Hyde Mine Sand and Gravel

Preliminary Technical Information Report

December 17, 2021

Prepared for

Palmer Coking Coal Company, LLP (PCCC)
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12/17/2021

Submitted by

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Section 1

1. Project Overview

The Hyde Mine Sand and Gravel site is a sand and gravel mine operation with associated utilities, access roads, and material processing & stormwater infrastructure. This site is located in Section 19 and 20, Township 21 North, Range 07 East, W.M., southeast of the Franklin Ridge Sand and Gravel Mine. The site includes the parcel numbered 302107-9080 for a total of approximately 240 acres.

The purpose of this Technical Information Report (TIR) is to address Full Drainage Review requirements as outlined in the 2021 King County Surface Water Design Manual (SWDM). These requirements will be reviewed and addressed for pre-developed (existing) conditions, phased mining activities, and post mine (reclamation) conditions.

According to Section 1.1.2.4 of the SWDM, the proposed phased mining area (site) is subject to a Full Drainage Review because the site will be an active sand and gravel mine that needs to show compliance with current standards. A Full Drainage Review consists of reviewing Core Requirements #1-9 and Special Requirements #1-5 as outlined in Table 1.1.2.A of the SWDM. A discussion of these requirements can be found in Section 2 of this report.

A Site Plan map is provided following this section showing the proposed mining phases and limits (Figure 1.3). The basins for existing, mining, and reclamation conditions are described in detail in Section 4 and the associated basin maps are included in Appendix A of this report.

The existing site is an undeveloped area that has been logged and replanted over time, in phases, since 2009 for most of the site. There are powerlines that cross the parcel in the southern portion of the site and access roads throughout. There are some moderate to steep slopes onsite and the remainder of the site is relatively flat. Soils onsite include Everett & Alderwood Loams which are outwash-type soils with good infiltration characteristics. Refer to Figure 1.4 for soils information.

The site is in the Coal Creek (Green) drainage basin (WRIA number: 9) and is zoned RA5. See Figures 1.2 Vicinity Map and 1.3 Existing Site Conditions for more information.

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Figure 1.1

Part 1 PROJECT OWNER AND PROJECT ENGINEER

Project Owner: Palmer Coking Coal Company
Phone: (425) 432-4700
Address: PO Box 10 / 31407 SR 169
Black Diamond, WA 98010
Project Engineer: Laura Bartenhagen, PE
Company: ESM Consulting Engineers
Phone: (253) 838 - 6113

Part 2 PROJECT LOCATION AND DESCRIPTION

Project Name: Hyde Mine Rezone
DLS-Permitting
Permit #:
Location Township: 21
Range: 07
Section: 30
Site Address: Lot Q Enumclaw Franklin Road SE
Enumclaw, WA

Part 3 TYPE OF PERMIT APPLICATION

- ☐ Land use (e.g.,Subdivision / Short Subd. / UPD)
- ☐ Building (e.g.,M/F / Commercial / SFR)
- ☑ Clearing and Grading
- ☐ Right-of-Way Use
- ☑ Other Sand and Gravel Mining

Part 4 OTHER REVIEWS AND PERMITS[1]

- ☐ DFW HPA
- ☐ COE CWA 404
- ☐ ECY Dam Safety
- ☐ FEMA Floodplain
- ☑ COE Wetlands
- ☑ Other DNR and NPDES Permits
- ☐ Shoreline Management
- ☐ Structural Rockery/Vault/____
- ☐ ESA Section 7

Part 5 PLAN AND REPORT INFORMATION

Technical Information Report

Type of Drainage Review (check one):
- ☑ Full
- ☐ Targeted
- ☐ Simplified
- ☐ Large Project
- ☐ Directed

Date (include revision dates):
Date of Final:

Site Improvement Plan (Engr. Plans)

Plan Type (check one):
- ☑ Full
- ☐ Modified
- ☐ Simplified

Date (include revision dates):
Date of Final:

Part 6 SWDM ADJUSTMENT APPROVALS

Type (circle one): Standard / Experimental / Blanket

Description: (include conditions in TIR Section 2)
N/A

Approved Adjustment No. _____ Date of Approval: _____

[1] DFW: WA State Dept. of Fish and Wildlife. HPA: hydraulic project approval. COE: (Army) Corps of Engineers. CWA: Clean Water Act. ECY: WA State Dept. of Ecology. FEMA: Federal Emergency Management Agency. ESA: Endangered Species Act.

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Figure 1.1

Part 7 MONITORING REQUIREMENTS

Monitoring Required: Yes / No

Start Date: _____

Completion Date: _____

Describe: _____

Re: KCSWDM Adjustment No. _____

Part 8 SITE COMMUNITY AND DRAINAGE BASIN

Community Plan : N/A

Special District Overlays: N/A

Drainage Basin: Middle Green River & Coal Creek (Green) drainage basins

Stormwater Requirements: Flow Control (full infiltration) and Enhanced Basic Water Quality Treatment

Part 9 ONSITE AND ADJACENT SENSITIVE AREAS

- ☐ River/Stream _____
- ☐ Lake _____
- ☑ Wetlands A, B, C & D
- ☑ Closed Depression _____
- ☐ Floodplain _____
- ☐ Other _____
- ☑ Steep Slope _____
- ☐ Erosion Hazard _____
- ☐ Landslide Hazard _____
- ☑ Coal Mine Hazard _____
- ☐ Seismic Hazard _____
- ☐ Habitat Protection _____
- ☐ _____

Part 10 SOILS

Soil Type	Slopes	Erosion Potential
Everett Loam	0-15%	None
Everett Loam	15-30%	
Alderwood Loam	0-15%	

- ☐ High Groundwater Table (within 5 feet)
- ☐ Other _____
- ☐ Sole Source Aquifer
- ☐ Seeps/Springs

☐ Additional Sheets Attached

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Figure 1.1

Part 11 DRAINAGE DESIGN LIMITATIONS

REFERENCE	LIMITATION / SITE CONSTRAINT
☑ Core 2 – Offsite Analysis	
☐ Sensitive/Critical Areas	
☐ SEPA	
☐ LID Infeasibility	
☐ Other	
☐	

☐ Additional Sheets Attached

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)

Threshold Discharge Area:
(name or description)

Core Requirements (all 8 apply): All 9 Core Requirements apply to the project site

Discharge at Natural Location	Number of Natural Discharge Locations:
Offsite Analysis	Level: (1) / 2 / 3 dated: October 29, 2018
Flow Control (include facility summary sheet)	Level: 1 / 2 / (3) or Exemption Number _____ Flow Control BMPs _____
Conveyance System	Spill containment located at: _____
Erosion and Sediment Control / Construction Stormwater Pollution Prevention	CSWPP/CESCL/ESC Site Supervisor: _____ Contact Phone: _____ After Hours Phone: _____
Maintenance and Operation	Responsibility (circle one): (Private) / Public If Private, Maintenance Log Required: Yes / (No)
Financial Guarantees and Liability	Provided: Yes / (No)
Water Quality (include facility summary sheet)	Type (circle one): Basic / Sens. Lake / (Enhanced Basic) / Bog or Exemption No. _____ Landscape Management Plan: Yes / (No)
For Entire Project: % of Target Impervious that had a feasible FCBMP implemented_____	Total Replaced Impervious surfaces on the site_____ Total New Pervious Surfaces on the site_____ Repl. Imp. on site mitigated w/flow control facility_____ Repl. Imp. on site mitigated w/water quality facility_____ Repl. Imp. on site mitigated with FCBMP _____

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Figure 1.1

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)

Special Requirements (as applicable):

Area Specific Drainage Requirements	Type: CDA / SDO / MDP / BP / LMP / Shared Fac. / (None) Name: _____
Floodplain/Floodway Delineation	Type (circle one): Major / Minor / Exemption / (None) 100-year Base Flood Elevation (or range): _____ Datum:
Flood Protection Facilities	Describe: None
Source Control (commercial / industrial land use)	Describe land use: Describe any structural controls:
Oil Control	High-use Site: Yes / No Treatment BMP: _____ Maintenance Agreement: Yes / No with whom? _____

Other Drainage Structures

Describe:

Part 13 EROSION AND SEDIMENT CONTROL REQUIREMENTS

MINIMUM ESC REQUIREMENTS DURING CONSTRUCTION

- [x] Clearing Limits
- [x] Cover Measures
- [x] Perimeter Protection
- [ ] Traffic Area Stabilization
- [x] Sediment Retention
- [x] Surface Water Collection
- [x] Dewatering Control
- [x] Dust Control
- [ ] Flow Control
- [ ] Protection of Flow Control BMP Facilities (existing and proposed)
- [ ] Maintain BMPs / Manage Project

MINIMUM ESC REQUIREMENTS AFTER CONSTRUCTION

- [x] Stabilize exposed surfaces
- [x] Remove and restore Temporary ESC Facilities
- [ ] Clean and remove all silt and debris, ensure operation of Permanent Facilities, restore operation of Flow Control BMP Facilities as necessary
- [ ] Flag limits of SAO and open space preservation areas
- [ ] Other _____

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET Figure 1.1

Part 14 STORMWATER FACILITY DESCRIPTIONS (Note: Include Facility Summary and Sketch)				
Flow Control	Type/Description		Water Quality	Type/Description
☐ Detention	_____		☐ Vegetated Flowpath	_____
☑ Infiltration	_____		☐ Wetpool	_____
☐ Regional Facility	_____		☐ Filtration	_____
☐ Shared Facility	_____		☑ Oil Control	Spill Prevention Plan
☐ Flow Control BMPs	_____		☑ Spill Control	Spill Prevention Plan
☐ Other	_____		☑ Flow Control BMPs	Dispersion
			☐ Other	_____

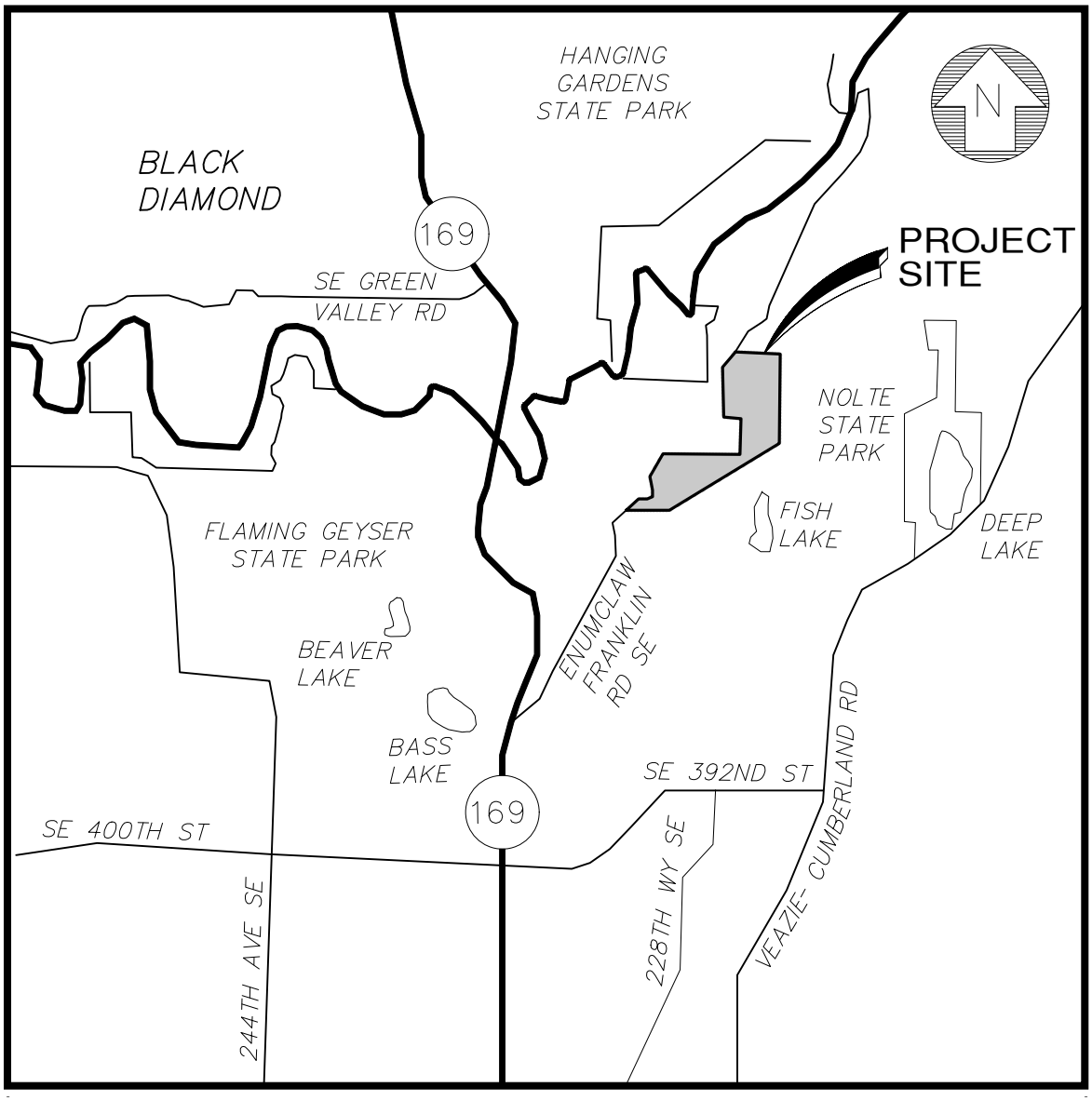
Part 15 EASEMENTS/TRACTS		Part 16 STRUCTURAL ANALYSIS
☐ Drainage Easement		☐ Cast in Place Vault
☐ Covenant		☐ Retaining Wall
☐ Native Growth Protection Covenant		☐ Rockery > 4' High
☐ Tract		☐ Structural on Steep Slope
☐ Other _____		☐ Other _____

