

# TECHNICAL INFORMATION REPORT

## FOR RAGING RIVER ROCK QUARRY

KING COUNTY, WASHINGTON



12/14/2017

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# RAGING RIVER

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#### **Appendix A – Parcel & Basin Information**

King County Parcel Report (2224079011, -9033, and -9035)

#### **Appendix B – Resource Review & Off-site Analysis Documentation**

FEMA Map (53033C0717 G)

USDA NRCS Site Soils Map

Sensitive Areas Map – King County iMap

Drainage Complaint Table

Raging River Impairments

#### **Appendix C – Basin and Detention Modeling Documentation**

MGS Flood Report

#### **Appendix D – Special Reports and Studies**

Geotechnical report by Riley Group

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Grading Permit, 1998

## SECTION 1: PROJECT OVERVIEW

The Raging River Rock Quarry project site is located off of Preston-Fall City Road along the north side of the Raging River. The subject parcel numbers are 2224079011, -9033, and -9035 and have a total area of 50.23 acres, located off Preston-Fall City Road. The site is bordered by single family residents or undeveloped lots. See Figure 1. 1 at the end of this section for a vicinity map. The King County tax parcel ID number for the parcel involved is included in Table 1. 1 below. (Refer to the King County parcel report included in Appendix A).

*Table 1. 1 King County Parcel ID*

<b>KC Parcel #</b>	<b>Parcel Area (AC)</b>
2224079011	20.21
2224079033	25.02
2224079035	5.00

The project site has identified two wetlands, one stream, associated buffers and is bounded by the Raging River, which flows northeast across the project boundary. The site slopes in a general easterly direction toward the river between 6% and 140%. The mined area is bowl-shaped and any runoff sheet flows northeasterly and is intercepted by a series of infiltration ponds. The soils present on-site range from Alderwood and Kitsap (B), Ovall gravelly loam (C), mixed alluvial sand (A), and Pilchuck loamy fine sand (A). Refer to the NRCS Soils Map in Appendix B.

The project site is currently a mining operation, and has been since the 1930s. A portion of the grading permit area has been excavated under previous mining operations. This study is to examine the current needs for water quality, as well as to project the water quality needs for future operations.

The project will be designed using the guidelines and requirements established in the 2016 King County Surface Water Design Manual (2016 KCSWDM). The project will result in the addition of more than 7,000 sf of pervious surface, and as such, a Full Drainage Review is required, per Table 1.1.2.A of the 2016 KCSWDM.

The drainage analysis for infiltration pond sizing was modeled using the approved MGS Flood software. The water quality facility sizing calculations are based on methods described in Chapter 6 of the 2016 KCSWDM.



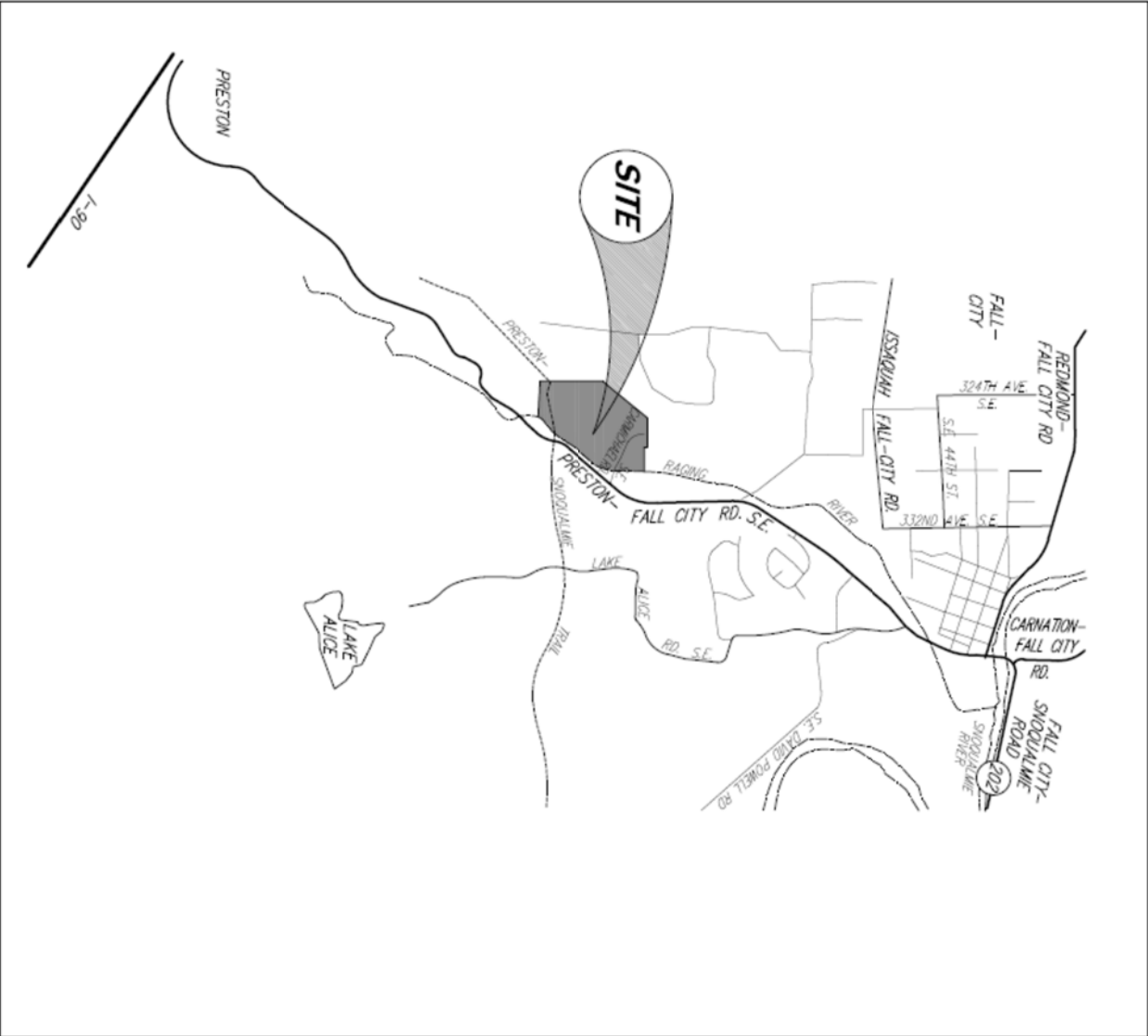


Figure 1. 1 Vicinity Map

## **SECTION 2: CONDITIONS AND REQUIREMENTS SUMMARY**

Per the Periodic Report and Decision dated September 15, 2017, the project has been requested to provide an analysis to determine if the site will be in compliance with the new 2016 King County Surface Water Design Manual (KCSWDM). This report is an amended version of the previously submitted TIR in 2016, which was based on the 2009 King County Surface Water Design Manual. Compliance for the project was previously shown and approved under the HartCrowser report dated February 25, 2002. The HartCrowser report followed the current 2009 King County Surface Water Design Manual (KCSWDM).

Following the flow chart on Figure 1.1.2.A of the 2016 Surface Water Design Manual, it is determined that the proposed onsite project will result in the addition of more than 7,000 sf of pervious surface. A Full Drainage Review is required, which triggers the analysis of each of the Core Requirements #1-#9 and all five Special Requirements #1-#5. For the purpose of this report, ensuring that the analysis is comprehensive and thorough, each Core Requirement and all Special Requirements are addressed below per Section 1.1 of the 2016 KCSWDM.

### **2.1 Core Requirements**

#### **2.1.1 Core Requirement #1: Discharge at the Natural Location**

This project will match the natural discharge location. Subsurface infiltration will quantify all stormwater with any possible overflows directed towards the northeast. Stormwater will be conveyed using interceptor swales with check dams, directed towards a train of sediment traps, settling ponds, and infiltration ponds to reduce the concentrated flows and encourage infiltration. The topography slopes southeasterly towards the Raging River.

#### **2.1.2 Core Requirement #2: Offsite Analysis**

This core requirement is addressed in Section 3 of this report. The Offsite Analysis of this project is determined to require a Level 2 (Tasks #1-#5) Offsite Analysis with a Conveyance System Nuisance Problem Type 1.

#### **2.1.3 Core Requirement #3: Flow Control**

The onsite infiltration ponds are designed for Conservation Flow Control (Level 2). The Conservation Flow Control Standard requires maintaining the durations of high flows at their pre-development levels for all flows greater than one-half of the 2-year peak flow through the 50-year peak flow. The pre-development peak flow rates for the 2-year and 10-year runoff events must also be maintained under this requirement. Historic site conditions are assumed as the predeveloped conditions.

#### **2.1.4 Core Requirement #4: Conveyance System**

The proposed conveyance system provides sufficient capacity for the 25-year, 15-minute storm event. The conveyance calculations are discussed in Section 5.

### **2.1.5 Core Requirement #5: Erosion and Sediment Control**

The proposed erosion and sedimentation control BMPs have been designed to meet the requirements and design standards in Appendix D of the 2016 KCSWDM. See Section 8 – ESC Analysis and Design.

### **2.1.6 Core Requirement #6: Maintenance and Operations**

The Raging River Quarry will be responsible for the onsite maintenance and operations of the stormwater management systems. Refer to section 10 of this report.

### **2.1.7 Core Requirement #7: Financial Guarantees and Liability**

This is a private operation with no proposed public improvements. A bond quantities worksheet is not applicable for this project.

### **2.1.8 Core Requirement #8: Water Quality**

This project is outside the drainage basin of the sensitive lakes or sphagnum bog wetlands, therefore the Basic Water Quality menu is applied. The Basic Water Quality Menu standards are found in the 2016 KCSWDM. See Section 4 for further discussion.

### **2.1.9 Core Requirement #9: Flow Control BMPs**

The project is greater than 22,000 sf therefore, BMPs as specified in Section 1.2.9.2.2 of the 2016 KCSWDM apply. The project currently infiltrates the sites storm water in infiltration ponds up to the 100-year storm event and therefore, meets the LID performance standard.

## **2.2 Special Requirements**

### **2.2.1 Special Requirement #1: Other Adopted Requirements**

This is not applicable for this project. This project is not part of a CDA, MDP, BP, SCP, SWCP, FHRP, LMP, nor a SFDP.

### **2.2.2 Special Requirement #2: Flood Hazard Area Delineation**

This is not applicable for this project. This project respects a 200-setback from the Raging River. The 200-foot setback protects any anticipated the flood area hazards associated with the river. Please see the FEMA Firm map in the Appendix.

### **2.2.3 Special Requirement #3: Flood Protection Facilities**

This is not applicable for this project. There are no flood protection facilities associated with the project's river frontage.

### **2.2.4 Special Requirement #4: Source Control**

This is not applicable for this project. This project will not connect to any public storm systems.

### **2.2.5 Special Requirement #5: Oil Control**

This is not applicable for this project. This project does not meet the thresholds as defined for a high-use site.

## **SECTION 3: OFFSITE ANALYSIS**

The Snoqualmie Watershed Water Quality Synthesis Report, dated January 2009, describes the Raging River as: “a very dynamic river with a very active channel during high-flow events. The gradient is relatively steep and the slopes of the river valley are prone to landslides. The channel condition of the Raging River may have been influenced by a legacy of timber harvest practices with impacts to stream temperature. Landslides and bank erosion due to road building and other activities can alter the width and shape of the river channel...”

For the reasons explained above, with great detail outlined in the report, the project is determined to require a Level 2 Offsite Analysis (Tasks #1-#5) with a Conveyance System Nuisance Problem Type 1.

### **TASK 1 Study Area Definition and Maps**

The proposed project contains parcel numbers 224079011, 224079033 & 224079035.

### **TASK 2 Resource Review**

#### **Basin Reconnaissance Summary Reports**

In 2009, King County prepared a report to synthesize information about the water quality in the Snoqualmie Watershed. The Raging River Sub-basin has been identified as being impaired for high temperatures, fecal coliform, and high pH levels.

#### **FEMA Maps**

A FEMA map dated May 20, 1996 number 53033C0717G was reviewed. The developable site is not located within a floodplain as it is covered by “Zone X – Outside of 500-year floodplain”. The FEMA Map is included in Appendix B.

#### **USDA Natural Resources Conservation Service Soil Survey**

The USDA Natural Resources Conservation Service (NRCS) Web Soil Survey covers the project site area and states that the area of interest is comprised of Alderwood and Kitsap (hydrologic soil group B), Oval gravelly loam (hydrologic soil group C), mixed alluvial sand (hydrologic soil group A), and Pilchuck loamy fine sand (hydrologic soil group A). Refer to the NRCS Soils Map in Appendix B.

#### **Environmentally Sensitive Areas**

King County lists this property within the erosion hazard, seismic hazard, and landslide hazard zones. The King County iMap exhibit is included in Appendix B.

#### **Downstream Drainage Complaints**

Drainage complaints were researched within the study area. King County lists nine complaints located within a quarter mile radius of the project site. However, each complaint has been closed within the

County's reporting system. There are no current documented downstream problems associated with this project site. See Drainage Complaint Exhibit in Appendix B.

### **TASK 3 Field Investigation**

Multiple field investigations have completed over the years by Core Design Inc. The initial downstream was completed on July 22, 2016 with follow up visits in October and December 2017.

#### **Tributary Area**

The Raging River Rock Quarry is 50.2 acres of the 20,000 acres of the Raging River Basin located in the Snoqualmie Watershed. The Rock Quarry contributes to 0.25% of the overall basin. The Rock Quarry slopes in the northeasterly direction, conveying most flows via subsurface infiltration from the ridge beyond the quarry down to the Raging River.

#### **Upstream Tributary Analysis**

The project site does not have a significant upstream tributary area. The extent of the basin is just beyond the property line to the northwest.

#### **Field Investigation**

The site is comprised of varying surface types and boundary conditions. The mine itself is bowl-shaped, situated in the north central region of the project site. There is a service road and vehicular bridge connecting the mining operation to Preston-Fall City Road, over the Raging River. The Raging River creates the easterly border of the site. The central and south central areas are predominately forested regions, yet to be mined. Along the northern boundary, the site contains reclaimed, or reforested, lands from previous mining operations. Nestled along the northwesterly border there are two wetlands that have been identified, flagged, and mapped. There is one identified stream (seasonal, non-fish bearing) on King County's iMap in the southern parcel. The stream course bisects the southern parcel, flowing easterly towards the Raging River. The topography generally slopes from the west to the east, consistent with the overall stormwater conveyance.

#### **Downstream Tributary Analysis**

Onsite the tributaries can be listed as: storm events, the two identified wetlands, and the seasonal stream. These tributaries extend across the property from the east to the west, conveying flows in a sub-surface manner towards the Raging River. The project site occupies 0.25% (less than 15%) of the Raging River Sub-Basin, therefore an assessment of a quarter-mile flowpath beyond the project site is required.

The following pages show photos of the upstream/downstream path.



Raging River Rock Quarry: The mining operation, looking at the bowl-like shape.



Culvert Conveyance: The mining operation conveying storm waters towards the settling/detention ponds.



Ponds A-C: Stormwater settling in the first of three ponds that parallel the drive aisle.



Pond D: Storm water in Pond D.





Pond E: Storm water detention Pond E.



Discharge after Pond H: Culvert discharge after the series of settling/detention ponds, directed towards the 200-foot river setback.



Raging River: A view looking north under the vehicle bridge along the Raging River, stabilized bank.



Raging River: A view looking south under the vehicle bridge along the Raging River, stabilized bank.

## **TASK 4 Drainage System Description and Problem Description**

See the Resource Review & Offsite Analysis Documentation in Appendix B, and further explanation in Task 5, below.

## **TASK 5 Mitigation of Existing and Potential Problems**

### **Downstream Drainage Problems Requiring Special Attention**

#### Type 1 – Conveyance System Nuisance Problems

There is a conveyance system nuisance problem along the Raging River. As indicated in the Snoqualmie Watershed Water Quality Synthesis Report, “the Raging River is a very dynamic river with an active channel during high-flow events. The gradient is relatively steep and the slopes of the river are prone to landslides... Landslides and bank erosion due to road building and other activities can alter the width and shape of the river channel, resulting in a wider, shallower channel...”

#### Type 2 – Severe Erosion Problems

There are no known, reported or observed current downstream severe erosion problems. The Snoqualmie Watershed Water Quality Synthesis Report does indicate that the Raging River suffers from bank erosion due to road building and other activities, as discussed in Type 1.

#### Type 3 – Severe Flooding Problems

There are no known, reported or observed current downstream severe flooding problems.

### **Downstream Water Quality Problems Requiring Special Attention**

The current EPA approved Water Quality Assessment 303(d) list for Washington State and the Snoqualmie Watershed Water Quality Synthesis Report (dated January 2009) were reviewed for each of the seven downstream water quality problem types to a distance of one mile downstream of the project site. The following discussion includes reference to the updated 303(d) list of impaired water bodies.

#### Type 1 – Bacteria Problems

The project site drains to Raging River, which is a category 4A for bacteria on the 303(d) list. A category 4A indicates that the water body has an approved total maximum daily load (TMDL) that is actively being implemented. The Synthesis Report listed fecal coliform in the Raging River as a basin of concern with minor failure to meet standards, in some cases localized problem only.



<b>Listing ID: 16693</b>			
<b>Main Listing Information</b>			
<b>Listing ID:</b> 16693	<b>2014 Category:</b> 4A		
<b>Waterbody Name:</b> RAGING RIVER	<b>2012 Category:</b> 1		
<b>Medium:</b> Water	<b>2008 Category:</b> 1		
<b>Parameter:</b> Bacteria	<b>2004 Category:</b> 1		
<b>WQI Project:</b> Snoqualmie River Watershed Multiparameter TMDL	<b>On 1998 303(d) List?:</b> N		
<b>Designated Use:</b> None Assigned	<b>On 1996 303(d) List?:</b> N		
<b>Assessment Unit</b>			
<b>Assessment Unit ID:</b> 17110010000209			
<b>Location Identification</b>			
<b>Counties:</b> King	<b>WRIA:</b> 7 - Snohomish		
<b>Waterbody ID (WBID):</b> None Assigned	<b>Waterbody Class:</b> RA		
<b>Town/Range/Section (Legacy):</b> 24N-7E-15			
<b>Basis</b>			
<p>Location ID: [T36200], [FCityXRR], [07Q070] – In water year 2005, 0 of 15 sample values (0%) showed an excursion of the % criterion for this waterbody (200 cfu/100mL). The geometric mean of 27.7 does not exceed the geometric mean criterion (100 cfu/100mL).</p> <p>Location ID: [T36200], [FCityXRR], [07Q070] – In water year 2004, 2 of 26 sample values (8%) showed an excursion of the % criterion for this waterbody (200 cfu/100mL). The geometric mean of 15 does not exceed the geometric mean criterion (100 cfu/100mL).</p> <p>Hallock (2004), Dept. of Ecology ambient station 07Q070 meets tested standards for fecal coliform.</p> <p>Location ID: [T36200], [FCityXRR], [07Q070] – In water year 2003, 1 of 9 sample values (11%) showed an excursion of the % criterion for this waterbody (200 cfu/100mL). The geometric mean of 68.4 does not exceed the geometric mean criterion (100 cfu/100mL).</p> <p>Location ID: [T36200], [FCityXRR], [07Q070] – In water year 2001, 1 of 9 sample values (11%) showed an excursion of the % criterion for this waterbody (200 cfu/100mL). The geometric mean of 23.3 does not exceed the geometric mean criterion (100 cfu/100mL).</p> <p>Hallock (2001) Dept. of Ecology Ambient Monitoring Station 07Q070 (Raging River at Fall City) shows a geometric mean of 23 does not exceed the criterion and that 10% of the samples does not exceed the percentile criterion from 10 samples collected during 2001.</p> <p>Hallock (2001) Dept. of Ecology Ambient Monitoring Station 07Q070 (Raging River at Fall City) shows a geometric mean of 10 does not exceed the criterion and that 0% of the samples does not exceed the percentile criterion from 3 samples collected during 2000.</p>			
<b>Remarks</b>			
<b>Remark</b>	<b>Modified By</b>	<b>Modified On</b>	<b>Visibility</b>
Combined Listing: Listing ID 45245 was rolled into this listing	Chad Brown	9/24/2015	Public
The TMDL set a load allocation downstream of the subject segment and requires implementation of the entire area to produce measured reductions that will allow the most downstream segment	Susan Braley	12/23/2014	Private

to meet the allocation. Therefore, this segment is associated with the TMDL load allocations and can be moved to Category 4A.			
This listing is part of the Snoqualmie River Watershed Multiparameter TMDL.	Susan Braley	12/23/2014	Public
Policy 1-11 was revised in July 2012 to specify that bacteria is assessed according to water year (Oct-Sept 30) from the previous assessment period of calendar year. the water water assessment is only applied to newly assessed data. Therefore, this listing contains data assessed by both water year and calendar year.	Jessica Archer	10/1/2014	Public
This listing contains E.coli data. E. coli is a subset of Fecal coliform bacteria therefore E.coli levels above the Fecal coliform standard can be used to infer an exceedance of this water quality standard.	Jessica Archer	10/1/2014	Public
Impairment was determined by exceedance of the percent criterion in water year(s) 2003 and 2001.	Jessica Archer	10/1/2014	Public
<b>EIM</b>			
<b>User Study ID:</b>	<b>User Location ID:</b>		
AMS001E	07Q070		
GONW0001	T36200		
GONW0001	FCityXRR		

Figure 3-3: Current Water Quality Conditions (Fecal Coliform Bacteria Levels)

#### Type 2 – Dissolved Oxygen (DO) Problems

Raging River is listed as a Category 2 on the impaired water body list for dissolved oxygen, not enough to require production of a water quality improvement (WQI) project at this time. The Synthesis Report does not list dissolved oxygen as an impairment nor a concern.

Listing ID: 10608			
Main Listing Information			
Listing ID: 10608	2014 Category: 2		
Waterbody Name: RAGING RIVER	2012 Category: 3		
Medium: Water	2008 Category: 3		
Parameter: Dissolved Oxygen	2004 Category: 1		
WQI Project: None Assigned	On 1998 303(d) List?: N		
Designated Use: None Assigned	On 1996 303(d) List?: N		
Assessment Unit			
Assessment Unit ID: 17110010000209			
Location Identification			
Counties: King	WRIA: 7 - Snohomish		
Waterbody ID (WBID): None Assigned	Waterbody Class: RA		
Town/Range/Section (Legacy): 24N-7E-15			
Basis			
Location ID: [T36200] — In 2005, 0 of 2 sample values (0%) showed an excursion of the criterion (9.5 mg/L) for this waterbody;			
Location ID: [T36200] — In 2004, 1 of 6 sample values (17%) showed an excursion of the criterion (9.5 mg/L) for this waterbody;			
Location ID: [T36200] — In 2003, 1 of 7 sample values (14%) showed an excursion of the criterion (9.5 mg/L) for this waterbody;			
Location ID: [07Q070] — In 2001, 0 of 9 sample values (0%) showed an excursion of the criterion (9.5 mg/L) for this waterbody;			
Hallock (2001) Dept. of Ecology Ambient Monitoring Station 07Q070 (Raging R @ Fall City) shows 0 excursions beyond the criterion out of 6 samples collected between 1993 - 2001 .			
Remarks			
Remark	Modified By	Modified On	Visibility
Fewer than three excursions exist from all data considered.	Jessica Archer	10/3/2014	Public
Historic Remarks: Critical temporal period not adequately captured to conclude non-impairment based on WQP Policy 1-11 (Sept 2006). -mh	Jessica Archer	10/3/2014	Public
EIM			
User Study ID:		User Location ID:	
AMS001E		07Q070	
GONW0001		T36200	

Figure 3-4: Current Water Quality Conditions (Dissolved Oxygen Levels)

### Type 3 – Temperature Problems

Raging River is listed as a Category 5 or on the impaired water body list for temperature. A category 5 indicates that the waters require a TMDL, known as the 303(d) list. The Synthesis Report listed high temperatures in the Raging River as an impaired violation of state standards or failure to meet TMDL guidelines, as applicable.

Listing ID: 10607			
Main Listing Information			
Listing ID: 10607	2014 Category: 5		
Waterbody Name: RAGING RIVER	2012 Category: 3		
Medium: Water	2008 Category: 3		
Parameter: Temperature	2004 Category: 1		
WQI Project: Snoqualmie River Watershed	On 1998 303(d) List?: N		
Temperature TMDL			
Designated Use: None Assigned	On 1996 303(d) List?: N		
Assessment Unit			
Assessment Unit ID: 17110010000209			
Location Identification			
Counties: King	WRIA: 7 - Snohomish		
Waterbody ID (WBID): None Assigned	Waterbody Class: RA		
Town/Range/Section (Legacy): 24N-7E-15			
Basis			
Location ID: 07RAG02.6 – In 2006, between 6/16/2006 and 9/14/2006, the 7-day mean of daily maximum values (7DADmax) exceeded the criterion for this waterbody (16°C) on 81 of 91 days (89%); The maximum exceedance during this period was 22.67°C for the 7-day period centered on 7/24/2006 ;			
{Supplemental Spawning Period}: Location ID: 07RAG02.6 – In 2006, during the supplemental criteria period, the 7-day mean of daily maximum values (7DADmax) exceeded the criterion for this waterbody (13°C) on 17 of 41 days (41%); The maximum exceedance during this period was 14.81°C for the 7-day period centered on 9/26/2006 ;			
Hallock (2001) Dept. of Ecology Ambient Monitoring Station 07Q070 (Raging R @ Fall City) shows 0 excursions beyond the criterion out of 6 samples collected between 1993 - 2001 .			
Remarks			
Remark	Modified By	Modified On	Visibility
Historical Remarks: There is insufficient data to meet minimum requirements according to Policy 1-11. Unknown if critical temporal period adequately captured to conclude non-impairment based on WQP Policy 1-11. -mh	Nicholas Groebner	4/24/2014	Public
Supplemental Criteria apply from Sep 15 - Jun 15	Nicholas Groebner	4/24/2014	Public
There is insufficient data to meet minimum requirements according to Policy 1-11.	Ken Koch	6/22/2011	Public
Unknown if critical temporal period adequately captured to conclude non-impairment based on WQP Policy 1-11. -mh	Mike Herold	9/24/2007	Public
EIM			
User Study ID:	User Location ID:		
AMS001E	07Q070		
GONW0001	FCityXRR		
GONW0001	T36200		
NCR10001	07RAG02.6		

Figure 3-5: Current Water Quality Conditions (Temperature Levels)

Type 4 – Metals Problems

There are no known or reported downstream metals problems.

