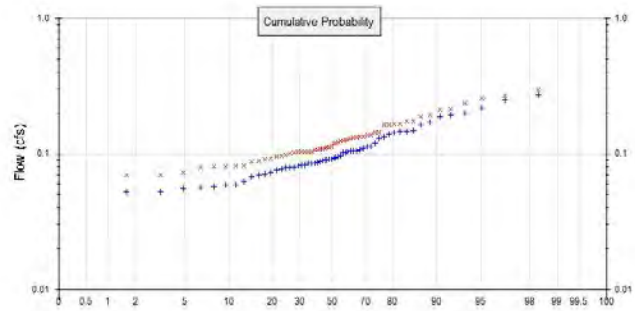
Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.418
Total Impervious Area: 0.166

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.332
Total Impervious Area: 0.252

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.095695
5 year	0.135624
10 year	0.165257
25 year	0.206466
50 year	0.23999
100 year	0.276011

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.118718
5 year	0.160706
10 year	0.190792
25 year	0.231486
50 year	0.263796
100 year	0.297858

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.147	0.173
1950	0.148	0.165
1951	0.089	0.107
1952	0.057	0.073
1953	0.057	0.079
1954	0.076	0.096
1955	0.082	0.104
1956	0.079	0.104
1957	0.106	0.131
1958	0.070	0.092

1959	0.058	0.082
1960	0.097	0.112
1961	0.085	0.108
1962	0.059	0.081
1963	0.086	0.104
1964	0.073	0.095
1965	0.114	0.138
1966	0.063	0.080
1967	0.147	0.166
1968	0.133	0.162
1969	0.103	0.125
1970	0.088	0.110
1971	0.106	0.132
1972	0.140	0.163
1973	0.053	0.070
1974	0.106	0.127
1975	0.110	0.133
1976	0.082	0.098
1977	0.077	0.092
1978	0.092	0.114
1979	0.105	0.143
1980	0.170	0.189
1981	0.092	0.120
1982	0.164	0.193
1983	0.094	0.127
1984	0.068	0.088
1985	0.092	0.121
1986	0.089	0.107
1987	0.104	0.145
1988	0.055	0.081
1989	0.079	0.102
1990	0.271	0.296
1991	0.193	0.215
1992	0.071	0.088
1993	0.053	0.070
1994	0.049	0.068
1995	0.079	0.104
1996	0.130	0.137
1997	0.103	0.124
1998	0.085	0.104
1999	0.217	0.257
2000	0.095	0.119
2001	0.083	0.111
2002	0.143	0.172
2003	0.120	0.134
2004	0.198	0.235
2005	0.088	0.109
2006	0.085	0.101
2007	0.249	0.267
2008	0.187	0.211
2009	0.113	0.132

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.2713	0.2960
2	0.2488	0.2674
3	0.2165	0.2569

4	0.1982	0.2353
5	0.1930	0.2147
6	0.1869	0.2106
7	0.1696	0.1935
8	0.1638	0.1892
9	0.1477	0.1726
10	0.1467	0.1717
11	0.1466	0.1661
12	0.1434	0.1645
13	0.1402	0.1633
14	0.1332	0.1622
15	0.1297	0.1446
16	0.1203	0.1429
17	0.1136	0.1380
18	0.1133	0.1373
19	0.1099	0.1335
20	0.1065	0.1333
21	0.1058	0.1317
22	0.1057	0.1317
23	0.1045	0.1306
24	0.1041	0.1272
25	0.1028	0.1270
26	0.1026	0.1249
27	0.0969	0.1242
28	0.0950	0.1209
29	0.0938	0.1195
30	0.0924	0.1192
31	0.0919	0.1135
32	0.0918	0.1121
33	0.0894	0.1107
34	0.0893	0.1102
35	0.0885	0.1088
36	0.0879	0.1077
37	0.0856	0.1073
38	0.0855	0.1068
39	0.0851	0.1043
40	0.0848	0.1041
41	0.0826	0.1039
42	0.0821	0.1039
43	0.0818	0.1035
44	0.0793	0.1017
45	0.0789	0.1006
46	0.0787	0.0979
47	0.0768	0.0960
48	0.0763	0.0946
49	0.0729	0.0922
50	0.0709	0.0916
51	0.0700	0.0883
52	0.0680	0.0875
53	0.0625	0.0816
54	0.0590	0.0813
55	0.0584	0.0807
56	0.0574	0.0799
57	0.0567	0.0788
58	0.0554	0.0728
59	0.0528	0.0700
60	0.0526	0.0696
61	0.0487	0.0679

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0478	1338	3061	228	Fail
0.0498	1156	2676	231	Fail
0.0517	1012	2366	233	Fail
0.0537	901	2105	233	Fail
0.0556	805	1861	231	Fail
0.0576	703	1662	236	Fail
0.0595	625	1487	237	Fail
0.0614	563	1341	238	Fail
0.0634	515	1198	232	Fail
0.0653	468	1071	228	Fail
0.0673	426	970	227	Fail
0.0692	388	884	227	Fail
0.0711	357	794	222	Fail
0.0731	325	721	221	Fail
0.0750	306	656	214	Fail
0.0770	278	598	215	Fail
0.0789	256	548	214	Fail
0.0808	237	506	213	Fail
0.0828	218	456	209	Fail
0.0847	204	427	209	Fail
0.0867	189	397	210	Fail
0.0886	173	375	216	Fail
0.0905	155	347	223	Fail
0.0925	144	318	220	Fail
0.0944	135	302	223	Fail
0.0964	127	286	225	Fail
0.0983	120	264	220	Fail
0.1003	115	254	220	Fail
0.1022	110	236	214	Fail
0.1041	101	210	207	Fail
0.1061	97	199	205	Fail
0.1080	90	177	196	Fail
0.1100	88	162	184	Fail
0.1119	83	151	181	Fail
0.1138	75	144	192	Fail
0.1158	73	138	189	Fail
0.1177	70	131	187	Fail
0.1197	65	122	187	Fail
0.1216	63	119	188	Fail
0.1235	57	112	196	Fail
0.1255	52	106	203	Fail
0.1274	51	102	200	Fail
0.1294	49	98	200	Fail
0.1313	45	91	202	Fail
0.1332	42	89	211	Fail
0.1352	42	80	190	Fail
0.1371	41	78	190	Fail
0.1391	38	75	197	Fail
0.1410	37	72	194	Fail
0.1429	36	67	186	Fail
0.1449	35	60	171	Fail
0.1468	31	59	190	Fail
0.1488	28	55	196	Fail
0.1507	27	53	196	Fail

0.1527	26	51	196	Fail
0.1546	25	48	192	Fail
0.1565	24	47	195	Fail
0.1585	23	46	200	Fail
0.1604	22	45	204	Fail
0.1624	22	41	186	Fail
0.1643	20	40	200	Fail
0.1662	17	33	194	Fail
0.1682	17	33	194	Fail
0.1701	15	32	213	Fail
0.1721	15	30	200	Fail
0.1740	15	29	193	Fail
0.1759	14	28	200	Fail
0.1779	14	25	178	Fail
0.1798	14	25	178	Fail
0.1818	13	23	176	Fail
0.1837	12	22	183	Fail
0.1856	12	22	183	Fail
0.1876	10	21	209	Fail
0.1895	9	19	211	Fail
0.1915	9	19	211	Fail
0.1934	6	17	283	Fail
0.1954	6	15	250	Fail
0.1973	6	15	250	Fail
0.1992	4	15	375	Fail
0.2012	4	15	375	Fail
0.2031	3	15	500	Fail
0.2051	3	14	466	Fail
0.2070	3	12	400	Fail
0.2089	3	11	366	Fail
0.2109	3	9	300	Fail
0.2128	3	9	300	Fail
0.2148	3	9	300	Fail
0.2167	2	8	400	Fail
0.2186	2	8	400	Fail
0.2206	2	7	350	Fail
0.2225	2	7	350	Fail
0.2245	2	7	350	Fail
0.2264	2	5	250	Fail
0.2283	2	5	250	Fail
0.2303	2	5	250	Fail
0.2322	2	5	250	Fail
0.2342	2	5	250	Fail
0.2361	2	4	200	Fail
0.2380	2	3	150	Fail
0.2400	2	3	150	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

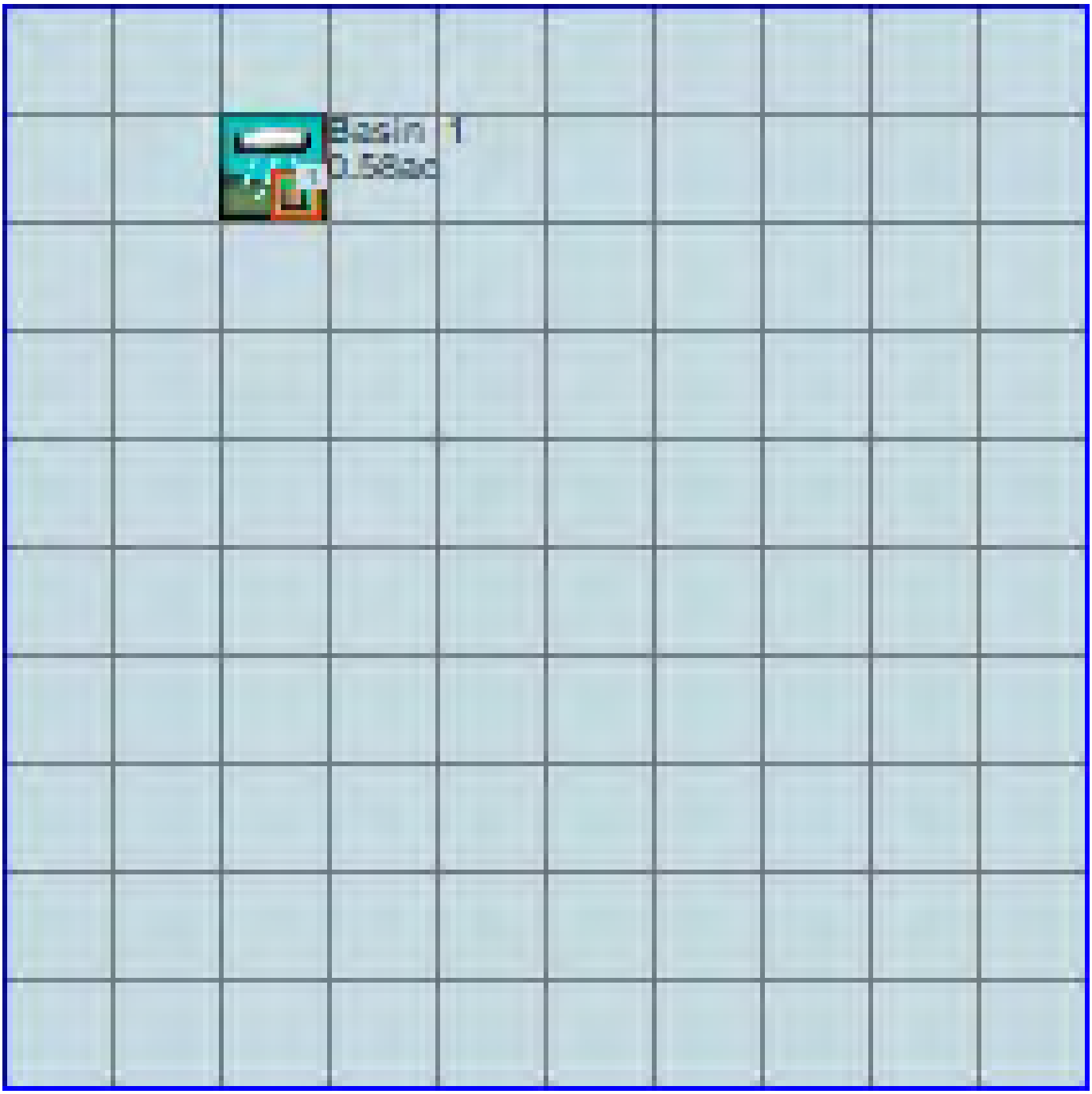
No PERLND changes have been made.

IMPLND Changes

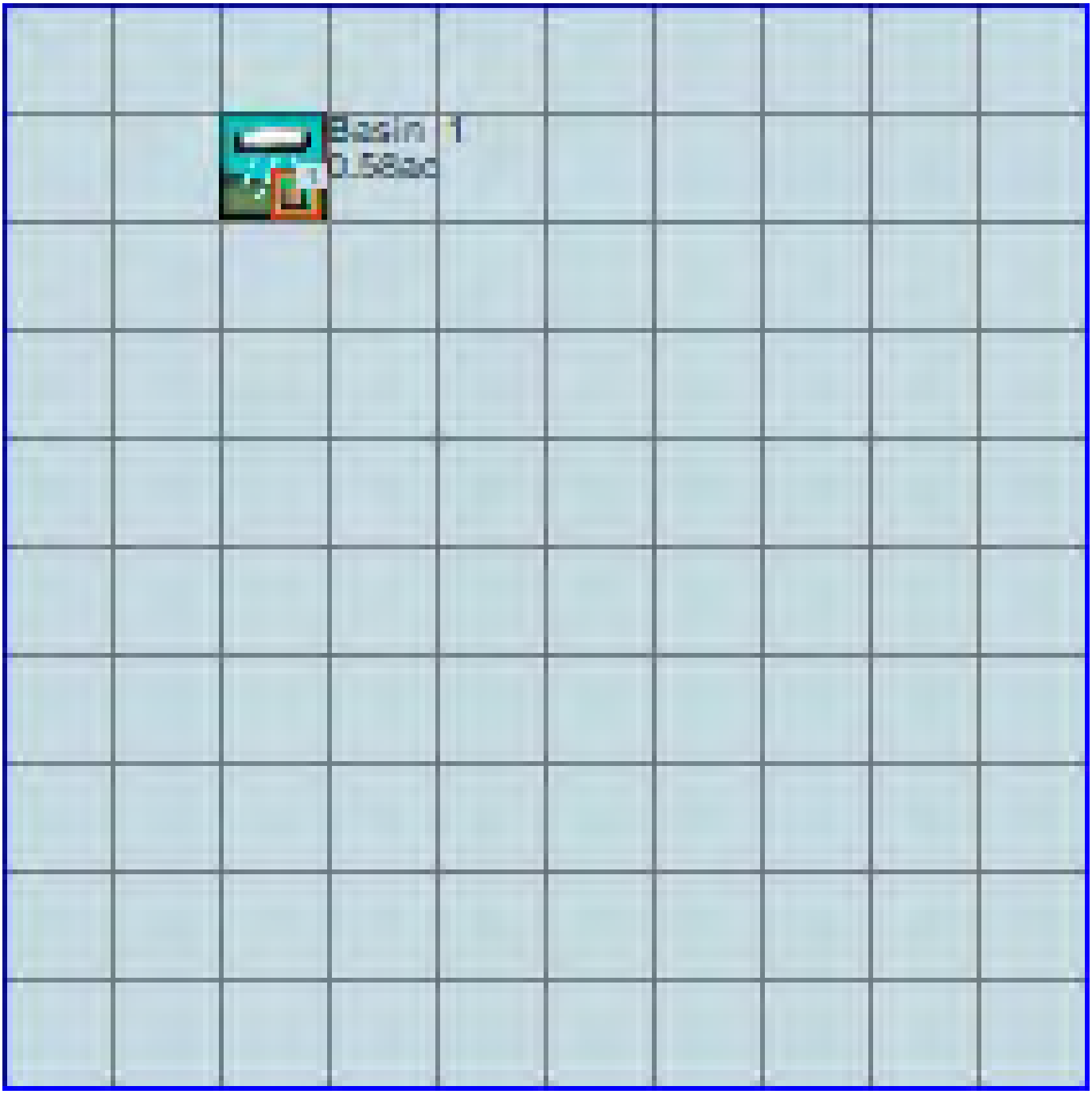
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   PrePeak Flows Ex Cond.MES
           27   PrePeak Flows Ex Cond.L61
           28   PrePeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       4
      IMPLND       6
      IMPLND       9
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
```

```
  16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  16             0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  16             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  16           0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  16             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    6      DRIVEWAYS/MOD          1    1    1   27    0
    9      SIDEWALKS/MOD          1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    6         0    0    1    0    0    0
    9         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    0    1    9
    6         0    0    4    0    0    0    1    9
    9         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    6         0    0    0    0    0
    9         0    0    0    0    0
  END IWAT-PARM1
```

```
  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    6            400      0.05       0.1      0.08
    9            400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    6              0         0
    9              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    6              0         0
    9              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                       0.418     COPY   501     12
PERLND  16                       0.418     COPY   501     13
IMPLND   4                       0.107     COPY   501     15
IMPLND   6                       0.057     COPY   501     15
IMPLND   9                       0.002     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                               ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
```

```
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><-------><-------><-------><-------><-------><-------><------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                           ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   MitPeak Flows Ex Cond.MES
           27   MitPeak Flows Ex Cond.L61
           28   MitPeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       1
      IMPLND       4
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
```

```
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16             0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
    4         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
```

```
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                       0.332     COPY   501     12
PERLND  16                       0.332     COPY   501     13
IMPLND   1                      0.1075     COPY   501     15
IMPLND   4                      0.1445     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<-----------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><-------><-------><-------><-------><-------><------->             ***
  END HYDR-PARM2
```

```
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Peak Flows Ex Cond
Site Name:	Fahsholtz Short Plat
Site Address:	
City:	
Report Date:	7/2/2018
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.833
Version Date:	2017/04/14
Version:	4.2.13

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.66
Pervious Total	0.66
Impervious Land Use	acre
DRIVEWAYS FLAT	0.13
SIDEWALKS FLAT	0.06
Impervious Total	0.19
Basin Total	0.85

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.29
Pervious Total	0.29
Impervious Land Use	acre
ROADS FLAT	0.56
Impervious Total	0.56
Basin Total	0.85

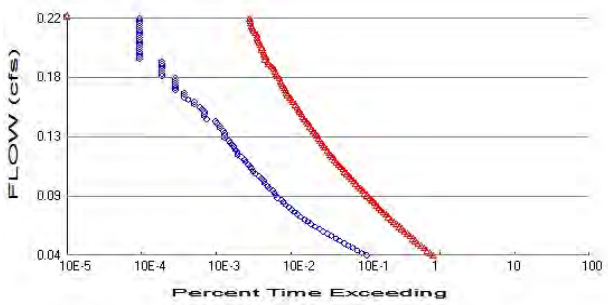
Element Flows To:

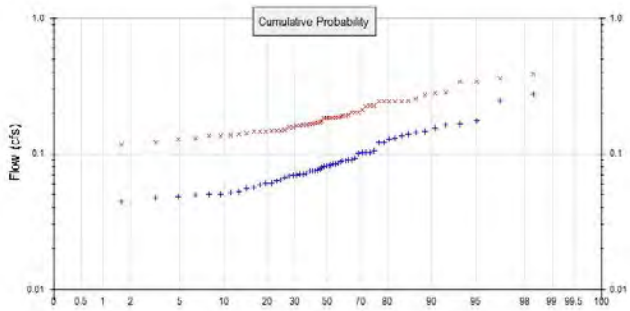
Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.66
Total Impervious Area: 0.19

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.29
Total Impervious Area: 0.56

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.081906
5 year	0.11842
10 year	0.146522
25 year	0.186798
50 year	0.220464
100 year	0.257442

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.18257
5 year	0.234504
10 year	0.270249
25 year	0.317086
50 year	0.353254
100 year	0.390559

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.129	0.247
1950	0.135	0.243
1951	0.081	0.156
1952	0.052	0.129
1953	0.048	0.135
1954	0.066	0.149
1955	0.070	0.169
1956	0.069	0.166
1957	0.090	0.193
1958	0.061	0.148

1959	0.048	0.142
1960	0.090	0.161
1961	0.074	0.165
1962	0.052	0.136
1963	0.072	0.155
1964	0.063	0.149
1965	0.102	0.203
1966	0.056	0.131
1967	0.140	0.224
1968	0.102	0.244
1969	0.089	0.183
1970	0.076	0.170
1971	0.088	0.202
1972	0.129	0.228
1973	0.051	0.116
1974	0.087	0.184
1975	0.100	0.203
1976	0.070	0.145
1977	0.050	0.145
1978	0.074	0.185
1979	0.083	0.242
1980	0.145	0.253
1981	0.082	0.192
1982	0.143	0.273
1983	0.079	0.212
1984	0.058	0.139
1985	0.074	0.189
1986	0.084	0.161
1987	0.084	0.244
1988	0.050	0.147
1989	0.055	0.163
1990	0.274	0.387
1991	0.165	0.283
1992	0.061	0.138
1993	0.044	0.115
1994	0.041	0.121
1995	0.070	0.168
1996	0.121	0.192
1997	0.092	0.183
1998	0.070	0.172
1999	0.176	0.359
2000	0.082	0.183
2001	0.064	0.185
2002	0.121	0.243
2003	0.105	0.185
2004	0.154	0.339
2005	0.081	0.163
2006	0.077	0.145
2007	0.246	0.341
2008	0.164	0.281
2009	0.102	0.228

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2742	0.3873
2	0.2461	0.3592
3	0.1763	0.3406

4	0.1650	0.3392
5	0.1644	0.2828
6	0.1545	0.2810
7	0.1452	0.2730
8	0.1428	0.2534
9	0.1403	0.2471
10	0.1353	0.2444
11	0.1295	0.2437
12	0.1291	0.2434
13	0.1213	0.2433
14	0.1208	0.2420
15	0.1047	0.2277
16	0.1024	0.2275
17	0.1018	0.2244
18	0.1016	0.2121
19	0.1001	0.2029
20	0.0923	0.2027
21	0.0904	0.2016
22	0.0904	0.1933
23	0.0890	0.1919
24	0.0883	0.1917
25	0.0871	0.1891
26	0.0844	0.1855
27	0.0842	0.1854
28	0.0832	0.1846
29	0.0822	0.1837
30	0.0816	0.1832
31	0.0814	0.1827
32	0.0808	0.1827
33	0.0789	0.1717
34	0.0767	0.1704
35	0.0764	0.1691
36	0.0745	0.1678
37	0.0743	0.1659
38	0.0743	0.1652
39	0.0719	0.1631
40	0.0704	0.1627
41	0.0703	0.1615
42	0.0700	0.1612
43	0.0696	0.1561
44	0.0690	0.1554
45	0.0663	0.1492
46	0.0636	0.1488
47	0.0632	0.1484
48	0.0608	0.1475
49	0.0608	0.1452
50	0.0584	0.1451
51	0.0560	0.1449
52	0.0553	0.1424
53	0.0522	0.1389
54	0.0520	0.1375
55	0.0506	0.1362
56	0.0504	0.1349
57	0.0496	0.1308
58	0.0484	0.1287
59	0.0477	0.1210
60	0.0442	0.1161
61	0.0412	0.1150

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0410	2207	17130	776	Fail
0.0428	1904	15622	820	Fail
0.0446	1654	14251	861	Fail
0.0464	1452	13034	897	Fail
0.0482	1261	11956	948	Fail
0.0500	1112	10889	979	Fail
0.0518	970	10027	1033	Fail
0.0536	865	9210	1064	Fail
0.0555	747	8472	1134	Fail
0.0573	663	7811	1178	Fail
0.0591	582	7174	1232	Fail
0.0609	522	6592	1262	Fail
0.0627	454	6070	1337	Fail
0.0645	397	5576	1404	Fail
0.0663	362	5108	1411	Fail
0.0682	326	4725	1449	Fail
0.0700	293	4355	1486	Fail
0.0718	263	4036	1534	Fail
0.0736	240	3713	1547	Fail
0.0754	221	3478	1573	Fail
0.0772	202	3247	1607	Fail
0.0790	185	3018	1631	Fail
0.0808	169	2804	1659	Fail
0.0827	160	2614	1633	Fail
0.0845	142	2443	1720	Fail
0.0863	136	2278	1675	Fail
0.0881	129	2098	1626	Fail
0.0899	121	1962	1621	Fail
0.0917	111	1834	1652	Fail
0.0935	105	1708	1626	Fail
0.0954	97	1598	1647	Fail
0.0972	93	1478	1589	Fail
0.0990	86	1384	1609	Fail
0.1008	80	1297	1621	Fail
0.1026	72	1214	1686	Fail
0.1044	67	1136	1695	Fail
0.1062	64	1067	1667	Fail
0.1080	61	999	1637	Fail
0.1099	57	937	1643	Fail
0.1117	53	871	1643	Fail
0.1135	52	822	1580	Fail
0.1153	46	774	1682	Fail
0.1171	41	726	1770	Fail
0.1189	41	691	1685	Fail
0.1207	39	658	1687	Fail
0.1225	37	610	1648	Fail
0.1244	35	580	1657	Fail
0.1262	33	555	1681	Fail
0.1280	32	527	1646	Fail
0.1298	28	506	1807	Fail
0.1316	28	477	1703	Fail
0.1334	28	457	1632	Fail
0.1352	27	428	1585	Fail
0.1371	24	407	1695	Fail

0.1389	24	384	1600	Fail
0.1407	22	362	1645	Fail
0.1425	21	345	1642	Fail
0.1443	16	323	2018	Fail
0.1461	15	308	2053	Fail
0.1479	15	299	1993	Fail
0.1497	15	280	1866	Fail
0.1516	14	271	1935	Fail
0.1534	13	260	2000	Fail
0.1552	11	248	2254	Fail
0.1570	11	230	2090	Fail
0.1588	9	221	2455	Fail
0.1606	8	210	2625	Fail
0.1624	8	196	2450	Fail
0.1643	8	187	2337	Fail
0.1661	6	179	2983	Fail
0.1679	6	175	2916	Fail
0.1697	6	166	2766	Fail
0.1715	6	161	2683	Fail
0.1733	6	156	2600	Fail
0.1751	6	149	2483	Fail
0.1769	4	142	3550	Fail
0.1788	4	136	3400	Fail
0.1806	4	132	3300	Fail
0.1824	4	126	3150	Fail
0.1842	4	118	2950	Fail
0.1860	4	109	2725	Fail
0.1878	4	106	2650	Fail
0.1896	2	98	4900	Fail
0.1915	2	98	4900	Fail
0.1933	2	94	4700	Fail
0.1951	2	92	4600	Fail
0.1969	2	88	4400	Fail
0.1987	2	88	4400	Fail
0.2005	2	84	4200	Fail
0.2023	2	80	4000	Fail
0.2041	2	78	3900	Fail
0.2060	2	76	3800	Fail
0.2078	2	76	3800	Fail
0.2096	2	71	3550	Fail
0.2114	2	68	3400	Fail
0.2132	2	65	3250	Fail
0.2150	2	64	3200	Fail
0.2168	2	62	3100	Fail
0.2187	2	61	3050	Fail
0.2205	2	60	3000	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

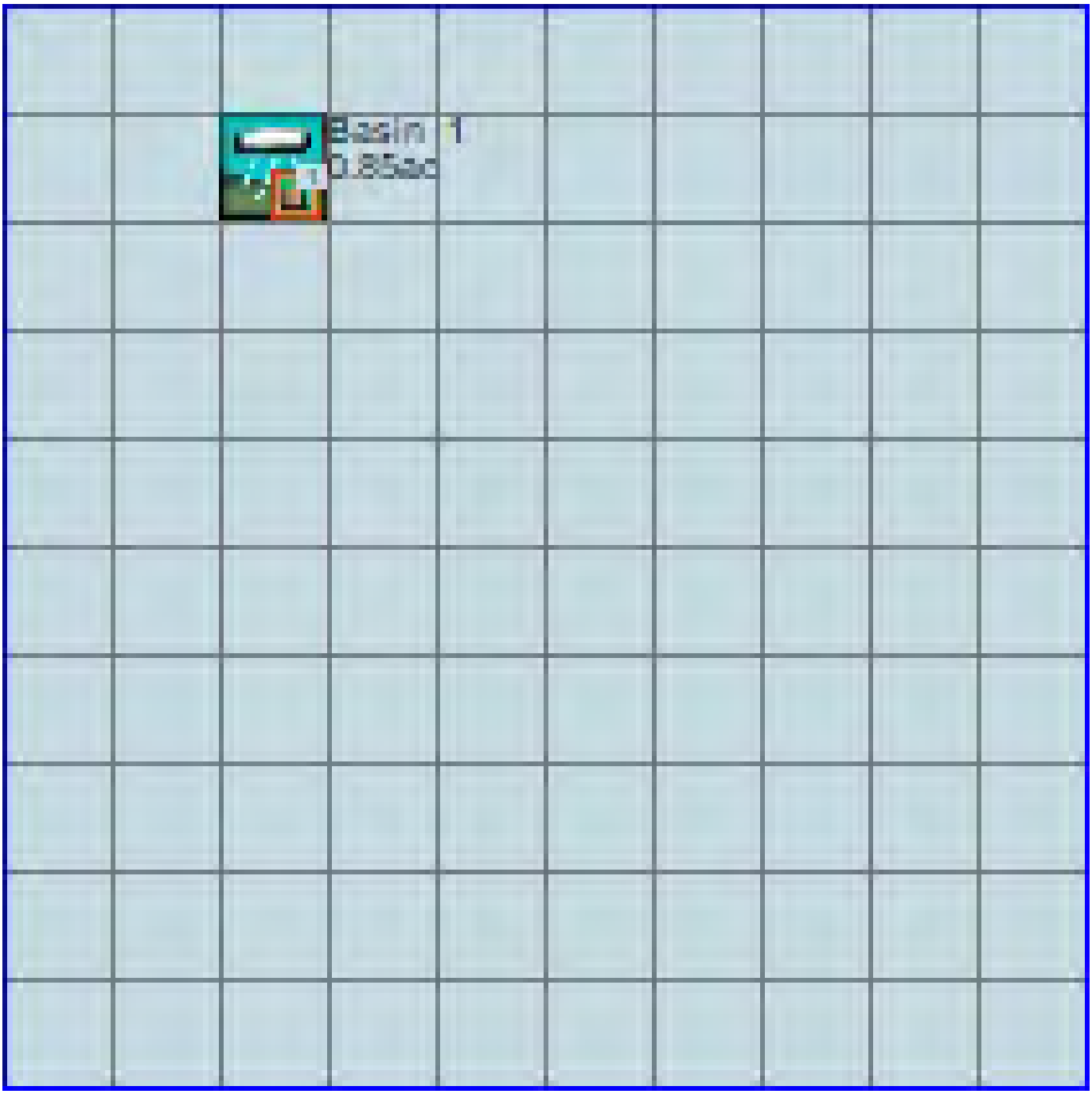
No PERLND changes have been made.

