PRELIMINARY
STORM DRAINAGE REPORT

FOR

STROM PROPERTY

REDMOND, WASHINGTON

10/2/2013

Prepared By: James Olsen, P.E., Michael A. Moody, P.E.
Date: April 2011
Revised: July 2013, October 2013

Core No.: 10079

STROM PROPERTY
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SECTION 1. PROJECT OVERVIEW

The Strom Property is a proposed single family residential development located approximately at the 11900 Block of the extension of 159th Avenue NE in Redmond. Washington. The subject property is 5.74 acres in size (250,034 sf) of which approximately 1.78 acres will be developed. A portion of the east side of the property that will be dedicated as ROW for the Greystone PRD is not included in the 1.78 acres of development. This is accounted for in the Greystone PRD project and will be constructed prior to the Strom plat development. The property is bordered by a large single family lot to the north, large single family lots to the east that will soon be developed as the Greystone PRD and residences to the west and south that is the Pyke (Kensington) development. See *Figure 1-1: Vicinity Map* on the following pages.

The property is currently vacant and forested. The portion of the property to be developed on the east side of the property generally slopes to the northwest with slopes varying from approximately 5% to 10%. The western portion of the property which will remain in its native state consists of steep slopes which drain to a ravine that runs north through the property. Stormwater runoff ultimately discharges to the NE 124th Street drainage system approximately 1,200 feet from the north property boundary.

Proposed development of the property will include construction of 13 single-family homes, along with an access tract, utilities and an open space/stormwater tract. Detention and water quality will be provided by an onsite combined detention/water quality vault located in Tract A.

The onsite vault has been designed per the requirements within the Washington State Department of Ecology's Stormwater Management Manual for Western Washington, February 2005 Edition and the City of Redmond Technical Notebook Issue 6. The drainage analysis for detention sizing was modeled using the King County Runoff Time Series software and includes the Strom developed basin. The drainage analysis for water quality sizing was modeled using WaterWorks hydrology software utilizing SBUH methodology and also includes both projects. Refer to Section 4 for more detail on the combined flow control and water quality calculations.

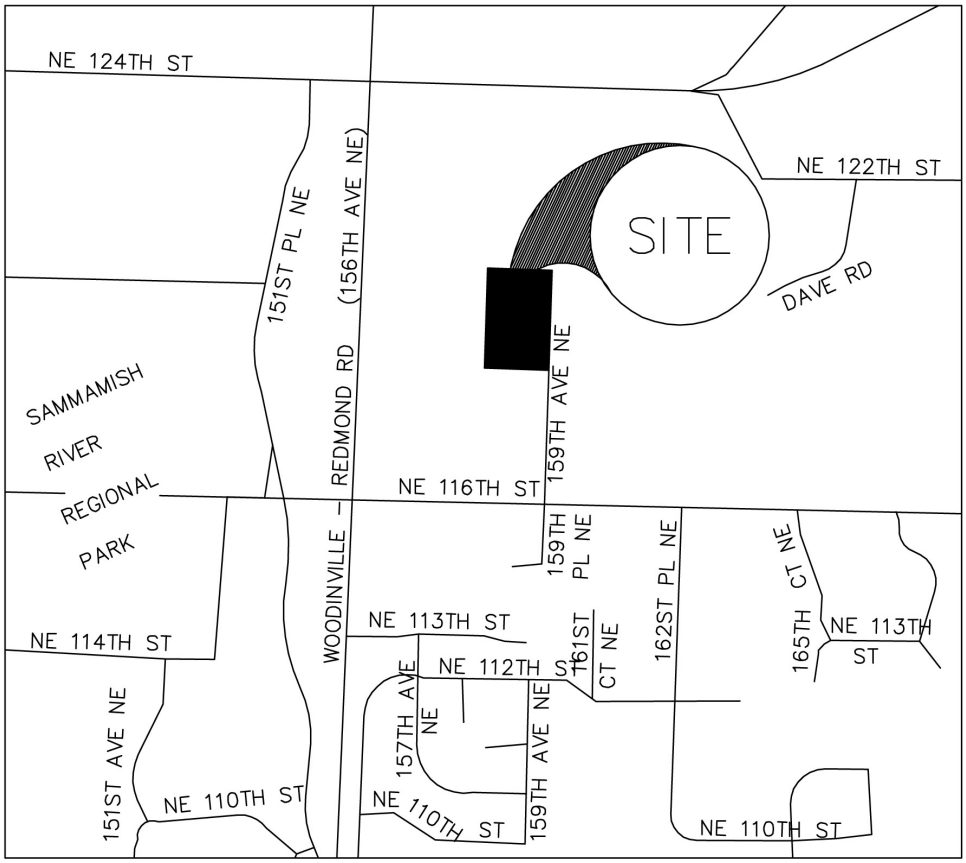


Figure 1-1: Vicinity Map

Wellhead Protection Zone Limitations

The project site, per the City of Redmond's Wellhead Protection Zone Map (shown below) is within Wellhead Protection Zone 4. See *Figure 1-2: City of Redmond Wellhead Protection Zone Map* included below.

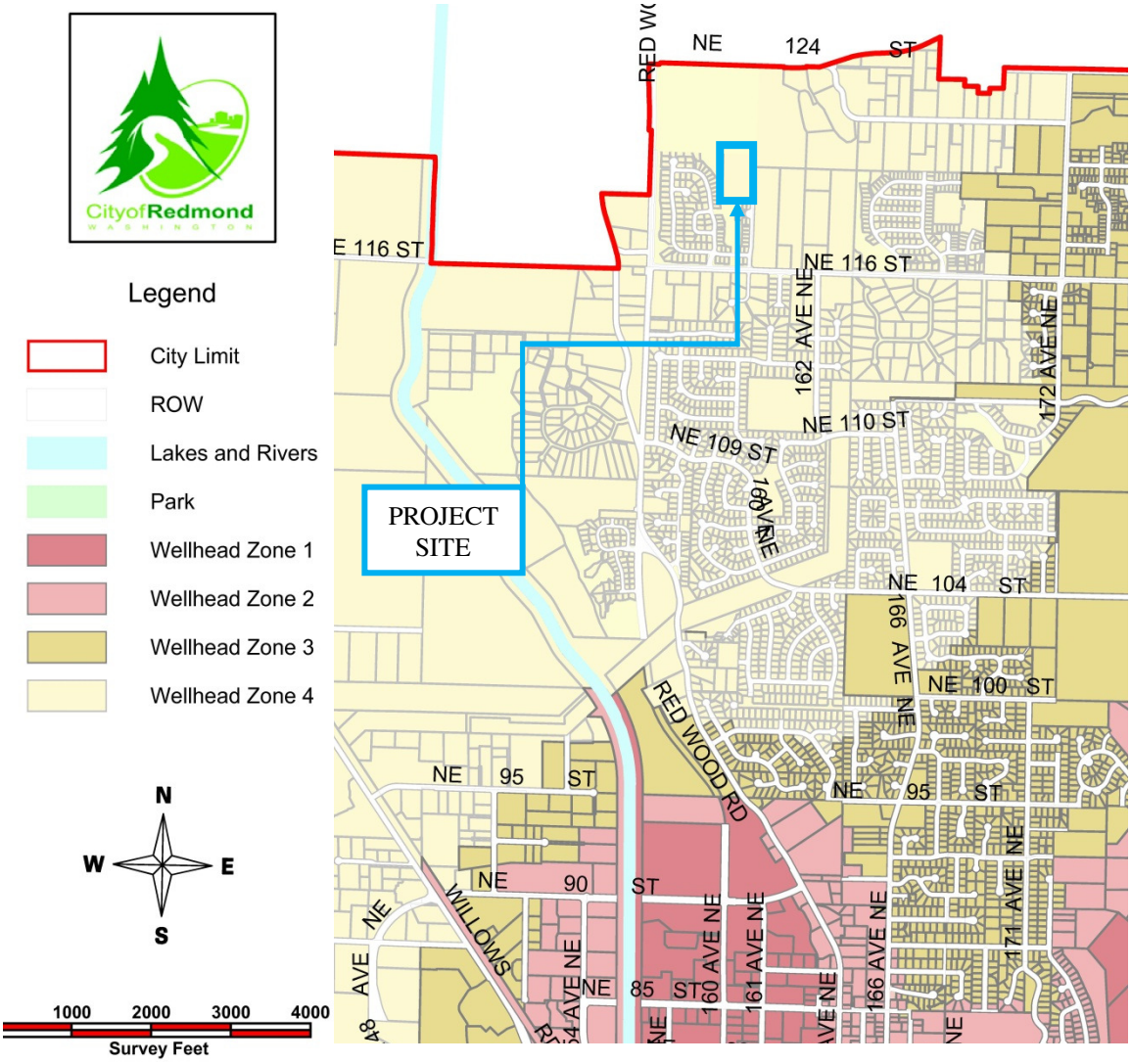


Figure 1-2: City of Redmond Wellhead Protection Zone Map

New Search | Property Tax Bill | Map This Property | Glossary of Terms | Area Report | Print Property Detail

PARCEL DATA

Parcel	262605-9014
Name	BURNSTEAD CONSTRUCTION LLC
Site Address	
Residential Area	072-004 (NE Appraisal District)
Property Name	

Jurisdiction	REDMOND
Levy Code	2025
Property Type	R
Plat Block / Building Number	
Plat Lot / Unit Number	
Quarter-Section-Township-Range	SE-26-26-5

Legal Description

LOT 3 LESS POR LY W OF LN DAF - BEG AT SE COR LOT 1 TH S 01-42-49 W TO S LN SD LOT 3 & TERM SD LN DESC - BOTH OF KC SHORT PLAT NO 181077 REC #8109300611 SD SP DAF- S 5 AC OF NW 1/4 OF SE 1/4 TGW SW 1/4 OF SE 1/4 SD SEC LESS S 25 ACS THOF & LESS 156TH AVE NE - PER KC LOT LN ADJ NO 484088 APPROVED 4-26-84
PLat Block:
Plat Lot:

LAND DATA

Highest & Best Use As If Vacant	SINGLE FAMILY
Highest & Best Use As Improved	(unknown)
Present Use	Vacant(Single-family)
Base Land Value SqFt	0
Base Land Value	1,040,000
% Base Land Value Impacted	40
Base Land Valued Date	1/23/2008
Base Land Value Tax Year	2009
Land SqFt	250,034
Acres	5.74

Percentage Unusable	0
Unbuildable	NO
Restrictive Size Shape	NO
Zoning	R4
Water	WATER DISTRICT
Sewer/Septic	(none)
Road Access	PRIVATE
Parking	
Street Surface	

Views

Rainier	
Territorial	
Olympics	
Cascades	
Seattle Skyline	
Puget Sound	
Lake Washington	
Lake Sammamish	
Lake/River/Creek	
Other View	

Waterfront

Waterfront Location	
Waterfront Footage	
Lot Depth Factor	
Waterfront Bank	
Tide/Shore	
Waterfront Restricted Access	
Waterfront Access Rights	NO
Poor Quality	
Proximity Influence	NO

Designations

Historic Site	
Current Use	
Nbr Bldg Sites	
Adjacent to Golf Fairway	NO
Adjacent to Greenbelt	NO
Other Designation	NO
Deed Restrictions	NO
Development Rights Purchased	NO
Easements	NO
Native Growth Protection Easement	NO
DNR Lease	NO

Nuisances

Topography	NO
Traffic Noise	
Airport Noise	
Power Lines	NO
Other Nuisances	NO

Problems

Water Problems	NO
Transportation Concurrency	NO
Other Problems	NO

Environmental

Environmental	NO

BUILDING

Reference Links:

- King County Tax Links
- Property Tax Advisor
- Washington State Department of Revenue (External link)
- Washington State Board of Tax Appeals (External link)
- Board of Appeals/Equalization
- Districts Report
- iMap
- Recorder's Office

