HALEY ALDRICH

www.haleyaldrich.com

PUBLIC REVIEW DRAFT REPORT ON

FORMER KOSMOS MILL FEASIBILITY STUDY
KOSMOS FLATS AREA
MORTON, WASHINGTON

by
Haley & Aldrich, Inc.
Seattle, Washington

for
Tacoma Power
Tacoma, Washington

DRAFT

File No. 0202832-001
June 2026

HALEY & ALDRICH, INC.
3131 ELLIOTT AVENUE
SUITE 600
SEATTLE, WA 98121
206.324.9530

SIGNATURE PAGE FOR

PUBLIC REVIEW DRAFT REPORT ON
FORMER KOSMOS MILL FEASIBILITY STUDY
KOSMOS FLATS AREA
MORTON, WASHINGTON

PREPARED FOR
TACOMA POWER
TACOMA, WASHINGTON

PREPARED BY:

DRAFT

Yida Fang, Ph.D., P.E.
Environmental Engineer
Haley & Aldrich, Inc.

REVIEWED AND APPROVED BY:

DRAFT

Angie Goodwin, L.H.G.
Senior Associate Hydrogeologist
Haley & Aldrich, Inc.

DRAFT

Andrew Kaparos, P.E.
Senior Associate Environmental Engineer
Haley & Aldrich, Inc.

DRAFT

Table of Contents

Page

List of Tables v
List of Figures v
List of Appendices v
List of Abbreviations and Acronyms vi

1. Introduction 1

1.1 PURPOSE AND OBJECTIVES 1
1.2 SITE BACKGROUND 1
1.2.1 Site Description 1
1.2.2 Site Elevations 2
1.2.3 Property Uses 2
1.3 PREVIOUS INVESTIGATIONS AND INTERIM REMEDIAL ACTIONS 3
1.3.1 Underground Storage Tank Removal 3
1.3.2 2019 Initial Site Investigation and Emergency Independent Remedial Action 4
1.3.3 2021 Site Investigation by Ecology and Debris Removal by Tacoma Power 5
1.3.4 RI and Copper Background Study 6
1.4 GEOLOGY AND HYDROGEOLOGY 8
1.4.1 Geology 8
1.4.2 Hydrogeology 9
1.5 CONCEPTUAL SITE MODEL 9
1.5.1 COCs 10
1.5.2 Contaminant Sources and Release Mechanisms 10
1.5.3 Contaminant Fate, Transport, and Exposure Routes 10
1.5.4 Potential Receptors and Exposure Pathways 12
1.5.5 Potential Exposure Scenarios 12
1.6 PROPOSED CLEANUP LEVELS AND POINTS OF COMPLIANCE 14
1.7 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS 16

2. Cleanup Action Alternatives 18

2.1 REMEDIAL ACTION OBJECTIVES 18
2.2 CLEANUP ACTION TECHNOLOGY SCREENING 19
2.3 CLEANUP ACTION ALTERNATIVE DESCRIPTIONS 19
2.3.1 Alternative 1 19
2.3.2 Alternative 2 20
2.3.3 Alternative 3 22
2.3.4 Alternative 4 23
2.3.5 Compliance Monitoring and Maintenance 25
2.3.6 Restoration Timeline 25

3. Evaluation of Cleanup Action Alternatives 26

3.1 GENERAL REQUIREMENTS 26

DRAFT

Table of Contents

		Page
3.1.1	Protect Human Health and the Environment	26
3.1.2	Comply With Cleanup Standards	26
3.1.3	Comply with Applicable State and Federal Laws	26
3.1.4	Prevent or Minimize Releases and Migration of Hazardous Substances	27
3.1.5	Provide Resilience to Climate Change Impacts	27
3.1.6	Provide for Compliance Monitoring	27
3.1.7	Not Rely Primarily on Institutional Controls and Monitoring	27
3.1.8	Not Rely Primarily on Dilution and Dispersion	27
3.1.9	Reasonable Restoration Time Frame	28
3.1.10	Use Permanent Solutions to the Maximum Extent Practicable	28
3.2	ACTION-SPECIFIC REQUIREMENTS	29
3.2.1	Remediation Levels	29
3.2.2	Institutional Controls	29
3.2.3	Financial Assurances	29
3.2.4	Periodic Reviews	29
3.3	MEDIA-SPECIFIC REQUIREMENTS	29
3.3.1	Soil at Current or Potential Future Residential Areas and Childcare Centers	29
3.3.2	Groundwater Cleanup Actions	30
3.4	CONSIDERATION OF PUBLIC CONCERNS	30
3.5	DCA CRITERIA AND PROCEDURE	31
3.5.1	DCA Criteria	31
3.5.2	DCA Procedure	32
3.6	DCA EVALUATION	33
4.	**Selected Cleanup Action Alternative**	**34**
References		**35**

DRAFT

List of Tables

Table No.	Title	Page (if embedded)
1	Monitoring Well Construction Details and Groundwater Elevations	
2	Proposed Soil Cleanup Standards in mg/kg	15
3	Proposed Groundwater Cleanup Standards in µg/L	15
4	Potential Applicable or Relevant and Appropriate Requirements	
5	Cleanup Action Technology Screening	
6	Cleanup Action Alternative 1 Cost Estimate	
7	Cleanup Action Alternative 2 Cost Estimate	
8	Cleanup Action Alternative 3 Cost Estimate	
9	Cleanup Action Alternative 4 Cost Estimate	
10	Alternatives Evaluation and Benefit Scoring	
11	DCA Calculations	

List of Figures

Figure No.	Title
1	Vicinity Map
2A	2019 to 2022 Site and Exploration Plan
2B	2019 to 2020 Site Features
3	Remedial Investigation Site and Exploration Plan
4	Cross Section A-A’
5	Cross Section B-B’
6	Hydrograph - Riffe Lake
7A	Hydrograph - Shallow Monitoring Wells
7B	Hydrograph - Deep Monitoring Wells
8	Groundwater Contours - Shallow Monitoring Wells
9	Groundwater Contours - Deep Monitoring Wells
10	Conceptual Site Model
11	Extent of Impacts in Soil
12	Extent of Impacts in Shallow Groundwater
13	Alternative 1 and 2
14	Alternative 3
15	Alternative 4

List of Appendices

Appendix	Title
A	Permeable Sorptive Barrier Case Studies

DRAFT

List of Abbreviations and Acronyms

AIRO	AIRO Environmental Services
AO	Agreed Order
ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
BMPs	best management practices
BTEX	benzene, toluene, ethylbenzene, and xylenes
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSM	conceptual site model
CUL	cleanup level
CWA	Clean Water Act
DOWL	DOWL Engineers
DCA	disproportionate cost analysis
DSR	Data Summary Report
Ecology	Washington State Department of Ecology
EISB	enhanced in-situ bioremediation
EPA	United States Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
FS	feasibility study
H:V	horizontal to vertical
Haley & Aldrich	Haley & Aldrich, Inc.
IRA	independent remedial action
LCC	Lewis County Code
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MNA	monitored natural attenuation
MTCA	Model Toxics Control Act
NAPL	non-aqueous phase liquid
NAVD 88	North American Vertical Datum of 1988
ORC	oxygen release compounds
PAH	polycyclic aromatic hydrocarbon
PMEP	Permanent to the Maximum Extent Practicable
POC	points of compliance
Property	Tacoma Power's property
PSB	Permeable Sorptive Barrier
RAO	remedial action objectives
RCW	Revised Code of Washington
RI	remedial investigation
SAP/QAPP	Sampling and Analysis Plan and a Quality Assurance Project Plan
SCO	sediment cleanup objective
Site	former Kosmos Mill
SMP	Soil Management Plan
SMS	Sediment Management Standards
SPP	solidified petroleum product

DRAFT

Tacoma Power	City of Tacoma, Power Division
TCL	Tacoma City Light
TEE	terrestrial ecological evaluation
TEQ	toxic equivalent concentration for cPAHs
TPH	total petroleum hydrocarbon
TPH-D	diesel-range total petroleum hydrocarbon
TPH-G	gasoline-range total petroleum hydrocarbon
TPH-O	oil-range total petroleum hydrocarbon
TPH-D+O	sum of total petroleum hydrocarbons in the diesel and oil range
U.S.	United States
USC	United States Code
UST	underground storage tank
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbons
WAC	Washington Administrative Code
WQPP	Water Quality Protection Plan

DRAFT

1. Introduction

On behalf of The City of Tacoma, Power Division (Tacoma Power), Haley & Aldrich, Inc. (Haley & Aldrich) has prepared this feasibility study (FS) report to evaluate, develop, and assess alternative cleanup actions at the former Kosmos Mill (Site). The Site is located approximately 7.3 miles southeast of Morton, Washington (tax parcel number 030775001000) and is accessible off State Route 12 via Kosmos Road, followed by Champion Haul Road (Figure 1).

1.1 PURPOSE AND OBJECTIVES

The purpose of the FS is to develop and evaluate potential cleanup action alternatives to enable selection of a cleanup action that meets the requirements of the Washington Administrative Code (WAC) 173-340-360 and conforms, as appropriate, to the expectations of WAC 173-340-370. The purpose of the cleanup action alternative is to protect human health and the environment and comply with cleanup standards and state and federal laws, to satisfy the threshold criteria as specified by WAC 173-340 under Washington State Department of Ecology's (Ecology) Model Toxics Control Act (MTCA).

1.2 SITE BACKGROUND

The background and physical setting information summarized below are based on Site visits and review of prior environmental data and documents.

Historically, the Site was established as a lumber mill in 1904. The former mill included railroad lines/tracks, several buildings, and a log pond. The City of Tacoma purchased the former Kosmos townsite and lumber mill in the 1960s, and the inhabitants were relocated. The land was acquired to create the Riffe Lake reservoir for recreational use and power generation. The lumber mill facility was abandoned and demolished prior to the 1968 completion of Mossyrock Dam. Riffe Lake is currently a component of the Cowlitz River Hydroelectric Project operated by Tacoma Power. Additional Site background and description information are provided in the Site investigation for the *Kosmos Mill Oil Cleanup Data Summary Report* (DSR), dated February 19, 2021 (Haley & Aldrich, 2021a) and the *Public Review Draft Remedial Investigation* (RI) *Report* (Haley & Aldrich, 2025).

1.2.1 Site Description

Tacoma Power's property (Property) is located in Rainey Valley, within the Riffe Lake reservoir, in an area referred to as Kosmos Flats and was purchased by the City of Tacoma in the 1960s. Rainey Creek bounds the Property to the north and west, Champion Haul Road to the east, and Riffe Lake to the south.

The Site is located within the Property with Rainey Creek to the west, the former log pond area to the south, an old mill road and the former stockpile area from the emergency independent remedial action (IRA) in 2019 to the east, and the north bank of the ravine and old mill road to the north (Figures 2A and 2B). The Site topography generally slopes to the south toward Riffe Lake, but the local topography gradually slopes to the northwest, toward Rainey Creek in the area near the identified petroleum seeps which were covered by a protective cap under the emergency IRA in 2019 (and described in the 2021 DSR).

DRAFT

The Kosmos Flats is a plateau and is referred to in this FS report as the upland area. This area was formerly the location of the Kosmos Lumber Mill. The building foundation, railroad rails, metal, and concrete debris from the former mill can be seen in the upland area. The former mill location is on the east bank, above an outside bend of Rainey Creek channel. Other Site features include a surface water conveyance ditch and a former log pond dike. There is approximately a 38-foot elevation difference between the top and bottom of the creek's bank and the bank ranges from 1 horizontal to 1 vertical (1H:1V) to 3H:1V slope along the Site. Downstream of the protective cap, the bank is generally at a 2H:1V slope. At the protective cap, the bank's slope is generally at a 3H:1V slope. Upstream of the protective cap, the bank steepens to 1H:1V with almost vertical portions for an approximate 300-foot length before the slope becomes less steep. Near the cap on the upstream side is a ravine that trends from the creek's bank to the east toward the upland area of the Site. This ravine contained metal and other debris from historical mill operation; however, most of the visible debris was removed by Tacoma Power in October 2021.

1.2.2 Site Elevations

All elevations discussed in this report are taken from the Tacoma City Light (TCL) datum, which is 3.96 feet below North American Vertical Datum of 1988 (NAVD 88).

The Site's ground surface elevation ranges from approximately 718 feet near the petroleum seep area at the toe of Rainey Creek to approximately 758 feet in the upland area at the top of the bank near the old lumber mill foundations. Rainey Creek's bed is at an approximate elevation of 716 feet adjacent to the protective cap. During the 2019 investigation and protective cap construction, Rainey Creek water elevation was approximately 719 feet.

In recent years, the reservoir's full-pool water levels have been maintained at an approximate elevation of 749 feet due to seismic safety concerns with the Mossyrock Dam spillway piers. This has prevented inundation and allowed the Site to be exposed for extended durations and for vegetation to grow. The reservoir's normal full-pool elevation is approximately 778.5 feet, which is the regulated Ordinary High Water Line and would submerge the upland portion of the Site.

Three extreme weather events have occurred since the seep observation in April 2019. The first was in the winter of 2019/2020, second was in the winter of 2025/2026, and third was in the spring 2026. High inflows and downstream flooding concerns have caused a rise in Rainey Creek and Riffe Lake's water levels. The associated backwatering resulted in the entire Site being inundated. In both instances, increased monitoring was conducted, and no adverse impacts were identified as a result of the inundation.

1.2.3 Property Uses

The Property is currently vacant with temporary signage and jersey barriers along the eastern side of the Site. The future Property uses are to be available to the public as a recreational wildlife area when accessible. Tacoma Power intends to return to a normal full-pool elevation of approximately 778.5 feet where the Site would be inundated during portions of the year for public recreation and water storage.

Parcel and Property Description:
The Site is within parcel number 030775001000 and located in the southwest quarter of Section 28, Township 12N, Range 05E.

DRAFT

Property legal description is ALL SECTION 28 LESS PART NW4 & PART SECTION 29 LESS N2 NE4 & PART TO NORTHERN PACIFIC RAILROAD COMPANY 28/29-12-5E.

Property use code is 48 Utilities.

Ecology Site Identifications:

- Facility/Site ID is 61559576
- Cleanup Site ID is 9890
- Underground Storage Tank (UST) ID is 200555
- Cleanup Site Name is Riffe Lake

Ecology Oversight:

- The Site is currently in an Agreed Order (AO) number DE 16955 with Ecology's Toxics Cleanup Program overseeing the remediation process, including this FS and the future draft Cleanup Action Plan.
- Tacoma Power also has a 401 Water Quality Certification permit (order no. 11-2001) for their hydroelectric project on Riffe Lake that Ecology's Water Quality Program oversees.