IMPLND Changes

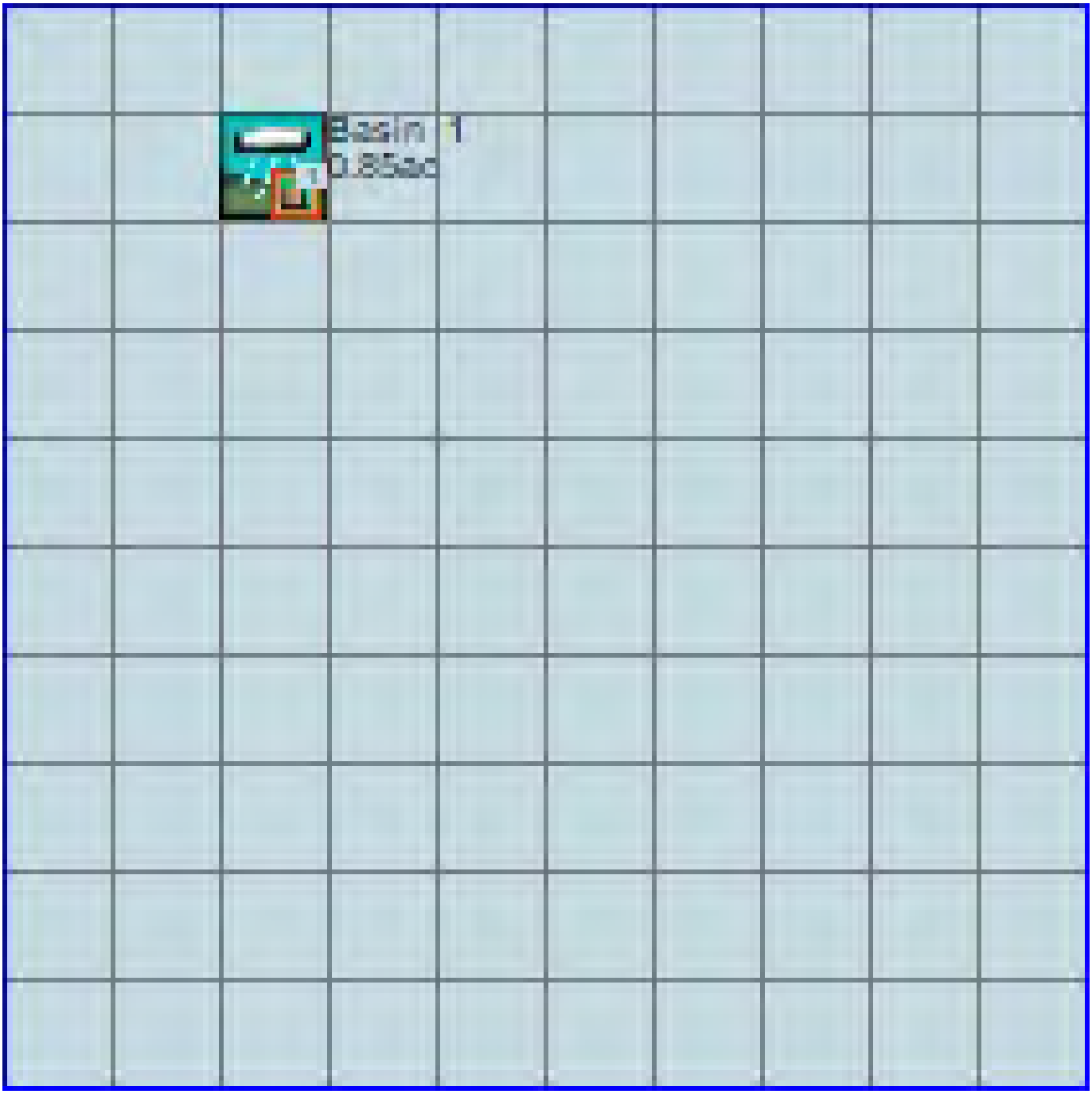
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   PrePeak Flows Ex Cond.MES
           27   PrePeak Flows Ex Cond.L61
           28   PrePeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       5
      IMPLND       8
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
```

```
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16             0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    5      DRIVEWAYS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    5         0    0    1    0    0    0
    8         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    5         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    5         0    0    0    0    0
    8         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    5            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
```

```
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    5              0         0
    8              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    5              0         0
    8              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                        0.66     COPY   501     12
PERLND  16                        0.66     COPY   501     13
IMPLND   5                        0.13     COPY   501     15
IMPLND   8                        0.06     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<-----------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><-------><-------><-------><-------><-------><------->             ***
  END HYDR-PARM2
```

```
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.833          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.833          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   MitPeak Flows Ex Cond.MES
           27   MitPeak Flows Ex Cond.L61
           28   MitPeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16             0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1             0         0
```

```
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                       0.29     COPY   501     12
PERLND  16                       0.29     COPY   501     13
IMPLND   1                       0.56     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                               ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *      *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                      ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.833          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.833          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Peak Flows Ex Cond
Site Name:	Eva Short Plat
Site Address:	
City:	
Report Date:	7/2/2018
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2017/04/14
Version:	4.2.13

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.17
Pervious Total	0.17
Impervious Land Use	acre
ROOF TOPS FLAT	0.15
DRIVEWAYS FLAT	0.04
SIDEWALKS FLAT	0.03
PARKING FLAT	0.05
Impervious Total	0.27
Basin Total	0.44

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.22
Pervious Total	0.22
Impervious Land Use	acre
ROADS FLAT	0.22
Impervious Total	0.22
Basin Total	0.44

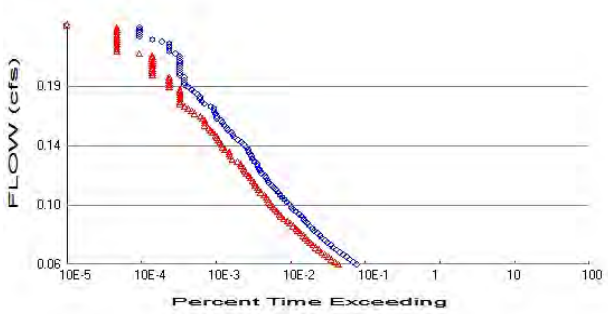
Element Flows To:

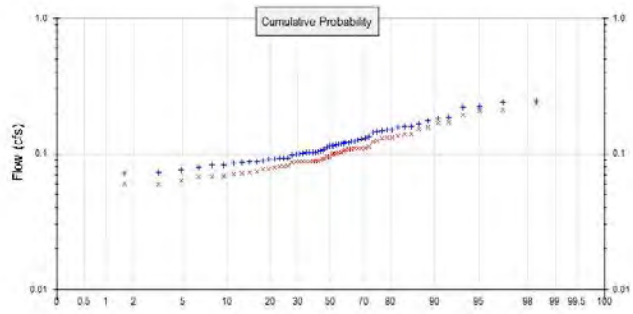
Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.17
Total Impervious Area: 0.27

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.22
Total Impervious Area: 0.22

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.114002
5 year	0.148635
10 year	0.172746
25 year	0.204627
50 year	0.229441
100 year	0.255195

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.09861
5 year	0.131249
10 year	0.154336
25 year	0.185245
50 year	0.209567
100 year	0.235028

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.158	0.141
1950	0.148	0.131
1951	0.098	0.087
1952	0.076	0.063
1953	0.082	0.068
1954	0.093	0.080
1955	0.103	0.087
1956	0.102	0.087
1957	0.122	0.107
1958	0.092	0.077

1959	0.087	0.071
1960	0.102	0.091
1961	0.102	0.089
1962	0.082	0.069
1963	0.099	0.086
1964	0.092	0.079
1965	0.128	0.113
1966	0.079	0.067
1967	0.143	0.132
1968	0.158	0.136
1969	0.116	0.102
1970	0.106	0.092
1971	0.127	0.110
1972	0.145	0.131
1973	0.072	0.059
1974	0.119	0.105
1975	0.124	0.109
1976	0.092	0.081
1977	0.088	0.076
1978	0.112	0.095
1979	0.150	0.123
1980	0.166	0.151
1981	0.117	0.100
1982	0.174	0.157
1983	0.130	0.109
1984	0.086	0.074
1985	0.118	0.101
1986	0.099	0.088
1987	0.149	0.124
1988	0.087	0.071
1989	0.109	0.089
1990	0.247	0.232
1991	0.186	0.171
1992	0.085	0.073
1993	0.070	0.059
1994	0.073	0.059
1995	0.103	0.088
1996	0.122	0.109
1997	0.115	0.102
1998	0.105	0.089
1999	0.238	0.210
2000	0.114	0.099
2001	0.115	0.095
2002	0.156	0.139
2003	0.121	0.108
2004	0.220	0.193
2005	0.101	0.089
2006	0.092	0.082
2007	0.222	0.209
2008	0.183	0.168
2009	0.134	0.109

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.2474	0.2322
2	0.2382	0.2103
3	0.2215	0.2090

4	0.2203	0.1935
5	0.1865	0.1711
6	0.1830	0.1678
7	0.1745	0.1565
8	0.1655	0.1512
9	0.1580	0.1406
10	0.1577	0.1394
11	0.1560	0.1356
12	0.1497	0.1319
13	0.1490	0.1314
14	0.1480	0.1308
15	0.1453	0.1240
16	0.1432	0.1235
17	0.1335	0.1128
18	0.1296	0.1097
19	0.1276	0.1092
20	0.1272	0.1092
21	0.1236	0.1090
22	0.1222	0.1085
23	0.1220	0.1084
24	0.1213	0.1073
25	0.1195	0.1046
26	0.1179	0.1023
27	0.1174	0.1017
28	0.1159	0.1012
29	0.1151	0.1003
30	0.1151	0.0990
31	0.1142	0.0953
32	0.1116	0.0948
33	0.1089	0.0918
34	0.1065	0.0911
35	0.1055	0.0893
36	0.1030	0.0891
37	0.1027	0.0888
38	0.1024	0.0886
39	0.1021	0.0878
40	0.1018	0.0876
41	0.1014	0.0874
42	0.0995	0.0871
43	0.0991	0.0869
44	0.0982	0.0863
45	0.0929	0.0818
46	0.0923	0.0808
47	0.0920	0.0801
48	0.0918	0.0791
49	0.0915	0.0775
50	0.0880	0.0765
51	0.0873	0.0738
52	0.0871	0.0732
53	0.0859	0.0712
54	0.0851	0.0710
55	0.0825	0.0689
56	0.0821	0.0680
57	0.0790	0.0672
58	0.0760	0.0628
59	0.0727	0.0592
60	0.0716	0.0592
61	0.0705	0.0591

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0570	1636	923	56	Pass
0.0587	1485	832	56	Pass
0.0605	1322	745	56	Pass
0.0622	1188	676	56	Pass
0.0640	1073	609	56	Pass
0.0657	977	556	56	Pass
0.0675	883	507	57	Pass
0.0692	799	463	57	Pass
0.0709	735	423	57	Pass
0.0727	672	387	57	Pass
0.0744	620	361	58	Pass
0.0762	564	339	60	Pass
0.0779	529	311	58	Pass
0.0796	485	287	59	Pass
0.0814	442	265	59	Pass
0.0831	415	251	60	Pass
0.0849	384	228	59	Pass
0.0866	361	210	58	Pass
0.0884	335	192	57	Pass
0.0901	317	171	53	Pass
0.0918	297	159	53	Pass
0.0936	274	149	54	Pass
0.0953	247	139	56	Pass
0.0971	226	130	57	Pass
0.0988	217	124	57	Pass
0.1005	204	115	56	Pass
0.1023	188	109	57	Pass
0.1040	175	105	60	Pass
0.1058	164	100	60	Pass
0.1075	153	94	61	Pass
0.1093	144	85	59	Pass
0.1110	135	79	58	Pass
0.1127	126	76	60	Pass
0.1145	117	72	61	Pass
0.1162	108	70	64	Pass
0.1180	105	65	61	Pass
0.1197	100	62	62	Pass
0.1214	96	59	61	Pass
0.1232	87	54	62	Pass
0.1249	83	52	62	Pass
0.1267	81	50	61	Pass
0.1284	77	46	59	Pass
0.1302	75	45	60	Pass
0.1319	69	41	59	Pass
0.1336	65	35	53	Pass
0.1354	63	33	52	Pass
0.1371	61	32	52	Pass
0.1389	58	32	55	Pass
0.1406	57	28	49	Pass
0.1424	55	26	47	Pass
0.1441	50	25	50	Pass
0.1458	46	24	52	Pass
0.1476	42	23	54	Pass

0.1493	38	22	57	Pass
0.1511	36	21	58	Pass
0.1528	34	19	55	Pass
0.1545	31	18	58	Pass
0.1563	30	17	56	Pass
0.1580	28	15	53	Pass
0.1598	26	15	57	Pass
0.1615	25	15	60	Pass
0.1633	22	14	63	Pass
0.1650	22	13	59	Pass
0.1667	21	11	52	Pass
0.1685	20	10	50	Pass
0.1702	20	9	45	Pass
0.1720	18	8	44	Pass
0.1737	15	7	46	Pass
0.1754	14	7	50	Pass
0.1772	13	7	53	Pass
0.1789	13	7	53	Pass
0.1807	12	7	58	Pass
0.1824	11	7	63	Pass
0.1842	10	7	70	Pass
0.1859	9	5	55	Pass
0.1876	8	5	62	Pass
0.1894	8	5	62	Pass
0.1911	8	5	62	Pass
0.1929	8	5	62	Pass
0.1946	7	3	42	Pass
0.1963	7	3	42	Pass
0.1981	7	3	42	Pass
0.1998	7	3	42	Pass
0.2016	7	3	42	Pass
0.2033	7	3	42	Pass
0.2051	7	3	42	Pass
0.2068	7	3	42	Pass
0.2085	7	3	42	Pass
0.2103	6	2	33	Pass
0.2120	5	1	20	Pass
0.2138	5	1	20	Pass
0.2155	5	1	20	Pass
0.2172	5	1	20	Pass
0.2190	4	1	25	Pass
0.2207	3	1	33	Pass
0.2225	2	1	50	Pass
0.2242	2	1	50	Pass
0.2260	2	1	50	Pass
0.2277	2	1	50	Pass
0.2294	2	1	50	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

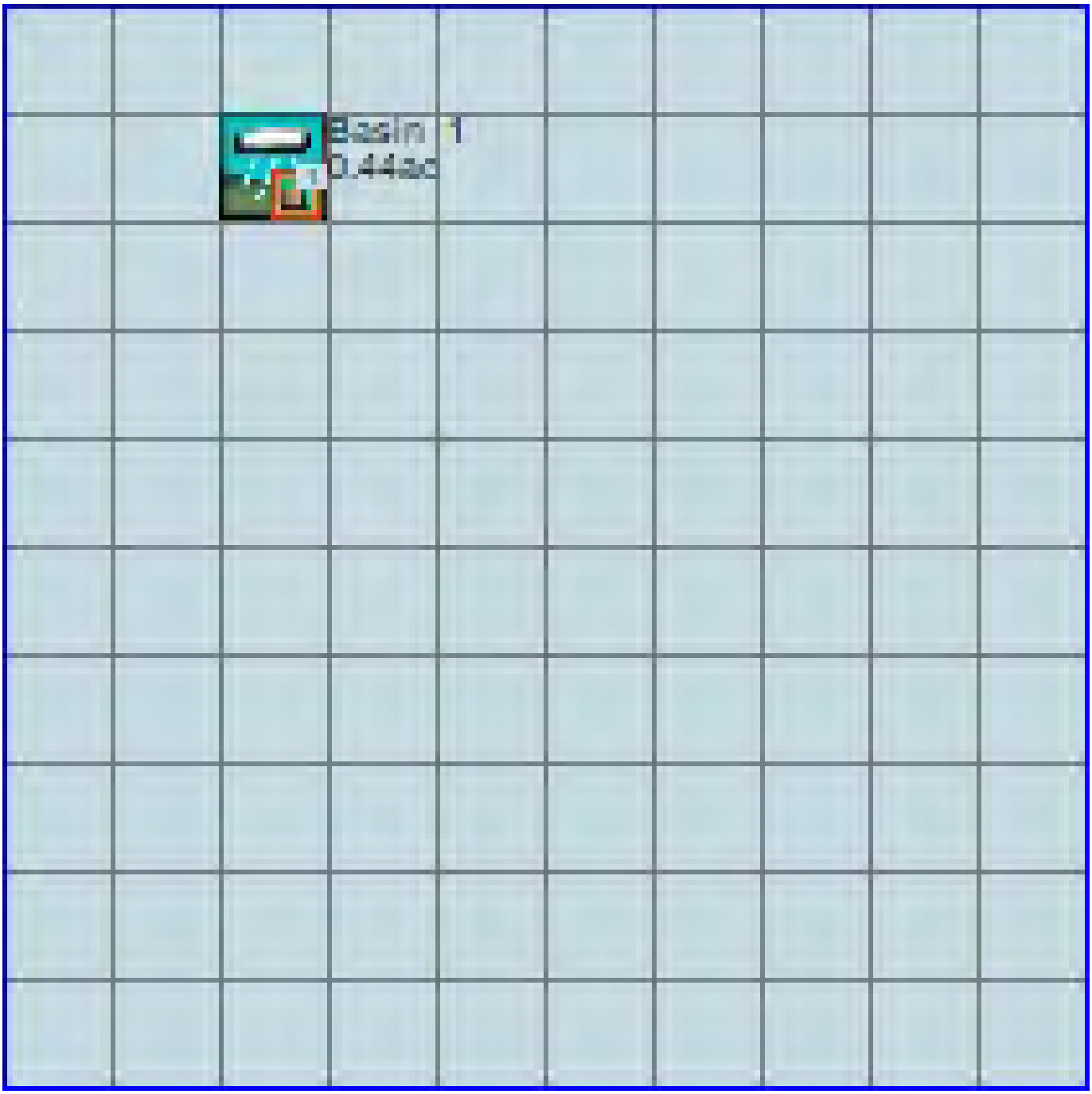
No PERLND changes have been made.

IMPLND Changes

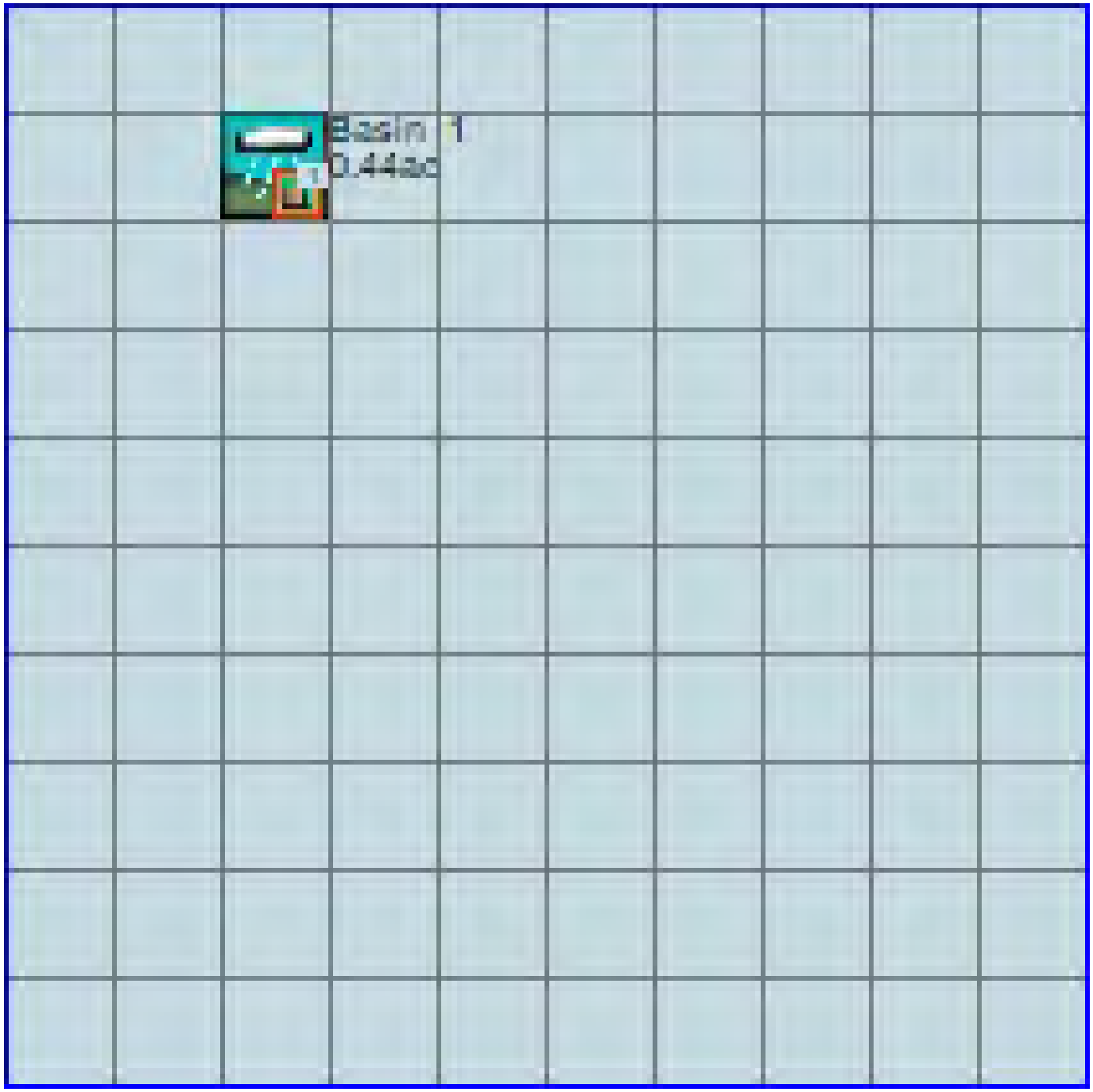
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   PrePeak Flows Ex Cond.MES
           27   PrePeak Flows Ex Cond.L61
           28   PrePeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       4
      IMPLND       5
      IMPLND       8
      IMPLND      11
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16             0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16           0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    5      DRIVEWAYS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
   11      PARKING/FLAT           1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
    8         0    0    1    0    0    0
   11         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
   11         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
```

```
    5         0    0    0    0    0
    8         0    0    0    0    0
   11         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
   11            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    5              0         0
    8              0         0
   11              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    5              0         0
    8              0         0
   11              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                        0.17     COPY   501     12
PERLND  16                        0.17     COPY   501     13
IMPLND   4                        0.15     COPY   501     15
IMPLND   5                        0.04     COPY   501     15
IMPLND   8                        0.03     COPY   501     15
IMPLND  11                        0.05     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                        in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
```

```
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   MitPeak Flows Ex Cond.MES
           27   MitPeak Flows Ex Cond.L61
           28   MitPeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16             0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1             0         0
```

```
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                       0.22     COPY   501     12
PERLND  16                       0.22     COPY   501     13
IMPLND   1                       0.22     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                               ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *      *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                      ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Peak Flows Ex Cond
Site Name:	7206 NE 129th St - West Basin - No East Roofs
Site Address:	
City:	
Report Date:	8/1/2018
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.833
Version Date:	2017/04/14
Version:	4.2.13

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.62
C, Lawn, Flat	0.59
Pervious Total	1.21
Impervious Land Use	acre
ROOF TOPS FLAT	0.07
DRIVEWAYS FLAT	0.02
SIDEWALKS FLAT	0.02
Impervious Total	0.11
Basin Total	1.32

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.38
C, Lawn, Flat	0.49
Pervious Total	0.87
Impervious Land Use	acre
ROADS FLAT	0.45
Impervious Total	0.45
Basin Total	1.32

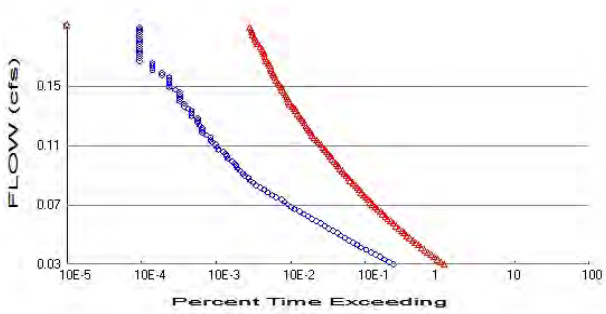
Element Flows To:

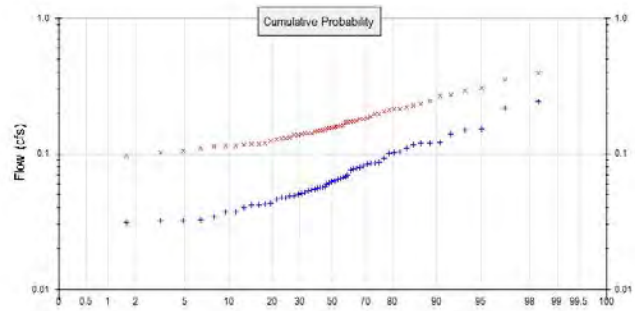
Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 1.21
Total Impervious Area: 0.11

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.87
Total Impervious Area: 0.45

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.063272
5 year	0.09704
10 year	0.123653
25 year	0.162475
50 year	0.1954
100 year	0.231957

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.15835
5 year	0.209453
10 year	0.246175
25 year	0.295978
50 year	0.335627
100 year	0.377525

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.102	0.226
1950	0.115	0.213
1951	0.085	0.149
1952	0.042	0.105
1953	0.034	0.109
1954	0.051	0.131
1955	0.063	0.142
1956	0.060	0.140
1957	0.070	0.172
1958	0.046	0.125

1959	0.042	0.114
1960	0.079	0.154
1961	0.056	0.145
1962	0.033	0.112
1963	0.055	0.137
1964	0.057	0.128
1965	0.076	0.181
1966	0.043	0.114
1967	0.120	0.219
1968	0.066	0.205
1969	0.062	0.160
1970	0.057	0.149
1971	0.065	0.172
1972	0.101	0.211
1973	0.040	0.103
1974	0.063	0.161
1975	0.082	0.180
1976	0.057	0.131
1977	0.032	0.117
1978	0.048	0.154
1979	0.049	0.195
1980	0.119	0.233
1981	0.054	0.162
1982	0.110	0.248
1983	0.052	0.174
1984	0.042	0.119
1985	0.047	0.157
1986	0.079	0.154
1987	0.077	0.197
1988	0.031	0.119
1989	0.032	0.131
1990	0.243	0.396
1991	0.140	0.271
1992	0.050	0.118
1993	0.037	0.095
1994	0.024	0.097
1995	0.053	0.141
1996	0.122	0.189
1997	0.083	0.170
1998	0.049	0.142
1999	0.151	0.305
2000	0.061	0.159
2001	0.037	0.149
2002	0.085	0.213
2003	0.086	0.174
2004	0.104	0.291
2005	0.067	0.149
2006	0.068	0.137
2007	0.216	0.349
2008	0.153	0.268
2009	0.092	0.183

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2429	0.3957
2	0.2164	0.3491
3	0.1528	0.3050

4	0.1507	0.2907
5	0.1404	0.2706
6	0.1217	0.2684
7	0.1200	0.2475
8	0.1194	0.2333
9	0.1155	0.2256
10	0.1097	0.2189
11	0.1042	0.2133
12	0.1019	0.2126
13	0.1014	0.2112
14	0.0924	0.2050
15	0.0863	0.1966
16	0.0849	0.1951
17	0.0845	0.1890
18	0.0832	0.1830
19	0.0818	0.1810
20	0.0788	0.1804
21	0.0786	0.1744
22	0.0769	0.1739
23	0.0758	0.1716
24	0.0695	0.1715
25	0.0678	0.1700
26	0.0667	0.1619
27	0.0658	0.1605
28	0.0650	0.1595
29	0.0634	0.1595
30	0.0633	0.1569
31	0.0621	0.1545
32	0.0606	0.1540
33	0.0597	0.1536
34	0.0571	0.1491
35	0.0565	0.1489
36	0.0565	0.1488
37	0.0559	0.1487
38	0.0546	0.1448
39	0.0538	0.1424
40	0.0531	0.1419
41	0.0520	0.1412
42	0.0506	0.1404
43	0.0502	0.1372
44	0.0491	0.1371
45	0.0488	0.1311
46	0.0477	0.1308
47	0.0473	0.1307
48	0.0459	0.1284
49	0.0432	0.1251
50	0.0424	0.1189
51	0.0417	0.1187
52	0.0415	0.1177
53	0.0401	0.1167
54	0.0373	0.1145
55	0.0371	0.1144
56	0.0343	0.1123
57	0.0326	0.1091
58	0.0320	0.1045
59	0.0319	0.1025
60	0.0309	0.0973
61	0.0239	0.0949

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0316	5148	24319	472	Fail
0.0333	4436	21881	493	Fail
0.0349	3839	19787	515	Fail
0.0366	3373	17821	528	Fail
0.0383	2911	16181	555	Fail
0.0399	2535	14662	578	Fail
0.0416	2199	13312	605	Fail
0.0432	1894	12059	636	Fail
0.0449	1655	10996	664	Fail
0.0465	1458	10048	689	Fail
0.0482	1284	9208	717	Fail
0.0498	1137	8395	738	Fail
0.0515	1014	7711	760	Fail
0.0531	897	7107	792	Fail
0.0548	791	6577	831	Fail
0.0564	695	6019	866	Fail
0.0581	610	5520	904	Fail
0.0598	540	5052	935	Fail
0.0614	466	4661	1000	Fail
0.0631	407	4284	1052	Fail
0.0647	365	3972	1088	Fail
0.0664	321	3675	1144	Fail
0.0680	279	3412	1222	Fail
0.0697	241	3129	1298	Fail
0.0713	217	2890	1331	Fail
0.0730	191	2686	1406	Fail
0.0746	181	2500	1381	Fail
0.0763	161	2340	1453	Fail
0.0780	136	2173	1597	Fail
0.0796	120	2021	1684	Fail
0.0813	105	1906	1815	Fail
0.0829	94	1777	1890	Fail
0.0846	83	1671	2013	Fail
0.0862	73	1582	2167	Fail
0.0879	68	1459	2145	Fail
0.0895	62	1355	2185	Fail
0.0912	58	1269	2187	Fail
0.0928	52	1185	2278	Fail
0.0945	49	1105	2255	Fail
0.0961	45	1045	2322	Fail
0.0978	42	966	2300	Fail
0.0995	40	918	2295	Fail
0.1011	38	873	2297	Fail
0.1028	35	813	2322	Fail
0.1044	31	766	2470	Fail
0.1061	30	728	2426	Fail
0.1077	29	684	2358	Fail
0.1094	27	644	2385	Fail
0.1110	23	612	2660	Fail
0.1127	22	576	2618	Fail
0.1143	21	545	2595	Fail
0.1160	19	500	2631	Fail
0.1177	18	475	2638	Fail
0.1193	18	439	2438	Fail

0.1210	16	413	2581	Fail
0.1226	14	392	2800	Fail
0.1243	14	378	2700	Fail
0.1259	14	357	2550	Fail
0.1276	13	343	2638	Fail
0.1292	12	325	2708	Fail
0.1309	12	310	2583	Fail
0.1325	12	293	2441	Fail
0.1342	10	278	2780	Fail
0.1358	10	267	2670	Fail
0.1375	10	247	2470	Fail
0.1392	9	241	2677	Fail
0.1408	8	223	2787	Fail
0.1425	8	210	2625	Fail
0.1441	7	203	2900	Fail
0.1458	7	195	2785	Fail
0.1474	7	190	2714	Fail
0.1491	7	180	2571	Fail
0.1507	7	172	2457	Fail
0.1524	6	164	2733	Fail
0.1540	5	158	3160	Fail
0.1557	5	150	3000	Fail
0.1574	5	144	2880	Fail
0.1590	5	136	2720	Fail
0.1607	5	131	2620	Fail
0.1623	4	126	3150	Fail
0.1640	4	123	3075	Fail
0.1656	3	119	3966	Fail
0.1673	3	115	3833	Fail
0.1689	3	112	3733	Fail
0.1706	3	108	3600	Fail
0.1722	2	101	5050	Fail
0.1739	2	99	4950	Fail
0.1755	2	95	4750	Fail
0.1772	2	93	4650	Fail
0.1789	2	91	4550	Fail
0.1805	2	88	4400	Fail
0.1822	2	83	4150	Fail
0.1838	2	76	3800	Fail
0.1855	2	73	3650	Fail
0.1871	2	72	3600	Fail
0.1888	2	70	3500	Fail
0.1904	2	65	3250	Fail
0.1921	2	64	3200	Fail
0.1937	2	63	3150	Fail
0.1954	2	60	3000	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

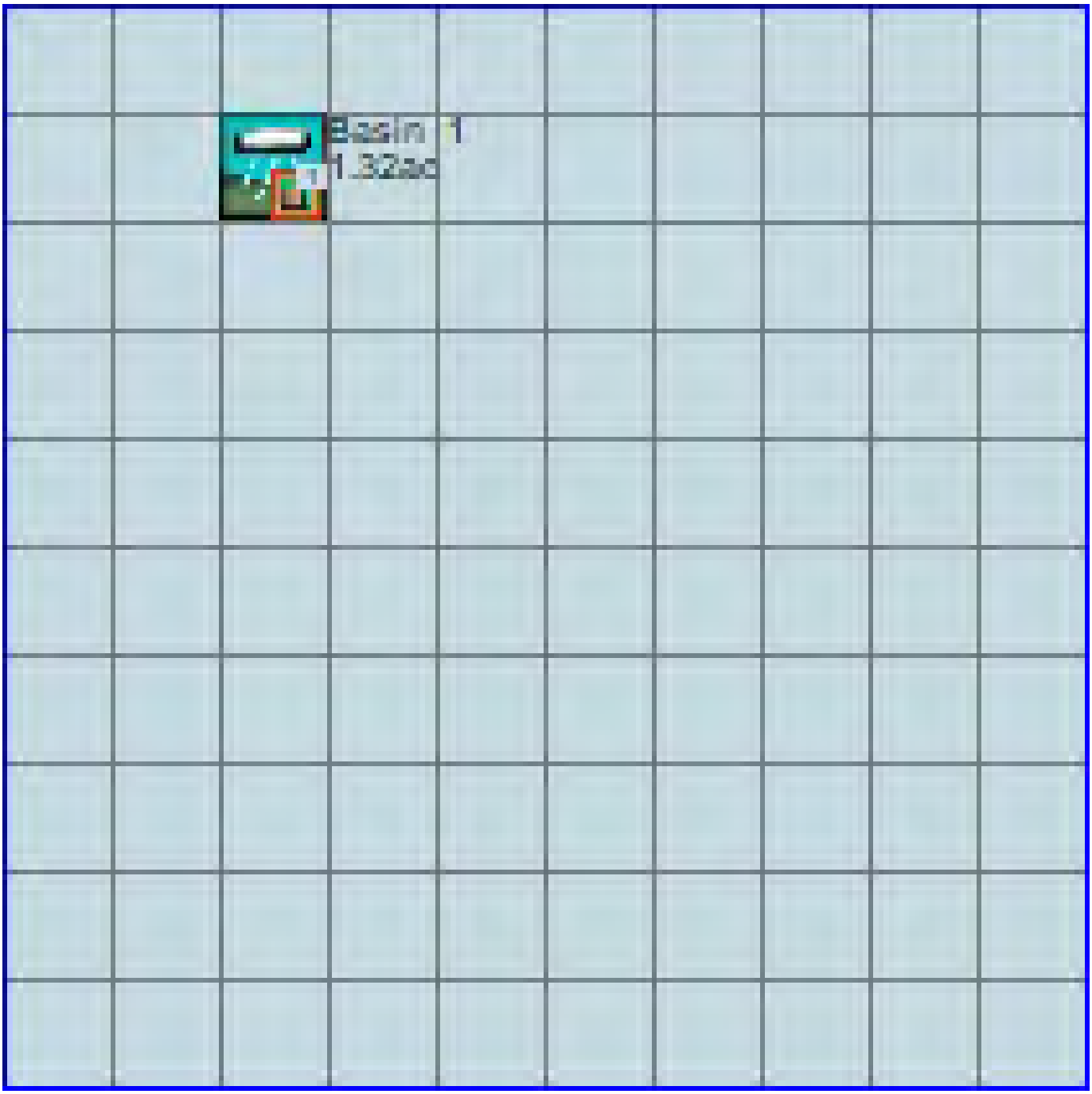
No PERLND changes have been made.