Type 5 – Phosphorous Problems

There are no known or reported downstream phosphorous problems.

Type 6 – Turbidity Problems

There are no known or reported downstream turbidity problems.

## Type 7 – High pH Problems

Raging River is listed as a Category 5 on the impaired water body list for pH problems. A Category 5 indicates that the waters require a TMDL, known as the 303(d) list. The Synthesis Report listed high pH in the Raging River as an impaired violation of state standards or failure to meet TMDL guidelines, as applicable.

Listing ID: 10609			
Main Listing Information			
Listing ID: 10609			2014 Category: 5
Waterbody Name: RAGING RIVER			2012 Category: 2
Medium: Water			2008 Category: 2
Parameter: pH			2004 Category: 2
WQI Project: None Assigned			On 1998 303(d) List?: Y
Designated Use: None Assigned			On 1996 303(d) List?: Y
Assessment Unit			
Assessment Unit ID: 17110010000209			
Location Identification			
Counties: King	WRIA: 7 - Snohomish		
Waterbody ID (WBID): WA-07-1104	Waterbody Class: RA		
Town/Range/Section (Legacy): 24N-7E-15			
Basis			
Location ID [T36200] – In 2005, 2 of 4 sample values (50%) showed an excursion of the criteria for this waterbody;			
Location ID [T36200] – In 2004, 3 of 13 sample values (23%) showed an excursion of the criteria for this waterbody;			
Location ID [T36200] – In 2003, 5 of 10 sample values (50%) showed an excursion of the criteria for this waterbody;			
Location ID [07Q070] – In 2001, 1 of 9 sample values (11%) showed an excursion of the criteria for this waterbody;			
Hallock (2004), Dept. of Ecology ambient station 07Q070 shows that of 1 sample none exceeded the criterion.			
Hallock (2001) Dept. of Ecology Ambient Monitoring Station 07Q070 (Raging R @ Fall City) shows 1 excursions beyond the criterion out of 21 samples collected between 1992 - 2001.			
Hallock (2001) Dept. of Ecology Ambient Monitoring Station 07Q070 (Raging R @ Fall City) shows 0 excursions beyond the criterion out of 6 samples collected between 1993 - 2001.			
Remarks			
Remark	Modified By	Modified On	Visibility
High pH Excursions	Jessica Archer	7/23/2014	Public
At least 10 percent of samples were excursion of the criteria in at least one year and at least 3 excursions exist from all data considered.	Jessica Archer	7/23/2014	Public
EIM			
User Study ID:	User Location ID:		
AMS001E	07Q070		
GONW0001	T36200		

Figure 3-6: Current Water Quality Conditions (pH Levels)

## SECTION 4: FLOW CONTROL AND WATER QUALITY DESIGN

### 4.1 Performance Standards

All stormwater facilities will show compliance with the new 2016 King County Surface Water Design Manual (KCSWDM) with Conservation Flow Control Standards.

#### Flow Control: Conservation Flow Control Standard

The Conservation Flow Control Standard requires maintaining the durations of high flows at their pre-development levels for all flows greater than one-half of the 2-year peak flow through the 50-year peak flow. The pre-development peak flow rates for the 2-year and 10-year runoff events must also be maintained under this requirement. We have assumed historic site conditions as the predeveloped conditions. The project proposes to use MGS Flood an approved continuous modeling software to show compliance.

#### Flow Control

Presetting facilities and infiltration ponds are proposed for all target surfaces on site to meet the conservation flow control standard. Presetting calculations are included in Section 4.4.

The MGS Flood report documentation is included in Appendix C.

#### Water Quality

The Basic Water Quality menu is applied, in our case, outside the drainage basin of the sensitive lakes or sphagnum bog wetlands. The Basic Water Quality Menu includes one pollutant removal target:

- Total Suspended Solids = 80% reduction

The Basic Water Quality Menu, described in detail in Section 6.1.1 of the 2016 KCSWDM (page 6-4), provides eight (8) options to meet the pollutant removal targets listed above.

- Option 1: Biofiltration Swale
- Option 2: Filter Strip
- Option 3: Wetpond
- Option 4: Wetvault
- Option 5: Stormwater Wetland
- Option 6: Combined Detention and Wetpool Facilities
- Option 7: Sand Filter
- Option 8: Proprietary Media Membrane Filters

## 4.2 Basin Modeling

### 4.2.1 Existing Conditions

The project site is currently a mining operation, and has been since the 1930s. The entire property consists of 50.23 acres and a portion of the site has been cleared and excavated under previous mining operations. This report will address Phase 1 of the mining operations which encompass a 10.75 acre drainage basin. Since the project proposes to fully infiltrate all the runoff up to the 100-year storm event, matching the predeveloped peaks and durations is not necessary.

<b>PREDEVELOPED</b>	Total Area = 10.75 acres
GROUND COVER	AREA(acres)
Till-Forest	10.75

### 4.2.2 Developed Conditions

The developed site area will change overtime depending on the clearing and excavation required for mining. The project proposes to break up the site into phases, Phase 1 is discussed in this report with future phases proposed at a later date. The stormwater runoff from phase 1 will be directed to pre-settling cells before entering the infiltration ponds per Section 5.2.1 of the 2016 KCSWDM. Sizing for the pre-settling ponds can be found later in this section. The drainage basin 10.75 acres was found to fully infiltrate up to the 100-year storm event. The maximum mining operation under the current assumptions consist of 6.65 acres within the 10.75 acres drainage basin. The remaining drainage basin area is composed of upstream tributary areas. Approximately 0.39 acres of the drainage basin is made up of offsite area. Refer to the offsite table below for the breakdown of areas.

<b>OFFSITE BASIN</b>	Total Area = 0.39 acres
GROUND COVER	AREA(acres)
Outwash-Forest	0.17
Till-Forest	0.22

The project proposes to model some of the impervious portions of the site as effective impervious surface using table 3.2.2.D. The proposed and existing access roads and parking lot area do not have a collection system and meet the definition in the manual. Refer to the developed conditions exhibit for the hatched areas modeled as an effective impervious surface. The following areas were modeled as 50% impervious and 50% till grass in the developed condition.



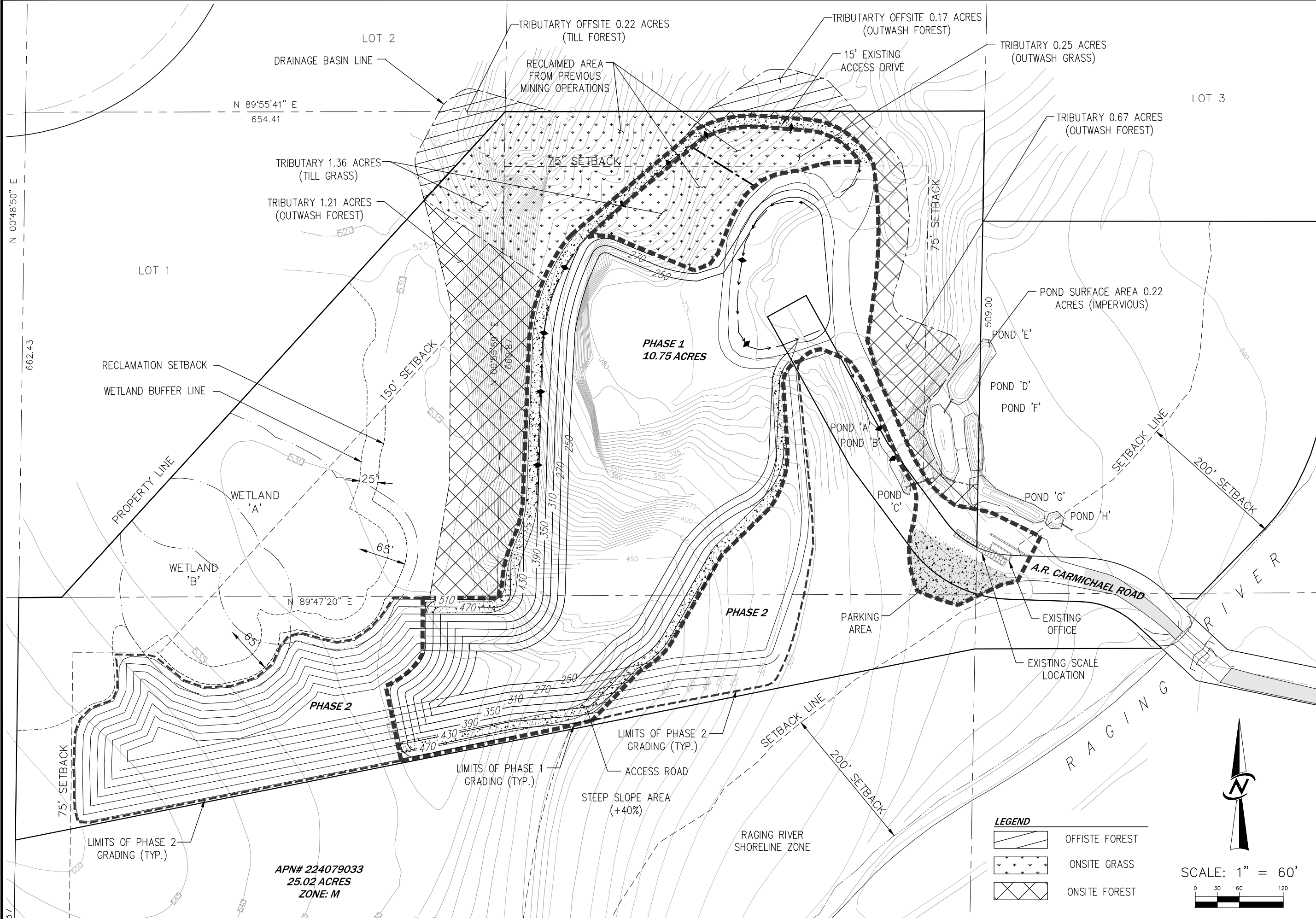
<b>EFFECTIVE IMPERVIOUS</b>	Total Area = 0.85 acres
Ground Cover	AREA(acres)
Access Roads and Parking Lot	0.85

Note the previously approved HartCrowser report applied a 50% effective impervious credit to the gravel lot, roads and rock crusher area. The land cover modeling within the past HartCrowser report differ from the assumptions within this report. Currently the onsite land cover is conservatively modeled with the majority of the mine site molded as impervious. Refer to the developed conditions exhibit at the end of this section. Since the mining operations are constantly moving and excavating, little is currently documented about the soil types and infiltration rates within mining operation itself. Therefore, an impervious assumption of 100% for the operation was given by DPER. At a future date, field testing may be performed to determine the actual characteristics of the onsite soils and land cover. The NRCS web soil survey located in Appendix B shows that the portions of the site were labeled as outwash soils prior to current mining operations.

Below is a summary of the developed areas used in modeling after taking in to account the upstream area and onsite effective impervious credit from above.

<b>DEVELOPED (PHASE 1)</b>	Total Area = 10.75 acres
GROUND COVER	AREA(acres)
Outwash-Forest	1.88
Till-Grass	1.78
Outwash-Grass	0.25
Impervious	6.45





DATE		DESIGNED		DRAWN		APPROVED		PROJECT MANAGER		<div><div><div>CORE</div><div>DESIGN</div></div><div>ENGINEERING • PLANNING • SURVEYING</div><div>14711 NE 29th Place Suite 101 Bellevue, Washington 98007 425.885.7877 Fax 425.885.7763</div></div>	
DECEMBER 2017		STACH L. BLOOM		STACH L. BLOOM		STACH L. BLOOM		KEVIN J. VANDERZANDEN			
REVISIONS											
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### 4.3 Flow Control Modeling

Using MGS Flood as the continuous runoff model the site was designed to fully infiltrate all runoff up to the 100-year storm event. *Note: Proposed flow control is 100% infiltration of developed runoff, so that there are no developed surface flows leaving the site, and matching release rates are moot in such case.* Previously the pond volumes were based on a survey information from 2007. Since then pond maintenance and sediment removal has increased the pond depths and volumes. The current infiltration ponds were surveyed in order to determine the modeling volumes. At the time of the survey the infiltration ponds were holding water and the pond bottoms could not be surveyed. Therefore, the top water surface elevation area was surveyed. The following depth assumptions were based on dipping a tape measure in multiple locations throughout the ponds. In addition, a 1:1 slope was assumed based on the field visits. Using the known surface area and assumed depths/slopes the pond volumes were determined. The pond volumes will be surveyed at a later date to confirm the assumptions used. The table below summarizes the infiltration ponds. Refer to the developed conditions exhibit above for the location and naming convention of the ponds.

Infiltration Pond	Modeled Volume (CF)
Pond D	15,724
Pond E	17,821
Pond F	9,085
Pond G-H	13,252
<b>Total</b>	<b>55,882</b>

The sites infiltration rates and sub surface conditions were documented by The Riley Group. The following calculations and assumptions have been summarized from the geotechnical report. Refer to Appendix E for the full geotechnical report calculations and infiltration rate testing. The infiltration rates were measured over three infiltration tests near the existing infiltration ponds. An average infiltration rate was determined to be 80 inches/hour for the site. In order to conservatively model the infiltration ponds, correction factors were applied to the field measure infiltration rate. Using the “Simplified method” in section 5.2.1 of the 2016 KCSWDM, a long term design infiltration rate was determined. Note that  $F_{geometry}$  assumed the most conservative reduction factor since the existing pond widths are narrow and a ground water was not encountered.

$$I_{design} = I_{measured} \times F_{testing} \times F_{geometry} \times F_{plugging}$$

Where:

$I_{design}$  = design infiltration rate

$I_{measured}$  = field measured infiltration rate (80 in/hr)

$F_{testing}$  = accounts for uncertainties in testing methods (0.5)

$F_{geometry}$  = accounts for facility geometry and ground water influences (0.25)

$F_{plugging}$  = based on soil type, accounts for reduction in infiltration rate over time (1.0)

$$I_{design} = 10 \text{ in/hr}$$

The following table displays the infiltration rates used for modeling in MGS Flood. The constant design infiltration rate function was used in the pond sizing instead of the more favorable MGS flood infiltration rate which addresses each pond separately. Ground water was not encountered up to a depth of 8 feet from the bottom of the infiltration ponds.

Infiltration Type	Long Term Infiltration Rate(in/hr)	Modeled Infiltration Rate(min/in)
Infiltration Pond	10	6

A summary of the MGS Flood Report is included below. The infiltration ponds are linked in series and the point of compliance shows the 100-year storm event is fully infiltrated. The full report is located in appendix C of this report.

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.456	2-Year	0.000
5-Year	0.707	5-Year	0.000
10-Year	0.938	10-Year	0.000
25-Year	1.374	25-Year	0.000
50-Year	1.889	50-Year	0.000
100-Year	2.062	100-Year	0.000
200-Year	3.041	200-Year	0.000

#### 4.4 Water Quality Calculations

The presetting ponds were calculated based on the 2016 King County Surface Water Design Manual Section 5.2.1. The required treatment volume was calculated as 0.25 times the basic water quality design volume in section 6.4.1.1. The following shows the calculations for the basic water quality design volume.

##### Wetvault (Basic)

The 6-month, 24-hour precipitation amount is assumed to be 72 percent of the 2-year, 24-hour amount per Section 6.2.1. The 2 year 24 hour precipitation for the project site is 3.0 inches. Therefore, the 6-month 24-hour precipitation is 2.16 inches. A copy of the KCSWDM isopluvial map, Figure 3.2.1.A is located at the end of this section.

##### Step 1: Average Weighted Curve Number

$$CN = \left( \frac{Ai \times 98 + Atg \times 86}{At} \right)$$

Where:

CN = Average Weighted Curve Number (Table 6.4.1.1.A)

Ai = Area Impervious (CN= 98) 6.45 acres

Atg = Area Till Grass (CN = 86) 1.78 acres

Atf = Area Till Forest (CN = 70) 0.22 acres

Aog = Area Outwash Grass (CN = 68) 0.25 acres

Aof = Area Outwash Forest (CN = 30) 2.05 acres

At = Total contributing site area (10.75 acres)

**CN = 82**

Step 2: Maximum Natural Detention (S)

$$S = \left( \frac{1000}{CN} \right) - 10$$

**S = 2.2**

Step 3: Runoff Depth (Q<sub>d</sub>)

$$Q_d = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

Where:

Q<sub>d</sub> = runoff depth in inches over the area

P = precipitation depth in inches over the area

S = potential maximum natural detention, in inches over the area due to infiltration, storage, etc.

**Q<sub>d</sub> = 0.75**

Step 4: Wetpool Design Volume

$$Vol_{req} = 3,630 \times Q_d \times At$$

Where:

Q<sub>d</sub> = runoff depth in inches over the area

At = Total contributing site area (10.75 acres)

**Vol<sub>req</sub> = 29,084 cf**

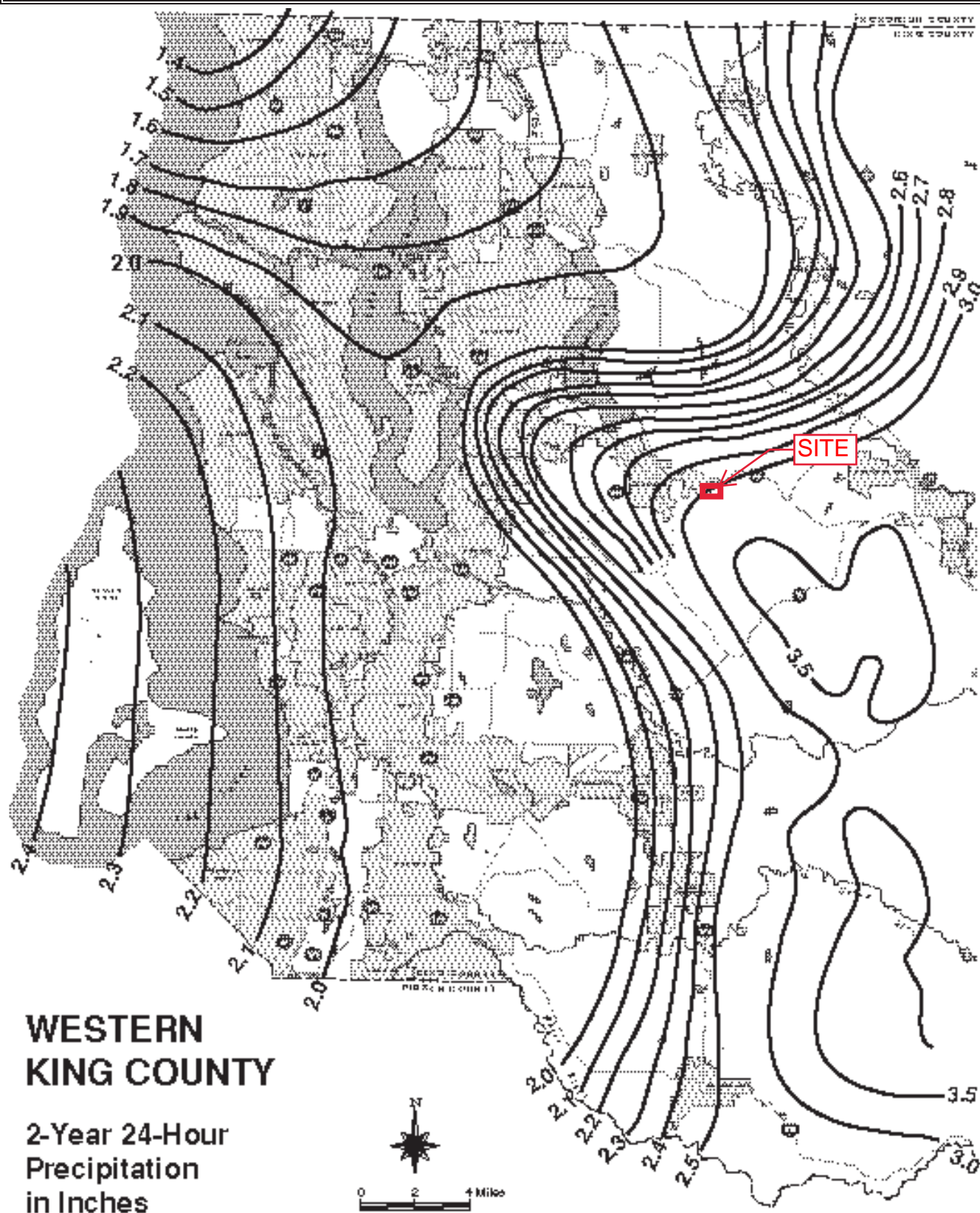
Using the equation above and the results from the previous steps, the required minimum wetvault volume, Vol<sub>req</sub> is **29,084 cubic feet**.

Pre-settling Pond

Using section 5.2.1 the pre-settling volume is 0.25 times the basic water quality volume. Therefore, the required pre-settling pond volume is 29,084 X 0.25 = 7,271 cubic feet. The provided presetting pond volume is **7,654 cf**.



FIGURE 3.2.1.A 2-YEAR 24-HOUR ISOPLUVIALS



## SECTION 5: CONVEYANCE SYSTEM ANALYSIS AND DESIGN

All conveyance systems have been designed in accordance with the 2016 King County Surface Water Design Manual (KCSWDM). The conveyance system has been designed to provide sufficient capacity to convey and contain, at a minimum, the 25-year peak developed condition flows. Pipe system structures may overtop for runoff events that exceed the 25-year design capacity provided that the 100-year runoff does not create a flooding or erosion problem. Peak flows used in all hydraulic calculations have been determined using MGS Flood. Refer to the unmitigated flow rates below.

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.456	2-Year	3.182
5-Year	0.707	5-Year	4.079
10-Year	0.938	10-Year	4.834
25-Year	1.374	25-Year	5.929
50-Year	1.889	50-Year	7.870
100-Year	2.062	100-Year	9.014
200-Year	3.041	200-Year	9.204

In order to convey the 25 year storm event the following pipes are required along with an average conveyance channel dimension. The 25 year unmitigated storm event at the point of confluence will see 5.9 cfs. Therefore, a 12" diameter conveyance pipe needs to be at a 2% slope or greater to convey the 25 year flow. Conveyances channels or ditches at a 3:1 side slope and 2% longitudinal slope would require a cross sectional area of approximately 2 square feet to convey the 25 year flow. A conveyance ditch that is flowing at an 8" depth and has a bottom width of 12" has a cross sectional area of approximately 2 square feet.



## **SECTION 6: SPECIAL REPORTS AND STUDIES**

➤ **Geotechnical Engineering Report (included in Appendix D)**

Prepared for: Raging River Quarry

Prepared by: David J. Baumgarten, L.H.G

Dated: August 15, 2016

The Riley Group Inc.

17522 Bothell Way Northeast

Bothell, Washington 98011

## **SECTION 7: OTHER PERMITS**

A copy of the Grading Permit issued by King County is include in Appendix F.

## SECTION 8: ESC ANALYSIS AND DESIGN

The site will utilize Appendix D of the 2016 KCSWDM and the standard design details from the 2014 Stormwater Management Manual for Western Washington for the erosion and sedimentation control design. Refer to the TESC plan at the end of this section, below is a breakdown of how each require element is addressed followed by pond sizing calculations

- 1) Preserve Vegetation/Mark Clearing Limits
  - i. The project will mark the grading limit extents of phase 1. The boundary of sensitive areas and their buffers will be left uncleared. All storm runoff is conveyed to the presettling and infiltration ponds.
- 2) Establish Construction Access
  - i. Stabilized Construction Entrance, BMP C105 (modified): Rock quarry spalls are placed to reduce the amount of sediment transported onto paved roads by vehicles or equipment.
  - ii. Dust Control, BMP C140: Paved construction entrance shall be stabilized and swept on a regular basis to reduce tracking of sediment.
- 3) Control Flow Rates
  - i. Sediment Trap, BMP C240: Three presettling ponds will filter out sediment from the mining operation before the stormwater is conveyed to the infiltration ponds. Based on the operations and maintenance manual sediment will be regularly removed from the traps once exceeding 6".
  - ii. Temporary Sediment Pond, BMP C241: Infiltration ponds will infiltrate all flows up to the 100-year storm event. Based on the operations and maintenance manual sediment will be regularly removed from the ponds once exceeding 6".
  - iii. Wattles, BMP C235: Runoff from the paved entrance road will be dispersed over the forest floor using rip rap and straw wattles. Straw wattles are also proposed on the bridge itself to eliminate sediment from entering the river below.
- 4) Install Sediment Controls
  - i. Sediment Trap, BMP C240: Three presettling ponds will filter out sediment from the mining operation before the stormwater is conveyed to the infiltration ponds.
  - ii. Temporary Sediment Pond BMP, C241: Infiltration ponds will infiltrate all flows up to the 100-year storm event.
  - iii. Wattles, BMP C235: Runoff from the paved road will be dispersed over the forest floor using rip rap and straw wattles.
- 5) Stabilize Soils
  - i. Disturbed soils will be limited to the mining operation. Quarry spalls are used around the site to minimize erosion in the conveyance channels. As the excavation progresses over the years, past mining faces/areas will be reclaimed and vegetated.
  - ii. Dust Control, BMP C240: The paved construction entrance shall be stabilized and swept on a regular basis where traffic will be entering or leaving a construction site.