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

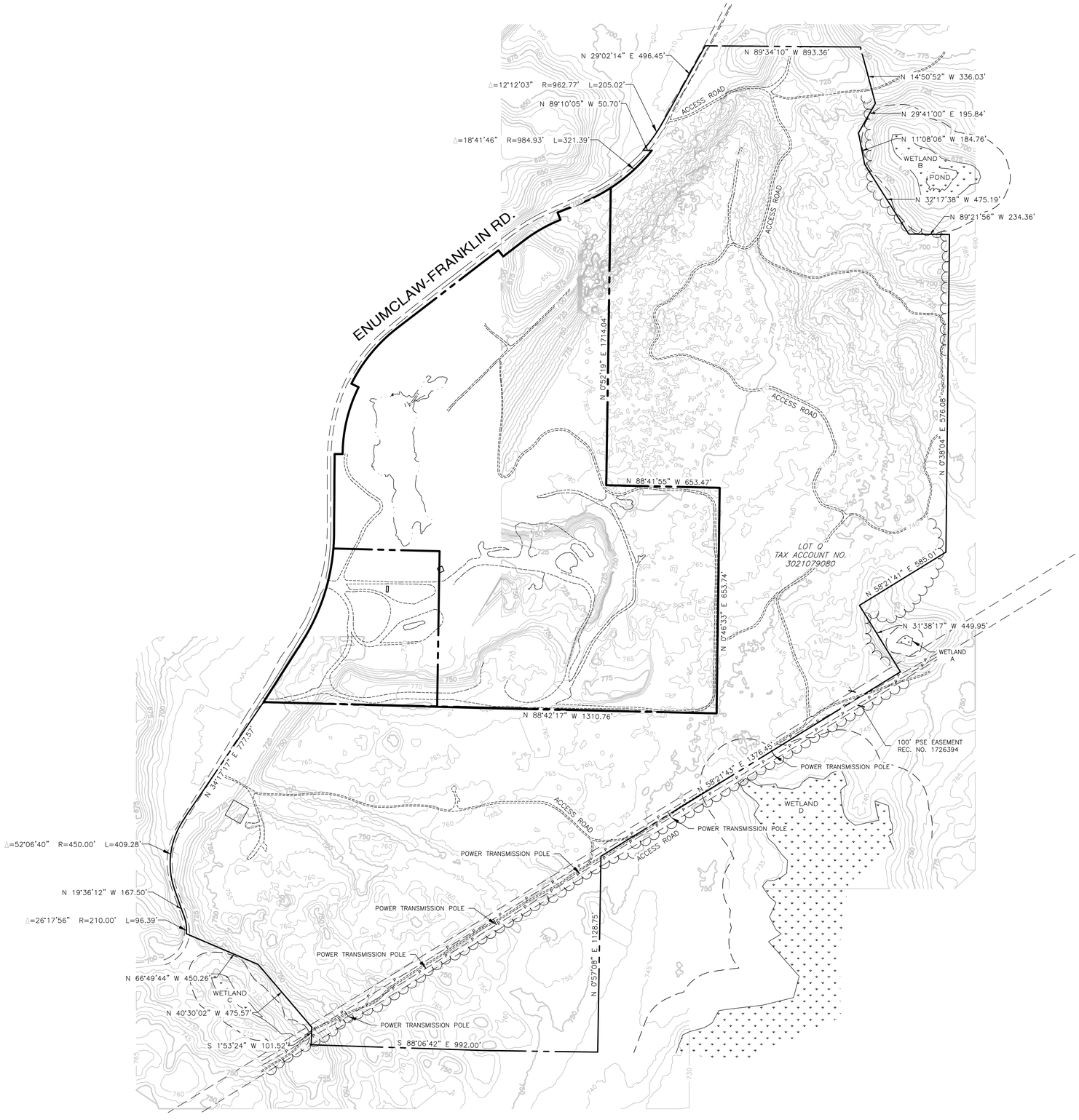
Part 17 SIGNATURE OF PROFESSIONAL ENGINEER
I, or a civil engineer under my supervision, have visited the site. Actual site conditions as observed were incorporated into this worksheet and the attached Technical Information Report. To the best of my knowledge the information provided here is accurate. *Signed/Date*

Figure 1.2 - Vicinity Map

Not To Scale



A PORTION OF SECTION 30, T. 21 N., R. 7 E., W.M., KING COUNTY, WASHINGTON



n

SCALE: 1" = 300'

300 150 0 300 600

CONTOUR INTERVAL = 5'

LEGEND

- PROPERTY BOUNDARY
- EXISTING ACCESS ROAD
- 700 EXISTING CONTOUR
- WETLAND BUFFER
- EDGE OF EX. VEGETATION

Figure 1.3 - Site Plan Existing Conditions

File: \\esm8\engr\ESM-JOBS\1960\002\020\plots\C-03.dwg
Plotted: 9/9/2021 7:58 AM Plotted By: Carl Roberts

REVISIONS		
NO.	DESCRIPTION/DATE	BY

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Civil Engineering
Public Works
Land Surveying
Project Management
Land Planning
Landscape Architecture
WASHINGTON

PALMER COKING COAL

HYDE MINE

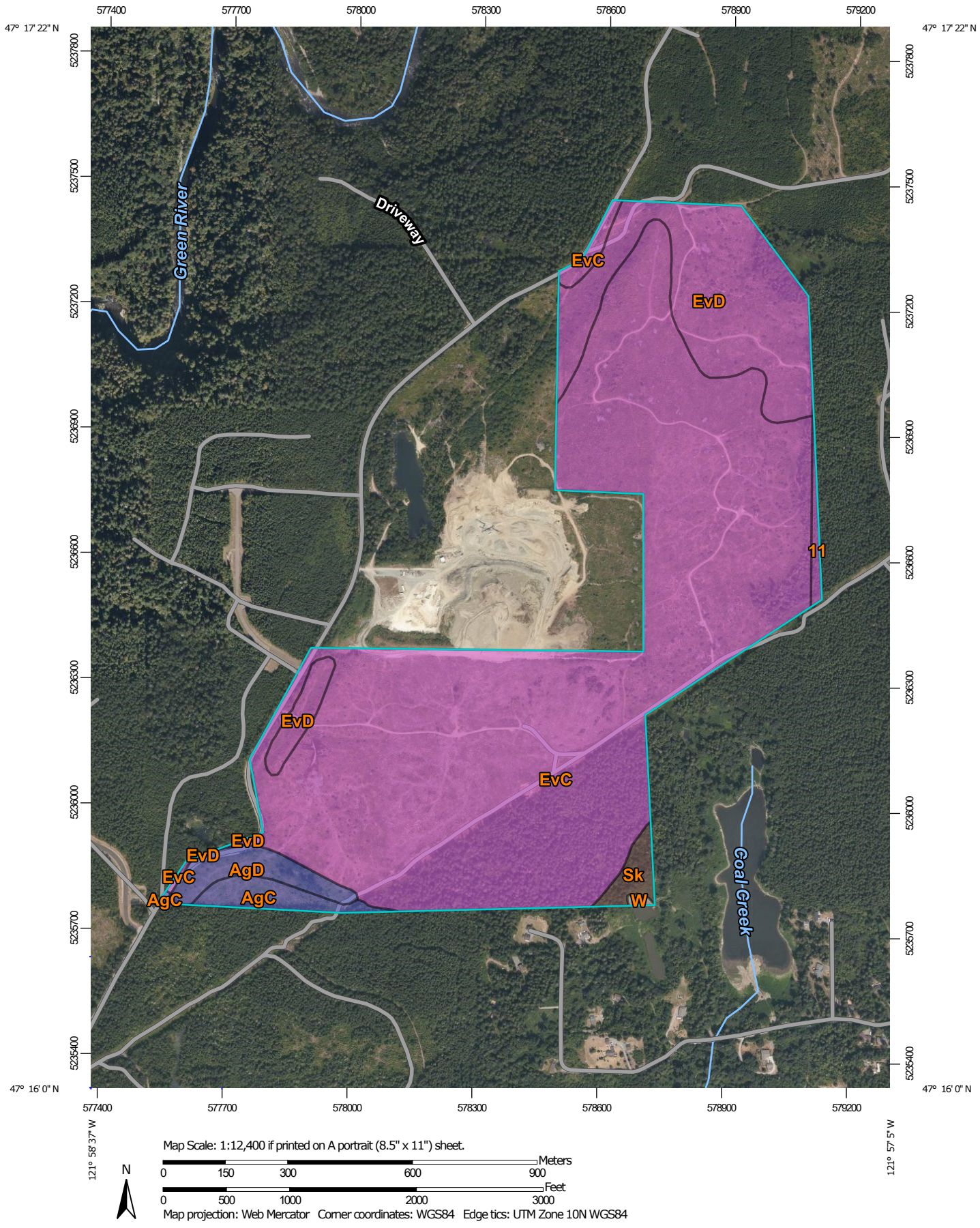
EXISTING CONDITIONS

KING COUNTY

JOB NO.:	1960-001-017
DWG. NAME:	C-3
DESIGNED BY:	LGB
DRAWN BY:	CJR
CHECKED BY:	
DATE:	09/09/2021
DATE OF PRINT:	

C-3

Figure 1.4 - Soils Map



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.

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 16, Jun 4, 2020

Soil Survey Area: Snoqualmie Pass Area, Washington (Parts of King and Pierce Counties)
Survey Area Data: Version 22, Jun 4, 2020

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jul 30, 2018—Aug 6, 2018

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
AgC	Alderwood gravelly sandy loam, 8 to 15 percent slopes	B	5.5	1.9%
AgD	Alderwood gravelly sandy loam, 15 to 30 percent slopes	B	7.2	2.5%
EvC	Everett very gravelly sandy loam, 8 to 15 percent slopes	A	225.2	78.4%
EvD	Everett very gravelly sandy loam, 15 to 30 percent slopes	A	44.1	15.4%
Sk	Seattle muck	B/D	3.3	1.1%
W	Water		0.3	0.1%
Subtotals for Soil Survey Area			**285.6**	**99.4%**
Totals for Area of Interest			**287.3**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
11	Barneston gravelly ashy coarse sandy loam, 8 to 15 percent slopes	A	1.7	0.6%
Subtotals for Soil Survey Area			**1.7**	**0.6%**
Totals for Area of Interest			**287.3**	**100.0%**

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.

Rating Options

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie. The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Section 2

2. Conditions and Requirements Summary

Review of the 9 Core Requirements and 5 Special Requirements

This section describes how the project will meet the SWDM Core and Special Requirements.

Core Requirement No. 1 Discharge at the Natural Location

In the existing conditions, the site infiltrates all stormwater runoff which is the natural discharge method for the existing site. Phased mining and reclamation conditions will continue to infiltrate in place, generally matching the existing natural discharge location.

Core Requirement No. 2 Off-site Analysis

A Level 1 Downstream Analysis was performed by ESM and is included in Section 3.

Core Requirement No. 3 Flow Control

According to the King County Flow Control Applications Map, the existing site is required to comply with the Conservation Flow Control (Level 2) Standards. The existing site currently infiltrates all onsite runoff in place due to the in-situ soils onsite and topography, therefore exceeding this requirement. See Sections 3 & 4 for supporting documentation and analysis.

Core Requirement No. 4 Conveyance System

There is no existing conveyance system onsite and there will not be any conveyance system in place after reclamation; however, there will likely be conveyance system components used during mining operations such as swales and culverts that will be constructed as needed to manage stormwater runoff. See Sections 4 & 5 of this report for more information.

Core Requirement No. 5 Erosion and Sediment Control

The Stormwater Pollution Prevention Plan (SWPPP) for this project will be prepared with the final TIR and will contain the relevant and necessary BMP measures for this project to maintain compliance with the applicable erosion and sedimentation limits. Erosion and Sediment Control (ESC) for the existing and reclamation conditions is not necessary; therefore, ESC has been prepared for the phased mining conditions of the project.

Mining activities for Hyde Mine will occur below grade where the stormwater runoff will infiltrate in place; therefore, erosion control requirements are satisfied because stormwater will not leave the site. Topsoil removal will occur in the dry months of July and August, ahead of mining. Additionally, a wheel wash will be installed near the site entrance to prevent sedimentation on Enumclaw-Franklin Road from trucks leaving the site during operations. See Section 8 of this report for more information.

Core Requirement No. 6 Maintenance and Operations

An Operations and Maintenance Manual will be prepared with the final TIR and will be included in Section 10.

Core Requirement No. 7 Financial Guarantees and Liability

Bond Quantities, Facility Summaries, and Declaration of Covenant will be coordinated with King County DPER as applicable to the property.

Core Requirement No. 8 Water Quality

If 50% or more of the runoff that drains to any proposed water quality facility is from an industrial land use, the Enhanced Basic Water Quality Menu has to be applied. Due to the size of the basin tributary to water quality treatment facilities, and the limited area to be disturbed during the proposed mining activities, this requirement is not anticipated to be applicable and Basic Water Quality Menu will be used for treatment of pollution generating impervious areas. Water quality treatment is described in Section 4 of this report.

Core Requirement No. 9 Flow Control BMPs

Applicable Flow Control Best Management Practices (BMPs) are listed and discussed in Section 4.

Special Requirement No. 1 Other Adopted Area-Specific Requirements

There are no master drainage plans, basin plans, salmon conservation plans, stormwater compliance plans, flood hazard reduction plan updates, or shared facility drainage plans for the existing site. Special Requirement No. 1 does not apply.

Special Requirement No. 2 Flood Hazard Area Delineation

The existing site location is not in a 100-year floodplain. Special Requirement No. 2 does not apply.

Special Requirement No. 3 Flood Protection Facilities

The existing property is does not have an existing flood protection facility. The proposed site improvements do not include the modification of an existing flood protection facility. Special Requirement No. 3 does not apply.

Special Requirement No. 4 Source Control

A Spill Prevention and Control Plan (referenced in Section 6 of this report) describes the circumstances and procedures required for spills onsite during mining operations. Additionally, per Section 1.3.4 – Mining Sand and Gravel of the SWDM, the site is required to have a wheel wash station (A-41 Wheel Wash System, and per Section D.2.1.4.3 of the SWDM). That wheel wash will be located near the site exit following the weigh scales.

Special Requirement No. 5 Oil Control

Oil control is addressed in the Spill Prevention and Control Plan, referenced in Section 6 of this report.

Section 3

3. Off-Site Analysis

The following is a Level 1 Downstream Analysis for the existing site per Core Requirement #2, Section 1.2.2 of the SWDM. The analysis is a qualitative survey to identify and evaluate offsite flooding, erosion, and water quality problems that may be created or aggravated by the existing site. The primary component of this offsite analysis is the downstream corridor. The second component is to evaluate the upstream drainage system to verify any offsite run-on that may impact the existing site.