IMPLND Changes

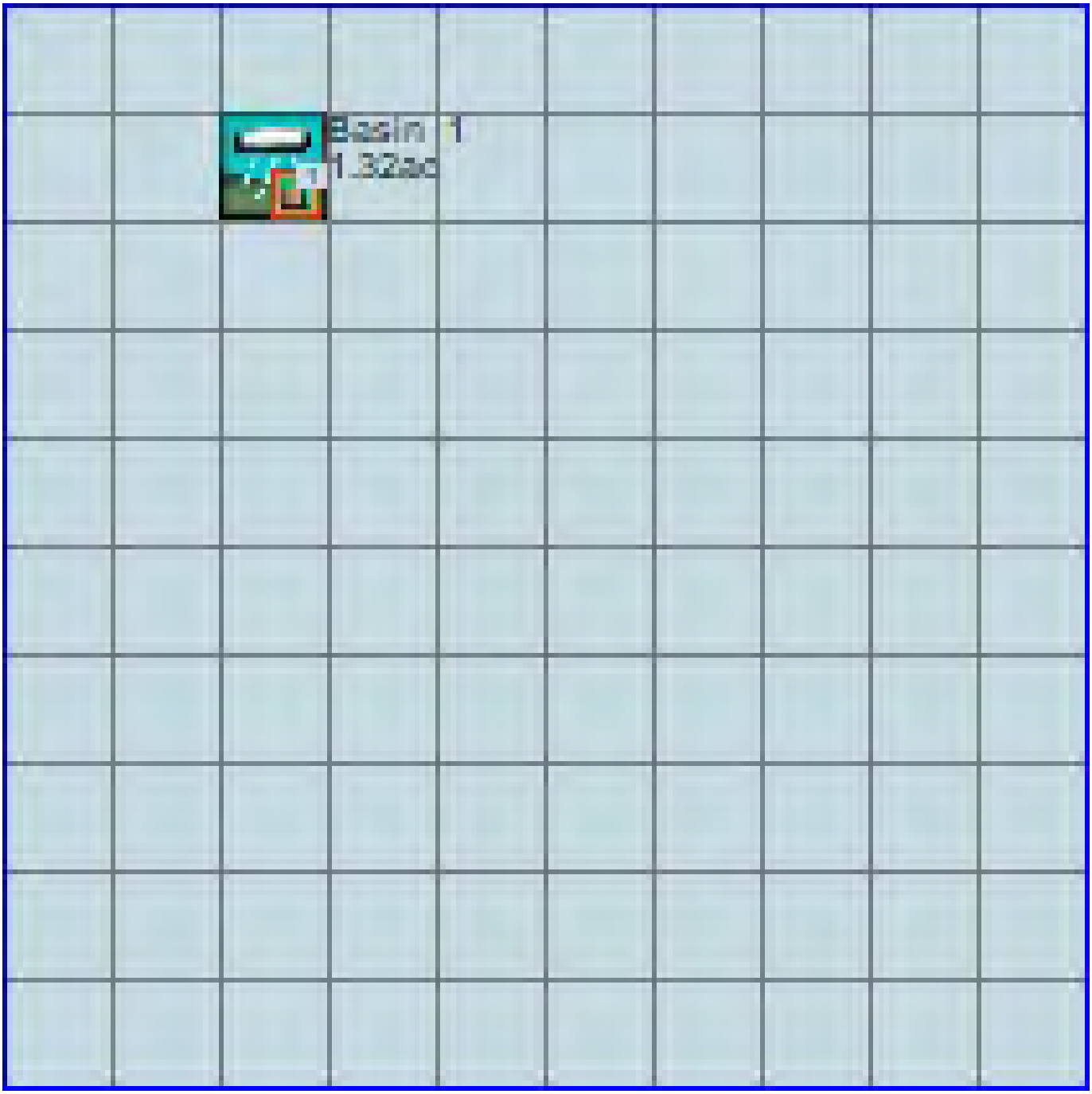
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   PrePeak Flows Ex Cond.MES
           27   PrePeak Flows Ex Cond.L61
           28   PrePeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      PERLND      16
      IMPLND       4
      IMPLND       5
      IMPLND       8
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                            in  out           ***
   10     C, Forest, Flat         1    1    1    1   27    0
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   10         0    0    1    0    0    0    0    0    0    0    0    0
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   10         0    0    0    0    0    0    0    0    0    0    0
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   10              0       4.5      0.08       400      0.05       0.5     0.996
   16              0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   10              0         0         2         2         0         0         0
   16              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   10            0.2       0.5      0.35         6       0.5       0.7
   16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   10              0         0         0         0       2.5         1         0
   16              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    5      DRIVEWAYS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
    8         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
  END PRINT-INFO
```

```
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    5         0    0    0    0    0
    8         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    5              0         0
    8              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    5              0         0
    8              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  10                        0.62     COPY   501     12
PERLND  10                        0.62     COPY   501     13
PERLND  16                        0.59     COPY   501     12
PERLND  16                        0.59     COPY   501     13
IMPLND   4                        0.07     COPY   501     15
IMPLND   5                        0.02     COPY   501     15
IMPLND   8                        0.02     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                        in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
```

```
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.833          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.833          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   MitPeak Flows Ex Cond.MES
           27   MitPeak Flows Ex Cond.L61
           28   MitPeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      PERLND      16
      IMPLND       1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   10     C, Forest, Flat         1    1    1    1   27    0
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   10         0    0    1    0    0    0    0    0    0    0    0    0
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   10         0    0    0    0    0    0    0    0    0    0    0
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   10              0       4.5      0.08       400      0.05       0.5     0.996
   16              0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   10              0         0         2         2         0         0         0
   16              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   10            0.2       0.5      0.35         6       0.5       0.7
   16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   10              0         0         0         0       2.5         1         0
   16              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
```

```
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1               0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1               0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  10                        0.38     COPY   501     12
PERLND  10                        0.38     COPY   501     13
PERLND  16                        0.49     COPY   501     12
PERLND  16                        0.49     COPY   501     13
IMPLND   1                        0.45     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<-----------------><---> User T-series  Engl Metr LKFG            ***
                                       in  out                               ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
```

```
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.833          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.833          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Peak Flows Ex Cond
Site Name:	7206 NE 129th St - East Basin - Includes East Roof
Site Address:	
City:	
Report Date:	8/2/2018
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.833
Version Date:	2017/04/14
Version:	4.2.13

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.38
C, Lawn, Flat	0.54
Pervious Total	0.92
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.92

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.27
C, Lawn, Flat	0.35
Pervious Total	0.62
Impervious Land Use	acre
ROOF TOPS FLAT	0.14
DRIVEWAYS FLAT	0.16
Impervious Total	0.3
Basin Total	0.92

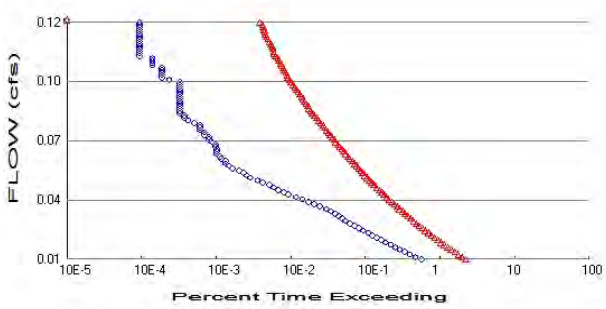
Element Flows To:

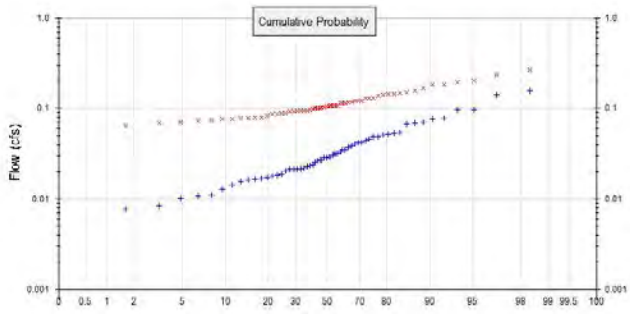
Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.92
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.62
Total Impervious Area: 0.3

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.029453
5 year	0.05292
10 year	0.071888
25 year	0.09966
50 year	0.123073
100 year	0.148797

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.106553
5 year	0.141458
10 year	0.166611
25 year	0.200802
50 year	0.228076
100 year	0.256944

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.051	0.153
1950	0.068	0.145
1951	0.053	0.101
1952	0.017	0.070
1953	0.014	0.073
1954	0.021	0.088
1955	0.033	0.096
1956	0.032	0.094
1957	0.029	0.116
1958	0.024	0.084

1959	0.020	0.076
1960	0.042	0.104
1961	0.021	0.097
1962	0.013	0.075
1963	0.022	0.092
1964	0.032	0.086
1965	0.035	0.122
1966	0.016	0.077
1967	0.071	0.149
1968	0.027	0.137
1969	0.026	0.107
1970	0.021	0.100
1971	0.029	0.115
1972	0.054	0.143
1973	0.018	0.069
1974	0.030	0.108
1975	0.039	0.122
1976	0.025	0.089
1977	0.008	0.078
1978	0.019	0.103
1979	0.011	0.130
1980	0.069	0.158
1981	0.017	0.109
1982	0.053	0.167
1983	0.029	0.116
1984	0.016	0.080
1985	0.010	0.105
1986	0.042	0.104
1987	0.040	0.131
1988	0.015	0.079
1989	0.011	0.087
1990	0.156	0.271
1991	0.078	0.184
1992	0.023	0.079
1993	0.019	0.063
1994	0.008	0.065
1995	0.027	0.095
1996	0.076	0.129
1997	0.049	0.115
1998	0.021	0.095
1999	0.097	0.205
2000	0.023	0.107
2001	0.005	0.099
2002	0.037	0.144
2003	0.046	0.118
2004	0.044	0.195
2005	0.031	0.101
2006	0.035	0.093
2007	0.141	0.239
2008	0.097	0.182
2009	0.049	0.122

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1564	0.2706
2	0.1412	0.2389
3	0.0966	0.2048

4	0.0965	0.1955
5	0.0782	0.1838
6	0.0762	0.1823
7	0.0709	0.1673
8	0.0693	0.1581
9	0.0677	0.1526
10	0.0544	0.1490
11	0.0534	0.1447
12	0.0525	0.1438
13	0.0507	0.1432
14	0.0491	0.1374
15	0.0488	0.1311
16	0.0464	0.1301
17	0.0436	0.1293
18	0.0425	0.1221
19	0.0423	0.1221
20	0.0403	0.1220
21	0.0391	0.1182
22	0.0370	0.1162
23	0.0346	0.1156
24	0.0346	0.1152
25	0.0331	0.1149
26	0.0322	0.1086
27	0.0317	0.1081
28	0.0309	0.1075
29	0.0295	0.1073
30	0.0293	0.1051
31	0.0288	0.1045
32	0.0287	0.1041
33	0.0269	0.1035
34	0.0267	0.1008
35	0.0263	0.1008
36	0.0252	0.1001
37	0.0240	0.0993
38	0.0231	0.0975
39	0.0228	0.0955
40	0.0220	0.0950
41	0.0213	0.0947
42	0.0213	0.0942
43	0.0212	0.0929
44	0.0212	0.0924
45	0.0204	0.0885
46	0.0189	0.0880
47	0.0185	0.0872
48	0.0181	0.0863
49	0.0172	0.0839
50	0.0168	0.0798
51	0.0164	0.0791
52	0.0161	0.0790
53	0.0154	0.0778
54	0.0144	0.0769
55	0.0129	0.0763
56	0.0110	0.0751
57	0.0109	0.0728
58	0.0101	0.0701
59	0.0083	0.0690
60	0.0077	0.0649
61	0.0049	0.0635

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0147	12008	47312	394	Fail
0.0158	10027	42093	419	Fail
0.0169	8464	37580	443	Fail
0.0180	7195	33794	469	Fail
0.0191	6192	30351	490	Fail
0.0202	5364	27292	508	Fail
0.0213	4667	24576	526	Fail
0.0224	4030	22202	550	Fail
0.0235	3523	20037	568	Fail
0.0246	3059	18106	591	Fail
0.0257	2674	16459	615	Fail
0.0268	2336	14938	639	Fail
0.0279	2014	13569	673	Fail
0.0290	1764	12335	699	Fail
0.0300	1520	11238	739	Fail
0.0311	1316	10273	780	Fail
0.0322	1161	9417	811	Fail
0.0333	1047	8609	822	Fail
0.0344	948	7914	834	Fail
0.0355	841	7285	866	Fail
0.0366	732	6737	920	Fail
0.0377	639	6203	970	Fail
0.0388	523	5685	1086	Fail
0.0399	437	5236	1198	Fail
0.0410	368	4825	1311	Fail
0.0421	306	4436	1449	Fail
0.0432	252	4124	1636	Fail
0.0443	198	3807	1922	Fail
0.0454	173	3540	2046	Fail
0.0465	145	3260	2248	Fail
0.0476	127	3009	2369	Fail
0.0487	110	2785	2531	Fail
0.0497	89	2592	2912	Fail
0.0508	77	2430	3155	Fail
0.0519	61	2271	3722	Fail
0.0530	55	2120	3854	Fail
0.0541	50	1977	3954	Fail
0.0552	43	1866	4339	Fail
0.0563	35	1732	4948	Fail
0.0574	32	1640	5125	Fail
0.0585	29	1554	5358	Fail
0.0596	29	1433	4941	Fail
0.0607	25	1324	5296	Fail
0.0618	24	1241	5170	Fail
0.0629	22	1181	5368	Fail
0.0640	22	1092	4963	Fail
0.0651	22	1030	4681	Fail
0.0662	21	961	4576	Fail
0.0673	21	911	4338	Fail
0.0684	19	863	4542	Fail
0.0694	17	820	4823	Fail
0.0705	17	770	4529	Fail
0.0716	15	722	4813	Fail
0.0727	15	683	4553	Fail

0.0738	13	642	4938	Fail
0.0749	13	605	4653	Fail
0.0760	13	582	4476	Fail
0.0771	11	540	4909	Fail
0.0782	9	503	5588	Fail
0.0793	8	478	5975	Fail
0.0804	8	444	5550	Fail
0.0815	7	418	5971	Fail
0.0826	7	395	5642	Fail
0.0837	7	377	5385	Fail
0.0848	7	362	5171	Fail
0.0859	7	344	4914	Fail
0.0870	7	325	4642	Fail
0.0881	7	313	4471	Fail
0.0891	7	297	4242	Fail
0.0902	7	282	4028	Fail
0.0913	7	269	3842	Fail
0.0924	7	255	3642	Fail
0.0935	7	244	3485	Fail
0.0946	7	229	3271	Fail
0.0957	7	217	3100	Fail
0.0968	5	206	4120	Fail
0.0979	4	194	4850	Fail
0.0990	4	191	4775	Fail
0.1001	4	184	4600	Fail
0.1012	4	174	4350	Fail
0.1023	4	167	4175	Fail
0.1034	3	164	5466	Fail
0.1045	3	155	5166	Fail
0.1056	3	148	4933	Fail
0.1067	3	144	4800	Fail
0.1078	2	133	6650	Fail
0.1088	2	128	6400	Fail
0.1099	2	126	6300	Fail
0.1110	2	123	6150	Fail
0.1121	2	120	6000	Fail
0.1132	2	116	5800	Fail
0.1143	2	110	5500	Fail
0.1154	2	106	5300	Fail
0.1165	2	100	5000	Fail
0.1176	2	98	4900	Fail
0.1187	2	96	4800	Fail
0.1198	2	94	4700	Fail
0.1209	2	91	4550	Fail
0.1220	2	89	4450	Fail
0.1231	2	82	4100	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

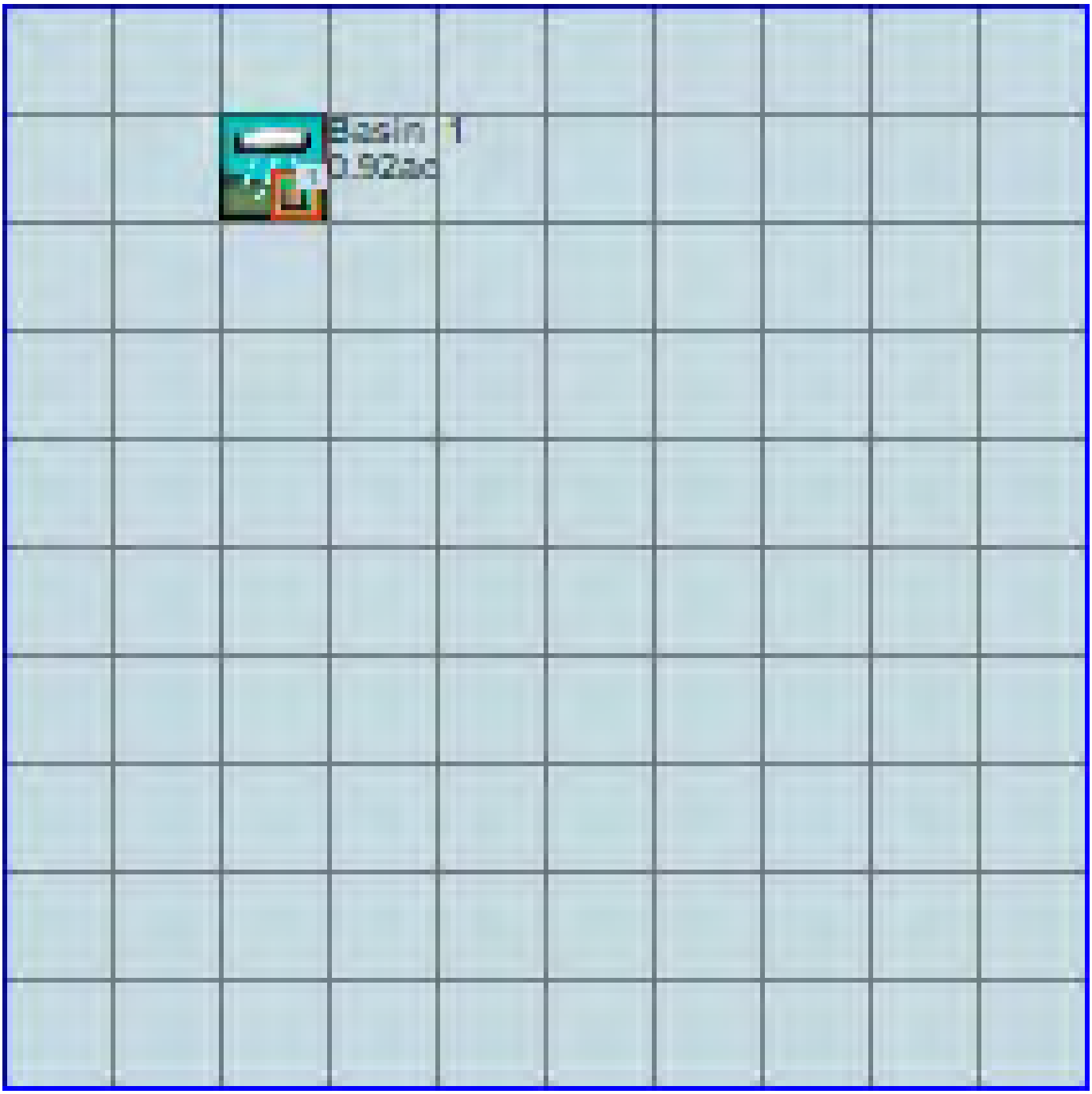
No PERLND changes have been made.

IMPLND Changes

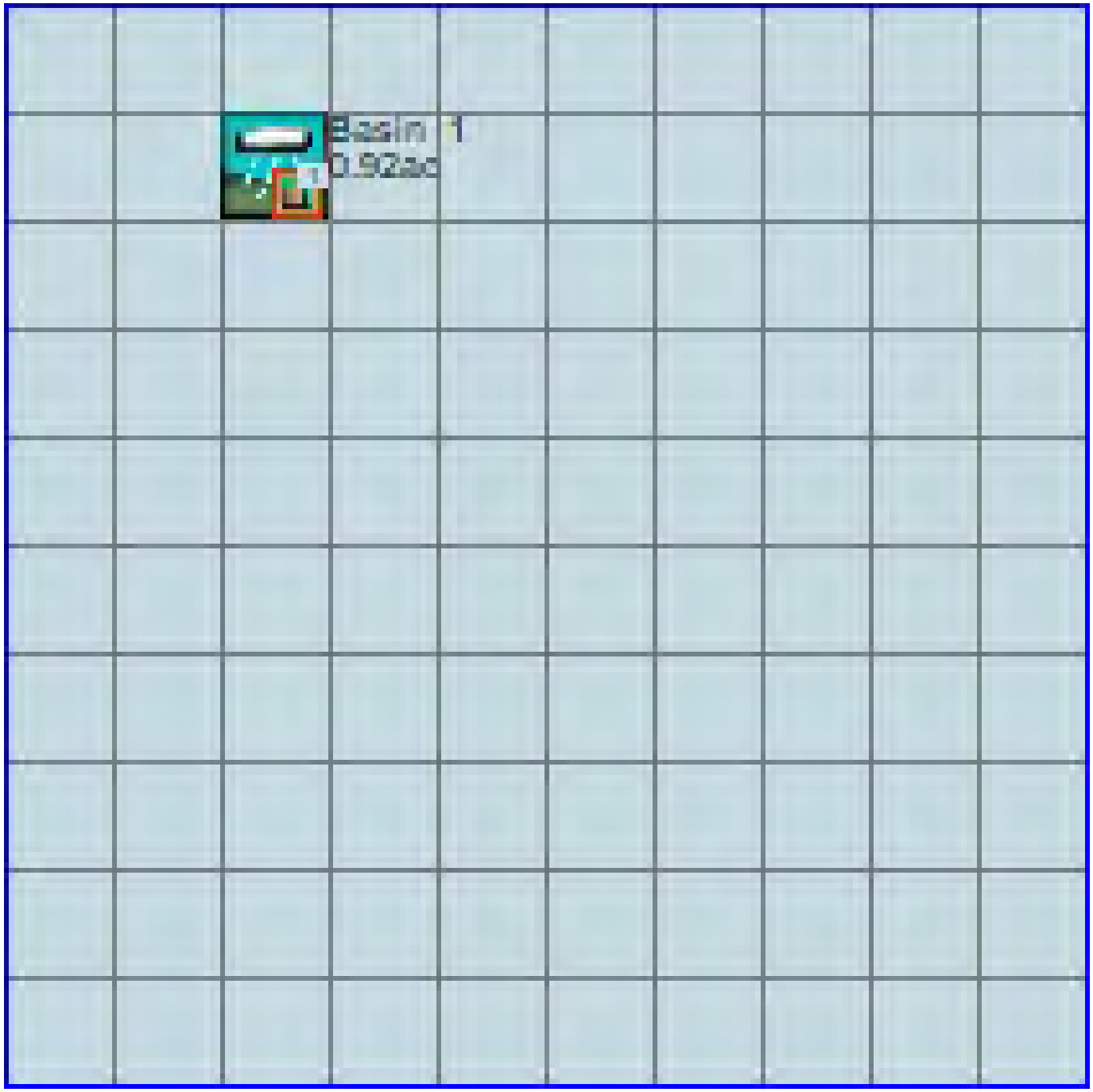
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   PrePeak Flows Ex Cond.MES
           27   PrePeak Flows Ex Cond.L61
           28   PrePeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      PERLND      16
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   10     C, Forest, Flat         1    1    1    1   27    0
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   10         0    0    1    0    0    0    0    0    0    0    0    0
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
```

```
  10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  10         0    0    0    0    0    0    0    0    0    0    0
  16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  10              0       4.5      0.08       400      0.05       0.5     0.996
  16              0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  10              0         0         2         2         0         0         0
  16              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                  ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  10            0.2       0.5      0.35         6       0.5       0.7
  16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  10              0         0         0         0       2.5         1         0
  16              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
```

```
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  10                        0.38     COPY   501     12
PERLND  10                        0.38     COPY   501     13
PERLND  16                        0.54     COPY   501     12
PERLND  16                        0.54     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                        in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES
```

```
SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.833          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.833          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Peak Flows Ex Cond.wdm
MESSU      25   MitPeak Flows Ex Cond.MES
           27   MitPeak Flows Ex Cond.L61
           28   MitPeak Flows Ex Cond.L62
           30   POCPeak Flows Ex Cond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      PERLND      16
      IMPLND       4
      IMPLND       5
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   10     C, Forest, Flat         1    1    1    1   27    0
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   10         0    0    1    0    0    0    0    0    0    0    0    0
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   10         0    0    0    0    0    0    0    0    0    0    0
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   10              0       4.5      0.08       400      0.05       0.5     0.996
   16              0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   10              0         0         2         2         0         0         0
   16              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   10            0.2       0.5      0.35         6       0.5       0.7
   16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   10              0         0         0         0       2.5         1         0
   16              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    5      DRIVEWAYS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
```

```
    4         0    0    0    0    0
    5         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    5              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    5              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  10                        0.27     COPY   501     12
PERLND  10                        0.27     COPY   501     13
PERLND  16                        0.35     COPY   501     12
PERLND  16                        0.35     COPY   501     13
IMPLND   4                        0.14     COPY   501     15
IMPLND   5                        0.16     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                        in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO
```

```
  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.833          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.833          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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Attachment B
Lola and Lake Park II Short Plat Pricing Analysis

AltaTerra

Prepared for:

10110 128th Ave NE Kirkland WA 98033

10110 128th Ave NE, Kirkland, WA 98033

August 8, 2018

Windermere
REAL ESTATE

Information used to prepare this report has been obtained from multiple sources, including: MLS records of pending listings and recent sales; public records; and the current owner(s) of the subject property. The broker preparing this report has not independently verified the accuracy or completeness of any information obtained from sources reasonably believed by the broker to be reliable.

Property Summary

10110 128th Ave NE Kirkland WA 98033
10110 128th Ave NE, Kirkland, WA 98033

Bedrooms:	5	**MLS Area:**	560
Bathrooms:	4	**Community:**	Rose Hill
Square Feet:	4,040	**School District:**	Lake Washington
Living Area (SF):	4,040	**Elementary School:**	Twain
Lot Size:	8,900 SqFt	**Middle School:**	Rose Hill
Property Type:	Single-Family	**High School:**	Lake Washington
Year Built:	2019		
County:	King		

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Pricing Analysis

10110 128th Ave NE Kirkland WA 98033
10110 128th Ave NE, Kirkland, WA 98033

Approximate Market Value:
$1,700,000 - $2,000,000

The estimated range within this report is generated from the comparable sales that look to have similar overall features to this particular home. Comparable sales were chosen for their similar overall size, location, age, quality of construction and features that have been displayed within the MLS reports. Due to the fact this short plat is made up of 3 unique homes, it is unlikely to find an exact replica of each individual home, therefore a total of 5 comparable homes were used to bracket the overall features within each home. The supply of recent similar active inventory has increased as of lately and therefore we've seen a slight softening in home prices that look to be listed based on slightly older sales data. We typically see strong price increases in the start of the year with some softening noted during the late spring - early summer time frame. The combination of rising interest rates and slightly more available inventory has allowed Buyer's to be a little more picky about the homes they are willing to offer on.

We do our best to estimate the overall Buyer reaction to the subject home, but please understand that this estimate is solely based on historical data supplied by the MLS. The range included within this report is used to help bracket the unique features that could influence a Buyer when presenting the Seller with an offer. The plans that were presented to me represented a 4,040 square foot home with a 2 car garage and high end modern finishes throughout. If the subject home turns out to be at or slightly above this size, I believe this home will be priced towards the upper end of this range. If the homes are built to a slightly smaller scale, then I would estimate pricing closer towards the bottom-middle part of this range.

Price Based on Average Sales

Average Price of Sold Comparable Properties	$1,779,627

Price Based on Square Footage

Average $/SqFt of Sold Comparable Properties	$489.53
Square Footage of Subject Property	4,040
Price based on square footage of Subject Property	$1,977,691

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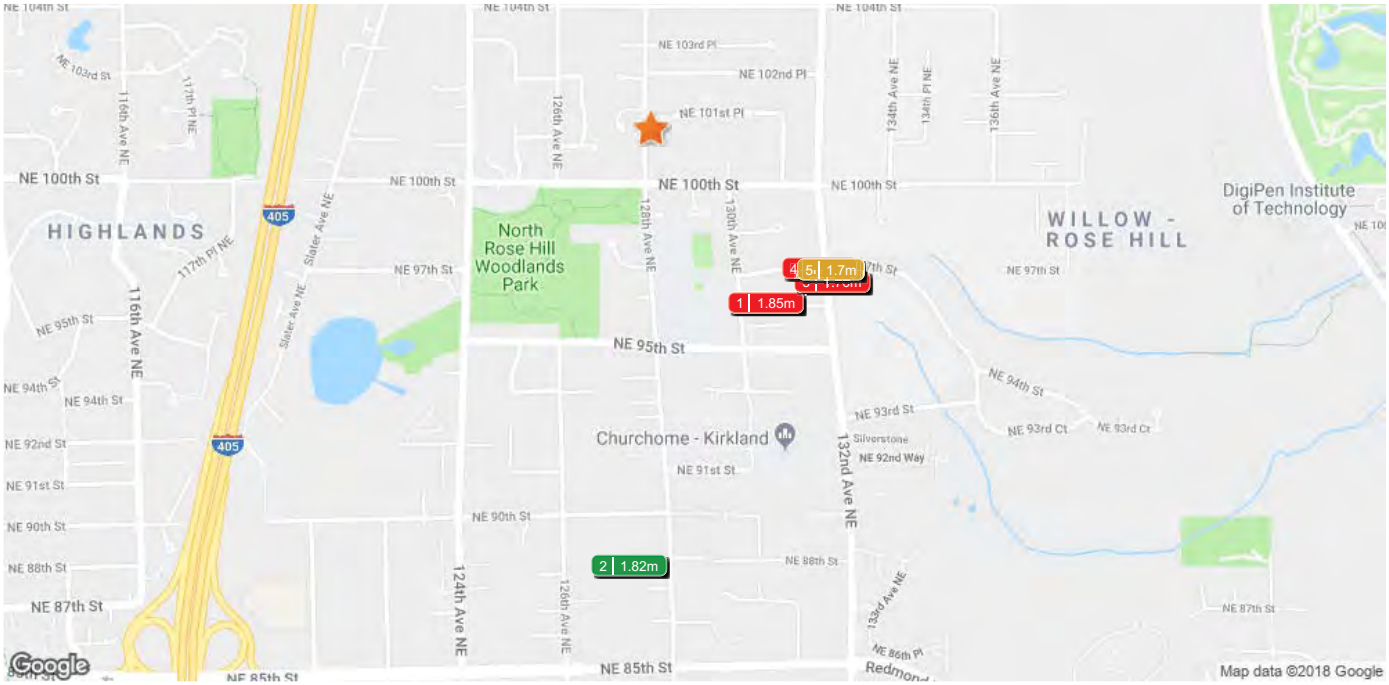
Listing Location Map



Subject Property · Active · Pending · Sold

Subject Property	Price	Beds	Baths	Days	SqFt	$/SqFt
10110 128th Ave NE, Kirkland		5	4		4,040	-

Active Properties	Listing Price	Beds	Baths	Days	SqFt	$/SqFt
2. 8738 126th Ave NE, Kirkland	$1,824,995	4	2.75	20	3,961	$461

Pending Properties	Listing Price	Beds	Baths	Days	SqFt	$/SqFt
5. 13116 NE 97th St 3 3, Kirkland	$1,699,850	5	2.75	48	3,422	$497

Sold Properties	Sale Price	Beds	Baths	Days	SqFt	$/SqFt
1. 9541 130th Ave NE, Kirkland	$1,850,000	5	3.25	4	3,888	$476
3. 13110 NE 97th St 2, Kirkland	$1,760,000	5	2.75	0	3,640	$484
4. 13102 NE 97th St 1, Kirkland	$1,728,880	5	2.75	8	3,395	$509

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Listing Overview

Listing Courtesy of: *Northwest MLS*

SOLD

$1,850,000

1. 9541 130th Ave NE, Kirkland, WA 98033

Status/Price:

Status:	Sold	**Days:**	4	**$/SqFt:**	$476
List Price:	$1,798,000	**Original List Price:**	$1,798,000	**Sold Price:**	$1,850,000
% Of List Price:	103%	**Sold Date:**	04/20/2018		

Listing Detail:

Bedrooms:	5	**Bathrooms:**	3.25	**Property Type:**	Residential
Building Style:	2 Story	**Square Feet:**	3,888	**Lot Size:**	9,921 SqFt
Lot Dimensions:	76.32FT X 130.65FT	**Year Built:**	2018	**County:**	King County
		Tax Amount:	$2,975	**Tax Year:**	2017
HOA Dues:	$0	**MLS #:**	1265445	**MLS Area:**	560
Community:	North Rose Hill	**School District:**	Lkw	**Elementary School:**	Twain Elem
Middle School:	Rose Hill Middle	**High School:**	Lake Wash High		

Features:

Kitchen:	Kitchen W/Eating Space - Main	**Fireplace:**	1	**Roof:**	Composition
Basement:	None	**Heat/AC:**	Forced Air, Central a/C	**Exterior:**	Wood Products, Stone
Garage:	2, Garage-Attached	**Fuel:**	Natural Gas	**Bathroom Details:**	Full Bath 2, Half Bath 1, Three Quarter Bath 1
		Floors:	Wall to Wall Carpet, Hardwood	**Senior Community:**	No

Description:

MN Custom Homes presents a luxurious Craftsman masterpiece in convenient Rose Hill neighborhood. Huge backyard and secluded bonus room are perfect for large groups. High ceilings and an open floor plan adjacent to a giant deck are ideal for entertaining. Viking appliances and Butlers Pantry in epicurean kitchen. Beautiful Master Suite with walk-in shower and huge walk-in closet. Main floor includes guest suite and private den. Smart Home and Green features throughout. Lake Washington School District.

All information provided is deemed reliable but is not guaranteed and should be independently verified.

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Listing Overview

Listing Courtesy of:
Northwest MLS

SOLD

$1,850,000

1. 9541 130th Ave NE, Kirkland, WA 98033

Property Photos:

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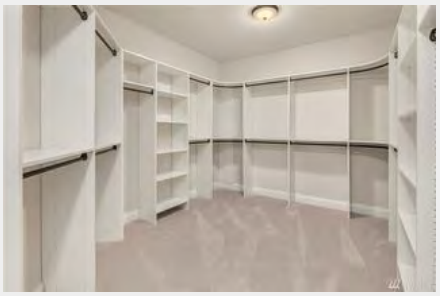
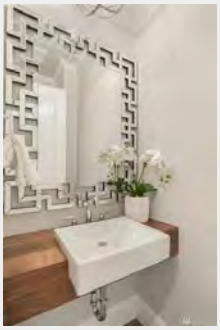
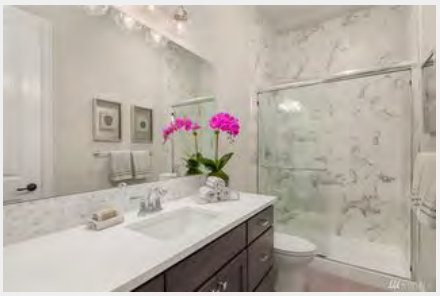
Listing Overview

1. 9541 130th Ave NE, Kirkland, WA 98033







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Listing Overview

1. 9541 130th Ave NE, Kirkland, WA 98033

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Listing Overview

Listing Courtesy of: Northwest MLS

ACTIVE

$1,824,995

2. 8738 126th Ave NE, Kirkland, WA 98033

Status/Price:

Status:	Active	**Days:**	20	**$/SqFt:**	$461
List Price:	$1,824,995	**Original List Price:**	$1,824,995		

Listing Detail:

Bedrooms:	4	**Bathrooms:**	2.75	**Property Type:**	Residential
Building Style:	2 Story	**Square Feet:**	3,961	**Lot Size:**	10,557 SqFt
Year Built:	2018	**County:**	King County	**Tax Amount:**	$3,743
Tax Year:	2018	**HOA Dues:**	$0	**MLS #:**	1329013
MLS Area:	560	**Community:**	Rose Hill	**School District:**	Lkw
Elementary School:	Twain Elem	**Middle School:**	Rose Hill Middle	**High School:**	Lake Wash High

Features:

Kitchen:	Kitchen W/Eating Space - Main	**Fireplace:**	1	**Roof:**	Composition
Basement:	None	**Heat/AC:**	Radiant, Forced Air	**Exterior:**	Stone, Cement Planked
Garage:	3, Garage-Attached	**Fuel:**	Natural Gas, Electric	**Bathroom Details:**	Full Bath 2, Three Quarter Bath 1
		Floors:	Wall to Wall Carpet, Hardwood, Ceramic Tile	**Senior Community:**	No

Description:

Stunning new construction in central Rose Hill! Beautifully appointed, sunlit and spacious with soaring ceilings and thoughtful design. Generous home office with vaulted ceilings, 2 story dining room and functional great room. Chef's kitchen features oversized gas range w/pot filler. Main floor guest room with adjacent 3/4 bath. Owner's suite with luxurious bath includes soaking tub and heated floors. Enjoy built-ins and a wet bar in the upstairs bonus. Level, fully fenced yard. Excellent Lake WA schools!

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Listing Overview

Listing Courtesy of:
Northwest MLS

ACTIVE

$1,824,995

2. 8738 126th Ave NE, Kirkland, WA 98033

Property Photos:

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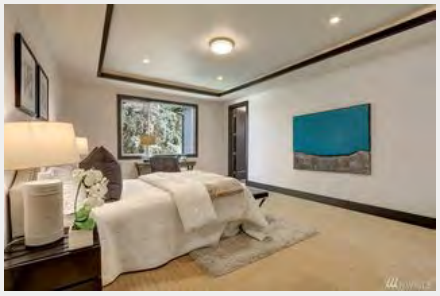
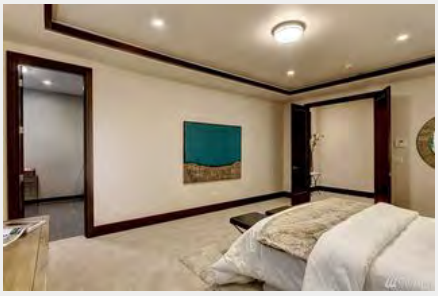
Listing Overview

2. 8738 126th Ave NE, Kirkland, WA 98033

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Listing Overview

2. 8738 126th Ave NE, Kirkland, WA 98033

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Listing Overview

Listing Courtesy of: *Northwest MLS*

SOLD

$1,760,000

3. 13110 NE 97th St 2, Kirkland, WA 98033

Status/Price:

Status:	Sold	**Days:**	0	**$/SqFt:**	$484
List Price:	$1,760,000	**Original List Price:**	$1,760,000	**Sold Price:**	$1,760,000
% Of List Price:	100%	**Sold Date:**	04/30/2018		

Listing Detail:

Bedrooms:	5	**Bathrooms:**	2.75	**Property Type:**	Residential
Building Style:	2 Story	**Square Feet:**	3,640	**Lot Size:**	8,479 SqFt
Year Built:	2018	**County:**	King County	**Tax Amount:**	$0
Tax Year:	2018	**HOA Dues:**	$0	**MLS #:**	1255571
MLS Area:	560	**Community:**	North Rose Hill	**School District:**	Lkw
Elementary School:	Twain Elem	**Middle School:**	Rose Hill Middle	**High School:**	Lake Wash High
Subdivision:	AURA				

Features:

Kitchen:	Kitchen W/Eating Space - Main	**Fireplace:**	2	**Roof:**	Composition
Basement:	None	**Heat/AC:**	Forced Air, Central a/C	**Exterior:**	Cement/Concrete
Garage:	3, Garage-Attached	**Fuel:**	Natural Gas	**Bathroom Details:**	Full Bath 2, Three Quarter Bath 1
		Floors:	Ceramic Tile, Hardwood, Wall to Wall Carpet	**Senior Community:**	No

Description:

Welcome to AURA-Merit's newest N. Rose Hill community. Exceptional Merit SMART Home conveniently located in a quiet loc. near Twain Elem. Enjoy luxury and indulgence of high-end design. Central A/C. Chefs kitchen w/Thermadore package, quartz waterfall island, spa-style master bath, covered/heated deck, prof. landscaping, skylights and open floor plan. Main floor den/office+BR and 3/4 bath. SMART features include Lutron lighting, August keyless entry/doorbell camera, Nest thermo and AMAZON Echo/Alexa.