- 6) Protects Slopes
  - i. Interceptor Dike and swale, BMP C200: conveyance channels and ditches will convey water from the construction surfaces to the appropriate sediment control measure.
  - ii. Pipe Slope Drain, BMP C204: To prevent runoff near the bridge crossing from entering the river directly a pipe slope drain is proposed. Runoff will be conveyed to straw wattles and rip rap on the forest floor.
- 7) Protects Drain Inlets
  - i. Storm Drain Inlet Protection, BMP C220: Protect all existing storm drain inlets from sedimentation.
- 8) Stabilize Channels and Outlets
  - i. Check Dams, BMP C207: Existing check dams in the swales/ditched reduce the velocity of concentrated flow. Existing channels are armored with quarry spalls to reduce erosion potential.
  - ii. Outlet Protection, BMP C209: Existing rip rap protects and disperses runoff from the paved road onto the forest floor. It reduces the velocity and minimizes the potential for downstream erosion. Rip rap is proposed for the outlet of the pipe slope drain along with straw wattles.
- 9) Control Pollutants
  - i. Dust Control, BMP C140: Paved construction entrance shall be stabilized and swept on a regular basis to minimize any sediment tracking from vehicles.
- 10) Control Dewatering
  - i. Dewatering is not anticipated for the project.
- 11) Maintain BMPs
  - i. All BMPs will be maintained and repaired in accordance with BMP specifications. Refer to section 10 for operations and maintenance.
- 12) Manage the Project
  - i. Future project mining operations will be under a separate report. This report covers all phase 1 operations.
- 13) Protect Low Impact Development BMPs
  - i. Refer to section 10 for operations and maintenance of the infiltration ponds.

The calculations for sizing the sediment ponds area included below. The existing presettling ponds and infiltration ponds will be utilized as the retention facility. An emergency outfall exists for any flows over the 100 year storm event. The following is the unmitigated developed 15-min time step flow rates from MGS Flood. The project proposes to continue operations through the wet season (October 1 to April 30). Therefore, the 10 year flow rate was used with the sizing equations per KCSWDM D.2.1.5.2.

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.456	2-Year	3.182
5-Year	0.707	5-Year	4.079
10-Year	0.938	10-Year	4.834
25-Year	1.374	25-Year	5.929
50-Year	1.889	50-Year	7.870
100-Year	2.062	100-Year	9.014
200-Year	3.041	200-Year	9.204

Sizing Formula Wet Season:

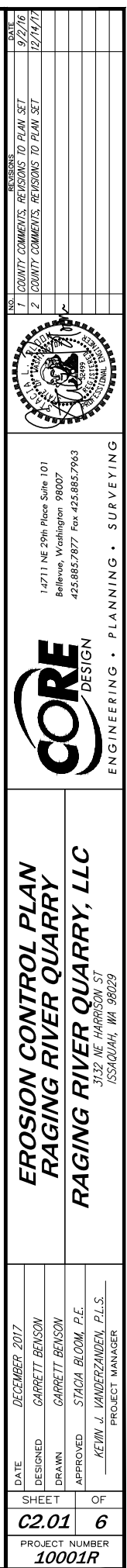
SA =  $2 \times 10_{\text{year}} / 0.00096$  or 2080 square feet per cfs of inflow

SA= 10,046 square feet required

A required sediment trap volume was determined based on the basic geometry in KCSWDM D.2.1.5.2. A depth of 3.5', side slopes of 3:1 and length to width ratio of 3:1 were used. This yielded a required volume of 26,336 cf based on the required surface area square footage. The project currently provides more than enough volume with the existing presettling ponds and infiltration ponds.

**Volume Required = 26,336 cf**

**Volume Provided (Presettling ponds + Pond D and E) = 40,816 cf**



## **SECTION 9: BOND QUANTITIES, FACILITY SUMMARIES, AND DECLARATION OF COVENANT**

This is a private operation with no proposed public improvements. A bond quantities worksheet is not applicable for this project.

## **SECTION 10: OPERATIONS AND MAINTENANCE**

A general location and description of the stormwater management facilities are as follows.

Runoff from the mine will be collected in the existing conveyance systems composed of pipes and ditches. All runoff from the mine is conveyed to presettling ponds along the south west side of Carmichael Road. After the water is treated in the settling ponds, a 12" pipe conveys flows to the infiltration ponds to the northeast. The operation and maintenance of the facilities described above will be performed by Raging River Quarry. Note that the paved conduction entrance will be swept as necessary to prevent sediment transport and sediment build up over 6" in the infiltration and presettling ponds will be removed on a regular basis.

Design of the storm drainage system is based on the 2016 King County Surface Water Design Manual. The operations and maintenance information for the proposed facilities are included at the end of this section. It is a copy of Appendix A of the 2016 KCSWDM.

The Raging River Quarry will be responsible for the onsite maintenance and operations of the stormwater management systems.



**NO. 2 – INFILTRATION FACILITIES**

<b>Maintenance Component</b>	<b>Defect or Problem</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Results Expected When Maintenance Is Performed</b>
Site	Trash and debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Infiltration Pond, Top or Side Slopes of Dam, Berm or Embankment	Rodent holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents removed or destroyed and dam or berm repaired.
	Tree growth	Tree growth threatens integrity of dams, berms or slopes, does not allow maintenance access, or interferes with maintenance activity. If trees are not a threat to dam, berm, or embankment integrity or not interfering with access or maintenance, they do not need to be removed.	Trees do not hinder facility performance or maintenance activities.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted slope.	Slopes stabilized using appropriate erosion control measures. If erosion is occurring on compacted slope, a licensed civil engineer should be consulted to resolve source of erosion.
	Settlement	Any part of a dam, berm or embankment that has settled 4 inches lower than the design elevation.	Top or side slope restored to design dimensions. If settlement is significant, a licensed civil engineer should be consulted to determine the cause of the settlement.
Infiltration Pond, Tank, Vault, Trench, or Small Basin Storage Area	Sediment accumulation	If two inches or more sediment is present or a percolation test indicates facility is working at or less than 90% of design.	Facility infiltrates as designed.
	Liner damaged (If Applicable)	Liner is visible or pond does not hold water as designed.	Liner repaired or replaced.
Infiltration Tank Structure	Plugged air vent	Any blockage of the vent.	Tank or vault freely vents.
	Tank bent out of shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape.	Tank repaired or replaced to design.
	Gaps between sections, damaged joints or cracks or tears in wall	A gap wider than ½-inch at the joint of any tank sections or any evidence of soil particles entering the tank at a joint or through a wall.	No water or soil entering tank through joints or walls.
Infiltration Vault Structure	Damage to wall, frame, bottom, and/or top slab	Cracks wider than ½-inch, any evidence of soil entering the structure through cracks or qualified inspection personnel determines that the vault is not structurally sound.	Vault is sealed and structurally sound.

**NO. 2 – INFILTRATION FACILITIES**

<b>Maintenance Component</b>	<b>Defect or Problem</b>	<b>Conditions When Maintenance Is Needed</b>	<b>Results Expected When Maintenance Is Performed</b>
Inlet/Outlet Pipes	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Access Manhole	Cover/lid not in place	Cover/lid is missing or only partially in place. <b>Any open manhole requires immediate maintenance.</b>	Manhole access covered.
	Locking mechanism not working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to remove	One maintenance person cannot remove cover/lid after applying 80 lbs of lift.	Cover/lid can be removed and reinstalled by one maintenance person.
	Ladder rungs unsafe	Missing rungs, misalignment, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Large access doors/plate	Damaged or difficult to open	Large access doors or plates cannot be opened/removed using normal equipment.	Replace or repair access door so it can be opened as designed.
	Gaps, doesn't cover completely	Large access doors not flat and/or access opening not completely covered.	Doors close flat; covers access opening completely.
	Lifting Rings missing, rusted	Lifting rings not capable of lifting weight of door or plate.	Lifting rings sufficient to lift or remove door or plate.
Infiltration Pond, Tank, Vault, Trench, or Small Basin Filter Bags	Plugged	Filter bag more than ½ full.	Replace filter bag or redesign system.
Infiltration Pond, Tank, Vault, Trench, or Small Basin Pre-settling Ponds and Vaults	Sediment accumulation	6" or more of sediment has accumulated.	Pre-settling occurs as designed
Infiltration Pond, Rock Filter	Plugged	High water level on upstream side of filter remains for extended period of time or little or no water flows through filter during heavy rain storms.	Rock filter replaced evaluate need for filter and remove if not necessary.
Infiltration Pond Emergency Overflow Spillway	Rock missing	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. Rip-rap on inside slopes need not be replaced.	Spillway restored to design standards.
	Tree growth	Tree growth impedes flow or threatens stability of spillway.	Trees removed.

**NO. 5 – CATCH BASINS AND MANHOLES**

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Structure	Sediment	Sediment exceeds 60% of the depth from the bottom of the catch basin to the invert of the lowest pipe into or out of the catch basin or is within 6 inches of the invert of the lowest pipe into or out of the catch basin.	Sump of catch basin contains no sediment.
	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the catch basin opening or is blocking capacity of the catch basin by more than 10%.	No Trash or debris blocking or potentially blocking entrance to catch basin.
		Trash or debris in the catch basin that exceeds ⅓ the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the catch basin.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within catch basin.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that catch basin is unsound.	Catch basin is sealed and is structurally sound.
		Cracks wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	No cracks more than ¼ inch wide at the joint of inlet/outlet pipe.
	Settlement/misalignment	Catch basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the catch basin at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.

**NO. 5 – CATCH BASINS AND MANHOLES**

<b>Maintenance Component</b>	<b>Defect or Problem</b>	<b>Condition When Maintenance is Needed</b>	<b>Results Expected When Maintenance is Performed</b>
Metal Grates (Catch Basins)	Unsafe grate opening	Grate with opening wider than $\frac{7}{8}$ inch.	Grate opening meets design standards.
	Trash and debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris. footnote to guidelines for disposal
	Damaged or missing	Grate missing or broken member(s) of the grate. <b>Any open structure requires urgent maintenance.</b>	Grate is in place and meets design standards.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. <b>Any open structure requires urgent maintenance.</b>	Cover/lid protects opening to structure.
	Locking mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to Remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.

**NO. 6 – CONVEYANCE PIPES AND DITCHES**

<b>Maintenance Component</b>	<b>Defect or Problem</b>	<b>Conditions When Maintenance is Needed</b>	<b>Results Expected When Maintenance is Performed</b>
Pipes	Sediment & debris accumulation	Accumulated sediment or debris that exceeds 20% of the diameter of the pipe.	Water flows freely through pipes.
	Vegetation/roots	Vegetation/roots that reduce free movement of water through pipes.	Water flows freely through pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damage to protective coating or corrosion	Protective coating is damaged; rust or corrosion is weakening the structural integrity of any part of pipe.	Pipe repaired or replaced.
	Damaged	Any dent that decreases the cross section area of pipe by more than 20% or is determined to have weakened structural integrity of the pipe.	Pipe repaired or replaced.
Ditches	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet of ditch and slopes.	Trash and debris cleared from ditches.
	Sediment accumulation	Accumulated sediment that exceeds 20% of the design depth.	Ditch cleaned/flushed of all sediment and debris so that it matches design.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Vegetation	Vegetation that reduces free movement of water through ditches.	Water flows freely through ditches.
	Erosion damage to slopes	Any erosion observed on a ditch slope.	Slopes are not eroding.
	Rock lining out of place or missing (If Applicable)	One layer or less of rock exists above native soil area 5 square feet or more, any exposed native soil.	Replace rocks to design standards.

**NO. 7 – DEBRIS BARRIERS (E.G., TRASH RACKS)**

<b>Maintenance Component</b>	<b>Defect or Problem</b>	<b>Condition When Maintenance is Needed</b>	<b>Results Expected When Maintenance is Performed.</b>
Site	Trash and debris	Trash or debris plugging more than 20% of the area of the barrier.	Barrier clear to receive capacity flow.
	Sediment accumulation	Sediment accumulation of greater than 20% of the area of the barrier	Barrier clear to receive capacity flow.
Structure	Cracked broken or loose	Structure which bars attached to is damaged - pipe is loose or cracked or concrete structure is cracked, broken or loose.	Structure barrier attached to is sound.
Bars	Bar spacing	Bar spacing exceeds 6 inches.	Bars have at most 6 inches spacing.
	Damaged or missing bars	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than ¾ inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Repair or replace barrier to design standards.

NO. 11 – GROUNDS (LANDSCAPING)			
Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash or litter	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Trees and Shrubs	Hazard	Any tree or limb of a tree identified as having a potential to fall and cause property damage or threaten human life. <b>A hazard tree identified by a qualified arborist must be removed as soon as possible.</b>	No hazard trees in facility.
	Damaged	Limbs or parts of trees or shrubs that are split or broken which affect more than 25% of the total foliage of the tree or shrub.	Trees and shrubs with less than 5% of total foliage with split or broken limbs.
		Trees or shrubs that have been blown down or knocked over.	No blown down vegetation or knocked over vegetation. Trees or shrubs free of injury.
		Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Tree or shrub in place and adequately supported; dead or diseased trees removed.

NO. 12 – ACCESS ROADS			
Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet (i.e., trash and debris would fill up one standard size garbage can).	Roadway drivable by maintenance vehicles.
		Debris which could damage vehicle tires or prohibit use of road.	Roadway drivable by maintenance vehicles.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Blocked roadway	Any obstruction which reduces clearance above road surface to less than 14 feet.	Roadway overhead clear to 14 feet high.
		Any obstruction restricting the access to a 10- to 12 foot width for a distance of more than 12 feet or any point restricting access to less than a 10 foot width.	At least 12-foot of width on access road.
Road Surface	Erosion, settlement, potholes, soft spots, ruts	Any surface defect which hinders or prevents maintenance access.	Road drivable by maintenance vehicles.
	Vegetation on road surface	Trees or other vegetation prevent access to facility by maintenance vehicles.	Maintenance vehicles can access facility.
Shoulders and Ditches	Erosion	Erosion within 1 foot of the roadway more than 8 inches wide and 6 inches deep.	Shoulder free of erosion and matching the surrounding road.
	Weeds and brush	Weeds and brush exceed 18 inches in height or hinder maintenance access.	Weeds and brush cut to 2 inches in height or cleared in such a way as to allow maintenance access.
Modular Grid Pavement	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damaged or missing	Access surface compacted because of broken or missing modular block.	Access road surface restored so road infiltrates.



# Appendix A

## Parcel & Basin Information

King County Parcel Reports

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## PARCEL

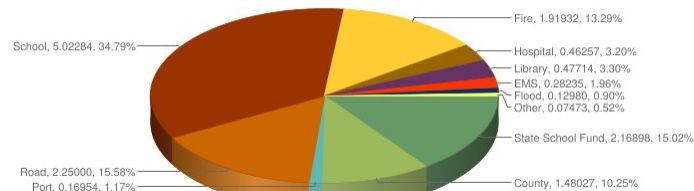
Parcel Number	222407-9011
Name	RAGING RIVER QUARRY LLC
Site Address	
Legal	SE 1/4 OF NW 1/4 OF SW 1/4 T6W R10E S 1/2 OF SW 1/4 LY W OF RAGING RIVER & N OF LN BEG 331.05 FT S OF NW COR TH N 77-06-00 E 1334.70 FT TO E LN OF SW 1/4 OF SW 1/4 75 FT S OF NE COR TH E 150 FT TO C/L OF RIVER T6W R10E S 1/2 OF NW 1/4 OF SW 1/4 BEG ON S LN OF SUBD 58.56 FT E OF SW COR TH N 42-22-27 E 897.83 FT TO NW COR OF SE 1/4 OF NW 1/4 OF SW 1/4 TH S 00-55-06 W 660.99 FT TO S LN OF SD SUBD TH S 89-46-17 W ALG SD S LN 594.53 FT TO BEG LESS CO RD PER KC LOT LN ADJ NO 582025

## BUILDING 1

Year Built		<input type="text" value="7"/>
Total Square Footage		
Number Of Bedrooms		
Number Of Baths		
Grade		
Condition		
Lot Size	885574	
Views	No	
Waterfront		

## TOTAL LEVY RATE DISTRIBUTION

Tax Year: 2016 Levy Code: 6694 Total Levy Rate: \$14.43755 Total Senior Rate: \$8.77176



42.82% Voter Approved

[Click here to see levy distribution comparison by year.](#)

## TAX ROLL HISTORY

Valued Year	Tax Year	Appraised Land Value (\$)	Appraised Imps Value (\$)	Appraised Total (\$)	Taxable Land Value (\$)	Taxable Imps Value (\$)	Taxable Total (\$)
2015	2016	226,000	0	226,000	226,000	0	226,000
2014	2015	208,000	0	208,000	208,000	0	208,000
2013	2014	230,000	0	230,000	230,000	0	230,000
2012	2013	236,000	0	236,000	236,000	0	236,000
2011	2012	242,000	0	242,000	242,000	0	242,000
2010	2011	255,000	0	255,000	255,000	0	255,000
2009	2010	255,000	0	255,000	255,000	0	255,000
2008	2009	300,000	0	300,000	300,000	0	300,000
2007	2008	307,000	0	307,000	307,000	0	307,000
2006	2007	283,000	0	283,000	283,000	0	283,000
2005	2006	274,000	0	274,000	274,000	0	274,000
2004	2005	265,000	0	265,000	265,000	0	265,000
2003	2004	253,000	0	253,000	253,000	0	253,000
2002	2003	253,000	0	253,000	253,000	0	253,000
2001	2002	220,000	0	220,000	220,000	0	220,000
2000	2001	311,000	0	311,000	311,000	0	311,000
1999	2000	271,000	0	271,000	271,000	0	271,000
1998	1999	250,000	0	250,000	250,000	0	250,000
1997	1998	0	0	0	220,000	0	220,000

## Reference Links:

- [King County Taxing Districts Codes and Levies \(.PDF\)](#)
- [King County Tax Links](#)
- [Property Tax Advisor](#)
- [Washington State Department of Revenue \(External link\)](#)
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1996	1997	0	0	0	220,000	0	220,000
1994	1995	0	0	0	220,000	0	220,000
1992	1993	0	0	0	209,900	0	209,900
1990	1991	0	0	0	160,200	0	160,200
1988	1989	0	0	0	74,800	0	74,800
1986	1987	0	0	0	74,800	0	74,800
1984	1985	0	0	0	67,000	0	67,000
1983	1984	0	0	0	67,000	0	67,000
1982	1983	0	0	0	76,000	0	76,000

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## PARCEL

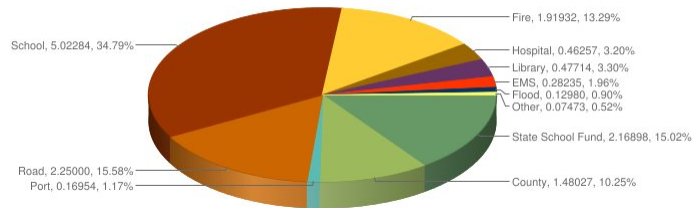
Parcel Number	222407-9033
Name	RAGING RIVER QUARRY LLC
Site Address	
Legal	POR OF S 1/2 OF SW 1/4 LY W OF CENTER OF RAGING RIVER & S OF FOLG LN BEG 331.05 FT S OF NW COR OF SW 1/4 OF SW 1/4 TH N 77-06-00 E 1334.70 FT TO E LN SD SUB DIV 75 FT S OF NE COR THOF E 150 FT M/L TO CENTER OF RAGING RIVER LESS CO RD

## BUILDING 1

Year Built		
Total Square Footage		
Number Of Bedrooms		
Number Of Baths		
Grade		
Condition		
Lot Size	1125154	
Views	No	
Waterfront	RIVER/SLOUGH	

## TOTAL LEVY RATE DISTRIBUTION

Tax Year: 2016 Levy Code: 6694 Total Levy Rate: \$14.43755 Total Senior Rate: \$8.77176



42.82% Voter Approved

[Click here to see levy distribution comparison by year.](#)

## TAX ROLL HISTORY

Valued Year	Tax Year	Appraised Land Value (\$)	Appraised Imps Value (\$)	Appraised Total (\$)	Taxable Land Value (\$)	Taxable Imps Value (\$)	Taxable Total (\$)
2015	2016	260,000	0	260,000	260,000	0	260,000
2014	2015	239,000	0	239,000	239,000	0	239,000
2013	2014	287,000	0	287,000	287,000	0	287,000
2012	2013	294,000	0	294,000	294,000	0	294,000
2011	2012	302,000	0	302,000	302,000	0	302,000
2010	2011	318,000	0	318,000	318,000	0	318,000
2009	2010	318,000	0	318,000	318,000	0	318,000
2008	2009	375,000	0	375,000	375,000	0	375,000
2007	2008	368,000	0	368,000	368,000	0	368,000
2006	2007	340,000	0	340,000	340,000	0	340,000
2005	2006	329,000	0	329,000	329,000	0	329,000
2004	2005	318,000	0	318,000	318,000	0	318,000
2003	2004	303,000	0	303,000	303,000	0	303,000
2002	2003	303,000	0	303,000	303,000	0	303,000
2001	2002	264,000	0	264,000	264,000	0	264,000
2000	2001	319,000	0	319,000	319,000	0	319,000
1999	2000	278,000	0	278,000	278,000	0	278,000
1998	1999	256,000	0	256,000	256,000	0	256,000
1997	1998	0	0	0	225,000	0	225,000
1996	1997	0	0	0	225,000	0	225,000
1994	1995	0	0	0	225,000	0	225,000

Reference  
Links:

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1992	1993	0	0	0	221,400	0	221,400
1990	1991	0	0	0	169,000	0	169,000
1988	1989	0	0	0	87,400	0	87,400
1986	1987	0	0	0	87,400	0	87,400
1984	1985	0	0	0	78,200	0	78,200
1982	1983	0	0	0	78,200	0	78,200

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## PARCEL

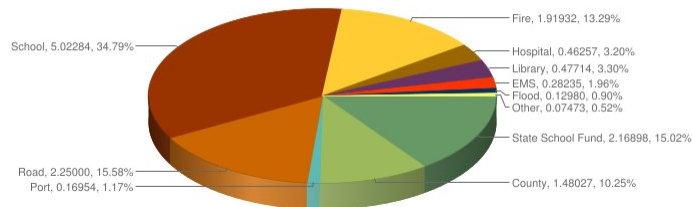
Parcel Number	222407-9035
Name	RAGING RIVER QUARRY LLC
Site Address	
Legal	LOT 4 KC SHORT PLAT NO 880098 REC NO 8202050393 SD PLAT DAF - POR OF NE 1/4 OF SW 1/4 & S 163 FT OF SE 1/4 OF NW 1/4 LY WLY OF RAGING RIVER LESS CO RD

## BUILDING 1

Year Built		<input type="text" value=""/>
Total Square Footage		
Number Of Bedrooms		
Number Of Baths		
Grade		
Condition		
Lot Size	219978	
Views	No	
Waterfront	RIVER/SLOUGH	

## TOTAL LEVY RATE DISTRIBUTION

Tax Year: 2016 Levy Code: 6694 Total Levy Rate: \$14.43755 Total Senior Rate: \$8.77176



42.82% Voter Approved

[Click here to see levy distribution comparison by year.](#)

## TAX ROLL HISTORY

Valued Year	Tax Year	Appraised Land Value (\$)	Appraised Imps Value (\$)	Appraised Total (\$)	Taxable Land Value (\$)	Taxable Imps Value (\$)	Taxable Total (\$)
2015	2016	190,000	0	190,000	190,000	0	190,000
2014	2015	175,000	0	175,000	175,000	0	175,000
2013	2014	139,000	0	139,000	139,000	0	139,000
2012	2013	143,000	0	143,000	143,000	0	143,000
2011	2012	147,000	0	147,000	147,000	0	147,000
2010	2011	155,000	0	155,000	155,000	0	155,000
2009	2010	155,000	0	155,000	155,000	0	155,000
2008	2009	183,000	0	183,000	183,000	0	183,000
2007	2008	186,000	0	186,000	186,000	0	186,000
2006	2007	172,000	0	172,000	172,000	0	172,000
2005	2006	167,000	0	167,000	167,000	0	167,000
2004	2005	162,000	0	162,000	162,000	0	162,000
2003	2004	155,000	0	155,000	155,000	0	155,000
2002	2003	201,000	0	201,000	201,000	0	201,000
2001	2002	175,000	0	175,000	175,000	0	175,000
2000	2001	223,000	0	223,000	223,000	0	223,000
1999	2000	194,000	0	194,000	194,000	0	194,000
1998	1999	179,000	0	179,000	179,000	0	179,000
1997	1998	0	0	0	157,600	0	157,600
1996	1997	0	0	0	157,600	0	157,600
1994	1995	0	0	0	157,600	0	157,600
1992	1993	0	0	0	128,500	0	128,500

Reference  
Links:

- [King County Taxing Districts Codes and Levies \(.PDF\)](#)
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1990	1991	0	0	0	98,100	0	98,100
1988	1989	0	0	0	44,500	0	44,500
1986	1987	0	0	0	44,500	0	44,500
1984	1985	0	0	0	25,000	0	25,000
1983	1984	0	0	0	25,000	0	25,000
1982	1983	0	0	0	18,600	0	18,600

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## Appendix B

### Resource Review & Off-site Analysis Documentation

FEMA Map (53033C0717 G)