This Level 1 downstream analysis is composed of the following 4 tasks:

Task 1 – Define and map the study area
Task 2 – Downstream Resource Review for 1-mile downstream
Task 3 – Field Inspection
Task 4 – Drainage System Description and Problem Descriptions
Task 5 - Mitigation of Existing or Potential Problems

Task 1: Study Area Definition and Maps

The existing site is in the Duwamish – Green River Watershed within the Duwamish-Green Water Resource Inventory Area (WRIA #9). The drainage study area extends beyond the perimeter of the mining area and the parcel boundary along Enumclaw Franklin Road SE to include the areas draining to the closed depressions. Since the existing site infiltrates all runoff, the drainage study area is sufficient and is not required to extend any further. See Figure 1.3 for a map of the basic study area.

Task 2: Resource Review

Flow Control Map

According to the King County Flow Control Map, the existing site is required to meet Conservation Flow Control (Level 2) standards per the SWDM.

Site Soils

A preliminary study of the soils in and around the existing site has been completed with the online resources available via Web Soil Survey. The soils onsite are predominantly outwash (as indicated by the Everett and Indianola soils with a rating of “A”) with favorable infiltration characteristics.

See Figure 1.4 for the Soils Map provided by Web Soil Survey.

Road Drainage Problems

None noted.

Wetlands Inventory

According to the 1990 King County Wetlands Inventory Notebooks, there are no recorded wetlands within the parcel boundary. See Figure 1.3 for Site Conditions.

Migrating River Study

None noted.

Downstream Drainage Complaints

According to iMap, there are no relevant downstream drainage complaints within the scope of this study. Refer to Figure 3.1.

Critical Area Overview

According to available Critical Areas maps and studies:

Wetlands / Streams / Lakes:	Based on the wetland report completed by Sewall Wetland Consulting, Inc. on March 25, 2021, there are three wetlands adjacent to the property (Wetlands A, B, and C) as well as one wetland where only the buffer extends into the property (Wetland D).
Erosion & Landslide Hazards:	None Mapped
Steep Slope Hazards:	Based on the Summary of Ground Water and Slope Conditions by Bennett Consulting, PLLC, dated August 13, 2021, there are sloped areas on the project site with gradients in excess of 40% that are classified as steep; however, it was noted in that report that those slopes are underlain by coarse grained gravel outwash at their natural angle of repose since deposition. Those slopes are well drained and have been logged multiple times without raveling or slumping; therefore, the slopes are considered stable in their existing condition.
100-Year Flood Plain:	None Mapped
Aquifer Recharge:	None Mapped
Seismic Hazard:	None Mapped
Coal Mine Hazard:	The northern portion of the - 9080 parcel is mapped in a coal mine hazard area which is recommended by the geotechnical reports to be declassified.

See Figure 3.1 for more information regarding the mapped environmental hazards near the existing site.

List of Polluted Waters

The Water Quality Assessment was completed by Ecology with water bodies divided into the following categories:

Category 1: Meets standards for parameter(s) for which it has been tested.
Category 2: Waters of concern.
Category 3: Waters with no data or insufficient data available.
Category 4: Polluted waters that do not require a TMDL because a) they have an approved TMDL being implemented, or b) they have a pollution control program in place that should solve the problem, or c) are impaired by a non-pollutant such as low water flow, dams, or culverts.
Category 5: Polluted waters that require a TMDL – the 303(d) list.

Based on the Ecology website, there is an unnamed stream locally known as Icy Creek that is topographically downstream of the site (approximately 700 feet due southwest) and is tributary to Green River (approximately 3700 feet west). This unnamed stream is shown on the Water Quality Atlas Map to be listed as Category 2 for bioassessment and Category 1 for temperature. Green River is shown on the Water Quality Atlas Map to be listed as Category 1 for ammonia-N & bacteria, Category 2 for pH, Category 4A for temperature and Category 5 for dissolved oxygen

The only water quality problem that triggers the 303(d) list is the existing Green River Category 5 dissolved oxygen (DO). The proposed development is not anticipated to aggravate the DO problem because a vault is not proposed. Furthermore, the 240-acre permit area is located more than a quarter mile from Green River and the property is significantly less than 15% of the Green River Watershed at the downstream location.

Task 3: Field Inspection (Level 1 Inspection)

A Level 1 Downstream Analysis was completed by ESM Consulting Engineers in the morning on October 29, 2018, when it was partly cloudy and 52°F. During the inspection no indications of overland flow or flooding onsite were observed and the site appeared to infiltrate stormwater runoff in place.

Task 4: Drainage Description and Problem Descriptions

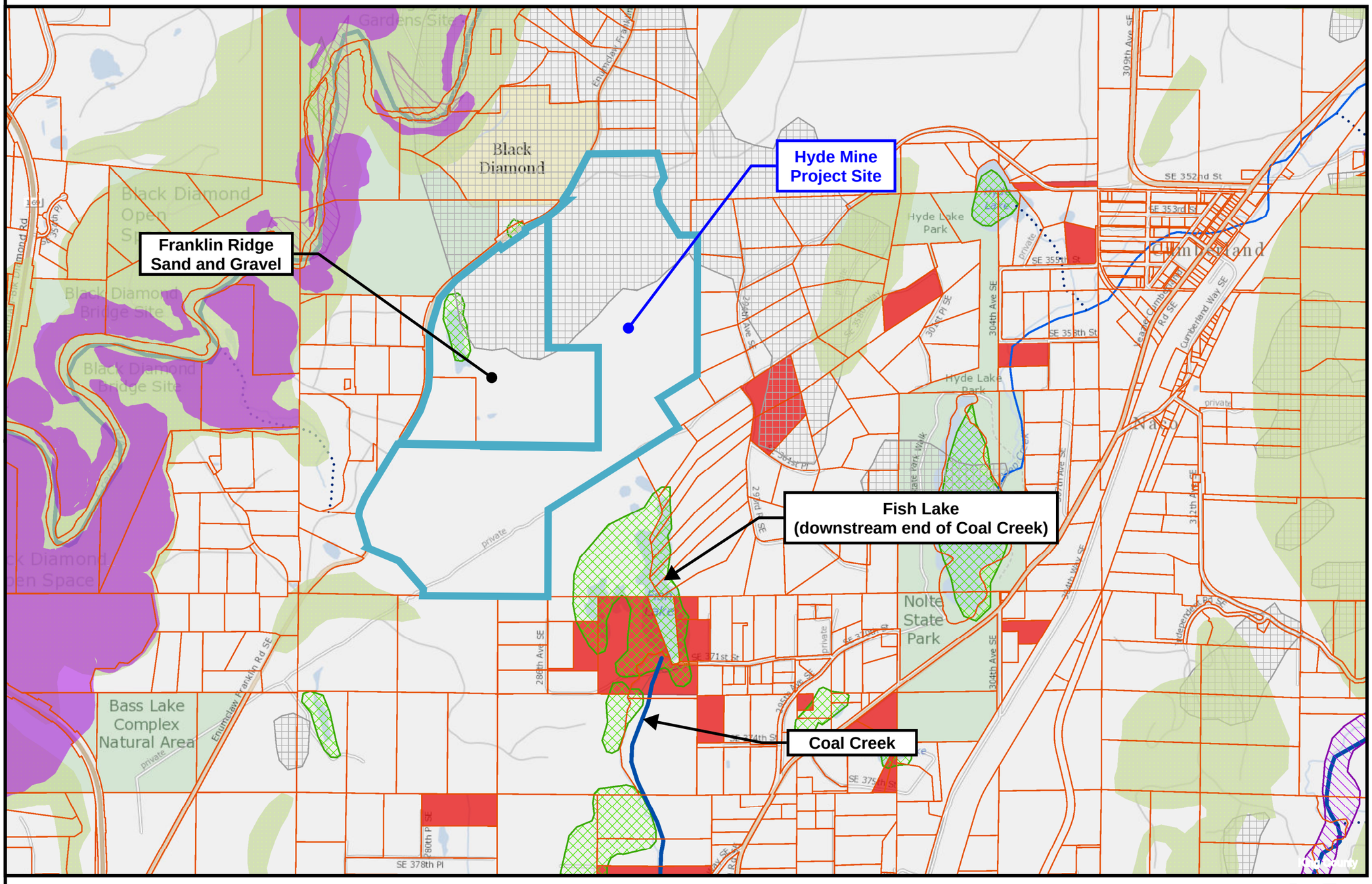
Stormwater drainage basins for the property have been delineated as shown on Figures 3.3A, 3.3B, as well as the Existing Conditions Basin Plan Exhibit (Figure 1 of Appendix A).

There do not appear to be any drainage issues onsite or downstream due to the latent infiltration capacity of the native soils in the area.

Task 5: Mitigation of Existing or Potential Problems

No problems have been identified on the property and therefore no mitigation is proposed.

Figure 3.1 - Environmental Hazards



Legend

- Parcels
- Potential landslide hazard areas (2016, see explanation-->)
- Erosion hazard (1990 SAO)
- Seismic hazard (1990 SAO)
- Coal mine hazard (1990 SAO)

Stream (1990 SAO)

- class 1
- class 2 perennial
- class 2 salmonid
- class 3
- unclassified
- Wetland (1990 SAO)
- Sensitive area notice on title

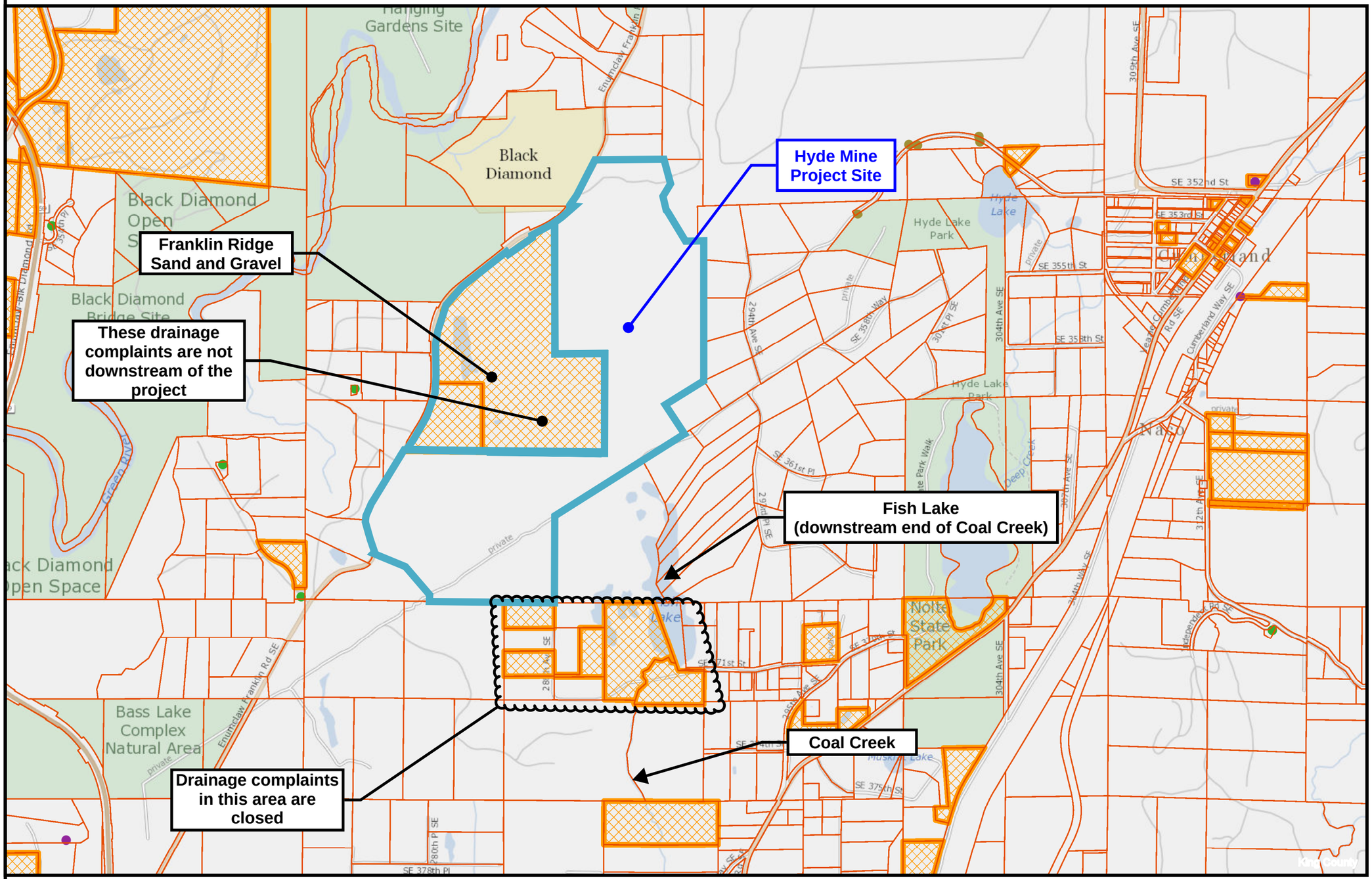
Date: 7/12/2021

Notes:

N

King County

Figure 3.2 - Drainage Complaints



Legend

- Parcels

Stormwater facilities

- Bonded
- Commercial-MF
- Commercial-SF
- Construction
- DOT
- FMD
- Regional
- Residential
- Drainage complaints