All information provided is deemed reliable but is not guaranteed and should be independently verified.

Travis Stewart
Windermere Real Estate/Central Inc

travisstewart@windermere.com
(425) 443-8728

Listing Overview

Listing Courtesy of: *Northwest MLS*

SOLD

$1,728,880

4. 13102 NE 97th St 1, Kirkland, WA 98033

Status/Price:

Status:	Sold	**Days:**	8	**$/SqFt:**	$509
List Price:	$1,728,885	**Original List Price:**	$1,728,885	**Sold Price:**	$1,728,880
% Of List Price:	100%	**Sold Date:**	06/07/2018		

Listing Detail:

Bedrooms:	5	**Bathrooms:**	2.75	**Property Type:**	Residential
Building Style:	2 Story	**Square Feet:**	3,395	**Lot Size:**	7,680 SqFt
Year Built:	2018	**County:**	King County	**Tax Amount:**	$0
Tax Year:	2018	**HOA Dues:**	$0	**MLS #:**	1292843
MLS Area:	560	**Community:**	North Rose Hill	**School District:**	Lkw
Elementary School:	Twain Elem	**Middle School:**	Rose Hill Middle	**High School:**	Lake Wash High
Subdivision:	AURA				

Features:

Kitchen:	Kitchen W/Eating Space - Main	**Fireplace:**	2	**Roof:**	Composition
Basement:	None	**Heat/AC:**	Forced Air, Central a/C	**Exterior:**	Cement Planked
Garage:	3, Garage-Attached	**Fuel:**	Natural Gas	**Bathroom Details:**	Full Bath 2, Three Quarter Bath 1
		Floors:	Wall to Wall Carpet, Hardwood, Ceramic Tile	**Senior Community:**	No

Description:

Welcome to AURA by Merit Homes. Quiet enclave of 3 side-by-side homes. Massive great room w/huge windows, main floor BR and 3/4 bath. Luxury features: Central A/C, sprinklers. Smart home-enabled includes Nest thermo/August smart door lock/Lutron Casseta lights/Amazon Echo w/Alexa voice control. Tankless H20. Beautiful kit. w/waterfall slab island and lift-up cabinets. Fridge/W/D included. Spa-inspired master bath w/large walk in. Outdoor room has gas fireplace, radiant heater. Close to MS, Google.

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Listing Overview

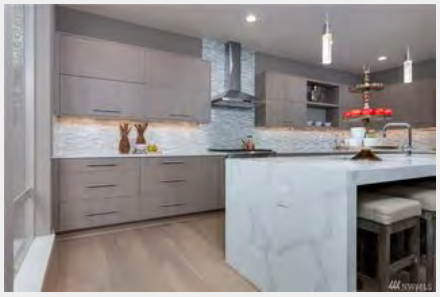
Listing Courtesy of:
Northwest MLS

SOLD

$1,728,880

4. 13102 NE 97th St 1, Kirkland, WA 98033

Property Photos:



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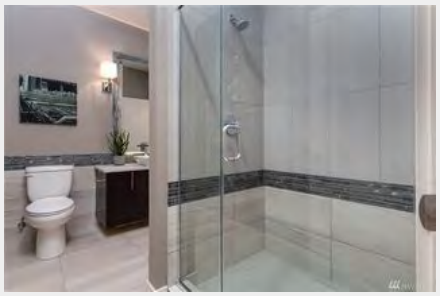
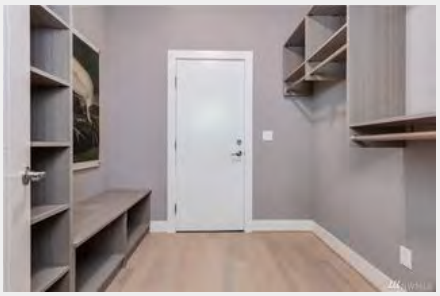
4. 13102 NE 97th St 1, Kirkland, WA 98033





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4. 13102 NE 97th St 1, Kirkland, WA 98033

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Listing Overview

Listing Courtesy of: *Northwest MLS*

PENDING

$1,699,850

5. 13116 NE 97th St 3 3, Kirkland, WA 98033

Status/Price:

Status:	Pending	**Days:**	48	**$/SqFt:**	$497
List Price:	$1,699,850	**Original List Price:**	$1,749,850		

Listing Detail:

Bedrooms:	5	**Bathrooms:**	2.75	**Property Type:**	Residential
Building Style:	2 Story	**Square Feet:**	3,422	**Lot Size:**	8,081 SqFt
Year Built:	2018	**County:**	King County	**Tax Amount:**	$0
Tax Year:	2018	**HOA Dues:**	$0	**MLS #:**	1311119
MLS Area:	560	**Community:**	North Rose Hill	**School District:**	Lkw
Elementary School:	Twain Elem	**Middle School:**	Rose Hill Middle	**High School:**	Lake Wash High
Subdivision:	AURA				

Features:

Kitchen:	Kitchen W/Eating Space - Main	**Fireplace:**	2	**Roof:**	Composition
Basement:	None	**Heat/AC:**	Forced Air, Central a/C	**Exterior:**	Cement/Concrete
Garage:	3, Garage-Attached	**Fuel:**	Natural Gas	**Bathroom Details:**	Full Bath 2, Three Quarter Bath 1
		Floors:	Ceramic Tile, Hardwood, Wall to Wall Carpet	**Senior Community:**	No

Description:

Welcome to AURA-Merit's newest N. Rose Hill community. Exceptional Merit SMART Home conveniently located in a quiet loc. near Twain Elem. Enjoy luxury and indulgence of high-end design. 3-car garage. Central A/C. Chefs kitchen package, quartz waterfall island, spa-style master bath, covered/heated deck, prof. landscaping, skylights and open floor plan. Main floor BR and 3/4 bath. SMART features include Lutron lighting, August keyless entry/doorbell camera, and AMAZON Echo/Alexa. Hurry-only 1 home left.

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Listing Overview

Listing Courtesy of:
Northwest MLS

PENDING

$1,699,850

5. 13116 NE 97th St 3 3, Kirkland, WA 98033

Property Photos:

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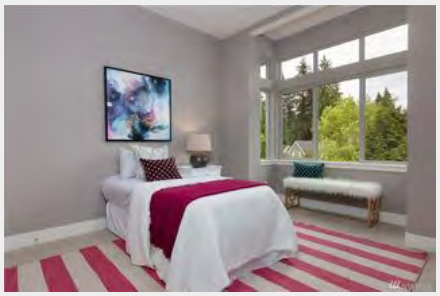
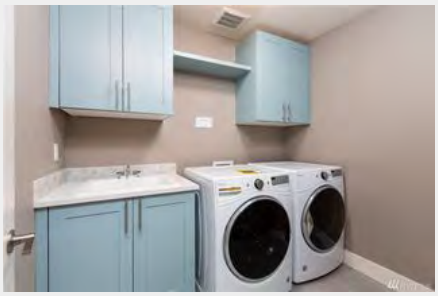

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5. 13116 NE 97th St 3 3, Kirkland, WA 98033

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Side by Side Comparisons

Windermere REAL ESTATE

	Subject Property	Comparable #1	Comparable #2	Comparable #3
Address	10110 128th Ave NE	9541 130th Ave NE	8738 126th Ave NE	13110 NE 97th St 2
City, State, Zip	Kirkland, WA 98033	Kirkland, WA 98033	Kirkland, WA 98033	Kirkland, WA 98033
Status	-	Sold	Active	Sold
Bedrooms	5	5	4	5
Bathrooms	4	3.25	2.75	2.75
Sqft	4,040	3,888	3,961	3,640
Lot SqFt	8,900	9,921	10,557	8,479
Year Built	2019	2018	2018	2018
Property Type	Single-Family	Residential	Residential	Residential
Days on Market	-	4	20	-
List Price	-	$1,798,000	$1,824,995	$1,760,000
Original List Price		$1,798,000	$1,824,995	$1,760,000
% Of List Price	-	103%	-	100%
Sold Price	-	$1,850,000	-	$1,760,000
Sold Date	-	04/20/2018	-	04/30/2018
$/SqFt	-	$476	$461	$484
$/Lot SqFt	-	$186	$173	$208
MLS #	-	1265445	1329013	1255571
County	King	King County	King County	King County
Tax Amount	$0	$2,975	$3,743	$0
Tax Year	-	2017	2018	2018
Bathroom Details	-	Full Bath 2, Half Bath 1, Three Quarter Bath 1	Full Bath 2, Three Quarter Bath 1	Full Bath 2, Three Quarter Bath 1
Basement	-	None	None	None
Garage	-	2, Garage-Attached	3, Garage-Attached	3, Garage-Attached
Fireplace	-	1	1	2
Fuel	-	Natural Gas	Natural Gas, Electric	Natural Gas
Heat/AC	-	Forced Air, Central a/C	Radiant, Forced Air	Forced Air, Central a/C
Roof	-	Composition	Composition	Composition

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Side by Side Comparisons

	Subject Property	Comparable #4	Comparable #5
Address	10110 128th Ave NE	13102 NE 97th St 1	13116 NE 97th St 3 3
City, State, Zip	Kirkland, WA 98033	Kirkland, WA 98033	Kirkland, WA 98033
Status	-	Sold	Pending
Bedrooms	5	5	5
Bathrooms	4	2.75	2.75
Sqft	4,040	3,395	3,422
Lot SqFt	8,900	7,680	8,081
Year Built	2019	2018	2018
Property Type	Single-Family	Residential	Residential
Days on Market	-	8	48
List Price	-	$1,728,885	$1,699,850
Original List Price		$1,728,885	$1,749,850
% Of List Price	-	100%	-
Sold Price	-	$1,728,880	$0
Sold Date	-	06/07/2018	-
$/SqFt	-	$509	$497
$/Lot SqFt	-	$225	$210
MLS #	-	1292843	1311119
County	King	King County	King County
Tax Amount	$0	$0	$0
Tax Year	-	2018	2018
Bathroom Details	-	Full Bath 2, Three Quarter Bath 1	Full Bath 2, Three Quarter Bath 1
Basement	-	None	None
Garage	-	3, Garage-Attached	3, Garage-Attached
Fireplace	-	2	2
Fuel	-	Natural Gas	Natural Gas
Heat/AC	-	Forced Air, Central a/C	Forced Air, Central a/C
Roof	-	Composition	Composition

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Status Comparisons

	Bed	Bath	SqFt	Lot SqFt	List Price	$/SqFt	Sold Date	Sale Price	Adj Price	Days
Active Properties										
2. 8738 126th Ave NE, Kirkland	4	2.75	3,961	10,557	$1,824,995	$461	-	$0	-	20
Pending Properties										
5. 13116 NE 97th St 3 3, Kirkland	5	2.75	3,422	8,081	$1,699,850	$497	-	$0	-	48
Sold Properties										
1. 9541 130th Ave NE, Kirkland	5	3.25	3,888	9,921	$1,798,000	$476	04/20/2018	$1,850,000	-	4
3. 13110 NE 97th St 2, Kirkland	5	2.75	3,640	8,479	$1,760,000	$484	04/30/2018	$1,760,000	-	0
4. 13102 NE 97th St 1, Kirkland	5	2.75	3,395	7,680	$1,728,885	$509	06/07/2018	$1,728,880	-	8

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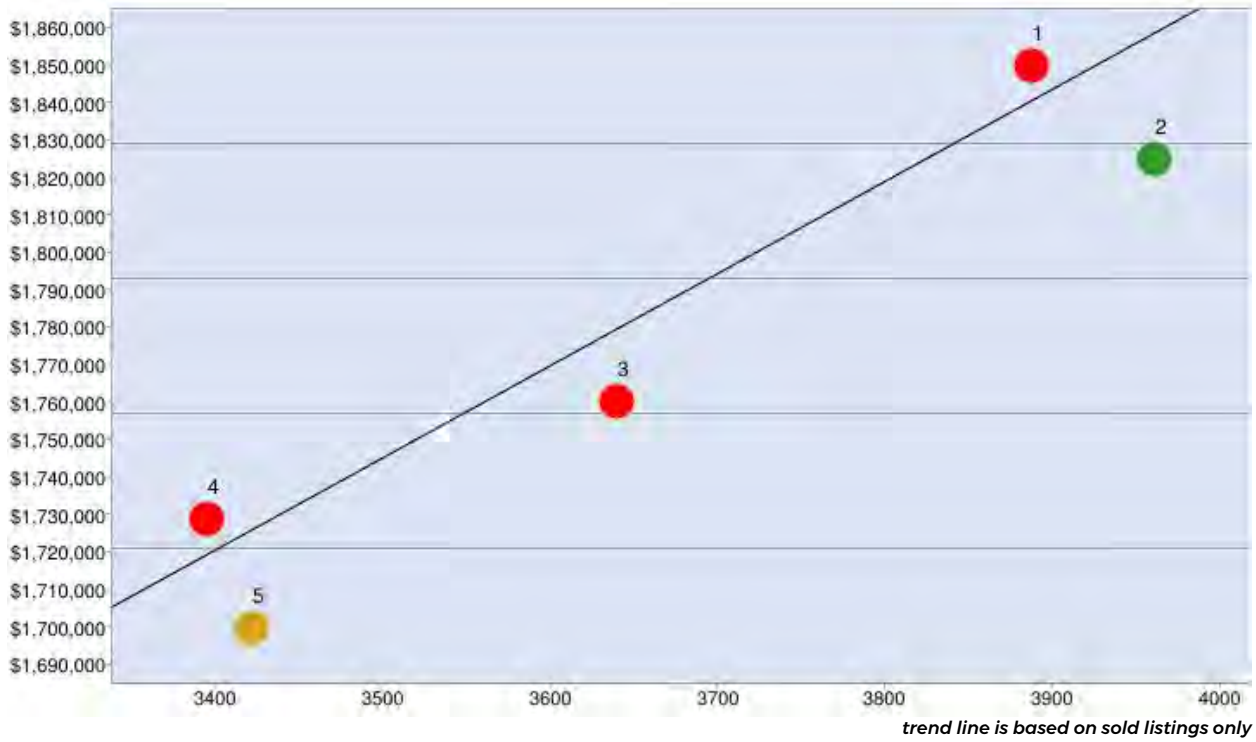
Price & Size



Active Properties

2. 8738 126th Ave NE, Kirkland	$1,824,995	4 beds	2.75 baths	3,961 SqFt	$461 / SqFt

Pending Properties

5. 13116 NE 97th St 3 3, Kirkland	$1,699,850	5 beds	2.75 baths	3,422 SqFt	$497 / SqFt

Sold Properties

1. 9541 130th Ave NE, Kirkland	$1,850,000	5 beds	3.25 baths	3,888 SqFt	$476 / SqFt
3. 13110 NE 97th St 2, Kirkland	$1,760,000	5 beds	2.75 baths	3,640 SqFt	$484 / SqFt
4. 13102 NE 97th St 1, Kirkland	$1,728,880	5 beds	2.75 baths	3,395 SqFt	$509 / SqFt

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Travis Stewart

Broker
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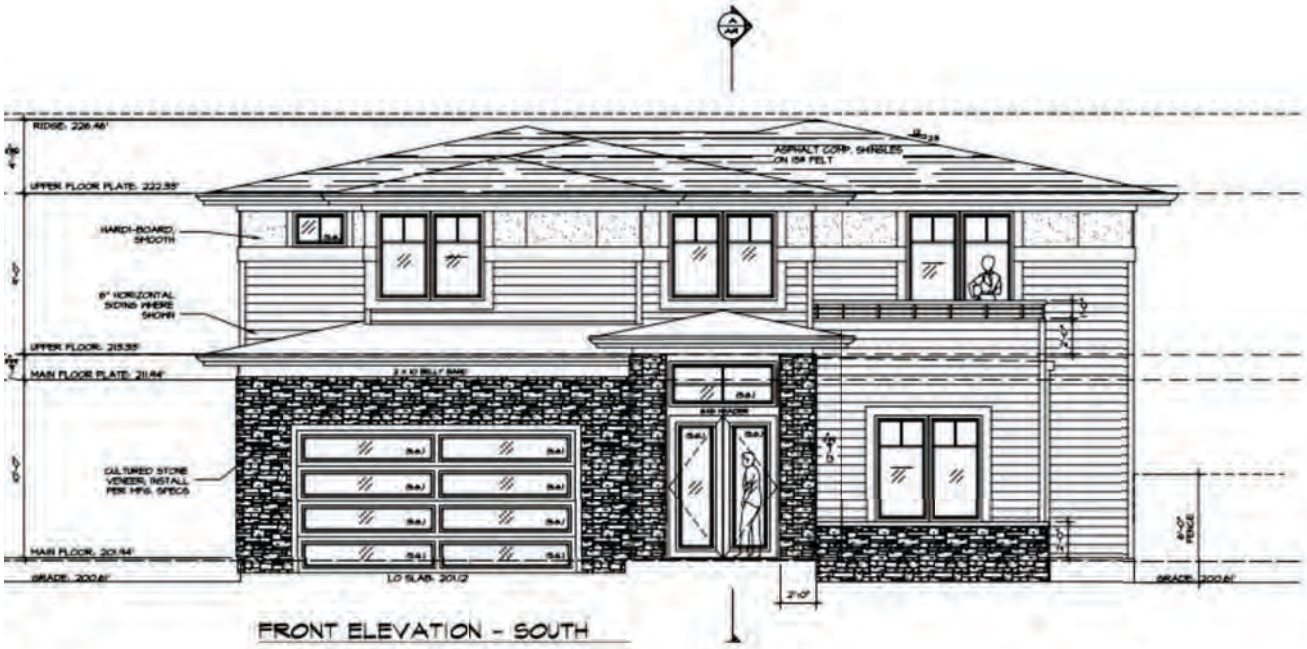
737 Market Street
Kirkland, WA 98033
http://teamstewartre.com

Mobile Phone: (425) 443-8728
Office Phone: (425) 823-4600
Fax: (425) 820-6318

Travis Stewart approaches everything in life with an energy and optimism that is contagious. The fact that he backs it up with exceptional communication skills, a whatever-it-takes work ethic and the utmost integrity has earned him the respect and loyalty of clients and colleagues alike. People just like working with Travis. Whether you are buying or selling a home, you can count on getting the best possible outcome, and having a great time in the process.

Travis's prior experience as a certified real estate appraiser and his time spent working for a local Title and Escrow company offers exceptional value to his clients. He brings to each transaction an insider's knowledge of the process, deep insight into property valuation, and a vast network of relationships with industry experts who can help make every purchase and sale go as smoothly as possible. Client's often say of Travis: "I felt like I was his #1 priority." That helpful attitude and attentiveness continues even after the sale is complete. Whether he's making sure your move goes smoothly or recommending a trusted contractor, Travis continues to be an ongoing resource and advocate for each of his clients.

Born and raised on the Eastside, Travis really knows and loves the area neighborhoods. Travis and his wife Jessica live in Bothell with their son Will and golden retriever Bella. A former professional wakeboarder, he still spends as much time as he can on the water.



Prepared for:

Davido Consulting Group, Inc.

319 8th St S, Kirkland, WA 98033

August 8, 2018

Windermere
REAL ESTATE

Information used to prepare this report has been obtained from multiple sources, including: MLS records of pending listings and recent sales; public records; and the current owner(s) of the subject property. The broker preparing this report has not independently verified the accuracy or completeness of any information obtained from sources reasonably believed by the broker to be reliable.

Property Summary

Davido Consulting Group, Inc.
319 8th St S, Kirkland, WA 98033

Bedrooms:	5
Bathrooms:	4
Square Feet:	3,796
Living Area (SF):	3,796
Lot Size:	8,600 SqFt
Property Type:	Single-Family
Year Built:	2018
County:	King
MLS Area:	560
Community:	Everest Park
Subdivision:	Lake Park II Shores
School District:	Lake Washington
Elementary School:	Lakeview Elementary
Middle School:	Kirkland Middle
High School:	Lake Washington High
Building Style:	12 - 2 Story

Features:

New Construction:	Yes
Floors:	2
Garage:	2, Attached
Parking:	Driveway
Master:	Upstairs
Kitchen:	Open Concept
Roof:	Composition
Heat/AC:	Forced Air
Fuel:	Natural Gas
Fireplace:	2
View:	Partial Lake
Exterior:	Hardi/Stone/Wood
Bathroom Details:	Full Bath 2, Half Bath 1, Three Quarter Bath 2

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Pricing Analysis

Davido Consulting Group, Inc.
319 8th St S, Kirkland, WA 98033

Approximate Market Value:
$2,000,000 - $2,400,000

The estimated range within this report is generated from the comparable sales that look to have similar overall features to this particular home. Comparable sales were chosen for their similar overall size, location, age, quality of construction and features that have been displayed within the MLS reports. Due to the fact this short plat is made up of 5 unique homes, it is unlikely to find an exact replica of each individual home, therefore a total of 9 comparable homes were used to bracket the overall features within each home. The supply of recent similar active inventory has increased as of lately and therefore we've seen a slight softening in home prices that look to be listed based on slightly older sales data. We typically see strong price increases in the start of the year with some softening noted during the late spring - early summer time frame. The combination of rising interest rates and slightly more available inventory has allowed Buyer's to be a little more picky about the homes they are willing to offer on.

We do our best to estimate the overall Buyer reaction to the subject home, but please understand that this estimate is solely based on historical data supplied by the MLS. The range included within this report is used to help bracket the unique features that could influence a Buyer when presenting the Seller with an offer. Lots 1 & 2 appear to be closer to 8th st with no potential west facing views. In my opinion, these two homes would most likely be offered at the bottom end of our estimated range where lots 3, 4 & 5 could potentially be listed at the top of our estimated range due to their potential to have lake views from the west facing sides of the properties.

Price Based on Average Sales

Average Price of Sold Comparable Properties	$2,063,167

Price Based on Square Footage

Average $/SqFt of Sold Comparable Properties	$559.93
Square Footage of Subject Property	3,796
Price based on square footage of Subject Property	$2,125,510

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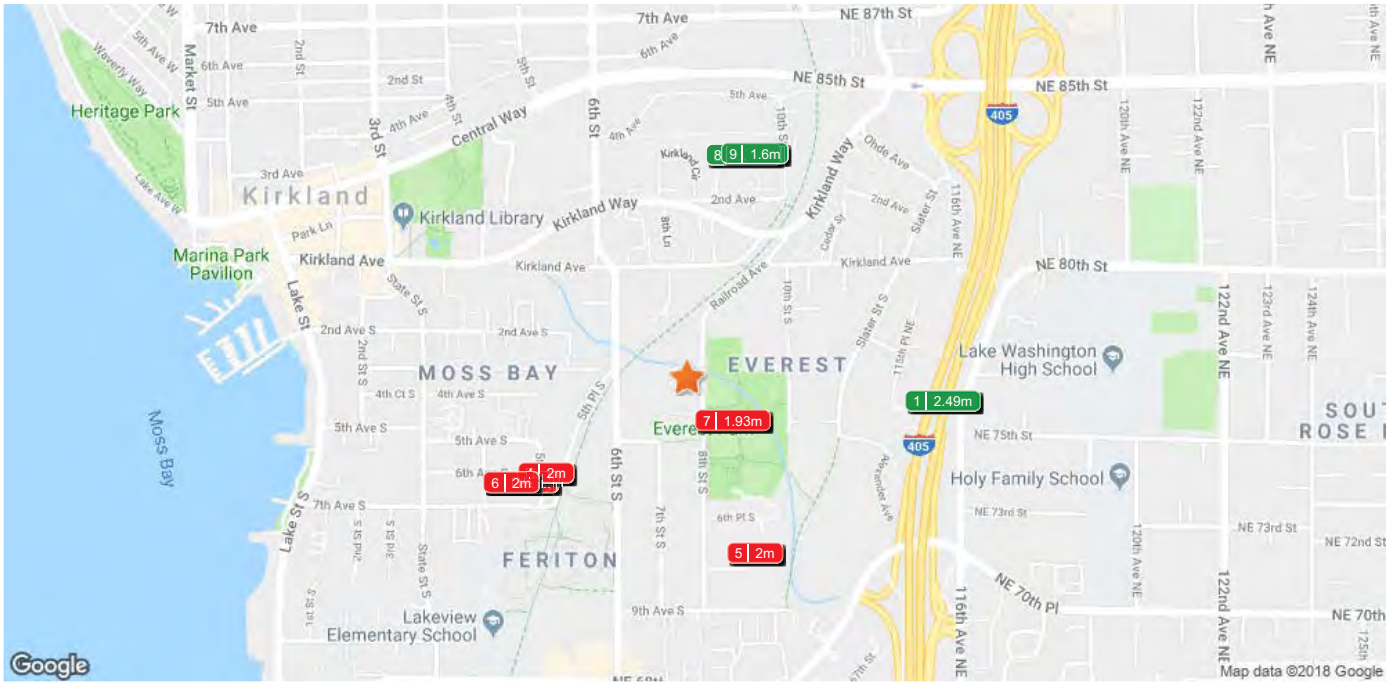
Listing Location Map



Subject Property Active Sold

Subject Property	Price	Beds	Baths	Days	SqFt	$/SqFt
319 8th St S, Kirkland		5	4		3,796	-

Active Properties	Listing Price	Beds	Baths	Days	SqFt	$/SqFt
1. 7620 115th Place NE, Kirkland	$2,488,000	5	4	6	4,797	$519
8. 824 2nd Ave, Kirkland	$1,649,950	4	3.25	19	3,430	$481
9. 826 2nd Ave, Kirkland	$1,599,950	4	3.25	19	3,430	$466

Sold Properties	Sale Price	Beds	Baths	Days	SqFt	$/SqFt
2. 706 4th Lane S, Kirkland	$2,398,000	5	4	7	4,040	$594
3. 710 4th Lane S, Kirkland	$2,058,000	4	3.25	0	3,659	$562
4. 420 6th Ave S, Kirkland	$2,000,000	4	3.5	7	3,350	$597
5. 714 8th St S, Kirkland	$2,000,000	4	2.75	5	3,772	$530
6. 714 4th Lane S, Kirkland	$1,998,000	4	3.25	6	3,659	$546
7. 333 8th St S, Kirkland	$1,925,000	4	3.25	6	3,630	$530

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Listing Overview

Listing Courtesy of: Northwest MLS

ACTIVE

$2,488,000

1. 7620 115th Place NE, Kirkland, WA 98033

Status/Price:

Status:	Active	**Days:**	6	**$/SqFt:**	$519
List Price:	$2,488,000	**Original List Price:**	$2,488,000		

Listing Detail:

Bedrooms:	5	**Bathrooms:**	4	**Property Type:**	Residential
Building Style:	2 Story	**Square Feet:**	4,797	**Lot Size:**	10,656 SqFt
Year Built:	2018	**County:**	King County	**Tax Amount:**	$15,801
Tax Year:	2018	**HOA Dues:**	$0	**MLS #:**	1334845
MLS Area:	560	**Community:**	Everest Park	**School District:**	Lkw
Elementary School:	Lakeview Elem	**Middle School:**	Kirkland Middle	**High School:**	Lake Wash High

Features:

Kitchen:	Kitchen W/Eating Space - Upper	**Fireplace:**	1	**View:**	See Remarks, Mountain, Lake, City
Basement:	None	**Heat/AC:**	Radiant, High Efficiency, Ductless Hp-Mini Split	**Roof:**	Flat
Garage:	2, Garage-Attached	**Fuel:**	Electric	**Exterior:**	See Remarks, Metal/Vinyl, Cement Planked, Brick
		Floors:	Wall to Wall Carpet, See Remarks, Hardwood, Ceramic Tile	**Bathroom Details:**	Full Bath 2, Half Bath 1, Three Quarter Bath 2
				Senior Community:	No

Description:

Blue Brick Homes welcomes their newest signature masterpiece.Modern sophistication meets urban luxury.Sweeping 270 deg wstrn views of Lk. Wash. and Olympics throughout the great room.Designed by renowned architect w/exquisite detail.Thermador applnces,custom cabinetry,Grohe fixtures,qrtz counter w/waterfall edge.Hand picked lighting,7 hrdwds,integrated office w/impressive glass door,metal railings set this home apart.Landscped front and secluded rear yard.Close to dwntwn Kirk,Google and Kirk Urban.

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Northwest MLS

ACTIVE

$2,488,000

1. 7620 115th Place NE, Kirkland, WA 98033

Property Photos:

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Listing Overview

Listing Courtesy of: *Northwest MLS*

SOLD

$2,398,000

2. 706 4th Lane S, Kirkland, WA 98033

Status/Price:

Status:	Sold	**Days:**	7	**$/SqFt:**	$594
List Price:	$2,398,000	**Original List Price:**	$2,398,000	**Sold Price:**	$2,398,000
% Of List Price:	100%	**Sold Date:**	10/26/2017		

Listing Detail:

Bedrooms:	5	**Bathrooms:**	4	**Property Type:**	Residential
Building Style:	2 Story	**Square Feet:**	4,040	**Lot Size:**	9,548 SqFt
Year Built:	2017	**County:**	King County	**Tax Amount:**	$4,163
Tax Year:	2017	**HOA Dues:**	$0	**MLS #:**	1187458
MLS Area:	560	**Community:**	Everest Park	**School District:**	Lkw
Elementary School:	Lakeview Elem	**Middle School:**	Kirkland Middle	**High School:**	Lake Wash High
Subdivision:	Lake Park Lane				

Features:

Kitchen:	Kitchen W/Eating Space - Main	**Fireplace:**	2	**View:**	Lake, Mountain, Territorial
Basement:	None	**Heat/AC:**	Forced Air	**Roof:**	Composition, Flat
Garage:	2, Garage-Attached	**Fuel:**	Natural Gas	**Exterior:**	Stone, Wood, Wood Products, Cement Planked
		Floors:	Ceramic Tile, Hardwood, Wall to Wall Carpet	**Bathroom Details:**	Full Bath 2, Half Bath 1, Three Quarter Bath 2
				Senior Community:	No

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Listing Overview

Description:

DBH presents Stunning Craftsmanship conveniently located across from Everest Park, and just seconds to desirable downtown waterfront! Wolf and Sub-Zero Appliances, large island w/Alaska White Granite countertop and Stacked Stone Fireplace. Outside Patio includes Fireplace w/flush mount heaters and TV, connects to beautiful expansive yard. Spacious ceiling height-10-ft main and 9-ft upper floors. Gorgeous Master Suite including views of Lk WA, w/custom built cedar bench and planter box off master deck!

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Listing Overview

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SOLD

$2,398,000

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Property Photos:

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Listing Overview

2. 706 4th Lane S, Kirkland, WA 98033

Travis Stewart
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Listing Overview

Listing Courtesy of: *Northwest MLS*

SOLD

$2,058,000

3. 710 4th Lane S, Kirkland, WA 98033

Status/Price:

Status:	Sold	**Days:**	0	**$/SqFt:**	$562
List Price:	$2,058,000	**Original List Price:**	$2,058,000	**Sold Price:**	$2,058,000
% Of List Price:	100%	**Sold Date:**	05/26/2017		

Listing Detail:

Bedrooms:	4	**Bathrooms:**	3.25	**Property Type:**	Residential
Building Style:	2 Story	**Square Feet:**	3,659	**Lot Size:**	8,075 SqFt
Year Built:	2017	**County:**	King Co.	**Tax Amount:**	$4,021
Tax Year:	2017	**HOA Dues:**	$0	**MLS #:**	1110732
MLS Area:	560	**Community:**	Everest Park	**School District:**	Lkw
Elementary School:	Lakeview Elem	**Middle School:**	Kirkland Middle	**High School:**	Lake Wash High
Subdivision:	Lake Park Lane				

Features:

Kitchen:	Kitchen W/O Eating Space - Main	**Fireplace:**	1	**View:**	Territorial, Lake
Basement:	None	**Heat/AC:**	Forced Air	**Roof:**	Composition
Garage:	2, Garage-Attached	**Fuel:**	Natural Gas	**Exterior:**	Stone, Cement/Concrete
		Floors:	Wall to Wall Carpet, Hardwood, Ceramic Tile	**Bathroom Details:**	Full Bath 2, Half Bath 1, Three Quarter Bath 1
				Senior Community:	No

Description:

DBH presents stunning craftsmanship located across the street from Everest Park overlooking LK Washington located just seconds to the downtown waterfront! Chef's kitchen includes custom cabinetry, Wolf/Sub Zero appliances and granite-quartz countertops. Fabulous floor plan includes master floor plan includes main floor guest suite, tall ceilings - 10 main/9 upper and 2 covered patios. The master suite offers a spa bath w/expansive closet. Beautiful landscape design features flag and spacious backyard!

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Listing Overview

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Listing Overview

Listing Courtesy of: *Northwest MLS*

SOLD

$2,000,000

4. 420 6th Ave S, Kirkland, WA 98033

Status/Price:

Status:	Sold	**Days:**	7	**$/SqFt:**	$597
List Price:	$2,000,000	**Original List Price:**	$2,000,000	**Sold Price:**	$2,000,000
% Of List Price:	100%	**Sold Date:**	04/12/2018		

Listing Detail:

Bedrooms:	4	**Bathrooms:**	3.5	**Property Type:**	Residential
Building Style:	2 Story	**Square Feet:**	3,350	**Lot Size:**	6,000 SqFt
Year Built:	2014	**County:**	King County	**Tax Amount:**	$13,796
Tax Year:	2017	**HOA Dues:**	$0	**MLS #:**	1244581
MLS Area:	560	**Community:**	Downtown	**School District:**	Lkw
Elementary School:	Lakeview Elem	**Middle School:**	Kirkland Middle	**High School:**	Lake Wash High

Features:

Kitchen:	Kitchen W/Eating Space - Main	**Fireplace:**	1	**View:**	City, Lake, Mountain, Territorial
Basement:	None	**Heat/AC:**	Radiant, Ductless Hp-Mini Split	**Roof:**	Flat
Garage:	2, Garage-Attached	**Fuel:**	Natural Gas	**Exterior:**	Wood, Cement Planked
		Floors:	Ceramic Tile, Hardwood, Wall to Wall Carpet	**Bathroom Details:**	Full Bath 3, Half Bath 1
				Senior Community:	No

Description:

Better than new 4-star Built Green. Designed by Medici and built by premier local builder DKWozniak. Sited on a quiet street, walking distance to waterfront, Google, Lakeview Elementary and the Cross Kirkland Corridor. Beautifully designed spaces and excellent floor plan with soaring ceilings and exquisite finishes. Main floor and master bath features in-floor radiant heat + mini splits in every room. All bedrooms up including a stunning master suite with dual walk in closets, and spa-like bath.