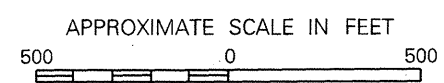
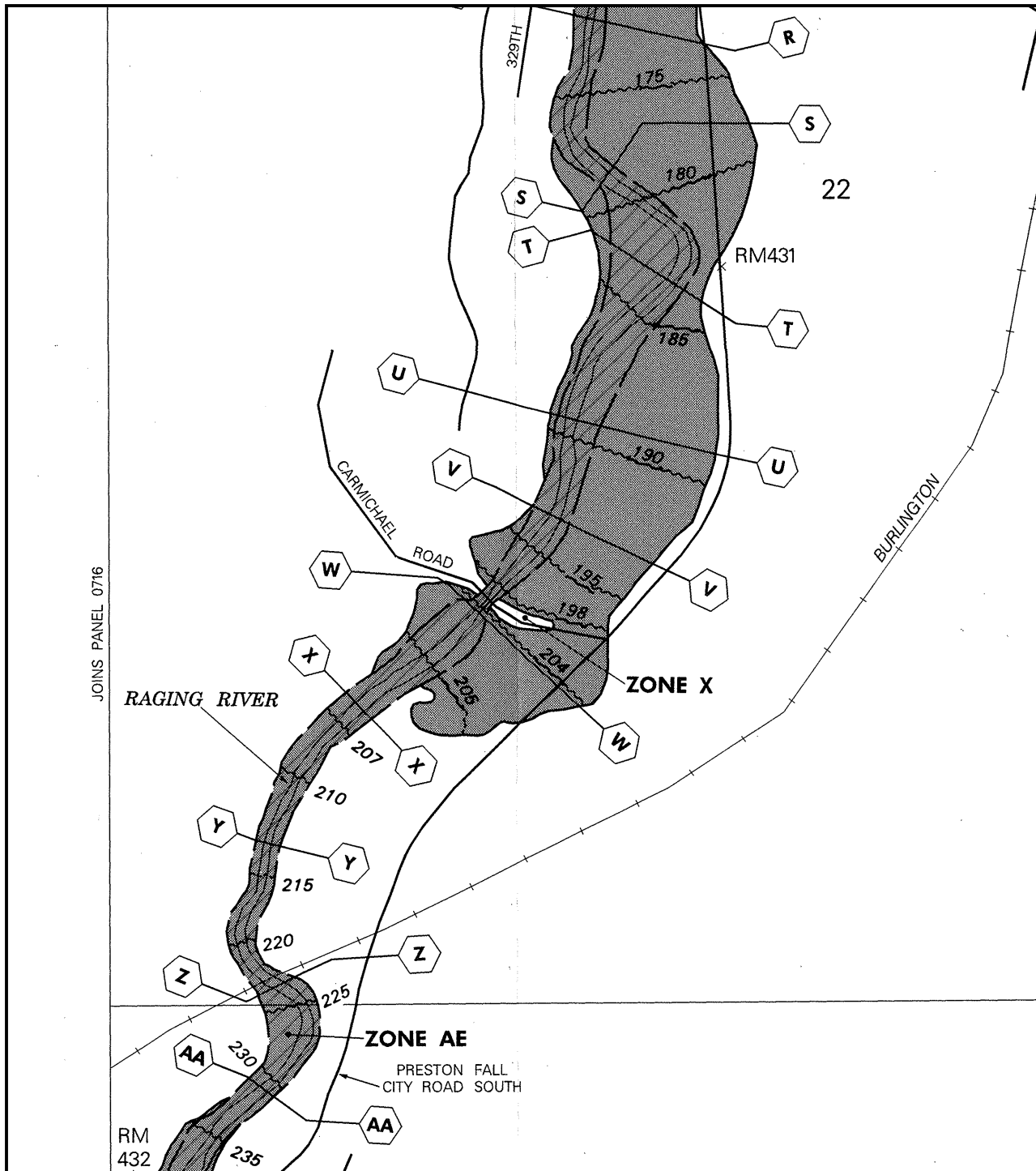
USDA NRCS Site Soils Map

Sensitive Areas Map – King County iMap

Drainage Complaints

Raging River Impairments Table





**NATIONAL FLOOD INSURANCE PROGRAM**

**FIRM**  
**FLOOD INSURANCE RATE MAP**  
 KING COUNTY,  
 WASHINGTON AND  
 INCORPORATED AREAS

**PANEL 717 OF 1725**  
 (SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
KING COUNTY, UNINCORPORATED AREAS	530071	0717	G
SNOQUALMIE, CITY OF	530090	0717	G

**MAP NUMBER**  
**53033C0717 G**

**MAP REVISED:**  
**MAY 20, 1996**

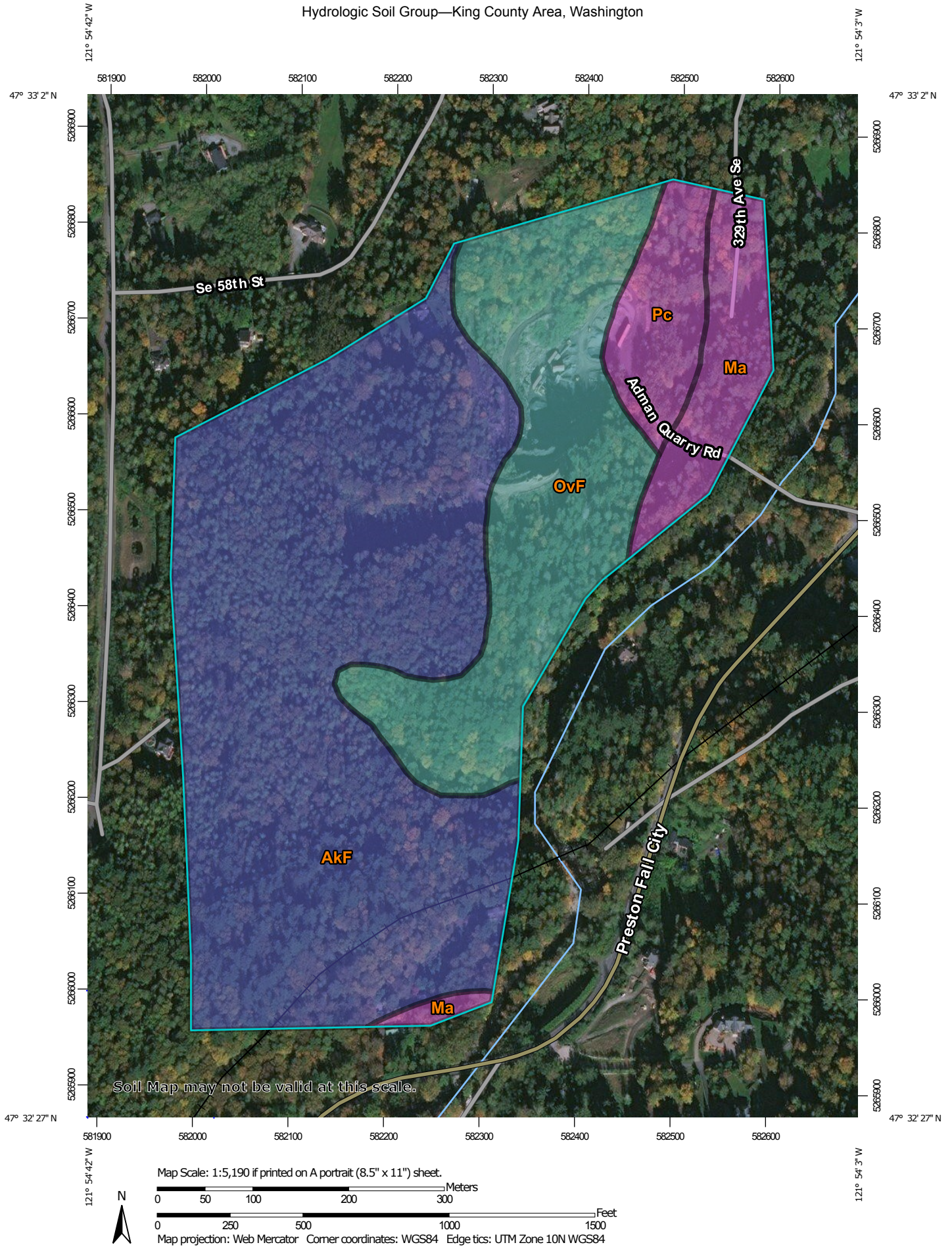


Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)

JOINS PANEL 0716

# Hydrologic Soil Group—King County Area, Washington



**Natural Resources  
Conservation Service**


Web Soil Survey  
National Cooperative Soil Survey

11/3/2017  
Page 1 of 4



## MAP LEGEND

### Area of Interest (AOI)









 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons





 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Lines

 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Points




 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available


### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

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 map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL:  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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 13, Sep 7, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 29, 2016—Oct 10, 2016

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.

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AkF	Alderwood and Kitsap soils, very steep	B	53.2	61.6%
Ma	Mixed alluvial land	A	6.5	7.6%
OvF	Ovall gravelly loam, 40 to 75 percent slopes	C	21.5	24.9%
Pc	Pilchuck loamy fine sand	A	5.1	5.9%
<b>Totals for Area of Interest</b>			<b>86.3</b>	<b>100.0%</b>

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

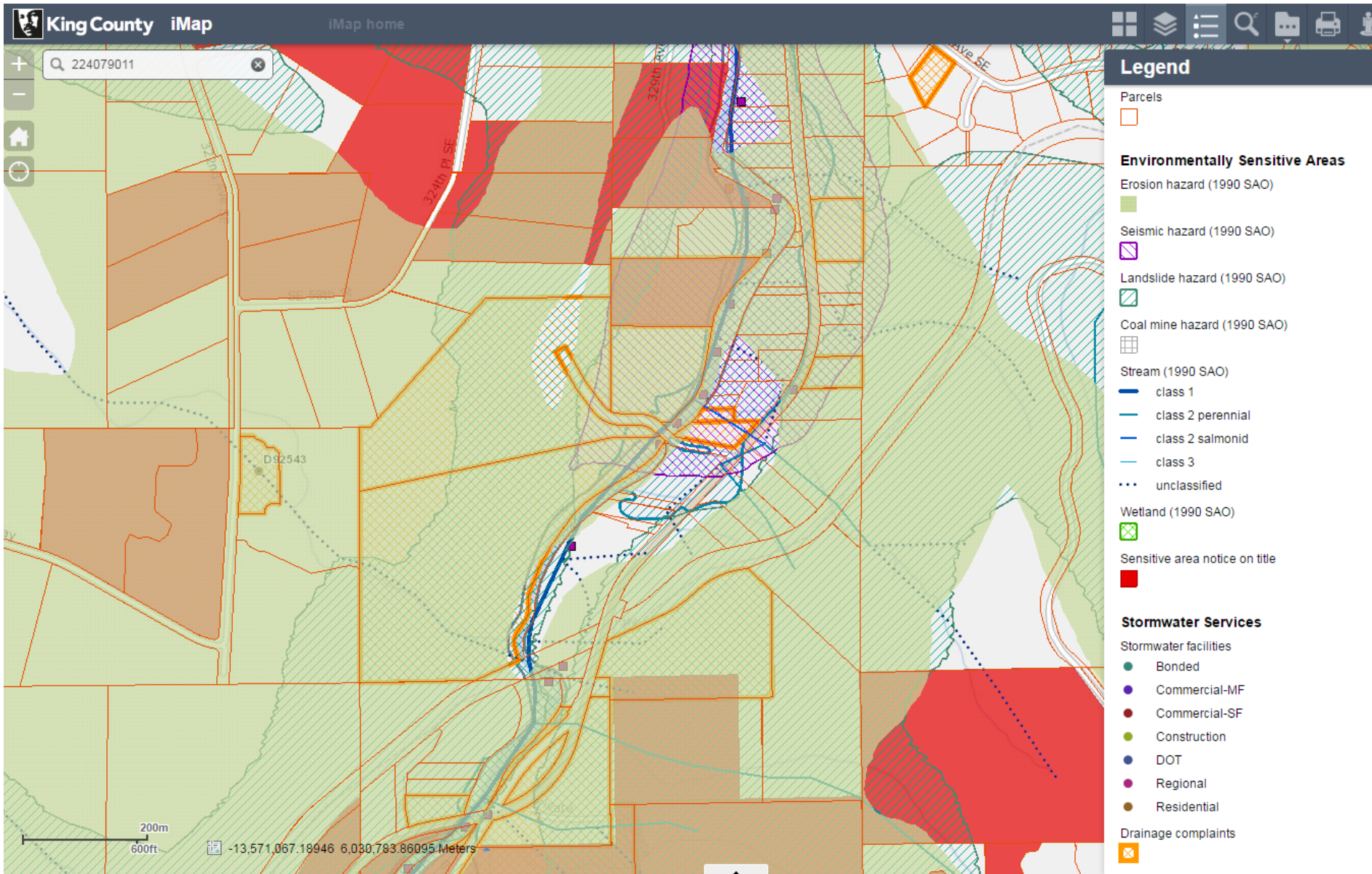
Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

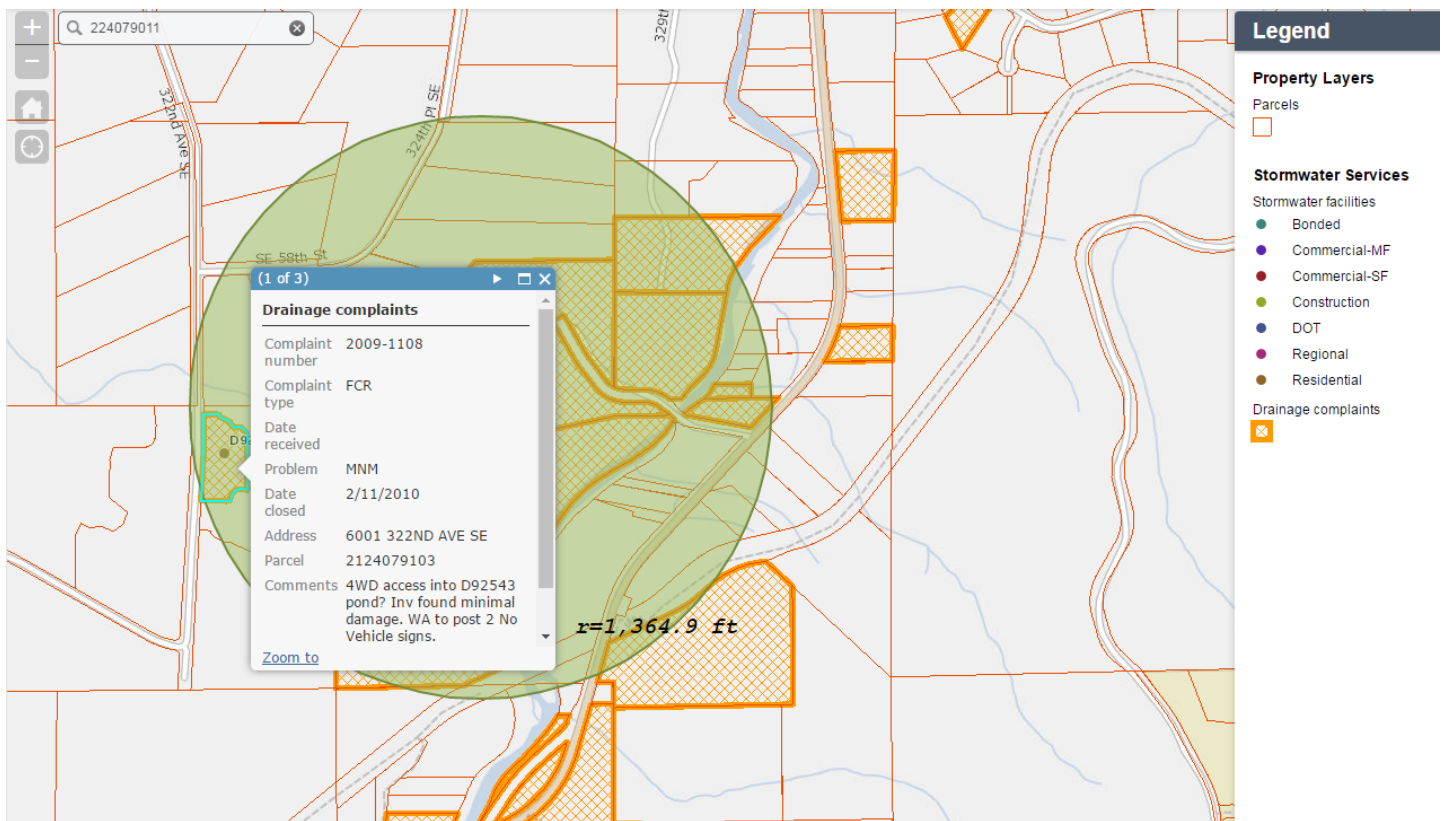
Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.



## DRAINAGE COMPLAINT



Complaint: #2009-1108

Problem Type: FCR, Facility Complaint – Residential

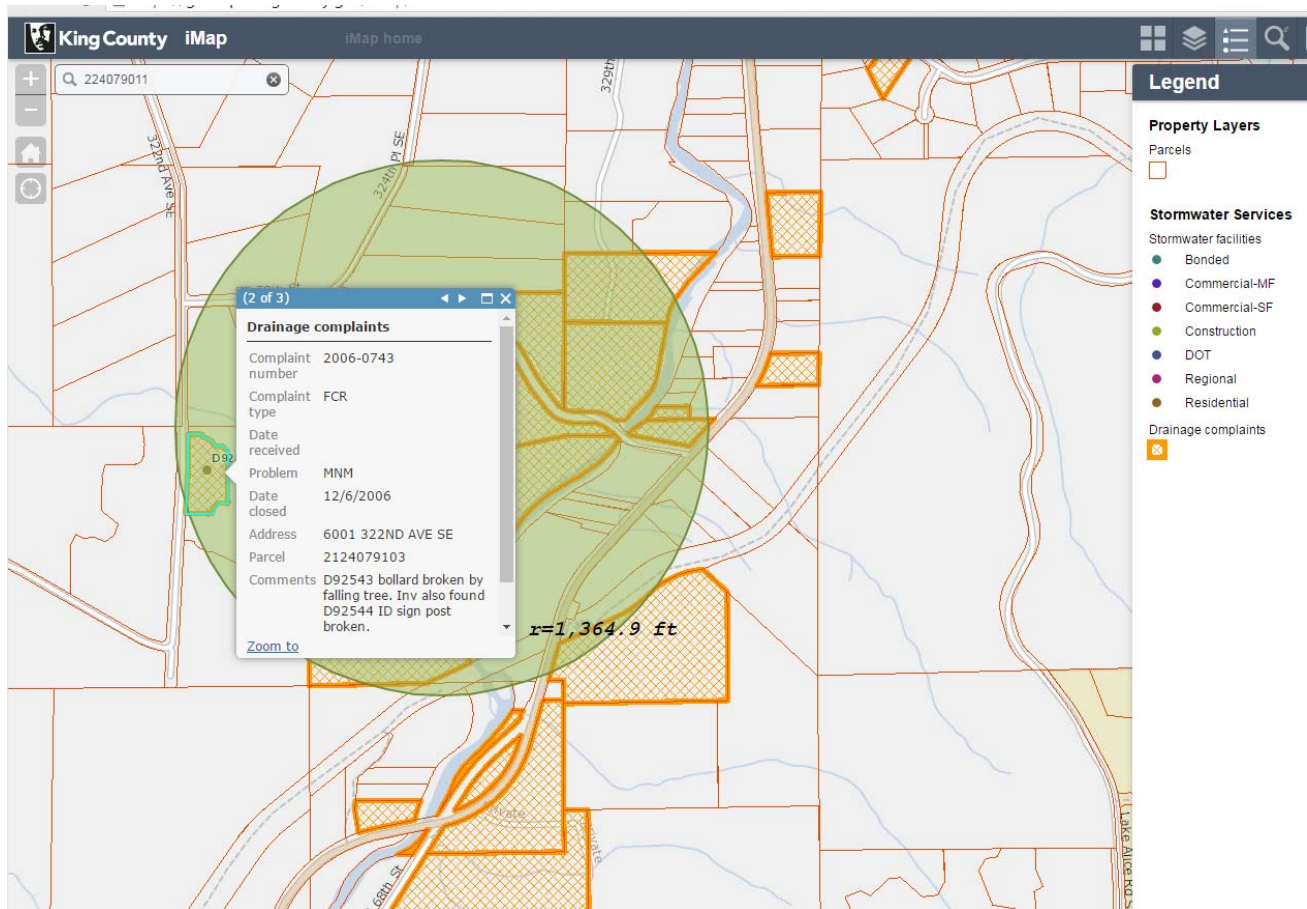
Problem: MNM, Needs Maintenance

Date Closed: 2/11/2010

This complaint was a maintenance complaint on a residential lot. Complaint was addressed and closed.



## DRAINAGE COMPLAINT



Complaint: #2006-0743

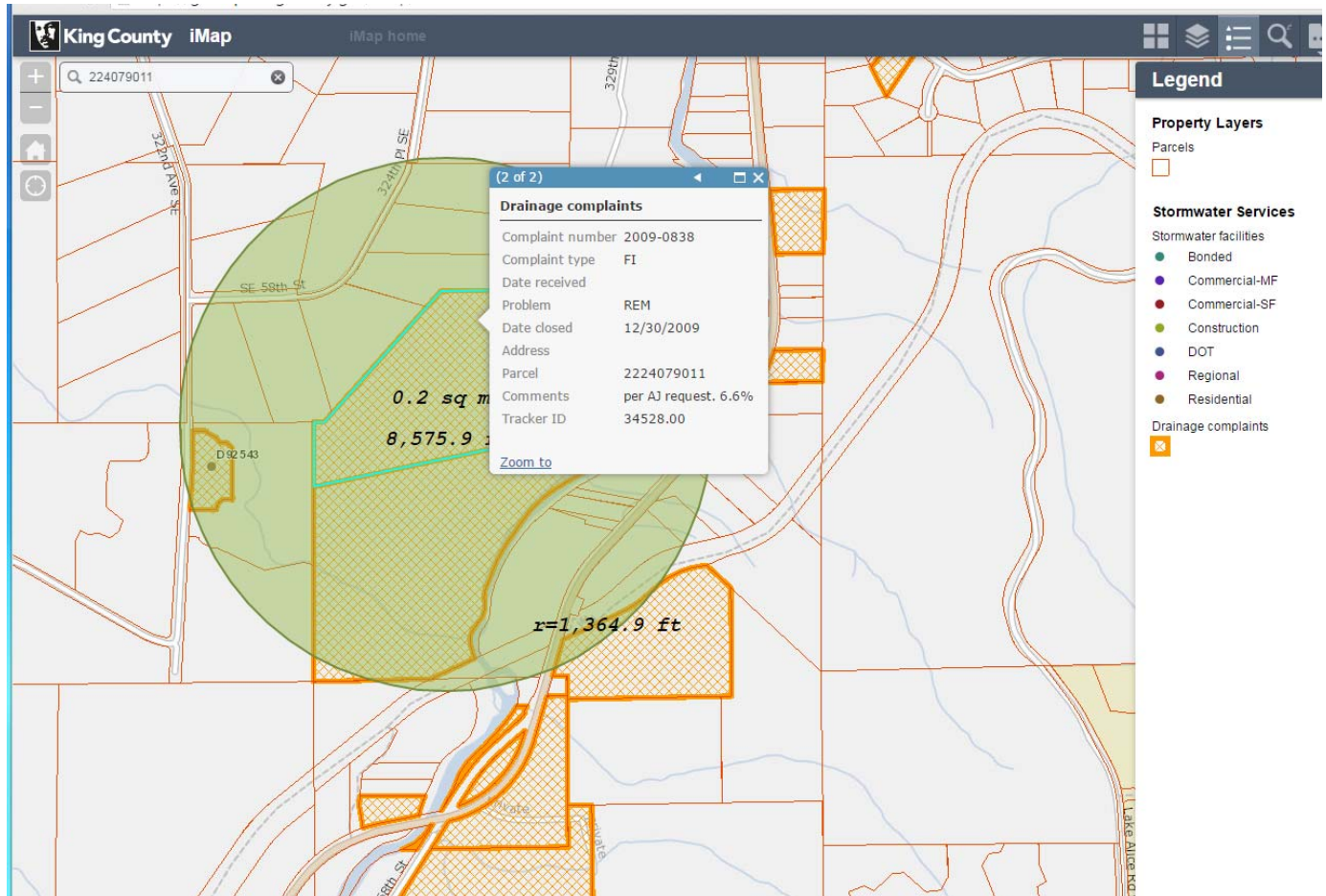
Problem Type: FCR, Facility Complaint – Residential

Problem: MNM, Needs Maintenance

Date Closed: 12/06/2006

This complaint was a maintenance complaint on a residential lot. Complaint was addressed and closed.

## DRAINAGE COMPLAINT



Complaint: #2009-0838

Problem Type: FI, Stormwater Maintenance Fee Investigation

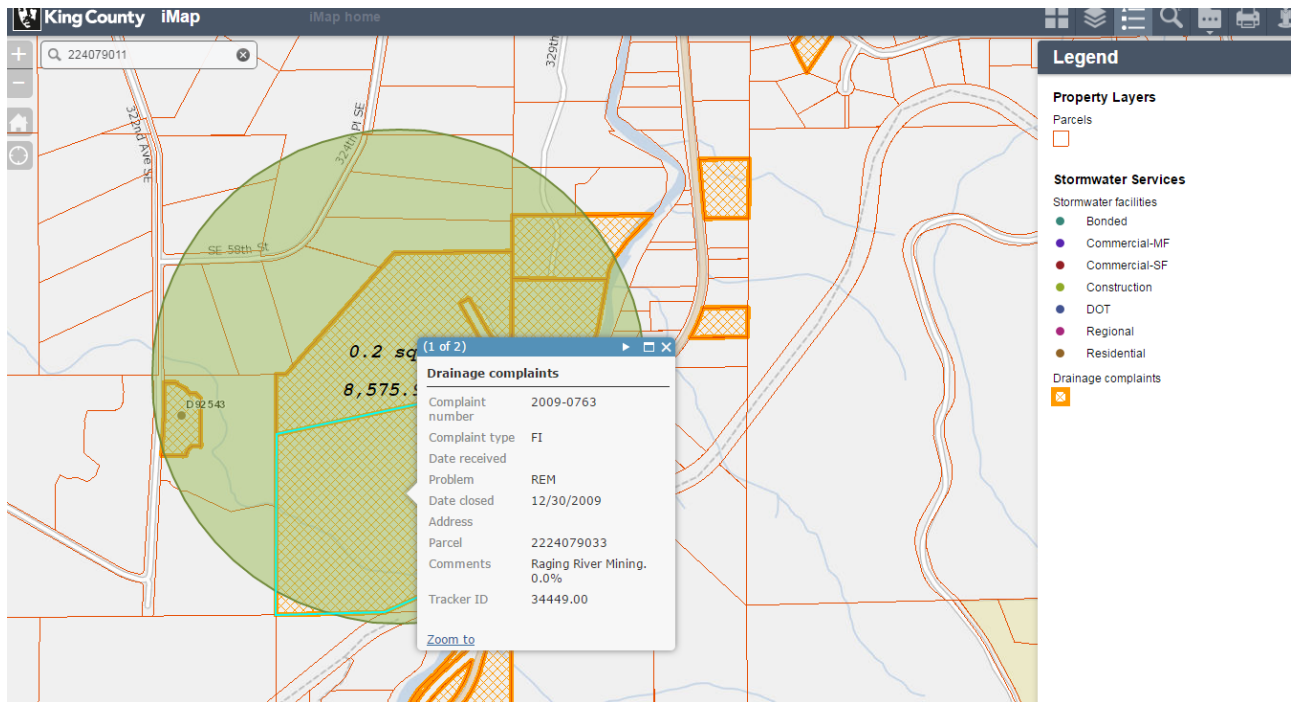
Problem: REM, Remeasure

Date Closed: 12/30/2009

This complaint was a fee complaint. Complaint was addressed by a remeasurement and closed.