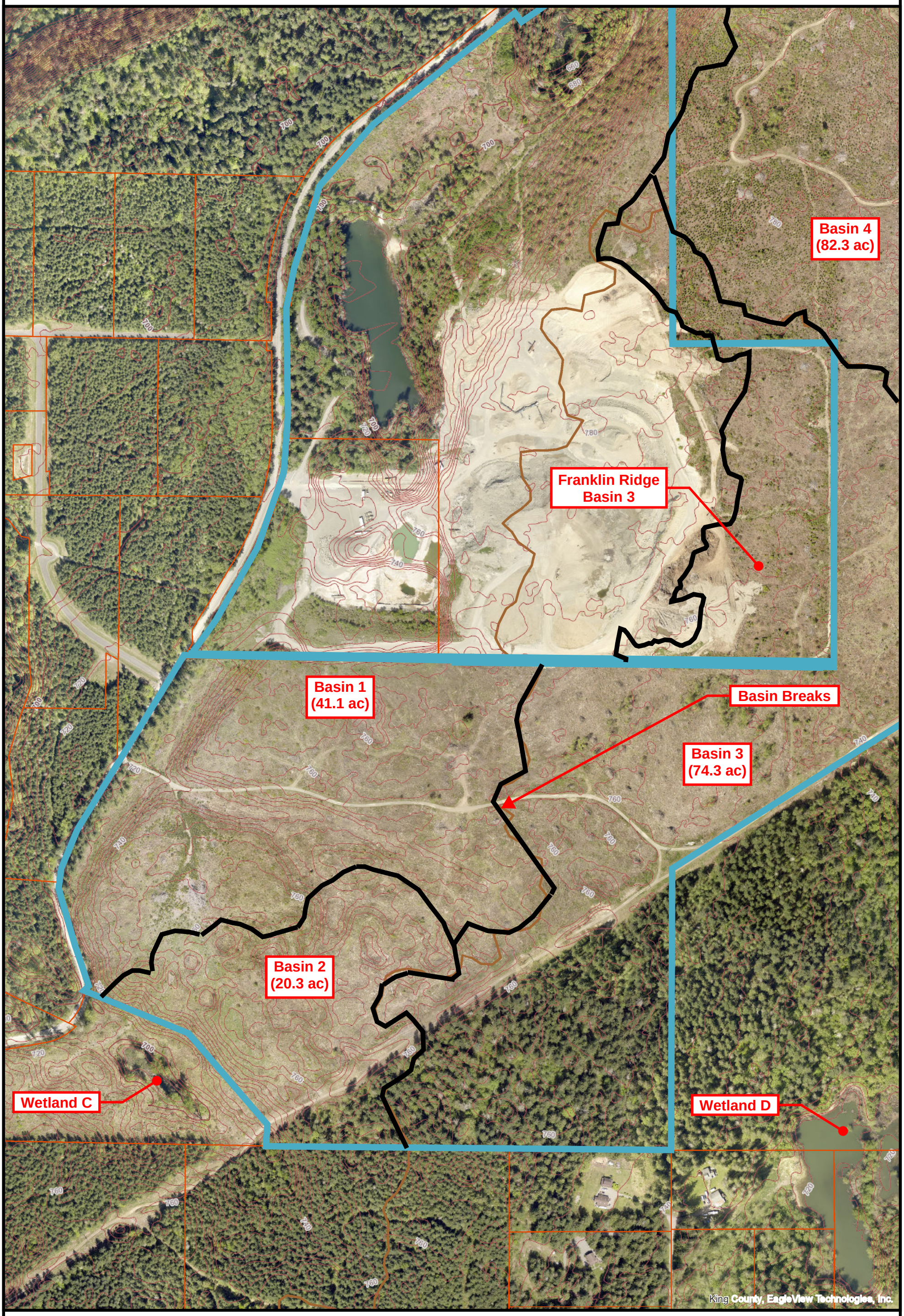
Date: 7/12/2021

Notes:

N

King County

Figure 3.3A - Existing Basin Map (Southern Portion)



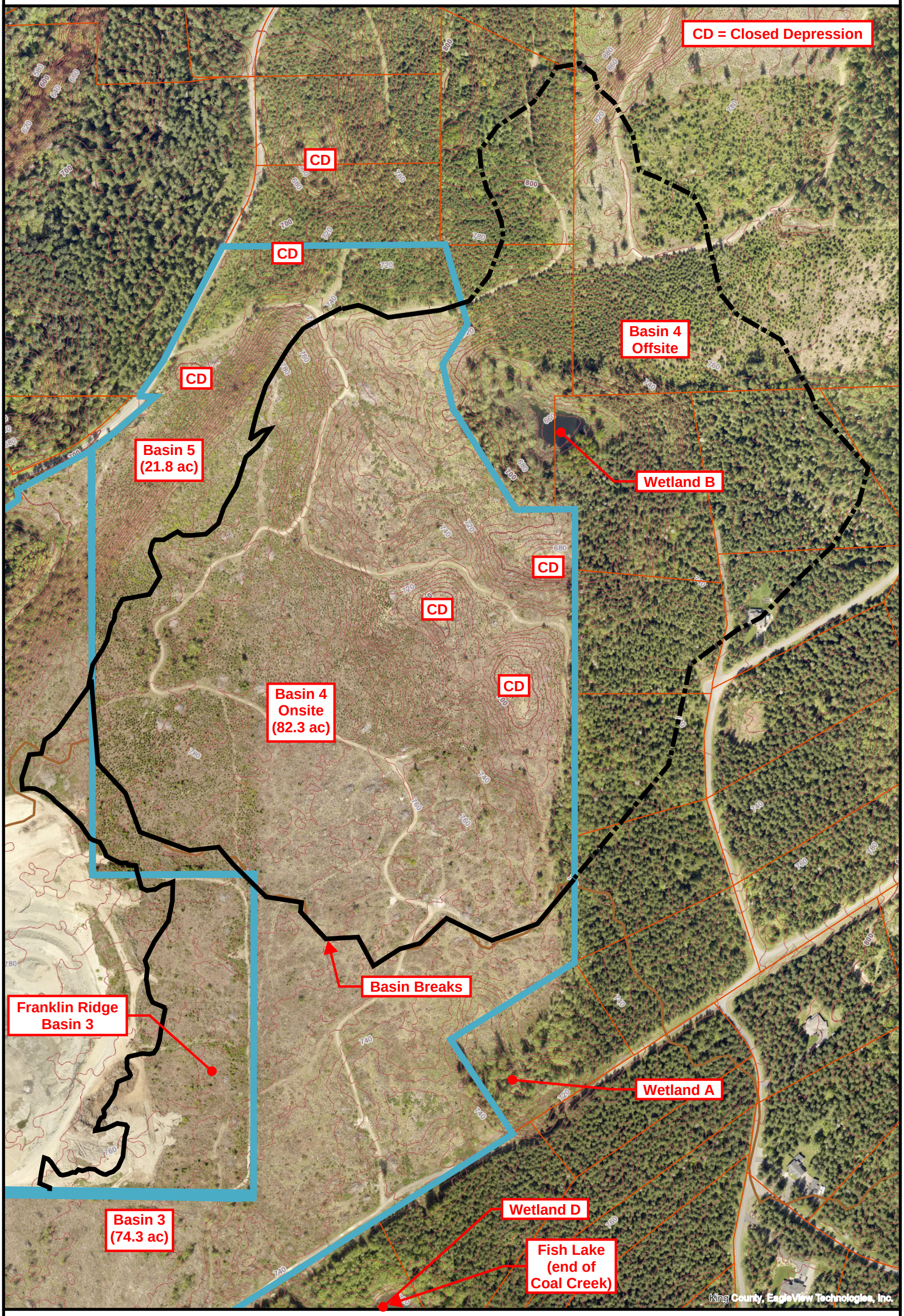
Date: 7/1/2021

Notes:

N

King County

Figure 3.3B - Existing Basin Map (Northern Portion)



Date: 7/1/2021

Notes:

N

King County

Section 4

4. Flow Control & Water Quality Facility Analysis and Design

Stormwater Overview

The 240-acre permit area is proposed for a sand and gravel mine where stormwater has historically infiltrated onsite. Active mining operations will occur below the existing grade elevation, which infiltrates collected stormwater in place.

The property stormwater analysis is divided into the following categories, and each were reviewed in this section to verify compliance to the SWDM:

- Pre-Developed/Existing Conditions
    - Hydrology
    - Performance Standards
    - Flow Control
    - Water Quality
    - Flow Control BMPs
- Phased Mining Conditions
    - Hydrology
    - Performance Standards
    - Flow Control
    - Water Quality
    - Flow Control BMPs
- Reclamation Conditions
    - Hydrology
    - Performance Standards
    - Flow Control
    - Water Quality
    - Flow Control BMPs

PRE-DEVELOPED/EXISTING CONDITIONS

Hydrology

The 240-acre permit area was originally forested land cover with outwash soil types and contains a drainage basin break between the Middle Green River and Coal Creek (Green) basins.

Following landfall onsite, all stormwater remains onsite and infiltrates due to the local topography and available infiltration capacity of the existing soils. The upstream basin from the adjacent Franklin Ridge Sand and Gravel mine report (Franklin Ridge Basin 3) to the west of the site disperses and infiltrates in-place as well; therefore, no upstream run-on is anticipated from that area. The existing site has been logged and replanted in phases in the last decade and is in various stages of growth throughout, however it has been forested land cover for the purposes of pre-developed conditions.

The basin outlines were determined based on existing topography and are shown on Figure 1 of Appendix A. Stormwater accumulation onsite is anticipated to infiltrate due to the land cover and soil types. The soils onsite are outwash (Type A/B), as indicated by the soils map in Section 3 of this report. The land cover has been summarized and tabulated according to the aerial photo included in Figures 3.3A and 3.3B, which generally reflect the condition of the site. Most of the property (165.5 acres) is located in the Middle Green River basin. For more information, see Table 4.1 below.

Table 4.1 – Existing Conditions Summary

Cover*	Basin #	Basin Location	Area (acres)
Forest	1	Middle Green River	41.1
Forest	2	Middle Green River	20.3
Forest	3	Coal Creek (Green)	74.3
Forest	4	Middle Green River	82.3
Forest	5	Middle Green River	21.8
Forest	**Total**		**239.8**

* Existing infrequently used access roads are anticipated to fully disperse and infiltrate and are therefore categorized as forest in this table.

Existing Basin 1 (41.1 acres)

This basin is bounded on the west by Enumclaw Franklin Road SE, on the north by the Franklin Ridge Sand and Gravel mine, on the south by local high points in the existing site topography, and on the east by the Coal Creek / Green River basin break (within the Green River basin). This basin has a single gravel road to allow access to the powerline easement and infiltrates.

Existing Basin 2 (20.3 acres)

This basin is bounded to the southwest by the parcel boundary, to the north by the local high points separating Existing Basin 1, and to the east by the Coal Creek / Green River basin break (within the Green River basin). This basin has a powerline easement with access roads and infiltrates. Wetland C is located offsite, downstream of this basin.

Existing Basin 3 (74.3 acres)

This basin is bounded to the west by the Franklin Ridge Sand and Gravel mine, to the north and west by the Coal Creek / Green River basin break (within the Coal Creek basin), and to the southeast by the parcel boundary. This basin has a powerline easement with access roads and infiltrates. Wetland D is located downstream of this basin, to the southeast, with a portion of the wetland buffer on the property. Wetland A is also located downstream of this basin, offsite, to the east.

Existing Basin 4 (82.3 acres)
This basin is bounded to the west by the ridge on the site's interior, to the south by the Coal Creek / Green River basin break (within the Green River basin), and to the west by the parcel boundary; however, the actual basin appears to extend outside of the parcel boundary (not accounted for in the basin totals mentioned here). This basin has access roads and several localized closed depressions and infiltrates. Wetland B is located downstream of this basin, offsite, to the northeast.

Existing Basin 5 (21.8 acres)
This basin is bounded to the west by Enumclaw Franklin Road SE and to the east by the ridge on the site's interior between Existing Basin 4 (within the Green River basin). This basin contains access roads and infiltrates.

Basin Considerations:

- All of the adjacent upstream area from the Franklin Ridge Sand and Gravel mine (Franklin Ridge Basin 3 on Figure 3.3A) will disperse and infiltrate in place; therefore, no upstream run-on is anticipated.
- All of the logged area onsite was replanted after logging is considered forest.
- All of the existing access roads are infrequently used and are fully dispersed into the adjacent vegetation. From there, runoff infiltrates in place; therefore, the existing road area onsite was considered forest.
- The marked Wetlands A, B, C & D are located downstream of the property, however, stormwater is anticipated to infiltrate prior to reaching these wetlands.

The existing site is considered to be equivalent to forest, which meets flow control requirements by definition; therefore, the existing site was not modeled.

Performance Standards
The existing site has not been developed and is considered to be forested; therefore, the existing site does not require mitigation or modeling.

Flow Control
Since the project site is undeveloped, the site is considered to be forested and does not require additional mitigation in its current state.

Water Quality
Since the project site is undeveloped, the site is considered to be forested and does not require additional mitigation in its current state.

Flow Control BMPs
Since the project site is undeveloped, the site is considered to be forested and does not require additional mitigation in its current state.

PHASED MINING CONDITIONS

Hydrology

Phased mining will progress in phases as outlined below and shown on Figure 2 of Appendix A. As a phased area completes mining operations, that area will be reclaimed and converted back to a forested condition (to match the pre-developed/existing basin). This will minimize the exposure of the areas surrounding the mining operations to the effects of the hydrologic changes on the site. While a phased area is being mined, stormwater is estimated to infiltrate within the mining area due to the excessively drained nature of gravel; therefore, no runoff will occur in from the active phased mining area prior to reclamation.

Table 4.2 – Mining Conditions Summary

Basin #	Forest Cover Area (acres)	Disturbed Sand and Gravel Mining Area (acres)	Total Area (acres)
Phase 1A	2.1	22.8	24.9
Phase 1B	2.7	19.4	22.1
Phase 2	5.0	57.0	62.0
Phase 3	3.3	45.2	48.5
Phase 4	14.7	67.6	82.3
Total	**27.8**	**212.0**	**239.8**

Basin Phase 1A (Disturbed 22.8 acres)

This basin will be the first phase of mining operations and will contain the wheel wash for trucks leaving the site, a portable office, and portable restrooms that are anticipated to remain at this location throughout the phased mining operations. The mining operations components, including stockpiles and the mobile crushing and screening equipment will move as necessary from the Basin Phase 1A to the subsequent phases, converting the already mined areas back to reclaimed conditions.

Basin Phase 1B (Disturbed 19.4 acres)

This basin includes a subsequent active mining area with access roads and moved mining operations. Due to the excessively drained nature of the active mining area, stormwater infiltrates in place.

Basin Phase 2 (Disturbed 57.1 acres)

This basin includes a subsequent active mining area with access roads and moved mining operations. Due to the excessively drained nature of the active mining area, stormwater infiltrates in place. There are a 4 power structures within the mining area of this basin that will not be disturbed during mining activities (which includes a buffer and grading to the mining floor elevation). Stormwater runoff is estimated to infiltrate in place at the base of the structure (near the existing ground elevation) or sheetflow on the graded sides to the mining floor elevation and then infiltrate in place.

Basin 3 – Phase 3 (Disturbed 45.2 acres)

This basin includes a subsequent active mining area with access roads and moved mining operations. Due to the excessively drained nature of the active mining area, stormwater infiltrates in place.

Basin 4 – Phase 4 (Disturbed 67.6 acres)

This basin includes a subsequent active mining area with additional access roads and moved mining operations. Due to the excessively drained nature of the active mining area, stormwater infiltrates in place. The northern portion of this basin will be bounded by a 5-ft berm to contain stormwater runoff onsite for infiltration.

Performance Standards

Hydrology Model

The approved hydrology model used for this analysis is the 2012 Western Washington Hydrology Model (WWHM) software, which incorporates all the methods required for determining compliance with the flow control and water quality standards specified below.