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Listing Overview

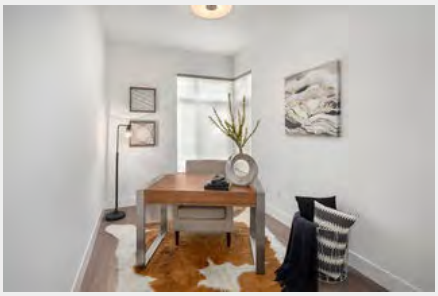
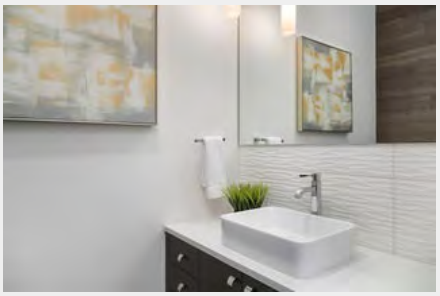
Listing Courtesy of:
Northwest MLS

SOLD

$2,000,000

4. 420 6th Ave S, Kirkland, WA 98033

Property Photos:

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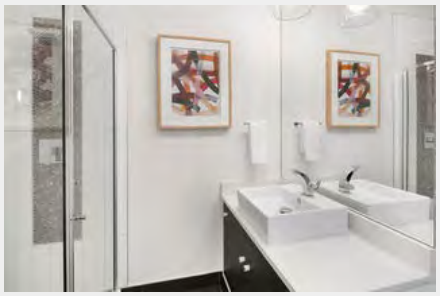
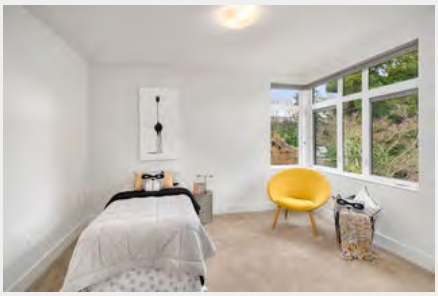
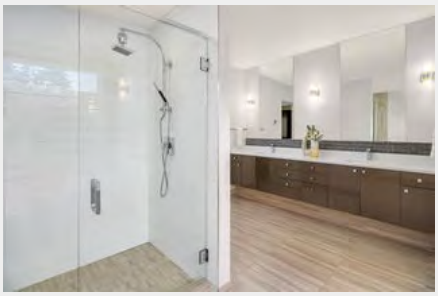
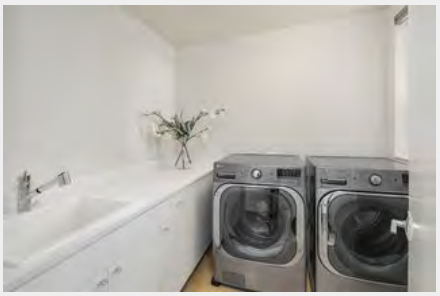
Listing Overview

4. 420 6th Ave S, Kirkland, WA 98033

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Listing Overview

Listing Courtesy of: *Northwest MLS*

SOLD

$2,000,000

5. 714 8th St S, Kirkland, WA 98033

Status/Price:

Status:	Sold	**Days:**	5	**$/SqFt:**	$530
List Price:	$2,000,000	**Original List Price:**	$2,000,000	**Sold Price:**	$2,000,000
% Of List Price:	100%	**Sold Date:**	04/26/2018		

Listing Detail:

Bedrooms:	4	**Bathrooms:**	2.75	**Property Type:**	Residential
Building Style:	2 Story	**Square Feet:**	3,772	**Lot Size:**	13,725 SqFt
Lot Dimensions:	13,725	**Year Built:**	2016	**County:**	King County
Tax Amount:	$14,327	**Tax Year:**	2017	**HOA Dues:**	$0
MLS #:	1251962	**MLS Area:**	560	**Community:**	Kirkland
School District:	Lkw	**Elementary School:**	Lakeview Elem	**Middle School:**	Kirkland Middle
High School:	Lake Wash High	**Subdivision:**	Everest Park		

Features:

Kitchen:	Kitchen W/Eating Space - Main	**Fireplace:**	1	**View:**	Lake, Mountain, Partial, Territorial
Basement:	None	**Heat/AC:**	Forced Air	**Roof:**	Composition
Garage:	3, Garage-Attached, Off-Street Parking	**Fuel:**	Electric, Natural Gas	**Exterior:**	Stone, Wood, Cement Planked
		Floors:	Ceramic Tile, Hardwood, Slate, Wall to Wall Carpet	**Bathroom Details:**	Full Bath 2, Three Quarter Bath 1
				Senior Community:	No

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Listing Overview

Description:

Nature's serenity calls from the heart of Kirkland! 1/3 acre oasis within minutes' walk to the market, schools, parks, trails, the lake or ballet class! 4 bedrooms + flex rooms could mean a fifth if desired. Impressive entry, grand staircase, and great room with soaring ceilings are punctuated by a stellar chefs kitchen, impeccable millwork, hand scraped hardwoods, high end designer finishes, and the dreamiest master suite complete with perfect spa tub - ready to melt away the days concerns!

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Listing Overview

Listing Courtesy of:
Northwest MLS

SOLD

$2,000,000

5. 714 8th St S, Kirkland, WA 98033

Property Photos:

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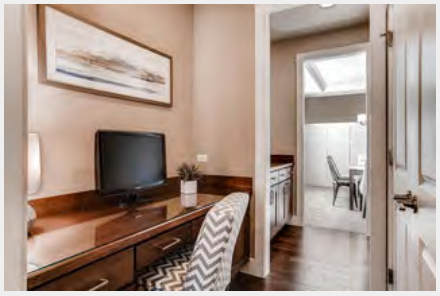
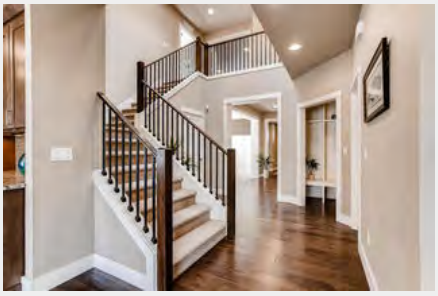
Listing Overview

5. 714 8th St S, Kirkland, WA 98033





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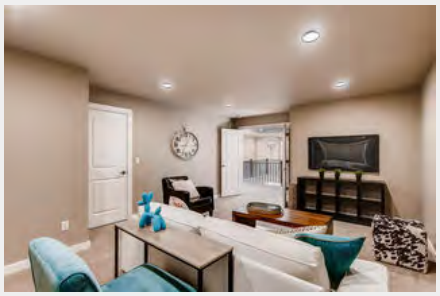

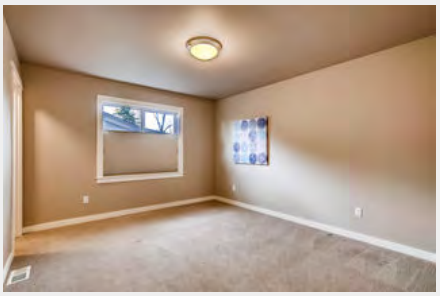

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Listing Overview

Listing Courtesy of: *Northwest MLS*

SOLD

$1,998,000

6. 714 4th Lane S, Kirkland, WA 98033

Status/Price:

Status:	Sold	**Days:**	6	**$/SqFt:**	$546
List Price:	$1,998,000	**Original List Price:**	$1,998,000	**Sold Price:**	$1,998,000
% Of List Price:	100%	**Sold Date:**	05/10/2017		

Listing Detail:

Bedrooms:	4	**Bathrooms:**	3.25	**Property Type:**	Residential
Building Style:	2 Story	**Square Feet:**	3,659	**Lot Size:**	8,075 SqFt
Year Built:	2017	**County:**	King Co.	**Tax Amount:**	$4,021
Tax Year:	2017	**HOA Dues:**	$0	**MLS #:**	1094485
MLS Area:	560	**Community:**	Everest Park	**School District:**	Lkw
Elementary School:	Lakeview Elem	**Middle School:**	Kirkland Middle	**High School:**	Lake Wash High

Features:

Kitchen:	Kitchen W/Eating Space - Main	**Fireplace:**	1	**View:**	Lake
Basement:	None	**Heat/AC:**	Forced Air	**Roof:**	Composition, Flat
Garage:	2, Garage-Attached	**Fuel:**	Natural Gas	**Exterior:**	Cement Planked, Wood, Wood Products
		Floors:	Ceramic Tile, Hardwood, Wall to Wall Carpet	**Bathroom Details:**	Full Bath 2, Half Bath 1, Three Quarter Bath 1
				Senior Community:	No

Description:

DBH presents Stunning Craftsmanship located across the street from Everest Park overlooking LK Washington located just seconds to the desirable downtown waterfront! Chefs Kitchen includes Custom cabinetry, Wolf/Sub Zero Appliances, and granite-quartz countertops. Fabulous floor plan includes main floor guest suite, tall ceilings-10 main/9 upper, and 2 covered patios. The Master Suite offers a Luxurious spa bath w/expansive closet. Beautiful landscape design features flat and spacious backyard!

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Listing Overview

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Listing Overview

Listing Courtesy of:
Northwest MLS

SOLD

$1,998,000

6. 714 4th Lane S, Kirkland, WA 98033

Property Photos:

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Listing Overview

Listing Courtesy of: Northwest MLS

SOLD

$1,925,000

7. 333 8th St S, Kirkland, WA 98033

Status/Price:

Status:	Sold	**Days:**	6	**$/SqFt:**	$530
List Price:	$1,898,000	**Original List Price:**	$1,898,000	**Sold Price:**	$1,925,000
% Of List Price:	101%	**Sold Date:**	02/03/2017		

Listing Detail:

Bedrooms:	4	**Bathrooms:**	3.25	**Property Type:**	Residential
Building Style:	2 Story	**Square Feet:**	3,630	**Lot Size:**	8,074 SqFt
Year Built:	2016	**County:**	King Co.	**Tax Amount:**	$2,803
Tax Year:	2016	**HOA Dues:**	$0	**MLS #:**	1054919
MLS Area:	560	**Community:**	Everest Park	**School District:**	Lkw
Elementary School:	Lakeview Elem	**Middle School:**	Kirkland Middle	**High School:**	Lake Wash High

Features:

Kitchen:	Kitchen W/Eating Space - Main	**Fireplace:**	1	**View:**	Lake, Territorial
Garage:	2, Garage-Attached	**Heat/AC:**	Forced Air	**Roof:**	Composition, Flat
		Fuel:	Natural Gas	**Exterior:**	Cement Planked, Wood, Wood Products
		Floors:	Ceramic Tile, Hardwood, Wall to Wall Carpet	**Bathroom Details:**	Full Bath 2, Half Bath 1, Three Quarter Bath 1
				Senior Community:	No

Description:

Design Built Homes presents Stunning Craftsmanship conveniently located across the street from Everest Park and just seconds to desirable downtown waterfront! Features Belmont Cabinets, Wolf and Sub Zero Appliances, and granite-quartz slab countertops throughout. Thoughtful design includes two covered patios, spacious ceiling height-10' main and 9' upper, guest suite main floor, and upstairs bonus room. Master Suite offers stunning views of Lake Washington, plus luxurious spa bath with heated floors!

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Listing Overview

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$1,925,000

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Listing Overview

Listing Courtesy of: Northwest MLS

ACTIVE

$1,649,950

8. 824 2nd Ave, Kirkland, WA 98033

Status/Price:

Status:	Active	**Days:**	19	**$/SqFt:**	$481
List Price:	$1,649,950	**Original List Price:**	$1,649,950		

Listing Detail:

Bedrooms:	4	**Bathrooms:**	3.25	**Property Type:**	Residential
Building Style:	Tri Level	**Square Feet:**	3,430	**Lot Size:**	12,122 SqFt
Year Built:	2018	**County:**	King County	**Tax Amount:**	$6,315
Tax Year:	2018	**HOA Dues:**	$0	**MLS #:**	1332648
MLS Area:	560	**Community:**	Downtown	**School District:**	Lkw

Features:

Kitchen:	Kitchen W/Eating Space - Main	**Fireplace:**	1	**Roof:**	Composition
Garage:	2, Garage-Attached	**Fuel:**	Natural Gas, Electric	**Exterior:**	Wood Products, Wood, Cement/Concrete
		Floors:	Wall to Wall Carpet, Vinyl, Hardwood, Ceramic Tile	**Bathroom Details:**	Full Bath 2, Half Bath 1, Three Quarter Bath 1
				Senior Community:	No

Description:

Incredible opportunity to own NEW CONSTRUCTION just blocks from the heart of DOWNTOWN KIRKLAND. Enjoy peaceful private street with no traffic! Flexible floorpan with ground and upper level bedrooms, den/office, and high-end chef's dream kitchen, allows you to create your own perfect lifestyle. All easily accessible within minutes to shops, restaurants, waterfront, and parks. Award winning schools, easy commute to anywhere on the Eastside and Seattle! Don't miss the chance to call Kirkland home!

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Listing Overview

Listing Courtesy of:
Northwest MLS

ACTIVE

$1,649,950

8. 824 2nd Ave, Kirkland, WA 98033

Property Photos:

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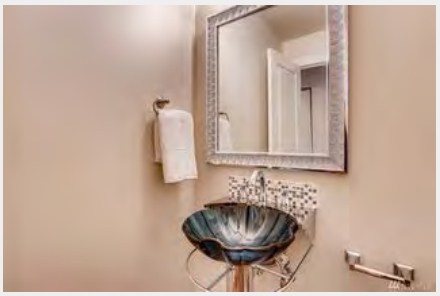
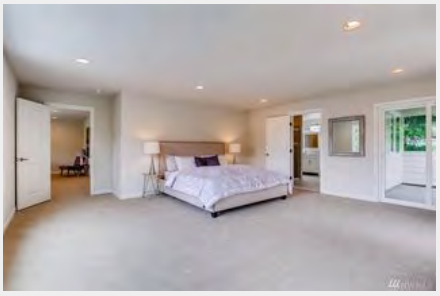
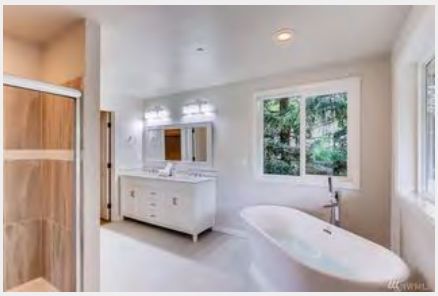
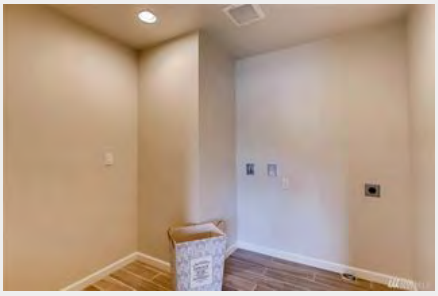
Listing Overview

8. 824 2nd Ave, Kirkland, WA 98033









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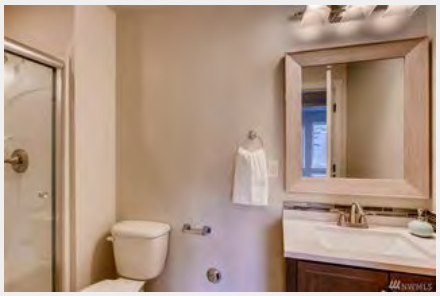

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Listing Overview

Listing Courtesy of: Northwest MLS

ACTIVE

$1,599,950

9. 826 2nd Ave, Kirkland, WA 98033

Status/Price:

Status:	Active	**Days:**	19	**$/SqFt:**	$466
List Price:	$1,599,950	**Original List Price:**	$1,599,950		

Listing Detail:

Bedrooms:	4	**Bathrooms:**	3.25	**Property Type:**	Residential
Building Style:	Tri Level	**Square Feet:**	3,430	**Lot Size:**	12,168 SqFt
Year Built:	2018	**County:**	King County	**Tax Amount:**	$6,166
Tax Year:	2018	**HOA Dues:**	$0	**MLS #:**	1332633
MLS Area:	560	**Community:**	Downtown	**School District:**	Lkw

Features:

Kitchen:	Kitchen W/Eating Space - Main	**Fireplace:**	1	**Roof:**	Composition
Garage:	2, Garage-Attached	**Fuel:**	Natural Gas, Electric	**Exterior:**	Wood Products, Wood, Cement/Concrete
		Floors:	Wall to Wall Carpet, Vinyl, Hardwood, Ceramic Tile	**Bathroom Details:**	Full Bath 2, Half Bath 1, Three Quarter Bath 1
				Senior Community:	No

Description:

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Listing Overview

Listing Courtesy of:
Northwest MLS

ACTIVE

$1,599,950

9. 826 2nd Ave, Kirkland, WA 98033

Property Photos:

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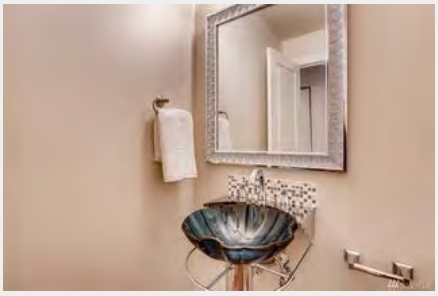
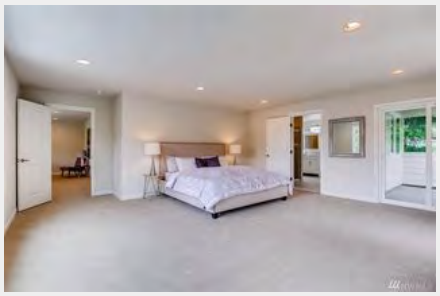
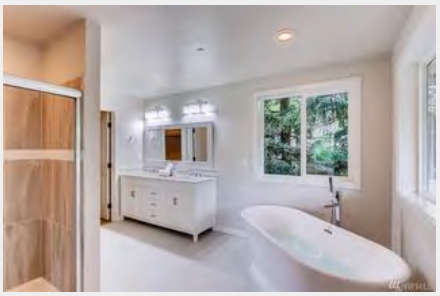
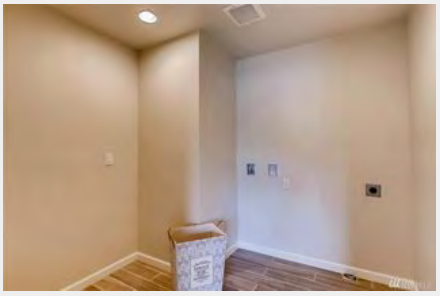
9. 826 2nd Ave, Kirkland, WA 98033









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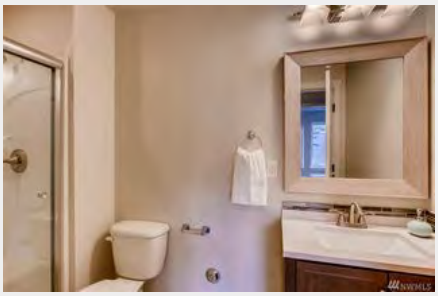
9. 826 2nd Ave, Kirkland, WA 98033



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Side by Side Comparisons

Windermere REAL ESTATE

	Subject Property	Comparable #1	Comparable #2	Comparable #3
Address	319 8th St S	7620 115th Place NE	706 4th Lane S	710 4th Lane S
City, State, Zip	Kirkland, WA 98033	Kirkland, WA 98033	Kirkland, WA 98033	Kirkland, WA 98033
Status	-	Active	Sold	Sold
Bedrooms	5	5	5	4
Bathrooms	4	4	4	3.25
Sqft	3,796	4,797	4,040	3,659
Lot SqFt	8,600	10,656	9,548	8,075
Year Built	2018	2018	2017	2017
Property Type	Single-Family	Residential	Residential	Residential
Days on Market	-	6	7	-
List Price	-	$2,488,000	$2,398,000	$2,058,000
Original List Price		$2,488,000	$2,398,000	$2,058,000
% Of List Price	-	-	100%	100%
Sold Price	-	-	$2,398,000	$2,058,000
Sold Date	-	-	10/26/2017	05/26/2017
$/SqFt	-	$519	$594	$562
$/Lot SqFt	-	$233	$251	$255
MLS #	-	1334845	1187458	1110732
County	King	King County	King County	King Co.
Tax Amount	$0	$15,801	$4,163	$4,021
Tax Year	-	2018	2017	2017
Bathroom Details	Full Bath 2, Half Bath 1, Three Quarter Bath 2	Full Bath 2, Half Bath 1, Three Quarter Bath 2	Full Bath 2, Half Bath 1, Three Quarter Bath 2	Full Bath 2, Half Bath 1, Three Quarter Bath 1
Basement	-	None	None	None
Garage	2, Attached	2, Garage-Attached	2, Garage-Attached	2, Garage-Attached
Fireplace	2	1	2	1
Fuel	Natural Gas	Electric	Natural Gas	Natural Gas
Heat/AC	Forced Air	Radiant, High Efficiency, Ductless Hp-Mini Split	Forced Air	Forced Air
Roof	Composition	Flat	Composition, Flat	Composition
View	Partial Lake	See Remarks, Mountain, Lake, City	Lake, Mountain, Territorial	Territorial, Lake

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Side by Side Comparisons

	Subject Property	Comparable #4	Comparable #5	Comparable #6
Address	319 8th St S	420 6th Ave S	714 8th St S	714 4th Lane S
City, State, Zip	Kirkland, WA 98033	Kirkland, WA 98033	Kirkland, WA 98033	Kirkland, WA 98033
Status	-	Sold	Sold	Sold
Bedrooms	5	4	4	4
Bathrooms	4	3.5	2.75	3.25
Sqft	3,796	3,350	3,772	3,659
Lot SqFt	8,600	6,000	13,725	8,075
Year Built	2018	2014	2016	2017
Property Type	Single-Family	Residential	Residential	Residential
Days on Market	-	7	5	6
List Price	-	$2,000,000	$2,000,000	$1,998,000
Original List Price		$2,000,000	$2,000,000	$1,998,000
% Of List Price	-	100%	100%	100%
Sold Price	-	$2,000,000	$2,000,000	$1,998,000
Sold Date	-	04/12/2018	04/26/2018	05/10/2017
$/SqFt	-	$597	$530	$546
$/Lot SqFt	-	$333	$146	$247
MLS #	-	1244581	1251962	1094485
County	King	King County	King County	King Co.
Tax Amount	$0	$13,796	$14,327	$4,021
Tax Year	-	2017	2017	2017
Bathroom Details	Full Bath 2, Half Bath 1, Three Quarter Bath 2	Full Bath 3, Half Bath 1	Full Bath 2, Three Quarter Bath 1	Full Bath 2, Half Bath 1, Three Quarter Bath 1
Basement	-	None	None	None
Garage	2, Attached	2, Garage-Attached	3, Garage-Attached, Off-Street Parking	2, Garage-Attached
Fireplace	2	1	1	1
Fuel	Natural Gas	Natural Gas	Electric, Natural Gas	Natural Gas
Heat/AC	Forced Air	Radiant, Ductless Hp-Mini Split	Forced Air	Forced Air
Roof	Composition	Flat	Composition	Composition, Flat
View	Partial Lake	City, Lake, Mountain, Territorial	Lake, Mountain, Partial, Territorial	Lake

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Side by Side Comparisons

	Subject Property	Comparable #7	Comparable #8	Comparable #9
Address	319 8th St S	333 8th St S	824 2nd Ave	826 2nd Ave
City, State, Zip	Kirkland, WA 98033	Kirkland, WA 98033	Kirkland, WA 98033	Kirkland, WA 98033
Status	-	Sold	Active	Active
Bedrooms	5	4	4	4
Bathrooms	4	3.25	3.25	3.25
Sqft	3,796	3,630	3,430	3,430
Lot SqFt	8,600	8,074	12,122	12,168
Year Built	2018	2016	2018	2018
Property Type	Single-Family	Residential	Residential	Residential
Days on Market	-	6	19	19
List Price	-	$1,898,000	$1,649,950	$1,599,950
Original List Price		$1,898,000	$1,649,950	$1,599,950
% Of List Price	-	101%	-	-
Sold Price	-	$1,925,000	-	-
Sold Date	-	02/03/2017	-	-
$/SqFt	-	$530	$481	$466
$/Lot SqFt	-	$238	$136	$131
MLS #	-	1054919	1332648	1332633
County	King	King Co.	King County	King County
Tax Amount	$0	$2,803	$6,315	$6,166
Tax Year	-	2016	2018	2018
Bathroom Details	Full Bath 2, Half Bath 1, Three Quarter Bath 2	Full Bath 2, Half Bath 1, Three Quarter Bath 1	Full Bath 2, Half Bath 1, Three Quarter Bath 1	Full Bath 2, Half Bath 1, Three Quarter Bath 1
Basement	-	-	-	-
Garage	2, Attached	2, Garage-Attached	2, Garage-Attached	2, Garage-Attached
Fireplace	2	1	1	1
Fuel	Natural Gas	Natural Gas	Natural Gas, Electric	Natural Gas, Electric
Heat/AC	Forced Air	Forced Air	-	-
Roof	Composition	Composition, Flat	Composition	Composition
View	Partial Lake	Lake, Territorial	-	-

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Status Comparisons

		Bed	Bath	SqFt	Lot SqFt	List Price	$/SqFt	Sold Date	Sale Price	Adj Price	Days
Active Properties											
1.	7620 115th Place NE, Kirkland	5	4	4,797	10,656	$2,488,000	$519	-	$0	-	6
8.	824 2nd Ave, Kirkland	4	3.25	3,430	12,122	$1,649,950	$481	-	$0	-	19
9.	826 2nd Ave, Kirkland	4	3.25	3,430	12,168	$1,599,950	$466	-	$0	-	19
Sold Properties											
2.	706 4th Lane S, Kirkland	5	4	4,040	9,548	$2,398,000	$594	10/26/2017	$2,398,000	-	7
3.	710 4th Lane S, Kirkland	4	3.25	3,659	8,075	$2,058,000	$562	05/26/2017	$2,058,000	-	0
4.	420 6th Ave S, Kirkland	4	3.5	3,350	6,000	$2,000,000	$597	04/12/2018	$2,000,000	-	7
5.	714 8th St S, Kirkland	4	2.75	3,772	13,725	$2,000,000	$530	04/26/2018	$2,000,000	-	5
6.	714 4th Lane S, Kirkland	4	3.25	3,659	8,075	$1,998,000	$546	05/10/2017	$1,998,000	-	6
7.	333 8th St S, Kirkland	4	3.25	3,630	8,074	$1,898,000	$530	02/03/2017	$1,925,000	-	6

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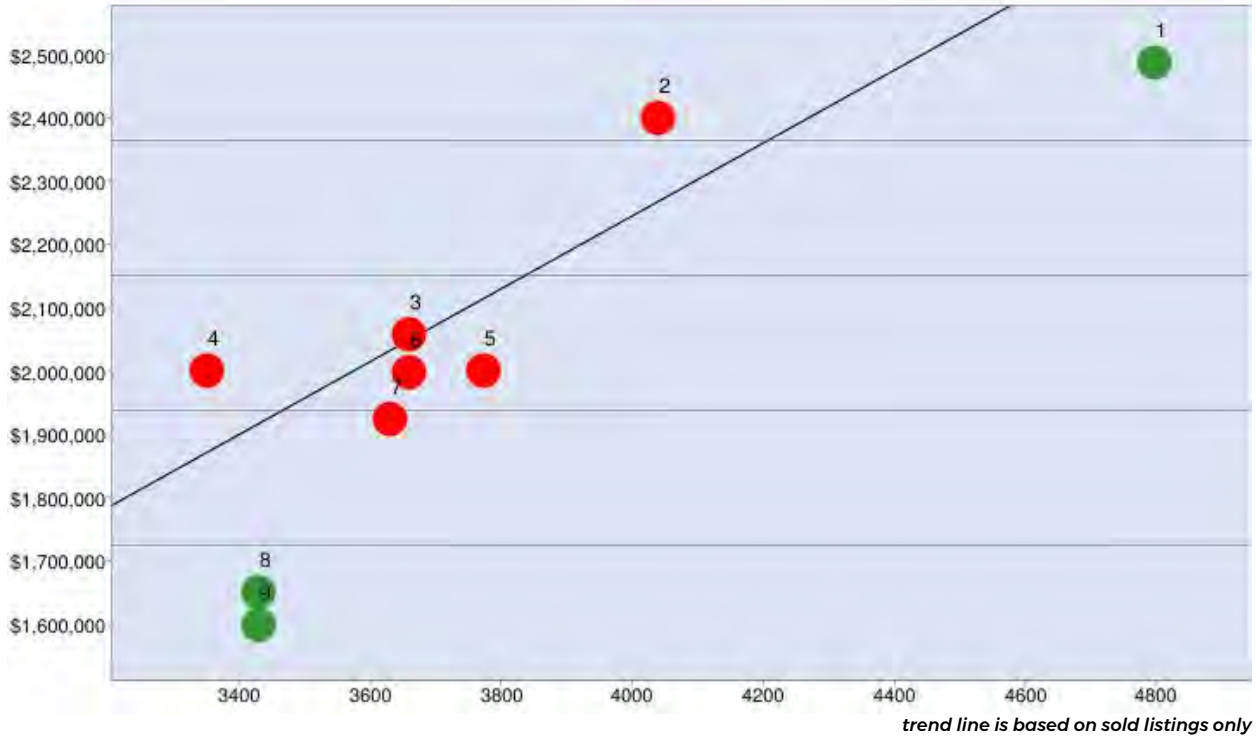
Price & Size



Active Properties

1. 7620 115th Place NE, Kirkland	$2,488,000	5 beds	4 baths	4,797 SqFt	$519 / SqFt
8. 824 2nd Ave, Kirkland	$1,649,950	4 beds	3.25 baths	3,430 SqFt	$481 / SqFt
9. 826 2nd Ave, Kirkland	$1,599,950	4 beds	3.25 baths	3,430 SqFt	$466 / SqFt

Sold Properties

2. 706 4th Lane S, Kirkland	$2,398,000	5 beds	4 baths	4,040 SqFt	$594 / SqFt
3. 710 4th Lane S, Kirkland	$2,058,000	4 beds	3.25 baths	3,659 SqFt	$562 / SqFt
4. 420 6th Ave S, Kirkland	$2,000,000	4 beds	3.5 baths	3,350 SqFt	$597 / SqFt
5. 714 8th St S, Kirkland	$2,000,000	4 beds	2.75 baths	3,772 SqFt	$530 / SqFt
6. 714 4th Lane S, Kirkland	$1,998,000	4 beds	3.25 baths	3,659 SqFt	$546 / SqFt
7. 333 8th St S, Kirkland	$1,925,000	4 beds	3.25 baths	3,630 SqFt	$530 / SqFt

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Travis Stewart approaches everything in life with an energy and optimism that is contagious. The fact that he backs it up with exceptional communication skills, a whatever-it-takes work ethic and the utmost integrity has earned him the respect and loyalty of clients and colleagues alike. People just like working with Travis. Whether you are buying or selling a home, you can count on getting the best possible outcome, and having a great time in the process.

Travis's prior experience as a certified real estate appraiser and his time spent working for a local Title and Escrow company offers exceptional value to his clients. He brings to each transaction an insider's knowledge of the process, deep insight into property valuation, and a vast network of relationships with industry experts who can help make every purchase and sale go as smoothly as possible. Client's often say of Travis: "I felt like I was his #1 priority." That helpful attitude and attentiveness continues even after the sale is complete. Whether he's making sure your move goes smoothly or recommending a trusted contractor, Travis continues to be an ongoing resource and advocate for each of his clients.

Born and raised on the Eastside, Travis really knows and loves the area neighborhoods. Travis and his wife Jessica live in Bothell with their son Will and golden retriever Bella. A former professional wakeboarder, he still spends as much time as he can on the water.

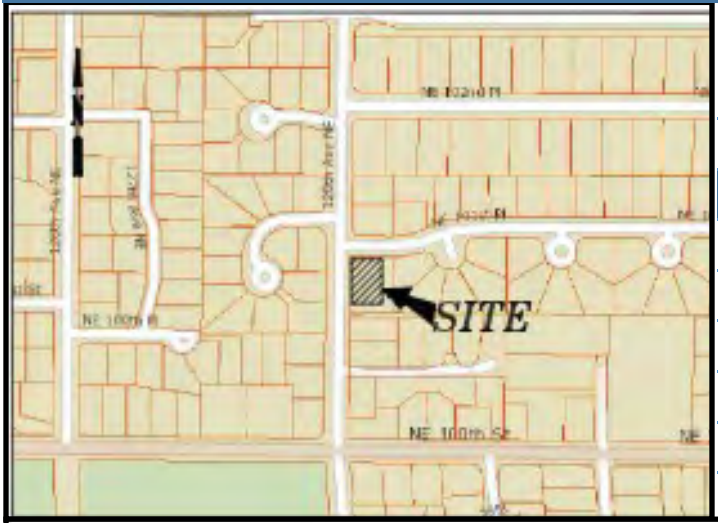
Attachment C
Lola and Lake Park II Short Plat
Project Summary Sheets

AltaTerra

Project Name/ Address:	Lola Short Plat (2 lots) 10110 128th Ave NE

Description: This project involves demolition of a single-family residence on a gently sloping vegetated lot in the North Rose Hill neighborhood and the construction of two single-family homes on two newly created lots.

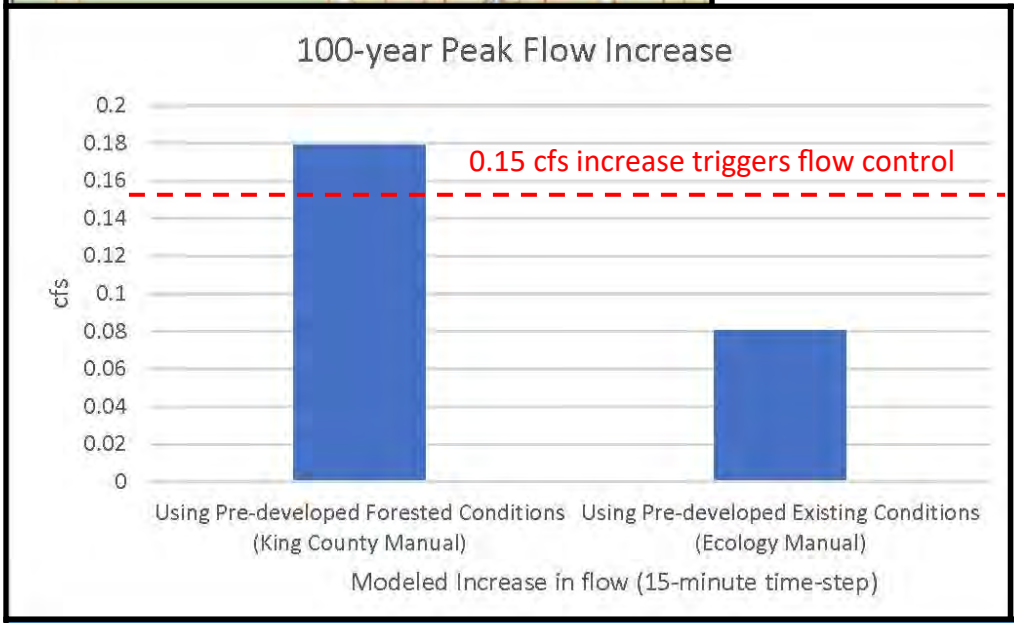
Site Location



Site Characteristics

Total Site Area (ac)	Existing (pre-developed) Impervious Area (ac)	Post-developed Impervious Area (ac)
0.43	0.12	0.21

Existing Surface Area Type	Area (ac.)
Roof	0.04
Sidewalk	0.05
Driveway	0.03
Forest	0.13
Lawn	0.18



Is flow control required:

Under *King County Manual*? **YES**

With *Ecology Provision**? **NO**

*Ecology has a provision that all projects creating more than 10,000 SF or new/ replaced impervious surface require detention.