1.3 PREVIOUS INVESTIGATIONS AND INTERIM REMEDIAL ACTIONS

In 2019, a seep of petroleum hydrocarbons was discovered along the bank of Rainey Creek near the Site. Tacoma Power began investigations and implemented measures to mitigate risks to human and environmental health once the seep was discovered. The Site currently includes parts of the former Kosmos Lumber Mill and the bank of Rainey Creek, shown within the area of potential effect. A detailed summary of events is provided in the 2025 RI Report (Haley & Aldrich, 2025).

1.3.1 Underground Storage Tank Removal

Two USTs related to the lumber mill were discovered at the Site in 1992, which were subsequently removed by AIRO Environmental Services (AIRO). The first UST was a 500-gallon steel tank, located south of the observed seeps and found partially exposed along an earthen bank of Rainey Creek, labeled Site D in Figure 2A. It was filled with lake water and did not exhibit a sheen or other indicators for the presence of petroleum products. Sampling results were not detected at or above laboratory reporting limit of 0.01 milligrams per liter (mg/L) for polychlorinated biphenyls or 10 mg/L for total halogens (AIRO, 1993).

The second UST, a 5,000-gallon tank, was located below ground level near the remaining mill facility foundations, labeled Site A in Figure 2A. The UST contained petroleum products with the presence of halogenated hydrocarbons. Soil containing heavy oil-range petroleum at concentrations exceeding MTCA Method A soil cleanup levels (CULs) surrounded the 5,000-gallon UST. A total volume of 87 cubic yards of contaminated soil was removed and disposed of at the Kitsap County Landfill (AIRO, 1993). The 1993 report is provided in Appendix B of the 2021 DSR (Haley & Aldrich, 2021a).

Ten additional USTs were discovered at the former Kosmos townsite, located approximately one-third of a mile to the northeast of the Site and north of Rainey Creek (Figure 1). Approximately 25,900 tons of contaminated soil was excavated from the townsite, remediated in that location using thermal

DRAFT

desorption, and used as backfill for the excavations. Analytical results of groundwater samples collected by DOWL Engineers (DOWL) within the former townsite indicated that contaminants did not migrate away from the UST perimeter set by the monitoring wells, but concentrations above MTCA Method A CULs were detected in the suspected central area of the contaminated plume (DOWL, 1993). As the former Kosmos townsite is located one-third of a mile northeast from the Site, the DOWL 1993 report was not included as an appendix to the 2021 DSR (Haley & Aldrich, 2021a).

1.3.2 2019 Initial Site Investigation and Emergency Independent Remedial Action

In 2019 and 2020, following the observation of the seep in April 2019, an initial Site investigation and emergency IRA were conducted upland of the seep area (Figure 2A). In November and December 2019, 12 test pits (TP-2, TP-3, TP-5 through TP-8, and TP-10 through TP-15) were excavated to depths of 5 to 20 feet below ground surface (bgs) and 10 sonic borings (borings B-1 through B-10) were advanced to depths of 40 to 50 feet bgs in the upland area of the Site. Grab groundwater samples were collected from four of the borings (B-4, B-6, B-7, and B-9).

Analytical results from soil samples collected from borings and test pits indicate the presence of total petroleum hydrocarbons (TPH) in the gasoline-, diesel-, and oil-range (TPH-G, TPH-D, TPH-O, respectively); and polycyclic aromatic hydrocarbons (PAHs), specifically carcinogenic polycyclic aromatic hydrocarbons (cPAHs) in soil at concentrations above CULs. These constituents were observed to be primarily in the upper 10 to 15 feet of soil in the upland area of the Site during the 2019 investigation. An isolated area near the former Site A (5,000-gallon UST) was found to contain petroleum-contaminated soil in the upper 2.5 feet bgs. Additionally, TPH-D, TPH-O, and cPAHs were found in soil above CULs on the edge of the creek bank and bottom, as well as the creek bank underneath the protective cap.

Two groundwater samples were analyzed for and contained total metals (arsenic, cadmium, chromium, and lead) above CULs; however, the samples also contained high levels of turbidity and total suspended solids.

As part of the emergency IRA, Anderson Environmental Contractors, Tacoma Power's selected contractor, temporarily diverted the flow of Rainey Creek away from the work area in order to excavate the surface and subsurface contamination. During this flow diversion, non-aqueous phase liquid (NAPL) was observed (brown, oil-like, and heavy sheen) at the edge of the bank and creek bottom directly adjacent to the location of the petroleum seeps on the bank. After excavation in the area where the protective cap was to be installed, one soil sample (sample Creekbed 1 on Figure 2A) was collected from the exposed edge of the bank and next to the creek bottom at an approximate elevation of 717 feet. Three additional soil samples (samples LB-1 through LB-3) were collected from the lower bank at an approximate elevation of 719 to 718 feet, and three soil samples (samples UB-1 through UB-3) were collected from the upper bank at an approximate elevation of 746 to 745 feet. The samples were analyzed for TPH-G, TPH-D, TPH-O, metals, PAHs, and volatile organic compounds (VOCs). TPH-D, TPH-O, and cPAHs were detected at concentrations above MTCA Method A CULs in soil samples Creekbed 1 and LB-2, all other analytes were either not detected at or above laboratory reporting limits or were detected at concentrations below applicable MTCA Method A CULs.

Surface water samples of Rainey Creek were collected in general accordance with Tacoma Power's Water Quality Protection Plan (WQPP), to monitor the effectiveness of the best management practices (BMPs) that Tacoma Power had implemented during earthwork activities during the emergency IRA. Surface water sample analytical results showed elevated TPH-O, TPH-D, copper, and zinc in areas

DRAFT

adjacent to the construction area, but not downstream of the protective cap area, indicating the effectiveness of the BMPs.

Surface water samples were collected by Tacoma Power from ponded water in or near the stockpile during the emergency IRA in December 2019 and January 2020 (Figure 2A). Water from heavy rains and surface runoff around the stockpile had to be diverted to keep the stockpile from becoming saturated. A surface water sample (Stockpile #1) was collected within the stockpile area and the analytical results were above indicator levels for pH, turbidity, TPH-D, and TPH-O. Surface water from the diversion trench was sampled (T1 and T2) multiple times in January and February 2020. The analytical results were below the indicator levels, except for pH for the February event.

To remove the stockpiles in an expedited manner, Tacoma Power had to maintain a low water level in the area. Due to heavy rains and surface runoff, the volume of water was increasing in the stockpile area, requiring Tacoma Power to intermittently discharge to the log pond area for infiltration for approximately eight hours on February 8, 2020. Two surface water samples (Log Pond #1 and #2) were collected (Figure 2A). The sample results were above the indicator levels for pH and turbidity (Log Pond #2 only), and were below indicator levels for TPH-D and TPH-O.

Ponded water was observed in the former stockpile area and near the former building foundations. These areas were sampled (SOP 1 and COP 1, respectively) on March 3,2020 (Figure 2A). The samples contained concentrations of pH, turbidity, copper, and zinc above the indicator levels. Sample SOP 1 contained elevated concentrations of TPH-D and TPH-O above indicator levels.

There were no releases of the ponded water tested in March 2020 outside of the stockpile area. The stockpile area was seeded in April 2020 to promote vegetation growth. The vegetation struggled to establish within the stockpile area, especially in the depressed areas where water ponded. Additional petroleum-like sheens were observed, and in September 2020, Tacoma Power submitted a plan to Ecology that was reviewed and approved to cover the stockpile area with bioretention soil and biofiltration seed. This temporary measure is to further stabilize the stockpile area, fill in the depressed areas to promote drainage, and to promote further vegetation growth.

More details about the initial Site investigation, the emergency IRA, analytical results, and sample locations are described in the 2021 DSR (Haley & Aldrich, 2021a).

1.3.3 2021 Site Investigation by Ecology and Debris Removal by Tacoma Power

During a March 2021 on-Site visit by Ecology's Water Quality Program, a layer of solidified petroleum product (SPP) was observed as a ledge on the east bank of Rainey Creek on the north side of the ravine (Figure 3). The layer is resistant to erosion as it is observed to be sand and gravel cemented in a hard petroleum matrix and was overhanging the stream bank along the bank top (i.e., the soil beneath the SPP had been eroded). The ledge of the SPP is approximately 16 feet long by 2 feet wide and 3 to 7 inches thick, and the eastern portion is covered with alluvium.

On April 16, 2021, Ecology sampled the SPP ledge and submitted for chemical analyses of TPH-D; TPH-O; TPH-G; total metals (arsenic, cadmium, chromium, hexavalent chromium, copper, lead, nickel, zinc, and mercury); PAHs; benzene, toluene, ethylbenzene, and xylene (BTEX); and extractable and volatile petroleum hydrocarbons (EPH and VPH, respectively). Analytical results indicated concentrations in soil exceed MTCA Method A CULs for TPH-D, TPH-O, and cPAHs. There were detectable concentrations of

DRAFT

some metals below applicable MTCA Method A CULs. There were no detectable concentrations in the VPH range or for BTEX compounds. There were detectable concentrations in the EPH range. Since this Site can be submerged during high reservoir levels, leach testing was performed on the SPP ledge soil sample to determine if there was a risk to surface water quality. The leaching test was completed using distilled water in a modified toxicity characteristic leaching procedure and the leachate (labeled as Rinsate in the laboratory report) was analyzed for TPH-D, TPH-O, and metals. Results show TPH-D, TPH-O, and copper levels exceed WQPP indicator levels. The laboratory report for the Ecology samples were provided in Appendix D of the 2021 RI Work Plan (Haley & Aldrich, 2021b).

In May 2021, Tacoma Power personnel observed a partially exposed SPP layer in the ravine east of the SPP ledge. It is not known if this is connected to the SPP ledge. The eastern portion of this layer is also covered by alluvium.

SPP debris was found scattered on the Site's upland surface and Rainey Creek bank. Tacoma Power personnel are continuing to note the location and collect this debris as it is discovered and dispose of it off Site. As of May 2023, Tacoma Power inspects the Site on at least a bi-weekly basis, or more frequently depending on water levels per the inspection requirements.

On October 4 and 5, 2021, Tacoma Power collected and removed the visible metal debris in the ravine and graded the area by moving non-impacted soil from the edges of the ravine to fill in the lower, depressed areas to prevent exposure to surface water. Additionally, the SPP layer located north of the ravine was removed approximately 4 feet toward the east and disposed of off Site to Hillsboro Landfill. Ecology's Water Quality Program approved the plan and oversaw construction.

1.3.4 RI and Copper Background Study

As described above, Site investigations began in 2019 and were documented in the 2021 DSR (Haley & Aldrich, 2021a). From 2022 onward, activities followed the 2021 RI Work Plan (Haley & Aldrich, 2021b) and included geophysical surveys, soil and groundwater investigations, surface water and sediment sampling, and a copper background study in June 2025. No sheens on ponded water have been observed since April 2022.

The following sections summarize the investigations results by media.

1.3.4.1 Soil

A total of 193 soil samples were analyzed for TPH, VOCs, PAHs, and metals between 2022 and 2025. Results were compared to Site-specific MTCA Method B screening levels, ecological criteria, sediment cleanup objectives (SCOs), and natural background concentrations. Additional details are provided in the 2025 RI Report, and a brief summary is provided below.

- **TPH:** After evaluating EPH and VPH results, three different areas were identified where gasoline-range petroleum hydrocarbons appeared to be the primary constituent. Gasoline-range petroleum hydrocarbons generally fall within the C5-C13 carbon ranges and middle to heavy fuels/oils generally fall within the C8 C34 carbon ranges. Site-specific screening levels of 1,000 milligrams per kilogram (mg/kg) for the vadose zone and 30 mg/kg[1] for the saturated zone

[1] A Site-specific MTCA Method B TPH screening level for the protection of groundwater of 18 mg/kg in the saturated zone was calculated by the evaluation of EPH and VPH results using the MTCA TPH 12.0 tool. However,

DRAFT

were calculated for the areas where gasoline-range petroleum hydrocarbons were the primary constituents. Site-specific screening levels of 1,000 mg/kg for the vadose zone and 550 mg/kg for the saturated zone were calculated for the areas where gasoline-range petroleum hydrocarbons were not the primary constituents. TPH was detected in 42 samples; 32 exceeded Site-specific screening levels. Eight shallow samples (0 to 1 feet bgs) exceeded SCO or ecological screening levels. Most hydrocarbons resembled weathered Bunker C fuel; and in areas dominated by gasoline-range hydrocarbons, the hydrocarbon distributions are more representative of a weathered mineral spirit-like product(s).

- **VOCs:** Benzene, ethylbenzene, xylenes, and chlorinated solvents were detected above screening levels in multiple samples; however, they were not retained as a contaminant of concern (COC) in soil because there is no known source of chlorinated solvents at the Site and they were not detected in groundwater, indicating that the soil-to-groundwater pathway is not complete for these constituents.
- **PAHs:** Detected in 19 samples; key exceedances included 1-thylnaphthalene, benzo(a)pyrene, fluoranthene, and pyrene. The toxic equivalent concentration (TEQ) for cPAH exceeded screening levels in four samples.
- **Metals:** Copper exceeded Site-specific background and screening levels in 40 of 109 samples. Other exceedances included barium (wildlife criteria), hexavalent chromium, lead, nickel, and zinc. However, only lead and zinc were retained as COCs as the other metals were detected at concentrations exceeding the natural background concentration in less than 10 percent of the samples analyzed, the maximum detected concentrations were less than two times the natural background concentration, no known source of the metals (hexavalent chromium or copper), and/or the metal was not detected in groundwater, indicating that the soil to groundwater pathway is not complete.

1.3.4.2 Groundwater

Seven grab samples and 24 monitoring well samples were collected between 2022 and 2023.