## DRAINAGE COMPLAINT



Complaint: #2009-0763

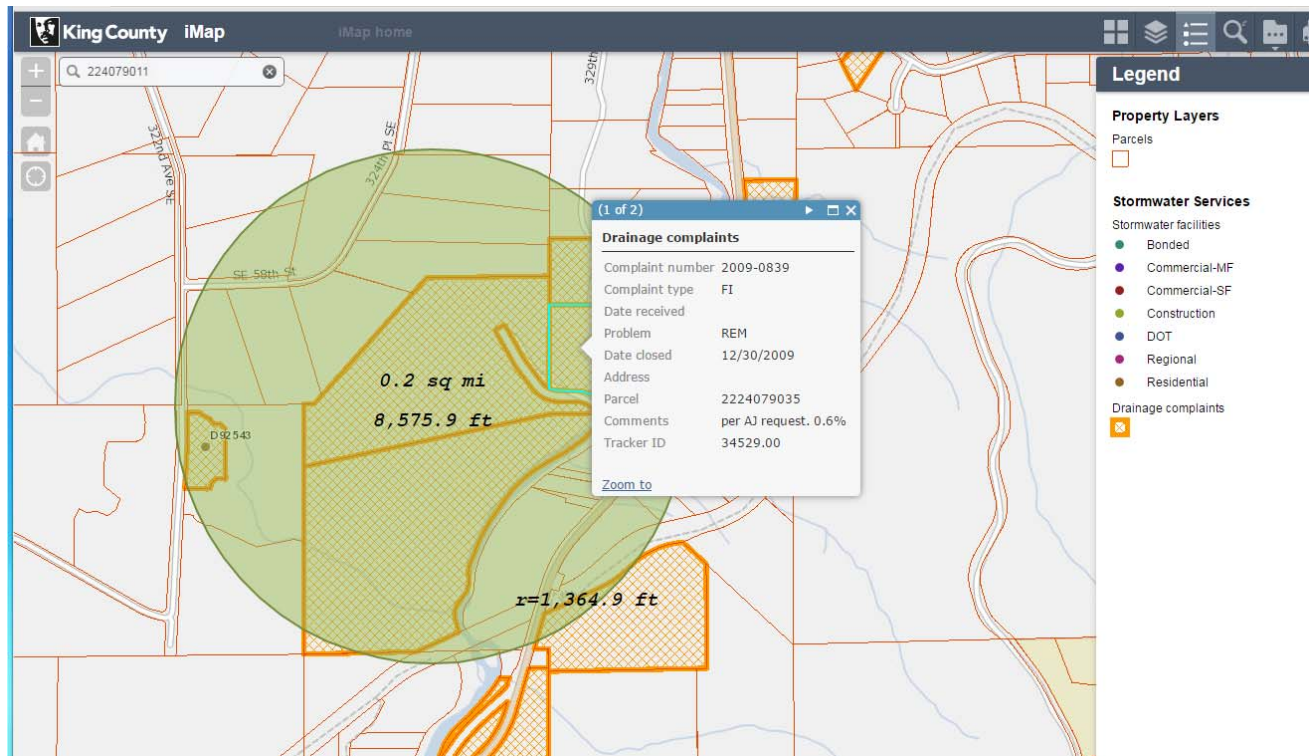
Problem Type: FI, Stormwater Maintenance Fee Investigation

Problem: REM, Remeasure

Date Closed: 12/30/2009

This complaint was a fee complaint. Complaint was addressed by a remeasurement and closed.

## DRAINAGE COMPLAINT



Complaint: #2009-0839

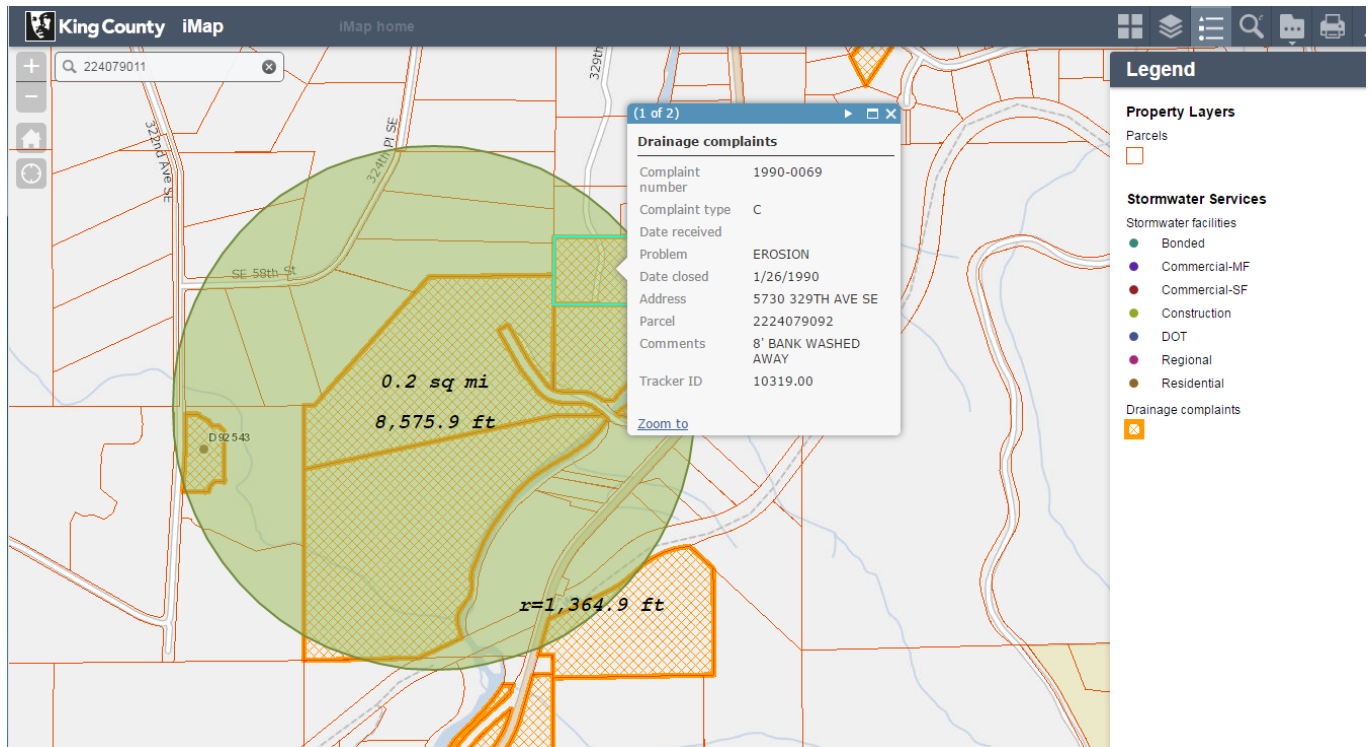
Problem Type: FI, Stormwater Maintenance Fee Investigation

Problem: REM, Remeasure

Date Closed: 12/30/2009

This complaint was a fee complaint. Complaint was addressed by a remeasurement and closed.

## DRAINAGE COMPLAINT



Complaint: #1990-0069

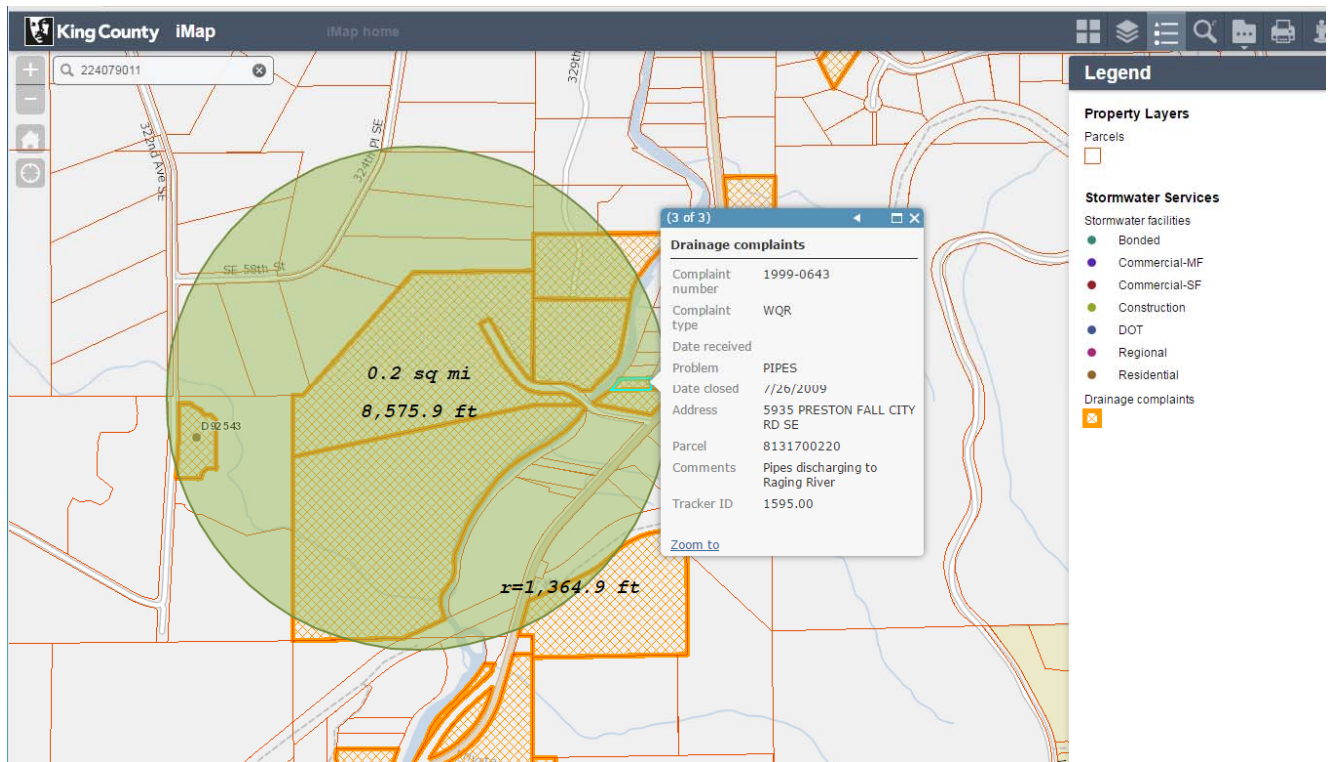
Problem Type: C, Action Request

Problem: Erosion

Date Closed: 1/26/1990

This complaint was an erosion complaint. Complaint was addressed and closed. This complaint shows that there is an erosion potential.

## DRAINAGE COMPLAINT



Complaint: #1999-0643

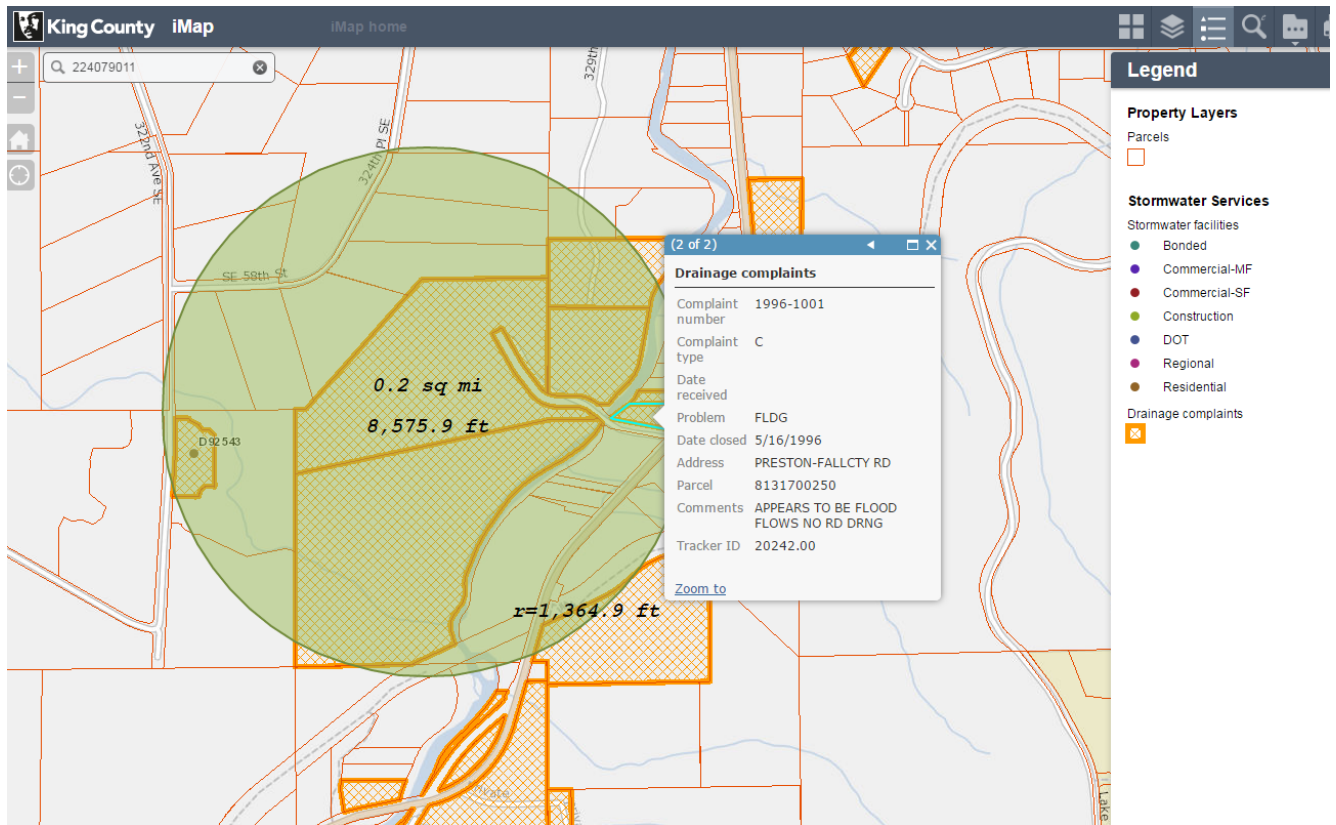
Problem Type: WQR, Water Quality Engineering Review

Problem: Pipes

Date Closed: 7/26/2009

This complaint was a water quality complaint. This complaint indicates that pipes were discharging to Raging River. Complaint was addressed and closed.

## DRAINAGE COMPLAINT



Complaint: #1996-1001

Problem Type: C, Action Request

Problem: FLDG, Flooding (?)

Date Closed: 5/16/1996

This complaint appears to be flood related. Complaint was addressed and closed.

The screenshot displays the King County iMap web application. The main map area shows a green circular overlay with the text "0.2 sq mi" and "8,575.9 ft". A small orange square with a crosshair is located within the green area, labeled "D 92543". A blue line representing a waterway or road runs through the area, with a label "r=1.36". The map is overlaid with a grid of orange lines representing property boundaries. On the right side, there is a "Legend" panel with two sections: "Property Layers" and "Stormwater Services". The "Stormwater Services" section includes a list of facilities: Bonded, Commercial-MF, Commercial-SF, Construction, DOT, Regional, and Residential. Below this is a "Drainage complaints" section with a small orange square icon. A pop-up window titled "(2 of 3)" is open, displaying "Drainage complaints" for a specific complaint number. The pop-up window contains the following information:

Drainage complaints	
Complaint number	2011-0820
Complaint type	FIR
Date received	
Problem	SFTD
Date closed	5/10/2012
Address	6322 PRESTON-FALL CITY RD SE
Parcel	8131700420
Comments	65-10 INQUIRY, ELIGIBLE FOR DISCOUNT, COVENANT SEND BUT NO

At the bottom of the pop-up window, there is a "Zoom to" link.

Date Closed: 5/10/2012

This complaint appears to be related to the fees. Complaint indicates that an inquiry was made, recipient was/is eligible for a discount, but no response was received. Complaint was addressed and closed.



[illegible]

## Appendix C

# Detention Facility Sizing

MGS Flood Report



# MGS FLOOD PROJECT REPORT

Program Version: MGSFlood 4.43  
Program License Number: 200210008  
Project Simulation Performed on: 12/08/2017 11:05 AM  
Report Generation Date: 12/08/2017 11:06 AM

Input File Name: 10001R MGS Flood Survey 1-1.fld  
Project Name: Raging River  
Analysis Title:  
Comments:

## PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected  
Climatic Region Number: 0

Full Period of Record Available used for Routing  
Precipitation Station : 96006005 Puget East 60 in\_5min 10/01/1939-10/01/2097  
Evaporation Station : 961060 Puget East 60 in MAP  
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1  
HSPF Parameter Region Name : USGS Default

\*\*\*\*\* Default HSPF Parameters Used (Not Modified by User) \*\*\*\*\*

## \*\*\*\*\* WATERSHED DEFINITION \*\*\*\*\*

### Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	10.750	10.750
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	10.750	10.750

### -----SCENARIO: PREDEVELOPED

Number of Subbasins: 1

----- Subbasin : Predev -----  
-----Area (Acres) -----  
Till Forest 10.750  
-----  
Subbasin Total 10.750

### -----SCENARIO: POSTDEVELOPED

Number of Subbasins: 2

----- Subbasin : Dev Onsite -----  
-----Area (Acres) -----  
Till Grass 1.780  
Outwash Forest 1.880  
Outwash Grass 0.250  
Impervious 6.450  
-----  
Subbasin Total 10.360

----- Subbasin : Dev Offsite -----  
-----Area (Acres) -----  
Till Forest 0.220

Outwash Forest 0.170  
-----  
Subbasin Total 0.390

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: PREDEVELOPED  
Number of Links: 0

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: POSTDEVELOPED  
Number of Links: 4

-----  
**Link Name: Pond D**  
Link Type: Structure  
Downstream Link Name: Pond E

Prismatic Pond Option Used  
Pond Floor Elevation (ft) : 100.00  
Riser Crest Elevation (ft) : 112.00  
Max Pond Elevation (ft) : 112.10  
Storage Depth (ft) : 12.00  
Pond Bottom Length (ft) : 66.9  
Pond Bottom Width (ft) : 4.0  
Pond Side Slopes (ft/ft) : L1= 1.00 L2= 1.00 W1= 1.00 W2= 1.00  
Bottom Area (sq-ft) : 268.  
Area at Riser Crest El (sq-ft) : 2,545.  
(acres) : 0.058  
Volume at Riser Crest (cu-ft) : 15,724.  
(ac-ft) : 0.361  
Area at Max Elevation (sq-ft) : 2569.  
(acres) : 0.059  
Vol at Max Elevation (cu-ft) : 16,489.  
(ac-ft) : 0.379

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 10.00

Riser Geometry  
Riser Structure Type : Circular  
Riser Diameter (in) : 18.00  
Common Length (ft) : 0.000  
Riser Crest Elevation : 112.00 ft

Hydraulic Structure Geometry

Number of Devices: 0

-----  
**Link Name: Pond E**  
Link Type: Structure  
Downstream Link Name: Pond F

Prismatic Pond Option Used  
Pond Floor Elevation (ft) : 100.00  
Riser Crest Elevation (ft) : 112.00  
Max Pond Elevation (ft) : 112.10  
Storage Depth (ft) : 12.00  
Pond Bottom Length (ft) : 75.1  
Pond Bottom Width (ft) : 4.5  
Pond Side Slopes (ft/ft) : L1= 1.00 L2= 1.00 W1= 1.00 W2= 1.00  
Bottom Area (sq-ft) : 338.  
Area at Riser Crest El (sq-ft) : 2,824.

(acres) : 0.065  
Volume at Riser Crest (cu-ft) : 17,821.  
(ac-ft) : 0.409  
Area at Max Elevation (sq-ft) : 2850.  
(acres) : 0.065  
Vol at Max Elevation (cu-ft) : 18,670.  
(ac-ft) : 0.429

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 10.00

Riser Geometry  
Riser Structure Type : Circular  
Riser Diameter (in) : 18.00  
Common Length (ft) : 0.000  
Riser Crest Elevation : 112.00 ft

Hydraulic Structure Geometry

Number of Devices: 0

---

**Link Name: Pond F**

Link Type: Structure  
Downstream Link Name: Pond G-H

Prismatic Pond Option Used  
Pond Floor Elevation (ft) : 100.00  
Riser Crest Elevation (ft) : 109.00  
Max Pond Elevation (ft) : 109.10  
Storage Depth (ft) : 9.00  
Pond Bottom Length (ft) : 56.5  
Pond Bottom Width (ft) : 6.0  
Pond Side Slopes (ft/ft) : L1= 1.00 L2= 1.00 W1= 1.00 W2= 1.00  
Bottom Area (sq-ft) : 339.  
Area at Riser Crest El (sq-ft) : 1,788.  
(acres) : 0.041  
Volume at Riser Crest (cu-ft) : 9,085.  
(ac-ft) : 0.209  
Area at Max Elevation (sq-ft) : 1808.  
(acres) : 0.041  
Vol at Max Elevation (cu-ft) : 9,623.  
(ac-ft) : 0.221

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 10.00

Riser Geometry  
Riser Structure Type : Circular  
Riser Diameter (in) : 18.00  
Common Length (ft) : 0.000  
Riser Crest Elevation : 109.00 ft

Hydraulic Structure Geometry

Number of Devices: 0

---

**Link Name: Pond G-H**

Link Type: Structure  
Downstream Link: None

Prismatic Pond Option Used  
Pond Floor Elevation (ft) : 100.00  
Riser Crest Elevation (ft) : 106.00  
Max Pond Elevation (ft) : 106.10  
Storage Depth (ft) : 6.00  
Pond Bottom Length (ft) : 98.6

Pond Bottom Width (ft) : 15.0  
 Pond Side Slopes (ft/ft) : L1= 1.00 L2= 1.00 W1= 1.00 W2= 1.00  
 Bottom Area (sq-ft) : 1479.  
 Area at Riser Crest El (sq-ft) : 2,986.  
 (acres) : 0.069  
 Volume at Riser Crest (cu-ft) : 13,252.  
 (ac-ft) : 0.304  
 Area at Max Elevation (sq-ft) : 3014.  
 (acres) : 0.069  
 Vol at Max Elevation (cu-ft) : 13,850.  
 (ac-ft) : 0.318

Constant Infiltration Option Used

Infiltration Rate (in/hr): 10.00

Riser Geometry

Riser Structure Type : Circular  
 Riser Diameter (in) : 18.00  
 Common Length (ft) : 0.000  
 Riser Crest Elevation : 106.00 ft

Hydraulic Structure Geometry

Number of Devices: 0

# \*\*\*\*\*FLOOD FREQUENCY AND DURATION STATISTICS\*\*\*\*\*

## -----SCENARIO: PREDEVELOPED

Number of Subbasins: 1

Number of Links: 0

## -----SCENARIO: POSTDEVELOPED

Number of Subbasins: 2

Number of Links: 4

\*\*\*\*\* Link: Pond G-H

\*\*\*\*\* Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs) WSEL Peak (ft)

=====	
1.05-Year	100.000
1.11-Year	100.000
1.25-Year	100.000
2.00-Year	100.000
3.33-Year	100.000
5-Year	100.000
10-Year	100.000
25-Year	100.000
50-Year	102.064
100-Year	102.939

## \*\*\*\*\*Groundwater Recharge Summary\*\*\*\*\*

Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation  
 Model Element Recharge Amount (ac-ft)

Subbasin: Predev 2648.348

Total: 2648.348

Total Post Developed Recharge During Simulation  
 Model Element Recharge Amount (ac-ft)

Subbasin: Dev Onsite 1369.367

Subbasin: Dev Offsite 140.752  
Link: Pond D Not Computed  
Link: Pond E Not Computed  
Link: Pond F Not Computed  
Link: Pond G-H 0.902

Total: 1511.021

**Total Predevelopment Recharge is Greater than Post Developed**  
**Average Recharge Per Year, (Number of Years= 158)**  
**Predeveloped: 16.762 ac-ft/year, Post Developed: 9.563 ac-ft/year**

\*\*\*\*\***Water Quality Facility Data**\*\*\*\*\*

-----**SCENARIO: PREDEVELOPED**

Number of Links: 0

-----**SCENARIO: POSTDEVELOPED**

Number of Links: 4

\*\*\*\*\* Link: Pond G-H

\*\*\*\*\*

Basic Wet Pond Volume (91% Exceedance): 11142. cu-ft  
Computed Large Wet Pond Volume, 1.5\*Basic Volume: 16713. cu-ft

Time to Infiltrate 91% Treatment Volume, (Hours): 6.34

Infiltration/Filtration Statistics-----

Inflow Volume (ac-ft): 0.90  
Inflow Volume Including PPT-Evap (ac-ft): 0.90  
Total Runoff Infiltrated (ac-ft): 0.90, 100.00%  
Total Runoff Filtered (ac-ft): 0.00, 0.00%  
Primary Outflow To Downstream System (ac-ft): 0.00  
Secondary Outflow To Downstream System (ac-ft): 0.00  
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

\*\*\*\*\***Compliance Point Results**\*\*\*\*\*

Scenario Predeveloped Compliance Subbasin: Predev

Scenario Postdeveloped Compliance Link: Pond G-H

\*\*\* **Point of Compliance Flow Frequency Data** \*\*\*

Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
-----			
2-Year	0.456	2-Year	0.000
5-Year	0.707	5-Year	0.000
10-Year	0.938	10-Year	0.000
25-Year	1.374	25-Year	0.000
50-Year	1.889	50-Year	0.000
100-Year	2.062	100-Year	0.000
200-Year	3.041	200-Year	0.000

\*\* Record too Short to Compute Peak Discharge for These Recurrence Intervals

\*\*\*\* **Flow Duration Performance** \*\*\*\*

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	0.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	0.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	0.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

-----  
MEETS ALL FLOW DURATION DESIGN CRITERIA:   PASS  
-----

**\*\*\*\* LID Duration Performance \*\*\*\***

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	0.0%	PASS

-----  
MEETS ALL LID DURATION DESIGN CRITERIA:       PASS  
-----

## Appendix D

### Special Reports and Studies

Geotechnical report by Riley Group



## **STORMWATER INFILTRATION EVALUATION**

**PREPARED BY:**

**THE RILEY GROUP, INC.  
17522 BOTHELL WAY NORTHEAST  
BOTHELL, WASHINGTON 98011**

**PREPARED FOR:**

**RAGING RIVER QUARRY  
C/O MR. JOHN PRIEBE  
3123 NORTHEAST HARRISON STREET  
ISSAQUAH, WASHINGTON 98029**

**RGI PROJECT No. 2016-088A**

**STORMWATER INFILTRATION EVALUATION  
RAGING RIVER QUARRY  
KING COUNTY TAX PARCELS 2224079011, 2224079033, AND 2224079035  
FALL CITY, WASHINGTON**

**AUGUST 15, 2016**





August 15, 2016

John Priebe  
Raging River Quarry  
3123 Northeast Harrison Street  
Issaquah, Washington 98029

**Subject: Stormwater Infiltration Assessment  
Raging River Quarry  
King County Tax Parcels 2224079011, 2224079033, and 2224079035  
Fall City, Washington  
RGI Project No. 2016-088A**

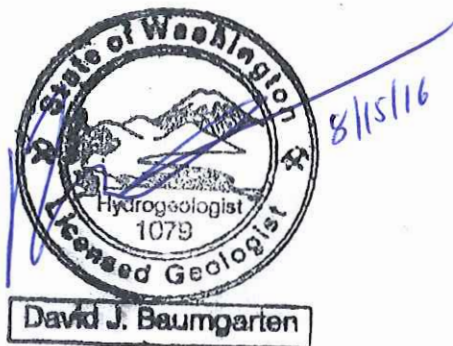
Dear Mr. Priebe:

As requested, The Riley Group, Inc. (RGI) has performed a Stormwater Infiltration Assessment regarding the existing stormwater ponds at the Raging River Quarry site in Fall City, Washington (herein referred to as the Site). The location of the Site is shown on Figure 1. Our services were completed in accordance with our workplan dated June 28, 2016 and authorized by Mr. John Priebe on July 13, 2016.