Flow Control Standard

Per the Flow Control Map, the existing site is required to release stormwater at rates compliant with Conservation Flow Control (Level 2) standards. According to Section 3.2.2.2: *Durations and Peaks for Flow Control Standards* of the SWDM, those standards specify that the mitigated peak flow rates match the predeveloped 2-year and 10-year peak flow rates. Additionally, the standard specifies that the developed discharge durations must be strictly below the predeveloped discharge durations from 50% of the 2-year peak flow to the 2-year peak flow and continue approximating discharge durations to the full 50-year peak flow without a duration increase greater than 10%. The Log Pearson Type III extreme value analysis (specified in Bulletin 17B) is typically used to determine the peak flows due to the skew of the rainfall data and the 100-year peak flow being beyond the length of the available data record within the Landsburg rain gauge.

The site complies with and exceeds this requirement because there is no discharge due to full infiltration of stormwater runoff onsite (within the Middle Green River basin).

The portion of the site that lies within the Coal Creek (Green) basin also fully infiltrates stormwater runoff onsite or in closed depressions nearby.

Water Quality Standard

Due to the site's zoning and use, Enhanced Basic Water Quality Treatment is needed for stormwater runoff on this site. From Section 1.2.8.1.A:

> *If **50% or more** of the runoff that drains to any proposed water quality facility is from one or more of the following land uses, **then the Enhanced Basic WQ menu shall be used** in place of the Basic WQ menu for the design of this facility, **except if such treatment is waived or reduced by the area-specific exceptions at the end of this subsection**:*
>
> *1. Residential subdivision development in which the actual density of single family units is equal to or greater than 8 units per acre of developed area.*
> *2. **Commercial, industrial**, or multifamily land use.*
> *3. A road with an expected average daily traffic (ADT) count of 2,000 or more vehicles or expected to serve 200 or more homes. Note: those roads defined in the King County Road Design and Construction Standards as urban subaccess streets, rural subaccess streets, urban minor access streets – residential, rural minor access streets – residential, urban subcollectors, and rural subcollectors all serve less than 100 homes by definition.*

If 50% or more of the runoff that drains to any proposed water quality facility is from an industrial land use, the Enhanced Basic Water Quality Menu has to be applied. Due to the size of the basin tributary to water quality treatment facilities, and the limited area to be disturbed during the proposed mining activities, this requirement is not anticipated to be applicable and is further verified in this section under Water Quality.

Flow Control

For the purpose of stormwater analysis in this section of the report, the phased disturbed mining site area (excluding the reclaimed and non-active phased mining areas) is considered to be the developed conditions.

The areas of vehicle traffic shown on Figure 2 in Appendix A were estimated based on existing access roads. Mining operations, including stockpiles and equipment are anticipated to move across the phases. The active mine floor elevation across the site is 720.0-ft and is topographically lower than the majority of the site's perimeter; therefore, stormwater runoff from the edges of the mined area will disperse and infiltrate toward the mine floor.

In summary, the flow control provided for the site consists of full dispersion and full infiltration for the site during phased mining operations.

Water Quality

The 240-acre permit area will perform sand and gravel mining activities in phases as outlined earlier in this report. As a phased area completes mining operations, that area will be reclaimed and converted back to a forested condition (to match the pre-developed/existing basin). This will minimize the area for mining operations and associated effects to water quality.

The pollution generating impervious surfaces are estimated to be access roads and the mining operations components that move from phase to phase, such as the mobile crushing and screening equipment. These pollution generating impervious surface areas were conservatively estimated at 5.0 acres per mining phase.

Water quality has been evaluated for the following basins for phased mining conditions as described in Table 4.3 below.

Table 4.3 – Water Quality Runoff

Basin #	Mining Operations Industrial Use Impervious Area (acres)	Disturbed Sand and Gravel Mining Area (acres)	Industrial Use Runoff (%)
Phase 1A	5.0	22.8	22%
Phase 1B	5.0	19.4	26%
Phase 2	5.0	57.0	9%
Phase 3	5.0	45.2	11%
Phase 4	5.0	67.6	7%
Total	**25.0**	**212.0**	**12%**

At most, 26% of any basin and associated stormwater runoff that is directed to a water quality facility will come from the industrial use. Since this is below the 50% threshold, the phased basins and overall, the 240-acre permit area does not require the use of the Enhanced Basic Water Quality Menu and can be reduced to the Basic Water Quality Menu for treatment.

Basic water quality treatment will be provided using filter strips for the high use access roads throughout each phased mining area and bioswales for the concentrated mining operations area. As noted above, the pollution generating impervious area is not anticipated to exceed 5.0 acres within each phased mining area.

Filter Strip

Since the filter strip for the high use access roads will be on the mine floor (where the general topography is flat), a prescriptive filter strip design has been computed with a lateral and longitudinal slope of 1.0% and a Manning's roughness of 0.35 for the grass (due to lower maintenance requirements). With a unit roadway length of 100 lineal feet, width of 20 feet (to allow vehicle passing), and an estimate 25 feet of upstream non-pollution generating pervious area (mined or unmined area that is modeled as pasture), the estimated grass filter strip length (as measured perpendicular to the direction of the road) is 12 feet (11.6 calculated). The filter strip would provide basic water quality treatment then infiltrate in the mining floor area.

Bioswale

For the concentrated mining operations area, basic water quality treatment will be provided using bioswales sized for a maximum of 2.0 acres of impervious and 3.0 acres of pasture. The mining operations area is anticipated to be generally flat; therefore, the bottom of the swale is 1.0% with a water quality design flow depth of 0.33-feet (4-inches). The Manning's n (0.030) chosen from Table 4.4.1.B of the SWDM for the conveyance flows is representative of the channel conditions during phased mining operations. Using the maximum 5.0 acres of pollution generating impervious area per phased mining area, two to three bioswales would be necessary per basin. The bioswale would provide basic water quality treatment then overflow to the mining floor area and infiltrate. See Table 4.4 below for the typical bioswale parameters.

Table 4.4 – Typical Bioswale Parameters

Swale Shape	Trapezoidal
Channel Slope (%)	1.0
Side Slope	3:1
Bottom Width (ft)	9.0 (8.36 calculated)
Basin Size (ac)	5.0
Water Quality Flow (cfs)	0.3833 x 2.55 = 0.977
Maximum Water Quality Flow Depth (ft)	0.33 w/ n_{wq}=0.20
Maximum 100-year, 24-hour Flow (cfs)	1.938
Maximum 100-year, 24-hour Flow Depth (ft)	0.14 w/ n=0.030
Total Depth (ft)	1.0
Freeboard (ft)	0.67
Length (ft)	200 (171.1 calculated)

In summary, the pollution generating impervious areas in each phase should be routed through a filter strip or to a bioswale using the prescriptive design specified above, to be constructed as needed during phased mining operations as the mining areas change. Both prescriptive filter strip and bioswale calculations have factors of safety built in to ensure adequate water treatment. For more information, see the calculations attached in Appendix B.

Flow Control BMPs

Flow control BMPs were evaluated for phased mining conditions as outlined in the SWDM under Section 1.2.9.2.2 – Large Lot BMP Requirements. The phased mining site is largely logged and has been replanted forested area that the infrequently access roads disperse into and infiltrate. The ground cover within the active mining area is somewhat excessively drained (typical of gravel mines) so most rainfall and stormwater run-on will infiltrate in place.

In summary, the intent of stormwater runoff rate and volume attenuation is achieved through the full dispersion and full infiltration flow control BMPs.

RECLAMATION CONDITIONS

Hydrology

Reclamation activities are anticipated to occur simultaneously or short after mining activities. The mining area would be cleared as operations migrate to expose the target material and topsoil as well as clean soil disposal will be moved to approximate pre-mining contours and covered for planting with Douglas fir trees, pines, and other native conifers.

The basin outlines were determined based on anticipated reclamation topography as shown on Figure 3 in Appendix A. Since the final reclamation land cover and topography will approximate pre-developed historic site conditions (i.e. the entire site will be forested conditions in both cases and the area for each reclamation basin generally matches the corresponding existing basin), the anticipated stormwater response to the land cover will remain infiltration. Table 4.5 in this section of the report summarizes the reclamation basin areas that were disturbed during active mining.

Table 4.5 – Reclamation Conditions Summary

Cover*	Basin #	Coal Creek (Green)	Middle Green River
Forest	1	Middle Green River	39.9
Forest	2	Middle Green River	18.5
Forest	3	Coal Creek (Green)	80.8
Forest	4	Middle Green River	72.5
Forest	5	Middle Green River	28.1
Forest	**Total**		**239.8**

* Any remaining access roads after the site is fully reclaimed will be infrequently used and are anticipated to fully disperse and infiltrate, therefore categorized as forest in this table.

Reclaimed Basin 1 (39.9 acres)

This basin remains similar in size, shape, and location as Existing Basin 1, being reduced from 41.1 acres to 39.9 acres (3% decrease). This basin is anticipated to infiltrate in place.

Reclaimed Basin 2 (18.5 acres)

This basin remains similar in size, shape, and location as Existing Basin 2, being reduced from 20.3 acres to 18.5 acres (9% decrease). This basin is anticipated to continue to have a single gravel road to allow access to the powerline easement and will continue to infiltrate in place. Wetland C is located offsite, downstream of this basin.

Reclaimed Basin 3 (80.8 acres)

This basin remains similar in size, shape, and location as Existing Basin 3, being increased from 74.3 acres to 80.8 acres (8% increase). This basin is anticipated to continue to have a single gravel road to allow access to the powerline easement and will continue to infiltrate in place. Wetland D is located downstream of this basin, to the southeast, with a portion of the wetland buffer on the property. Wetland A is also located downstream of this basin, offsite, to the east.

Reclaimed Basin 4 (72.5 acres)

This basin remains similar in size, shape, and location as Existing Basin 4, being reduced from 82.3 acres to 72.5 acres (12% decrease). This basin is anticipated to infiltrate in place. Wetland B is located downstream of this basin, offsite, to the northeast.

Reclaimed Basin 5 (28.1 acres)
This basin remains similar in size, shape, and location as Existing Basin 5, being increased from 21.8 acres to 28.1 acres (22% increase). This basin is anticipated to infiltrate in place.

Basin Considerations:

- The existing and reclaimed basins size, shape, and location will remain similar. Since the reclaimed basins will be replanted forest and will infiltrate in place, the basin size variations are not anticipated to impact the existing stormwater flow patterns.
- Access roads will remain infrequently used and be fully dispersed into the adjacent vegetation.
- The marked Wetlands A, B, C & D are located downstream of the property, however, stormwater is anticipated to infiltrate prior to reaching these wetlands.

The reclaimed site will be forested conditions, which meets flow control requirements by definition; therefore, the reclaimed site was not modeled.

Performance Standards

The reclaimed site will not be developed as part of this project and is considered to be forested; therefore, the reclamation site will not require mitigation or modeling.

Flow Control

Since the project site will be undeveloped, the site is considered to be forested and will not require additional mitigation.

Water Quality

Since the project site will be undeveloped, the site is considered to be forested and will not require additional mitigation.

Flow Control BMPs

Since the project site will be undeveloped, the site is considered to be forested and will not require additional mitigation.

Section 5

5. Conveyance System Analysis and Design

There is no existing conveyance system onsite and there will not be any conveyance system in place after reclamation; however, there will likely be conveyance system components used during mining operations such as swales and culverts that will be constructed as needed to manage stormwater runoff. See Sections 4 & 5 of this report for more information.

Section 6

6. Special Reports and Studies

The following reports are included in this submittal under separate cover:

1. Coal Mine Hazards by Icicle Creek Engineers dated July 30, 2006.
2. Summary of Ground Water and Slope Conditions by Bennett Consulting, PLLC, dated August 13, 2021.
3. Project History: Hyde Gravel 24.5 Acre Mine Site by Palmer Coking Coal dated August 2021.
4. Project History: Hyde Gravel Lot Q by Palmer Coking Coal dated August 2021.
5. Traffic Impact Analysis dated April 30, 2021.
6. Critical Areas Designation (for Wetland A) by Sewall Wetland Consulting, Inc., dated March 21, 2021.
7. Critical Areas Designation (for Wetland B) by Sewall Wetland Consulting, Inc., dated March 25, 2021.
8. Critical Areas Designation (for Wetland C) by Sewall Wetland Consulting, Inc., dated March 25, 2021.
9. Critical Areas Designation (for Wetland D) by Sewall Wetland Consulting, Inc., dated March 25, 2021.
10. Critical Areas Designation (for Lot Q) by Sewall Wetland Consulting, Inc., dated March 25, 2021.
11. Wildlife Species Utilization and Available Habitats Assessment by Habitat Technologies dated June 14, 2021.
12. Critical Area Report Preliminary Coal Mine Hazard Assessment by Brian Beaman, P.E., P.G. under Icicle Creek Engineers file no. 0102-016 and dated October 18, 2021.
13. SEPA Checklist dated November 2021.

Furthermore, the following documents were reviewed (copies can be provided upon request) in the preparation of this report and are hereby referenced:

1. Technical Information Report by CH2M Hill, Inc., dated February 4, 1998.
2. Revised Report, Geological Engineering Services, Coal Mine Hazard Assessment
3. Report Addendum Geological Engineering Services Severe Coal Mine Hazard Reclamation by Icicle Creek Engineers, Inc. dated February 7, 2000.
4. Letter Supplement No. 2 Hydrogeologic Consultation by Icicle Creek, Inc., dated September 12, 2002.
5. Memorandum for Critical Areas Feasibility Study by Ecological Land Services, Inc., dated June 22, 2006.
6. Report of Geological Engineering Services Hydrogeologic Assessment by Icicle Creek Engineers, Inc. dated November 4, 2016.
7. Franklin Ridge Sand and Gravel Technical Information Report by ESM Consulting Engineers, LLC., dated October 16, 2019.

Section 7

7. Other Permits

The property will obtain the necessary permits for a sand and gravel mining site pursuant to the Department of Natural Resources (DNR) surface mining regulations, a grading permit per King County clearing and grading ordinance, and any other relevant permits.