- **Grab Samples:** Organics were not detected or below screening levels. Total copper, lead, and mercury exceeded potable water criteria in four samples; dissolved metals exceeded in one sample, likely biased by high turbidity.
- **Monitoring Wells:**
  - Shallow wells (June 2022): total petroleum hydrocarbons in the diesel and oil range (TPH-D+O) exceeded screening levels in all wells; PAHs (pyrene, methylnaphthalene, fluoranthene) exceeded in MW-2S and MW-3S.
  - Deep wells (Nov 2022): All analytes below screening levels.
  - February and May 2023: TPH-D+O and TPH-O exceeded in shallow wells; copper and lead exceeded in select wells; PAHs exceeded in MW-2S and MW-3S.
  - Aug 2023: Copper and lead exceeded in MW-4D; PAHs exceeded in MW-2S and MW-3S.
- COCs retained for groundwater include TPH-D+O, 1-methylnapthalene, fluorene, and pyrene.

the MTCA Method A TPH soil screening levels were used because the Site-specific screening level was lower than the corresponding MTCA Method A screening level (Ecology, 2023).

DRAFT

1.3.4.3 Surface Water

Six samples collected during high (June 2022) and low (Nov 2022) water levels.

- June: No detections above reporting limits; all below WQPP indicator levels.
- Nov: TPH-D detected in one sample (below indicator level); chromium detected in two samples (well below indicator level).

1.3.4.4 Sediment

Two sampling events in 2022.

- April: Five samples; TPH-O detected in two samples (below SCO); chrysene and mercury detected at trace levels; metals below SCO.
- October: Twelve samples; PAHs detected in three samples (below SCO); metals below SCO. No exceedances observed.

1.3.4.5 Copper Background Study (2025)

Fifteen soil samples collected using incremental sampling methodology.

- Copper ranged from 15 to 50 mg/kg; Site-specific background concentration calculated as 52.15 mg/kg using MTCA statistical methods. Minor deviations from the work plan did not affect study validity.

1.4 GEOLOGY AND HYDROGEOLOGY

Our understanding of Site geology and hydrogeology is based on explorations and wells completed by Haley & Aldrich in 2019, 2022 through 2023, and 2025, as well as historical investigation activities completed by AIRO.

1.4.1 Geology

The Site is located along Rainey Creek in the Cowlitz River watershed. During the late Pleistocene, the Cowlitz glacier extended from its source on Mount Rainier roughly to the town of Salkum, Washington, west of the Site. During this Epoch, the Cowlitz glacier advanced and retreated on at least four distinct occurrences. These glaciations produced three distinct outwash deposits. The earliest deposit was the Wingate Hill outwash, followed by the Hayden Creek drift, and most recently the Evans Creek outwash.

In the Rainey Creek valley, glacial deposits are represented as the Hayden Creek drift. The Hayden Creek drift is dominantly composed of outwash deposits expressed as poorly graded gravel deposits and localized till deposits. It is also common to find loess deposits up to 3 feet thick in the Hayden Creek formation. The entire Hayden Creek formation is described as heavily oxidized to depths up to 30 feet.

Soil from borings and test pits conducted by Haley & Aldrich (during the 2019 initial Site investigation and 2022 RI) are generally consistent with expected outwash deposits of the Hayden Creek formation. Soil in the upland area generally consisted of sandy silts to silty sands with gravel in the upper 5 to 15 feet and silty gravel with sand and some cobbles to poorly graded coarse sand below 15 feet. Additionally, localized fine-grained organic deposits of silt and clay were found in low-lying vegetated

DRAFT

areas in the upper 5 feet during the 2019 initial Site investigation and the 2022 RI. Topsoil consisting of soil material with high organic content was generally encountered in the first couple of feet. Shallow soil encountered during the 2025 copper background study was consistent with the 2019 and 2022 investigations and consisted of sandy silts to silty sands with varying amounts of gravel, cobbles, and organics. Fill material was also encountered in the upper 5 to 10 feet containing concrete, wood, and metal debris. Silts and/or clay with sand and gravel was generally encountered below the topsoil and was observed up until approximately 5 to 15 feet bgs. Fill also contains TPH-like staining below 28 to 35 feet bgs in exploration B-2 (petroleum analytical results from soil sample collected at a depth of 30 to 35 feet bgs were not detected at or above laboratory reporting limits for TPH-G, TPH-D, and TPH-O). The outwash deposits were encountered below the fill. Till-like material was only observed in the bank samples taken on the west side of Rainey Creek, opposite of the Site. Based on observations during the emergency IRA construction and sediment samples collected along Rainey Creek, the sediment material generally consists of gray clayey sand with gravel and cobbles.

Generalized subsurface cross sections A-A' and B-B' are illustrated in Figures 4 and 5, respectively.

1.4.2 Hydrogeology

In 1992, groundwater was encountered during the excavation of Site A at approximately 10 to 11 feet bgs (AIRO, 1993). In 1993, at the former townsite (located to the northeast of the Site) groundwater was encountered during the assessment at approximately 6 to 11 feet bgs and flowed to the southwest, toward Riffe Lake, and that depth to groundwater varies seasonally (DOWL, 1993).

During the investigations, deeper groundwater in the upland area was generally encountered from 36 to 47 feet bgs (an approximate elevation of 710 to 721 feet), and shallower groundwater was generally encountered from 5 to 15 feet bgs (an approximate elevation of 741 to 754 feet). The elevation of Riffe Lake reservoir during the time of the Site investigations ranged from approximately 692.5 to 747.7 feet (Figure 6; U.S. Geological Survey, 2023). Figures 7A and 7B illustrate the shallow and deep groundwater elevations collected from the investigations and compared with the published Riffe Lake reservoir elevations, respectively. Groundwater measurements collected during the RI activities by Tacoma Power and Haley & Aldrich staff are presented in Table 1 (attached).

Based on the historical groundwater information and groundwater conditions found at the time of the investigations, deep groundwater levels are inferred to be tied to the reservoir levels, as we observed a stable deep groundwater elevation (around 717 to 720 feet) when lake levels are low and then an increase in deep groundwater elevations when the reservoir levels rise. The shallow groundwater levels have more seasonal variation in the winter and spring months (Figure 7B); however, there does seem to be some comparison to shallow groundwater elevations to reservoir levels, specifically in MW-3S (Figure 7A). Groundwater elevations may fluctuate as water is retained and released from the Mossyrock Dam. The depth to shallow groundwater generally ranged between 5 and 15 feet bgs (approximate elevation of 754 and 741 feet TCL). Based on the groundwater measurements at the Site, saturated soil was conservatively assumed to be at a depth of 5 feet bgs (approximate elevation of 752 feet TCL). Groundwater elevation contours for shallow and deep wells are illustrated in Figures 8 and 9, respectively.

1.5 CONCEPTUAL SITE MODEL

This section presents a conceptual site model (CSM) for the Site based on the data collected during the initial Site investigation, emergency IRA, and RI activities for the Site. The CSM identifies potential

DRAFT

sources of contamination, contaminant fate and transport mechanisms/pathways, and potential receptor groups (human and ecological) and exposure pathways. Development of a CSM is dynamic and iterative and may be refined as additional information becomes available. The CSM is the basis for developing technically feasible cleanup alternatives and selecting a final cleanup as part of the FS process. The current CSM for the Site is discussed below and depicted in Figure 10.

1.5.1 COCs

- Soil: TPH (the sum of TPH-G, TPH-D, and TPH-O), 1-methylnaphthalene, benzo(a)pyrene, cPAH-TEQ, fluoranthene, pyrene, lead, zinc
- Groundwater: TPH-D+O (the sum of TPH-D and TPH-O), 1-methylnaphthalene, fluoranthene, pyrene
- Surface water: none
- Sediment: none
- Air: none

1.5.2 Contaminant Sources and Release Mechanisms

Possible contaminant sources are from historical usage of petroleum products during the lumber mill operation from 1904 to sometime in the 1960s; unknown and former known leaking USTs, unknown and known UST piping, and petroleum-impacted soil associated with the former USTs; and possible unknown sources. During the initial Site investigations and emergency IRA protective cap excavation and construction, pipes and NAPL were discovered and appeared to be running in the direction of the seep areas. Additional pipes were discovered during RI activities near the location of the former UST Site A and scattered throughout the area of the former lumber mill. An abandoned culvert with petroleum-like odor was observed in the drainage ravine directly to the north of the cap location during the emergency IRA. An additional SPP ledge and layer were observed north of the ravine and within the ravine, respectively.

1.5.3 Contaminant Fate, Transport, and Exposure Routes

Possible contaminant transport routes from the Site were identified in the previous 2021 DSR. The primary transport mechanisms include leaching of chemicals in soil to groundwater, groundwater flow to surface water and sediment, and stormwater runoff to soils and/or sediments. The transport pathways could possibly result in exposures to ecological receptors within Rainey Creek and Riffe Lake, and potential human receptors via fish consumption and direct contact with contaminated soil or sediments. The following sections focus on the possible transport pathways and exposure routes from the Site.

The primary mechanisms likely to influence the fate and transport of chemicals at the Site include natural biodegradation of organic chemicals; sorption to soil and sediment; advection and dispersion in groundwater; volatilization of volatile chemicals from soil or groundwater to air; leaching of chemicals from soil to groundwater; and discharge of chemically impacted soil, groundwater, and sediment to surface water. The relative importance of these processes varies depending on the chemical and physical properties of the released contaminant. The properties of soil, sediment, and the dynamics of groundwater flow also affect contaminant fate and transport.

DRAFT

The fate and transport processes of heavy fuel oil depend on the composition of the contaminant and the environment affected by the contaminant. In general, when heavy fuel enters the environment, the individual products comprising the fuel partition to various environmental compartments according to their own physical-chemical properties (American Petroleum Institute, 2012).

The Site is partially vegetated and mostly unpaved, except for former mill structure concrete foundation slabs that are still visible. Therefore, the soil-to-groundwater migration pathway is complete for some analytes because of the potential for infiltration of precipitation through unpaved areas and through cracks in the former foundations into the vadose-zone soil. Leaching of near-surface soil impacts during precipitation events could result in impacts to shallow groundwater at the Site. In addition, transport parameters change when the Site is fully submerged. Lighter-than-water contamination will move vertically upward toward the water's surface when soil is fully saturated.

COCs identified to be present on the Site are discussed in Section 1.5.1 and their characteristics include the following:

- **TPH** refers to any mixture of hydrocarbons originating from crude oil. The mixture could include lighter fractions such as gasoline, as well as heavier fractions such as diesel oils, hydraulic fluids, and lubricating oils. Most of the soil samples appear to contain petroleum hydrocarbon distributions similar to weathered Bunker C fuel. In areas dominated by gasoline-range hydrocarbons, the hydrocarbon distributions are more representative of a weathered mineral spirit-like product(s). TPH can adsorb to soil particles, volatilize, and leach to and migrate in groundwater.
  - TPH results in shallow groundwater were flagged as not resembling the fuel standards used for quantitation and are likely associated with polar constituents such as petroleum metabolites (primarily from the aerobic biodegradation of petroleum) and natural organics. TPH-D and TPH-O were reported at concentrations exceeding typical aqueous solubilities for middle distillate fuels (e.g., diesel) or residual fuel oils (e.g., Bunker C). Given that the groundwater samples generally did not show any evidence of petroleum sheen or elevated turbidities, it is unlikely that the reported TPH-D and TPH-O detections in groundwater can be derived from middle to high molecular weight hydrocarbons. Furthermore, hydrocarbon concentrations reported in the EPH analyses, which utilize separation procedures that minimize the presence of polar constituents (silica gel cleanup), were typically much lower than the reported TPH-D+O concentrations. Individual PAHs and VOCs typically associated with petroleum products were also generally not encountered in the groundwater samples. The reported TPH detections (particularly in the diesel- and oil-ranges) are likely polar petroleum metabolites (e.g., organic acids, alcohols) and potentially natural organics.
- **Metals** occur naturally and can be deposited in the environment by anthropogenic means. They are dense compared to other common materials and are persistent in the environment. They do not degrade into nontoxic forms; however, they may be transformed into insoluble and biologically unavailable forms. Metals are transported primarily by being adsorbed on or absorbed in suspended particulate matter; therefore, soils and sediments are the most significant sink for metals. Certain metals (e.g., arsenic, lead, and mercury) can be bioaccumulative.
- **PAHs** are a group of organic compounds that are ubiquitous in the environment and are often associated with TPH. In general, PAHs do not dissolve easily in water and, because of their low

DRAFT

solubilities, typically partition into sediments and soils versus into groundwater. Solubility and bioaccumulation potential vary among different PAH compounds.

1.5.4 Potential Receptors and Exposure Pathways

For a contaminant to present a risk to human health and/or the environment, the pathway from the contaminant to the receptor must be complete. A complete exposure pathway consists of four necessary elements: (1) a source and mechanism of chemical release; (2) a transport or retention medium for released chemical(s); (3) a point of potential contact with the impacted medium (referred to as exposure point); and (4) an exposure route (e.g., soil ingestion) at the exposure point. The potential receptors and exposure pathways are presented below.

The sediment pathway is currently incomplete; however, because the Site may be seasonally submerged in the future, potential pathways are present. Potential transport pathways are as follows.

Soil

- Direct contact of soil exposure pathway (complete);
- Soil leaching-to-groundwater transport pathway (complete);
- Soil leaching-to-groundwater-to-sediment transport pathway (currently incomplete, could be complete in the future); and
- Soil leaching-to-groundwater-to-surface water transport pathways (currently incomplete, could be complete in the future).

Groundwater

- Groundwater-ingestion exposure pathway (currently incomplete, could be complete in the future);
- Groundwater-to-surface water transport pathway (currently incomplete, could be complete in the future); and
- Groundwater-to-sediment water transport pathway (currently incomplete, could be complete in the future).

Sediment

- Ingestion by humans of contaminated fish and shellfish exposed to contaminated sediment. Direct contact with and incidental ingestion of sediment by humans during shoreline recreation, clam-digging, net-fishing, etc. (currently incomplete, could be complete in the future).
- Benthic Community. Exposure of benthic species (species living in or on the sediment, including shellfish) through contact with, ingestion of, or filtration of contaminated sediment (currently incomplete, could be complete in the future).

1.5.5 Potential Exposure Scenarios

The primary purpose of the human health CSM is to identify potential receptor groups and to describe pathways by which those populations may be exposed to Site-related chemicals in the environment. Populations that may be exposed to contaminants at a Site and pathways by which these populations may come into contact with contaminants are identified. A complete pathway requires:

DRAFT

- A source and mechanism for release of constituents;
- A transport or retention medium;
- A potential environmental contact (exposure point) with the affected medium; and
- An exposure route at the exposure point.

The Property is currently vacant with signage and jersey barriers east of the Site; however, the Site will be accessible to the public as a recreational wildlife area, and this is expected to continue into the foreseeable future. The Site will be seasonally submerged in the future for recreation and to generate power at the Mossyrock Hydroelectric Dam, potentially changing the pathways for exposure and release.