If you have any questions or require additional information, please contact us.

Respectfully submitted,

THE RILEY GROUP, INC.



David J. Baumgarten, L.H.G.  
Senior Hydrogeologist

Ricky R. Wang, PhD, PE  
Principal Engineer

## 1.0 Introduction

---

The purpose of this evaluation was to assess infiltration rates and subsurface conditions in the existing Site stormwater ponds and a stormwater pond reserve area as designated by Core Design. Our infiltration assessment focused on the area of nested and connected stormwater ponds northeast of the Site access road and scale house. This area includes Pond D, Pond E, Pond F, Pond G, and Pond H, as well as the area reserved for future ponds, as necessary, as shown on Figure 2.

RGI understands the Site stormwater ponds have existed for decades and have functioned well in managing/infiltrating Site stormwater runoff. We also understand that the Site stormwater ponds in this area have an outfall from Pond H into the 200 foot buffer between mining operations and the Raging River. The current Site owner indicated there has not been any stormwater outfall from Pond H to the river buffer during the history of Site operations with all of the stormwater infiltrating in the stormwater pond system.

As part of an application to King County regarding continued quarrying at the site, the County requested a study to document infiltration rates in the existing stormwater ponds.

## 2.0 Site Description

---

The Site is comprised of three King County Tax Parcels 2224079011, 2224079033, and 2224079035 accessed from Preston-Fall City Road, near Fall City, Washington. The three tax parcels comprise an area of 51.2 acres. The Site is currently occupied by an active rock quarry.

## 3.0 Site Conditions

---

### 3.1 SURFACE

The Site is a rock quarry, located on the north side of the Raging River between Preston and Fall City, Washington. Access to the Site is from Preston-Fall City Road with a paved access road to a wooden bridge which spans the Raging River, followed by additional paved road to the scale house located on the lower portion of the quarry. Site slopes are generally to the east toward the Raging River between 6% and 140%. Runoff from the upper active quarrying area sheet flows across the quarry area and is then intercepted by a series of ditches which ultimately discharge to the stormwater ponds (Ponds E through H).

### 3.2 GEOLOGY

Review of the *Geologic Map of the Fall City 7.5-Minute Quadrangle, King County, Washington* by Joe Dragovich, et. al. (2007) indicates the bedrock at the quarry is Tukwila Formation, tuff (Evt<sub>t</sub>), which generally consists of andesitic tuff breccia. Unconsolidated geologic units mapped in the area of the stormwater ponds include alluvial fan deposits (Qaf) and landslide deposits (Qls).

### 3.3 SOILS

In general, subsurface conditions in the stormwater pond area consists of a layer of brown fine to medium sand, approximately 8 to 10 feet thick, underlain by brown fine to coarse sand with gravel and cobbles. Both the fine to medium sand and the underlying coarse sand with gravel and cobbles are interpreted to be alluvial fan deposits.

Silty sand with a gravel was encountered in the infiltration test IT-2 excavation, completed in Pond F. The coarser grained fraction (gravel/cobbles) of the sediment appeared similar to the sediments described above, however the silt content of the finer grained fraction (sand) was much higher. This could be a depositional anomaly. It might also be an accumulation of silt in the upper end of Pond F as the IT-1 excavation was in the north end of Pond F immediately down gradient of the inflow from Pond E.

### 3.4 GROUNDWATER

Groundwater was not encountered in any of the subsurface explorations completed in the stormwater pond area to the maximum depths of the excavations. Test pits completed in Pond E, F, and G extended to a depth of approximately eight feet below the bottom of the ponds. No signs of mottling, which could indicate seasonal high groundwater levels, were observed in the test pits completed in the pond bottoms.

## 4.0 Field Explorations

---

On July 20 and August 2, 2016, RGI oversaw the completion of three infiltration tests (IT-1, IT-2, and IT-3) in the bottoms of Pond E (IT-1), Pond F (IT-2), and Pond G (IT-3), as shown on Figure 2. RGI also observed the completion of test pits TP-1 and TP-2. Test pit TP-1 was completed in the reserve area for a future sediment/infiltration pond. Test pit TP-2 was completed in the bottom of Pond G. Soil logs of subsurface conditions encountered in infiltration test pits (IT-1, IT-2, and IT-3) and test pits TP-1 and TP-2 are included in Attachment A.

Infiltration test were conducted using a modified pilot infiltration test (PIT) methodology. An excavation was made at the infiltration test locations in the bottom of Pond E and Pond F and then water was introduced into the infiltration test pit. A water level between 0.5 and 1 foot was maintained in the infiltration test pit to presoak the subsurface. The infiltration rates were measured under falling head conditions after the presoaking period.

#### Infiltration Test IT-1

Infiltration test IT-1 was completed in the bottom of Pond E (Figure 2). Subsurface conditions at the IT-1 location consist of brown fine to coarse sand with gravel and cobbles.

Infiltration test IT-1 was conducted at a depth of approximately 2 feet below the bottom of Pond E. The infiltration pit measured approximately four by four feet. A staff gauge

was placed in the base of the infiltration test pit to monitor water levels and water was introduced into the infiltration test pit. A water level of at least 0.5 feet was maintained in the IT-1 during the soaking period. Approximately 3,600 gallons of water were introduced into IT-1. The field infiltration rate measured in IT-1 was approximately 85 inches/hour in the coarse sand and gravel in the bottom of Pond E.

The infiltration test IT-1 pit was overexcavated at the end of the infiltration test. Subsurface conditions included brown fine to coarse sand and gravel with cobbles to the depth excavated, approximately 8 feet below the bottom of Pond E. Groundwater was not encountered in the IT-1 overexcavation and no signs of seasonal high groundwater (mottling) were observed.

#### Infiltration Test IT-2

Infiltration test IT-2 was completed in the bottom of Pond F (Figure 2). Subsurface conditions at the IT-2 location consist of brown silty fine to coarse sand with gravel and cobbles.

Infiltration test IT-2 was conducted at a depth of approximately 2 feet below the bottom of Pond F. The infiltration pit measured approximately three by four feet. A staff gauge was placed in the base of the infiltration test pit to monitor water levels and water was introduced into the infiltration test pit. A water level of at least 0.5 feet was maintained in the IT-2 pit during the soaking period. Approximately 500 gallons of water were introduced into IT-1. The field infiltration rate measured in IT-2 was approximately 4 inches/hour.

The infiltration test IT-2 pit was overexcavated at the end of the infiltration test. Subsurface conditions included brown silty fine to coarse sand and gravel with cobbles to the depth excavated, approximately 7 feet below the bottom of Pond F. Groundwater was not encountered in the IT-2 overexcavation and no signs of seasonal high groundwater (mottling) were observed.

#### Infiltration Test IT-3

Infiltration test IT-3 was completed in the bottom of Pond G (Figure 2). Subsurface conditions at the IT-3 location consist of brown silty fine to coarse sand with gravel and cobbles.

Infiltration test IT-3 was conducted at a depth of approximately 3 feet below the bottom of Pond G. The infiltration pit measured approximately three by four feet. A staff gauge was placed in the base of the infiltration test pit to monitor water levels and water was introduced into the infiltration test pit. A water level of at least 0.5 feet was maintained in the IT-3 pit during the soaking period. Approximately 3,600 gallons of water were introduced into IT-3. The field infiltration rate measured in IT-3 was approximately 150 inches/hour.

The infiltration test IT-3 pit was overexcavated at the end of the infiltration test. Subsurface conditions included brown silty fine to coarse sand and gravel with cobbles to the depth excavated, approximately 8 feet below the bottom of Pond G. Groundwater was not encountered in the IT-3 overexcavation and no signs of seasonal high groundwater (mottling) was observed.

## 5.0 Laboratory Testing

---

Samples of the infiltration receptor sediments from Ponds E, F and G, and from TP-1 in the reserve area were transported to our laboratory for grain size analysis. The results and descriptions of the laboratory tests are enclosed in Appendix B.

Grain size analyses show good correlation with field measured infiltration rates.

- The highest field measured infiltration rate of approximately 150 inches/hour in infiltration test IT-3 corresponds to a grain size analysis which determined the infiltration receptor sediment is a sandy gravel, with less than 3 percent fines (minus 200).
- The next highest field measured infiltration rate of approximately 85 inches/hour in infiltration test IT-1 corresponds to a grain size analysis which determined the infiltration receptor sediment is a gravely sand with less than 5 percent fines (minus 200).
- The lowest field measured infiltration rate of approximately 3.6 inches/hour in infiltration test IT-2 corresponds to a grain size analysis which determined the infiltration receptor sediment is a silty sand with 25 percent fines (minus 200).
- The grain-size analysis for the sediment sample from TP-1, in the future reserve area, shows a similar grain size distribution to the grain size analyses from IT-1 and IT-3. Grain-size analysis for the stormwater receptor sediments indicates a gravely sand for IT-1 and a sandy gravel for IT-3. The grain-size analysis for the stormwater receptor sediment in TP-1 indicates a well graded gravel with some sand with less than two percent fines.

## 6.0 Design Infiltration Rate

---

The “simplified method” described in Section 5.4.1 (KCSWDM, 2009) was used to evaluate a long-term design infiltration rate from the field measured rates using the modified PIT methodology. The simplified methodology includes correction factors for uncertainties in testing, depth to groundwater or impervious layer, infiltration facility geometry, and potential reductions in permeability from biological activity or plugging with fines. The simplified method estimates the maximum design infiltration rate.

### Simplified Method I<sub>design</sub>

$$I_{design} = I_{measured} \times F_{testing} \times F_{geometry} \times F_{plugging}$$

Where:

$I_{design}$  = design infiltration rate

$I_{measured}$  = field measured infiltration rate

$F_{testing}$ :  $F_{testing}$  accounts for uncertainties in the testing method

$F_{geometry}$ :  $F_{geometry}$  accounts for the influence of the infiltration facility geometry and depth to ground water or an impervious layer on the infiltration rate.

$F_{plugging}$ :  $F_{plugging}$  accounts for potential reductions in infiltration rates over time due to the plugging of the pond surfaces.

#### $I_{measured}$

$I_{measured}$  was an average of the three infiltration test completed in Pond E (IT-1), Pond F (IT-2) and Pond G (IT-3).

<u>Infiltration Test</u>	<u>Field Measured Rate</u>
IT-1	85 inches/hour
IT-2	3.6 inches/hour
IT-3	150 inches/hour

An  $I_{measured}$  = 80 inches/hour was used in the simplified method calculation

#### $F_{testing}$

$F_{testing}$  per the KCSWDM 2009 dictates an  $F_{testing}$  value of 0.30 for small scale (EPA method tests) and an  $F_{testing}$  of 0.50 for large-scale modified PIT testing. An  $F_{testing}$  value of 0.50 was used in the simplified method calculation.

#### $F_{geometry}$

$F_{geometry}$  is determined by:

$$F_{geometry} = 4 D/W + 0.05$$

Where:

D = depth from the bottom of the proposed facility to the maximum wet-season water table or nearest impervious layer, whichever is less.

W = width of facility

Because the stormwater facilities are not a single facility but a series of elongated ponds separated by check dams with overflow and the fact neither groundwater or an impervious layer were encountered, estimating  $F_{\text{geometry}}$  was difficult. Therefore, we applied a conservative  $F_{\text{geometry}}$  factor of 0.25.

#### **F<sub>plugging</sub>**

$F_{\text{plugging}}$  values are presented in the 2009 KCSWDM (pg 5-59) based on soil types. A value of 1.0 was chosen for the coarse sands and cobbles in the pond bottoms and the fact the infiltration ponds are preceded by a water quality facility (settling pond).

#### **Simplified Method I<sub>design</sub>**

$$I_{\text{design}} = I_{\text{measured}} \times F_{\text{testing}} \times F_{\text{geometry}} \times F_{\text{plugging}}$$

$$I_{\text{design}} = (80 \text{ inches/hour}) \times (0.50) \times (0.25) \times (1.0)$$

$$I_{\text{design}} = \mathbf{10 \text{ inches/hour}}$$

Based on the Site infiltration testing results and application of the KCSWDM simplified method a maximum design infiltration rate of 10 inches/hour was calculated for the coarse sand and gravel with cobbles stormwater receptor sediments in the stormwater pond area.

## **7.0 Discussion**

---

RGI conducted three modified Pilot infiltration tests in the bottom of ponds E, F, and G. Based on our review of the field measured rates and application of the simplified method for evaluation field measured infiltration rates, we calculated a maximum long-term design infiltration rate of 10-inches/hour.

Subsurface conditions observed in the field indicate the stormwater infiltration receptor sediments at the Site are a coarse sand and gravel with cobbles, interpreted to be alluvial fan deposits. The grain-size analysis indicates the stormwater receptor sediment in the future reserve area is similar in composition to the stormwater receptor sediments in the bottom of Ponds E and G, as such we would expect similar infiltration rates.

Indications of seasonal high groundwater were not observed in the subsurface explorations below the bottom of ponds E, F, and G and the exploration in the future reserve stormwater management area. Explorations in ponds E, F, and G extended to the maximum depth possible the excavator could reach, approximately 8 feet below the pond bottoms. Site specific survey data indicate the pond bottom elevations of the existing stormwater ponds

are approximately 18 to 11 feet above the ordinary high water mark for the Raging River where it flows under the access bridge into the quarry.

## **8.0 PROJECT LIMITATIONS**

---

This report is the property of Mr. John Priebe, the Raging River Quarry, and their authorized representatives or affiliates and was prepared in a manner consistent with the level of skill and care ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions. This report is intended for specific application to the Raging River Quarry located near Fall City, Washington. No other warranty, expressed or implied, is made.

The analyses and recommendations presented in this report are based upon data obtained from our review of available information at the time of preparing this report, our observations of the infiltration testing and subsurface explorations in the stormwater pond area, as well as, laboratory analysis of the stormwater receptor sediments. Conditional changes may occur through time by natural or human-made process on this or adjacent properties. Additional changes may occur in legislative standards, which may or may not be applicable to this report. These changes, beyond RGI's control, may render this report invalid, partially or wholly. If variations appear evident, RGI should be requested to reevaluate the recommendations in this report.

*Please contact the undersigned at (425) 415-0551 should you have any questions or need additional information.*

*Attachments: Figure 1, Site Vicinity Map*

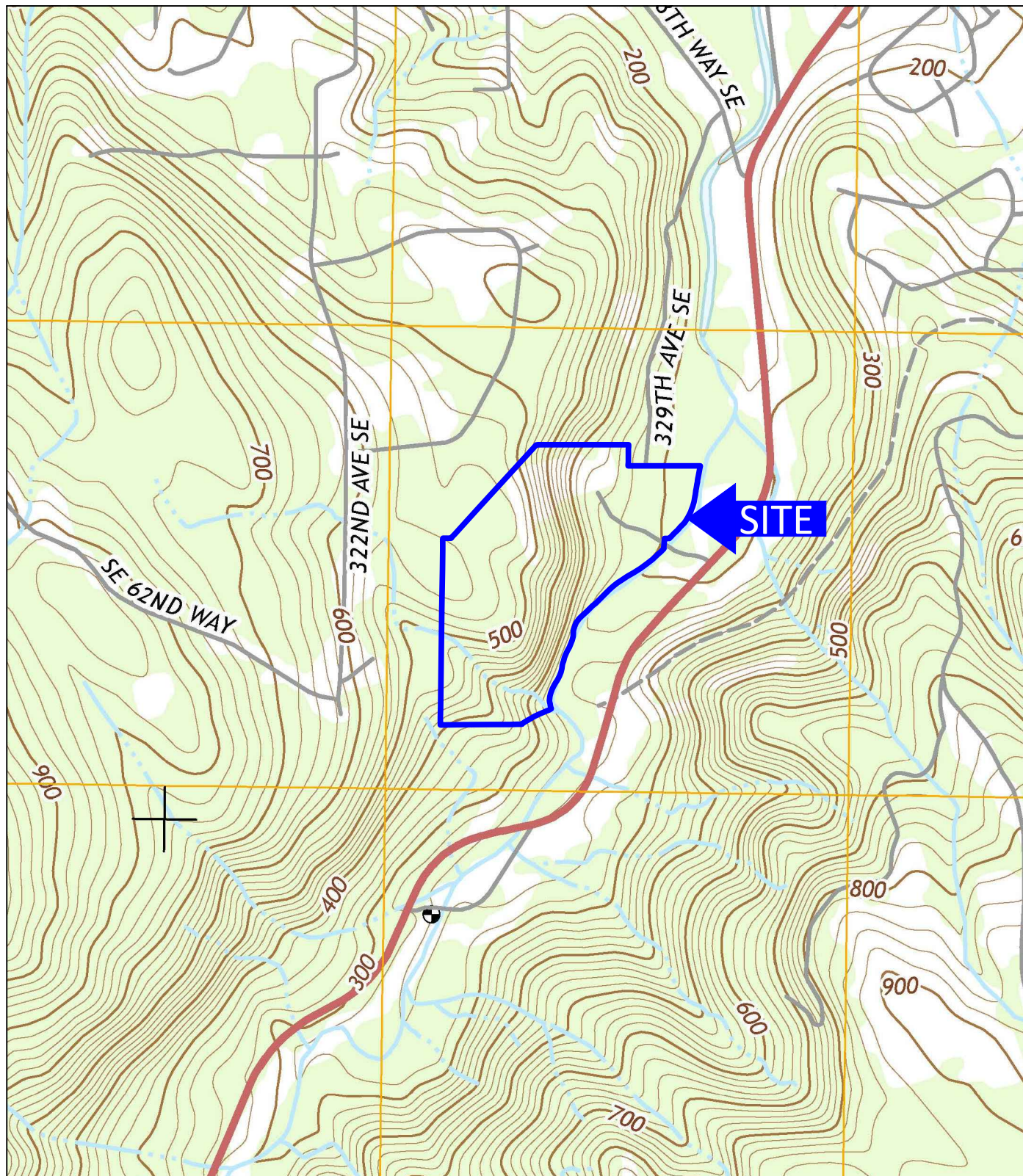
*Figure 2, Site Map*

*Figure 3, Site Representation with Cross Section A-A'*

*Attachment A, Infiltration Test/Test Pits Logs*

*Attachment B, Grain-size Analyses*





USGS, 2014, Fall City, Washington  
7.5-Minute Quadrangle

Approximate Scale: 1"=1000'

0 500 1000 2000



Corporate Office  
17522 Bothell Way Northeast  
Bothell, Washington 98011  
Phone: 425.415.0551  
Fax: 425.415.0311

Raging River Quarry

RGI Project Number  
2016-088A

Site Vicinity Map

Figure 1

Date Drawn:  
08/2016

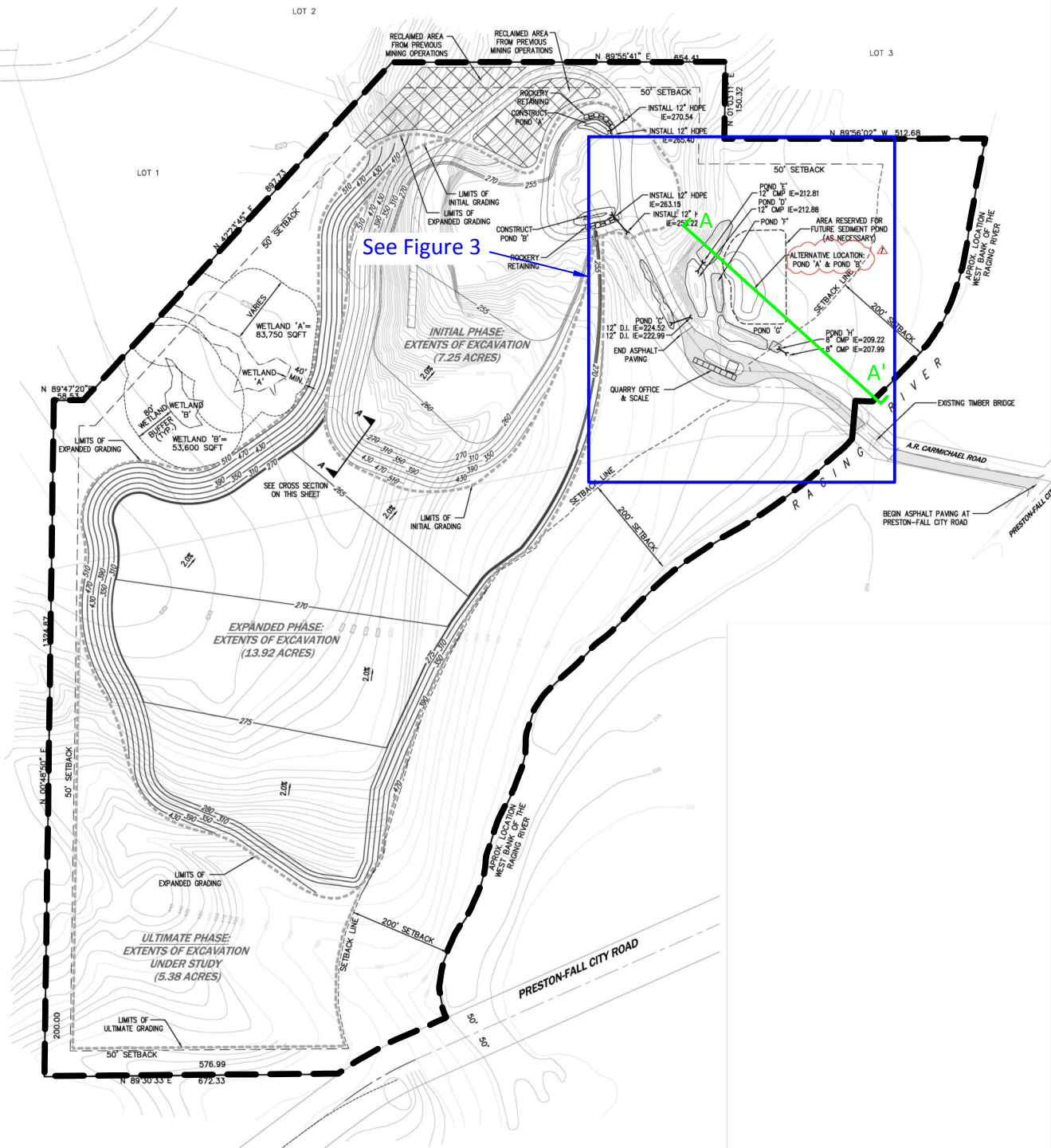
Address: 32715 William Carmichael Road, Fall City, Washington 98024



KING COUNTY  
SHORT PLAT  
1185038  
REC. NO.  
8611170922

LOT 2

KING COUNTY  
SHORT PLAT  
19050173  
REC. NO.  
1701229021

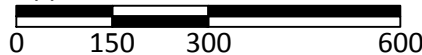


See Figure 3



= Cross section location A - A'  
= Site Boundary

Approximate Scale: 1"=300'