Developer Cost Implications

Estimated detention facility cost = $63,000 ($31,500/lot)

Estimated sale price of homes = $3,400,000 ($1,700,000/lot)

Facility cost as % of sale price = 1.9 %

Project Name/ Address:	Lake Park II Short Plat (5 lots) 319 8th Street S

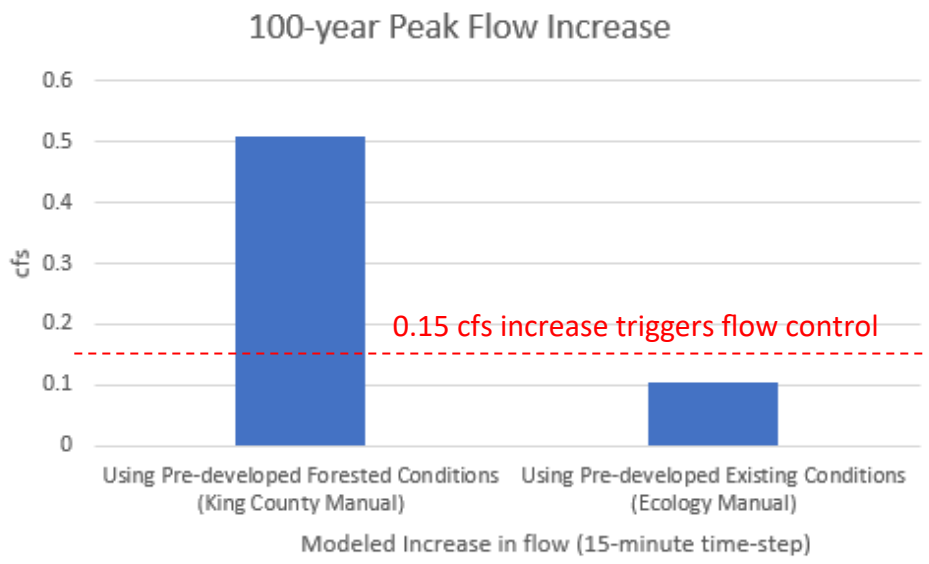
Description: This project involves demolition of a single-family residence on a large mostly lawn, moderately sloping lot in the Everest neighborhood and construction of five single-family homes on five newly created lots. The lots drains to two discharge areas.

Site Location

Site Characteristics

Total Site Area (ac)	Existing (pre-developed) Impervious Area (ac)	Post-developed mpervious Area (ac)
1.12	0.09	0.61

Existing Surface Area Type	Area (ac.)
Roof	0.04
Sidewalk	0.02
Driveway	0.03
Forest	0.03
Lawn	1.0



Is flow control required:

Under *King County Manual*? **YES**

Under *Ecology Manual**? **YES**

* Ecology has a provision that all projects creating more than 10,000 SF of new/replaced impervious surface require detention.

Developer Cost Implications

Estimated detention facility cost = $301,000 ($60,200/lot)

Estimated sale price of homes = $10,000,000 ($2,000,000/lot)

Facility cost as % of sale price = 3 %

Attachment D
Redevelopment Analysis Methodology and Tables of Results

AltaTerra

Redevelopment Methodology

An analysis of potential redevelopment in two different drainage areas in the Champagne and Forbes Creek Basins was undertaken for this study to determine the conditions for which flow control would be required on redevelopment parcels and potential cumulative impacts. In each basin a smaller drainage area was delineated to conduct the analysis on parcels with the potential to redevelop that are contained within the sub-drainage area. The following GIS layers were used in the analysis:

- Redevelopment layer
- Existing impervious surface coverage
- Aerial photography
- Topographic contours

The attribute file from the redevelopment GIS layer was exported to excel for the analysis.

Table D-1 lists the attributes used in the analysis from the original redevelopment file and new data added to the excel file for the analysis.

Table D- 1. List of attributes used in analysis

Attribute	Description	How is it Used?
NbrUnits	Number of existing property units (houses, apartments, etc.)	Baseline condition of property.
NetRES	Number of potential new property units (houses, apartments, etc.)	Potential increase in units on property based on current zoning. NbrUnits plus NetRES is equal to potential build-out of property.
ORIG_SQFT	Parcel size in square feet	Not used
COKLandUse	Current zoning (i.e., single family, commercial, vacant, etc.)	
ESA_SQFT	Area of parcel that is occupied by critical areas	ESA-SQFT is area assumed to be undevelopable.
GIS_SQFT	Area available for development (ORIG_SQFT minus ESA_SQFT)	This is the parcel area that was used in analysis.
MinLotSQFT	Minimum lot square footage	GIS_SQFT divided by MinLotSQFT equals the maximum number of units. NetRES = Max. units - NbrUnits
Estimated impervious surface (square feet)	Impervious surface coverage on each redevelopment parcel from impervious surface GIS coverage	Used to calculate estimated flow increases from pre-developed to proposed developed conditions, assuming build-out.
Slope	Visually estimated from topographic GIS layer for each redevelopment parcel (flat, moderate, or steep)	Used in calculations of estimated flow increases from pre-developed to proposed

		developed conditions, assuming build-out.
Predominant land cover	Visually estimated from aerial photograph	Used in calculations of estimated flow increases from pre-developed to proposed developed conditions assuming build-out.
Existing conveyance system	Visually estimated from GIS stormwater conveyance layer	Not used.
New impervious surface	Calculated as described below	Used in calculations of estimated flow increases from pre-developed to proposed developed conditions assuming build-out.

For each redevelopment parcel, the new impervious surface that could be constructed on each parcel was calculated as follows:

$$New\ Impervious\ Surface = \frac{\text{Lot size}}{2} - Existing\ Impervious\ Surface$$

The maximum allowable impervious surface per Kirkland code is 50%.

The table of area factors developed from WWHM model runs (Attachment E) for different site conditions (i.e., slope and vegetation), and precipitation factors (1.0 or 0.833) that result in 0.15 cfs increase for the 100-year peak flow at 15-minute time steps was used to evaluated potential increases from predeveloped existing or predeveloped forested conditions.

The following calculation was used to evaluated potential increases in 100-year peak flows using Ecology Manual methodology:

$$Flow\ Increase = \frac{\text{New Impervious Surface}}{\text{Area Factor (from table)}} x\ 0.15$$

The following calculation was used to evaluated potential increases in 100-year peak flows using KCSWDM methodology:

$$Flow\ Increase = \frac{\text{Lot Size}}{\text{Area Factor (from table)}} x\ 0.15$$

The area factors used in the analysis for Champagne and Forbes creek drainage areas are listed in the table in Attachment E. The area of land cover conversion that results in an increase of 0.15 cfs for the 100-year peak flow was scaled to the lot size or area of new impervious surface.

Below is an example of how the increases in flow were estimated by Ecology Manual and KCSWDM methodology for a lot with the following pre- and post-development characteristics in the Forbes Creek drainage area with a precipitation factor of 1:

Example Parcel

Lot size = 0.85

Existing impervious surface = 0.11 ac

New impervious surface = 0.32 ac

Site is flat, with grass

For the part of the site that is converted to impervious from lawn, it would take 0.409 acres to result in flow of 0.15 cfs. Area Factor for Ecology Manual methodology (lawn to impervious for only new impervious area) = 0.409

For a post-developed site condition of 50% Impervious, 50% Lawn, Flat Site, it would take 0.328 acres to result in flow of 0.15 cfs. Area Factor for King County methodology (forested to 50% impervious, 50% lawn) = 0.328

Estimated flow increase using Ecology Manual methodology:

$$0.12cfs = \frac{0.32\text{ac}}{0.409\text{ac}} x\ 0.15cfs$$

Estimated flow increase using KCSWDM methodology:

$$0.39cfs = \frac{0.85\text{ac}}{0.328\text{ac}} x\ 0.15cfs$$

Area Factors were used for different site scenarios to estimate increases in flow.

Once the flow increases were calculated for each redevelopment parcel, the flows were compared against criteria for whether flow control would be required (i.e., greater than 0.15 cfs). Additionally, the potential impervious surface coverage based on optimal build-out was compared to the Ecology Manual's 10,000 square foot threshold for flow control requirements.

Each parcel was flagged with a yes or no for meeting the following criteria:

1. Impervious surface coverage greater than 10,000 square feet?
2. 100-year peak flow increase greater than 0.15 cfs compared to existing conditions (Ecology Manual methodology)?
3. 100-year peak flow increase greater than 0.15 cfs compared to pre-developed forested conditions (KCSWDM methodology)?

Four different combinations resulted for the redevelopment sites evaluated.

1. No flow control required under Ecology Manual or KCSWDM methodology
2. Flow control required by KCSWDM, but not by the Ecology Manual (10,000 square foot threshold or flow)
3. Flow control required by KCSWDM, exceeds 10,000 square foot threshold, but not Ecology Manual flow control threshold. These are sites, where if the Ecology Manual methodology were adopted, developers may choose to limit impervious to under 10,000 square foot threshold to reduce need for flow control.

4. Flow control required under both methodology and exceeds 10,000 square foot threshold

Flow Control Facility Sizes and Costs

Flow control facility sizes were estimated for redevelopment parcels assuming maximum build-out conditions, using a ratio of 0.28 of the total site acres as an indicator of the acre-ft of flow control needed. This ratio was determined based on the average (ranging from 0.25 to 0.32) flow control facility size per acre for the eight approved development sites evaluated in this study. Additionally, the cost of flow control was assumed to be $740,000 per acre-feet using a combination of costs for two different sites (Lola and Eva) evaluated. The Lola Short Plat included a detention pipe, which is less expensive, and the Eva Short Plat included a detention vault, which is more expensive. For the purposes of this analysis, it was assumed that 75% of applicants would choose a less expensive flow control option if possible (pipe), and therefore the cost of flow control was skewed toward the detention pipe cost using 75% Lola values, and 25% Eva values (detention vault), scaled for size.

Property costs for potential regional (off-site) treatment were estimated by reviewing King County assessor's information for parcels in both the Champagne and Forbes Creek basins. An average cost of $777,000/acre in the Champagne Creek basin and $960,000/acre in the Forbes Creek basin was used for property costs associated with regional flow control facility estimates.

Table D-1
Forbes Creek Redevelopment Analysis Results

NbrUnits	NetRES	Size of short-plat	COKLandU	Existing Impervious estimated from GIS (sq. ft.)	Assumed New Impervious (sq. ft)	Existing Impervious (ac)	Assumed new imperious (ac.)	Total Site Area (ac)	Existing plus new impervious greater than 10,000 sq. ft?	Estimated increase in 100-year peak flow from only new impervious on sites with no flow control (using existing conditions) [a]	Would flow control be required under Ecology (increase from new impervious >0.15cfs?	100-year flow increase from predeveloped forested conditions [b]	Would flow control be required under King County (increase from total predeveloped site conditions >0.15cfs)?	Detention size (ac. Ft) (0.28 ac. Ft/ac. site)[c]	Estimated detention cost per site (75% Lola, 25% Eva, scaled for size, $740,000/ac-ft detention)[d]	Estimated Slope (visual from GIS)	Predominant Landcover (visual from aerial)	Existing conveyance (visual from GIS)
1	1	2	SF	3670	5263.13	0.08	0.12	0.41	NO	0.04	NO	0.19	YES	0.11	$ 84,983.68	flat	grass	12 in pipe
1	1	2	SF	3707	6139.96	0.09	0.14	0.45	NO	0.12	NO	0.24	YES	0.13	$ 93,677.26	mod to steep	forest	15 in pipe
1	1	2	SF	3100	6938.65	0.07	0.16	0.46	YES	0.13	NO	0.24	YES	0.13	$ 95,500.85	mod to steep	forest	15 in pipe
1	1	2	SF	2403	7302.84	0.06	0.17	0.45	NO	0.14	NO	0.24	YES	0.12	$ 92,334.75	moderate	forest	none
1	1	2	SF	7083	2842.09	0.16	0.07	0.46	NO	0.03	NO	0.24	YES	0.13	$ 94,420.54	moderate	grass and trees	12 in pipe
1	1	2	SF	10,882	0	0.25	0.00	0.40	YES	0.00	NO	0.21	YES	0.11	$ 81,861.90	mod to steep	imp	12 in pipe
1	3	4	SF	3500	11502.11	0.08	0.26	0.69	YES	0.22	YES	0.36	YES	0.19	$ 142,719.78	mod to steep	forest	ditch and culvert
1	1	2	SF	4744	4446.37	0.11	0.10	0.42	NO	0.09	NO	0.22	YES	0.12	$ 87,430.88	mod to steep	forest	8 in pipe
1	1	2	SF	3864	3636.42	0.09	0.08	0.34	NO	0.04	NO	0.18	YES	0.10	$ 71,353.87	Moderate	grass and trees	12 in pipe
1	1	2	SF	5347	3153.19	0.12	0.07	0.39	NO	0.03	NO	0.21	YES	0.11	$ 80,865.01	Moderate	grass and trees	12 in pipe
1	2	3	SF	6600	5100.43	0.15	0.12	0.54	YES	0.04	NO	0.25	YES	0.15	$ 111,309.86	flat	grass and trees	ditch and culvert
0	0	0	COM	56535	0	1.30	0.00	1.26	YES	0.00	NO	0.58	YES	0.35	$ 260,635.42	flat	impervious	18 in pipe
1	2	3	SF	4593	13906.36	0.11	0.32	0.85	YES	0.22	YES	0.39	YES	0.24	$ 175,990.24	flat	trees and grass	12 in pipe
1	3	4	SF	6694	11805.87	0.15	0.27	0.85	YES	0.19	YES	0.39	YES	0.24	$ 175,995.13	flat	trees and grass	12 in pipe
1	1	2	SF	2500	5884.72	0.06	0.14	0.38	NO	0.05	NO	0.18	YES	0.11	$ 79,766.48	flat	grass	12 in pipe
1	1	2	SF	3500	4885.34	0.08	0.11	0.39	NO	0.04	NO	0.18	YES	0.11	$ 79,772.35	flat	grass	12 in pipe
1	1	2	SF	2177	7422.89	0.05	0.17	0.44	NO	0.08	NO	0.23	YES	0.12	$ 91,326.80	moderate	grass	12 in pipe
1	1	2	SF	3784	4016.18	0.09	0.09	0.36	NO	0.04	NO	0.19	YES	0.10	$ 74,205.58	moderate	grass	12 in pipe
1	1	2	SF	2992	7007.78	0.07	0.16	0.46	NO	0.07	NO	0.24	YES	0.13	$ 95,131.05	moderate	grass	24 in pipe
1	1	2	SF	3297	4710.82	0.08	0.11	0.37	NO	0.05	NO	0.19	YES	0.10	$ 76,180.96	moderate	grass	12 in pipe
1	1	2	SF	2538	4928.25	0.06	0.11	0.34	NO	0.05	NO	0.18	YES	0.10	$ 71,028.79	moderate	grass	12 in pipe
1	1	2	SF	3000	4675.00	0.07	0.11	0.35	NO	0.05	NO	0.19	YES	0.10	$ 73,014.69	moderate	grass	12 in pipe
1	1	2	SF	2768	6595.23	0.06	0.15	0.43	NO	0.07	NO	0.23	YES	0.12	$ 89,075.34	moderate	grass	12 in pipe
1	1	2	SF	2781	4801.95	0.06	0.11	0.35	NO	0.05	NO	0.18	YES	0.10	$ 72,139.00	Moderate	grass and trees	12 in pipe
1	1	2	SF	2119	5463.82	0.05	0.13	0.35	NO	0.06	NO	0.18	YES	0.10	$ 72,137.78	Moderate	grass and trees	12 in pipe
1	1	2	SF	3482	4016.68	0.08	0.09	0.34	NO	0.04	NO	0.18	YES	0.10	$ 71,337.29	Moderate	grass and trees	12 in pipe
0	589	589	COM	524914	0	12.05	0.00	15.21	YES	0.00	NO	6.96	YES	4.26	$ 3,151,968.72	flat	impervious	36 in pipe
0	28	28	COM	25,000	0	0.57	0.00	0.74	YES	0.00	NO	0.34	YES	0.21	$ 152,782.83	flat	impervious	12 in pipe
0	0	0	VAC	0	15492.30	0.00	0.36	0.71	YES	0.13	NO	0.33	YES	0.20	$ 147,383.08	flat	grass	12 in pipe
0	0	0	VAC	5400	10092.61	0.12	0.23	0.71	YES	0.08	NO	0.33	YES	0.20	$ 147,386.06	flat	grass	12 in pipe
0	0	0	PLOT	21284	0	0.49	0.00	0.71	YES	0.00	NO	0.33	YES	0.20	$ 147,379.90	flat	impervious	12 in pipe
0	27.8833	27.8833	VAC	21284	0	0.49	0.00	0.71	YES	0.00	NO	0.38	YES	0.20	$ 147,383.15	moderate	impervious	12 in pipe
0	22	22	COM	25000	0	0.57	0.00	0.58	YES	0.00	NO	0.31	YES	0.16	$ 120,951.19	moderate	impervious	18 in pipe
1	-1	0	SF	2140	3032.50	0.05	0.07	0.24	NO	0.03	NO	0.11	NO			flat	grass	12 in pipe
1	-1	0	SF	2076	3077.56	0.05	0.07	0.24	NO	0.03	NO	0.11	NO			flat	grass	12 in pipe
2	-2	0	SF	7090	17133.15	0.16	0.39	1.11	YES	0.33	YES	0.59	YES	0.31	$ 230,442.45	mod to steep	forest	12 in pipe
0	0	0	COM	38000	0	0.87	0.00	1.13	YES	0.00	NO	0.52	YES	0.32	$ 234,235.00	flat	impervious	12 in pipe
1	2	3	SF	6591	8410.65	0.15	0.19	0.69	YES	0.07	NO	0.31	YES	0.19	$ 142,715.44	flat	grass	stream
0	1	1	VAC	0	19913.79	0.00	0.46	0.91	YES	0.38	YES	0.48	YES	0.26	$ 189,446.17	moderate	forest	stream
0	1	1	VAC	0	19461.03	0.00	0.45	0.89	YES	0.37	YES	0.47	YES	0.25	$ 185,138.95	moderate	forest	stream
0	1	1	VAC	0	19184.50	0.00	0.44	0.88	YES	0.36	YES	0.47	YES	0.25	$ 182,508.22	moderate	forest	stream
0	1	1	VAC	0	18329.16	0.00	0.42	0.84	YES	0.35	YES	0.44	YES	0.24	$ 174,371.06	moderate	forest	stream
0	2	2	UTL	5800	2436.44	0.13	0.06	0.38	NO	0.03	NO	0.20	YES	0.11	$ 78,355.82	moderate	lawn	12 in pipe
1	4	5	SF	2310	16443.84	0.05	0.38	0.86	YES	0.14	NO	0.39	YES	0.24	$ 178,411.18	flat	grass	ditch and culvert
1	2	3	SF	10481	3684.48	0.24	0.08	0.65	YES	0.03	NO	0.30	YES	0.18	$ 134,760.67	flat	grass	ditch and culvert
1	1	2	SF	2200	15025.36	0.05	0.34	0.79	YES	0.28	YES	0.42	YES	0.22	$ 163,870.32	moderate	forest and grass	12 in pipe
0	1	1	VAC	0	6237.29	0.00	0.14	0.29	NO	0.05	NO	0.13	NO			flat	grass	12 in pipe
1	1	2	SF	2078	5922.27	0.05	0.14	0.37	NO	0.09	NO	0.17	YES	0.10	$ 76,109.14	flat	forest and grass	12 in pipe
0	2	2	SF	2342	5433.49	0.05	0.12	0.36	NO	0.05	NO	0.16	YES	0.10	$ 73,970.71	flat	grass	12 in pipe
1	2	3	SF	5923	11576.00	0.14	0.27	0.80	YES	0.10	NO	0.37	YES	0.22	$ 166,473.51	flat	grass	12 in pipe
1	3	4	SF	11182	5544.35	0.26	0.13	0.77	YES	0.05	NO	0.35	YES	0.22	$ 159,123.00	flat	lawn	ditch and culvert
1	3	4	SF	7483	10016.62	0.17	0.23	0.80	YES	0.08	NO	0.37	YES	0.22	$ 166,479.40	flat	grass	ditch and culvert
1	3	4	SF	3820	13680.11	0.09	0.31	0.80	YES	0.12	NO	0.37	YES	0.22	$ 166,484.08	flat	grass	ditch and culvert
1	1	2	SF	4883	3764.24	0.11	0.09	0.40	NO	0.03	NO	0.18	YES	0.11	$ 82,263.88	flat	grass	12 in pipe
1	5	6	SF	4711	5913.83	0.11	0.14	0.49	YES	0.05	NO	0.22	YES	0.14	$ 101,077.35	flat	grass	12 in pipe
1	1	2	SF	2328	1422.07	0.05	0.03	0.17	NO	0.01	NO	0.08	NO			flat	grass	12 in pipe

Table D-1
Forbes Creek Redevelopment Analysis Results

NbrUnits	NetRES	Size of short-plat	COKLandU	Existing Impervious estimated from GIS (sq. ft.)	Assumed New Impervious (sq. ft)	Existing Impervious (ac)	Assumed new imperious (ac.)	Total Site Area (ac)	Existing plus new impervious greater than 10,000 sq. ft?	Estimated increase in 100-year peak flow from only new impervious on sites with no flow control (using existing conditions) [a]	Would flow control be required under Ecology (increase from new impervious >0.15cfs?	100-year flow increase from predeveloped forested conditions [b]	Would flow control be required under King County (increase from total predeveloped site conditions >0.15cfs)?	Detention size (ac. Ft) (0.28 ac. Ft/ac. site)[c]	Estimated detention cost per site (75% Lola, 25% Eva, scaled for size, $740,000/ac-ft detention)[d]	Estimated Slope (visual from GIS)	Predominant Landcover (visual from aerial)	Existing conveyance (visual from GIS)
1	1	2	SF	5600	0	0.13	0.00	0.20	NO	0.00	NO	0.09	NO			flat	grass	none
1	2	3	SF	3099	1588.42	0.07	0.04	0.22	NO	0.02	NO	0.11	NO			moderate	grass and trees	ditch and culvert
1	2	3	SF	2600	2087.60	0.06	0.05	0.22	NO	0.02	NO	0.11	NO			moderate	grass and trees	ditch and culvert
1	-1	0	SF	2726	2668.53	0.06	0.06	0.25	NO	0.03	NO	0.13	NO			moderate	grass	12 in pipe
1	-1	0	SF	2901	7745.08	0.07	0.18	0.49	YES	0.08	NO	0.26	YES	0.14	$ 101,279.47	moderate	grass and lake	12 in pipe
1	-1	0	SF	2479	20232.51	0.06	0.46	1.04	YES	0.22	YES	0.55	YES	0.29	$ 216,061.73	moderate	grass and lake	12 in pipe
1	1	2	SF	3000	7013.04	0.07	0.16	0.46	NO	0.07	NO	0.24	YES	0.13	$ 95,257.24	moderate	grass and trees	18 in pipe
1	1	2	SF	5000	6450.11	0.11	0.15	0.53	YES	0.12	NO	0.28	YES	0.15	$ 108,928.53	moderate	trees and grass	none
1	1	2	SF	5000	8414.66	0.11	0.19	0.62	YES	0.16	YES	0.33	YES	0.17	$ 127,617.89	moderate	trees and grass	stream
0	1	1	VAC	0	3751.77	0.00	0.09	0.17	NO	0.07	NO	0.09	NO			moderate	trees	12 in pipe
1	1	2	SF	7000	1603.44	0.16	0.04	0.40	NO	0.01	NO	0.18	YES	0.11	$ 81,847.20	flat	grass and trees	6 in pipe
1	1	2	SF	2950	5333.19	0.07	0.12	0.38	NO	0.10	NO	0.20	YES	0.11	$ 78,800.56	moderate	trees	8 inch pipe
1	1	2	SF	3120	10754.77	0.07	0.25	0.64	YES	0.20	YES	0.34	YES	0.18	$ 131,995.06	moderate	trees	12 in pipe
0	1	1	VAC	0	2283.33	0.00	0.05	0.10	NO	0.02	NO	0.06	NO			moderate	grass	none
2	2	4	MF	2500	3738.48	0.06	0.09	0.29	NO	0.03	NO	0.13	NO			flat	grass	ditch and culvert
1	3	4	SF	4533	2064.63	0.10	0.05	0.30	NO	0.02	NO	0.14	NO			flat	grass	ditch and culvert
2	4	6	SF	4881	5329.80	0.11	0.12	0.47	YES	0.06	NO	0.25	YES	0.13	$ 97,138.53	moderate	grass	18 in pipe
1	2	3	SF	6348	9055.85	0.15	0.21	0.71	YES	0.18	YES	0.37	YES	0.20	$ 146,541.70	mod to steep	forest	stream and pipes
0	0	0	COM	12000	0	0.28	0.00	0.39	YES	0.00	NO	0.20	YES	0.11	$ 79,976.12	moderate	impervious	12 in pipe
0	0	0	COM	20000	0	0.46	0.00	0.49	YES	0.00	NO	0.22	YES	0.14	$ 101,207.91	flat	impervious	12 in pipe
0	0	0	COM	18000	0	0.41	0.00	0.45	YES	0.00	NO	0.21	YES	0.13	$ 93,714.04	flat	impervious	12 in pipe
0	0	0	PO	15247	0	0.35	0.00	0.60	YES	0.00	NO	0.28	YES	0.17	$ 125,189.58	flat	grass	12 in pipe
1	1	2	SF	6812	1115.94	0.16	0.03	0.36	NO	0.01	NO	0.19	YES	0.10	$ 75,421.03	Mod	lawn	12 in pipe
1	1	2	SF	2029	6886.66	0.05	0.16	0.41	NO	0.13	NO	0.22	YES	0.11	$ 84,817.53	moderate	forest	8 in pipe
1	2	3	SF	2784	9777.50	0.06	0.22	0.58	YES	0.18	YES	0.30	YES	0.16	$ 119,501.47	moderate	forest	8 in pipes
1	1	2	SF	5000	4689.90	0.11	0.11	0.44	NO	0.05	NO	0.23	YES	0.12	$ 92,183.04	Moderate	lawn	12 in pipe
1	1	2	SF	6521	1015.02	0.15	0.02	0.35	NO	0.01	NO	0.16	YES	0.10	$ 71,692.50	flat	lawn	8 in pipe
1	4	5	SF	7746	13003.66	0.18	0.30	0.95	YES	0.14	NO	0.50	YES	0.27	$ 197,398.05	moderate	grass	ditch and culvert
1	1	2	SF	6681	3693.58	0.15	0.08	0.48	YES	0.07	NO	0.25	YES	0.13	$ 98,696.61	moderate	trees and lawn	12 in pipe
1	1	2	SF	2000	5709.27	0.05	0.13	0.35	NO	0.06	NO	0.19	YES	0.10	$ 73,340.73	moderate	lawn	12 in pipe
1	3	4	SF	2653	29873.10	0.06	0.69	1.49	YES	0.57	YES	0.79	YES	0.42	$ 309,431.00	moderate	forest	stream
1	1	2	SF	2602	7531.74	0.06	0.17	0.47	YES	0.14	NO	0.25	YES	0.13	$ 96,405.45	moderate	forest	18 in pipe
1	1	2	SF	2831	5748.50	0.06	0.13	0.39	NO	0.11	NO	0.21	YES	0.11	$ 81,619.51	moderate	forest	18 in pipe
1	1	2	SF	3093	5186.02	0.07	0.12	0.38	NO	0.10	NO	0.20	YES	0.11	$ 78,760.91	moderate	forest	18 in pipe
1	1	2	SF	5564	3143.47	0.13	0.07	0.40	NO	0.03	NO	0.21	YES	0.11	$ 82,836.89	moderate	grass and trees	18 in pipe
1	1	2	SF	3996	4277.96	0.09	0.10	0.38	NO	0.04	NO	0.17	YES	0.11	$ 78,712.76	flat	grass	ditch and culvert
1	1	2	SF	5000	5500.96	0.11	0.13	0.48	YES	0.05	NO	0.22	YES	0.13	$ 99,898.97	flat	grass and trees	12 in pipe
1	2	3	SF	5285	8214.38	0.12	0.19	0.62	YES	0.07	NO	0.28	YES	0.17	$ 128,423.89	flat	grass	ditch and culvert
1	1	2	SF	13238	0	0.30	0.00	0.42	YES	0.00	NO	0.19	YES	0.12	$ 86,281.90	flat	imp	12 in pipe
1	1	2	SF	4193	3522.77	0.10	0.08	0.35	NO	0.06	NO	0.16	YES	0.10	$ 73,402.58	flat	trees	ditch and culvert
0	1	1	VAC	0	4815.04	0.00	0.11	0.22	NO	0.04	NO	0.10	NO			flat	grass	ditch and culvert
1	1	2	SF	3636	6103.71	0.08	0.14	0.45	NO	0.05	NO	0.20	YES	0.13	$ 92,656.93	flat	grass and trees	ditch and culvert
1	6	7	SF	3265	23585.38	0.07	0.54	1.23	YES	0.45	YES	0.65	YES	0.35	$ 255,436.13	moderate	forest	ditch and culvert
1	6	7	SF	5281	25421.65	0.12	0.58	1.41	YES	0.27	YES	0.74	YES	0.39	$ 292,083.99	moderate	grass and trees	ditch and stream
0	1	1	VAC	1830	166.95	0.04	0.00	0.09	NO	0.00	NO	0.04	NO			flat	grass	12 in pipe
0	1	1	VAC	0	6214.39	0.00	0.14	0.29	NO	0.07	NO	0.15	YES	0.08	$ 59,119.47	moderate	grass	12 in pipe
1	6	7	SF	3795	27162.67	0.09	0.62	1.42	YES	0.29	YES	0.75	YES	0.40	$ 294,510.07	moderate	grass and trees	12 in pipe
0	1	1	VAC	0	30448.05	0.00	0.70	1.40	YES	0.58	YES	0.74	YES	0.39	$ 289,661.85	moderate	forest	ditch and culvert
1	2	3	SF	8225	29834.42	0.19	0.68	1.75	YES	0.32	YES	0.92	YES	0.49	$ 362,071.21	moderate	grass and forest	stream
1	1	2	SF	3000	4946.28	0.07	0.11	0.36	NO	0.04	NO	0.17	YES	0.10	$ 75,595.46	flat	lawn and trees	ditch and culvert
1	1	2	SF	4066	5003.51	0.09	0.11	0.42	NO	0.04	NO	0.19	YES	0.12	$ 86,281.10	flat	grass	ditch and culvert
1	1	2	SF	6700	4698.23	0.15	0.11	0.52	YES	0.04	NO	0.24	YES	0.15	$ 108,434.94	flat	grass	ditch and culvert
1	1	2	SF	3304	6510.73	0.08	0.15	0.45	NO	0.05	NO	0.21	YES	0.13	$ 93,370.58	flat	lawn	12 in pipe
1	2	3	SF	3103	8610.97	0.07	0.20	0.54	YES	0.07	NO	0.25	YES	0.15	$ 111,438.67	flat	grass	12 in pipe
1	6	7	SF	3638	22084.49	0.08	0.51	1.18	YES	0.24	YES	0.62	YES	0.33	$ 244,706.15	moderate	grass	12 in pipe
1	1	2	SF	5040	4152.77	0.12	0.10	0.42	NO	0.04	NO	0.22	YES	0.12	$ 87,453.75	moderate	lawn	12 in pipe