Rainey Creek and Riffe Lake, which are directly adjacent to the Site and approximately 1,500 feet to the southwest, respectively, as well as the land on and around the Site provide habitat that have attracted recreational visitors in the past and most likely will in the future.

The CSM presented in this report is developed to ensure that all potentially significant pathways and receptors under current and reasonable future Site scenarios are evaluated. Based on the current (and potential future) Property use, the anticipated receptors may include construction workers and recreational users (including hunters and anglers). The following pathways are potentially complete for human exposure:

Construction Workers - Construction workers could potentially be exposed to chemicals in environmental media on the Site by the following pathways:

- Direct skin contact with or incidental ingestion of chemically impacted soil, sediment, or groundwater during excavations on the Site.
- Inhalation of wind-borne particulates on or migrating off Site from chemically impacted soil being handled or exposed during excavations on the Site.
- Inhalation of outdoor air vapors emanating from soil, sediment, or groundwater with volatile chemical impacts on Site or migrating off the Site.

Recreational Visitors and Anglers - The Property and the surrounding area is currently closed with signs to recreational visitors stating “Area Closed, No Trespassing”, indicating that the area is closed to the public and no trespassing is allowed with violators being subject to prosecution under Revised Code of Washington (RCW) 9A.52.080. Property roads are gated and not readily accessible by vehicles; however, pedestrians could access the area. Riffe Lake is still accessible to the general public, who could be exposed to chemicals migrating to the water or from the subsurface soils by the following potential pathways:

- Direct skin contact with and incidental ingestion of surface water or sediment from Rainey Creek or Riffe Lake that has been chemically impacted via discharges of chemically impacted groundwater migrating off the Site.
- Ingestion of chemicals bioaccumulated in the tissue of fish from chemically impacted surface water or sediment in Rainey Creek and Riffe Lake. Anglers may fish near the Site by boat or from accessible shoreline. Fish may be caught for personal consumption; fish tissue may bioaccumulate any chemicals present in sediment and surface water.

DRAFT

- Ingestion of chemicals bioaccumulated in terrestrial plants and/or animals from impacted soil at the Site.
- Direct skin contact with and/or incidental ingestion of chemically impacted soil near the seepage area.
- Inhalation of wind-borne particulates on or migrating off the Site from chemically impacted soil.
- Inhalation of outdoor air vapors emanating from soil or groundwater with volatile chemical impacts on or migrating off the Site.

Surface Water and Sediment - The Site and the surrounding area will be submerged in the future, creating new exposure pathways and receptors. When Riffe Lake submerges the Site, aquatic ecosystems and the general public could be exposed to chemicals migrating to the water or sediment by the following potential pathways:

- Human direct contact with surface water and sediment by recreational users and subsistence fishers.
- Direct contact with Riffe Lake surface water and sediment by aquatic ecological receptors (e.g., fish, invertebrates such as shellfish, birds, amphibians).
- Uptake of surface water/sediment contaminants into aquatic ecological species such as fish and shellfish (i.e., aquatic organism bioaccumulation), which then would be consumed as prey by humans.
- Uptake of surface water/sediment contaminants into aquatic ecological species, which then would be consumed as prey by upper-tropic-level aquatic ecological receptors.

Terrestrial Wildlife - There is potential for terrestrial wildlife to access the Property and be exposed to chemicals in the shallow surface soils by the following potential pathways:

- Direct contact with and/or ingestion of contaminated soil, sediments, or surface water through portions of the body contacting the ground, bathing, or through incidental contact with fugitive dust emissions from impacted areas.
- Inhalation of wind-borne particulates from chemically impacted soil.

1.6 PROPOSED CLEANUP LEVELS AND POINTS OF COMPLIANCE

The MTCA Method B CULs for the protection of direct contact and the most stringent CUL for the protection of potable groundwater, surface water via groundwater, and sediment via groundwater are used. Metals were compared to the Ecology-derived natural background concentrations, if the natural background concentrations exceeded the most stringent applicable CUL. TPH was compared to MTCA Method B soil CUL for the protection of groundwater quality: leaching pathway. Because the Site does not qualify for a terrestrial ecological evaluation (TEE) exclusion and will likely be used for utility/commercial uses in the future, MTCA Ecological Indicator Soil Concentrations for Protection of Terrestrial Animals (Table 749-3) are also used as proposed CULs. Furthermore, because the Site will potentially be submerged for part of the year in the future, soil COCs were also compared to freshwater sediment management standards. For groundwater COCs, MTCA Method B CULs for the protection of drinking water, surface water, and sediment are used.

DRAFT

Tables 2 and 3, below, summarize the proposed soil and groundwater CULs, respectively, selected for the Site COCs.

Table 2. Proposed Soil Cleanup Standards in mg/kg

Contaminant of Concern	Project CULs	Most Stringent CUL for the Protection of Potable Groundwater, Surface Water via Groundwater, and Sediment via Groundwater in Vadose/Saturated Zone Soil	Direct Contact	Site-Specific TEE (Commercial/ Industrial)	SMS Lower Tier Freshwater Benthic SCOs	Natural Background Concentrations
TPH[1]	1,000/550[2]	1,000/550	2,200	NA	NA	NA
TPH[1]	1,000/30	1,000/30[3]	1,500	NA	NA	NA
TPH-D	340	NA	NA	6,000	340	NA
Benzo(a)pyrene	0.1875[4]	0.0003/0.000015	0.1875	12	NA	NA
fluoranthene	0.02/0.001	0.02/0.0010	3,200	NA	NA	NA
pyrene	0.02/0.0015	0.02/0.0010	2,400	NA	NA	NA
1-Methylnaphthalene	0.0468/0.0024	0.0468/0.0024	19.6	NA	NA	NA
cPAH-TEQ	0.19[4]	0.084/0.0042	0.19	NA	NA	NA
Lead[4]	118	250/21	250	118	360	10.9
Zinc[4]	360	29.9/1.49	24,000	360	3,200	85.6

Notes:

SMS = Sediment Management Standards

1. *TPH value is the sum of TPH-G, TPH-D, and TPH-O.*
2. *The proposed CUL is the calculated Site-specific screening level for soil where mixed-range petroleum hydrocarbons are the primary constituent.*
3. *The proposed CUL is the calculated Site-specific screening level for soil where gasoline-range petroleum hydrocarbons are the primary constituent.*
4. *The soil to groundwater pathway is incomplete, thus the next most stringent applicable CUL is listed.*

Table 3. Proposed Groundwater Cleanup Standards in µg/L

Contaminant of Concern	Project CULs[1]
TPH-D+TPH-O	500
fluoranthene	0.02
pyrene	0.015
1-Methylnaphthalene	1.5

Notes:

µg/L = micrograms per liter

1. *The Project CULs are the most stringent values for the protection of groundwater, sediment, and surface water.*

Proposed points of compliance (POC) for this Site are the standard POC for soil and groundwater in accordance with WAC 173-340-740(6) and WAC 173-340-720(8).

Soil. The standard POC for soil CULs based on the protection of groundwater shall be established in the soil throughout the Site (WAC 173-340-740[6][b]). The groundwater level fluctuates between 5 and 15 feet bgs at this Site. The standard POC for soil CULs based on direct contact shall be established in the

DRAFT

soils throughout the Site from the ground surface to 15 feet bgs, which is a reasonable estimate of the depth that could be accessed during construction activities (WAC 173-340-740[6][d]). The standard POC for soil CULs based on ecological and benthic considerations shall be established in the soils from the ground surface to 6 feet bgs (WAC 173-340-740[6][e] and (WAC 173-340-7490[4][a]).

The POC for Site soil CULs is selected to be 15 feet bgs because it represents the most stringent depth in accordance with WAC 173-340-740(6) and WAC 173-340-720(8).

Groundwater. The standard POC shall be established throughout the Site from the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the Site (WAC 173-340-720[8][b]).

The POC for groundwater CULs at this Site is selected to be 15 feet bgs because the source of COCs is from the soil and 15 feet is the deepest (observed to date) the vadose zone flocculates at this Site.

The extent of COC impacts in soil and shallow groundwater at this Site is shown in Figures 11 and 12 and are described in detail in the 2025 RI report (Haley & Aldrich, 2025).

1.7 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This section identifies potential applicable or relevant and appropriate requirements (ARARs) for assessing and implementing remedial alternatives at the Site. The potential ARARs focus on federal, state, or local statutes, regulations, criteria, and guidelines. The types of potential ARARs evaluated for the Site include contaminant-, location-, and action-specific, as defined in the following paragraphs. Each type of potential ARAR is evaluated in Table 4 (attached), and applicable ARARs are listed below.

In general, only the substantive requirements of ARARs are applied to MTCA cleanup sites being conducted under a legally binding agreement with Ecology (WAC 173-340-710[9][b]). Therefore, cleanup actions under a formal agreement with Ecology are generally exempt from the procedural requirements specified in certain state and federal laws. This exemption also applies to permits or approvals required by local governments.

Contaminant-specific ARARs are usually health- or risk-based numerical values or methodologies that, when applied to Site-specific conditions, result in the establishment of numerical contaminant values that regulatory agencies generally recognize as protective of human health and the environment.

Applicable contaminant-specific ARARs include:

- United States Environmental Protection Agency (EPA) Clean Water Act (CWA) regulates pollution to waters of the United States (U.S.) as defined by the CWA.
- Washington State Water Quality Standards (WAC 173-201a) set limits for various hydrocarbons and metals in surface water to protect aquatic life and human health.
- National Primary Drinking Water Regulations establish maximum contaminant levels for organic and inorganic chemicals in drinking water.
- Washington MTCA (RCW 70A.305; Chapter 173-340 WAC) regulate soil and groundwater CULs.
- SMS (RCW 90.48 and 70.105D; Chapter 173-204 WAC) regulate sediment CULs.

DRAFT

Action-specific ARARs are relevant to specific cleanup action methods and technologies, and to actions conducted to support cleanup. Action-specific ARARs dictate how certain activities, such as treatment, disposal practices, and media monitoring programs, must be conducted. Typically, these ARARs are not fully defined until a preferred cleanup action has been selected and refined. However, considering the range of potential action-specific ARARs early in the process can help focus the selection of a preferred remedial alternative.

Applicable action-specific ARARs include the following.

- U.S. Clean Air Act (42 United States Code [USC] § 7401 et seq. and 40 Code of Federal Regulations [CFR] Part 50),Washington Clean Air Act and Implementing Regulations (RCW 70A.15; Chapter 173-400 WAC), and General Regulations for Air Pollution Sources (Southwest Clean Air Agency Section 400) protect ambient air quality by limiting air emissions and taking reasonable precautions to prevent fugitive dust from becoming airborne, which are applicable to remedial alternatives involving construction.
- U.S. Resource Conservation and Recovery Act (42 USC § 6901 et seq.), Subtitle D—Managing Municipal and Solid Waste (40 CFR Parts 257 and 258), and Washington Solid Waste Handling Standards (RCW 70A.205; Chapter 173-350 WAC) to establish guidelines and criteria for management of non-hazardous solid waste, which are applicable to remedial alternatives involving off-Site disposal of contaminated soil designated as non-hazardous waste. Washington Solid Waste Handling Standards (RCW 70.95 and WAC 173-351 and 173-304), establishes minimum standards for handling and disposing of solid waste, including contaminated soils, construction debris, and garbage generated during site remediation.
- U.S. Occupational Safety and Health Act (29 CFR Parts 1904, 1910, and 1926) and Washington Industrial Safety and Health Act (RCW 49.17; Title 296 WAC) to establish site worker and visitor health and safety requirements during implementation of the cleanup action.
- Underground Injection Control Program (WAC 173-218) establishes guidelines and criteria for the injection of biological or chemical oxidants into injection wells or trenches.
- Accreditation of Environmental Laboratories (RCW 43.21A.230 and WAC 173-50) required persons or organizations submitting analytical data under the purview of Ecology, Department of Health, and other entities, to use environmental laboratories which are accredited.
- U.S. Federal Water Pollution Control Act--Water Quality Certification (Clean Water Act; 33 USC § 1341, Section 401) and Implementing Regulations to obtain certification from the state that discharges will comply with applicable water quality standards.
- U.S. Army Corps of Engineers (USACE) Section 404 of the Clean Water Act regulates the discharge of dredged or fill material into Waters of the United States. Section 404 is potentially relevant to the Site because portions of the proposed cleanup construction work will occur below the ordinary high water mark.
- The Washington Hydraulic Code (RCW 77.55; Chapter 220-660 WAC) requires a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife for construction activities that use, divert, obstruct, or change the natural bed or flow of state waters. Although the cleanup action alternatives are not expected to divert, obstruct, or change flow, some work may occur below the ordinary high water mark; therefore, an HPA is likely required.

DRAFT

- Washington State Environmental Policy Act (SEPA - RCW 43.21C; Chapter 197-11 WAC) to identify and analyze environmental impacts associated with the selected cleanup action.
- Lewis County Stormwater Management (Lewis County Code [LCC] 15.45) provides guidelines for erosion control and construction stormwater management.
- Noise Control Act of 1974 (RCW 70.107, WAC 173-60, LCC 9.40) and Public Disturbance Noise (LCC Chapter 1.23) establishes maximum noise levels. Construction activities will be limited to normal working hours, to the extent possible, to minimize noise impacts.
- General Provisions (LCC 17.05) provides the authority for and procedures to be followed in regulating the physical development of Lewis County.
- Minimum Standards for Construction and Maintenance of Wells [RCW 18.104; Chapter 173-160 WAC] lists the minimum standards for the construction and decommissioning of water and monitoring wells.

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in a specific location. Some examples of special locations are floodplains, wetlands, historic sites, and sensitive ecosystems or habitats.

- U.S. Archaeological and Historic Preservation Act (16 USC § 469, 470 et seq.; 36 CFR Parts 65 and 800) and Washington Archaeological Sites and Resources (RCW 27.44, 27.48, and 27.53; Chapter 25-48 WAC) to establish requirements to preserve and recover significant artifacts, preserve historic and archaeological properties and resources, and minimize harm to national landmarks.
- Shoreline Management Act of 1971 (RCW 90.58) and implementing regulations and Shoreline Use Policies and Regulations (Lewis County Shoreline Master Program) actions are prohibited with 200 feet of shorelines of statewide significance unless permitted.

2. Cleanup Action Alternatives

This section describes the candidate remedial technologies that were identified and screened to develop potential remedial alternatives for further evaluation in this FS.