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Raging River Quarry

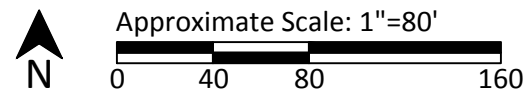
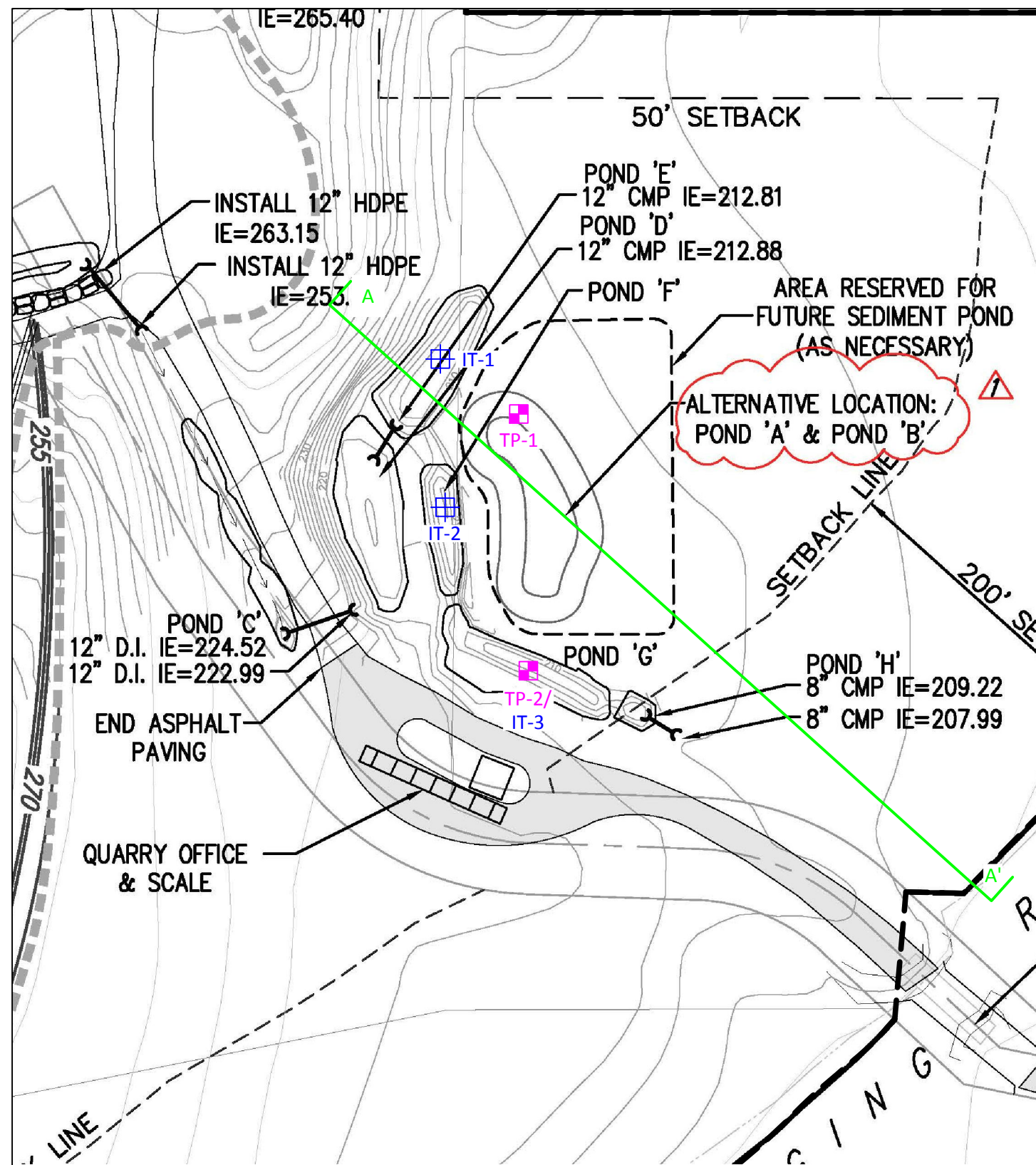
RGI Project Number  
2016-088A

Site Map

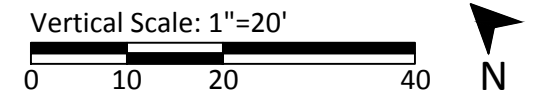
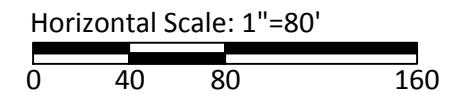
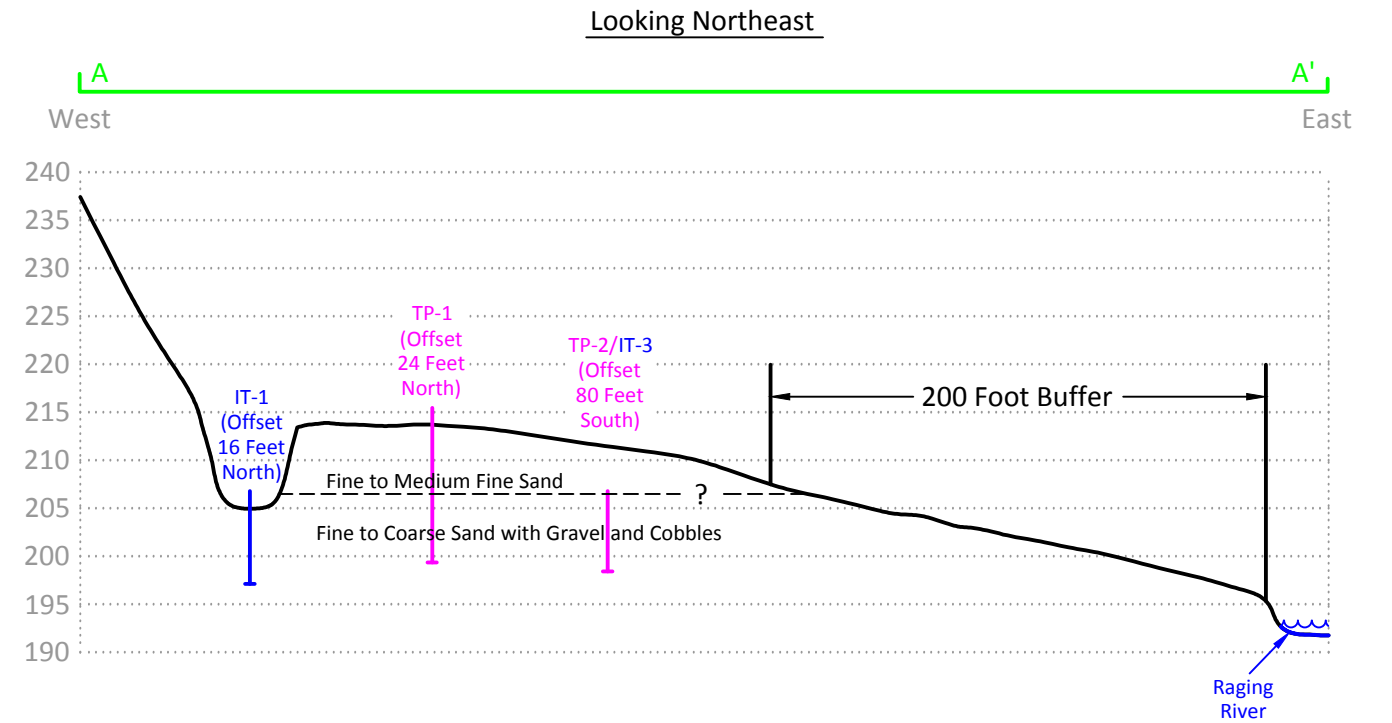
Figure 2


Date Drawn:  
08/2016

Address: 32715 William Carmichael Road, Fall City, Washington 98024



- A — A' — = Cross section location A - A'
- ⊕ = Infiltration Test Location by RGI, July 2016
- = Test Pit Location by RGI, July 2016
- = Site Boundary




 <b>RILEYGROUP</b>	Corporate Office 17522 Bothell Way Northeast Bothell, Washington 98011 Phone: 425.415.0551 Fax: 425.415.0311	Raging River Quarry		Figure 3
		RGI Project Number 2016-088A	Site Representation with Cross Section A - A'	Date Drawn: 08/2016
	Address: 32715 William Carmichael Road, Fall City, Washington 98024			

Project Name: **Raging River Quarry**Project Number: **2016-088A**Client: **Raging River Quarry**Test Pit No.: **IT-1**

Sheet 1 of 1

Date(s) Excavated: <b>07/20/16</b>	Logged By <b>DB</b>	Surface Conditions: <b>Sand and Gravel (Pond Bottom)</b>
Excavation Method: <b>Excavator</b>	Bucket Size: <b>4 Feet</b>	Total Depth of Excavation: <b>8 feet bgs</b>
Excavator Type: <b>Track-Mounted</b>	Excavating Contractor: <b>RGI</b>	Approximate Surface Elevation <b>n/a</b>
Groundwater Level: <b>Not Encountered</b>	Sampling Method(s) <b>n/a</b>	Compaction Method <b>Bucket Tamp</b>
Test Pit Backfill: <b>Native Soils</b>	Location <b>32715 William Carmichael Road, Fall City, Washington 98024</b>	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
0				SW		Brown, fine to coarse SAND with gravel, large cobbles, and trace silt	
						Infiltration test run at 2 feet below the bottom of Pond E	
5							
						Test pit completed at 8 feet below the bottom of Pond E	
10							
15							
20							

Project Name: **Raging River Quarry**Project Number: **2016-088A**Client: **Raging River Quarry**Test Pit No.: **IT-2**

Sheet 1 of 1

Date(s) Excavated: <b>07/20/16</b>	Logged By <b>DB</b>	Surface Conditions: <b>Sand and Gravel (Pond Bottom)</b>
Excavation Method: <b>Excavator</b>	Bucket Size: <b>4 Feet</b>	Total Depth of Excavation: <b>8 feet bgs</b>
Excavator Type: <b>Track-Mounted</b>	Excavating Contractor: <b>RGI</b>	Approximate Surface Elevation <b>n/a</b>
Groundwater Level: <b>Not Encountered</b>	Sampling Method(s) <b>n/a</b>	Compaction Method <b>Bucket Tamp</b>
Test Pit Backfill: <b>Native Soils</b>	Location <b>32715 William Carmichael Road, Fall City, Washington 98024</b>	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
0				SM		Brown, silty, fine to coarse SAND with gravel and large cobbles	
						Infiltration test run at 3 feet below the bottom of Pond F	
5							
						Test pit completed at 8 feet below the bottom of Pond F	
10							
15							
20							

Project Name: **Raging River Quarry**Project Number: **2016-088A**Client: **Raging River Quarry**Test Pit No.: **TP-1**

Sheet 1 of 1

Date(s) Excavated: <b>07/20/16</b>	Logged By <b>DB</b>	Surface Conditions: <b>Forest Duff</b>
Excavation Method: <b>Excavator</b>	Bucket Size: <b>4 Feet</b>	Total Depth of Excavation: <b>14 feet bgs</b>
Excavator Type: <b>Track-Mounted</b>	Excavating Contractor: <b>RGI</b>	Approximate Surface Elevation <b>n/a</b>
Groundwater Level: <b>Not Encountered</b>	Sampling Method(s) <b>n/a</b>	Compaction Method <b>Bucket Tamp</b>
Test Pit Backfill: <b>Native Soils</b>	Location <b>32715 William Carmichael Road, Fall City, Washington 98024</b>	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			Topsoil			
				SP		Brown, fine to medium SAND with silt	
	5						
				SW		Brown, fine to coarse SAND with gravel and cobbles	
	10						
	15					Test pit completed at 14 feet bgs	
	20						



Project Name: **Raging River Quarry**Project Number: **2016-088A**Client: **Raging River Quarry**Test Pit No.: **TP-2/IT-3**

Sheet 1 of 1

Date(s) Excavated: <b>07/20/16</b>	Logged By <b>DB</b>	Surface Conditions: <b>Sand and Gravel (Pond Bottom)</b>
Excavation Method: <b>Excavator</b>	Bucket Size: <b>4 Feet</b>	Total Depth of Excavation: <b>8 feet bgs</b>
Excavator Type: <b>Track-Mounted</b>	Excavating Contractor: <b>RGI</b>	Approximate Surface Elevation <b>n/a</b>
Groundwater Level: <b>Not Encountered</b>	Sampling Method(s) <b>n/a</b>	Compaction Method <b>Bucket Tamp</b>
Test Pit Backfill: <b>Native Soils</b>	Location <b>32715 William Carmichael Road, Fall City, Washington 98024</b>	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			SP-SM		Brown, fine to coarse SAND with gravel and silt	
				SW		Brown, fine to coarse SAND with gravel, cobbles Infiltration test run at 3 feet below the bottom of Pond G	
	5						
						Test pit completed at 8 feet below the bottom of Pond G	
	10						
	15						
	20						

Project Name: **Raging River Quarry**

Project Number: **2016-088A**

Client: **Raging River Quarry**



## Key to Logs

### Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8

#### COLUMN DESCRIPTIONS

- |   |  |
|---|--|
| <p><b>1</b> Elevation (feet): Elevation (MSL, feet).</p> <p><b>2</b> Depth (feet): Depth in feet below the ground surface.</p> <p><b>3</b> Sample Type: Type of soil sample collected at the depth interval shown.</p> <p><b>4</b> Sample Number: Sample identification number.</p> | <p><b>5</b> USCS Symbol: USCS symbol of the subsurface material.</p> <p><b>6</b> Graphic Log: Graphic depiction of the subsurface material encountered.</p> <p><b>7</b> MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.</p> <p><b>8</b> REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.</p> |
|---|--|

#### FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity  
 COMP: Compaction test  
 CONS: One-dimensional consolidation test  
 LL: Liquid Limit, percent

PI: Plasticity Index, percent  
 SA: Sieve analysis (percent passing No. 200 Sieve)  
 UC: Unconfined compressive strength test, Qu, in ksf  
 WA: Wash sieve (percent passing No. 200 Sieve)

#### MATERIAL GRAPHIC SYMBOLS

	Silty SAND (SM)		Poorly graded SAND with Silt (SP-SM)
	Poorly graded SAND (SP)		Well graded SAND (SW)

#### TYPICAL SAMPLER GRAPHIC SYMBOLS

	Auger sampler		Continuous
	Bulk Sample		Grab Sample
	3-inch-OD California w/ brass rings		2.5-inch-OD Modified California w/ brass liners
	CME Sampler		Pitcher Sample

#### OTHER GRAPHIC SYMBOLS

	Water level (at time of drilling, ATD)
	Water level (after waiting)
	Minor change in material properties within a stratum
	Inferred/gradational contact between strata
	Queried contact between strata

#### GENERAL NOTES

- 1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
- 2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.



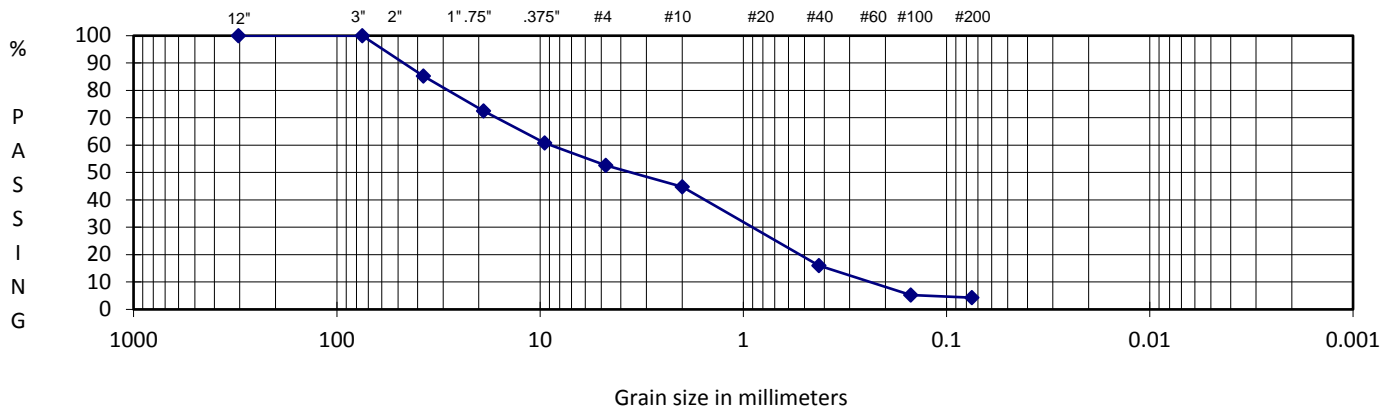
**GRAIN SIZE ANALYSIS**  
**ASTM D421, D422, D1140, D2487, D6913**

PROJECT TITLE	Raging River	SAMPLE ID/TYPE	IT-1
PROJECT NO.	2016-088	SAMPLE DEPTH	
TECH/TEST DATE	ELW 7/24/2016	DATE RECEIVED	7/21/2016

<b>WATER CONTENT (Delivered Moisture)</b>		Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture	
Wt Wet Soil & Tare (gm)	(w1)	Weight Of Sample (gm)	4087.8
Wt Dry Soil & Tare (gm)	(w2)	Tare Weight (gm)	33.9
Weight of Tare (gm)	(w3)	(W6) Total Dry Weight (gm)	4053.9

Weight of Water (gm)	(w4=w1-w2)	298.4	<b>SIEVE ANALYSIS</b>	
Weight of Dry Soil (gm)	(w5=w2-w3)	4053.9	Wt Ret	Cumulative
Moisture Content (%)	(w4/w5)*100	7	(Wt-Tare)	(%Retained)

% COBBLES	0.0	12.0"	33.9	0.00	0.00	100.00	cobbles
% C GRAVEL	27.4	3.0"	33.9	0.00	0.00	100.00	coarse gravel
% F GRAVEL	19.9	2.5"					coarse gravel
% C SAND	7.9	2.0"					coarse gravel
% M SAND	28.8	1.5"	631.1	597.20	14.73	85.27	coarse gravel
% F SAND	11.7	1.0"					coarse gravel
% FINES	4.3	0.75"	1146.3	1112.40	27.44	72.56	fine gravel
% TOTAL	100.0	0.50"					fine gravel
D10 (mm)	0.23	0.375"	1624.3	1590.40	39.23	60.77	fine gravel
D30 (mm)	0.9	#4	1953.6	1919.70	47.35	52.65	coarse sand
D60 (mm)	9	#10	2273.8	2239.90	55.25	44.75	medium sand
Cu	39.1	#20					medium sand
Cc	0.4	#40	3439.5	3405.60	84.01	15.99	fine sand
		#60					fine sand
		#100	3874.9	3841.00	94.75	5.25	fine sand
		#200	3913.8	3879.90	95.71	4.29	finer
		PAN	4087.8	4053.90	100.00	0.00	silt/clay



DESCRIPTION	Gravelly SAND with trace silt
USCS	SP

Prepared For: Raging River Quarry

Reviewed By: KMW

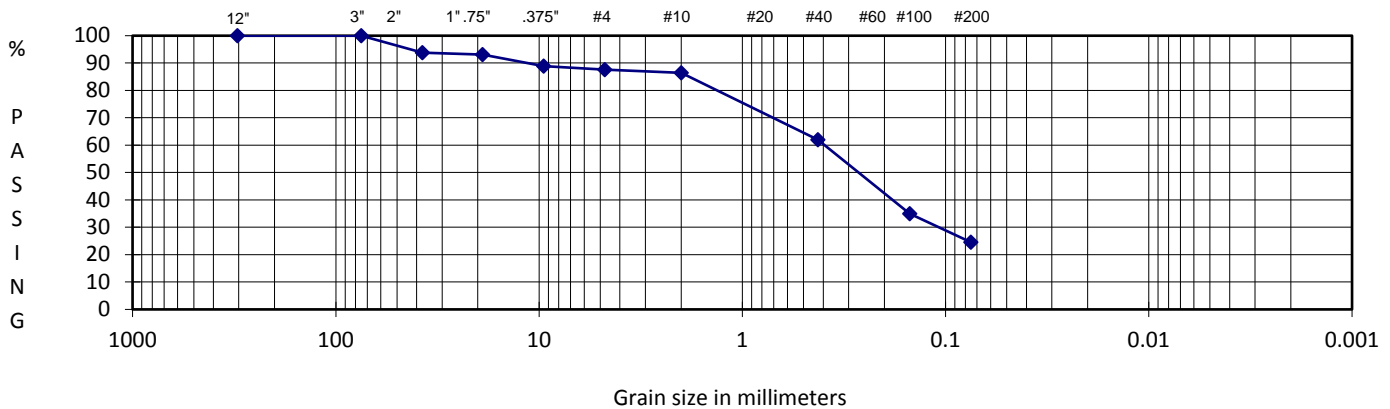
**GRAIN SIZE ANALYSIS**  
**ASTM D421, D422, D1140, D2487, D6913**

PROJECT TITLE	Raging River	SAMPLE ID/TYPE	IT-2
PROJECT NO.	2016-088	SAMPLE DEPTH	
TECH/TEST DATE	ELW 7/24/2016	DATE RECEIVED	7/21/2016

<u>WATER CONTENT (Delivered Moisture)</u>			<u>Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture</u>	
Wt Wet Soil & Tare (gm)	(w1)	2029.7	Weight Of Sample (gm)	1761.3
Wt Dry Soil & Tare (gm)	(w2)	1761.3	Tare Weight (gm)	252.0
Weight of Tare (gm)	(w3)	252.0	(W6) Total Dry Weight (gm)	1509.3

Weight of Water (gm)	(w4=w1-w2)	268.4	<b>SIEVE ANALYSIS</b>	
Weight of Dry Soil (gm)	(w5=w2-w3)	1509.3	Wt Ret	(Wt-Tare)
Moisture Content (%)	(w4/w5)*100	18	+Tare	Cumulative

% COBBLES	0.0	12.0"	252.0	0.00	0.00	100.00	cobbles
% C GRAVEL	6.8	3.0"	252.0	0.00	0.00	100.00	coarse gravel
% F GRAVEL	5.6	2.5"					coarse gravel
% C SAND	1.2	2.0"					coarse gravel
% M SAND	24.4	1.5"	344.8	92.80	6.15	93.85	coarse gravel
% F SAND	37.5	1.0"					coarse gravel
% FINES	24.5	0.75"	355.3	103.30	6.84	93.16	fine gravel
% TOTAL	100.0	0.50"					fine gravel
		0.375"	420.6	168.60	11.17	88.83	fine gravel
D10 (mm)		#4	439.1	187.10	12.40	87.60	coarse sand
D30 (mm)		#10	457.5	205.50	13.62	86.38	medium sand
D60 (mm)		#20					medium sand
Cu		#40	825.2	573.20	37.98	62.02	fine sand
Cc		#60					fine sand
		#100	1234.2	982.20	65.08	34.92	fine sand
		#200	1390.9	1138.90	75.46	24.54	finer
		PAN	1761.3	1509.30	100.00	0.00	silt/clay



DESCRIPTION	Silty SAND with trace gravel
USCS	SM

Prepared For: Raging River Quarry

Reviewed By: KMW

# GRAIN SIZE ANALYSIS

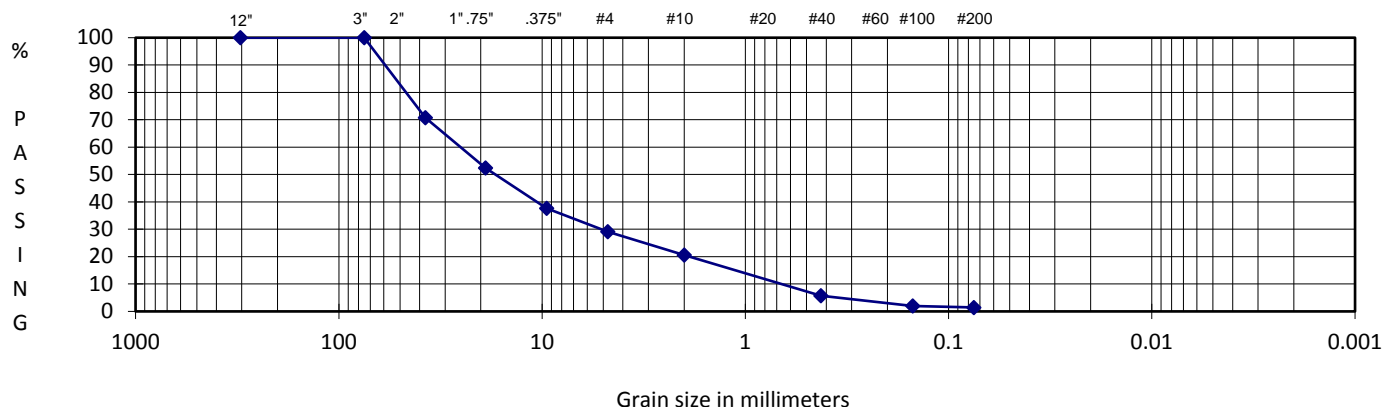
## ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Raging River	SAMPLE ID/TYPE	TP-1
PROJECT NO.	2016-088A	SAMPLE DEPTH	
TECH/TEST DATE	EW - 8/5/2016	DATE RECEIVED	8/5/2016

<b>WATER CONTENT (Delivered Moisture)</b>		Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture	
Wt Wet Soil & Tare (gm)	(w1)	Weight Of Sample (gm)	3301.5
Wt Dry Soil & Tare (gm)	(w2)	Tare Weight (gm)	34.0
Weight of Tare (gm)	(w3)	(W6) Total Dry Weight (gm)	3267.5

Weight of Water (gm)	(w4=w1-w2)	<b>SIEVE ANALYSIS</b>	
Weight of Dry Soil (gm)	(w5=w2-w3)	Wt Ret	Cumulative
Moisture Content (%)	(w4/w5)*100	(Wt-Tare)	(%Retained)
		+Tare	{(wt ret/w6)*100}
			(100-%ret)

% COBBLES	0.0	12.0"	34.0	0.00	0.00	100.00	cobbles
% C GRAVEL	47.6	3.0"	34.0	0.00	0.00	100.00	coarse gravel
% F GRAVEL	23.4	2.5"					coarse gravel
% C SAND	8.5	2.0"					coarse gravel
% M SAND	14.8	1.5"	988.1	954.10	29.20	70.80	coarse gravel
% F SAND	4.3	1.0"					coarse gravel
% FINES	1.5	0.75"	1587.9	1553.90	47.56	52.44	fine gravel
% TOTAL	100.0	0.50"					fine gravel
		0.375"	2072.6	2038.60	62.39	37.61	fine gravel
D10 (mm)	0.17	#4	2351.8	2317.80	70.93	29.07	coarse sand
D30 (mm)	0.25	#10	2628.0	2594.00	79.39	20.61	medium sand
D60 (mm)	0.5	#20					medium sand
Cu	2.9	#40	3112.8	3078.80	94.22	5.78	fine sand
Cc	0.7	#60					fine sand
		#100	3238.4	3204.40	98.07	1.93	fine sand
		#200	3254.0	3220.00	98.55	1.45	finer
		PAN	3301.5	3267.50	100.00	0.00	silt/clay