Below is a list of existing permits for the property:

1. Relevant information about this proposal from King County DPER file no. L07TY402 (Franklin Ridge Sand and Gravel) may be included when applying for the subject property rezone;
2. State of Washington D.N.R. surface mining permit no. 70-012951;
3. King County D.P.E.R. clearing / grading permit No. L98G0056;
4. Coal mine hazard; landslide-steep slope hazard; and landslide hazard drainage area report was prepared by Brian Beaman, P.E., P.G. under Icicle Creek Engineers file no. 0102-010 and dated May 2, 2006. The report was reviewed by Todd Hurley, engineering geologist for King County D.D.E.S. under coal mine hazard file no. L06SA435 and a sensitive area notice was recorded under King County Recording No. 20060808001130;
5. Department of Ecology N.P.D.E.S. and state waste discharge permit No. WAG-503006 (AKA SWPPP);
6. Bennett Consulting PLLC's Project No. GBC 16-01 – results of gravel exploration drilling;
7. Department of Archaeology and Historic Preservation (DAHP) Log No. 051313-08 – DNR Management Plan;
8. SEPA checklist dated for Hyde Gravel Pit surface mining, clearing, and grading activities. 10-23-97

Section 8

8. ESC Analysis and Design

The ESC Design is shown on the Mining Excavation and Temporary Erosion and Sediment Control (TESC) Plan sheets.

A wheel wash will be installed near the site entrance to prevent sedimentation on Enumclaw-Franklin Road from trucks leaving the site during operations. This wheel wash will have an overflow channel that allows excess wash water to discharge into an adjacent closed depression for infiltration onsite.

Mining activities will generally occur below grade and capture and infiltrate all sediment laden stormwater. Berms and filter fabric fence are proposed in phases 3 and 4 of the mining activities with a minimum of 5 feet in height to prevent sediment laden stormwater to flow towards the existing wetlands. Furthermore, a 30 feet wide vegetated setback is proposed along the entire property line.

For more information, see the Mining Excavation and TESC Plan sheets.

A Stormwater Pollution Prevention Plan will be prepared with the final TIR which will summarize the relevant TESC BMPs.

Section 9

9. Bond Quantities, Facility Summary, and Declaration of Covenant

Bond Quantities, Facility Summaries, and Declaration of Covenant will be coordinated with King County DPER as applicable to the property.

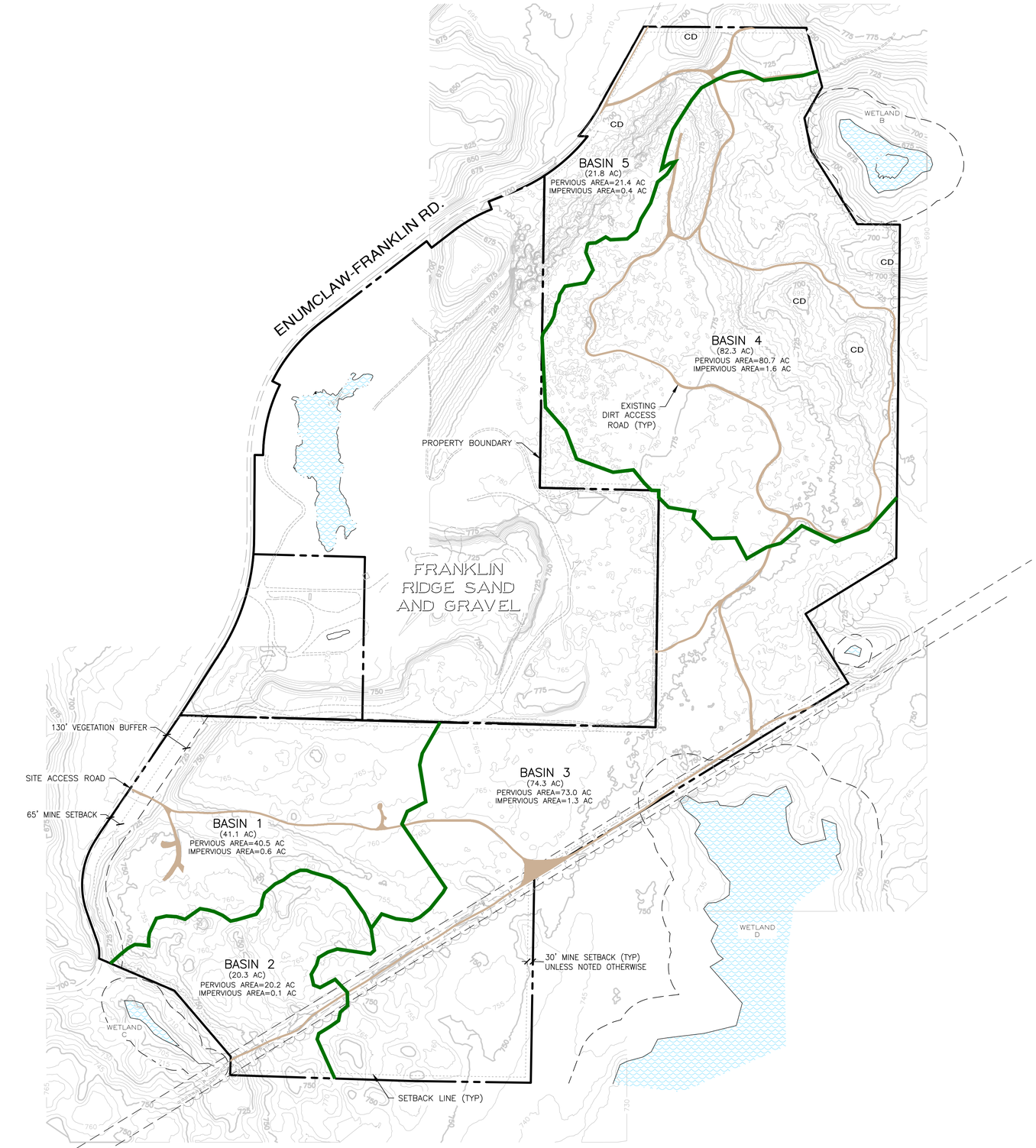
Section 10

10. Operations and Maintenance

An Operations and Maintenance Manual will be prepared with the final TIR.

Appendix A

A PORTION OF SECTION 30, T. 21 N., R. 7 E., W.M., KING COUNTY, WASHINGTON



n

SCALE: 1" = 300'

300 150 0 300 600

CONTOUR INTERVAL = 5'

LEGEND

- PROPERTY BOUNDARY
- BASIN OUTLINE
- 700 EXISTING CONTOUR
- WETLAND BUFFER
- EDGE OF EX. VEGETATION
- EXISTING LOGGED FOREST
- EXISTING DIRT ACCESS ROAD
- FLOW ARROW
- CD CLOSED DEPRESSION

REVISIONS

NO.	DESCRIPTION/DATE	BY

CONSULTING ENGINEERS LLC
33400 8th Ave S, Suite 205
Federal Way, WA 98003
www.esmcivil.com
ESM
FEDERAL WAY (253) 838-6113
EVERETT (425) 297-1900
Land Planning
Landscape Architecture
Land Surveying
Project Management
Civil Engineering
Public Works

PALMER COKING COAL

HYDE MINE

BASIN PLAN – EXISTING CONDITIONS

KING COUNTY WASHINGTON

JOB NO.:	1960-001-017
DWG. NAME:	EN-03
DESIGNED BY:	LGB
DRAWN BY:	CJR
CHECKED BY:	
DATE:	09/22/2021
DATE OF PRINT:	

FIG 1

1 OF 1 SHEETS

File: \\esm-fs\ENGR\ESM-JOBS\1960\002\020\exhibits\EN-03A.dwg
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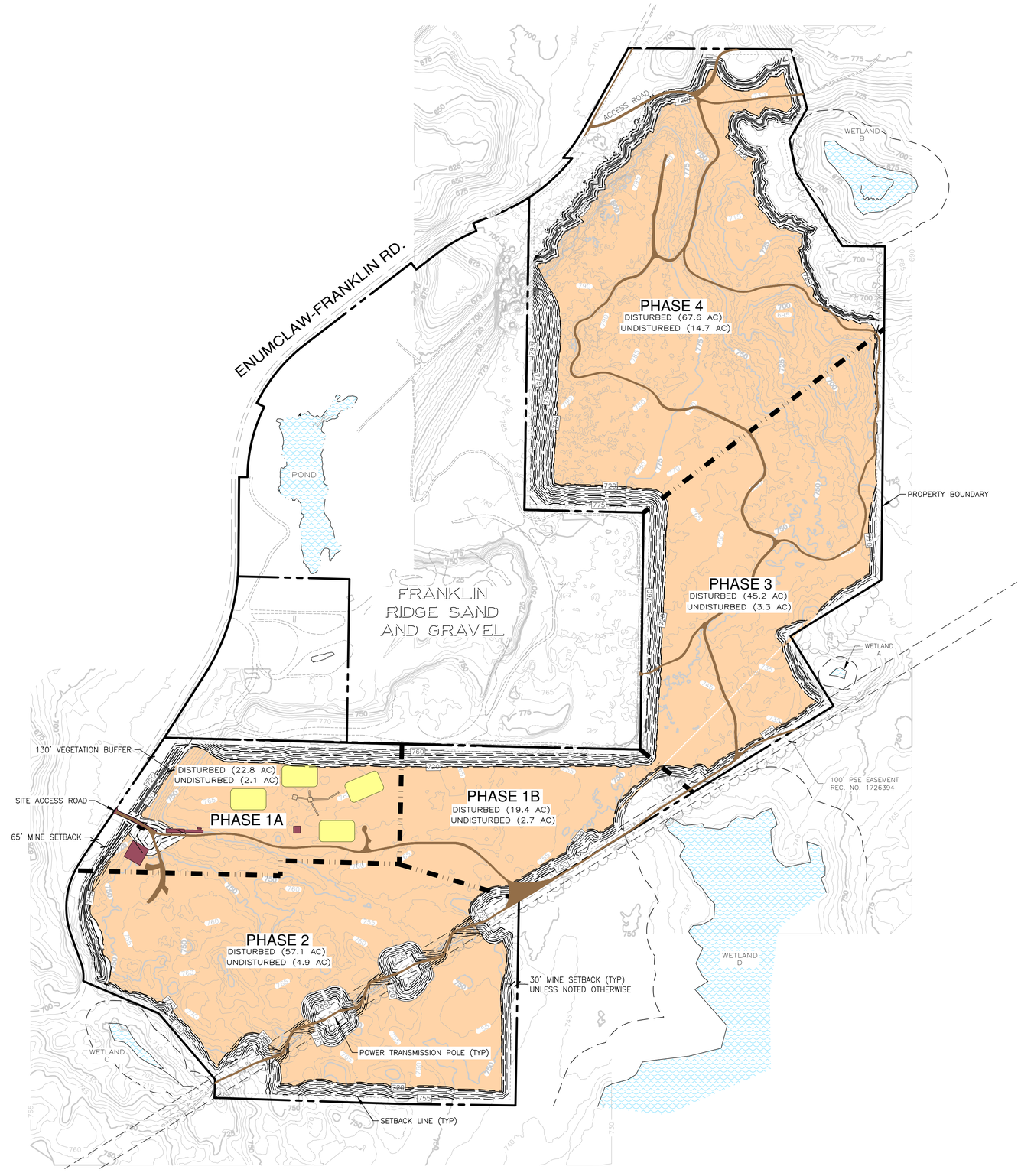
A PORTION OF SECTION 30, T. 21 N., R. 7 E., W.M., KING COUNTY, WASHINGTON



n

SCALE: 1" = 300'

300 150 0 300 600

CONTOUR INTERVAL = 5'

LEGEND

- PROPERTY BOUNDARY
- PHASE LINE
- EXISTING CONTOUR (700)
- EXISTING CONTOUR (700)
- WETLAND BUFFER
- EDGE OF EX. VEGETATION
- FLAT AREA/MINING FLOOR (DISTURBED AREA)
- STOCK PILE
- IMPERVIOUS (PGIS)
- EXISTING DIRT ACCESS ROAD

REVISIONS		
NO.	DESCRIPTION/DATE	BY

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33400 8th Ave S, Suite 205
Federal Way, WA 98003
www.esmcivil.com
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EVERETT (425) 297-1900
Land Planning
Landscape Architecture
Land Surveying
Project Management
Civil Engineering
Public Works

PALMER COKING COAL

HYDE MINE

MINING CONDITIONS

KING COUNTY, WASHINGTON

JOB NO.:	1960-001-017
DWG. NAME:	EN-04
DESIGNED BY:	LGB
DRAWN BY:	CJR
CHECKED BY:	
DATE:	09/22/2021
DATE OF PRINT:	

FIG-2

1 OF 1 SHEETS

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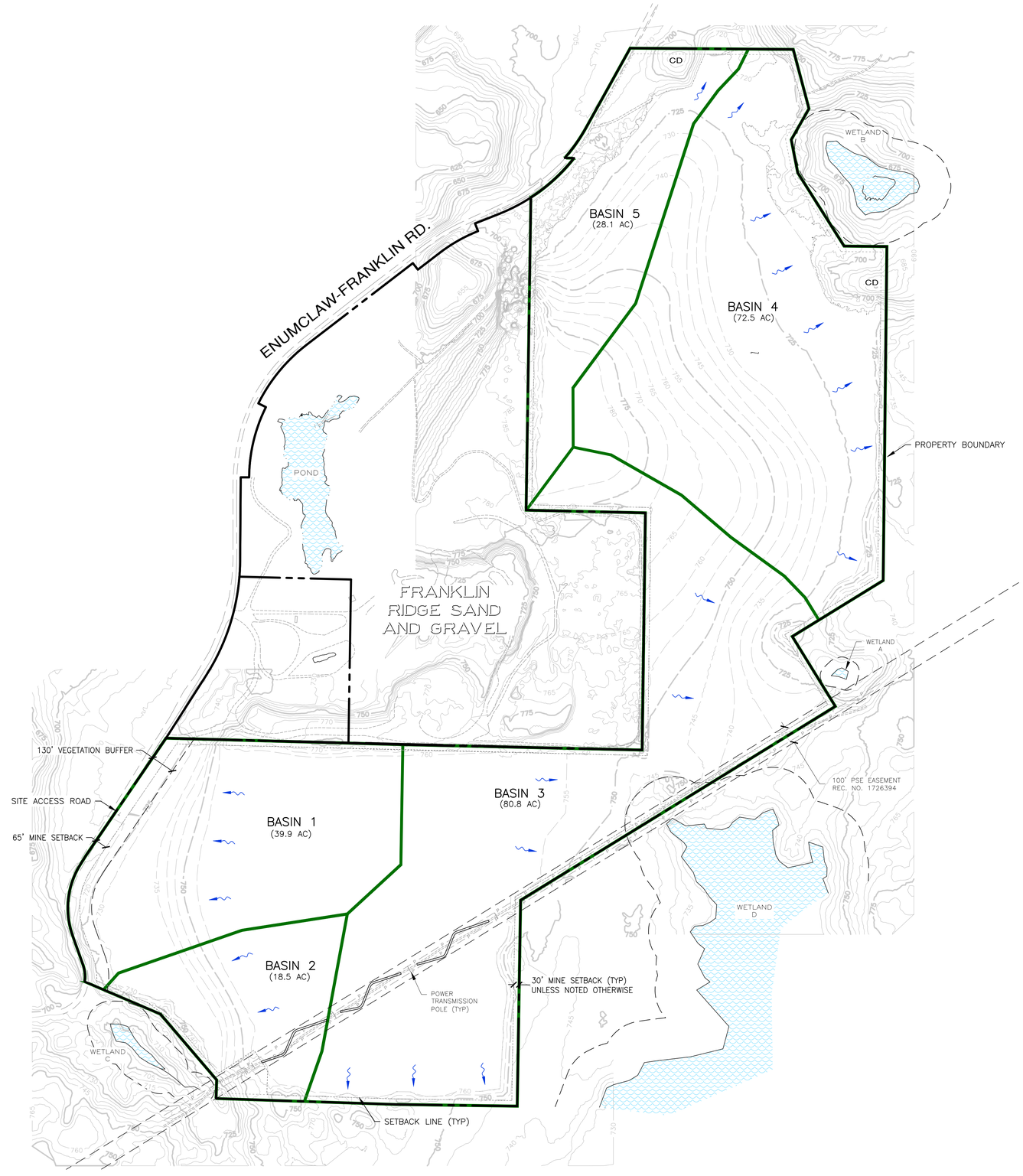
A PORTION OF SECTION 30, T. 21 N., R. 7 E., W.M., KING COUNTY, WASHINGTON



n

SCALE: 1" = 300'