  Scanned images of surveys and other map documents

TAX ROLL HISTORY

Account	Valued Year	Tax Year	Omit Year	Levy Code	Appraised Land Value	Appraised Imps Value	Appraised Total Value	New Dollars	Taxable Land Value	Taxable Imps Value	Taxable Total Value	Tax Value Reason
262605901400	2012	2013		2025	$836,000	$0	$836,000	$0	$836,000	$0	$836,000	
262605901400	2011	2012		2025	$832,000	$0	$832,000	$0	$832,000	$0	$832,000	
262605901400	2010	2011		2025	$884,000	$0	$884,000	$0	$884,000	$0	$884,000	
262605901400	2009	2010		2025	$884,000	$0	$884,000	$0	$884,000	$0	$884,000	
262605901400	2008	2009		2025	$1,040,000	$0	$1,040,000	$0	$1,040,000	$0	$1,040,000	
262605901400	2007	2008		2025	$890,000	$0	$890,000	$0	$890,000	$0	$890,000	
262605901400	2006	2007		2025	$802,000	$0	$802,000	$0	$802,000	$0	$802,000	
262605901400	2005	2006		2025	$764,000	$0	$764,000	$0	$764,000	$0	$764,000	
262605901400	2004	2005		2025	$695,000	$0	$695,000	$0	$695,000	$0	$695,000	
262605901400	2003	2004		2025	$662,000	$0	$662,000	$0	$662,000	$0	$662,000	
262605901400	2002	2003		2025	$640,000	$0	$640,000	$0	$640,000	$0	$640,000	
262605901400	2001	2002		2025	$457,000	$0	$457,000	$0	$457,000	$0	$457,000	
262605901400	2000	2001		2025	$420,000	$0	$420,000	$0	$420,000	$0	$420,000	
262605901400	1999	2000		2025	$108,000	$0	$108,000	$0	$108,000	$0	$108,000	
262605901400	1998	1999		2025	$98,000	$0	$98,000	$0	$98,000	$0	$98,000	
262605901400	1997	1998		2025	$0	$0	$0	$0	$86,000	$0	$86,000	
262605901400	1996	1997		2025	$0	$0	$0	$0	$86,100	$0	$86,100	
262605901400	1994	1995		7260	$0	$0	$0	$0	$86,100	$0	$86,100	
262605901400	1992	1993		7260	$0	$0	$0	$0	$128,300	$0	$128,300	
262605901400	1990	1991		7260	$0	$0	$0	$0	$128,600	$0	$128,600	
262605901400	1988	1989		7260	$0	$0	$0	$0	$98,100	$0	$98,100	
262605901400	1986	1987		7260	$0	$0	$0	$0	$98,100	$0	$98,100	
262605901400	1985	1986		7260	$0	$0	$0	$0	$60,000	$0	$60,000	
262605901400	1984	1985		7260	$0	$0	$0	$0	$60,000	$0	$60,000	
262605901400	1983	1984		7260	$0	$0	$0	$0	$60,000	$0	$60,000	
262605901400	1982	1983		7260	$0	$0	$0	$0	$109,000	$0	$109,000	

SALES HISTORY

Excise Number	Recording Number	Document Date	Sale Price	Seller Name	Buyer Name	Instrument	Sale Reason
2423788	20091230001687	12/21/2009	$0.00	BURNSTEAD CONSTRUCTION CO I	BURNSTEAD FREDERICK H+JOAN ET AL	Quit Claim Deed	Other
2423839	20091230001700	12/21/2009	$0.00	BURNSTEAD FREDERICK H+JOAN ET AL	BURNSTEAD CONSTRUCTION LLC	Quit Claim Deed	Other
1621812	199806292263	6/12/1998	$220,000.00	STROM ASSOCIATES L LC	BURNSTEAD CONSTRUCTION CO	Statutory Warranty Deed	None
1474545	199603180190	1/17/1996	$0.00	STROM ASSOCIATES	STROM ASSOCIATES L L C	Quit Claim Deed	Other

REVIEW HISTORY

PERMIT HISTORY

HOME IMPROVEMENT EXEMPTION

SECTION 2: CONDITIONS AND REQUIREMENTS SUMMARY

The proposed project is classified as a "Large Project" per Section 3.5, page 57, within the City of Redmond Clearing, Grading, and Stormwater Management Technical Notebook, Issue No. 6 dated February 23, 2012 (Technical Notebook). Per Figure 3.2 (shown below) and Section 3.5, "all minimum requirements apply to the new impervious surfaces and converted pervious surfaces."

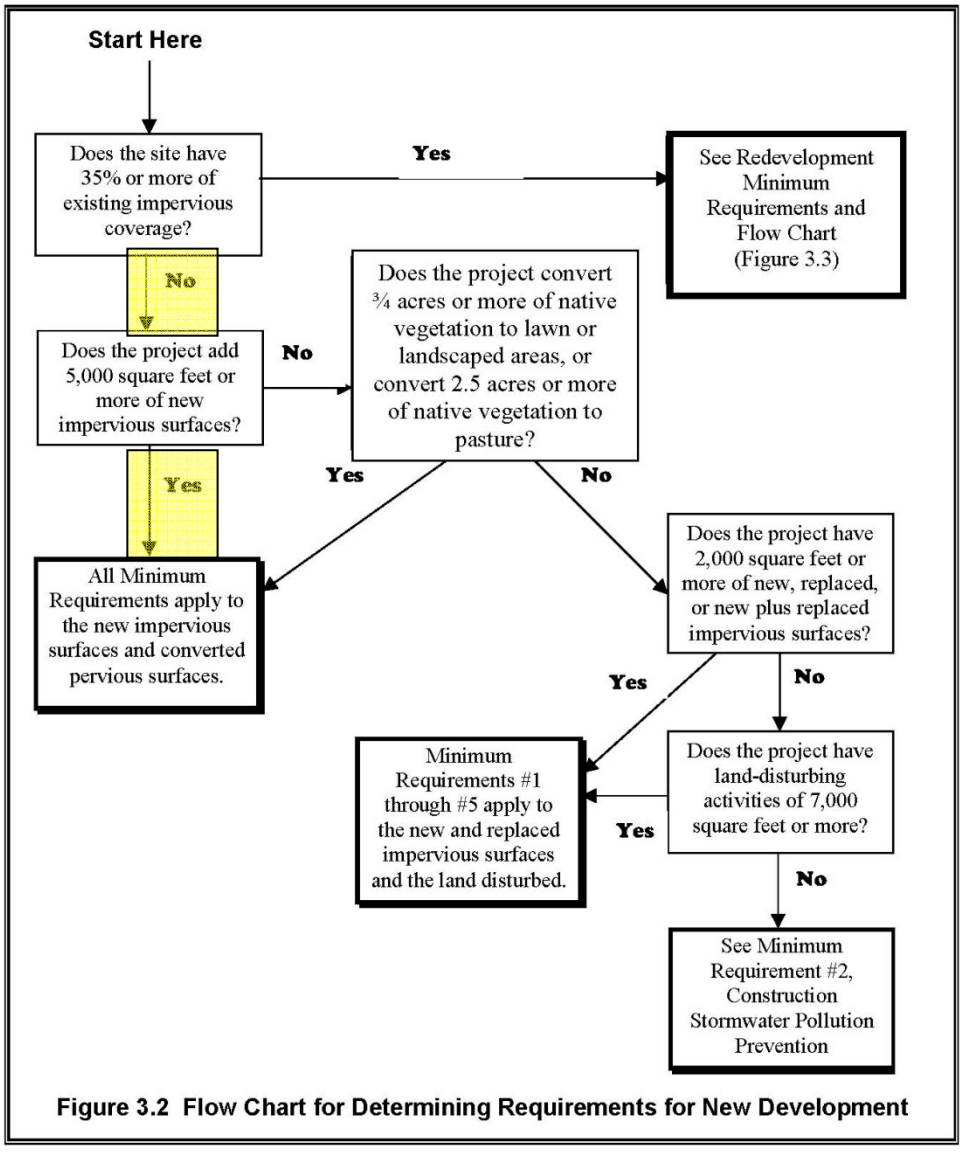


Figure 3.2 Flow Chart for Determining Requirements for New Development

The City of Redmond Clearing, Grading, and Stormwater Management Technical Notebook, Issue Number 6 discusses wellhead protection within the City and corresponding restrictions and limitations.

Section 2.5.5, beginning on page 24 of the Technical Notebook, provides the following summary regarding **Groundwater Protection** in Wellhead Protection Zone 4:

> "In Wellhead Protection Zone 4, runoff from pollution generating impervious surfaces can be infiltrated without treatment provided the soil profile provides treatment per Chapter 3.3 of Volume III of the 2005 Ecology Manual. Infiltration of runoff from non-pollution generating impervious areas considered to be clean, including most roofs and sidewalks, is strongly encouraged where feasible."

As noted above, infiltration is encouraged in Wellhead Protection Zone 4 provided the soil profile supports the applicable water quality treatment requirements.

Minimum Requirement #1: Preparation of Stormwater Site Plans: Preliminary Civil Plans under separate cover and Preliminary Storm Drainage Report herein have been prepared for the subject project. The proposed project is classified as a "Large Project" per Section 3.5, page 57, within the Technical Notebook.

Minimum Requirement #2: Construction Stormwater Pollution Prevention: All new development and redevelopment shall comply with the Construction SWPPP Element #1 through Element #12 listed in the 2005 DOE Stormwater Manual. The Strom Property project disturbs more than 7,000 square feet of land and will require a Construction SWPPP. Erosion/Sedimentation Control and Construction Stormwater Pollution Prevention Plans will be completed during final engineering design.

Minimum Requirement #3: Source Control Pollution: RMC 13.06.066 requires that applicable adopted source control BMPs (operational and structural) be used on all sites *except* Single Family Residential sites. As this project is a Single Family Residential site Source Control BMPs do not apply.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls: Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, *to the maximum extent practicable*. The manner by which runoff is discharged from the project site *must not cause a significant adverse impact to downstream receiving waters* and down gradient properties. Discharge from the site is not to the existing natural discharge location in order to minimize adverse impacts to downstream receiving waters (see Section 3 of this Report for the downstream analysis and discussion of the natural discharge location and Section 4 of this Report for analysis and discussion of the flow control and water quality design location).

The Strom Property is immediately adjacent to the Greystone PRD project and is within the same Threshold Discharge Area as defined in the 2005 DOE Stormwater Management Manual for Western Washington (Figure 2.1, page 2-7, Volume 1). In order to protect the riparian corridor that begins upstream of this project site, continues through the project

parcel and downstream (through areas of steep slopes) to NE 124th Street, a portion of the rear yards (lots 4 through 13) will be directed via sheet flow dispersion per DOE BMP T5.30 to the downstream riparian system to recharge wetland and stream areas. This approach is supported by Wetland Resources, the project wetland biologist. Page 4 of the "Critical Area Study and Mitigation Plan," dated June 10, 2013, states that "the areas mapped as wetlands are saturated to the surface for more than 12.5 percent of the growing season, thereby fulfilling wetland hydrology criteria." This confirms that recharging the wetland and stream areas is beneficial to the hydrologic system. However, page 5 of the "Critical Area Study and Mitigation Plan" states that "the subject wetlands have limited potential to perform water quality improvement functions" and " while these wetlands function to maintain base flows for the on-site Class II stream, they have little potential for reducing peak flows," suggesting limits to the amount of site area used to recharge the wetland and stream areas.

Per the City of Redmond Technical Notebooks, Washington State Department of Ecology's BMP T5.30 – Full Dispersion, may be used for "fully dispersing runoff from impervious surfaces and cleared areas of development sites that protect at least 65% of the site in a forest or native condition" (page 5-22, Volume V, 2005 DOE Stormwater Management Manual for Western Washington). Additionally, the design guidelines provided on page 5-25 of the 2005 DOE Manual state that:

> "the runoff from cleared areas that are comprised of bare soil, non-native landscaping, lawn and/or pasture is considered to be fully dispersed if it is dispersed through at least 25 feet of native vegetation in accordance with the following criteria:
>
> 1. The contributing flowpath of cleared area being dispersed must be no more than 150 feet, and
> 2. Slopes within the 25-foot minimum flowpath through native vegetation should be no steeper than 8%. If this criterion cannot be met due to site constraints, the 25-foot flowpath length must be increased 1.5 feet for each percent increase in slope above 8%."

Speaking of the proposed lot pad areas and rear yards for the proposed lots, page 10 of the Critical Area Study and Mitigation Plan states that "the temporarily impacted areas shall be fully restored to native vegetation." Full dispersion for the restored native vegetation in the rear yard areas will therefore be implemented and directed toward the onsite wetland areas in order to maintain existing beneficial hydrologic patterns without adversely impacting the hydroperiod or depending on the wetlands for flow control or water quality treatment.

The remaining site area will be detained, treated and discharged down the slope (with appropriate slope protection) to the natural discharge location.

Minimum Requirement #5: On-Site Stormwater Management: Projects shall employ On-site Stormwater Management Best Management Practices (BMPs) to infiltrate, disperse, and retain stormwater runoff onsite to the maximum extent feasible without causing flooding or erosion impacts. Roof Downspout Control BMPs, functionally equivalent to those described in Chapter 3 of Volume III of the 2005 DOE Stormwater Manual, and Soil Quality BMPs, functionally equivalent to those in Chapter 5 of Volume V of the DOE Stormwater Manual, shall be required to reduce the hydrologic disruption of developed sites.