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NbrUnits	NetRES	Size of short-plat	COKLandU	Existing Impervious estimated from GIS (sq. ft.)	Assumed New Impervious (sq. ft)	Existing Impervious (ac)	Assumed new imperious (ac.)	Total Site Area (ac)	Existing plus new impervious greater than 10,000 sq. ft?	Estimated increase in 100-year peak flow from only new impervious on sites with no flow control (using existing conditions) [a]	Would flow control be required under Ecology (increase from new impervious >0.15cfs?	100-year flow increase from predeveloped forested conditions [b]	Would flow control be required under King County (increase from total predeveloped site conditions >0.15cfs)?	Detention size (ac. Ft) (0.28 ac. Ft/ac. site)[c]	Estimated detention cost per site (75% Lola, 25% Eva, scaled for size, $740,000/ac-ft detention)[d]	Estimated Slope (visual from GIS)	Predominant Landcover (visual from aerial)	Existing conveyance (visual from GIS)
1	1	2	SF	5200	4995.75	0.12	0.11	0.47	YES	0.04	NO	0.21	YES	0.13	$ 96,995.38	flat	lawn	12 in pipe
1	1	2	SF	2100	7175.17	0.05	0.16	0.43	NO	0.11	NO	0.19	YES	0.12	$ 88,237.65	flat	trees and grass	12 in pipe
1	3	4	SF	5341	9845.52	0.12	0.23	0.70	YES	0.11	NO	0.37	YES	0.20	$ 144,474.11	moderate	grass	18 in pipe
2	3	5	SF	9968	12806.02	0.23	0.29	1.05	YES	0.14	NO	0.55	YES	0.29	$ 216,656.42	moderate	grass	stream
1	2	3	SF	3189	10611.50	0.07	0.24	0.63	YES	0.09	NO	0.33	YES	0.18	$ 131,288.47	flat	grass	ditch and culvert
1	1	2	SF	3500	6434.75	0.08	0.15	0.46	NO	0.05	NO	0.21	YES	0.13	$ 94,512.44	flat	grass and trees	12 in pipe
1	1	2	SF	4330	5014.05	0.10	0.12	0.43	NO	0.04	NO	0.23	YES	0.12	$ 88,892.93	flat to mod	grass and trees	12 in pipe
1	1	2	SF	3500	6399.88	0.08	0.15	0.45	NO	0.05	NO	0.24	YES	0.13	$ 94,180.71	flat to mod	grass and trees	12 in pipe
1	1	2	SF	2556	4656.66	0.06	0.11	0.33	NO	0.04	NO	0.15	YES	0.09	$ 68,616.30	flat	grass and trees	12 in pipe
1	1	2	SF	2500	4756.51	0.06	0.11	0.33	NO	0.04	NO	0.15	YES	0.09	$ 69,033.49	flat	grass and trees	12 in pipe
1	1	2	SF	4900	4758.94	0.11	0.11	0.44	NO	0.04	NO	0.23	YES	0.12	$ 91,888.54	flat to mod	lawn	12 in pipe
1	1	2	SF	3400	4962.35	0.08	0.11	0.38	NO	0.04	NO	0.18	YES	0.11	$ 79,553.72	flat	lawn	12 in pipe
1	2	3	SF	5317	6570.69	0.12	0.15	0.55	YES	0.12	NO	0.29	YES	0.15	$ 113,091.30	moderate	forest	12 in pipe
1	1	2	SF	3200	4056.49	0.07	0.09	0.33	NO	0.03	NO	0.15	YES	0.09	$ 69,033.32	flat	lawn	12 in pipe
1	1	2	SF	4979	3832.31	0.11	0.09	0.40	NO	0.03	NO	0.19	YES	0.11	$ 83,824.78	flat	lawn	12 in pipe
1	3	4	SF	4848	11375.13	0.11	0.26	0.74	YES	0.10	NO	0.34	YES	0.21	$ 154,335.79	flat	grass	12 in pipe
1	1	2	SF	6000	1213.93	0.14	0.03	0.33	NO	0.01	NO	0.17	YES	0.09	$ 68,628.38	flat to mod	lawn	12 in pipe
1	1	2	SF	3433	4241.77	0.08	0.10	0.35	NO	0.04	NO	0.19	YES	0.10	$ 73,012.48	flat to mod	lawn	12 in pipe
2	-2	0	MF	1775	4665.90	0.04	0.11	0.30	NO	0.05	NO	0.16	YES	0.08	$ 61,274.28	moderate	grass	12 in pipe
0	0	0	PO	3500	1423.86	0.08	0.03	0.23	NO	0.01	NO	0.10	NO			flat	grass	12 in pipe
1	1	2	SF	2679	5321.10	0.06	0.12	0.37	NO	0.04	NO	0.17	YES	0.10	$ 76,107.48	flat	grass and trees	12 in pipe
1	4	5	SF	4381	16314.83	0.10	0.37	0.95	YES	0.17	YES	0.50	YES	0.27	$ 196,885.99	moderate	trees and grass	ditch and culvert
1	12	13	VAC	28349	56746.15	0.65	1.30	3.91	YES	1.07	YES	2.06	YES	1.09	$ 809,536.93	moderate	forest	stream
2	4	6	SF	5993	3664.01	0.14	0.08	0.44	NO	0.04	NO	0.23	YES	0.12	$ 91,870.20	moderate	grass	ditch and culvert
1	2	3	SF	6533	4886.65	0.15	0.11	0.52	YES	0.05	NO	0.28	YES	0.15	$ 108,638.77	moderate	grass	12 in pipe
1	4	5	SF	4585	16669.59	0.11	0.38	0.98	YES	0.32	YES	0.52	YES	0.27	$ 202,201.60	moderate	forest	none
2	1	3	SF	4890	43000.11	0.11	0.99	2.20	YES	0.46	YES	1.16	YES	0.62	$ 455,593.73	moderate	grass and lake	ditch and culvert
2	12	14	SF	17124	34457.53	0.39	0.79	2.37	YES	0.29	YES	1.08	YES	0.66	$ 490,711.35	flat	grass	none
1	1	2	SF	2940	4367.42	0.07	0.10	0.34	NO	0.04	NO	0.15	YES	0.09	$ 69,517.74	flat	grass	12 in pipe
0	4	4	VAC	0	41308.61	0.00	0.95	1.90	YES	0.44	YES	1.00	YES	0.53	$ 392,981.82	moderate	grass and lake	ditch and culvert
1	2	3	SF	1501	9409.03	0.03	0.22	0.50	YES	0.08	NO	0.23	YES	0.14	$ 103,790.58	flat	grass	12 in pipe
0	0	0	COM	23000	0	0.53	0.00	0.70	YES	0.00	NO	0.32	YES	0.20	$ 146,026.91	flat	impervious	12 in pipe
1	1	2	SF	3100	5141.29	0.07	0.12	0.38	NO	0.05	NO	0.20	YES	0.11	$ 78,401.95	mod	trees and lawn	12 in pipe
3	2	5	SF	7942	10558.18	0.18	0.24	0.85	YES	0.11	NO	0.45	YES	0.24	$ 175,997.99	moderate	trees and grass	ditch and culvert
0	243	243	COM	250000	0	5.74	0.00	6.21	YES	0.00	NO	2.84	YES	1.74	$ 1,286,385.59	flat	impervious	18 in pipe
1	1	2	SF	2822	5610.82	0.06	0.13	0.39	NO	0.06	NO	0.20	YES	0.11	$ 80,224.11	moderate	grass	12 in pipe
0	3	3	SF	5023	10557.34	0.12	0.24	0.72	YES	0.09	NO	0.33	YES	0.20	$ 148,220.68	flat	grass and trees	12 in pipe
1	4	5	SF	5602	27396.19	0.13	0.63	1.52	YES	0.29	YES	0.80	YES	0.42	$ 313,922.16	moderate	grass	stream
0	2	2	VAC	5124	4215.27	0.12	0.10	0.43	NO	0.05	NO	0.23	YES	0.12	$ 88,847.44	mod	grass	ditch and culvert
0	4	4	VAC	1780	4531.55	0.04	0.10	0.29	NO	0.05	NO	0.15	YES	0.08	$ 60,043.74	moderate	grass	ditch and culvert
0	1	1	VAC	4300	134.01	0.10	0.00	0.20	NO	0.00	NO	0.09	NO			flat	grass	12 in pipe
0	4	4	VAC	0	7661.69	0.00	0.18	0.35	NO	0.08	NO	0.19	YES	0.10	$ 72,888.04	moderate	bare earth	ditch and culvert
1	4	5	SF	11874	8582.80	0.27	0.20	0.94	YES	0.07	NO	0.43	YES	0.26	$ 194,612.00	flat	grass	8 in pipe
0	4	4	SF	690	15618.39	0.02	0.36	0.75	YES	0.25	YES	0.34	YES	0.21	$ 155,146.86	flat	trees and grass	12 in pipe
0	2	2	VAC	1710	2641.17	0.04	0.06	0.20	NO	0.03	NO	0.11	NO			moderate	grass	ditch and culvert
1	2	3	SF	4973	6274.04	0.11	0.14	0.52	YES	0.07	NO	0.27	YES	0.14	$ 106,996.61	moderate	grass	12 in pipe
1	1	2	SF	7684	2252.95	0.18	0.05	0.46	NO	0.02	NO	0.24	YES	0.13	$ 94,533.30	moderate	grass	12 in pipe
1	1	2	SF	7121	1669.97	0.16	0.04	0.40	NO	0.01	NO	0.18	YES	0.11	$ 83,631.29	flat	grass	12 in pipe
1	1	2	SF	5309	4342.97	0.12	0.10	0.44	NO	0.04	NO	0.20	YES	0.12	$ 91,822.24	flat	grass	12 in pipe
1	1	2	SF	3084	5424.23	0.07	0.12	0.39	NO	0.05	NO	0.18	YES	0.11	$ 80,941.47	flat	grass	12 in pipe
1	2	3	SF	3690	7336.50	0.08	0.17	0.51	YES	0.12	NO	0.23	YES	0.14	$ 104,898.56	flat	trees and grass	none
1	1	2	SF	5380	2537.03	0.12	0.06	0.36	NO	0.04	NO	0.17	YES	0.10	$ 75,317.17	flat	trees and grass	ditch and culvert
1	1	2	SF	3635	3726.99	0.08	0.09	0.34	NO	0.03	NO	0.15	YES	0.09	$ 70,036.96	flat	grass	none
1	1	2	SF	2937	4424.38	0.07	0.10	0.34	NO	0.04	NO	0.15	YES	0.09	$ 70,031.15	flat	grass	none
1	2	3	SF	4800	6505.46	0.11	0.15	0.52	YES	0.10	NO	0.24	YES	0.15	$ 107,552.39	flat	forest	none
1	2	3	SF	5675	5542.80	0.13	0.13	0.52	YES	0.09	NO	0.24	YES	0.14	$ 106,718.45	flat	trees and grass	ditch and culvert

Table D-1
Forbes Creek Redevelopment Analysis Results

NbrUnits	NetRES	Size of short-plat	COKLandU	Existing Impervious estimated from GIS (sq. ft.)	Assumed New Impervious (sq. ft)	Existing Impervious (ac)	Assumed new imperious (ac.)	Total Site Area (ac)	Existing plus new impervious greater than 10,000 sq. ft?	Estimated increase in 100-year peak flow from only new impervious on sites with no flow control (using existing conditions) [a]	Would flow control be required under Ecology (increase from new impervious >0.15cfs?	100-year flow increase from predeveloped forested conditions [b]	Would flow control be required under King County (increase from total predeveloped site conditions >0.15cfs)?	Detention size (ac. Ft) (0.28 ac. Ft/ac. site)[c]	Estimated detention cost per site (75% Lola, 25% Eva, scaled for size, $740,000/ac-ft detention)[d]	Estimated Slope (visual from GIS)	Predominant Landcover (visual from aerial)	Existing conveyance (visual from GIS)
1	1	2	SF	4527	5729.64	0.10	0.13	0.47	YES	0.05	NO	0.22	YES	0.13	$ 97,574.64	flat	grass	12 in pipe
1	1	2	SF	5000	4543.21	0.11	0.10	0.44	NO	0.09	NO	0.23	YES	0.12	$ 90,787.60	moderate	forest	ditch and culvert
1	5	6	SF	3500	6867.74	0.08	0.16	0.48	YES	0.13	NO	0.25	YES	0.13	$ 98,631.56	moderate	forest	ditch and culvert
1	2	3	SF	3609	1643.47	0.08	0.04	0.24	NO	0.02	NO	0.13	NO			moderate	trees and grass	ditch and culvert
0	0	0	COM	26417	0	0.61	0.00	0.62	YES	0.00	NO	0.28	YES	0.17	$ 128,203.36	flat	impervious	30 in pipe
0	0	0	COM	10000	0	0.23	0.00	0.28	NO	0.00	NO	0.13	NO			flat	impervious	12 in pipe
0	4	4	PO	33767	0	0.78	0.00	1.12	YES	0.00	NO	0.51	YES	0.31	$ 231,765.17	flat	impervious	8 in pipe
1	0	1	VAC	2585	1346.72	0.06	0.03	0.18	NO	0.02	NO	0.08	NO			flat	trees	8 in pipe
1	1	2	SF	7000	1118.45	0.16	0.03	0.37	NO	0.01	NO	0.20	YES	0.10	$ 77,233.36	moderate	grass	8 in pipe
1	1	2	SF	3120	6875.28	0.07	0.16	0.46	NO	0.07	NO	0.24	YES	0.13	$ 95,088.21	moderate	grass	8 in pipe
1	1	2	SF	5513	4481.81	0.13	0.10	0.46	NO	0.05	NO	0.24	YES	0.13	$ 95,083.76	moderate	grass	8 in pipe
1	1	2	SF	2889	7106.45	0.07	0.16	0.46	NO	0.08	NO	0.24	YES	0.13	$ 95,089.87	moderate	grass	8 in pipe
1	1	2	SF	5143	5268.47	0.12	0.12	0.48	YES	0.06	NO	0.25	YES	0.13	$ 99,047.61	moderate	grass	8 in pipe
1	4	5	SF	3930	14569.02	0.09	0.33	0.85	YES	0.16	YES	0.45	YES	0.24	$ 175,986.98	moderate	grass	12 in pipe
1	1	2	SF	4318	2960.38	0.10	0.07	0.33	NO	0.02	NO	0.15	YES	0.09	$ 69,241.52	flat	lawn	12 in pipe
1	3	4	SF	6949	8552.11	0.16	0.20	0.71	YES	0.09	NO	0.38	YES	0.20	$ 147,466.91	moderate	grass	12 in pipe
1	3	4	SF	4070	14430.27	0.09	0.33	0.85	YES	0.15	YES	0.45	YES	0.24	$ 175,998.91	moderate	grass	18 in pipe
1	1	2	SF	7000	2650.30	0.16	0.06	0.44	NO	0.02	NO	0.20	YES	0.12	$ 91,806.35	flat	lawn	12 in pipe
1	1	2	SF	5884	3973.98	0.14	0.09	0.45	NO	0.03	NO	0.21	YES	0.13	$ 93,782.09	flat	lawn	12 in pipe
1	2	3	SF	2629	10036.35	0.06	0.23	0.58	YES	0.19	YES	0.31	YES	0.16	$ 120,489.50	moderate	forest	12 in pipe
1	2	3	SF	3248	10379.67	0.07	0.24	0.63	YES	0.20	YES	0.33	YES	0.18		moderate	forest	12 in pipe
1	2	3	SF	3514	9127.86	0.08	0.21	0.58	YES	0.17	YES	0.31	YES	0.16		moderate	forest	12 in pipe
2	1	3	MF	4810	697.19	0.11	0.02	0.25	NO	0.01	NO	0.13	NO			moderate	trees	12 in pipe
0	100	100	COM	127316	0	2.92	0.00	3.43	YES	0.00	NO	1.57	YES	0.96	$ 709,933.33	flat	impervious	18 in pipe
1	1	2	SF	5195	3942.24	0.12	0.09	0.42	NO	0.06	NO	0.19	YES	0.12	$ 86,925.49	flat	forest	12 in pipe
1	1	2	SF	4281	4698.48	0.10	0.11	0.41	NO	0.05	NO	0.22	YES	0.12	$ 85,424.59	moderate	forest and grass	12 in pipe
1	1	2	SF	4748	4888.10	0.11	0.11	0.44	NO	0.04	NO	0.23	YES	0.12	$ 91,671.25	flat to moderate	grass and trees	none
1	1	2	SF	11925	0	0.27	0.00	0.48	YES	0.00	NO	0.22	YES	0.14	$ 100,162.43	flat	lawn	12 in pipe
0	1	1	VAC	0	3601.54	0.00	0.08	0.17	NO	0.06	NO	0.08	NO			flat	forest	6 in pipe
0	1	1	VAC	5400	0	0.12	0.00	0.21	NO	0.00	NO	0.10	NO			flat	lawn	6 in pipe
1	3	4	SF	2970	11562.35	0.07	0.27	0.67	YES	0.12	NO	0.35	YES	0.19	$ 138,250.84	moderate	trees and grass	6 in pipe
1	1	2	SF	3865	3785.53	0.09	0.09	0.35	NO	0.06	NO	0.16	YES	0.10	$ 72,781.93	flat	trees and grass	ditch and culvert
1	1	2	SF	3500	7199.41	0.08	0.17	0.49	YES	0.06	NO	0.22	YES	0.14	$ 101,786.88	flat	grass	ditch and culvert
1	1	2	SF	2473	5138.41	0.06	0.12	0.35	NO	0.05	NO	0.18	YES	0.10	$ 72,409.72	moderate	trees and grass	6 in pipe
1	1	2	SF	4137	3435.93	0.09	0.08	0.35	NO	0.04	NO	0.18	YES	0.10	$ 72,043.71	moderate	trees and grass	6 in pipe
0	1	1	VAC	0	3205.64	0.00	0.07	0.15	NO	0.05	NO	0.07	NO			flat	forest	ditch and culvert
1	1	2	SF	4300	3132.21	0.10	0.07	0.34	NO	0.06	NO	0.18	YES	0.10	$ 70,704.97	moderate	forest	none
1	1	2	SF	3042	4174.59	0.07	0.10	0.33	NO	0.08	NO	0.18	YES	0.09	$ 68,653.72	moderate	forest	12 in pipe
0	0	0	PO	13000	0	0.30	0.00	0.30	YES	0.00	NO	0.14	NO	0.08	$ 62,539.33	flat	impervious	12 in pipe
0	0	0	COM	12000	0	0.28	0.00	0.30	YES	0.00	NO	0.14	NO	0.08	$ 61,328.69	flat	impervious	12 in pipe
0	0	0	COM	16547	0	0.38	0.00	0.40	YES	0.00	NO	0.19	YES	0.11	$ 83,897.20	flat	impervious	12 in pipe
0	0	0	COM	21000	0	0.48	0.00	0.49	YES	0.00	NO	0.23	YES	0.14	$ 102,048.89	flat	impervious	18 in pipe
0	0	0	COM	7000	0	0.16	0.00	0.23	NO	0.00	NO	0.11	NO			flat	impervious	12 in pipe
0	0	0	COM	7711	0	0.18	0.00	0.24	NO	0.00	NO	0.11	NO			flat	impervious	12 in pipe
0	0	0	COM	7000	0	0.16	0.00	0.24	NO	0.00	NO	0.11	NO			flat	impervious	12 in pipe
0	0	0	COM	7645	0	0.18	0.00	0.25	NO	0.00	NO	0.11	NO			flat	impervious	12 in pipe
1	2	3	SF	2500	2276.71	0.06	0.05	0.22	NO	0.02	NO	0.12	NO			moderate	grass and trees	none
1	2	3	SF	3243	1531.07	0.07	0.04	0.22	NO	0.02	NO	0.12	NO			moderate	grass and trees	none
2	1	3	MF	3477	1766.84	0.08	0.04	0.24	NO	0.01	NO	0.11	NO			flat	grass	18 in pipe
1	1	2	SF	3500	4148.86	0.08	0.10	0.35	NO	0.08	NO	0.19	YES	0.10	$ 72,766.06	moderate	forest	12 in pipe
1	1	2	SF	3025	4289.81	0.07	0.10	0.34	NO	0.08	NO	0.18	YES	0.09	$ 69,588.10	moderate	forest	12 in pipe
1	1	2	SF	3560	5300.26	0.08	0.12	0.41	NO	0.10	NO	0.21	YES	0.11	$ 84,290.41	moderate	forest	none
1	1	2	SF	3267	4635.94	0.08	0.11	0.36	NO	0.04	NO	0.17	YES	0.10	$ 75,183.15	flat	lawn	12 in pipe
1	4	5	SF	5796	12344.42	0.13	0.28	0.83	YES	0.10	NO	0.38	YES	0.23	$ 172,575.57	flat	grass	12 in pipe
1	1	2	SF	1725	5973.85	0.04	0.14	0.35	NO	0.05	NO	0.16	YES	0.10	$ 73,241.54	flat	grass	ditch and culvert
1	2	3	SF	5043	5859.52	0.12	0.13	0.50	YES	0.05	NO	0.23	YES	0.14	$ 103,719.09	flat	grass	12 in pipe

Table D-1
Forbes Creek Redevelopment Analysis Results

NbrUnits	NetRES	Size of short-plat	COKLandU	Existing Impervious estimated from GIS (sq. ft.)	Assumed New Impervious (sq. ft)	Existing Impervious (ac)	Assumed new imperious (ac.)	Total Site Area (ac)	Existing plus new impervious greater than 10,000 sq. ft?	Estimated increase in 100-year peak flow from only new impervious on sites with no flow control (using existing conditions) [a]	Would flow control be required under Ecology (increase from new impervious >0.15cfs?	100-year flow increase from predeveloped forested conditions [b]	Would flow control be required under King County (increase from total predeveloped site conditions >0.15cfs)?	Detention size (ac. Ft) (0.28 ac. Ft/ac. site)[c]	Estimated detention cost per site (75% Lola, 25% Eva, scaled for size, $740,000/ac-ft detention)[d]	Estimated Slope (visual from GIS)	Predominant Landcover (visual from aerial)	Existing conveyance (visual from GIS)
1	1	2	SF	3143	5174.58	0.07	0.12	0.38	NO	0.08	NO	0.17	YES	0.11	$ 79,127.76	flat	trees and grass	none
1	1	2	SF	3577	6961.47	0.08	0.16	0.48	YES	0.13	NO	0.26	YES	0.14	$ 100,255.83	moderate	forest	none
1	1	2	SF	2858	5953.88	0.07	0.14	0.40	NO	0.05	NO	0.19	YES	0.11	$ 83,830.17	flat	lawn	none
1	1	2	SF	3066	6548.93	0.07	0.15	0.44	NO	0.06	NO	0.20	YES	0.12	$ 91,469.89	flat	grass and trees	12 in pipe
1	1	2	SF	3000	6277.43	0.07	0.14	0.43	NO	0.10	NO	0.22	YES	0.12	$ 88,259.16	flat to moderate	forest	none
1	1	2	SF	6684	2530.19	0.15	0.06	0.42	NO	0.03	NO	0.22	YES	0.12	$ 87,657.46	moderate	grass	none
1	1	2	SF	2773	4904.91	0.06	0.11	0.35	NO	0.05	NO	0.19	YES	0.10	$ 73,042.37	moderate	grass	12 in pipe
1	1	2	SF	7270	2716.64	0.17	0.06	0.46	NO	0.04	NO	0.21	YES	0.13	$ 95,006.07	flat	trees and grass	12 in pipe
1	3	4	SF	3131	13419.09	0.07	0.31	0.76	YES	0.25	YES	0.40	YES	0.21		moderate	forest	6 in pipe
2	4	6	SF	8218	2151.22	0.19	0.05	0.48	YES	0.04	NO	0.25	YES	0.13	$ 98,645.66	moderate	trees and grass	8 in pipe
3	-1	2	SF	10854	0	0.25	0.00	0.49	YES	0.00	NO	0.22	YES	0.14	$ 101,311.77	flat	grass	12 in pipe
2	1	3	SF	6024	5903.66	0.14	0.14	0.55	YES	0.05	NO	0.25	YES	0.15	$ 113,471.55	flat	lawn	12 in pipe
1	3	4	SF	9450	7064.81	0.22	0.16	0.76	YES	0.13	NO	0.40	YES	0.21	$ 157,110.62	moderate	forest	6 in pipe
0	0	0	COM	185000	0	4.25	0.00	5.79	YES	0.00	NO	2.65	YES	1.62	$ 1,199,093.98	flat	impervious	stream and pipes
0	2	2	SF	2597	4851.03	0.06	0.11	0.34	NO	0.04	NO	0.16	YES	0.10	$ 70,855.46	flat	grass	12 in pipe
3	13	16	SF	1043	59003.72	0.02	1.35	2.76	YES	0.50	YES	1.26	YES	0.77		flat	grass	12 in pipe
1	8	9	SF	3078	31921.93	0.07	0.73	1.61	YES	0.34	YES	0.85	YES	0.45		moderate	grass and trees	18 in pipe
0	3	3	SF	7740	4703.07	0.18	0.11	0.57	YES	0.04	NO	0.26	YES	0.16	$ 118,374.88	flat	grass	12 in pipe
0	2	2	SF	2469	5618.29	0.06	0.13	0.37	NO	0.05	NO	0.17	YES	0.10	$ 76,936.90	flat	grass and trees	8 in pipe

[a] Estimated increase in flow was scaled from impervious surface "magic numbers" for impervious surfaces and slope of lot (flat, moderate), and type of land cover (forest or lawn). (Increase impervious/Ac. Imp. that result in increase of 0.15) x by 0.15 = assumed flow increase.

[b] Estimated increase in flow was scaled from 50% imp, 50% pervious "magic numbers" for slope of lot (flat, moderate). (Lot size/Ac. 50%imp+50%perv that result in increase of 0.15) x by 0.15 = assumed flow increase.

[c] Estimated detention size is equal to lot size multiplied by 0.28, which is the average ratio of detention size (ac.-ft.) to lot size for the first five real parcels evaluated in Task 2 (2- to 4-lot short plats)

[d] Estimated cost of detention is equal to 75% of the cost of detention per ac-ft for Lola short plat plus 25% of the cost of detention per ac-ft for Eva short plat ($740,000/ac-ft).

No detention required under Ecology or King County
Detention required by King County, but not by Ecology
Exceeds 10,000 sq. ft. threshold, but not Ecology flow threshold
Detention required under both manuals, and exceeds 10,000 sq. ft. threshold
Exceeds 10,000 sq. ft threshold, but no detention required otherwise under King County or Ecology

Table D-2
Champagne Creek Redevelopment Analysis Results

NbrUnits	NetRES	Short-Plat Size	COKLandUs	Ex. Impervious Surface estimated from GIS (sq. ft.)	Assumed new Impervious (sq ft)	Ex. Impervious (ac)	Assumed new imperious (ac.)	Total Site Area (ac)	Existing plus new impervious greater than 10,000 sq. ft?	Would flow control be required under Ecology?	Would flow control be required under King County (Kirkland)?	Estimated increase in 100-year peak flow from only new impervious on sites with no flow control (using existing	100-year flow increase from predeveloped forested conditions [b]	Detention size (ac. Ft) (0.28 ratio)[c]	Estimated detention cost per site (75% Lola, 25% Eva, scaled for size, $740,000/ac-ft detention)[d]	Estimated Slope (visual from GIS)	Predominant Landcover (visual from aerial)	Existing conveyance (visual from GIS)
0	10	10	SF	4574	8342.69934	0.11	0.19	1.26	Yes	No	Yes	0.13	0.51	0.35	$ 261,662.14	moderate	forest	pipe (12 in) to north
1	2	3	SF	5607	3946.846128	0.13	0.09	0.44	No	No	Yes	0.03	0.15	0.12	$ 90,888.75	flat	grass, trees	tank, pipes
1	2	3	SF	5300	3864.14691	0.12	0.09	0.42	No	No	Yes	0.04	0.17	0.12	$ 87,181.42	moderate	grass	pipe (12 in) to east
0	8.653419	8.653418881	VAC	0	4006.621242	0.00	0.09	0.18	No	No	No	0.04	0.07			moderate	forested	pipe (12 in)
2	18	20	SF	33900	20987.33257	0.78	0.48	2.52	Yes	Yes	Yes	0.22	1.03	0.71	$ 522,160.48	mod to mod-steep	trees and lawn	pipe (12 in) to north
1	5	6	SF	9000	15604.97268	0.21	0.36	1.13	Yes	Yes	Yes	0.25	0.46	0.32	$ 234,074.85	mod to mod-steep	forest	none
1	4	5	SF	3590	11492.39955	0.08	0.26	0.69	Yes	No	Yes	0.12	0.28	0.19	$ 143,483.62	moderate	forest and lawn	pipe (12 in) to west
1	2	3	SF	4500	4794.91293	0.10	0.11	0.43	No	No	Yes	0.08	0.17	0.12	$ 88,425.43	moderate	forest	pipe (12 in) to west
1	1	2	SF	3200	4368.44	0.07	0.10	0.35	No	No	No	0.05	0.14			moderate	grass and forest	pipe (12 in) to west
1	4	5	SF	6000	22105.53435	0.14	0.51	1.29	Yes	Yes	Yes	0.19	0.44	0.36	$ 267,376.80	flat	forest and lawn	none
1	1	2	SF	7300	2401.89	0.17	0.06	0.45	No	No	Yes	0.03	0.18	0.12	$ 92,297.14	moderate	lawn	pipe (12 in) to west
1	2	3	SF	7000	2991.961621	0.16	0.07	0.46	No	No	Yes	0.03	0.19	0.13	$ 95,056.68	moderate	grass	ditch and culvert
1	2	3	SF	5500	4469.659739	0.13	0.10	0.46	No	No	Yes	0.05	0.19	0.13	$ 94,844.51	moderate	grass	ditch and culvert
1	2	3	SF	4300	4966.679886	0.10	0.11	0.43	No	No	Yes	0.05	0.17	0.12	$ 88,156.84	moderate	grass	pipe (12 in) to west
1	2	3	SF	4100	4875.340017	0.09	0.11	0.41	No	No	Yes	0.05	0.17	0.12	$ 85,385.24	moderate	lawn and trees	ditch and culvert
1	1	2	SF	5000	526.31	0.11	0.01	0.25	No	No	No	0.01	0.10			moderate	lawn	pipe (6 in) to west
1	3	4	SF	11,094	15,218	0.25	0.35	1.21	Yes	Yes	Yes	0.16	0.49	0.34	$ 250,314.54	moderate	lawn	ditch and culvert
1	2	3	SF	6300	6442.01781	0.14	0.15	0.59	Yes	No	Yes	0.07	0.24	0.16	$ 121,218.83	moderate	lawn and trees	pipe (12 in) to west
1	5	6	SF	3900	18960.20407	0.09	0.44	0.87	Yes	Yes	Yes	0.20	0.35	0.24	$ 180,393.42	moderate	grass, trees	none
1	5	6	SF	3523	18960.24957	0.08	0.44	0.87	Yes	Yes	Yes	0.20	0.35	0.24	$ 180,393.85	moderate	grass, trees	none
1	1	2	SF	4500	1661.22	0.10	0.04	0.28	No	No	No	0.02	0.12			moderate	grass, trees	none
1	1	2	SF	3000	3104.60	0.07	0.07	0.28	No	No	No	0.03	0.11			moderate	grass	pipe (12 in) to west
1	1	2	SF	3000	3178.47	0.07	0.07	0.28	No	No	No	0.03	0.10			flat	grass, trees	pipe (12 in) to east
1	1	2	SF	3000	3176.72	0.07	0.07	0.28	No	No	NO	0.03	0.10			flat to mod	grass, trees	pipe (12 in) to east
1	1	2	SF	4800	3975.35	0.11	0.09	0.40	No	No	Yes	0.04	0.16	0.11	$ 83,482.63	Moderate	lawn and trees	ditch and culvert
1	5	6	SF	6000	18988.36375	0.14	0.44	0.87	Yes	Yes	Yes	0.20	0.36	0.24	$ 180,661.31	Moderate	lawn	Ditch and culvert
1	5	6	SF	4000	18988.29206	0.09	0.44	0.87	Yes	Yes	Yes	0.20	0.36	0.24	$ 180,660.63	moderate	lawn and trees	ditch and culvert
1	5	6	SF	3000	18989.44932	0.07	0.44	0.87	Yes	Yes	Yes	0.20	0.36	0.24	$ 180,671.64	moderate	trees and lawn	pipe (15 in) on south
1	5	6	SF	3365	18876.6248	0.08	0.43	0.87	Yes	Yes	Yes	0.30	0.35	0.24	$ 179,598.30	Moderate	forest	pipe (12 in) to west
1	1	2	SF	2439	3048.30	0.06	0.07	0.25	No	No	No	0.03	0.10			Moderate	lawn, imp	Ditch and culvert
1	1	2	SF	4000	1596.58	0.09	0.04	0.26	No	No	No	0.02	0.10			Moderate	lawn	Ditch and culvert
1	1	2	SF	5000	673.90	0.11	0.02	0.26	No	No	NO	0.01	0.09			Flat	lawn	pipe (12 in) to south
0	9	9	PO	18379	30622.7175	0.42	0.70	1.41	Yes	Yes	Yes	0.49	0.57	0.39	$ 291,342.58	moderate	forest	pipe (12 in) to east
1	1	2	SF	4000	6453.66	0.09	0.15	0.48	Yes	No	Yes	0.10	0.20	0.13	$ 99,449.00	moderate	forest	none
1	1	2	SF	4700	5835.79	0.11	0.13	0.48	Yes	No	Yes	0.09	0.20	0.14	$ 100,230.27	Moderate	forest	none
1	1	2	SF	2,300	5078.06	0.05	0.12	0.34	No	No	No	0.04	0.12			flat	lawn	ditch and culvert
1	8	9	SF	3000	23723.30012	0.07	0.54	1.09	Yes	Yes	Yes	0.25	0.44	0.31	$ 225,706.25	Moderate	lawn and trees	Pipe (12 in)
1	8	9	SF	6000	22202.93838	0.14	0.51	1.02	Yes	Yes	Yes	0.23	0.42	0.29	$ 211,242.57	Moderate	lawn and trees	Pipe (12 in)
0	8	8	VAC	0	20445.85519	0.00	0.47	0.94	Yes	Yes	Yes	0.21	0.38	0.26	$ 194,526.89	Moderate	Lawn	Ditch
0	5.681245	5.681245111	UTL	1741	2628.474458	0.04	0.06	0.12	No	No	No	0.02	0.04			Flat	lawn	ditch and culvert
1	1	2	SF	2002	7560.47	0.05	0.17	0.44	No	No	Yes	0.12	0.18	0.12	$ 90,970.75	moderate	forest	none
1	2	3	SF	2200	11065.59603	0.05	0.25	0.61	Yes	No	Yes	0.12	0.25	0.17	$ 126,199.79	Moderate	forest, lawn	none
1	2	3	SF	7000	6265.610023	0.16	0.14	0.61	Yes	No	Yes	0.07	0.25	0.17	$ 126,199.93	moderate	forest, lawn	none
1	3	4	SF	3400	15061.26168	0.08	0.35	0.69	Yes	Yes	Yes	0.16	0.28	0.19	$ 143,301.55	Moderate	lawn, forest	Ditch and culvert
1	2	3	SF	1762	10991.43602	0.04	0.25	0.59	Yes	No	Yes	0.12	0.24	0.16	$ 121,327.45	Moderate	lawn and trees	Ditch and culvert
1	1	2	SF	3000	4489.61	0.07	0.10	0.34	No	No	No	0.05	0.12			Flat to mod	lawn	ditch
1	1	2	SF	5000	3282.21	0.11	0.08	0.38	No	No	Yes	0.03	0.16	0.11	$ 78,791.26	Flat to mod	lawn	detention pipe
1	1	2	SF	3300	4656.85	0.08	0.11	0.37	No	No	Yes	0.05	0.15	0.10	$ 75,696.02	Moderate	lawn	ditch
2	8	10	SF	8800	22293.40581	0.20	0.51	1.02	Yes	Yes	Yes	0.23	0.42	0.29	$ 212,103.22	moderate	lawn and trees	stream
2	27	29	SF	6341	40471.80265	0.15	0.93	1.86	Yes	Yes	Yes	0.42	0.76	0.52	$ 385,040.03	moderate	grass, trees	stream
1	1	2	SF	7465	2793.45	0.17	0.06	0.47	Yes	No	Yes	0.03	0.19	0.13	$ 97,591.90	moderate	trees and lawn	none
1	1	2	SF	3400	4159.96	0.08	0.10	0.35	No	No	No	0.04	0.14			moderate	lawn and trees	none

Table D-2
Champagne Creek Redevelopment Analysis Results

NbrUnits	NetRES	Short-Plat Size	COKLandU	Ex. Impervious Surface estimated from GIS (sq. ft.)	Assumed new Impervious (sq ft)	Ex. Impervious (ac)	Assumed new imperious (ac.)	Total Site Area (ac)	Existing plus new impervious greater than 10,000 sq. ft?	Would flow control be required under Ecology?	Would flow control be required under King County (Kirkland)?	Estimated increase in 100-year peak flow from only new impervious on sites with no flow control (using existing	100-year flow increase from predeveloped forested conditions [b]	Detention size (ac. Ft) (0.28 ratio)[c]	Estimated detention cost per site (75% Lola, 25% Eva, scaled for size, $740,000/ac-ft detention)[d]	Estimated Slope (visual from GIS)	Predominant Landcover (visual from aerial)	Existing conveyance (visual from GIS)
1	**1**	2	SF	5100	2207.02	0.12	0.05	0.34	No	No	No	0.02	0.14			moderate	lawn and trees	ditch and culvert
1	**1**	2	SF	4000	3495.17	0.09	0.08	0.34	No	No	No	0.04	0.14			moderate	trees and lawn	ditch and culvert
1	2	3	SF	4002	8007.346356	0.09	0.18	0.55	Yes	No	Yes	0.08	0.22	0.15	$ 114,248.69	moderate	trees and lawn	ditch and culvert
1	2	3	SF	6190	5529.822384	0.14	0.13	0.54	Yes	No	Yes	0.06	0.22	0.15	$ 111,494.36	Moderate	trees and lawn	Pipe (12 in) to north
1	**1**	2	SF	2381	5278.20	0.05	0.12	0.35	No	No	No	0.06	0.14			moderate	grass, trees	Pipe (18 in) to west
1	2	3	SF	6800	5394.323009	0.16	0.12	0.56	Yes	No	Yes	0.06	0.23	0.16	$ 116,008.44	moderate	trees and lawn	Pipe (12 in) to south
0	47	47	PLOT	170092	172268.6483	3.90	3.95	7.91	Yes	Yes	Yes	1.80	3.22	2.21	$ 1,638,864.94	moderate	grass	private pipes and detention
1	20	21	SF	11500	58642.02454	0.26	1.35	2.69	Yes	Yes	Yes	0.61	1.10	0.75	$ 557,899.08	moderate	Forest, grass	pipe (15 in) on south
2	14	16	SF	10,000	45842.76156	0.23	1.05	2.10	Yes	Yes	Yes	0.48	0.86	0.59	$ 436,135.66	Moderate	Grass, trees	Ditch and culvert
0	2	2	VAC	1945	3761.64	0.04	0.09	0.26	No	No	No	0.04	0.11			moderate	grass	pipe (8 in)
2	**1**	3	SF	8021	5820.195522	0.18	0.13	0.64	Yes	No	Yes	0.06	0.26	0.18	$ 131,675.65	moderate	forest and lawn	none
0	13	13	SF	0	35584.09852	0.00	0.82	1.63	Yes	Yes	Yes	0.37	0.67	0.46	$ 338,541.76	moderate	grass	irrigation pipes?
0	7	7	SF	5000	20614.34734	0.11	0.47	0.95	Yes	Yes	Yes	0.22	0.39	0.27	$ 196,129.81	moderate	lawn	none

[a] Estimated increase in flow was scaled from impervious surface "magic numbers" for impervious surfaces and slope of lot (flat, moderate), and type of land cover (forest or lawn). (Increase impervious/Ac. Imp. that result in increase of 0.15) x by 0.15 = assumed flow increase.