300 150 0 300 600

CONTOUR INTERVAL = 5'

LEGEND

- PROPERTY BOUNDARY
- BASIN OUTLINE
- 700 EXISTING CONTOUR
- WETLAND BUFFER
- FLOW ARROW
- CD CLOSED DEPRESSION

REVISIONS		
NO.	DESCRIPTION/DATE	BY

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PALMER COKING COAL

HYDE MINE

BASIN PLAN – RECLAMATION CONDITIONS

KING COUNTY WASHINGTON

JOB NO.:	1960-001-017
DWG. NAME:	EN-05
DESIGNED BY:	LGB
DRAWN BY:	CJR
CHECKED BY:	
DATE:	09/20/2021
DATE OF PRINT:	

FIG-3

1 OF 1 SHEETS

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Appendix B

WWHM2012

PROJECT REPORT

For

Hyde Mine
Water Quality Flows

General Model Information

Project Name:	Hyde Mine
Site Name:	Water Quality Flows
Site Address:	
City:	
Report Date:	10/20/2021
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.000 (adjusted)
Version Date:	2019/09/13
Version:	4.2.17

Landuse Basin Data

WQ - Unit Roadway

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Pasture, Flat	0.06
Pervious Total	0.06

Impervious Land Use	acre
ROADS FLAT	0.05
Impervious Total	0.05
Basin Total	0.11

Element Flows To:

Surface	Interflow	Groundwater

WQ - Stockpile Area

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Pasture, Flat	3
Pervious Total	3

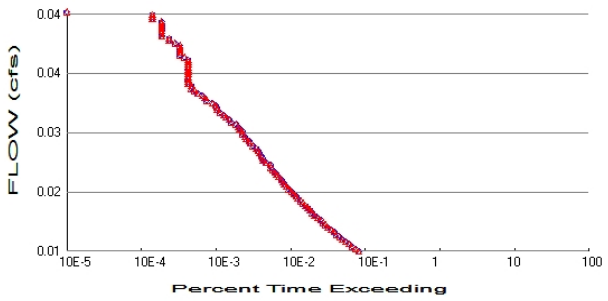
Impervious Land Use	acre
ROADS FLAT	2
Impervious Total	2
Basin Total	5

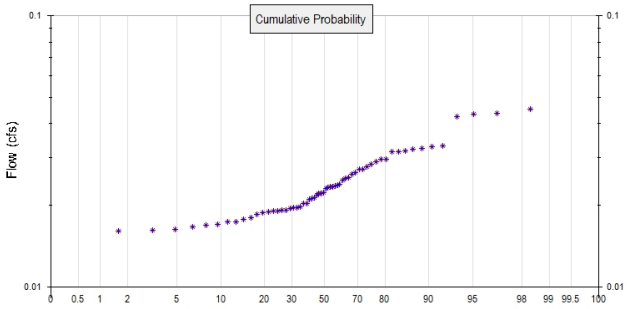
Element Flows To:

Surface	Interflow	Groundwater

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.06
Total Impervious Area: 0.05

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.06
Total Impervious Area: 0.05

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.022839
5 year	0.029014
10 year	0.033314
25 year	0.039002
50 year	0.043431
100 year	0.048029

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.022839
5 year	0.029014
10 year	0.033314
25 year	0.039002
50 year	0.043431
100 year	0.048029

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

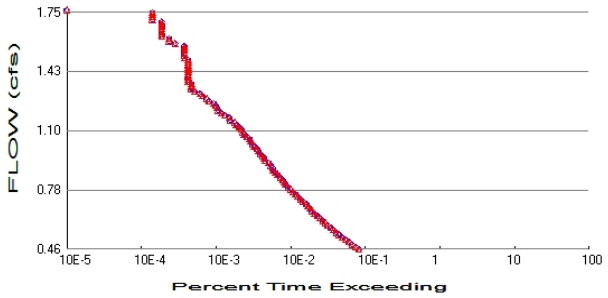
Year	**Predeveloped**	**Mitigated**
1949	0.030	0.030
1950	0.032	0.032
1951	0.019	0.019
1952	0.016	0.016
1953	0.018	0.018
1954	0.019	0.019
1955	0.021	0.021
1956	0.020	0.020
1957	0.023	0.023
1958	0.019	0.019

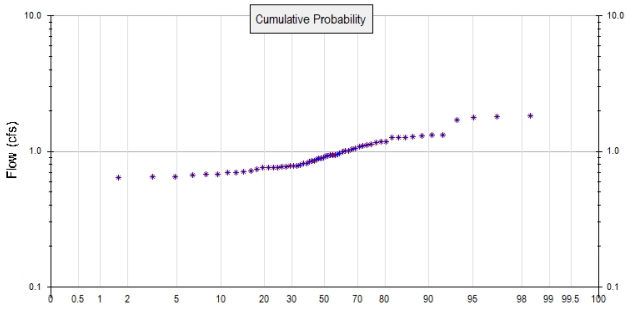
Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.0071 acre-feet
On-line facility target flow:	0.0095 cfs.
Adjusted for 15 min:	0.0095 cfs.
Off-line facility target flow:	0.0054 cfs.
Adjusted for 15 min:	0.0054 cfs.

POC 2





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 3
Total Impervious Area: 2

Mitigated Landuse Totals for POC #2
Total Pervious Area: 3
Total Impervious Area: 2

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.915145
5 year	1.165187
10 year	1.339636
25 year	1.570693
50 year	1.750829
100 year	1.938057

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.915145
5 year	1.165187
10 year	1.339636
25 year	1.570693
50 year	1.750829
100 year	1.938057

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1949	1.182	1.182
1950	1.270	1.270
1951	0.755	0.755
1952	0.643	0.643
1953	0.708	0.708
1954	0.741	0.741
1955	0.852	0.852
1956	0.815	0.815
1957	0.926	0.926
1958	0.757	0.757
1959	0.787	0.787

Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume:	0.2841 acre-feet
On-line facility target flow:	0.3833 cfs.
Adjusted for 15 min:	0.3833 cfs.
Off-line facility target flow:	0.2165 cfs.
Adjusted for 15 min:	0.2165 cfs.

Mitigated Schematic

Disclaimer

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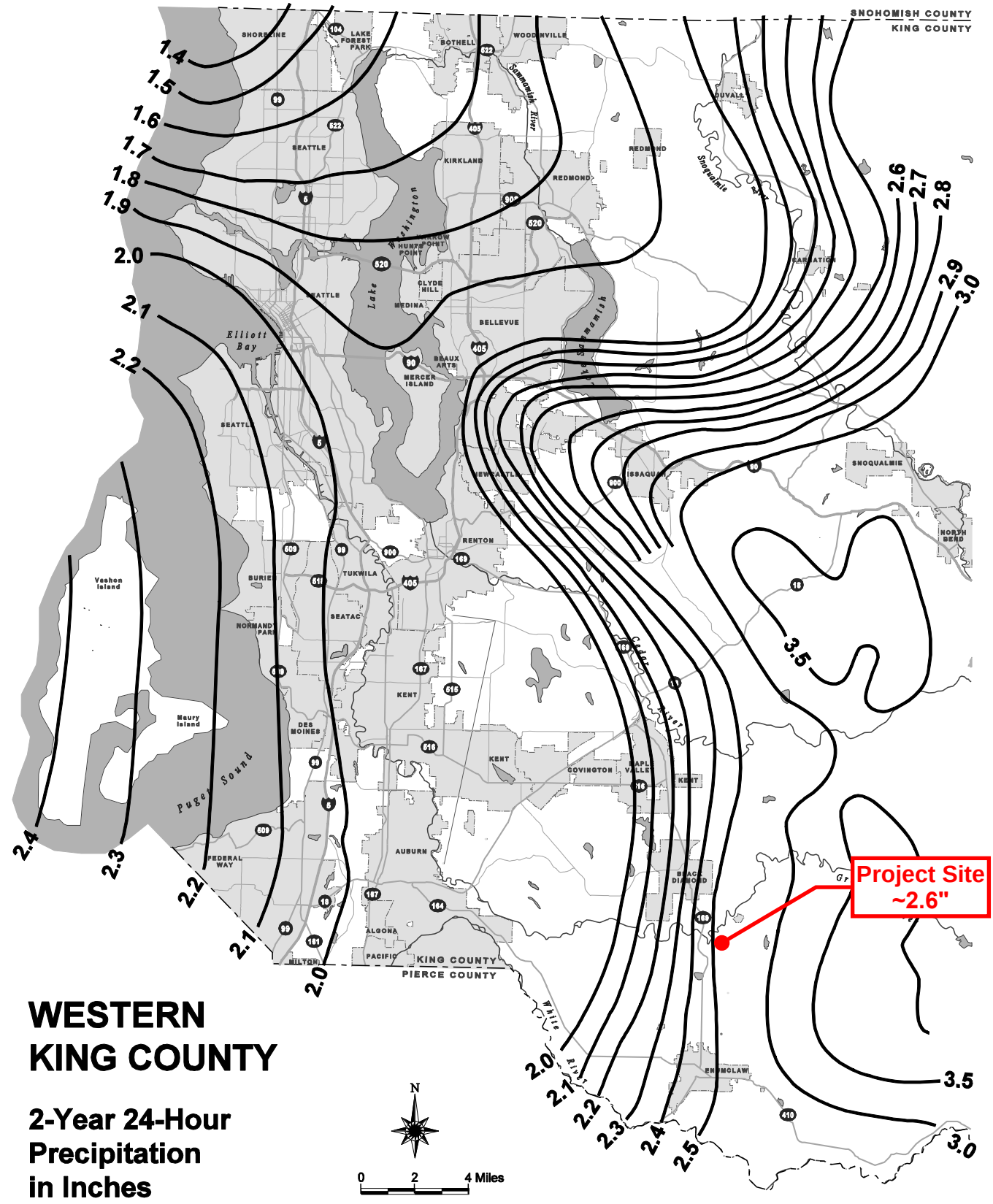
FIGURE 3.2.1.A 2-YEAR 24-HOUR ISOPLUVIALS



2-yr Precipitation = 2.6 [from Figure 3.2.1.A]
6-mo Precipitation = 0.72 * 2-yr = 1.87
k_online = ((1.87-1.50)/(2.00-1.50) * (2.74-2.02)) + 2.02 = 2.55

>>> **k_online = 2.55** <<<

Intermediate values of the ratio *k* for WWHM are calculated by linear interpolation.

(Note: This table does not apply to flow-based non-water quality BMPs; see relevant flow rate requirements for flow-based non-water quality BMPs in Appendix C.)

TABLE 6.2.1.A
ADJUSTMENT FACTOR *k* FOR CALCULATING MODIFIED WATER QUALITY FLOW RATE FROM MODELED ON-LINE/OFF-LINE RATES

SBUH Peak/WWHM On-Line 15-min WQ Flow Ratio vs 6-month Precipitation for 0% to 100% Impervious Areas		SBUH Peak/WWHM Off-Line 15-min WQ Flow Ratio vs 6-month Precipitation for 0% to 100% Impervious Areas	
6-month, 24-hr precipitation (72% of the 2-yr), Inches	Ratio, k_online	6-month, 24-hr precipitation (72% of the 2-yr), Inches	Ratio, *k*
0.80	1.01	0.80	1.95
1.00	1.30	1.00	2.44
1.50	2.02	1.50	3.68
2.00	2.74	2.00	4.92
2.50	3.45	2.50	6.16
2.90	4.03	2.90	7.15

Intermediate values of k for WWHM are calculated by linear interpolation

SBUH Peak/MGSFlood On-Line and Off-Line 15-min WQ Flow Ratio vs 6-month Precipitation for 0% to 100% Impervious Areas

For **on-line** facilities: $k = 1.41\ (P72\%, 2\text{-yr.}) - 0.052$ (Eq. 6-1)

For **off-line** facilities: $k = 2.50\ (P72\%, 2\text{-yr.}) - 0.052$ (Eq. 6-2)

where: *P*72%, 2-yr = 72% of the 2-year, 24-hour precipitation depth (in.)

Note: If the 6-month, 24-hour precipitation depth (in.) is known for the project site, that value may be used instead of *P*72%, 2-yr.

The ratio between the 91st percentile flow event and the estimated 6-month, 24-hour flow rate varies with location and percent of impervious area in the modeled drainage basin. The correlations in the table account for these variations. When designing bioswales and other flow rate based facilities,

multiply the on-line or off-line water quality design flow rate determined with the approved model by the coefficient *k* (off-line or on-line) determined from the associated table (see Methods of Analysis for guidance on selection of on-line or off-line flow rate and application of the associated correlation). Unless amended to reflect local precipitation statistics, the 6-month, 24-hour precipitation amount may be assumed to be 72 percent of the 2-year, 24-hour amount determined either with the approved model or by interpolating between isopluvials for the 2-year, 24-hour precipitation. Isopluvials for 2-year, 24-hour amounts for Western Washington are reprinted in Section 3.2.1, Figure 3.2.1.A.