DESCRIPTION: Well-graded GRAVEL with some sand and trace silt

USCS: GW

Prepared For: Raging River Quarry

Reviewed By: EW

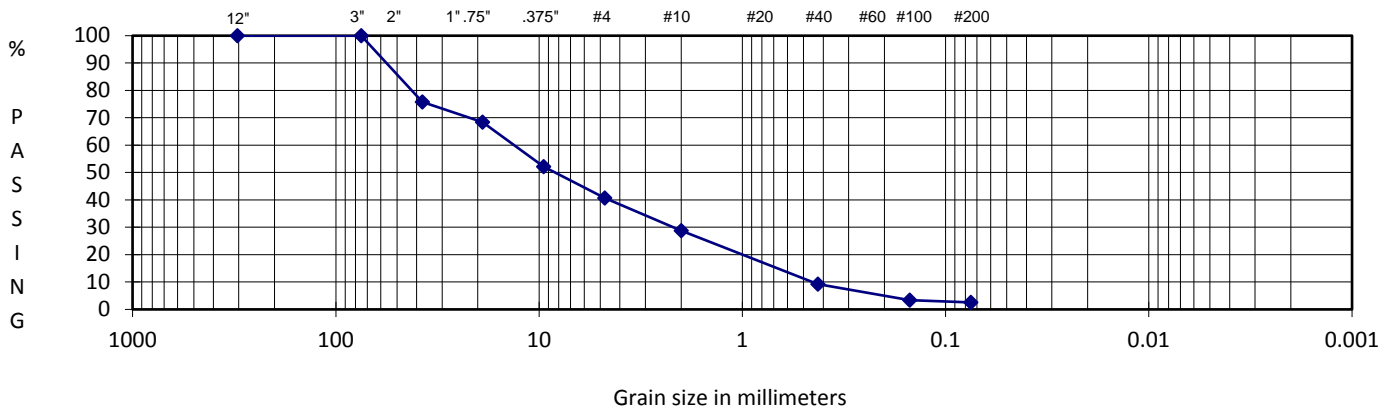
**GRAIN SIZE ANALYSIS**  
**ASTM D421, D422, D1140, D2487, D6913**

PROJECT TITLE	Raging River	SAMPLE ID/TYPE	IT-3/TP-2
PROJECT NO.	2016-088	SAMPLE DEPTH	
TECH/TEST DATE	ELW 7/24/2016	DATE RECEIVED	7/21/2016

<u>WATER CONTENT (Delivered Moisture)</u>			<u>Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture</u>	
Wt Wet Soil & Tare (gm)	(w1)	2298.5	Weight Of Sample (gm)	2191.8
Wt Dry Soil & Tare (gm)	(w2)	2191.8	Tare Weight (gm)	249.9
Weight of Tare (gm)	(w3)	249.9	(W6) Total Dry Weight (gm)	1941.9

Weight of Water (gm)	(w4=w1-w2)	106.7	<b>SIEVE ANALYSIS</b>	
Weight of Dry Soil (gm)	(w5=w2-w3)	1941.9	Wt Ret	(Wt-Tare)
Moisture Content (%)	(w4/w5)*100	5	+Tare	Cumulative

% COBBLES	0.0	12.0"	249.9	0.00	0.00	100.00	cobbles
% C GRAVEL	31.6	3.0"	249.9	0.00	0.00	100.00	coarse gravel
% F GRAVEL	27.7	2.5"					coarse gravel
% C SAND	12.0	2.0"					coarse gravel
% M SAND	19.5	1.5"	719.0	469.10	24.16	75.84	coarse gravel
% F SAND	6.7	1.0"					coarse gravel
% FINES	2.6	0.75"	863.4	613.50	31.59	68.41	fine gravel
% TOTAL	100.0	0.50"					fine gravel
D10 (mm)	0.45	0.375"	1178.8	928.90	47.83	52.17	fine gravel
D30 (mm)	2.1	#4	1401.4	1151.50	59.30	40.70	coarse sand
D60 (mm)	14	#10	1633.9	1384.00	71.27	28.73	medium sand
Cu	31.1	#20					medium sand
Cc	0.7	#40	2012.0	1762.10	90.74	9.26	fine sand
		#60					fine sand
		#100	2126.3	1876.40	96.63	3.37	fine sand
		#200	2142.2	1892.30	97.45	2.55	finer
		PAN	2191.8	1941.90	100.00	0.00	silt/clay



DESCRIPTION	Sandy GRAVEL with trace silt
USCS	GP

Prepared For: Raging River Quarry

Reviewed By: KMW

## Appendix E

### Other Permits

Grading Permit, 1998



King County  
Department of Development  
and Environmental Services  
900 Oakesdale Avenue S.W.  
Renton, Washington 98055-1219

Activity No: L98GR035  
Project No: L73G1592  
Page: 1 of 1  
Date Issued:  
Expires: 2-4-99

APPROVED

\* GRADING PERMIT \*

Permit Type: GRADING PERMIT RENEWAL

Type Code: G-EXTEND

Title: GRADING PERMIT #1592-599

Description: GRADING RIVER MINING

Location: 32715 WILLIAM CARMICHAEL RD

Zone: MP

Parcel: 222407-9033 STR: SW,SW,22-24-07

Block:

Lot:

Plat:

Applicant: CADMAN GRAVEL

Phone number: 206-867-1234

Appl. Address: P.O. BOX 538

REDMOND, WA 98073

#### OTHER INFORMATION:

Total Site Area:	10	acres
Total Volume Disturbed:	UNKNOWN	yards
Vol. Fill/Exc. in 12 Mos:	0	yards
Non-Rehabilitated area:	10	acres
Rehabilitated area:	0	acres
Associated Permits:		

#### CONTACT

Please refer to the above "Project Number" when making inquiries regarding this application. For inquiries call 296-6610. FOR INSPECTIONS CALL 296-6610.

#### CERTIFICATION

I have read the attached conditions of approval and understand that failure to comply with all conditions set forth herein shall necessitate an immediate work stoppage until such time as compliance with the stipulated conditions is attained. Failure to comply with, or repeated violations of permit conditions, may result in permit suspension and/or revocation as provided for in K.C.C. Title 23. The granting of this permit shall not be construed as satisfying the requirements of other Federal, State or local government permits or authorizations. The operation to be undertaken through this grading Permit shall be conducted in accordance with the conditions contained herein and shall generally comply with the provisions of K.C.C. 16.28 and other applicable ordinances.

Owner/Owner's Agent Signature

7/18/98

Date

Permit

Place



King County  
Department of Development  
and Environmental Services  
900 Oakesdale Avenue S.W.  
Renton, Washington 98055-1219

Activity No: L98GR035  
Project No: L73G1592  
Page : 1 of 1  
Status : APPROVED  
Date : 06/15/98

\* APPLICATION ACKNOWLEDGEMENT \*

Permit Type : GRADING PERMIT RENEWAL

Type Code: G-EXTEND

Title : GRADING PERMIT #1592-599

Description : RAGING RIVER MINING

Location : 32715 WILLIAM CARMICHAEL RD

Zone: MP

Parcel: 222407-9033 STR: SW,SW,22-24-07

Block:

Lot:

Plat:

Applicant : CADMAN GRAVEL

Phone number: 206-867-1234

Appl.Address: P.O. BOX 538

REDMOND, WA 98073

OTHER INFORMATION:

Total Site Area:	10	acres
Total Volume Disturbed:	UNKNOWN	yards
Vol. Fill/Exc.in 12 Mos:	0	yards
Non-Rehabilitated area:	10	acres
Rehabilitated area:	0	acres
Associated Permits:		

\*\*\*\*\* CONTACT \*\*\*\*\*

Please refer to the above "Project Number" when making inquiries regarding this application. To make inquiries call 296-6610.

\*\*\*\*\* CERTIFICATION \*\*\*\*\*

I certify under penalty of perjury under the laws of the State of Washington that the information furnished by the owner or owner's agent in support of this application is true and correct. I further certify that all applicable King County requirements for the work authorized by this permit, if issued, will be met and that violation thereof will be cause for code enforcement action.

  
Owner/Owner's Agent Signature

7/12/98  
Date

REDMOND  
Place





King County  
Department of Development  
and Environmental Services  
900 Oakesdale Avenue S.W.  
Renton, Washington 98055-1219

Applicant : CADMAN GRAVEL  
Appl. Address: P.O. BOX 538  
REDMOND, WA 98073  
Phone Number: 206-867-1234

Activity No: L98GR035  
Project No : L73G1592  
Page : 1 of 1  
Date : 09/01/98

\* GRADING PERMIT CONDITIONS \*

The conditions attached to this cover sheet apply to the permit referenced here.  
All conditions must be complied with by the contractor and verified by a  
Grading Inspector (CALL 296-6610) or this permit will become null and void.

PROJECT REFERENCE INFORMATION:

Location : 32715 WILLIAM CARMICHAEL RD  
Title : GRADING PERMIT #1592-599  
Description : GRADING RIVER MINING

OTHER INFORMATION:

Total Site Area:	10	acres
Total Volume Disturbed:	UNKNOWN	yards
Vol. Fill/Exc. in 12 Mos:	0	yards
Non-Rehabilitated area:	10	acres
Rehabilitated area:	0	acres
Associated Permits:		

REVIEWED BY:

(Grading)







\*\* CONDITIONS OF PERMIT/APPROVAL \*\*

DATE: 06/15/98

PAGE: 1

Activity No: C92G051R TYPE: G-RENEW

Location: 32715 WILLIAM CARMICHAEL RD

GRADING/MINING GENERAL COND'S

- 0005 - SITE SHALL BE OPERATED AT ALL TIMES IN CONFORMANCE WITH THE CONDITIONS OF DIVISION FILES #134-74-R, 007-80-SH, AND 122-86-R.
- 0030 - If work is to be suspended for 30 or more consecutive calendar days, permittee shall notify the Grading Section prior to the cessation of work indicating their intention to do so and also prior to restarting operations.
- 0051 - WORK SHALL BE LIMITED TO MINING WITHIN TAX PARCEL 2224079011 PER THE APPROVED PLANS ON FILE WITH THE GRADING SECTION DATED 2-2-83. WORK WITH TAX PARCELS 2224079010 & 2224079033 SHALL BE AUTHORIZED ONLY UPON APPROVAL OF REVISED PLANS TO BE SUBMITTED BY PERMITTEE.
- 0080 - All work shall comply with the provisions of King County Ordinance 3139, relating to noise control.
- 0096 - HOURS OF OPERATION SHALL BE LIMITED TO 7:00 A.M. TO 7:00 P.M. MONDAY THROUGH FRIDAY; EXCEPT THAT LOADING OF TRUCKS SHALL BE LIMITED TO 7:30 A.M. TO 4:00 P.M. SATURDAY HOURS ARE LIMITED TO 8:00 A.M. TO 4:30 P.M. FOR MAINTENANCE ONLY.
- 0120 - Permittee shall abide by the regulations of the Puget Sound Air Pollution Control Agency (PSAPCA).
- 0140 - You must call 1-800-424-5555 not less than 48 hours before beginning excavation where any underground utilities may be located. Failure to do so could mean bearing substantial repair costs (up to three times the cost of repairs to the service).
- 0160 - A Forest Practices Permit may be required by the Washington State Department of Natural Resources for clearing associated with this permit. Contact DNR at (206) 825-1631 for information.
- 0170 - A National Pollutant Discharge Elimination System (NPDES) permit for surface water discharge and/or a Temporary Water Quality Modification permit may be required for this project. Contact the Washington State Department of Ecology at (206) 649-7000 for information.
- 0500 - A copy of the approved plans, conditions, and permit must be on the job site whenever construction is in progress.



Activity No: C92G051R TYPE: G-RENEW

Location: 32715 WILLIAM CARMICHAEL RD

- 0600 - No external signs shall be permitted except those authorized by the King County Zoning Code or as required by this permit.
- 1150 - The tops and the toes of cut and fill slopes shall be set back from property boundaries as far as necessary for safety of the adjacent properties and to prevent damage resulting from water runoff or slope erosion.
- 1160 - The tops and the toes of cut and fill slopes shall be set back from structures as far as is necessary for adequacy of foundation support and to prevent damage as a result of water runoff or slope erosion.
- 2010 - Approval of this erosion/sedimentation control (ESC) plan does not constitute an approval of permanent road or drainage design (e.g. size and location of roads, pipes, restrictors, channels, retention facilities, utilities, etc.).
- 2020 - The implementation of these ESC plans and the construction, maintenance, replacement, and upgrading of these ESC facilities is the responsibility of the permittee until all construction is approved.
- 2030 - The boundaries of the clearing limits shown on this plan shall be clearly flagged in the field prior to construction. During the construction period, no disturbance beyond the flagged clearing limits shall be permitted. The flagging shall be maintained by the permittee for the duration of construction.
- 2040 - The ESC facilities shown on this plan must be constructed in conjunction with all clearing and grading activities, and in such a manner as to ensure that sediment-laden water does not enter the drainage system or violate applicable water standards. (KCC 9.04.090, KCC 9.12.025)
- 2110 - Stabilized construction entrances and wash pads shall be installed at the beginning of construction and maintained for the duration of the project. Additional measures may be required to ensure that all paved areas are kept clean for the duration of the project. (RCW 46.61.655.)
- 2130 - Where seeding for temporary erosion control is required, fast germinating grasses shall be applied at an appropriate rate (e.g. annual or perennial rye applied at approximately 80 pounds per acre).



Activity No: C92G051R TYPE: G-RENEW  
Location: 32715 WILLIAM CARMICHAEL RD

- 4060 - Waste or spoil piles shall be leveled.
- 4110 - Excavations not made to a water-producing depth shall be graded or backfilled in a manner to encourage the uses permitted within the underlying zone classification. Specifically: a) Grading or backfilling shall be made with non-noxious, nonflammable, noncombustible solids; b) The peaks and depressions of the area shall be reduced to a gently rolling topography in substantial conformity to the land area immediately surrounding and which will minimize erosion.
- 4120 - Where mining is by open pit, bench, or quarry methods, reclamation shall be performed in the following manner: a) Slopes between successive benches shall not, in unconsolidated material, be steeper than 1 and 1/2 foot horizontal to 1 foot vertical, and shall be topsoiled and revegetated; b) Slopes between successive benches in consolidated material shall have no prescribed angle of slope, and no attempt need be made to resurface or plant; c) All slopes in consolidated material shall be scaled of loose rock per the requirements of MSHA; d) Bench width and spacing shall be as shown on the reclamation plan as may be amended by King County and the Washington State Department of Natural Resources.
- 5010 - Road access to sites developed for mining or quarrying of minerals or materials shall be controlled by means of a gate. A sign warning of hazardous conditions, if such exist, shall be affixed to the gate or placed in a conspicuous manner near the gate. If the property has an exterior boundary line which is a common property line with developed R or S classified property, then a solid wall or fence not less than 5 feet in height shall be installed and maintained. (KCC 21.42.030A.)
- 5020 - Mining and quarrying shall be permitted up to within 10 feet of any property line other than Q-M classified property provided all provisions herein set forth are complied with and provided further that such mining or quarrying does not impair lateral support or cause earth movements or erosion to extend beyond the exterior boundary lines of the property. Structures or buildings shall not be located closer than 100 feet to an R or S property line, except where the common property line is so situated as to cause an elevation difference of 50 feet or more within said 100-foot setback, and in such case the required 100-foot setback may be reduced by the amount the slope distance exceeds the horizontal distance but in no event shall the structures or buildings be located closer than 50 feet to said common property line. Office buildings, scale facilities, equipment storage buildings, and other similar buildings or structures and stockpiles shall be excepted from this provision but shall not be located closer than 20 feet to an R or S property line.



Activity No: C92G051R TYPE: G-RENEW

Location: 32715 WILLIAM CARMICHAEL RD

- 2140 - Where straw mulch for temporary erosion control is required, it shall be applied at a minimum thickness of 2 inches.
- 2160 - Temporary sediment control facilities shall be constructed in accordance with the details shown. Temporary sediment control facility locations may be moved to suit field conditions subject to approval of the engineer and applicable governmental agencies.
- 2170 - All ponds and ditches and other erosion-sedimentation facilities shall be maintained in good working condition throughout construction.
- 2190 - Grass seeding will be done using an approved hydro-seeder or as otherwise approved by DDES. The performance bond, if required, will not be released until the grass is established, unless otherwise approved by DDES.
- 2200 - The erosion and sedimentation control systems depicted on this drawing are intended to be minimum requirements to meet anticipated site conditions. As construction progresses and unexpected or seasonal conditions dictate, the permittee should anticipate that more siltation and sedimentation control facilities will be necessary to ensure complete siltation control on the proposed site. During the course of construction, it shall be the obligation and responsibility of the permittee to address any new conditions that may be created by his activities and to provide additional facilities over and above minimum requirements as may be needed to protect adjacent properties and water quality of the receiving drainage system.
- 4010 - Upon the exhaustion of minerals or materials on the permanent abandonment of the quarrying or mining operation, all buildings, structures, apparatus, or appurtenances accessory to the operation will be removed or otherwise dismantled to the satisfaction of the director.
- 4020 - All excavations must either be made to a water producing depth or backfilled and graded to allow natural drainage.
- 4050 - Excavations shall be reclaimed in a manner which will not allow water to collect and permit stagnant water to remain. Suitable drainage systems approved by the director shall be constructed or installed if natural drainage is not possible.



Activity No: C92G051R TYPE: G-RENEW  
Location: 32715 WILLIAM CARMICHAEL RD

S property line. (KCC 21.42.030B.)

5030 - All uses shall conform to the landscaping requirements set forth in KCC Chapter 21.51. (KCC 21.42.030C.)

5040 - Emission of smoke from any source other than heat processing equipment shall not exceed a percentage smoke density (average smoke emission) of 30% except when building a new fire or when due to breakdowns of a temporary nature. Said percentage smoke density shall be measured in conformance with the methods set forth in the United States Bureau of Mines publication Information Circular 7118 entitled, "Ringelmann Smoke Chart" edition of August, 1955. Continuous readings at appropriate time intervals of not less than 30 seconds shall be made, and in no event shall the average smoke emission be calculated for a duration of less than 60 minutes. (KCC 21.42.090.)

5050 - Blasting and all other activities shall be so conducted that ground vibrations measured next to structures or buildings situated on adjacent "R" or "S" property do not exceed the maximum amplitude of ground vibrations as related to frequencies of vibrations set forth in the following table: (KCC 21.47.100(A).)

Table of Frequency - Amplitude Relations	
Frequency of Ground Motion in Cycles per Second	Maximum Amplitude of Ground Motion, in Inches
up to 10 . . . . .	not more than 0.0305
20 . . . . .	0.0153
30 . . . . .	0.0102
40 . . . . .	0.0076
50 . . . . .	0.0061
60 . . . . .	0.0051

5060 - Where ground frequency and displacement characteristics in relation to known quantities of detonated explosives have been determined by instrumentation, using either an accelerometer or a seismograph, the allowable quantity of explosives used in relation to distance may be established by the formula:

$$\frac{2}{(50/D)^2} C K = 1$$

where D = Distance from the blast in feet

C = Quantity of explosive detonated instantaneously in pounds

K = Ground transmission constant

The energy ratio thus determined shall not exceed 1, and all measurements shall be taken at the most critical location. (KCC 21.42.100B.)



Activity No: C92G051R TYPE: G-RENEW

Location: 32715 WILLIAM CARMICHAEL RD

5070 - When ground characteristics for any specific blasting location have been determined by instrumentation, special explosives quantity limits for that location may be approved by the King County engineer, if said limits are computed and certified by a qualified vibration measurement specialist.  
(KCC 21.42.100C.)

5080 - In the absence of approved methods of instrumentation to restrict vibration to the levels specified in the foregoing table, the quantity of explosives used in blasting shall not exceed the following:

Quantity-Distance Table

Distance from the blast area to the nearest building, neither mine or quarry-owned, nor mine or quarry-leased in feet	Maximum quantity of explosives per shot for instantaneous firing or per delay for delay firing, in pounds	
	Normal	Abnormal
	overburden	overburden (1)
100 See Fn (2)	340 See Fn (3)	70 (See Fn (4))
200	420 See Fn (5)	78 (See Fn (6))
300	525	100
400	635	125
500	800	160
600	950	200
700	1175	245
800	1500	300
900	1830	360
1000	2250	430
1200	3500	610
1400	-	820
1600	-	1250
1800	-	1900
2000	-	3000

Footnote (1) Abnormal overburden is that which is unusually deep (more than 50 feet to bedrock), has a water table near the surface, or is so composed as to be spongy, flexible, or reverberant.

Footnote (2) 100 feet shall be the minimum allowable distance when approved missile protection methods are used.

Footnote (3) No more than 10 pounds of explosive material shall be placed in any single charge.

Footnote (4) No more than 5 pounds of explosive material shall be placed in any single charge.

Footnote (5) No more than 20 pounds of explosive material shall be placed in any single charge.

Footnote (6) No more than 8 pounds of explosive material shall be placed in any single charge.

(KCC 21.42.100D.)



Activity No: C926051R TYPE: G-RENEW

Location: 32715 WILLIAM CARMICHAEL RD

5090 - Mining and quarrying shall be conducted in a manner which will not allow water to collect and permit stagnant water to remain in excavations. (KCC 21.42.110.)

5100 - Maximum allowable daytime sound pressure levels as measured next to occupied buildings or structures situated on adjacent R or S property shall not exceed the following standards at least 90% of the time between the hours of 5:00 a.m. and 10:00 p.m.

Sound Pressure Levels

Frequency band in cycles/second	Sound pressure level in decibels re 0.0002 microbar
25 - 300 . . . . .	80
300 - 2400 . . . . .	70
Above 2400 . . . . .	60

Maximum allowable nighttime sound pressure levels as measured next to occupied buildings or structures situated on adjacent "R" or "S" property shall not exceed the following standards at least 90% of the time between the hours of 10:00 p.m. and 5:00 a.m.

Sound Pressure Levels

Frequency band in cycles/second	Sound pressure level in decibels re 0.0002 microbar
25 - 300 . . . . .	70
300 - 2400 . . . . .	63
Above 2400 . . . . .	55

Sound pressure levels shall be measured by a sound level meter and associated octave band filter manufactured according to standards prescribed by the American Standards Association. (KCC 21.42.050.)

5110 - Odors from gases or other odorous matter shall not be emitted in quantities as to be unreasonably offensive beyond the exterior property lines. (KCC 21.42.060.)

5120 - Toxic gases and matter shall not be emitted in quantities damaging to health, to animals, vegetation or property beyond the exterior property lines. (KCC 21.42.070.)

5130 - Dust, dirt, and fly ash or airborne solids from any source shall not be emitted in quantities as to adversely affect adjacent property. (KCC 21.42.080.)

5140 - No building or structure shall be located closer than 20 feet to property lines other than R or S zoned property or to a public right-of-way (KCC 21.42.160), except that if any such structure exceeds 45 feet in height, it should be set back from each property line 1 foot additional for each 1 foot it exceeds 45 feet.



King County  
Department of Development  
and Environmental Services  
900 Oakesdale Avenue S.W.  
Renton, Washington 98055-1219

\*\* CONDITIONS OF PERMIT/APPROVAL \*\*

DATE: 06/15/98

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Activity No: C92G051R TYPE: G-RENEW

Location: 32715 WILLIAM CARMICHAEL RD

- 5160 - Fencing, where required by the director, to protect life, limb, and property shall be installed with lockable gates which must be closed and locked when not working the site. The fence must be no less than 5 feet in height, and the fence material shall have no horizontal opening larger than 2 inches.
- 7020 - During hauling operations, permittee shall provide effective dust control measures consisting of water, asphalt treated base, chemical dust palliatives, or equivalent measures to control dust from this operation.
- 7040 - Permittee shall be responsible for implementing all appropriate measures needed (i.e. paving, sweepers, and/or other techniques) to keep streets and roads used as haul routes for export or import of material clean and free from debris, mud, etc.





Activity No: C92G051R TYPE: G-RENEW

Location: 32715 WILLIAM CARMICHAEL RD

5070 - When ground characteristics for any specific blasting location have been determined by instrumentation, special explosives quantity limits for that location may be approved by the King County engineer, if said limits are computed and certified by a qualified vibration measurement specialist. (KCC 21.42.100C.)

5080 - In the absence of approved methods of instrumentation to restrict vibration to the levels specified in the foregoing table, the quantity of explosives used in blasting shall not exceed the following:

Quantity-Distance Table

Distance from the blast area to the nearest building, neither mine or quarry-owned, nor mine or quarry-leased in feet	Maximum quantity of explosives per shot for instantaneous firing or per delay for delay firing, in pounds	
	Normal	Abnormal
	overburden	overburden (1)
100 See Fn (2)	340 See Fn (3)	70 (See Fn (4))
200	420 See Fn (5)	78 (See Fn (6))
300	525	100
400	635	125
500	800	160
600	950	200
700	1175	245
800	1500	300
900	1830	360
1000	2250	430
1200	3500	610
1400	-	820
1600	-	1250
1800	-	1900
2000	-	3000

Footnote (1) Abnormal overburden is that which is unusually deep (more than 50 feet to bedrock), has a water table near the surface, or is so composed as to be spongy, flexible, or reverberant.

Footnote (2) 100 feet shall be the minimum allowable distance when approved missile protection methods are used.

Footnote (3) No more than 10 pounds of explosive material shall be placed in any single charge.

Footnote (4) No more than 5 pounds of explosive material shall be placed in any single charge.

Footnote (5) No more than 20 pounds of explosive material shall be placed in any single charge.

Footnote (6) No more than 8 pounds of explosive material shall be placed in any single charge.

(KCC 21.42.100D.)