Explain how this project conforms to the North Redmond Neighborhood Plan in the Community Development guide

Per Figure 3.1 in Volume III Chapter 3 of the DOE Manual, roof downspouts should be connected to street drainage system with perforated stub-outs. For this project, the design for the perforated stub-outs apply to single family detached homes and requires a minimum setback of 25' from the utility trenches or foundation drains and 50' setback from any structure, property line, or steep slope per Section 2.9.3.3, page 42, of the City of Redmond Technical Notebook. This cannot be accommodated for with the current site layout; roof stubs will therefore be solid PVC and connected to the tight-lined storm drainage system.

Additional On-Site Stormwater Management BMPs per Section 8.7 of the Technical Notebook will be assessed and applied to the project site as appropriate during the final engineering phase of the project. This typically would include amending onsite soils with compost material to increase interflow runoff time as well as flow dispersion for lawn areas as discussed under Minimum Requirement #4 above.

Minimum Requirement #6: Runoff Treatment: The following require construction of stormwater treatment facilities (see Table 2.1 included below):

- Projects in which the total of pollution generating impervious surface (PGIS) is 5,000 square feet or more in a threshold discharge area of the project, or
- Projects in which the total of pollution-generating pervious surfaces (PGPS) is three-quarters (3/4) of an acre or more in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site.

This project results in a total of approximately 8,300 square feet of PGIS and therefore requires construction of a stormwater treatment facility.

Table 2.1 Treatment Requirements by Threshold Discharge Area

	<3/4 acres of PGPS	>3/4 acres PGPS	<5,000 sf PGIS	>5,000 sf PGIS
Treatment Facilities		X		X
On-site Stormwater BMPS	X	X	X	X

PGPS = pollution generating pervious surfaces
PGIS = pollution generating impervious surfaces
sf = square feet

Based on the *Treatment-Type Thresholds* in Section 2.5.6 of the Technical Notebook, the project site requires Basic Treatment. Design of the treatment facilities is described in Section 4 of this Report. The facility will be onsite, combined with the proposed detention facility for the project located in Tract A as shown on the Preliminary Civil Plans provided under separate cover.

Minimum Requirement #7: Flow Control: Per Section 2.5.7 of the Technical Notebook, the following require construction of flow control facilities and/or land use management BMPs that will achieve the standard flow control requirement for western Washington (see Table 2.2 included below):

- Projects in which the total effective impervious surfaces is 10,000 square feet or more in a threshold discharge area; or
- Projects that convert ¾ acres or more of native vegetation to lawn or landscape, or convert 2.5 acres or more of native vegetation to pasture in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site; or
- Projects that disturb one acre or more, that through a combination of impervious surfaces and converted pervious surfaces cause a 0.1 cubic feet per second increase in the 100-year flow frequency from a threshold discharge area as estimated using the Western Washington Hydrology Model or other approved model.

Table 2.2 Flow Control Requirements by Threshold Discharge Area

	Flow Control Facilities	On-site Stormwater Management BMPs
<3/4 acres conversion to lawn/landscape, or <2.5 acres to pasture		X
> 3/4 acres conversion to lawn/landscape, or > 2.5 acres to pasture	X	X
<10,000 square feet of effective impervious area per TDA		X
>10,000 square feet of effective impervious area per TDA	X	X
>0.1 cubic feet per second increase in the 100-year flood frequency for sites 1 acre or larger	X	X

This project results in a total of approximately 23,500 square feet of effective impervious surfaces and therefore requires construction of a flow control facility.

Per Section 2.5.7 of the Technical Notebook, the Standard Flow Control Requirements applies with the pre-developed condition to be modeled as forested land cover. Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow.

Design of the flow control facility is described in Section IV of this Report. The facility will be onsite, combined with the proposed water quality facility in Tract A as shown on the Preliminary Civil Plans provided under separate cover.

Minimum Requirement #8: Wetlands Protection: This requirement applies only to projects whose stormwater discharges into a wetland, either directly or indirectly through a conveyance system. An onsite wetland was identified and mapped within the project boundaries. However, the only discharges to the wetland are dispersed lawn areas. All other discharges are directed away from the onsite wetland.

The proposed development has the potential to indirectly affect the wetland by routing surface water runoff away from the wetland to the stormwater detention facility. However, the dispersed lawn areas from Lots 4 through 13 will recharge the wetland area to provide sufficient and equivalent hydrologic function as in the existing condition.

Minimum Requirement #9: Operations and Maintenance: Per Section 2.5.9 of the Technical Notebook, an operation and maintenance manual that is consistent with the provisions in Volume V of the 2005 DOE Manual is required for all proposed public and private stormwater facilities including flow control and treatment facilities, conveyance systems, constructed source controls, and green infrastructure. The operations and maintenance manual shall be a stand-alone document prepared in accordance with the City of Redmond O&M Manual Template (see Appendix N of the Technical Notebook). The development proposal shall include provisions for maintenance of facilities in perpetuity.

The Operation and Maintenance Manual will be included in the final storm drainage report during final engineering design.

SECTION 3. OFF-SITE ANALYSIS

Upstream:

Upon construction of the 159th Avenue NE road improvements that will be completed as part of the Greystone PRD project, no upstream drainage will be received onto the subject property. The drainage from the future extension of 159th Avenue NE has been accounted for in the calculations of the Greystone PRD project which borders this project site to the east. Therefore there is no upstream tributary area that will flow to the proposed site. There is a cost sharing agreement with the developers of Greystone and the Strom plat which requires the Greystone plat to provide the road improvements along the frontage of the Strom parcel.

Downstream Resource Review:

The following resources were reviewed in preparation of this report.

Redmond Sensitive Areas Maps

These maps were reviewed for *Erosion Hazard* (Map 64.8), *Wetlands* (Map 64.4), *Landslide Hazard* (Map 64.7), and *Seismic Hazard* (Map 64.9). The western and northern portion of the property has steep slopes (40% or greater) and there is a Class III Stream running through the site from south to north. The project site includes on site Wetland areas and includes some Landslide Hazard Area, both near the northern limits of the parcel.

See maps included at the end of this Section.

FEMA – Flood Insurance Rate Map (FIRM #53033C0380F)

This panel is not available and is reported to be in Zone X, with no flood areas identified on or near the site. This was also confirmed on the City of Redmond Parcel Viewer online interactive GIS map system.

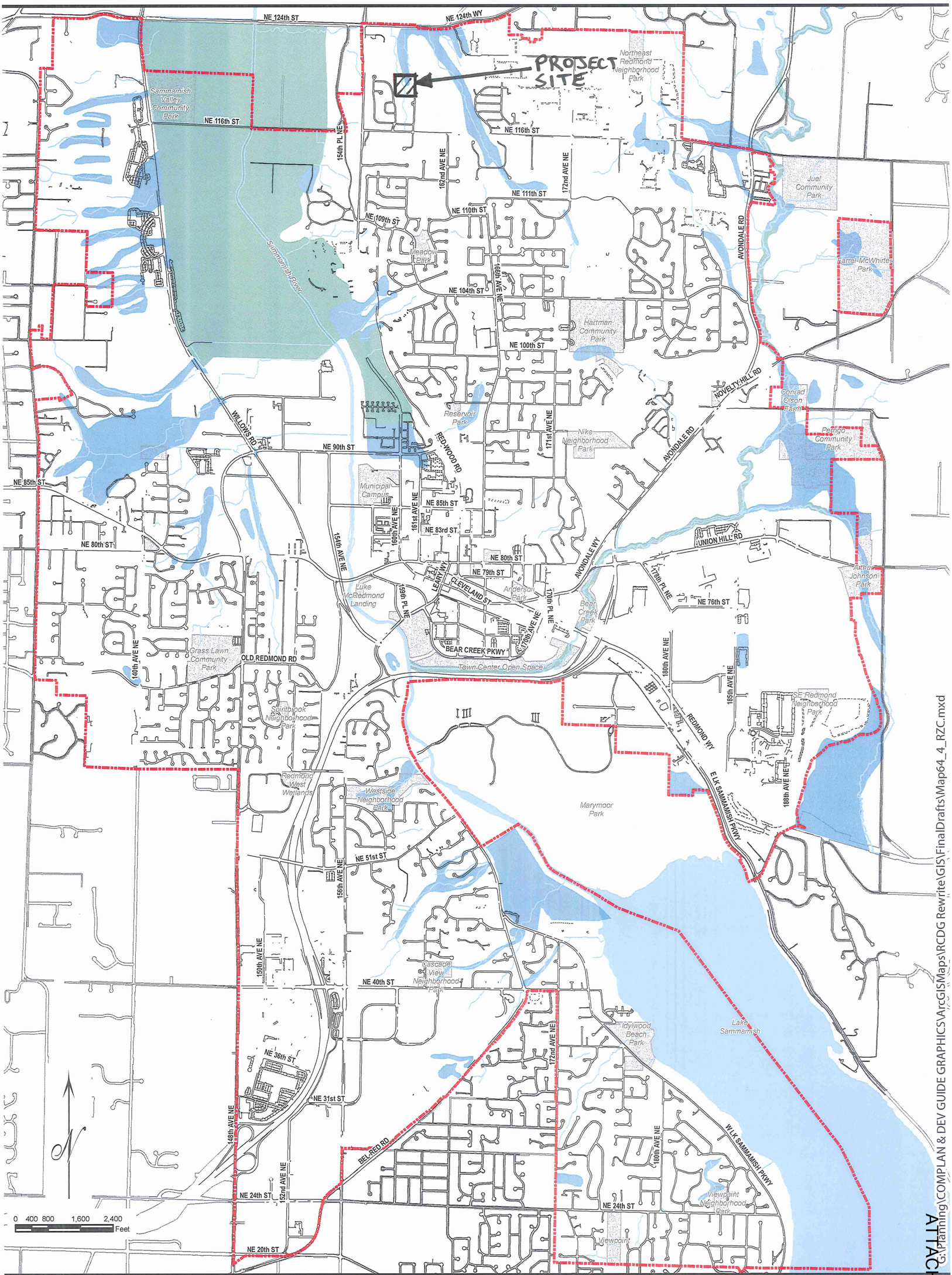
USDA Natural Resources Conservation Service Soil Survey

The soil for this property is classified as AgC (Alderwood gravelly sandy loam, 6 to 15 percent slopes) and AgD (Alderwood gravelly sandy loam, 15 to 30 percent slopes) from the *Natural Resources Conservation Service Soil Survey.* (See the Strom Property Site Soils Map included at the end of this Section).

Downstream Field Investigation:

Stormwater runoff leaves the site and flows northwesterly down slope to a ravine which bisects the property. The ravine runs generally northerly from the north line of the property, meandering at the base of two rather steep slopes. The stream bed is approximately 2 to 4 feet in width with a gravel base. Some portions of the stream bed have vertical sides due to local erosion. Other than an occasional fallen tree the stream bed is clear of encumbrances. Flow from the site continues northerly, meandering up to a point approximately 400 to 500 feet south of NE 124th Street. At this point the stream has been diverted from its original stream bed location and redirected to the northeast through a recent City of Redmond improvement project. The runoff continues through this improved area to a box culvert approximately 10 feet by 2 feet which crosses under NE 124th Street perpendicular flowing to the north. The box culvert has sediment accumulated in front of the culvert from what appears to be the recent construction/improvement area. At this point runoff flows westerly along north side of NE 124th Street to a point where it crosses under Redmond-Woodinville Road, continues westerly, and eventually flows into the Sammamish River. Other than local sedimentation, the downstream does not appear to have excessive erosion or stability issues.

The project proposes to direct stormwater from the onsite detention vault over the steep slope in an above ground pipe anchored to the slope. The pipe will then discharge onto an engineered energy dissipation device (riprap pad) to reduce the energy gained from the conveyance over the steep slope. The energy dissipator (riprap pad) will be sized according to City of Redmond design guidelines.



City of Redmond

Critical Areas Map
Effective: April 16, 2011

Map 64.4 Wetlands

Legend:

- Mixed Wetland/Upland
- Wetland
- Redmond City Limits

Sources:
USGS National Wetland Inventory
Aerial Photo Interpretation
SCS Soil Survey
City of Redmond

Note:
This map shall be used as a general guide. It represents approximate locations. Consult the Critical Areas Ordinance (CAO) for reporting requirements. In the event there is a conflict between the map and the criteria or standards of the CAO, the criteria shall prevail.