2.1 REMEDIAL ACTION OBJECTIVES

The primary objective for the FS and cleanup action is to identify and evaluate the most relevant remedial alternative that reduces contaminant exposure to levels that are protective to human health and the environment posed by the COCs. The goal of remedial actions at the Site is to protect human health and the environment. Remedial action objectives (RAOs) have been developed to protect receptors and provide the underlying basis for developing and evaluating remedial actions. These RAOs are presented as target goals to be achieved to the extent feasible and practicable. The RAOs for the Site are:

- Reduce or prevent potential risk to human health and/or the environment from hazardous substances at the Site;
- Prevent or limit potential exposure of current and future Site users or workers to hazardous substances;

DRAFT

- Prevent direct contact between human receptors and soil and/or groundwater that exceeds CULs; and
- Prevent migration of contamination into sediment and surface water.

2.2 CLEANUP ACTION TECHNOLOGY SCREENING

Remediation technologies considered in our evaluation are applicable to impacted soil and groundwater remediation, appropriate for the media at the Site, and capable of achieving the remediation objectives. We considered their reliability and relative cost, as well as whether they could be implemented effectively given contaminant characteristics and physical conditions at the Site.
The implementability of a technology—that is, the relative ease of installation and the time required to achieve a given level of performance—is assessed according to Site conditions. Implementability considers: (1) the technology's constructability (ability to build, construct, or implement the technology under actual Site conditions); (2) the time required to achieve the required level of performance as defined by the CULs and POC; (3) the technology's ability to be permitted; (4) the availability of the technology; and (5) other technology-specific factors.

To assess the reliability of a prospective technology, the EPA recommends identifying its stage of development, its performance record, and any inherent construction, operation, and maintenance problems. Technologies that are not fully demonstrated, perform poorly, or are unreliable should be eliminated (EPA, 1988). Relative costs of technologies and process options are used to distinguish between similar technologies with similar expected effectiveness. The alternatives retained for more detailed evaluation therefore are likely the most cost-effective and appropriate for the particular Site conditions.

Table 5 (attached) summarizes the screening assessment process, showing which technologies were retained for further evaluation and which were eliminated because of concerns about implementability, reliability, or cost. A total of 16 technologies were screened for this FS, of which eight were retained for further evaluation.

2.3 CLEANUP ACTION ALTERNATIVE DESCRIPTIONS

The technologies retained in the screening process were used to develop four remediation alternatives for further evaluation (Alternatives 1 through 4). The components of each alternative are summarized below and shown on Figures 13 through 15. The alternatives include compliance monitoring in accordance with WAC 173-340-410. Costs were estimated using cost estimates from vendors and subcontractors, RSMeans cost database, and recent Haley & Aldrich experience with similar items on other projects. Remediation alternative cost estimates are provided in Tables 6 through 9 (attached).

2.3.1 Alternative 1

Alternative 1 consists of the following components:

- Complete excavation and off-Site disposal of contaminated soil;
- Dewatering and treatment of impacted groundwater during construction;
- Replacement of excavated soils with clean fill;
- Soil sampling to confirm final excavation extent; and

DRAFT

- Compliance monitoring.

Excavation and Off-Site Disposal. Alternative 1 involves excavating soil exceeding applicable MTCA CULs from approximately 0 to 18 feet bgs. It also assumes the removal and off-Site disposal of the protective cap (that was installed during the 2019 Emergency IRA) and any residual contamination beneath it before Site closure, as well as any known left in-place pipes within the excavation depth, both inside and outside of the contaminated areas. The proposed locations of the excavation area (i.e., extent of soil contaminated area), protective cap, and known underground pipes are shown in Figure 13. The lateral and vertical excavation limits may be adjusted during construction based on the observed extent of soil contamination. For purposes of this FS and based on existing soil data and engineering estimations, it is assumed that no contaminated soil will be left in-place for this alternative. Approximately 18,200 cubic yards of COC-contaminated soil will be excavated and disposed of off-Site. The final extent of excavation for the Site will be determined based on field observations and will be confirmed with soil samples. Using a conversion factor of 1.5 from bank cubic yards to tonnage, this equates to an estimated 27,300 tons of COC-contaminated soil on the Site will be excavated and disposed of off-Site. Excavated soil and pipes are assumed to be non-hazardous and will be disposed of at a regulated Subtitle D landfill facility. Erosion control and site stabilization measures will be implemented during construction. Excavated areas will be backfilled to grade with clean imported fill and properly compacted.

A Sampling and Analysis Plan and a Quality Assurance Project Plan (SAP/QAPP) will be prepared to summarize compliance sampling procedures, locations, frequency, and analyses. Alternative 1 is shown in Figure 13 and the estimated cost is approximately $8,052,000 (Table 6, attached).

2.3.2 Alternative 2

Alternative 2 consists of the following components:

- Excavation and off-Site disposal of contaminated soil;
- Dewatering and treatment of impacted groundwater during construction;
- Replacement of excavated soils with clean fill;
- Soil sampling to confirm final excavation extent;
- Monitored natural attenuation (MNA);
- Institutional controls; and
- Compliance monitoring.

Excavation and Off-Site Disposal. The excavation and off-Site disposal approach in Alternative 2 will follow the same process described in Alternative 1, but will extend to a depth of 15 feet bgs (rather than 18 feet bgs). Alternative 2 involves excavating soil exceeding applicable MTCA CULs, removing the protective cap (and any residual contamination beneath it), as well as any known pipes left in place within the excavation depth, both inside and outside of the contaminated areas. Like Alternative 1, groundwater encountered during excavation will be dewatered and treated.

MNA. MNA relies on the natural processes of biodegradation, dispersion, dilution, sorption, volatilization, chemical stabilization, and/or biological stabilization to decrease (or “attenuate”) concentrations of contaminants in soil and groundwater. MNA is differentiated by natural attenuation in

DRAFT

that the Site is under intentional, long-term monitoring to demonstrate there are no increased levels of risk to human health and the environment. The MNA evaluation for the Site is provided below.

Natural attenuation includes a variety of physical, chemical, or biological processes that act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants (EPA, 1988). The known historical USTs, were removed in 1992 and no free product (i.e., NAPL) was observed during the 2022 and 2023 groundwater sampling, indicating that the source of petroleum impacts (i.e., residual contamination in soil) is contained.

MNA is most effective when the contaminant source has been removed and only small amounts of contaminants remain in the soil and/or groundwater. Natural attenuation is considered an appropriate remedy if requirements set out in WAC 173-340-370(7) are met. The explanations as to how these requirements are met are as follows:

1. *Source control (including removal and/or treatment of hazardous substances) has been conducted to the maximum extent practicable.* Several rounds of petroleum source removal activities have been conducted at the Site. Additional source removal is planned as described in Sections 2.3.1 through 2.3.4.
2. *Leaving contaminants on-Site during the restoration time frame does not pose an unacceptable threat to human health or the environment.* During the restoration time frame, potential receptors will be protected by institutional controls and compliance monitoring to prevent the use of groundwater as drinking water and to ensure groundwater COCs do not migrate to surface water and/or sediment.
3. *There is evidence that natural biodegradation or chemical degradation is occurring and will continue to occur at a reasonable rate at the site.* This criterion is determined by the following factors:
    a. *The status of the groundwater plume; if the plume is stable or shrinking, the restoration time frame will be shortened, and the plume will not continue to migrate and potentially impact other media or receptors.* The residual area of petroleum contamination is likely stable, because the TPH concentrations in shallow groundwater either decreased or remained stable during the quarterly groundwater sampling. Additionally, the likelihood of petroleum plume expansion is limited by the absence of free product observed during the RI Activities.
    b. *Destructive mechanisms of natural attenuation (i.e., chemical or biological degradation) are occurring and are substantial contributors to contaminant reductions observed at the Site. Over time, petroleum dissolved in groundwater becomes weathered through processes that include microbial biodegradation, adsorption to soil particles, volatilization, and dissolution or leaching. Biodegradation of petroleum in groundwater via microbial oxidation plays a major role in the weather process resulting in the creation of polar metabolites. A*s discussed in the 2025 RI report, the TPH-D and TPH-O detections and exceedances in shallow groundwater appear to be heavily influenced by polar metabolites, indicating that natural attenuation is occurring (Haley & Aldrich, 2025). According to Ecology's *Guidance on Remediation of Petroleum-Contaminated Ground Water by Natural Attenuation* (Ecology, 2005), geochemical indicators and physical observations of a reduced contaminant plume can be used to determine if natural attenuation will be effective. Dissolved oxygen concentrations measured in upgradient wells (MW-1S and MW-2S) were greater than downgradient wells (MW-3S and MW-4S), indicating that oxygen is being used as an electron acceptor.
4. *Appropriate monitoring requirements are conducted to ensure that the natural attenuation process is taking place, and that human health and the environment are protected.*

DRAFT

For Alternative 2, MNA will be used to address residual concentrations of COCs in groundwater. Five additional monitoring wells in the shallow groundwater will also be installed to establish background concentrations of natural attenuation parameters and further monitor the plume following cleanup actions (Figure 13).

Institutional Controls. Institutional controls will be applied in areas where groundwater concentrations exceed CULs. These controls include environmental covenants and administrative restrictions on land use and activities (e.g., groundwater extraction). The requirements for environmental covenants are presented in WAC 173-340-440(9).

A SAP/QAPP will be prepared to summarize compliance sampling procedures, locations, frequency, and analyses. Alternative 2 is shown in Figure 13 and the estimated cost is approximately $8,270,000 (Table 7, attached).

2.3.3 Alternative 3

Alternative 3 consists of the following components:

- Excavation and off-Site disposal of near surface contaminated soil;
- Excavation and off-Site disposal of metals-contaminated hot spots;
- Soil sampling to confirm final excavation extent;
- Placement of enhanced in-situ bioremediation (EISB) product (amended backfill);
- Replacement of excavated soils with clean fill;
- Institutional controls;
- MNA; and
- Compliance and performance monitoring.

Excavation and Off-Site Disposal. Alternative 3 includes excavation of soil exceeding applicable MTCA CULs from approximately 0 to 6 feet bgs, targeting the biologically active soil zone with institutional controls (Ecology, 2005), and targeted hot spot excavation (up to 10 feet) to remove soil with metals contamination. It also assumes the removal and off-Site disposal of the protective cap and any residual contamination beneath it, as well as any known left in place pipes within the excavation depth, both inside and outside of the contaminated areas. Lateral and vertical excavation limits may be adjusted based on the observed extent of soil contamination. Deeper soil contaminated by TPH and PAHs will be treated in-place using EISB to address potential residual soil impacts remaining beneath the water table. The areas that will be excavated and disposed of off-Site and treated in-place using EISB are shown in Figure 14. For purposes of this FS and based on existing soil data and engineering estimations, it is assumed that approximately 3,900 tons of contaminated soil will be treated in-place by EISB, while approximately 19,000 tons will be excavated and disposed of off-Site.

EISB. EISB is the injection or addition of oxygen release compounds (ORC) in the subsurface that stimulate aerobic biodegradation of target contaminants via the release of oxygen during the breakdown of metallic peroxide. In Alternative 3, amendments will be mixed with clean backfill and placed in the smear zone during backfilling. The treatment area will be intentionally saturated during the construction and amendment application to promote contact between the amendment and the target

DRAFT

treatment interval. Any potential inundation after application is not expected to shorten the ORC lifespan or redistribute the carbon amendment, provided the treatment interval remains saturated and hydraulic conditions do not create sustained, high-gradient flushing through the treatment zone. It is assumed that Regenesis' ORC or an approved equivalent product will be used, and Regenesis' technical team has confirmed the above interpretation. These flushing conditions are not anticipated based on historical groundwater flow conditions, the creek's lack of tidal influence, and because inundation is not expected to occur cyclically. Performance monitoring will be conducted to evaluate groundwater conditions, treatment performance, and potential effects of inundation on the treatment area.

After excavation of surficial contaminated soil, one application of amendments will be directly mixed in situ with clean backfill and placed within the smear zone. Additional applications via injection may be required based on compliance monitoring results (not included in cost estimate).

Demarcation Layer. Following excavation of the near surface soils, a continuous demarcation layer (e.g., orange geotextile fabric) would be placed over the excavation floor (after EISB and before backfilling). This alternative assumes that, after excavation of surface contaminants, the contaminants in the subsoil may be left in-place without harm to the surrounding environment. However, if contaminated soil is to be left in-place, a visual barrier should be installed to provide a warning to future workers that potentially contaminated soil remains beneath the barrier, in the event that work requires penetration of the ground surface in the area. It is assumed that an orange geotextile fabric would be an appropriate demarcation layer. The geotextile liner would allow for easy placement without installation damage by heavy equipment, and it is permeable.

MNA. Similar to Alternative 2, MNA will be implemented to reduce concentrations of COCs in residual groundwater in areas of the Site.

Institutional Controls. Similar to Alternative 2, institutional controls will be placed on the Site for the duration of the restoration time frame. Environmental covenants and administrative land use and activities restrictions would include areas with residual soil along with residual groundwater contamination.

A Soil Management Plan (SMP) will be prepared and implemented to guide any future construction activities that might disturb residual contaminated soil. The SMP will outline the location and proper handling and disposal of impacted soil during any potential construction activities. The impacted soil would be addressed at the time of construction.

Additional institutional controls may include on-Site features (such as signs) and educational programs (such as worker training).

A SAP/QAPP will be prepared to summarize compliance sampling procedures, locations, frequency, and analyses. Alternative 3 is shown in Figure 14 and the estimated cost is approximately $8,135,000 (Table 8, attached).

2.3.4 Alternative 4

Alternative 4 consists of the following components:

- Excavation and off-Site disposal of near-surface contaminated soil;

DRAFT

- Excavation and off-Site disposal of metals-contaminated hot spots;
- Placement of EISB product (amended backfill);
- Replacement of excavated soils with clean fill;
- Soil sampling to confirm final excavation extent;
- Installation of a Permeable Sorptive Barrier (PSB);
- MNA;
- Institutional controls; and
- Compliance monitoring.

The **Excavation and Off-Site Disposal, EISB,** and **Demarcation Layer** components in Alternative 4 will be identical to the processes described in Alternative 3.