[b] Estimated increase in flow was scaled from 50% imp, 50% pervious "magic numbers" for slope of lot (flat, moderate). (Lot size/Ac. 50%imp+50%perv that result in increase of 0.15) x by 0.15 = assumed flow increase.

[c] Estimated detention size is equal to lot size multiplied by 0.28, which is the average ratio of detention size (ac.-ft.) to lot size for the first five real parcels evaluated in Task 2 (2- to 4-lot short plats)

[d] Estimated cost of detention is equal to 75% of the cost of detention per ac-ft for Lola short plat plus 25% of the cost of detention per ac-ft for Eva short plat ($740,000/ac-ft).

No detention required under Ecology or King County
Detention required by King County, but not by Ecology
Exceeds 10,000 sq. ft. threshold, but not Ecology flow threshold
Detention required under both manuals, and exceeds 10,000 sq. ft. threshold

Attachment E
Table of WWHM Modeling Area Factors

AltaTerra

Area shown in the table is the surface area for the given land cover/slope/precipitation factor that will result in an increase of 0.15 cfs.

Magic Numbers in WWHM2012 (Using 15-Minute Timesteps)

Precipitation Factor	Land Cover	Area (SF)	Area (Acres)	100-Year Peak Flow Increase (CFS)
0.833	Imp, Flat	10,381	0.238	0.15
0.833	Imp, Mod	8,741	0.201	0.15
0.833	Imp, Steep	8,224	0.189	0.15
0.833	Lawn, Flat	25,624	0.588	0.15
0.833	Lawn, Mod	22,423	0.515	0.15
0.833	Lawn, Steep	19,128	0.439	0.15
0.833	Forest, Flat	121,097	2.780	0.15
0.833	Forest, Mod	116,741	2.680	0.15
0.833	50% Imp, 50% Lawn, Flat	19,036	0.437	0.15
0.833	50% Imp, 50% Lawn, Mod	16,054	0.369	0.15
0.833	Forest, Steep	80,865	1.856	0.15
0.833	50% Forest, 50% Lawn, Flat	22,063	0.507	1.15
0.833	50% Forest, 50% Lawn, Mod	19,161	0.440	2.15
0.833	Convert: C, Forest Flat to Imp. Flat	11,353	0.261	0.15
0.833	Convert: C, Forest Mod to Imp. Mod	9,449	0.217	0.15
0.833	Convert: C, Forest Steep to Imp. Steep	9,155	0.210	0.15
0.833	Convert: C, Lawn Flat to Imp. Flat	17,459	0.401	0.15
0.833	Convert: C, Lawn Mod to Imp. Mod	14,329	0.329	0.15
0.833	Convert: C, Lawn Steep to Imp. Steep	14,417	0.331	0.15
0.833	Convert: C, Forest Flat to C, Lawn Flat	32,496	0.746	0.15
0.833	Convert: C, Forest Mod to C, Lawn Mod	27,754	0.637	0.15
0.833	Convert: C, Forest Steep to C, Lawn Steep	25,054	0.575	0.15
1	Imp, Flat	8,429	0.194	0.15
1	Imp, Mod	7,126	0.164	0.15
1	Imp, Steep	6,680	0.153	0.15
1	Lawn, Flat	15,999	0.367	0.15
1	Lawn, Mod	14,488	0.333	0.15
1	Lawn, Steep	13,417	0.308	0.15
1	Forest, Flat	84,554	1.941	0.15
1	Forest, Mod	68,729	1.578	0.15
1	Forest, Steep	47,325	1.086	0.15
1	50% Imp, 50% Lawn, Flat	14,308	0.328	0.15
1	50% Imp, 50% Lawn, Mod	12,390	0.284	0.15
1	50% Forest, 50% Lawn, Flat	13,173	0.302	1.15
1	50% Forest, 50% Lawn, Mod	11,773	0.270	2.15
1	Convert: C, Forest Flat to Imp. Flat	9,365	0.215	0.15
1	Convert: C, Forest Mod to Imp. Mod	7,949	0.182	0.15
1	Convert: C, Forest Steep to Imp. Steep	7,772	0.178	0.15
1	Convert: C, Lawn Flat to Imp. Flat	17,828	0.409	0.15
1	Convert: C, Lawn Mod to Imp. Mod	14,013	0.322	0.15
1	Convert: C, Lawn Steep to Imp. Steep	13,299	0.305	0.15
1	Convert: C, Forest Flat to C, Lawn Flat	19,732	0.453	0.15
1	Convert: C, Forest Mod to C, Lawn Mod	18,354	0.421	0.15
1	Convert: C, Forest Steep to C, Lawn Steep	18,723	0.430	0.15

Attachment F
Stormwater Fee-in-lieu Summary Sheets

Stormwater Fee-in-Lieu Alternative A

Description: This alternative involves City development of a regional facility at a downstream location within a sub-basin and allow developers of certain short-plats to either (1) buy-in to the regional facility for equivalent detention required by the Kirkland/King County manual and not provide on-site detention if they fall below the Ecology manual criteria for detention, or (2) provide on-site detention according to the Kirkland/King County manual.

Background:

- Over 200 parcels are anticipated to be redeveloped into short-plats in a sub-area of the Forbes Creek Basin (shown in orange, pink and green) on Figure 1. Sub-area is outlined with a pink-dashed line.
- Over 100 parcels in the sub-area (shown in orange) would not trigger detention under the Ecology manual because they would be less than 10,000 square feet impervious and/or would result in less than 0.15 cfs flow increase over existing conditions for the 100-year peak flow. However, these same parcels would trigger detention under Kirkland's design manual (King County) requirements.
- Kirkland maintenance staff expressed frustration with inspection/maintenance of short-plat detention facilities because they are often in backyards (hard to access), not cared for (i.e., paved over), and increase workload because of the number of facilities.
- Kirkland developers have expressed frustration with building and siting detention facilities on short-plats because of conflicts with other City codes (i.e., tree retention), utilities, and building and site design.
- City Council has expressed an interest in making stormwater requirements easier for developers, but also not wanting to cause undo impacts to the environment.
- Stormwater Fee-in-lieu Alternative A and C represent alternatives that meets objectives for maintenance staff, developers, and City Council.

Assumptions:

- City would have the option of implementing this program with voluntary or compulsory participation by developers.
- City would build a regional facility in a downstream location within a basin of interest that is expected to redevelop. Figure 1 shows example regional facility in City park.
- City would allow developers whose lots met certain criteria to purchase detention in the regional facility equivalent to what would be required for on-site detention according to Kirkland requirements (King County manual). If developers chose to purchase detention in the regional facility, they would not be required to provide any on-site detention. If they chose not to purchase detention, they would be required to provide detention as Kirkland requires (King County manual).
- In order to participate, criteria that must be met is:
    - Impervious surface is <10,000 square feet
    - 100-year flow increase is <0.15 cfs from existing to proposed development (Ecology)
    - 100-year flow increase is >0.15 cfs from forested to proposed development (King County)
- By meeting Ecology criteria for NOT requiring detention, assumption is that there is no significant change to existing conditions.
- No basin transfer would occur. Treatment would occur in the same drainage basin.

Stormwater Fee-in-Lieu Alternative A

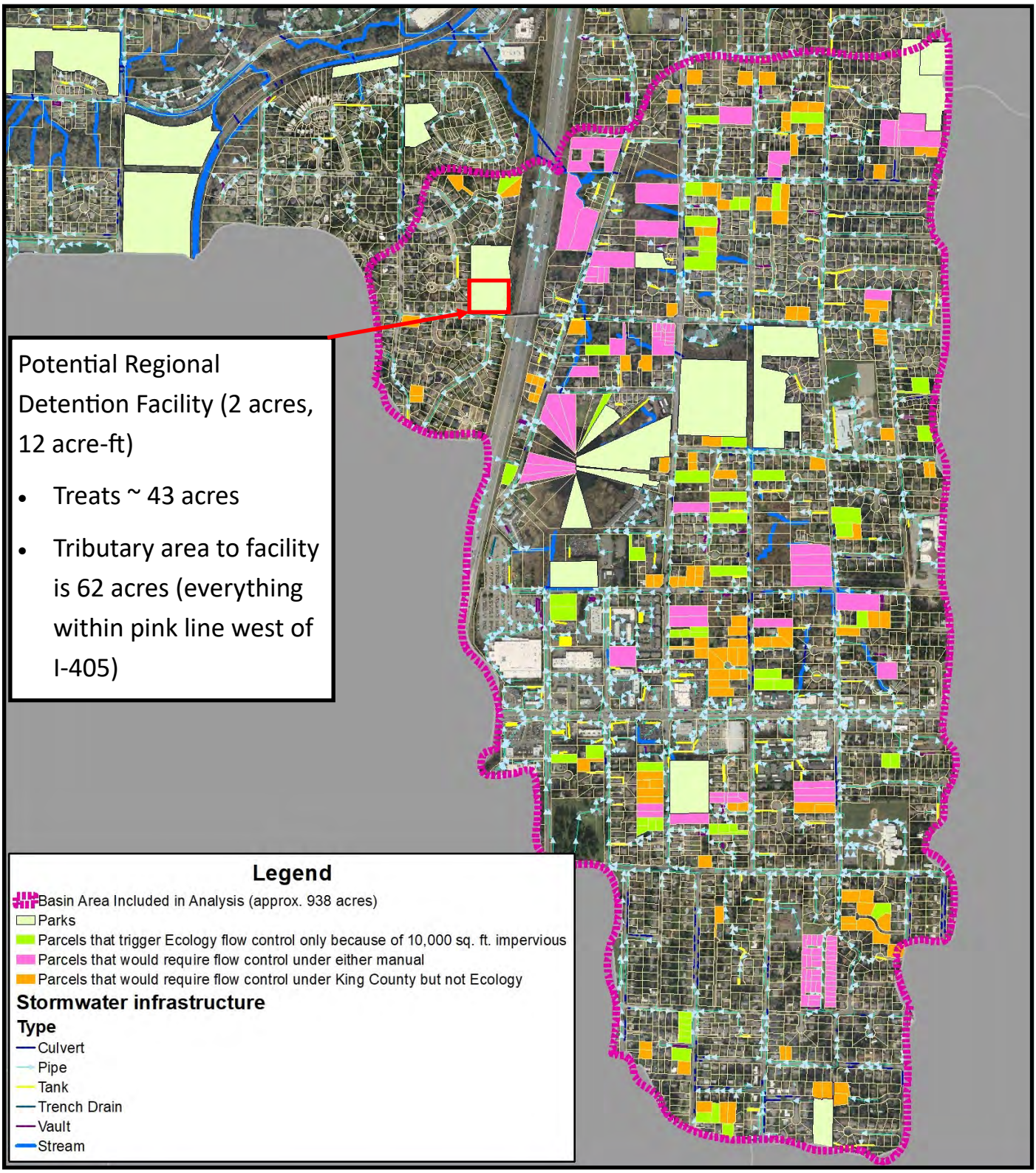

Figure 1. Forbes Creek Basin Sub-Area Analysis, showing potential regional detention facility location.

Stormwater Fee-in-Lieu Alternative A

Regional Detention Facility Size	Estimated Treatment Capacity	Estimated Treatment Needs (orange and green parcels)	Redevelopment parcels served by example regional facility	Estimated Cost of Regional Facility (without conveyance)
2 acres	12 acre-ft (43 acres developed parcels)	19.2 acre-ft	62%	~$9 million

Considerations for where City would implement this type of program:

1. Only for short-plats that fall within the criteria of meeting Ecology requirements for NO detention, but needing detention under King County. These are 2– or 3-lot short plats.
2. Only where regional detention can be built in locations downstream of most of the development, and upstream of any sensitive issues or ongoing impacts.
3. Where there is enough redevelopment anticipated to make a regional facility economical for the City to construct and recoup costs.
4. Voluntary or compulsory participation by developers? Voluntary participation will result in greater certainty for recouping costs; compulsory participation may require City to build additional facilities to keep up with demand.

Stormwater Fee-in-Lieu Alternative B

Description: This alternative involves City development of a regional facility at location within a sub-basin downstream of expected redevelopment and allow developers of certain short-plats to either (1) buy-in to the regional facility for equivalent detention required by the Kirkland/King County manual and not provide on-site detention if they fall below the Ecology manual criteria for detention, or (2) provide on-site detention according to

Background:

- Over 200 parcels are anticipated to be redeveloped into short-plats in a sub-area of the Forbes Creek Basin (shown in orange, pink and green) on Figure 1. Sub-area is outlined with a pink-dashed line.
- Over 100 parcels in the sub-area (shown in orange) would not trigger detention under the Ecology manual because they would be less than 10,000 square feet impervious and/or would result in less than 0.15 cfs flow increase over existing conditions for the 100-year peak flow. However, these same parcels would trigger detention under Kirkland's design manual (King County) requirements.
- Kirkland maintenance staff expressed frustration with inspection/maintenance of short-plat detention facilities because they are often in backyards (hard to access), not cared for (i.e., paved over), and increase workload because of the number of facilities.
- Kirkland developers have expressed frustration with building and siting detention facilities on short-plats because of conflicts with other City codes (i.e., tree retention), utilities, and building and site design.
- City Council has expressed an interest in making stormwater requirements easier for developers, but also not wanting to cause undo impacts to the environment.
- Stormwater Fee-in-lieu Alternative B represents an alternative that meets objectives for maintenance staff, developers, and City Council.

Assumptions:

- City would build a regional facility in a downstream location within a basin of interest that is expected to redevelop. Figure 1 shows example regional facility located within the same vicinity as the expected redevelopment.
- City would allow all developers purchase detention in the regional facility equivalent to what would be required for on-site detention according to Kirkland requirements (King County manual). If developers chose to purchase detention in the regional facility, they would not be required to provide any on-site detention. If they chose not to purchase detention, they would be required to provide detention as Kirkland requires (King County manual).
- No basin transfer would occur. Treatment would occur in the same threshold discharge area.

Stormwater Fee-in-Lieu Alternative B

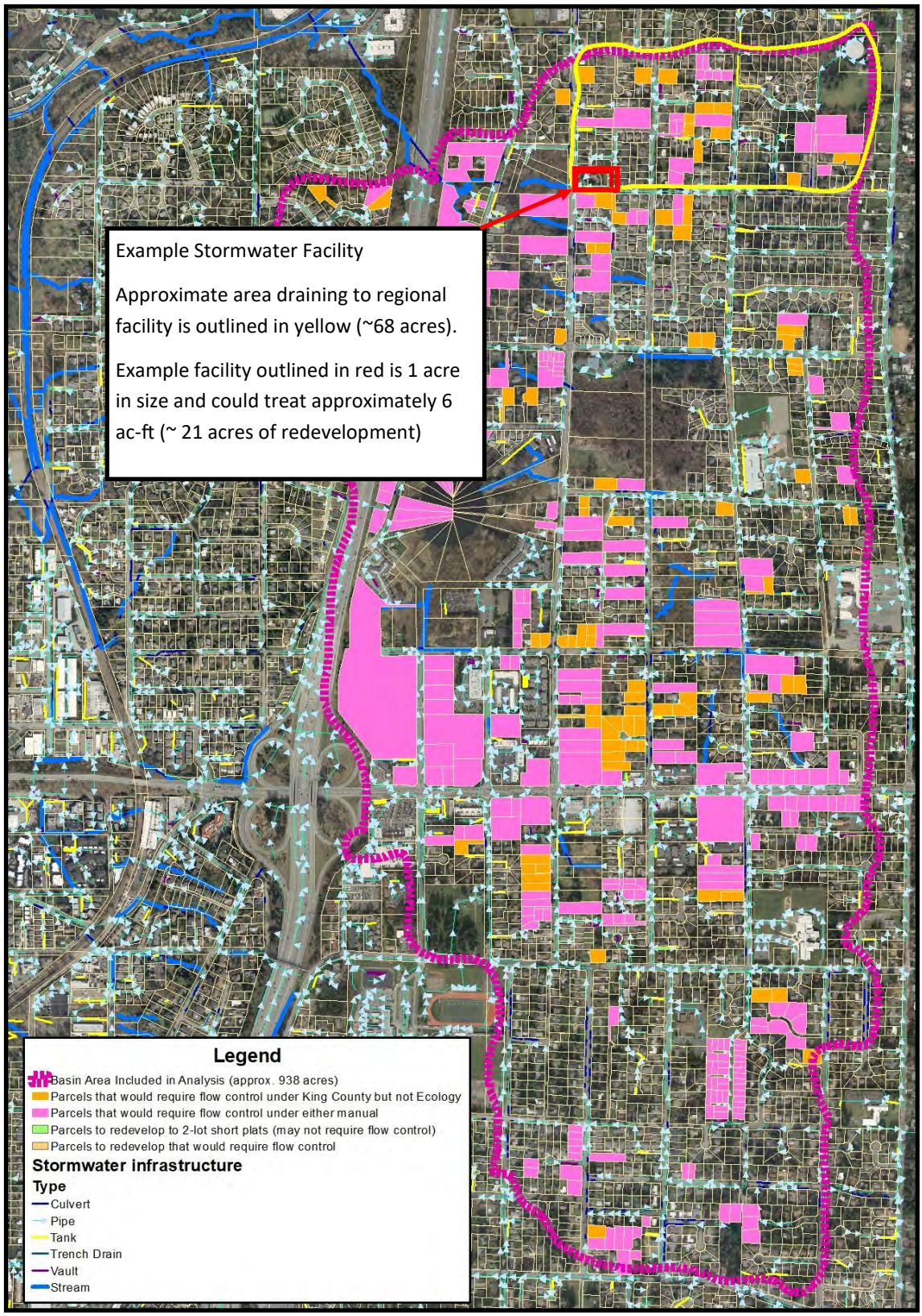

Figure 1. Forbes Creek Basin Sub-Area Analysis, showing potential regional detention facility location.

Stormwater Fee-in-Lieu Alternative B

Regional Detention Facility Size	Estimated Treatment Capacity	Estimated Treatment Needs (all redevelopment parcels in area shown)	Redevelopment parcels served by example regional facility	Estimated Cost of Regional Facility (without conveyance)
1 acres	6 acre-ft (21 acres developed parcels)	~12 acre-ft	>100%	~$4.5 million

Considerations for where City would implement this type of program:

1. All development within treatment area could be allowed to buy-in to facility to provide more certainty for City.
2. Facility could be sized to provide retrofit for untreated surfaces in neighborhood.
3. Where there is enough redevelopment anticipated to make a regional facility economical for the City to construct and recoup costs.

Attachment G
Implementation Steps for Stormwater Fee-in-lieu
Alternative A

AltaTerra

City of Kirkland
Pilot Stormwater Fee-in-Lieu Program
Scope of Work and Budget Estimate 3/19/2019

Introduction and Background

In the City's evaluation of the benefits and potential implications of modifying flow control standards for small short plats, alternative methods for achieving flow control basin-by-basin were evaluated. A pilot stormwater fee-in-lieu program has promise for the Forbes Creek basin because of the level of redevelopment that is anticipated to convert single family residential properties into small short plat developments consisting of two or more homes.

The scope and budget is to conduct technical and financial analysis necessary to implement the pilot project and design and operate a regional stormwater facility in the Forbes Creek basin (Figure 1).

Goals and Objectives

The specific project objectives include:

- Evaluate basin options for siting of a regional facility.
- Conduct neighborhood outreach in the vicinity of proposed regional stormwater facility.
- Evaluate financial risks and environmental benefits of the stormwater fee-in-lieu program.
- Develop technical criteria for participation in fee-in-lieu program and associated City stormwater policy modifications.
- Develop financial elements of the program, including price per credit in facility, escalation factors, etc.
- Develop 30% Plans, Specifications and Engineer's Estimate for regional stormwater facility.

Project Tasks

The tasks below describe the work that will be conducted to accomplish the project goals. All reports, agendas, models, and memos will be provided to the City in native electronic format.

Task 1- Project Management

Project management will include communications with the City of Kirkland Project Manager and the consultant team; scheduling and oversight of the various project activities; budget and schedule tracking and oversight, including preparation of monthly invoices and progress reports.

Assumptions:

- The project will be 12 months in duration, from May 2019 through April 2020.
- Monthly invoices and progress letters will provide a summary of budget status by task.
- A project kick-off meeting will be held with key Consultant team members and City staff. The meeting will last no more than 2 hours. The Consultant Project Manager will develop the agenda, prepare and provide copies of all necessary materials; take notes and provide a meeting summary. It is assumed that three members of the Consultant team will participate.
- Bi-weekly phone calls with Consultant and City Project Manager to discuss project progress, upcoming events and tasks, and any potential issues and remedies. The meetings are anticipated to be no more than ½ hour.

Deliverables:

- Twelve (12) monthly progress reports and project invoices.
- Project kick-off meeting agenda, materials, and meeting notes.
- Bi-weekly phone call notes.

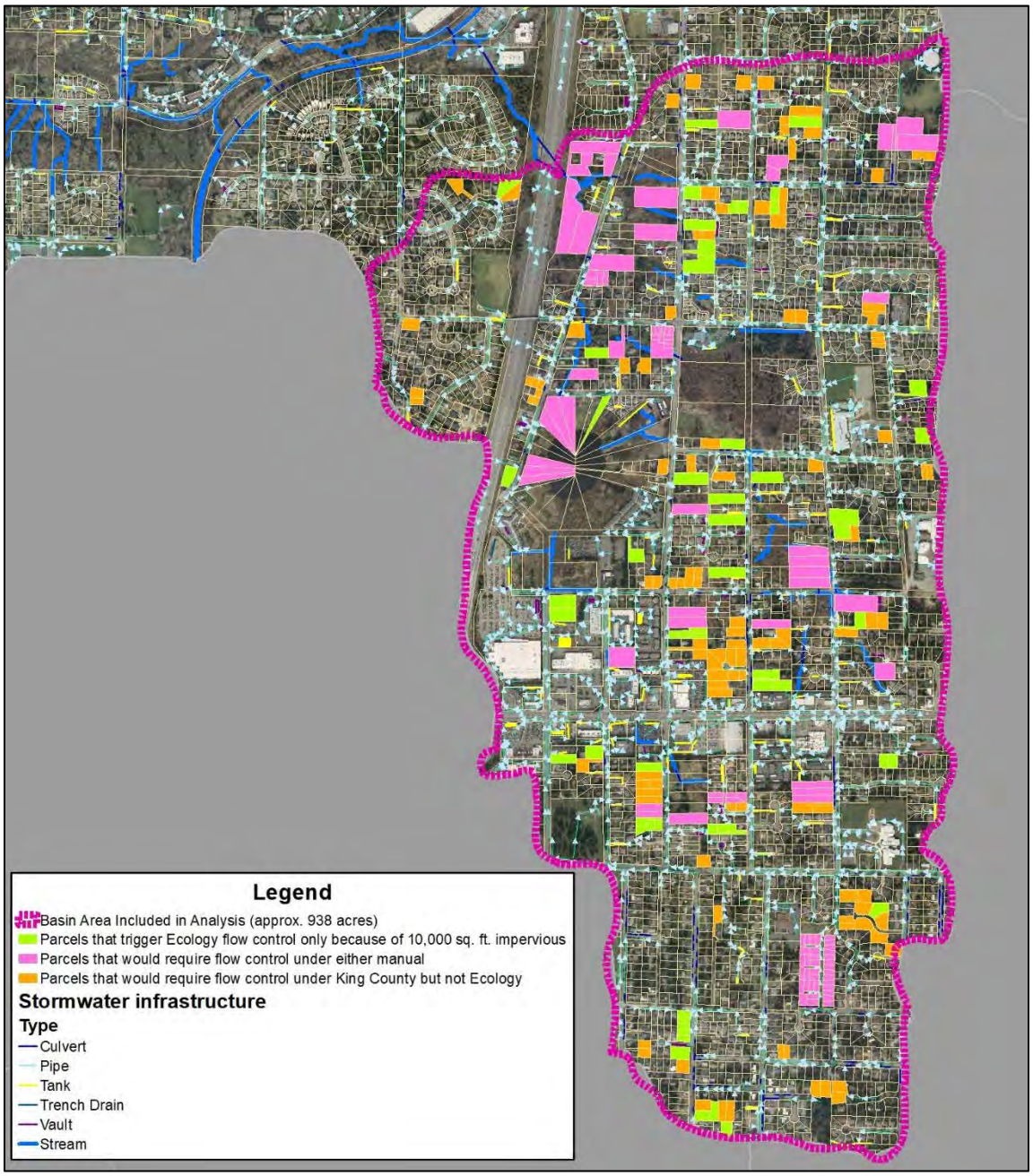

FIGURE 1. BASIN AREA INCLUDED IN PILOT STORMWATER FEE-IN-LIEU PROGRAM (OUTLINED IN PINK). REDEVELOPMENT PARCELS ARE SHOWN IN ORANGE, GREEN AND PINK.

Task 2- Pilot Area Evaluation

This task involves field review of the pilot project area to verify basin conditions, including open channel conveyances, existing stormwater facilities, and potential public properties for regional facility siting. Analysis to date completed on the pilot project area has been desk-top and GIS-based, so it will be necessary to verify that the

existing environmental conditions in the basin are unlikely to be impacted by in-basin mitigation swapping and the pilot regional stormwater facility is located where stormwater flow control is necessary and conveyance is feasible. Construction of a new regional facility will need to be designed to blend into neighborhood and/or park amenities that will be accepted by the public. Community outreach will be conducted in the vicinity of the proposed stormwater facility to solicit feedback on potential design options that will help ensure long-term project acceptance and success.

The following subtasks will be completed.

Task 2.1 Conduct document and data review

A document and data review will be conducted in the pilot basin area, including GIS data, current parcel development information to show which parcels are still available for redevelopment, modeling data (Forbes Creek Hydrologic Simulation Program-Fortran [HSPF] Hydrologic Model), geotechnical data, and critical areas studies.

Assumptions:

- The City will provide the relevant information prior to the start of the task including:
    - Updated GIS information with stormwater infrastructure, geologic mapping, and natural resources data.
    - Updated parcel development data to show parcels that redeveloped after the initial redevelopment analysis was conducted for the Forbes Creek basin.
    - Forbes Creek Hydrologic Simulation Program-Fortran (HSPF) Hydrologic Model
    - Geotechnical information for park parcels or public property that is of interest for potential stormwater facility development.
    - Critical areas studies conducted for development and/or public projects in the basin area.
- A GIS screening process will be conducted to confirm feasible regional facility sites. Up to 3 public properties will be identified for field reconnaissance.

Deliverables:

None. Data summaries will be provided in a memorandum describing results of evaluation (Task 2.7).

Task 2.2 Field reconnaissance

A field reconnaissance will be conducted based on the document and data review to visually observe existing stormwater facilities, stormwater conveyance including open channel conditions, and public properties that could be utilized for regional stormwater flow control.

Assumptions:

- Three members of the consultant team will conduct two (2) reconnaissance field visits of the Forbes Creek drainage area to review conveyance conditions, stormwater facility conditions, open channel conditions, natural resources, or other field conditions that warrant consideration for the stormwater fee-in-lieu pilot program. The field visits are expected to be one day in length.

Deliverables:

None. Field reconnaissance summaries will be described in the memorandum describing results of evaluation (Task 2.7)

Task 2.3 Hydrologic and hydraulic modeling

The existing Forbes Creek HSPF will be updated to evaluate potential regional facility in the pilot basin area. Additionally, the Western Washington Hydrologic Model (WWHM) may be used for the existing facility improvements, whichever modeling tool is most efficient.

Deliverables:

Updated model(s) will be provided to the City at the completion of this task. The model(s) will be used in evaluation of preliminary options (Task 2.4).

Task 2.4 Evaluate preliminary options

Public properties identified for potential regional facilities identified in Task 2.2 will be evaluated for feasibility in this subtask.

Assumptions:

- The existing drainage conveyance and contributing area characteristics in the vicinity of potential stormwater facility locations will be reviewed to determine conveyance, flow control, and water quality treatment feasibility.
- Modeling will be conducted to evaluate how improvements and/or new facilities can be used to meet flow control and water quality goals.
- Alternatives will be ranked according to their ability to meet technical pilot program objectives (flow control and water quality).

Deliverables:

Ranked alternatives and description of challenges, opportunities, and technical feasibility. Alternatives will be described in the memorandum describing results of evaluation (Task 2.7).

Task 2.5 Conduct community outreach

Community outreach will be conducted in the pilot basin area to identify community preferences, particularly on public properties. Community engagement is expected to include door-to-door canvassing in the immediate vicinity of potential stormwater facility upgrades and/or new facilities and community meeting targeting stakeholders.

Assumptions:

- At least 2 community meetings will be held to convey project details and solicit public opinion.
- Door-to-door canvassing will be conducted in near neighborhoods to solicit project input.

Deliverables:

Presentation materials, brochures and outreach materials to effectively convey project options to the public. Results of community outreach will be provided in the memorandum in Task 2.7.

Task 2.6 Geotechnical borings

Geotechnical borings will be advanced in up to four locations. The borings will either be used to assist in the evaluating how many redevelopment sites may opt out of the fee-in-lieu program due to good infiltration potential or will be used to aid in the development of 30% stormwater flow control and water quality treatment concepts.

Assumptions:

- At least 3 borings will be advanced at the site of the preferred regional facility; two shallow (up to 30 feet below ground surface) and one deep (up to 100 feet below ground surface).
- Up to three shallow (less than 10 feet) borings will be advanced in up to three locations where clusters of redevelopment is expected to occur so that subsurface conditions can be preliminarily assessed in these areas.
- The geotechnical data will be used to evaluate potential infiltration options, if feasible, groundwater depths and considerations for vault construction (if that option is chosen).

Deliverables:

Boring logs and memorandum describing results of geotechnical analysis.

Task 2.7 Selection of Preferred Alternatives and Technical Memorandum

Following the completion of the pilot area evaluation, it is anticipated that a single preferred location for a regional stormwater flow control and water quality facility and potentially upgrades to existing stormwater facilities will be selected. A technical memorandum will be prepared documenting the results of the pilot basin area evaluation, including modeling, geotechnical analysis, field reconnaissance, community outreach and selection of a preferred alternatives.

Assumptions:

- The memorandum will be no more than 30 pages, including tables and figures.
- The City will provide a consolidated set of review comments on the draft memorandum.
- All documents will be submitted electronically in Word and PDF formats.
- The final memorandum will incorporate the City's revisions.

Deliverables:

Draft and final memorandum.

Task 3- 30% Concept Plans and Engineering Estimate

This task involves preparing an engineering design report and concept drawings for the preferred alternative for the regional stormwater flow control and water quality facility. The 30% concept design tasks will include the following:

1. Facility size and flow calculations.
    a. Modeling will be conducted to size facility based on anticipated flow from contributing area. If necessary, a bypass or flow-splitter will be designed if space is limited.
    b. Facility will be sized to detain flow and provide water quality treatment in accordance with the 2016 King County Surface Water Design Manual (KCSWDM) and the City of Kirkland Addendum to the KCSWDM.
2. Flow metering at up to 3 locations for 6 months to calibrate flow model predictions.
3. Topographic survey of preferred site and contributing conveyance upgrades, if needed.
4. Locations and sizes of conveyance upgrades, if necessary.
5. Design report summarizing results of analysis and engineering design elements.
6. 30% Plans including site layout, flow control and water quality facilities, conveyance improvements, and details using Ecology Pre-Design format.
7. 30% Engineering cost estimate.
8. Schedule for development of 60%, 90% and final construction drawings and construction.

Deliverables:

- Draft and final design report.
- Preliminary, draft and final 30% Design Plans in Ecology Pre-Design format.

Task 4- Financial Analysis

This task involves conducting financial evaluation of the stormwater fee-in-lieu program including financing of the regional facility. The following analysis will be conducted:

1. Cost to design and construct the regional stormwater facility and potential financing options.
2. Operation and maintenance costs for regional stormwater facility compared to operation and maintenance costs for maintaining on-site facilities.
3. Develop unit-costs for stormwater credits, using cost models to compare on-site detention costs for developers and different risk profiles for the City to recoup costs of facility construction.
4. Assist City in developing an adjustment process for developers that choose to opt out of the program.
5. Assist City in development of tracking system to manage fee-in-lieu program.

6. Evaluate transferability of cost assumptions to other basins if program is expanded beyond pilot area.

The City will assist the consultant team in developing the above costs and assumptions to determine whether the City can break even on a stormwater fee-in-lieu facility at a price-point that makes sense for developers.

The following assumptions and deliverables are associated with this subtask.

Assumptions:

- The consultant team will conduct the financial analysis, including financing options for construction and operation of the facility and development of unit costs per credit of detention, with input from the City finance department.

Deliverables:

- Draft and final technical memorandum documenting results and recommendations of financial analysis.

Task 5- Policy Updates and Coordination with Ecology

This task involves assisting the City in the development of a policy addendum to Kirkland's stormwater code to allow stormwater fee-in-lieu in basins where regional stormwater facilities are constructed and a program is set-up for that purpose. Additionally, assistance will also be provided to coordinate with Ecology, if NPDES Permit modifications are necessary as a result of the stormwater fee-in-lieu program.

Assumptions:

- An NPDES Permit modification is not likely necessary as Ecology has indicated preliminary approval of the stormwater fee-in-lieu program concept as presented in January 2019.
- A policy describing the stormwater fee-in-lieu program is necessary as an addendum to the City's stormwater code that describes the program and provides staff and developers with an understanding of the key elements.
- The consultant team will provide policy and/or Ecology assistance, as required.

Deliverables:

- Draft policy language.
- Coordination with Ecology.

Budget

The estimated budget for this project is $477,640. Table 1 shows the preliminary estimates to complete each task as scoped above.

TABLE 1. BUDGET SUMMARY

Task	Estimate
1- Project Management	$13,130
2- Verify Site Conditions	$238,460
Conduct Document Review	*$10,923*
Field Reconnaissance	*$9,047*
H&H Modeling	*$83,858*
Evaluation Preliminary Options	*$27,924*
Geotechnical Analysis	*$57,962*
Community Outreach	*$27,923*
Draft and Final Technical Memorandum	*$20,823*
3- 30% Plans and Estimate	$140,450
4- Financial Analysis	$60,110
5- Policy Updates and Coordination with Ecology	$25,490
Total	**$477,640**