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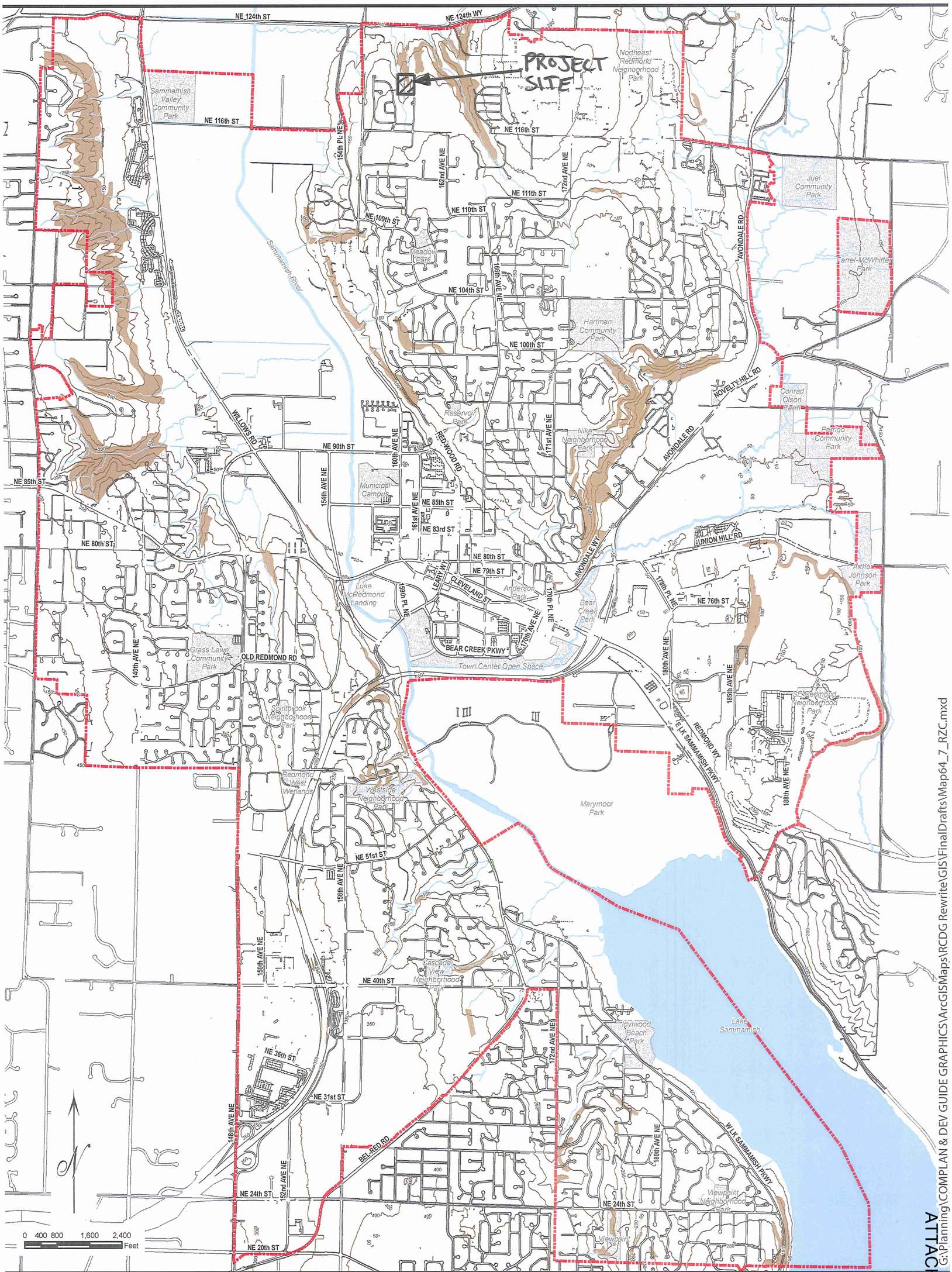
ATTACHMENT 21



City of Redmond

Critical Areas Map
Effective: April 16, 2011

Map 64.7 Landslide Hazard Areas

Legend:

- Landslide Hazard Areas
- Contours
- Redmond City Limits

Sources:
USGS Topographic Maps
USGS Geologic Maps

Note:
This map shall be used as a general guide. It represents approximate locations. Consult the Critical Areas Ordinance (CAO) for reporting requirements. In the event there is a conflict between the map and the criterial or standards of the CAO, the criteria shall prevail.

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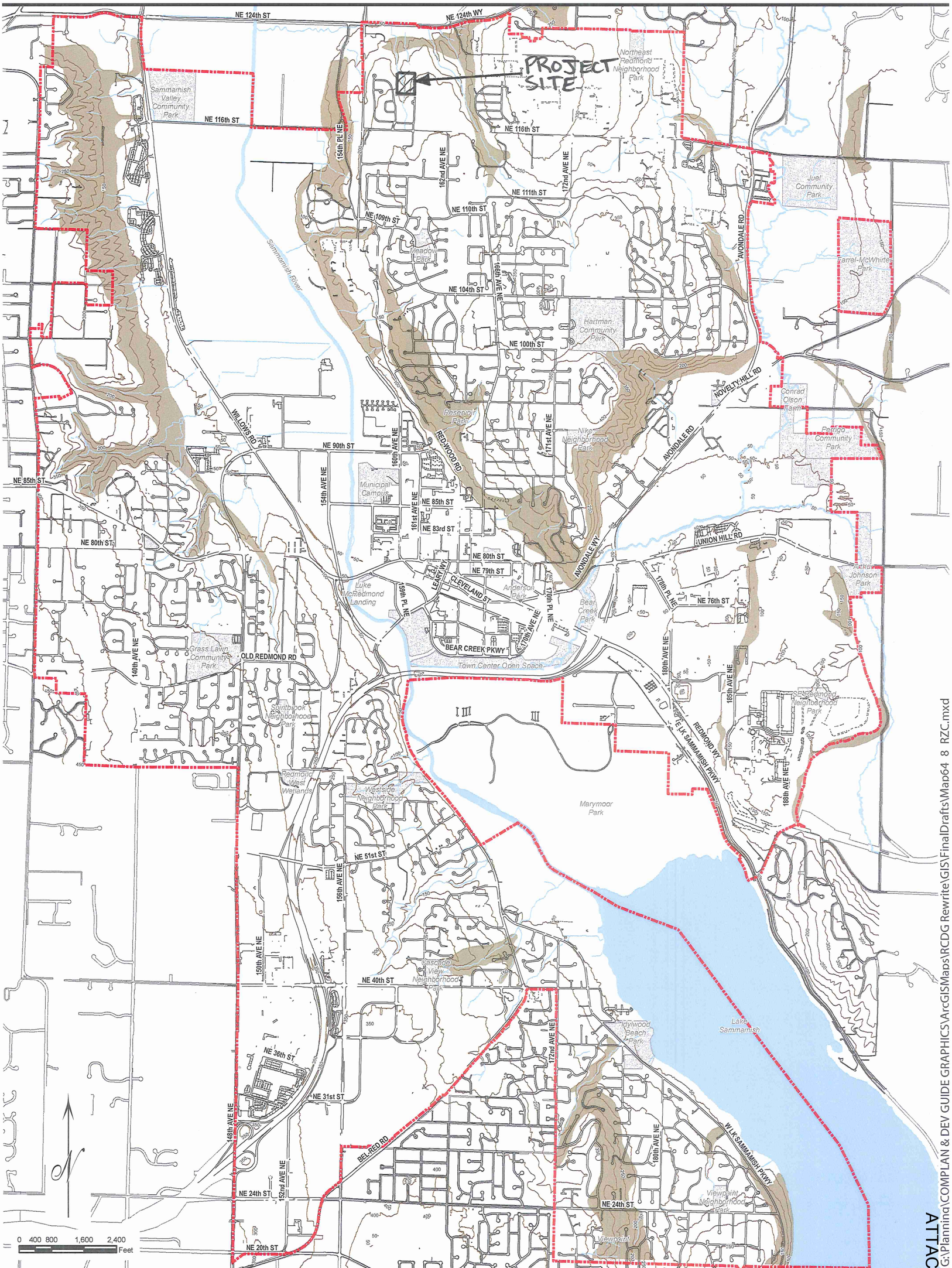

City of Redmond

Critical Areas Map
Effective: April 16, 2011

Map 64.8 Erosion Hazard Areas

Legend:

- Erosion Hazard Areas
- Contours
- Redmond City Limits

Sources:
SCS Soil Survey

Note:
This map shall be used as a general guide. It represents approximate locations. Consult the Critical Areas Ordinance (CAO) for reporting requirements. In the event there is a conflict between the map and the criteria or standards of the CAO, the criteria shall prevail.

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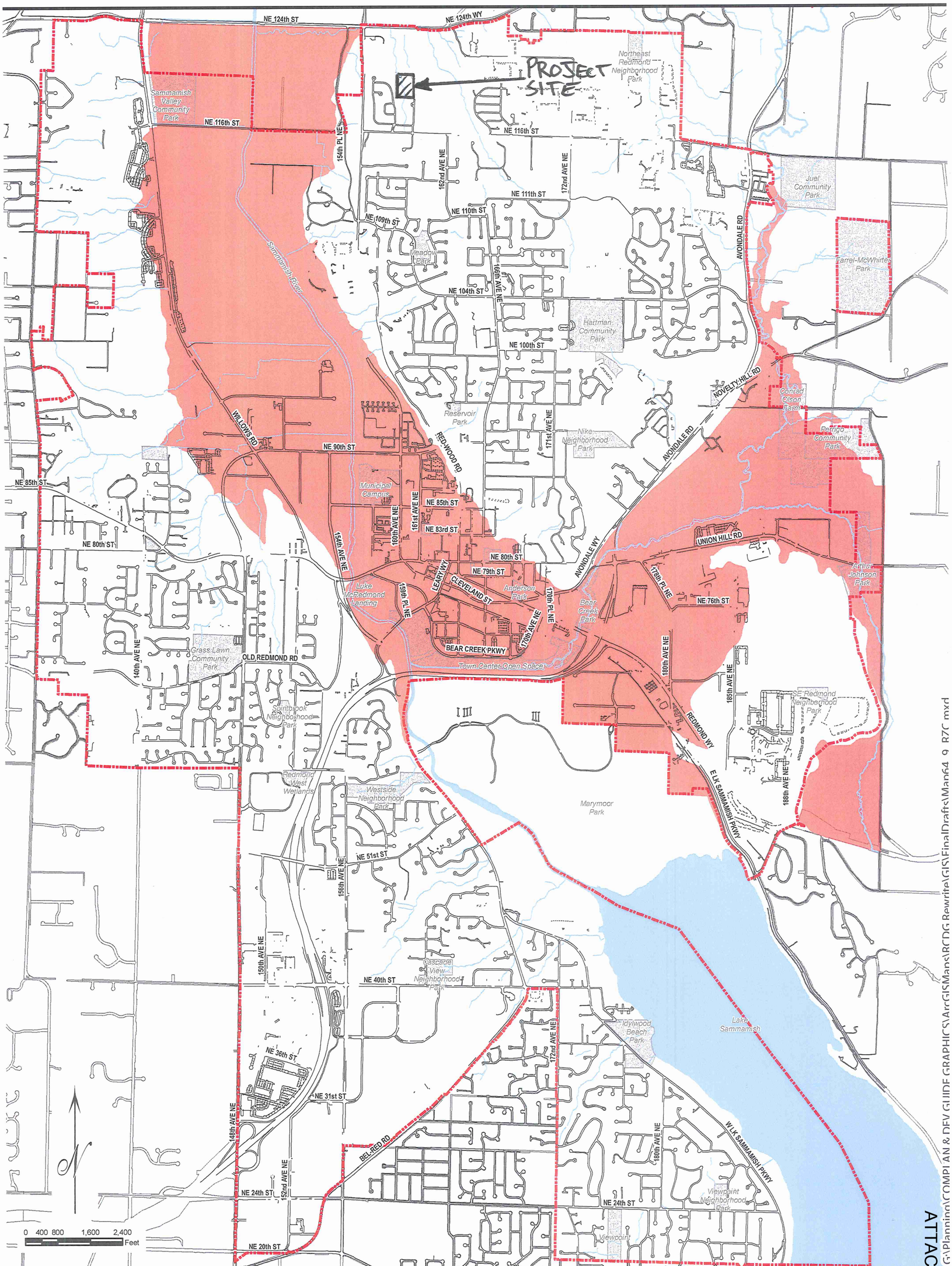
ATTACHMENT 21



City of Redmond

Critical Areas Map
Effective: April 16, 2011

Map 64.9 Seismic Hazard Areas

Legend:

- Seismic Hazard Areas
- Redmond City Limits

Sources:
USGS Geologic Maps

Note:
This map shall be used as a general guide. It represents approximate locations. Consult the Critical Areas Ordinance (CAO) for reporting requirements. In the event there is a conflict between the map and the criteria or standards of the CAO, the criteria shall prevail.