PSB. Alternative 4 also includes the injection and placement of liquid-activated carbon and electron acceptors into the shallow groundwater, smear zone, and over residual contaminated soil in a barrier-wall formation to intercept and remediate current and potential future groundwater flow to surface water. Activated carbon works as a sorbent for organic (carbon-based) compounds, while electron acceptors stimulate hydrocarbon biodegradation in-place. Contaminant removal by sorption is a function of the mass of available sorbent, its sorption equilibrium with contaminant mass, and the desorption and biodegradation rates. The PSB will be installed via 120 temporary injection points placed downgradient of residual contamination, screened from 6 to 25 feet bgs (see Figure 15). The injected amendments will be placed at the bottom of the excavation.

The remedial program will be designed based on the nature of the contaminant, the target groundwater matrix, distribution, and assumption that the Site will be inundated in the future. For cost estimating purposes, this FS assumed the PSB program will include injections and placement at the bottom of excavation of Regenesis PetroFix. Regenesis PetroFix (liquid) carbon and electron acceptors were chosen for cost estimating purposes based on prior experience and case studies demonstrating its effectiveness for Site COCs and application to sites near waterbodies. The two most relevant case studies to this alternative are provided by Regenesis in Appendix A. One study is an in-situ approach with injections applied next to a lake. The second study is an in-situ approach with injections at 10 to 20 feet bgs that were not affected by severe weather, including storm damage from a Category 5 hurricane. The PSB is expected to remain effective for 10 to 20 years, with a second application of liquid carbon assumed in year 15. The necessity, scope, and timing of the second application will be dependent and adjusted based on performance monitoring results and site accessibility due to inundation.

MNA. MNA will be implemented to address residual groundwater contamination in areas not downgradient of the PSB. Long-term monitoring will ensure protection of human health and the environment.

Institutional Controls. Institutional controls will be placed on all Site properties for the duration of the restoration time frame. These include environmental covenants and administrative restrictions on land use and activities (e.g., groundwater extraction).

DRAFT

A SAP/QAPP will be prepared to summarize compliance sampling procedures, locations, frequency, and analyses. Alternative 4 is shown in Figure 15 and the estimated cost is approximately $8,541,000 (Table 9, attached).

2.3.5 Compliance Monitoring and Maintenance

Monitoring, such as dust monitoring during excavation, will be conducted during implementation of the cleanup action alternative to confirm that human health and the environment are adequately protected during construction. Soil sampling will confirm excavation limits meet regulatory compliance under Alternatives 1 and 2.

Groundwater confirmation monitoring will be conducted under all alternative scenarios to verify that cleanup standards have been achieved. Five additional monitoring wells (including one to establish background parameters) will be installed in the shallow groundwater plume to monitor the conditions following cleanup actions and ensure the plume has been sufficiently remediated (Figure 13).

Tacoma Power intends to provide Site access for compliance monitoring. Reservoir water levels have not recently been intentionally suppressed, except when severe weather requires Tacoma Power to release water and temporarily inundate the Site. Since the project began seven years ago, the Site has been inundated three times for short durations (February 2020, December/January 2025, and March/April 2026). These short-term inundation events are not expected to affect compliance monitoring.

If Tacoma Power raises water levels, access will need to be evaluated and restored so the wells remain accessible during monitoring events. The remedial design could address well completion details, access provisions, and maintenance requirements needed to support long-term monitoring. If a monitoring well becomes inaccessible or unsuitable for sampling, Tacoma Power will repair, modify, or replace the well, as needed, to maintain a compliant monitoring network. If temporary inundation occurs due to extreme weather, the compliance monitoring schedule may need to be adjusted to allow water levels to recede enough for safe and practical access to monitoring wells.

Compliance monitoring for MNA is expected to be feasible long-term, provided the monitoring network remains accessible and functional. The potential monitoring schedule for each alternative is summarized below and reflected in the cost tables (Tables 6 through 9).

- Alternative 1: one year of quarterly Site closure monitoring.
- Alternative 2: four years of semi-annual compliance monitoring and one year of quarterly Site closure monitoring.
- Alternative 3: up to 30 years of five -year compliance monitoring and one year of quarterly Site closure monitoring.
- Alternative 4: up to 30 years of five -year compliance monitoring and one year of quarterly Site closure monitoring.

2.3.6 Restoration Timeline

The restoration timelines for Alternatives 1 and 2 are one year and five years, respectively. The effectiveness of these two alternatives is not expected to be impacted by the relatively short restoration timelines.

DRAFT

The restoration timelines for Alternatives 3 and 4 are up to 30 years. These alternatives would combine active source-area treatment with MNA to achieve long-term cleanup objectives. Each of these alternatives includes targeted hot spot excavation to remove higher-concentration source material and reduce contaminant mass, followed by EISB to further treat residual impacts in the smear zone and groundwater. MNA would then address remaining concentrations through naturally occurring processes such as biodegradation, dilution, dispersion, sorption, and volatilization, where applicable.

The 30-year restoration timeframe was assumed for comparative evaluation purposes and does not represent a fixed remedy duration. Long-term effectiveness would be assessed through compliance monitoring, including groundwater sampling and evaluation of contaminant concentration trends, geochemical conditions, and attenuation indicators. If monitoring shows that an alternative is not progressing toward cleanup standards as expected, the remedy could be adjusted through contingency actions (i.e., additional amendment injections, expanded treatment areas, or additional source removal). Based on the combination of source removal, active in-situ treatment, and performance monitoring, Alternatives 3 and 4 are expected to remain effective over the long term.

3. Evaluation of Cleanup Action Alternatives

3.1 GENERAL REQUIREMENTS

3.1.1 Protect Human Health and the Environment

The alternative must provide for overall protection of human health and the environment, including likely vulnerable populations and overburdened communities.

All of the alternatives prevent human and ecological exposure by remediating the source area and/or monitoring the groundwater plume for the duration of the restoration time frame.

3.1.2 Comply With Cleanup Standards

The alternative must comply with cleanup standards (CULs and the POCs where such CULs must be met) as established in WAC 173-340-700 through 173-340-760.

All four alternatives comply with cleanup standards as proposed in Section 1.6 by removing and permanently disposing of contaminated soil and/or containing contaminated soil under the requirements specified in WAC 173-340-740(6)(f).

3.1.3 Comply with Applicable State and Federal Laws

The alternative must comply with both applicable requirements and requirements determined to be relevant and appropriate, as defined through WAC 173-340-710. Additionally, the alternative must address local, state, and federal laws related to environmental protection, health and safety, transportation, and disposal.

All four cleanup action alternatives will attain and comply with all applicable ARARs, which are summarized in Table 4 (attached) and listed in Section 1.7.

DRAFT

3.1.4 Prevent or Minimize Releases and Migration of Hazardous Substances

The alternative must prevent or minimize present and future releases and migration of hazardous substances in the environment.

It is assumed that the Site will remain vacant over the foreseeable future and will be seasonally submerged up to six months out of the year. All four cleanup action alternatives prevent or minimize the present and future release and migration of COCs by removing or treating contaminated soil and/or groundwater or by containing contaminated soil and groundwater with a downgradient PSB.

3.1.5 Provide Resilience to Climate Change Impacts

The alternative must demonstrate resilience to climate change impacts that are highly likely to occur and could severely compromise its long-term effectiveness.

All four cleanup alternatives incorporate climate change resilience by permanently removing or treating contaminated soil and by continuously monitoring residual impacts in groundwater.

3.1.6 Provide for Compliance Monitoring

The alternative must provide for compliance monitoring, as established under WAC 173-340-410 and WAC 173-340-720 through 173-340-760. There are three types of compliance monitoring: protection, performance, and confirmational. Protection monitoring is designed to protect human health and the environment during the construction and operation and maintenance phases of the cleanup action. Performance monitoring confirms that the cleanup action has met cleanup and/or performance standards. Confirmational monitoring confirms the long-term effectiveness of the cleanup action once cleanup standards have been met or other performance standards have been attained.

All four cleanup action alternatives would meet compliance monitoring requirements, as each involves varying levels of all three types of monitoring.

3.1.7 Not Rely Primarily on Institutional Controls and Monitoring

A cleanup action should not rely primarily on institutional controls and monitoring when it is technically feasible to implement a more permanent remedy.

All four of the cleanup action alternatives meet this requirement, as none rely primarily on institutional controls and monitoring.

3.1.8 Not Rely Primarily on Dilution and Dispersion

The regulations state that cleanup actions should not rely primarily on dilution and dispersion unless the incremental costs of any active cleanup action measures over the costs of dilution and dispersion grossly exceed the incremental degree of benefits of active cleanup action measures over the benefits of dilution and dispersion.

All four cleanup action alternatives meet this requirement, as none rely on dilution or dispersion.

DRAFT

3.1.9 Reasonable Restoration Time Frame

The alternative must provide a reasonable restoration time frame. As laid out in WAC 173-340-360(4), determining whether an alternative provides for a reasonable restoration time frame involves balancing risks against the practicability of achieving a shorter time frame. The factors considered in evaluating whether the restoration time frame is reasonable are listed in WAC 173-340-360(4)(b) and include:

- The potential risks posed by the Site to human health and the environment, including likely vulnerable populations and overburdened communities.
- The practicability of achieving a shorter restoration time frame.
- Long-term effectiveness of the alternative. A longer restoration time frame may be selected if the remedy has a greater degree of long-term effectiveness than one that primarily relies on disposal, isolation, or containment.
- Current uses of the Site, surrounding areas, and associated resources that are or may be affected by releases from the Site.
- Potential future uses of the Site, surrounding areas, and associated resources that are or may be affected by releases from the Site.
- Availability of alternative water supplies.
- Likely effectiveness and reliability of institutional controls.
- Ability to control and monitor migration of hazardous substances from the Site.
- Toxicity of the hazardous substances.
- Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the Site or under similar Site conditions.
- Public concerns and Indian Tribes' rights and interests for Ecology-conducted or Ecology-supervised cleanup actions.

The restoration time frame, as defined in WAC 173-340-360, refers to the period required for a cleanup action to achieve the CULs at the POC. For this FS, the assumed restoration time frames are as follows:

- **Alternative 1:** Two years
- **Alternative 2:** Five years
- **Alternatives 3 and 4:** 30 years

All four alternatives are considered to provide a reasonable restoration time frame.

3.1.10 Use Permanent Solutions to the Maximum Extent Practicable

As outlined in WAC 173-340-360 (5) and in accordance with Publication 25-09-059 Guidance for Permanent to the Maximum Extent Practicable (PMEP), evaluation of this requirement involves conducting a disproportionate cost analysis (DCA), wherein the costs and benefits of each alternative are assessed, as defined by several evaluation criteria. The specific criteria that must be evaluated are specified in WAC 173-340-360(5)(d) and are discussed in Section 3.5, and the results of the DCA are discussed in Section 3.6.

DRAFT

3.2 ACTION-SPECIFIC REQUIREMENTS

A number of action-specific requirements are also listed in WAC 173-340-360(3)(b), although not all of these requirements are applicable to the Site or the alternatives being considered. The alternatives all meet the action-specific requirements, if applicable, as described below.

3.2.1 Remediation Levels

Remediation levels are defined as the particular concentration of a hazardous substance in any media above which a particular cleanup action component will be required as part of a cleanup action at the site; see WAC 173-340-200. Specific requirements pertaining to use of remediation levels are in WAC 173-340-355.

3.2.2 Institutional Controls

Institutional controls must comply with the specific requirements of WAC 173-340-440 and should demonstrably reduce risks to ensure a protective cleanup action. This requirement is applicable because three of the four alternatives include institutional controls. The alternatives that include institutional controls will meet this requirement because they will comply with the requirements of WAC 173-340-440, including documenting institutional controls in a restrictive covenant on the Property and notifying local governments.

3.2.3 Financial Assurances

Financial assurances must be provided at sites where the remedy includes engineered and/or institutional controls, in accordance with WAC 173-340-440(11). This requirement is applicable because three of the four cleanup alternatives include institutional controls. Financial assurances shall be of sufficient amount to cover all costs associated with operation and maintenance of the cleanup action, including institutional controls, compliance monitoring, and corrective measures.

3.2.4 Periodic Reviews

Periodic reviews must be conducted in accordance with WAC 173-340-420(2), including whenever Ecology conducts a remedy and whenever Ecology approves a remedy under an order, AO or consent decree. This requirement is applicable since the City of Tacoma is under an AO with Ecology is conducting the remedy.

3.3 MEDIA-SPECIFIC REQUIREMENTS

A number of media-specific requirements are also listed in WAC 173-340-360(3)(c), although not all of these requirements are applicable to the Site or the alternatives being considered. The alternatives all meet the media-specific requirements, if applicable, as described below.

3.3.1 Soil at Current or Potential Future Residential Areas and Childcare Centers

Specific requirements pertaining to soil cleanup at current or potential future residential areas, schools, and childcare centers are found in WAC 173-340-360(3)(c)(i). Since the Property is zoned as commercial/industrial, these requirements are not applicable to the cleanup action alternatives.

DRAFT

3.3.2 Groundwater Cleanup Actions

This requirement states that a permanent cleanup action shall be used to achieve the CULs for groundwater at the standard POCs where a permanent cleanup action is practicable or determined by the department to be in the public interest (WAC 173-340-360[3][c][ii]). The requirement also states that a nonpermanent groundwater cleanup action must treat or remove the source of groundwater contamination and contain contaminated groundwater to the maximum extent practicable (WAC 173-340-360[3][c][iii]).

This requirement is applicable because groundwater is an impacted media at the Site. While all of the alternatives are permanent, they are so to varying degrees. All alternatives comply with this media-specific requirement because they include active source area removal, treatment, and/or containment of contaminated groundwater to the maximum extent practicable.

3.4 CONSIDERATION OF PUBLIC CONCERNS

While Ecology is developing updated guidance for identifying and considering likely vulnerable populations and overburdened communities when conducting feasibility studies (Ecology Publication 25-09-059), the PMEP guidance identifies considerations for documenting cleanup action alternatives and DCAs. Consistent with the PMEP guidance, the RI report evaluated potential environmental justice concerns using EPA 's EJScreen tool and the Washington Environmental Health Disparities Map.

The RI environmental justice review identified indicators of likely vulnerable populations and overburdened communities within the area surrounding the Site. Specifically, the area within 5 miles of the Site is below the 80th percentile for EPA EJScreen pollution and source indices, but exceeds the 80th percentile for several socioeconomic indicators. The Washington Environmental Health Disparities Map also identifies the Site census tract as having elevated socioeconomic and sensitive-population rankings. These results show that the surrounding community includes socioeconomic and sensitive-population indicators that warrant consideration in the FS, cleanup alternative evaluation, and DCA.