Flow Volume to be Treated

When water quality treatment is required pursuant to the core and special requirements of this manual, the water quality design storm volume, when using an approved continuous runoff model, shall be equal to the simulated daily volume that represents the upper limit of the range of daily volumes that accounts for 91% of the entire runoff volume over a multi-decade period of record.

Alternatively, the water quality design volume of runoff can be predicted from a 24-hour storm with a 6-month return frequency (a.k.a., 6-month, 24-hour storm). Wetpool facilities are sized based upon use of the NRCS (formerly known as SCS) curve number equations for the 6-month, 24-hour storm[20]. Treatment facilities sized by this simple runoff volume-based approach are the same size whether they precede detention, follow detention, or are integral with the detention facility (i.e., a combined detention and wetpool facility).

The approved model calculates the water quality design volume directly. Alternatively, the NRCS method described in Section 6.4.1.1 may be used. Unless amended to reflect local precipitation statistics, the 6-month, 24-hour precipitation amount may be assumed to be 72 percent of the 2-year, 24-hour amount. Interpolating between isopluvials for the 2-year, 24-hour precipitation and multiplying by 72% yields the appropriate storm size. Isopluvials detailed for 2-year, 24-hour amounts for western King County are reprinted in Section 3.2.1, Figure 3.2.1.A. For locations east of the figure limits, precipitation amounts are more variable; use the 2-year, 24-hour isopluvial map located on the National Oceanic and Atmospheric Administration (NOAA) website at https://hdsc.nws.noaa.gov/hdsc/files25/Atlas2_Volume9.pdf.

Note that facilities which are sized based on volume and which include routing of flows through a detention facility, such as the detailed sand filter method, are significantly smaller when located downstream of detention, even though the same volume of water is treated in either situation. This is because the detention facility routing sequence stores peaks within the pond and releases them at a slow rate, reducing the size of the sand filter pond subsequently needed (the volume needed to store the peaks need not be provided again in the sand filter pond).

Treatable Flows

As stated in Chapter 1, only runoff from target pollution-generating surfaces must be treated using the water quality facility options indicated in the applicable water quality menu. These surfaces include both ***pollution-generating impervious surface*** and ***pollution-generating pervious surface***. "Target" means that portion from which runoff must be treated using a water quality facility as specified in Chapter 1. ***Pollution-generating impervious surfaces*** are those impervious surfaces which are subject to vehicular use, industrial activities, or storage of erodible or leachable materials, wastes, or chemicals; and which receive direct rainfall or the run-on or blow-in of rainfall. For subdivisions, target ***pollution-generating impervious surfaces*** typically include right-of-way improvements (roads), parking areas and driveways that are not ***fully dispersed*** as specified in Section 1.2.3.2. Metal roofs are also considered to be ***pollution-generating impervious surface*** unless they are coated with an inert, non-leachable material (see Reference 11-E); or roofs that are subject to venting significant amounts of dusts, mists, or fumes from manufacturing, commercial , or other indoor activities. ***Pollution-generating pervious surfaces*** are those

[20] For more information, see *Urban Hydrology for Small Watersheds,* Technical Release 55 (TR-55), June 1986, published by the NRCS. See Table 6.4.1.1.xx for CN values to be used with this manual.

TABLE 4.4.1.B VALUES OF ROUGHNESS COEFFICIENT "*n*" FOR OPEN CHANNELS

Type of Channel and Description	Manning's "*n*"* (Normal)
A. Constructed Channels	
a. Earth, straight and uniform	
1. Clean, recently completed	0.018
2. Gravel, uniform section, clean	0.025
3. With short grass, few weeds	0.027
b. Earth, winding and sluggish	
1. No vegetation	0.025
2. Grass, some weeds	0.030
3. Dense weeds or aquatic plants in deep channels	0.035
4. Earth bottom and rubble sides	0.030
5. Stony bottom and weedy banks	0.035
6. Cobble bottom and clean sides	0.040
c. Rock lined	
1. Smooth and uniform	0.035
2. Jagged and irregular	0.040
d. Channels not maintained, weeds and brush uncut	
1. Dense weeds, high as flow depth	0.080
2. Clean bottom, brush on sides	0.050
3. Same as #2, highest stage of flow	0.070
4. Dense brush, high stage	0.100
B. Natural Streams	
B-1 Minor streams (top width at flood stage < 100 ft.)	
a. Streams on plain	0.030
1. Clean, straight, full stage no rifts or deep pools	0.035
2. Same as #1, but more stones and weeds	0.040
3. Clean, winding, some pools and shoals	0.040
4. Same as #3, but some weeds	0.050
5. Same as #4, but more stones	
6. Sluggish reaches, weedy deep pools	0.070
7. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.100
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages	
1. Bottom: gravel, cobbles, and few boulders	0.040
2. Bottom: cobbles with large boulders	0.050
B-2 Floodplains	
a. Pasture, no brush	
1. Short grass	0.030
2. High grass	0.035
b. Cultivated areas	
1. No crop	0.030
2. Mature row crops	0.035
3. Mature field crops	0.040
c. Brush	
1. Scattered brush, heavy weeds	0.050
2. Light brush and trees	0.060
3. Medium to dense brush	0.070
4. Heavy, dense brush	0.100
d. Trees	
1. Dense willows, straight	0.150
2. Cleared land with tree stumps, no sprouts	0.040
3. Same as #2, but with heavy growth of sprouts	0.060
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.100
5. Same as #4, but with flood stage reaching branches	0.120

** Note: These "n" values are "normal" values for use in analysis of channels. For conservative design of channel capacity, the maximum values listed in other references should be considered. For channel bank stability, the minimum values should be considered.*

FILTER STRIP WORKSHEET

Project Name:

METHODS OF ANALYSIS (See SWDM Section 6.3.4)

k_online = 2.55
online_flow = 0.0095
Qwq = k_online * online_flow

Step 1) Calculate design flows

Filter strips usually precede other water quality facilities (See menus in Section 6.1)

Two-year flow	$Q_{2\text{-yr}}$	0.0228	(cfs)	*Section 6.2.1 WQ Design Flows*
Water quality design flow	Q_{wq}	0.0240	(cfs)	"

Requires weekly mowing

Step 2) Calculate design flow depth

Q_{wq} =	water quality design flow	0.0240	(cfs)	*Calculated in Step 1*
n_{wq} =	Manning's roughness coefficient	0.35		*Use 0.35 or 0.45, see p. 6-62*
W =	width of strip along imperv.	100.0	(ft)	*Determine now*
s =	longitudinal slope along path	0.01	(feet/ft)	*Determine now*

$$d_f = \left| \frac{Q_{wq}\, n_{wq}}{1.49\, Ws^{0.5}} \right|^{0.6}$$

design flow depth, d_f = 0.011 (ft) *Manning's formula, re-arranged*

- If the design flow depth is greater than I inch (0.083 ft), the flow must reduced, the strip width must be increased, or a different WQ facility must be used.

CHECK: 0.013 (ft) *< 0.083 ft, OK*

Step 3) Calculate the design flow velocity through the strip

Q_{wq} =	0.0240	(cfs)	*From Step 1*
W =	100	(ft)	*From Step 2*
d_f =	0.011	(ft)	*From Step 2*
$V_{wq} = Q_{wq} / Wd_f$	0.021	(fps)	*Flow Continuity Eq. w/ Wd_f for A*

- If V_{wq} exceeds 0.5 fps, a filter strip may not be used. Redesign site to use a gentler longitudinal slope, or use another WQ facility.

CHECK: 0.017 (fps) *< 0.5 fps, OK*

Step 4) Calculate length of filter strip

hydraulic residence time =	540	(s)	*Required 9 minutes*
design flow velocity, V_{wq} =	0.021	(fps)	*Calculated in Step 3*
$L = 540\, V_{wq}$	11.6	(ft)	

Size Summary

Land area is needed for the strip, access, & area outside the treatment area to convey high flows

Other Criteria

Flow spreading & energy dissipation
Access
Soil amendment
Planting requirements
Liners (Section 6.2.4)
Recommended design features (Section 6.3.4.2)

BIOSWALE WORKSHEET

Project Name:

METHODS OF ANALYSIS (See SWDM Section 6.3.1.1)

k_online = 2.55

Step 1) Calculate design flows

- *Bioswales generally precede other water quality facilities (See menus in Section 6.1)*
- *Design flows depend on sequence with detention facility. (Section 6.2.1)*

Preceding detention — Q_{wq} = modeled flow achieving 91% developed flow volume treated

Following detention — Q_{wq} = 2-yr release rate from detention facility

If no high flow bypass provided:	$Q_{100\text{-yr}}$	1.938	(cfs)	*See Section 6.3.1.1*
	$Q_{25\text{-yr}}$	1.571	(cfs)	*See Section 3.2.2 Runoff Files Method*
	$Q_{2\text{-yr}}$	0.915	(cfs)	"
Water quality design flow	Q_{wq}	0.977	(cfs)	*Section 6.2.1 WQ Design Flows and Volumes*

Land Cover Areas and Soil Types — *See Tables 3.2.2 B and 3.2.2.C*

Forest	☐ till	☐ outwash		(acres)	*Areas draining to swale (Section 3.2.2)*
Pasture	☐ till	☒ outwash	3	(acres)	"
Grass	☐ till	☐ outwash		(acres)	"
Wetland				(acres)	"
Impervious			2	(acres)	"

Time Step: 15-min — 15-min — *Required "15 min" (Section 6.2.1)*

Step 2) Calculate swale bottom width

$$b = \frac{Q_{wq}\, n_{wq}}{1.49\, y^{1.67}\, s^{0.5}}$$ bottom width of swale — 8.36 (ft) — *Simplified Manning's formula*

Q_{wq} =	water quality design flow	0.977	(cfs)	*Listed in Step 1*
n_{wq} =	Manning's roughness coefficient	0.20		*Required 0.20, shallow flow conditions*
y =	design flow depth	0.33	(ft)	*Mowed 2 in. (0.17ft), Rural 4 in. (0.33ft)*
s =	longitudinal slope, along flow	0.01	(feet/ft)	

- If the bottom width is calculated to be between 2 and 10 feet, proceed to Step 3.
- If bottom width is less than 2 feet, increase width to 2 feet and recalculate the design flow depth (y).
- If bottom width is more than 10 feet, increase longitudinal slope (s), increase design flow depth (y), install flow divider and flow spreader, or relocate swale after detention facility

Step 3) Determine design flow velocity

$V_{wq} = Q_{wq}/A_{wq}$	design flow velocity	0.317	(fps)	*Flow Continuity Equation, Q_{wq} from Step 1*
$A_{wq} = by+Zy^2$		3.084	(sf)	*Cross-sectional area at design depth*
Z =	side slope length per unit height	3:1	(feet/ft)	*Select now*

- If the velocity exceeds 1.0 fps, go back to Step 2 and modify longitudinal slope, bottom width, or depth.
- If the velocity is less than 1.0 fps, proceed to Step 4.

Step 4) Calculate swale length

$L = 540V_{wq}$ = swale length		171.1	(ft)	
540 =	hydraulic residence time	540	(s)	
V_{wq} =	design flow velocity	0.317	(fps)	*Calculated in Step 3*

- If the length is less than 100 feet, increase the length to 100 feet, leaving the bottom width unchanged.
- If the swale length can be accommodated on the site, proceed to Step 6.
- If the length is too long for the site, proceed to Step 5.

Step 5) Adjust swale layout to fit on site.

Increase initial bottom width and reduce initial swale length to provide an equivalent top area.

Required area $A_{top} = (b_i+b_{slope})L_i = (b_f+b_{slope})L_f$			(sf)	*Calculate top area at WQ design depth*
b_f =	increased bottom width		(ft)	*Select now; see Sections 6.3.1.2 and 6.3.2.2*
b_{slope} =	2Zy (ft) top width above sides		(ft)	*for max. allowable width*
L_f =	reduced length, $A_{top} / (b_f+b_{slope})$		(ft)	*Select now; Required minimum 100 ft*

- Go to Step 3 and recalculate design flow velocity (v) using b_f.
- **Recalculate to assure the 9 minute retention**

Step 6) Provide conveyance capacity for flows higher than Q_{wq}

Meet conveyance requirements of Section 1.2.4 and check conveyance and velocity of high flows.

A) Q_c =	$(1.49/n_c) A_c R_c^{0.67} s^{0.5}$	1.938	(cfs)	*Manning's Eq.; 100-yr or 25-yr flow in Step 1*
n_c =	Manning's roughness coefficient	0.030		*Manning's "n" from Table 4.4.1 B*
A_c =	$by_c + Zy_c^2$	1.39	(sf)	*Cross sectional area (trapezoidal section)*
R_c =	$A_c / (b+2y_c (Z^2+1)^{0.5})$	0.15	(ft)	*Hydraulic Radius (trapezoidal section)*
s =	longitudinal slope, along flow	0.01	(ft/ft)	*Selected in Step 2*
y_c =	depth of 25-yr or 100-yr flows	0.14	(ft)	*Calculate now*

- Check velocity of 100-yr peak flow...

B) $V_{100} = Q_{100} / A_{100}$ 1.4 (fps) → **< 3.0, OK**

- If V_{100} exceeds 3.0 fps, return to Step 2 and increase the bottom width or flatten slope.

Size Summary (Plan Area)

- *Land area is needed for the channel (top width including freeboard and any low-flow drain width), access, setbacks, and, if necessary, area to convey high flows.*
- *Longitudinal cross section includes conveyance depth y_c, swale plan length L_{plan} (channel elevation drop / slope), and, if necessary, underdrain and high flows.*

L_{plan} (channel elevation drop (ft) / slope) =	171.1	(ft)	*From Steps 3, 4 and 6*
WS plan area $A_{plan} = L_{plan}$ x (b + $2Zy_c$) =	1591.7	(sf)	*y_c from Step 6*

OTHER CRITERIA (Section 6.3.1.2)

Swale Geometry	Setbacks (Section 6.2.3)	Underdrains
Water Depth	Soil and plantings	Swale Divider
Flow Velocity, Energy Dissipation and Flow Spreading	Liners (Section 6.2.4)	Access