G:\Planning\COMPLAN & DEV GUIDE GRAPHICS\ArcGISMaps\RCDG Rewrite\GIS\FinalDrafts\Map64_9_R2C.mxd

ATTACHMENT 21

ATTACHMENT 21

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:6,000 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: King County Area, Washington
Survey Area Data: Version 7, Jul 2, 2012

Date(s) aerial images were photographed: 7/24/2006

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

ATTACHMENT 21

Map Unit Legend

King County Area, Washington (WA633)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AgC	Alderwood gravelly sandy loam, 6 to 15 percent slopes	5.7	100.0%
Totals for Area of Interest		**5.7**	**100.0%**

SECTION 4. FLOW CONTROL / WATER QUALITY ANALYSIS AND DESIGN

A. Hydraulic Analysis

The drainage analysis for detention sizing was modeled using the King County Runoff Time Series software. The drainage analysis for water quality sizing was modeled using WaterWorks hydrology software utilizing SBUH methodology. The site is located in the Sea-Tac rainfall region with a location scale factor of 1.0. Per the King County Soil Survey, the site soils are Alderwood (AgC), KCRTS group Till and hydrologic group C.

The precipitation rates used for this analysis are as follows:

6-month, 24-hour storm (72% 2-year, 24-hour storm)	→ 1.29 in.
2-year, 24-hour storm	→ 1.79 in.

Pre-developed Conditions

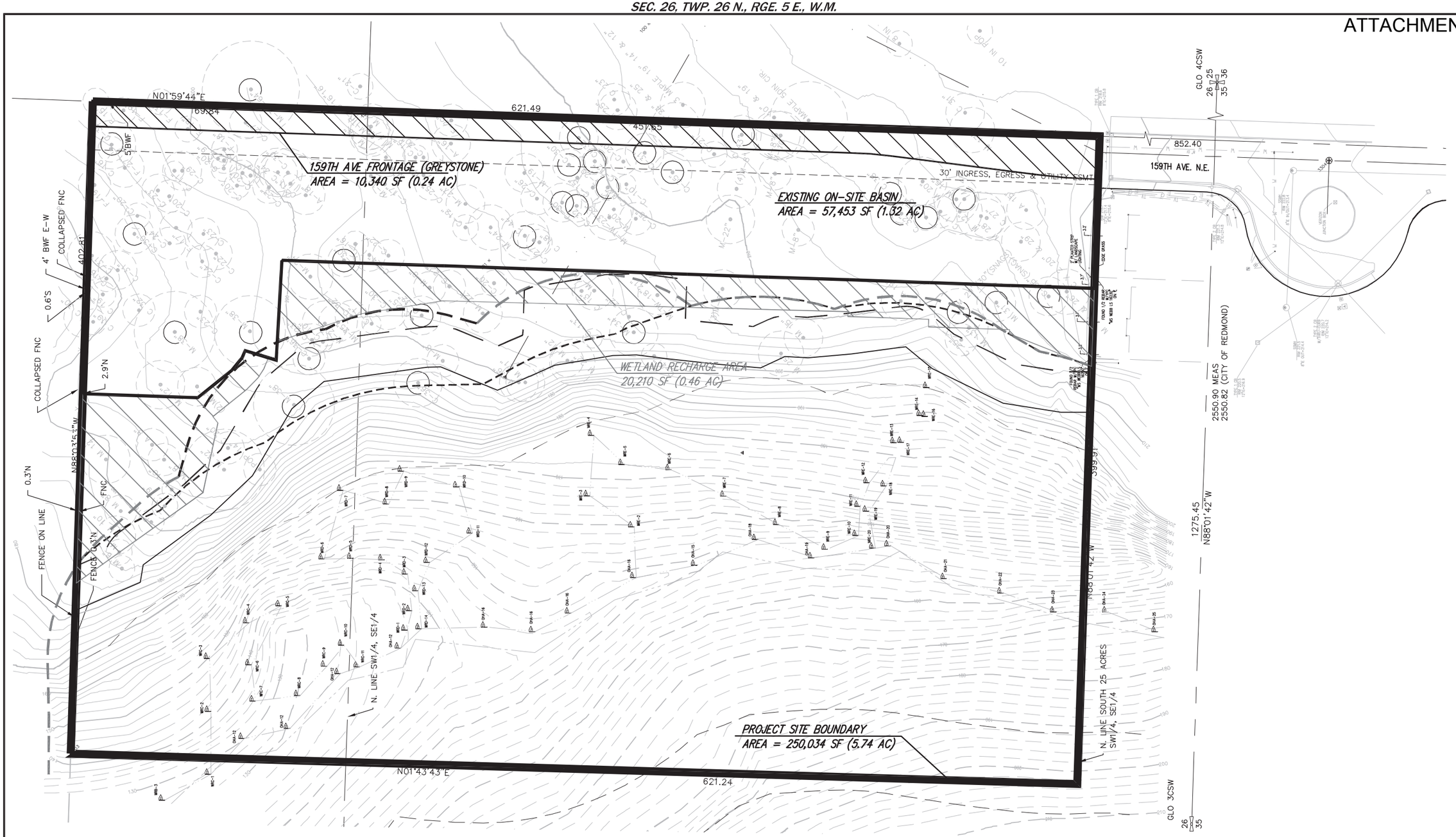
The property is currently vacant and forested. The portion of the property to be developed on the east side of the property generally slopes to the northwest with slopes varying from approximately 5% to 10%. The western portion of the property which will remain in its native state consists of steep slopes which drain to a ravine that runs north through the property. See *Figure 4-1: Existing Conditions Exhibit* on the following page.

The existing drainage basin boundary, 1.32 acres, will include the proposed created lots, open space tract, access tract and Tract A less the lot area proposed to recharge the onsite wetland and stream. Existing conditions for the project site were analyzed assuming 100% pervious ground cover consisting of forested land cover as defined in Section 2.3, page 8, in the Technical Notebook under the definition of "Pre-developed condition." The following information was used for generating time series and flow frequencies.

PREDEVELOPED CONDITIONS (10079_predev.tsf)	Total Area = 1.32 acres
GROUND COVER	AREA (acres)
Till-Forest	1.32

ATTACHMENT 21

SEC. 26, TWP. 26 N., RGE. 5 E., W.M.



LEGEND

- TELEPHONE RISER
- STORM DRAIN MANHOLE
- FOUND SURVEY MONUMENT (AS NOTED)
- TELEVISION RISER
- WATER VALVE
- SPRINKLER CONTROL BOX
- POWER TRANSFORMER
- SANITARY SEWER MANHOLE
- GAS MARKER
- POWER METER
- WATER METER
- MONITORING WELL
- FOUND 1/2" REBAR WITH YELLOW PLASTIC CAP "CORE 37555" EXCEPT AS NOTED OTHERWISE
- FLOW ARROW
- TRIBUTARY BASIN LINE

AREA SUMMARY

TOTAL AREA: 250,034 SF

PROJECT PARCEL ACCOUNTED FOR IN GREYSTONE PRD PROJECT (10,340 SF)

PROJECT PARCEL USED FOR WETLAND RECHARGE (20,210 SF)

UNDEVELOPED PROJECT PARCEL AREA (162,031 SF)

DEVELOPED EXISTING PARCEL AREA (57,453 SF)
1.32 AC TILL-FOREST

SCALE: 1" = 60'

0 30 60 120

NO.	REVISIONS	DATE

CORE DESIGN
ENGINEERING · PLANNING · SURVEYING
14711 NE 29th Place Suite 101
Bellevue, Washington 98007
425.885.7877 Fax 425.885.7963

FIGURE 4.1: EXISTING CONDITIONS EXHIBIT

STROM PROPERTY

BURNSTEAD CONSTRUCTION

11980 NE 24TH ST., SUITE 200
BELLEVUE, WA 98005

DATE	MARCH 2013
DESIGNED	JAMES A. OLSEN
DRAWN	MICHAEL A. MOODY
APPROVED	JAMES A. OLSEN
	JAMES A. OLSEN, P.E.
	PROJECT MANAGER

SHEET	OF
1	2

PROJECT NUMBER
10079

Developed Conditions

Proposed development of the property will include construction of 13 single-family homes, along with an access tract, utilities and open space. Detention and water quality will be provided by the proposed onsite combined detention/water quality facility located in Tract A. See *Figure 4-2: Developed Conditions Exhibit* on the following page.

The developed drainage basin boundary will be assumed to be the same as the existing drainage basin boundary, 1.32 acres, and includes the front yards and roofs for the proposed 13 lots in addition to the access road and the frontage of 159th Avenue NE. The remaining parcel area within the developed area (rear lots and open space Tract A) will be dispersed to the west to recharge the on-site wetland and stream. This area (0.46 acres) is therefore not included in the developed condition area.

The developed conditions of the project site were calculated using the method outlined in Section 2.9.3.2 of the Redmond Technical Notebook. The equation for impervious area for the plat. is as follows:

Total Impervious Area = (Area of Lots)*Maximum Impervious Surface Area*0.80 + Total Area of Impervious Streets and Sidewalks.

The "Maximum Impervious Surface Area" is delineated in the Redmond Zoning Code under RZC 21.08.060. This development is zoned R-4 making the Maximum Impervious Surface Area for Each Single Family Lot = 60% (Table 21.08.060B).

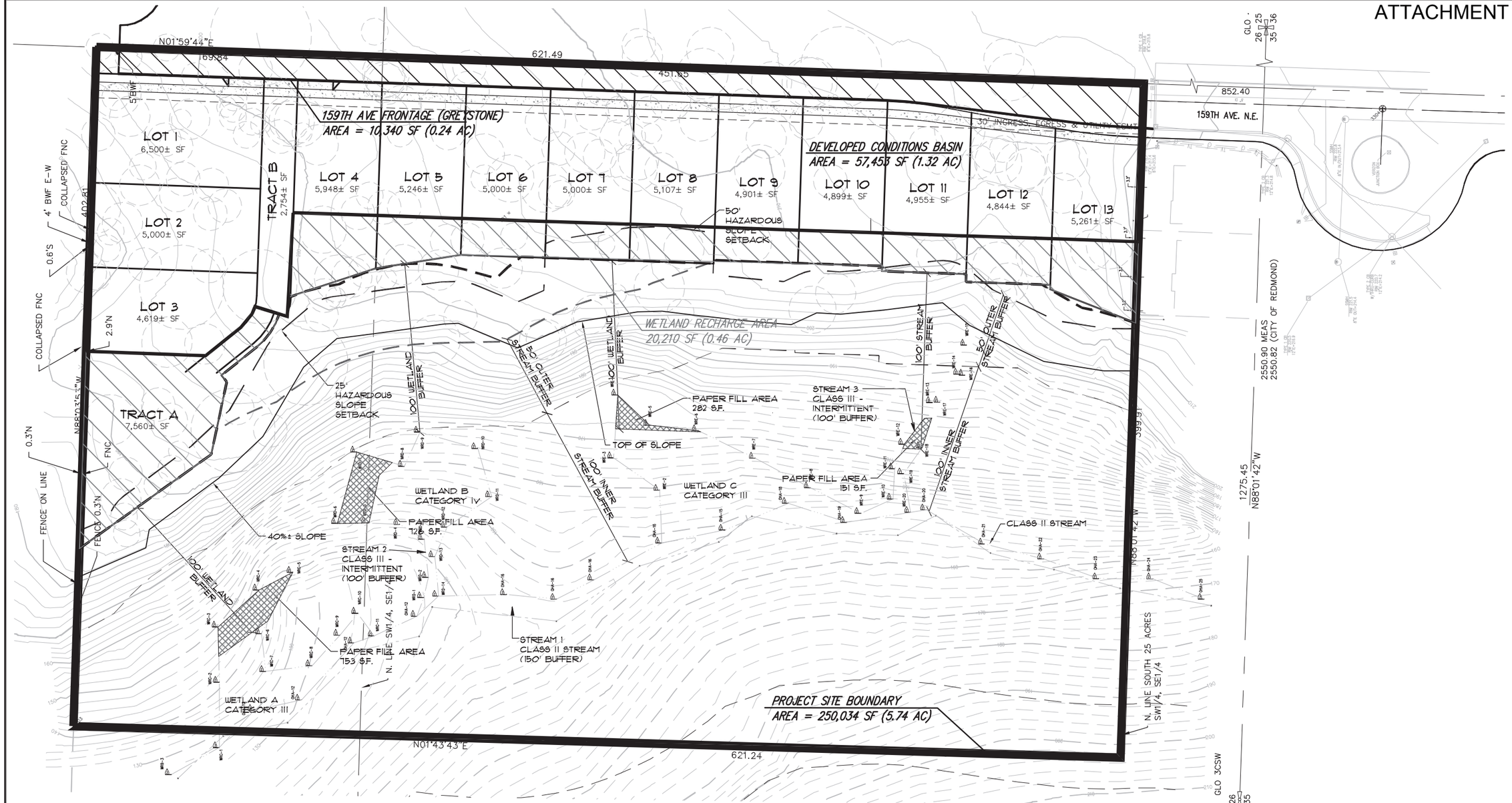
The total area of the single family lots is 67,173 square feet. The access tract is 2,754 square feet which is 97% impervious (measured from the site plan). The open space tract is 7,560 square feet and is 93% pervious (measured from the site plan). All frontage improvements in 159th Avenue NE are accounted for in the Greystone PRD project (North Basin). The total impervious area for the development is therefore, 67,173 sf*60%*0.80 + 2,670 sf + 400 sf = 35,313 sf or 0.81 acres.