Cleanup alternatives may affect likely vulnerable populations and overburdened communities by changing current and future exposure conditions for construction workers, recreational users, hunters, anglers, subsistence fishers, and ecological receptors. These potential effects are relevant because the Property is expected to be available for future public recreational use and may be seasonally submerged. Potential short-term impacts during implementation could include dust generation, erosion, stormwater impacts, truck traffic, contaminated material handling, and disturbance to Rainey Creek or Riffe Lake. Potential long-term impacts and benefits could include reduced exposure potential, protection of surface water and sediment, improved remedy reliability under recreational and seasonal inundation conditions, and the degree or reliance on long-term institutional or engineering controls.

Consistent with the PMEP guidance, the cleanup action alternative evaluation and DCA considered these potential impacts when ranking, scoring, and weighting the benefit criteria where appliable. Alternatives were ranked or scored more favorably when they would more reliably reduce exposure potential, remain protective under future recreational and seasonal inundation conditions, reduce reliance on long-term controls, and better manage short-term construction risks. These considerations were reflected primarily in protectiveness, permanence, long-term effectiveness, and management of implementation risks. The DCA did not apply a separate numerical environmental justice adjustment, but it informed the ranking, scoring, and, where applicable, weighting of the relevant benefit criteria.

DRAFT

These considerations affected the DCA outcome by supporting higher relative scores for alternatives that provide more reliable long-term protection, greater permanence, and lower potential for disproportionate short- or long-term impacts to nearby communities and resource users. Alternatives with greater reliance on long-term controls, greater implementation risks, or higher potential to affect potential users were ranked less favorably under the applicable benefit criteria.

The DCA also considered Tribal rights and interests by evaluating how each alternative would protect surface water, sediment, fish, aquatic habitat, and future recreational or fishing uses associated with Rainey Creek and Riffe Lake. These considerations were reflected primarily in the protectiveness, permanence, and long-term effectiveness criteria, and, where relevant, in the management of implementation risks for alternatives that may involve work near or within aquatic areas.

For this remedy, Ecology will also provide a mandatory public review and comment period on the FS. All public comments and concerns will be taken into consideration when finalizing the FS.

3.5 DCA CRITERIA AND PROCEDURE

Alternatives that meet requirements for cleanup actions are assessed to determine which use permanent solutions to the maximum extent practicable per WAC 173-340-360(5). This assessment is conducted by performing a DCA. A DCA was conducted for all four alternatives since all alternatives meet the cleanup action requirements.

3.5.1 DCA Criteria

The alternatives are compared by evaluating the following criteria: protectiveness, permanence, cost, effectiveness over the long term, management of implementation risks, and technical and administrative implementability. These evaluation criteria are defined below. The regulation gives a general discussion of the types of factors to consider when evaluating each criterion.

3.5.1.1 Protectiveness

The overall protectiveness provided by the alternative to human health and the environment, including likely vulnerable populations and overburdened communities. The degree to which existing risks are reduced, the time required to reduce risks at the Site and attain cleanup standards, the on- and off-Site risks remaining after implementing the alternative, and the improvement of the overall environmental quality provided by the alternative are evaluated against this criterion. For the purposes of the DCA evaluation, it is assumed that the Site will remain vacant and be seasonally submerged in the future.

3.5.1.2 Permanence

This criterion evaluates the degree to which the alternative permanently reduces the toxicity, mobility, or mass of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment processes, and the characteristics and quantity of treatment residuals generated.

DRAFT

3.5.1.3 Cost

This criterion evaluates the costs associated with the alternative, including construction costs (e.g., preconstruction engineering design and permitting, physical construction, waste management and disposal, compliance monitoring, establishment of institutional controls, and regulatory oversight) and postconstruction costs (e.g., operation and maintenance activities, replacement or repair of equipment, permit renewal, compliance monitoring, institutional controls, financial assurances, periodic reviews, and regulatory oversight).

3.5.1.4 Long-Term Effectiveness

Long-term effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on Site at concentrations that exceed CULs, the resilience of the alternative to climate change impacts, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. The following types of cleanup action components can be used as a guide, in descending order, when assessing the relative degree of long-term effectiveness: reuse or recycling; destruction or detoxification; immobilization or stabilization; on- or off-Site disposal in an engineered, lined, and monitored facility; on-Site isolation or containment with attendant engineering controls; and institutional controls and monitoring.

3.5.1.5 Implementation Risks

This criterion evaluates the risk to human health and the environment, including likely vulnerable populations and overburdened communities, associated with the alternative during construction and implementation, and the effectiveness of measures taken to manage such risks.

3.5.1.6 Technical and Administrative Implementability

This criterion assesses the ability of the alternative to be implemented, including consideration of the technical difficulty of designing, constructing, and implementing the alternative in a reliable and effective manner; availability of necessary off-Site facilities, services, and materials; administrative and regulatory requirements; scheduling, size, and complexity; monitoring requirements; access for construction operations and monitoring; and integration with existing Site operations and other current or potential cleanup actions.

3.5.2 DCA Procedure

To conduct the DCA, the alternatives are ranked by degree of permanence and the alternative that provides the greatest degree of permanence shall be the baseline remedial alternative (WAC 173-340-360[5][c][iii]).
The DCA evaluated cleanup action alternatives using the benefit criteria identified in Ecology Publication 25-09-059, Guidance for Making Cleanups Permanent to the Maximum Extent Practicable. Detailed DCA scoring and evaluation of the alternatives are provided in Table 10. The criteria were weighted to reflect their relative importance in evaluating overall environmental benefit. Protectiveness and long-term effectiveness were each assigned the highest weight, 30 percent, because they directly evaluate the ability of an alternative to reduce risk, protect human health and the environment, and maintain reliable cleanup performance over time. Permanence was assigned a weight of 20 percent, consistent with Ecology's preference for cleanup actions that permanently reduce the toxicity, mobility, or volume of

DRAFT

hazardous substances where practicable. Short-term risks and implementability were each assigned a weight of 10 percent because they affect construction-phase impacts and practical feasibility, but generally do not outweigh the primary objectives of achieving a protective, durable, and permanent cleanup action. This weighting approach emphasizes alternatives that provide reliable long-term protection and meaningful contaminant reduction, while also considering temporary implementation risks and practical constraints.

Professional judgment was used to score the alternatives on a scale of 1 (lowest) to 10 (highest) against the five non-cost DCA criteria outlined in Section 3.5.1.

A total weighted benefits score is obtained for each alternative by multiplying the five non-cost scores by their corresponding weighting factors and summing the weighted values. When assessing whether a remedial alternative uses permanent solutions to the maximum extent practicable, the test used WAC 173-340-360[5][c][iv], as follows:

> *"First, compare the costs and benefits of the baseline alternative with the costs and benefits of only the next most permanent alternative (not any of the other alternatives); and second, determine whether the incremental costs of the baseline alternative over the next most permanent alternative are disproportionate to the incremental degree of benefits of the baseline alternative over the next most permanent alternative.*
>
> *If the incremental costs are not disproportionate to the incremental degree of benefits, then the baseline alternative uses permanent solutions to the maximum extent practicable and the analysis under this subsection is complete.*
>
> *If the benefits of the two alternatives are the same or similar, then the lower cost alternative uses permanent solutions to the maximum extent practicable and the analysis under this subsection is complete.*
>
> *If the incremental costs are disproportionate to the incremental degree of benefits, then eliminate the baseline alternative from further analysis and make the next most permanent alternative the baseline for future analysis."*

3.6 DCA EVALUATION

We evaluated the alternatives against the DCA criteria outlined in Section 3.5.1, to determine whether the costs associated with each cleanup alternative are disproportionate relative to the incremental benefit of a lower-cost alternative. For the purposes of the DCA evaluation, it is assumed that the Site remain vacant and be seasonally submerged in the future. The evaluation of the DCA criteria for each alternative is summarized below and in Table 10 (attached).

The total weighted benefit score ranged from 5.9 for Alternative 3 to 8.5 for Alternative 1, and the costs ranged from $8,052,000 for Alternative 1 to $8,541,000 for Alternative 4. The components of these costs and assumptions made in the estimates are detailed in Tables 6 through 9 (attached).

The cleanup action alternatives are ranked by degree of permanence. This FS determined that Alternative 1 is the most permanent, followed by Alternatives 2, 4, and 3. The most permanent

DRAFT

alternative serves as the baseline cleanup action alternative against which the other alternatives are compared. Therefore, Alternative 1 is used as the baseline alternative.

Table 10 (attached) outlines the DCA evaluation, which is discussed further below, and Table 11 (attached) summarizes the DCA calculations and scoring.

The baseline alternative (Alternative 1) was compared to the next most permanent alternatives, and evaluated against the other DCA benefit criteria and scored on a weighted basis. Alternative 1 was determined to be the most protective and permanent option, with the shortest restoration time frame and lower long-term costs compared to the other alternatives. Therefore, Alternative 1 was selected as the apparent PMEP alternative.

4. Selected Cleanup Action Alternative

Alternative 1 has been selected as the preferred cleanup action alternative because it is the apparent PMEP alternative, as determined by the DCA. This alternative involves full excavation of contaminated soil to a depth of approximately 18 feet bgs. Impacted groundwater encountered during excavation will be dewatered, treated on Site, and properly disposed of. Confirmation soil samples will be collected from the excavation boundaries to verify that remaining in-place soil meets CULs. Following construction, groundwater performance monitoring will be conducted to ensure no residual groundwater contamination remains. Implementing this cleanup action will achieve the Site's cleanup action objectives.

DRAFT

References

1. AIRO Environmental Services, 1993. *Site Assessment Report, Former Kosmos Mill Site, Glenoma, WA*. Prepared for Tacoma Public Utilities by Airo Environmental Services Inc. March 31.

2. American Petroleum Institute, 2012. *Heavy Fuel Oils Category Analysis and Hazard Characterization*. Prepared for the US Environmental Protection Agency by The American Petroleum Institute Petroleum HPV Testing Group.

3. DOWL Engineers, 1993. *Site Characterization & Cleanup Action Report, Former Kosmos Townsite, Lewis County, WA*. Prepared for Tacoma Public Utilities by DOWL Engineers, June.

4. Haley & Aldrich, Inc. (Haley & Aldrich), 2021a. *Data Summary Report, Kosmos Mill Oil Cleanup, Kosmos Flats Area*. Prepared for Tacoma Public Utilities. February 19.

5. Haley & Aldrich, 2021b. *Remedial Investigation Work Plan, Kosmos Mill Oil Cleanup, Kosmos Flats Area*. Prepared for Tacoma Public Utilities. December 30.

6. Haley & Aldrich, 2025. *Public Review Draft Report, Former Kosmos Mill Remedial Investigation, Kosmos Flats Area.* Prepared for Tacoma Public Utilities, November.

7. United States Environmental Protection Agency, 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. OSWER Directive 9355.3-01. EPA-540-G89-004. October.

8. U.S. Geological Survey, 2023. United States Geological Survey National Water Information System for Riffe Lake Near Mossyrock, WA, Site 14234800, data accessed November. https://waterdata.usgs.gov/monitoring-location/USGS-14234800.

9. Washington State Department of Ecology (Ecology), 2005. Focus on Developing Soil Cleanup Standards Under the Model Toxics Control Act. Toxics Cleanup Program, Revised April.

10. Ecology, 2023. User's Guide for MTCATPH 12.0 & MTCASGL 12.0 Workbook Tools for Calculating Soil and Groundwater Cleanup Levels under the Model Toxics Control Act Cleanup Regulation, Toxics Cleanup Program, Revised November.

11. Ecology, 2025. Preliminary Cleanup Level Workbooks for South Lake Union. February.

DRAFT

TABLES

DRAFT

TABLE 1
MONITORING WELL CONSTRUCTION DETAILS AND GROUNDWATER ELEVATIONS
FORMER KOSMOS MILL
MORTON, WASHINGTON

Monitoring Well	Completion Date	Groundwater Measurement Date	TOM Elevation (ft TCL)	TOC	Total Depth (ft bgs)	Casing Diameter (in)	Screen Length (ft)	Depth to Top of Screen (feet bgs)	Depth to Bottom of Screen (feet bgs)	Top of Screen Elevation (ft TCL)	Bottom of Screen Elevation (ft TCL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft TCL)
MW-1S	6/27/2022	6/29/2022	757.25	756.87	20	2	10	5	15	751.87	741.87	5.00	751.87
		8/10/2022										10.43	746.44
		8/16/2022										11.48	745.39
		8/25/2022										13.02	743.85
		9/1/2022										14.47	742.40
		9/6/2022										15.12	741.75
		9/15/2022										15.12	741.75
		9/22/2022										15.12	741.75
		9/29/2022										15.12	741.75
		10/6/2022										15.12	741.75
		10/11/2022										15.09	741.78
		10/18/2022										15.12	741.75
		10/24/2022										15.12	741.75
		10/31/2022										N/A	N/A
		11/7/2022										11.71	745.15
		11/15/2022										9.58	747.29
		11/21/2022										11.12	745.74
		11/28/2022										11.68	745.19
		12/5/2022										11.12	745.74
		12/12/2022										8.99	747.88
		12/19/2022										10.04	746.83
		12/27/2022										9.38	747.48
		1/3/2023										N/A	N/A
		1/10/2023										8.17	748.70
		1/17/2023										9.15	747.71
		1/25/2023										8.53	748.34
		2/1/2023										9.48	747.38
		2/7/2023										9.97	746.89
		2/16/2023										8.20	748.66
		2/23/2023										7.28	749.58
		3/2/2023										9.35	747.52
		3/8/2023										8.92	747.94
		3/15/2023										5.18	751.68
		3/23/2023										9.02	747.84
		3/28/2023										9.12	747.75
		4/6/2023										9.02	747.84
		4/19/2023										7.87	748.99
		4/28/2023										7.41	749.45
		5/2/2023										8.43	748.43
		5/8/2023										9.78	747.09
		5/16/2023										10.63	746.24
		6/2/2023										11.94	744.92
		6/13/2023										15.52	741.35
		6/26/2023										13.48	743.38
		7/11/2023										14.99	741.87
		7/24/2023										14.99	741.87
MW-1D	10/31/2022	11/15/2022	757.217	756.72	60	2	20	38	58	719.22	698.72	37.53	719.18
		11/21/2022										36.25	720.46
		11/28/2022										36.45	720.27
		12/5/2022										36.25	720.46
		12/12/2022										37.50	719.22
		12/19/2022										38.06	718.66
		12/27/2022										37.47	719.25
		1/3/2022										N/A	N/A
		1/10/2023										36.75	719.97
		1/17/2023										36.68	720.04
		1/25/2023										36.88	719.84
		2/1/2023										37.43	719.28
		2/7/2023										37.73	718.99
		2/16/2023										37.99	718.72
		2/23/2023										38.06	718.66
		3/2/2023										38.64	718.08
		3/8/2023										38.62	718.10
		3/15/2023										38.68	718.04
		3/23/2023										38.75	717.97
		3/28/2023										38.88	717.84