When the open space tract and the rear yards (0.46 acres) are removed from the developed conditions routed to the onsite detention/water quality vault 0.01 acres of impervious and 0.45 acres of pervious are removed. The following information was used for generating time series and flow frequencies.

DEVELOPED CONDITIONS (10079_dev.tsf)	Total Area = 1.32 acres
GROUND COVER	AREA (acres)
Till-Grass (Landscaping)	0.52
Impervious	0.80

SEC. 26, TWP. 26 N., RGE. 5 E., W.M.

ATTACHMENT 21



LEGEND

- TELEPHONE RISER
- STORM DRAIN MANHOLE
- FOUND SURVEY MONUMENT (AS NOTED)
- TELEVISION RISER
- WATER VALVE
- SPRINKLER CONTROL BOX
- POWER TRANSFORMER
- SANITARY SEWER MANHOLE
- GAS MARKER
- POWER METER
- WATER METER
- MONITORING WELL
- ° FOUND 1/2" REBAR WITH YELLOW PLASTIC CAP "CORE 37555" EXCEPT AS NOTED OTHERWISE
- → FLOW ARROW
- —— TRIBUTARY BASIN LINE

AREA SUMMARY

TOTAL AREA: 57,453 SF (DEVELOPED AREA TO ON-SITE VAULT)
1.32 AC (0.80 AC IMPERVIOUS + 0.52 AC TILL-GRASS)

ACCESS TRACT B AREA: 2,754 SF (100% IMPERVIOUS)
0.06 AC IMPERVIOUS

LOT AREA: 54,523 SF (59% IMPERVIOUS)
0.74 AC IMPERVIOUS + 0.52 AC TILL-GRASS

SCALE: 1" = 60'

0 30 60 120

CORE DESIGN
ENGINEERING · PLANNING · SURVEYING
14711 NE 29th Place Suite 101
Bellevue, Washington 98007
425.885.7877 Fax 425.885.7963

NO. REVISIONS DATE

FIGURE 4.2: DEVELOPED CONDITIONS EXHIBIT

STROM PROPERTY

BURNSTEAD CONSTRUCTION
11980 NE 24TH ST, SUITE 200
BELLEVUE, WA 98005

DATE	MARCH 2013
DESIGNED	JAMES A. OLSEN
DRAWN	MICHAEL A. MOODY
APPROVED	JAMES A. OLSEN
	JAMES A. OLSEN, P.E. PROJECT MANAGER

SHEET 2 OF 2

PROJECT NUMBER 10079

B. Detention Calculations

A new vault is proposed onsite to collect, detain and treat the developed area for the entire project. The vault will be located in Tract A and will be used to provide detention and water quality for the project. The vault has been designed per the requirements within the Washington State Department of Ecology's Stormwater Management Manual for Western Washington, February 2005 Edition and the City of Redmond Technical Notebook Issue 6. The drainage analysis for detention sizing was modeled using the King County Runoff Time Series software and includes the Strom developed basin. The drainage analysis for water quality sizing was modeled using WaterWorks hydrology software utilizing SBUH methodology and also includes both projects. Refer to Section 4 for more detail on the combined flow control and water quality calculations.

The vault will be located in the open space Tract A and will be utilized for detention and water quality treatment of the developed drainage prior to discharge to the existing ditch and pipe conveyance system adjacent to 124th Avenue NE.

The Standard Flow Control Requirement per page 31 under Section 2.5.7 "Minimum Requirement #7: Flow Contrl" in the City of Redmond Technical Notebook, is equivalent to the KCRTS Level 2 Flow Control Standard. KCRTS will be utilized to size the detention vault. See attached KCRTS printouts.

The calculations yield a vault with a width of 31 feet, a length of 68 feet, and a 50-year maximum water surface depth of 8.29 feet and a corresponding volume of 17,391 cubic feet. The provided vault is 32' x 68' x 8.25' with a 50-year maximum water surface depth of 8.26 feet and a corresponding provided volume of 19,952 cubic feet.

C. Water Quality Calculations

Section 4.2 in Volume I of the Washington State Department of Ecology's Stormwater Management Manual for Western Washington, along with Section 2.5.6 in the City of Redmond Technical Notebook (Issue #6) were utilized to determine the required type of treatment facility for water quality treatment.

Basic Treatment is required for the Strom Property project and the proposed onsite combined detention/water quality vault will be utilized to provide treatment for the developed area of the project. Per page 10-4 in Volume V of the 2005 Stormwater Management Manual for Western Washington (DOE Manual), basic water quality treatment volume is defined as the volume of runoff from the water quality design storm – the 6-month, 24-hour storm event. Per page 4-1 in Volume V of the DOE Manual, the 6-month, 24-hour precipitation amount is assumed to be 72% of the 2-year, 24-hour amount.

The drainage analysis for water quality sizing was modeled using WaterWorks hydrology software that utilizes SBUH methodology. The proposed onsite project vault will provide both detention and water quality for the developed basin of the Strom Property (1.32 acres), the developed area not used to recharge the on-site wetland and stream.

The precipitation rates used for this analysis are as follows:

6-month, 24-hour storm (72% 2-year, 24-hour storm)	→ 1.3 in
2-year, 24-hour storm	→ 1.8 in

The required wetpool (dead storage) volume for the developed basin is 3,301 cubic feet (0.08 ac-ft). See the WaterWorks basin summary report below. The dead storage will be provided in a portion of the proposed vault facility below the outlet elevation. Dead storage will be 4 feet deep. The total dead storage volume provided is therefore 16' x 52' x 4' = 3,328 cubic feet.

```
6/7/13   12:31:3 pm      Core Design, Inc                    page   1
=====================================================================
                          BASIN SUMMARY

BASIN ID: 10079WQ       NAME: STROM WITH GREYSTONE WQ
SBUH METHODOLOGY
TOTAL AREA.......:   1.32 Acres     BASEFLOWS:   0.00 cfs
RAINFALL TYPE....:    TYPE1A                    PERV          IMP
PRECIPITATION....:   1.30 inches    AREA..:    0.52 Acres    0.80 Acres
TIME INTERVAL....:     10.00 min    CN....:   73.63         98.00
                                    TC....:   10.00 min    10.00 min
ABSTRACTION COEFF:   0.20
PEAK RATE:   0.19 cfs  VOL:   0.08 Ac-ft  TIME:    480 min
```

SECTION 5. APPENDIX

APPENDIX

KCRTS Input

```
                                        10079_Input
   KCRTS Program...File Directory:
C:\KC_SWDM\KC_DATA\
[C] CREATE a new Time Series
ST
       1.32       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.00       0.00       0.000000  Impervious
10079_predev.tsf
 T
    1.00000
 T
[C] CREATE a new Time Series
ST
       0.00       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.52       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.80       0.00       0.000000  Impervious
10079_dev.tsf
 T
    1.00000
 T
[T] Enter the Analysis TOOLS Module
[P] Compute PEAKS and Flow Frequencies
10079_predev.tsf
10079_predev.pks
[P] Compute PEAKS and Flow Frequencies
10079_dev.tsf
10079_dev.pks
[D] Compute Flow DURATION and Exceedence
10079_predev.tsf
10079_target.dur
 F
 F
          36
   0.231429E-02
   0.180000E-01
[R] RETURN to Previous Menu
```

Predeveloped Peaks

10079_predev

Flow Frequency Analysis
Time Series File:10079_predev.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.083	2	2/09/01 18:00	0.107	1	100.00	0.990
0.022	7	1/06/02 3:00	0.083	2	25.00	0.960
0.061	4	2/28/03 3:00	0.064	3	10.00	0.900
0.002	8	3/24/04 20:00	0.061	4	5.00	0.800
0.036	6	1/05/05 8:00	0.054	5	3.00	0.667
0.064	3	1/18/06 20:00	0.036	6	2.00	0.500
0.054	5	11/24/06 4:00	0.022	7	1.30	0.231
0.107	1	1/09/08 9:00	0.002	8	1.10	0.091
Computed Peaks			0.099		50.00	0.980

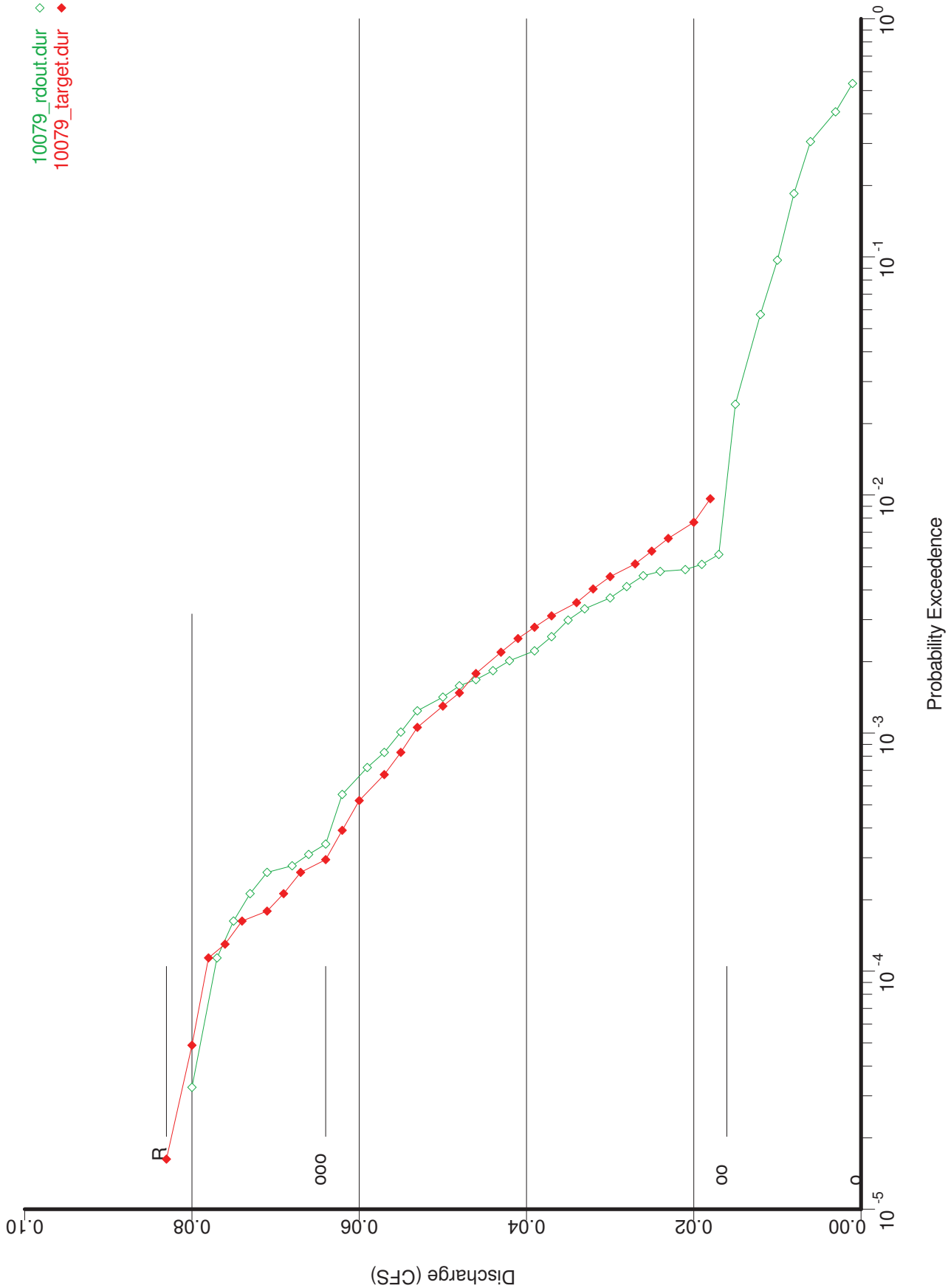
Developed Peaks

10079_dev

Flow Frequency Analysis
Time Series File:10079_dev.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---				-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak		- - Peaks - - (CFS)	Rank	Return Period	Prob
0.241	6	2/09/01	2:00	0.488	1	100.00	0.990
0.195	8	1/05/02	16:00	0.304	2	25.00	0.960
0.290	3	2/27/03	7:00	0.290	3	10.00	0.900
0.209	7	8/26/04	2:00	0.255	4	5.00	0.800
0.252	5	10/28/04	16:00	0.252	5	3.00	0.667
0.255	4	1/18/06	16:00	0.241	6	2.00	0.500
0.304	2	10/26/06	0:00	0.209	7	1.30	0.231
0.488	1	1/09/08	6:00	0.195	8	1.10	0.091
Computed Peaks				0.427		50.00	0.980

Durations Performance Plot



Vaut Output (required)

Retention/Detention Facility

Type of Facility:	Detention Vault
Facility Length:	68.00 ft
Facility Width:	31.00 ft
Facility Area:	2108. sq. ft
Effective Storage Depth:	8.25 ft
Stage 0 Elevation:	100.00 ft
Storage Volume:	17391. cu. ft
Riser Head:	8.25 ft
Riser Diameter:	12.00 inches
Number of orifices:	3

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	0.50	0.019	
2	5.50	1.13	0.057	4.0
3	7.25	0.50	0.007	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	100.00	0.	0.000	0.000	0.00
0.01	100.01	21.	0.000	0.001	0.00
0.02	100.02	42.	0.001	0.001	0.00
0.03	100.03	63.	0.001	0.001	0.00
0.04	100.04	84.	0.002	0.001	0.00
0.05	100.05	105.	0.002	0.001	0.00
0.21	100.21	443.	0.010	0.003	0.00
0.37	100.37	780.	0.018	0.004	0.00
0.53	100.53	1117.	0.026	0.005	0.00
0.69	100.69	1455.	0.033	0.006	0.00
0.86	100.86	1813.	0.042	0.006	0.00
1.02	101.02	2150.	0.049	0.007	0.00
1.18	101.18	2487.	0.057	0.007	0.00
1.34	101.34	2825.	0.065	0.008	0.00
1.50	101.50	3162.	0.073	0.008	0.00
1.66	101.66	3499.	0.080	0.009	0.00
1.83	101.83	3858.	0.089	0.009	0.00
1.99	101.99	4195.	0.096	0.010	0.00
2.15	102.15	4532.	0.104	0.010	0.00
2.31	102.31	4870.	0.112	0.010	0.00
2.47	102.47	5207.	0.120	0.011	0.00
2.64	102.64	5565.	0.128	0.011	0.00
2.80	102.80	5902.	0.136	0.011	0.00
2.96	102.96	6240.	0.143	0.012	0.00
3.12	103.12	6577.	0.151	0.012	0.00
3.28	103.28	6914.	0.159	0.012	0.00
3.44	103.44	7252.	0.166	0.013	0.00
3.61	103.61	7610.	0.175	0.013	0.00

Vaut Output (required)

3.77	103.77	7947.	0.182	0.013	0.00
3.93	103.93	8284.	0.190	0.013	0.00
4.09	104.09	8622.	0.198	0.014	0.00
4.25	104.25	8959.	0.206	0.014	0.00
4.41	104.41	9296.	0.213	0.014	0.00
4.58	104.58	9655.	0.222	0.015	0.00
4.74	104.74	9992.	0.229	0.015	0.00
4.90	104.90	10329.	0.237	0.015	0.00
5.06	105.06	10666.	0.245	0.015	0.00
5.22	105.22	11004.	0.253	0.015	0.00
5.39	105.39	11362.	0.261	0.016	0.00
5.50	105.50	11594.	0.266	0.016	0.00
5.51	105.51	11615.	0.267	0.016	0.00
5.52	105.52	11636.	0.267	0.017	0.00
5.54	105.54	11678.	0.268	0.018	0.00
5.55	105.55	11699.	0.269	0.020	0.00
5.56	105.56	11720.	0.269	0.022	0.00
5.57	105.57	11742.	0.270	0.025	0.00
5.58	105.58	11763.	0.270	0.026	0.00
5.59	105.59	11784.	0.271	0.027	0.00
5.76	105.76	12142.	0.279	0.034	0.00
5.92	105.92	12479.	0.286	0.039	0.00
6.08	106.08	12817.	0.294	0.043	0.00
6.24	106.24	13154.	0.302	0.046	0.00
6.40	106.40	13491.	0.310	0.050	0.00
6.56	106.56	13828.	0.317	0.053	0.00
6.73	106.73	14187.	0.326	0.056	0.00
6.89	106.89	14524.	0.333	0.058	0.00
7.05	107.05	14861.	0.341	0.061	0.00
7.21	107.21	15199.	0.349	0.063	0.00
7.25	107.25	15283.	0.351	0.064	0.00
7.26	107.26	15304.	0.351	0.064	0.00
7.27	107.27	15325.	0.352	0.065	0.00
7.28	107.28	15346.	0.352	0.065	0.00
7.29	107.29	15367.	0.353	0.066	0.00
7.45	107.45	15705.	0.361	0.070	0.00
7.62	107.62	16063.	0.369	0.073	0.00
7.78	107.78	16400.	0.376	0.076	0.00
7.94	107.94	16738.	0.384	0.078	0.00
8.10	108.10	17075.	0.392	0.081	0.00
8.25	108.25	17391.	0.399	0.083	0.00
8.35	108.35	17602.	0.404	0.393	0.00
8.45	108.45	17813.	0.409	0.957	0.00
8.55	108.55	18023.	0.414	1.690	0.00
8.65	108.65	18234.	0.419	2.480	0.00
8.75	108.75	18445.	0.423	2.760	0.00
8.85	108.85	18656.	0.428	3.020	0.00
8.95	108.95	18867.	0.433	3.260	0.00
9.05	109.05	19077.	0.438	3.480	0.00
9.15	109.15	19288.	0.443	3.680	0.00
9.25	109.25	19499.	0.448	3.880	0.00
9.35	109.35	19710.	0.452	4.060	0.00
9.45	109.45	19921.	0.457	4.240	0.00
9.55	109.55	20131.	0.462	4.410	0.00

Vaut Output (required)

```
      9.65     109.65      20342.     0.467  4.580      0.00
      9.75     109.75      20553.     0.472  4.730      0.00
      9.85     109.85      20764.     0.477  4.890      0.00
      9.95     109.95      20975.     0.482  5.040      0.00
     10.05     110.05      21185.     0.486  5.180      0.00

 Hyd  Inflow    Outflow         Peak             Storage
             Target    Calc  Stage   Elev   (Cu-Ft)    (Ac-Ft)
  1    0.49 *******    0.29  8.32  108.32     17529.      0.402
  2    0.24    0.13    0.08  7.82  107.82     16481.      0.378
  3    0.29 *******    0.07  7.29  107.29     15362.      0.353
  4    0.24 *******    0.06  6.87  106.87     14492.      0.333
  5    0.26 *******    0.03  5.62  105.62     11843.      0.272
  6    0.15 *******    0.02  5.24  105.24     11056.      0.254
  7    0.19 *******    0.01  5.19  105.19     10935.      0.251
  8    0.21 *******    0.01  3.05  103.05      6420.      0.147

----------------------------------
Route Time Series through Facility
  Inflow Time Series File:10079_dev.tsf
 Outflow Time Series File:10079_rdout

Inflow/Outflow Analysis
   Peak Inflow Discharge:      0.488 CFS at  6:00 on Jan  9 in Year 8
  Peak Outflow Discharge:      0.286 CFS at 10:00 on Jan  9 in Year 8
    Peak Reservoir Stage:       8.32  Ft
     Peak Reservoir Elev:     108.32  Ft
  Peak Reservoir Storage:   17529.    Cu-Ft
                        :       0.402 Ac-Ft

          Flow Frequency Analysis
  Time Series File:10079_rdout.tsf
  Project Location:Sea-Tac

  ---Annual Peak Flow Rates---      -----Flow Frequency Analysis-------
 Flow Rate  Rank  Time of Peak       - - Peaks - -  Rank  Return  Prob
   (CFS)                            (CFS)    (ft)        Period
   0.082      2   2/09/01 20:00      0.286    8.32    1  100.00   0.990
   0.015      7   1/07/02  4:00      0.082    8.19    2   25.00   0.960
   0.066      3   3/06/03 22:00      0.066    7.29    3   10.00   0.900
   0.012      8   8/26/04  8:00      0.058    6.88    4    5.00   0.800
   0.016      6   1/08/05  6:00      0.030    5.66    5    3.00   0.667
   0.030      5   1/19/06  3:00      0.016    5.34    6    2.00   0.500
   0.058      4  11/24/06  8:00      0.015    5.30    7    1.30   0.231
   0.286      1   1/09/08 10:00      0.012    3.05    8    1.10   0.091
Computed Peaks                       0.218    8.29        50.00   0.980

  Flow Duration from Time Series File:10079_rdout.tsf
 Cutoff    Count  Frequency   CDF    Exceedence_Probability
   CFS              %         %       %
   0.001   28774   46.924    46.924   53.076    0.531E+00
   0.004    7999   13.045    59.969   40.031    0.400E+00
   0.006    6018    9.814    69.783   30.217    0.302E+00
   0.008    8566   13.969    83.752   16.248    0.162E+00
```

Vaut Output (required)

0.010	4096	6.680	90.432	9.568	0.957E-01
0.013	2359	3.847	94.279	5.721	0.572E-01
0.015	2027	3.306	97.585	2.415	0.242E-01
0.017	1136	1.853	99.437	0.563	0.563E-02
0.020	26	0.042	99.480	0.520	0.520E-02
0.022	8	0.013	99.493	0.507	0.507E-02
0.024	4	0.007	99.499	0.501	0.501E-02
0.026	9	0.015	99.514	0.486	0.486E-02
0.029	34	0.055	99.569	0.431	0.431E-02
0.031	39	0.064	99.633	0.367	0.367E-02
0.033	22	0.036	99.669	0.331	0.331E-02
0.036	17	0.028	99.697	0.303	0.303E-02
0.038	28	0.046	99.742	0.258	0.258E-02
0.040	19	0.031	99.773	0.227	0.227E-02
0.042	14	0.023	99.796	0.204	0.204E-02
0.045	15	0.024	99.821	0.179	0.179E-02
0.047	8	0.013	99.834	0.166	0.166E-02
0.049	6	0.010	99.843	0.157	0.157E-02
0.052	10	0.016	99.860	0.140	0.140E-02
0.054	9	0.015	99.874	0.126	0.126E-02
0.056	14	0.023	99.897	0.103	0.103E-02
0.058	13	0.021	99.918	0.082	0.815E-03
0.061	5	0.008	99.927	0.073	0.734E-03
0.063	15	0.024	99.951	0.049	0.489E-03
0.065	8	0.013	99.964	0.036	0.359E-03
0.068	3	0.005	99.969	0.031	0.310E-03
0.070	2	0.003	99.972	0.028	0.277E-03
0.072	2	0.003	99.976	0.024	0.245E-03
0.074	2	0.003	99.979	0.021	0.212E-03
0.077	3	0.005	99.984	0.016	0.163E-03
0.079	3	0.005	99.989	0.011	0.114E-03
0.081	3	0.005	99.993	0.007	0.652E-04

Duration Comparison Anaylsis
Base File: 10079_predev.tsf
New File: 10079_rdout.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.018	0.99E-02	0.54E-02	-45.7	0.99E-02	0.018	0.015	-13.8
0.023	0.64E-02	0.50E-02	-21.6	0.64E-02	0.023	0.016	-29.6
0.028	0.50E-02	0.45E-02	-9.8	0.50E-02	0.028	0.025	-11.8
0.033	0.38E-02	0.33E-02	-12.0	0.38E-02	0.033	0.031	-6.9
0.038	0.29E-02	0.26E-02	-11.7	0.29E-02	0.038	0.036	-4.8
0.043	0.22E-02	0.20E-02	-10.3	0.22E-02	0.043	0.041	-5.5
0.048	0.15E-02	0.16E-02	7.5	0.15E-02	0.048	0.050	4.9
0.053	0.10E-02	0.13E-02	25.4	0.10E-02	0.053	0.056	5.9
0.058	0.62E-03	0.82E-03	31.6	0.62E-03	0.058	0.062	6.4
0.063	0.34E-03	0.49E-03	42.9	0.34E-03	0.063	0.066	4.9
0.068	0.23E-03	0.31E-03	35.7	0.23E-03	0.068	0.073	7.6
0.073	0.16E-03	0.23E-03	40.0	0.16E-03	0.073	0.077	5.4
0.078	0.11E-03	0.11E-03	0.0	0.11E-03	0.078	0.079	1.4
0.083	0.16E-04	0.00E+00	-100.0	0.16E-04	0.083	0.082	-1.1

Vaut Output (required)

```
Maximum positive excursion = 0.007 cfs (  9.5%)
occurring at 0.070 cfs on the Base Data:10079_predev.tsf
and at 0.076 cfs on the  New Data:10079_rdout.tsf

Maximum negative excursion = 0.008 cfs (-33.6%)
occurring at 0.024 cfs on the Base Data:10079_predev.tsf
and at 0.016 cfs on the  New Data:10079_rdout.tsf
```

Vaut Output (provided)

Retention/Detention Facility

Type of Facility:	Detention Vault
Facility Length:	68.00 ft
Facility Width:	32.00 ft
Facility Area:	2176. sq. ft
Effective Storage Depth:	8.25 ft
Stage 0 Elevation:	100.00 ft
Storage Volume:	17952. cu. ft
Riser Head:	8.25 ft
Riser Diameter:	12.00 inches
Number of orifices:	3

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	0.50	0.019	
2	5.50	1.13	0.057	4.0
3	7.25	0.50	0.007	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	100.00	0.	0.000	0.000	0.00
0.01	100.01	22.	0.001	0.001	0.00
0.02	100.02	44.	0.001	0.001	0.00
0.03	100.03	65.	0.001	0.001	0.00
0.04	100.04	87.	0.002	0.001	0.00
0.05	100.05	109.	0.002	0.001	0.00
0.21	100.21	457.	0.010	0.003	0.00
0.37	100.37	805.	0.018	0.004	0.00
0.53	100.53	1153.	0.026	0.005	0.00
0.69	100.69	1501.	0.034	0.006	0.00
0.86	100.86	1871.	0.043	0.006	0.00
1.02	101.02	2220.	0.051	0.007	0.00
1.18	101.18	2568.	0.059	0.007	0.00
1.34	101.34	2916.	0.067	0.008	0.00
1.50	101.50	3264.	0.075	0.008	0.00
1.66	101.66	3612.	0.083	0.009	0.00
1.83	101.83	3982.	0.091	0.009	0.00
1.99	101.99	4330.	0.099	0.010	0.00
2.15	102.15	4678.	0.107	0.010	0.00
2.31	102.31	5027.	0.115	0.010	0.00
2.47	102.47	5375.	0.123	0.011	0.00
2.64	102.64	5745.	0.132	0.011	0.00
2.80	102.80	6093.	0.140	0.011	0.00
2.96	102.96	6441.	0.148	0.012	0.00
3.12	103.12	6789.	0.156	0.012	0.00
3.28	103.28	7137.	0.164	0.012	0.00
3.44	103.44	7485.	0.172	0.013	0.00
3.61	103.61	7855.	0.180	0.013	0.00

Vaut Output (provided)

3.77	103.77	8204.	0.188	0.013	0.00
3.93	103.93	8552.	0.196	0.013	0.00
4.09	104.09	8900.	0.204	0.014	0.00
4.25	104.25	9248.	0.212	0.014	0.00
4.41	104.41	9596.	0.220	0.014	0.00
4.58	104.58	9966.	0.229	0.015	0.00
4.74	104.74	10314.	0.237	0.015	0.00
4.90	104.90	10662.	0.245	0.015	0.00
5.06	105.06	11011.	0.253	0.015	0.00
5.22	105.22	11359.	0.261	0.015	0.00
5.39	105.39	11729.	0.269	0.016	0.00
5.50	105.50	11968.	0.275	0.016	0.00
5.51	105.51	11990.	0.275	0.016	0.00
5.52	105.52	12012.	0.276	0.017	0.00
5.54	105.54	12055.	0.277	0.018	0.00
5.55	105.55	12077.	0.277	0.020	0.00
5.56	105.56	12099.	0.278	0.022	0.00
5.57	105.57	12120.	0.278	0.025	0.00
5.58	105.58	12142.	0.279	0.026	0.00
5.59	105.59	12164.	0.279	0.027	0.00
5.76	105.76	12534.	0.288	0.034	0.00
5.92	105.92	12882.	0.296	0.039	0.00
6.08	106.08	13230.	0.304	0.043	0.00
6.24	106.24	13578.	0.312	0.046	0.00
6.40	106.40	13926.	0.320	0.050	0.00
6.56	106.56	14275.	0.328	0.053	0.00
6.73	106.73	14644.	0.336	0.056	0.00
6.89	106.89	14993.	0.344	0.058	0.00
7.05	107.05	15341.	0.352	0.061	0.00
7.21	107.21	15689.	0.360	0.063	0.00
7.25	107.25	15776.	0.362	0.064	0.00
7.26	107.26	15798.	0.363	0.064	0.00
7.27	107.27	15820.	0.363	0.065	0.00
7.28	107.28	15841.	0.364	0.065	0.00
7.29	107.29	15863.	0.364	0.066	0.00
7.45	107.45	16211.	0.372	0.070	0.00
7.62	107.62	16581.	0.381	0.073	0.00
7.78	107.78	16929.	0.389	0.076	0.00
7.94	107.94	17277.	0.397	0.078	0.00
8.10	108.10	17626.	0.405	0.081	0.00
8.25	108.25	17952.	0.412	0.083	0.00
8.35	108.35	18170.	0.417	0.393	0.00
8.45	108.45	18387.	0.422	0.957	0.00
8.55	108.55	18605.	0.427	1.690	0.00
8.65	108.65	18822.	0.432	2.480	0.00
8.75	108.75	19040.	0.437	2.760	0.00
8.85	108.85	19258.	0.442	3.020	0.00
8.95	108.95	19475.	0.447	3.260	0.00
9.05	109.05	19693.	0.452	3.480	0.00
9.15	109.15	19910.	0.457	3.680	0.00
9.25	109.25	20128.	0.462	3.880	0.00
9.35	109.35	20346.	0.467	4.060	0.00
9.45	109.45	20563.	0.472	4.240	0.00
9.55	109.55	20781.	0.477	4.410	0.00

Vaut Output (provided)

```
      9.65     109.65      20998.     0.482  4.580      0.00
      9.75     109.75      21216.     0.487  4.730      0.00
      9.85     109.85      21434.     0.492  4.890      0.00
      9.95     109.95      21651.     0.497  5.040      0.00
     10.05     110.05      21869.     0.502  5.180      0.00

 Hyd  Inflow    Outflow         Peak             Storage
             Target    Calc  Stage   Elev   (Cu-Ft)    (Ac-Ft)
  1    0.49 *******    0.15  8.27  108.27     17999.      0.413
  2    0.24    0.13    0.07  7.69  107.69     16729.      0.384
  3    0.29 *******    0.06  7.24  107.24     15761.      0.362
  4    0.24 *******    0.06  6.73  106.73     14639.      0.336
  5    0.26 *******    0.02  5.57  105.57     12110.      0.278
  6    0.15 *******    0.01  5.10  105.10     11101.      0.255
  7    0.19 *******    0.01  5.09  105.09     11084.      0.254
  8    0.21 *******    0.01  2.97  102.97      6458.      0.148

----------------------------------
Route Time Series through Facility
  Inflow Time Series File:10079_dev.tsf
 Outflow Time Series File:10079_rdout

Inflow/Outflow Analysis
   Peak Inflow Discharge:      0.488 CFS at  6:00 on Jan  9 in Year 8
  Peak Outflow Discharge:      0.150 CFS at 11:00 on Jan  9 in Year 8
    Peak Reservoir Stage:       8.27  Ft
     Peak Reservoir Elev:     108.27  Ft
  Peak Reservoir Storage:   17999.    Cu-Ft
                        :       0.413 Ac-Ft

         Flow Frequency Analysis
  Time Series File:10079_rdout.tsf
  Project Location:Sea-Tac

  ---Annual Peak Flow Rates---      -----Flow Frequency Analysis-------
 Flow Rate  Rank  Time of Peak       - - Peaks - -  Rank  Return  Prob
   (CFS)                            (CFS)    (ft)        Period
   0.081      2   2/09/01 20:00      0.150    8.27    1  100.00   0.990
   0.015      7   1/07/02  5:00      0.081    8.08    2   25.00   0.960
   0.064      3   3/06/03 22:00      0.064    7.25    3   10.00   0.900
   0.012      8   8/26/04  8:00      0.056    6.74    4    5.00   0.800
   0.015      6   1/08/05  6:00      0.026    5.58    5    3.00   0.667
   0.026      5   1/19/06  5:00      0.015    5.23    6    2.00   0.500
   0.056      4  11/24/06  8:00      0.015    5.21    7    1.30   0.231
   0.150      1   1/09/08 11:00      0.012    2.97    8    1.10   0.091
Computed Peaks                       0.127    8.26        50.00   0.980

  Flow Duration from Time Series File:10079_rdout.tsf
 Cutoff    Count  Frequency   CDF    Exceedence_Probability
   CFS              %         %       %
   0.001   28471   46.430    46.430   53.570    0.536E+00
   0.003    7882   12.854    59.284   40.716    0.407E+00
   0.006    6207   10.122    69.406   30.594    0.306E+00
   0.008    7390   12.052    81.458   18.542    0.185E+00
```

Vaut Output (provided)

0.010	5423	8.844	90.302	9.698	0.970E-01
0.012	2420	3.947	94.248	5.752	0.575E-01
0.015	2047	3.338	97.586	2.414	0.241E-01
0.017	1135	1.851	99.437	0.563	0.563E-02
0.019	31	0.051	99.488	0.512	0.512E-02
0.021	15	0.024	99.512	0.488	0.488E-02
0.024	6	0.010	99.522	0.478	0.478E-02
0.026	12	0.020	99.542	0.458	0.458E-02
0.028	27	0.044	99.586	0.414	0.414E-02
0.030	27	0.044	99.630	0.370	0.370E-02
0.033	23	0.038	99.667	0.333	0.333E-02
0.035	21	0.034	99.702	0.298	0.298E-02
0.037	27	0.044	99.746	0.254	0.254E-02
0.039	20	0.033	99.778	0.222	0.222E-02
0.042	12	0.020	99.798	0.202	0.202E-02
0.044	12	0.020	99.817	0.183	0.183E-02
0.046	9	0.015	99.832	0.168	0.168E-02
0.048	6	0.010	99.842	0.158	0.158E-02
0.050	10	0.016	99.858	0.142	0.142E-02
0.053	11	0.018	99.876	0.124	0.124E-02
0.055	14	0.023	99.899	0.101	0.101E-02
0.057	11	0.018	99.917	0.083	0.832E-03
0.059	7	0.011	99.928	0.072	0.718E-03
0.062	10	0.016	99.945	0.055	0.554E-03
0.064	13	0.021	99.966	0.034	0.342E-03
0.066	2	0.003	99.969	0.031	0.310E-03
0.068	2	0.003	99.972	0.028	0.277E-03
0.071	1	0.002	99.974	0.026	0.261E-03
0.073	3	0.005	99.979	0.021	0.212E-03
0.075	3	0.005	99.984	0.016	0.163E-03
0.077	3	0.005	99.989	0.011	0.114E-03
0.080	5	0.008	99.997	0.003	0.326E-04

Duration Comparison Anaylsis
Base File: 10079_predev.tsf
New File: 10079_rdout.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.018	0.99E-02	0.53E-02	-47.2	0.99E-02	0.018	0.015	-14.9
0.023	0.64E-02	0.48E-02	-25.1	0.64E-02	0.023	0.016	-29.7
0.028	0.50E-02	0.42E-02	-16.0	0.50E-02	0.028	0.020	-26.7
0.033	0.38E-02	0.33E-02	-13.3	0.38E-02	0.033	0.030	-8.9
0.038	0.29E-02	0.24E-02	-17.3	0.29E-02	0.038	0.035	-7.4
0.043	0.22E-02	0.19E-02	-14.7	0.22E-02	0.043	0.039	-8.0
0.048	0.15E-02	0.16E-02	5.4	0.15E-02	0.048	0.049	2.6
0.053	0.10E-02	0.12E-02	19.0	0.10E-02	0.053	0.055	3.6
0.058	0.62E-03	0.80E-03	28.9	0.62E-03	0.058	0.061	5.5
0.063	0.34E-03	0.42E-03	23.8	0.34E-03	0.063	0.064	1.5
0.068	0.23E-03	0.28E-03	21.4	0.23E-03	0.068	0.072	5.5
0.073	0.16E-03	0.21E-03	30.0	0.16E-03	0.073	0.076	3.9
0.078	0.11E-03	0.82E-04	-28.6	0.11E-03	0.078	0.077	-1.0
0.083	0.16E-04	0.00E+00	-100.0	0.16E-04	0.083	0.081	-3.0

Vaut Output (provided)

```
Maximum positive excursion = 0.005 cfs (  7.4%)
occurring at 0.068 cfs on the Base Data:10079_predev.tsf
and at 0.073 cfs on the  New Data:10079_rdout.tsf

Maximum negative excursion = 0.009 cfs (-35.4%)
occurring at 0.025 cfs on the Base Data:10079_predev.tsf
and at 0.016 cfs on the  New Data:10079_rdout.tsf
```