DRAFT

TABLE 1
MONITORING WELL CONSTRUCTION DETAILS AND GROUNDWATER ELEVATIONS
FORMER KOSMOS MILL
MORTON, WASHINGTON

Monitoring Well	Completion Date	Groundwater Measurement Date	TOM Elevation (ft TCL)	TOC	Total Depth (ft bgs)	Casing Diameter (in)	Screen Length (ft)	Depth to Top of Screen (feet bgs)	Depth to Bottom of Screen (feet bgs)	Top of Screen Elevation (ft TCL)	Bottom of Screen Elevation (ft TCL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft TCL)
MW-1D	10/31/2022	4/6/2023	757.217	756.72	60	2	20	38	58	719.22	698.72	39.04	717.68
		4/19/2023										38.75	717.97
		4/28/2023										38.52	718.20
		5/2/2023										37.99	718.72
		5/8/2023										37.73	718.99
		5/16/2023										31.66	725.06
		6/2/2023										16.14	740.58
		6/13/2023										16.99	739.72
		6/26/2023										21.62	735.10
		7/11/2023										25.26	731.45
		7/24/2023										27.20	729.52
		8/15/2023										31.43	725.29
MW-2S	6/27/2022	6/29/2022	758.327	757.88	20.0	2	10	5	15	753.33	742.88	5.32	752.56
		8/10/2022										9.06	748.82
		8/16/2022										9.65	748.23
		8/25/2022										10.83	747.05
		9/1/2022										11.55	746.33
		9/6/2022										11.91	745.97
		9/15/2022										12.43	745.45
		9/22/2022										12.93	744.95
		9/29/2022										13.29	744.59
		10/6/2022										13.58	744.30
		10/11/2022										13.78	744.10
		10/18/2022										13.81	744.07
		10/24/2022										14.44	743.44
		10/31/2022										12.96	744.92
		11/7/2022										12.96	744.92
		11/15/2022										13.68	744.20
		11/21/2022										8.60	749.28
		11/28/2022										7.84	750.04
		12/5/2022										8.60	749.28
		12/12/2022										5.15	752.73
		12/19/2022										6.76	751.12
		12/27/2022										6.10	751.77
		1/3/2023										3.90	753.97
		1/10/2023										5.05	752.82
		1/17/2023										5.54	752.33
		1/25/2023										5.28	752.59
		2/1/2023										5.94	751.94
		2/7/2023										6.56	751.32
		2/16/2023										5.38	752.50
		2/23/2023										4.33	753.55
		3/2/2023										5.41	752.46
		3/8/2023										5.05	752.82
		3/15/2023										4.99	752.89
		3/23/2023										6.56	751.32
		3/28/2023										5.87	752.00
		4/6/2023										5.15	752.73
		4/19/2023										4.92	752.96
		4/28/2023										4.36	753.51
		5/2/2023										5.61	752.27
		5/8/2023										7.19	750.69
		5/16/2023										8.73	749.15
		6/2/2023										10.47	747.41
		6/13/2023										10.14	747.74
		6/26/2023										11.71	746.16
		7/11/2023										12.80	745.08
		7/24/2023										13.39	744.49
MW-2D	10/31/2022	11/15/2022	758.217	757.63	60.0	2	20	38	58	720.22	699.63	37.53	720.09
		11/21/2022										36.25	721.37
		11/28/2022										36.45	721.18
		12/5/2022										36.25	721.37
		12/12/2022										37.50	720.13
		12/19/2022										38.06	719.57
		12/27/2022										37.47	720.16
		1/3/2022										N/A	N/A

DRAFT

TABLE 1
MONITORING WELL CONSTRUCTION DETAILS AND GROUNDWATER ELEVATIONS
FORMER KOSMOS MILL
MORTON, WASHINGTON

Monitoring Well	Completion Date	Groundwater Measurement Date	TOM Elevation (ft TCL)	TOC	Total Depth (ft bgs)	Casing Diameter (in)	Screen Length (ft)	Depth to Top of Screen (feet bgs)	Depth to Bottom of Screen (feet bgs)	Top of Screen Elevation (ft TCL)	Bottom of Screen Elevation (ft TCL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft TCL)
MW-2D	10/31/2022	1/10/2023	758.217	757.63	60.0	2	20	38	58	720.22	699.63	36.75	720.88
		1/17/2023										36.68	720.95
		1/25/2023										36.88	720.75
		2/1/2023										37.43	720.19
		2/7/2023										37.73	719.90
		2/16/2023										37.99	719.63
		2/23/2023										38.06	719.57
		3/2/2023										38.64	718.99
		3/8/2023										38.62	719.01
		3/15/2023										38.68	718.95
		3/23/2023										38.75	718.88
		3/28/2023										38.88	718.75
		4/6/2023										39.04	718.59
		4/19/2023										38.75	718.88
		4/28/2023										38.52	719.11
		5/2/2023										37.99	719.63
		5/8/2023										37.73	719.90
		5/16/2023										31.66	725.97
		6/2/2023										16.14	741.49
		6/13/2023										16.99	740.63
		6/26/2023										21.62	736.01
		7/11/2023										25.26	732.36
		7/24/2023										27.20	730.43
		8/15/2023										31.43	726.20
MW-3S	6/27/2022	6/29/2022	756.66	756.18	20.0	2	10	5	15	751.66	741.18	4.69	751.49
		8/10/2022										9.28	746.90
		8/16/2022										10.20	745.98
		8/25/2022										11.38	744.80
		9/1/2022										12.43	743.75
		9/6/2022										12.89	743.29
		9/15/2022										13.55	742.63
		9/22/2022										14.24	741.94
		9/29/2022										14.50	741.68
		10/6/2022										14.80	741.38
		10/11/2022										14.80	741.38
		10/18/2022										14.83	741.35
		10/24/2022										14.99	741.19
		10/31/2022										7.28	748.90
		11/7/2022										7.28	748.90
		11/15/2022										6.79	749.39
		11/21/2022										7.28	748.90
		11/28/2022										9.55	746.63
		12/5/2022										7.28	748.90
		12/12/2022										7.25	748.93
		12/19/2022										14.40	741.78
		12/27/2022										7.68	748.50
		1/3/2023										5.84	750.34
		1/10/2023										10.76	745.42
		1/17/2023										11.91	744.27
		1/25/2023										9.65	746.53
		2/1/2023										10.89	745.29
		2/7/2023										11.81	744.37
		2/16/2023										10.04	746.14
		2/23/2023										9.68	746.50
		3/2/2023										9.84	746.34
		3/8/2023										8.83	747.35
		3/15/2023										6.46	749.72
		3/23/2023										14.27	741.91
		3/28/2023										12.96	743.22
		4/6/2023										9.38	746.80
		4/19/2023										10.79	745.39
		4/28/2023										7.94	748.24
		5/2/2023										13.71	742.47
		5/8/2023										14.37	741.81
		5/16/2023										14.53	741.65
		6/2/2023										13.06	743.12

DRAFT

TABLE 1
MONITORING WELL CONSTRUCTION DETAILS AND GROUNDWATER ELEVATIONS
FORMER KOSMOS MILL
MORTON, WASHINGTON

Monitoring Well	Completion Date	Groundwater Measurement Date	TOM Elevation (ft TCL)	TOC	Total Depth (ft bgs)	Casing Diameter (in)	Screen Length (ft)	Depth to Top of Screen (feet bgs)	Depth to Bottom of Screen (feet bgs)	Top of Screen Elevation (ft TCL)	Bottom of Screen Elevation (ft TCL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft TCL)
MW-3S	6/27/2022	6/13/2023	756.66	756.18	20.0	2	10	5	15	751.66	741.18	13.94	742.24
		6/26/2023										14.67	741.51
		7/11/2023										14.67	741.51
		7/24/2023										14.67	741.51
MW-3D	10/27/2022	11/15/2022	756.77	756.42	56.0	2	20	36	56	720.77	700.42	37.70	718.72
		11/21/2022										36.81	719.61
		11/28/2022										36.78	719.64
		12/5/2022										36.81	719.61
		12/12/2022										37.37	719.05
		12/19/2022										38.02	718.40
		12/27/2022										36.61	719.81
		1/3/2022										37.01	719.41
		1/10/2023										37.07	719.35
		1/17/2023										36.94	719.48
		1/25/2023										37.11	719.31
		2/1/2023										37.34	719.08
		2/7/2023										37.40	719.02
		2/16/2023										37.73	718.69
		2/23/2023										37.66	718.76
		3/2/2023										38.15	718.27
		3/8/2023										38.12	718.30
		3/15/2023										38.16	718.26
		3/23/2023										38.16	718.26
		3/28/2023										38.39	718.03
		4/6/2023										38.42	718.00
		4/19/2023										38.22	718.20
		4/28/2023										38.02	718.40
		5/2/2023										37.83	718.59
		5/8/2023										37.47	718.95
		5/16/2023										31.63	724.79
		6/2/2023										16.11	740.31
		6/13/2023										17.19	739.23
		6/26/2023										21.92	734.50
		7/11/2023										25.59	730.83
		7/24/2023										27.69	728.73
		8/15/2023										32.44	723.98
MW-4S	6/27/2022	6/29/2022	757.149	756.73	20.0	2	10	6	16	751.15	740.73	5.86	750.87
		8/10/2022										9.51	747.22
		8/16/2022										10.20	746.53
		8/25/2022										11.61	745.12
		9/1/2022										12.34	744.39
		9/6/2022										12.86	743.87
		9/15/2022										13.48	743.25
		9/22/2022										14.07	742.66
		9/29/2022										15.03	741.70
		10/6/2022										15.94	740.79
		10/11/2022										15.94	740.79
		10/18/2022										15.94	740.79
		10/24/2022										15.94	740.79
		10/31/2022										14.96	741.77
		11/7/2022										14.96	741.77
		11/15/2022										11.02	745.71
		11/21/2022										10.70	746.03
		11/28/2022										10.27	746.46
		12/5/2022										10.70	746.03
		12/12/2022										7.84	748.89
		12/19/2022										9.55	747.18
		12/27/2022										7.25	749.48
		1/3/2023										6.23	750.50
		1/10/2023										6.69	750.04
		1/17/2023										6.76	749.97
		1/25/2023										7.58	749.15
		2/1/2023										8.40	748.33
		2/7/2023										8.76	747.97
		2/16/2023										7.51	749.22
		2/23/2023										7.22	749.51

DRAFT

TABLE 1
MONITORING WELL CONSTRUCTION DETAILS AND GROUNDWATER ELEVATIONS
FORMER KOSMOS MILL
MORTON, WASHINGTON

Monitoring Well	Completion Date	Groundwater Measurement Date	TOM Elevation (ft TCL)	TOC	Total Depth (ft bgs)	Casing Diameter (in)	Screen Length (ft)	Depth to Top of Screen (feet bgs)	Depth to Bottom of Screen (feet bgs)	Top of Screen Elevation (ft TCL)	Bottom of Screen Elevation (ft TCL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft TCL)
MW-4S	6/27/2022	3/2/2023	757.149	756.73	20.0	2	10	6	16	751.15	740.73	7.87	748.85
		3/8/2023										7.68	749.05
		3/15/2023										6.82	749.90
		3/23/2023										8.69	748.03
		3/28/2023										8.53	748.20
		4/6/2023										7.68	749.05
		4/19/2023										7.74	748.99
		4/28/2023										6.73	750.00
		5/2/2023										7.28	749.45
		5/8/2023										9.02	747.71
		5/16/2023										9.91	746.82
		6/2/2023										11.22	745.51
		6/13/2023										13.94	742.79
		6/26/2023										12.53	744.20
		7/11/2023										14.11	742.62
		7/24/2023										15.55	741.18
MW-4D	10/28/2022	11/15/2022	756.946	756.68	57.0	2	20	37	57	719.95	699.68	35.96	720.72
		11/21/2022										37.73	718.95
		11/28/2022										37.66	719.01
		12/5/2022										37.73	718.95
		12/12/2022										38.12	718.55
		12/19/2022										38.42	718.26
		12/27/2022										37.96	718.72
		1/3/2022										38.16	718.52
		1/10/2023										37.73	718.95
		1/17/2023										37.76	718.91
		1/25/2023										37.86	718.82
		2/1/2023										38.06	718.62
		2/7/2023										38.19	718.49
		2/16/2023										38.35	718.32
		2/23/2023										38.22	718.45
		3/2/2023										38.71	717.96
		3/8/2023										38.71	717.96
		3/15/2023										38.71	717.96
		3/23/2023										38.71	717.96
		3/28/2023										38.75	717.93
		4/6/2023										38.94	717.73
		4/19/2023										38.75	717.93
		4/28/2023										38.55	718.13
		5/2/2023										38.39	718.29
		5/8/2023										38.22	718.45
		5/16/2023										31.92	724.75
		6/2/2023										16.31	740.37
		6/13/2023										17.68	738.99
		6/26/2023										22.31	734.37
		7/11/2023										29.23	727.44
		7/24/2023										28.08	728.59
		8/15/2023										32.97	723.71

NOTES:

bgs = below ground surface
ft = feet
in = inches
TCL = Tacoma City Light Datum
TOC = top of well casing
TOM = top of monument

DRAFT

TABLE 4
POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
FORMER KOSMOS MILL
MORTON, WASHINGTON

Authority	Resource	Implementing Laws/Regulations	ARAR?	Applicability
Contaminant-Specific ARARs				
Federal	Surface Water	EPA Clean Water Act (CWA)	Yes	The CWA is applicable to this Site because Riffe Lake and Rainey Creek are considered waters of the United States as defined in the CWA.
State	Surface Water	Washington State Water Quality Standards (WAC 173-201a)	Yes	The state water quality standards are applicable as Rainey Creek and Riffe Lake located within the Property or is downgradient of the source area.
Federal	Drinking Water	National Primary Drinking Water Regulations	Yes	Maximum contaminant levels (MCLs) for organic and inorganic chemicals in drinking water are applicable since groundwater could be used for drinking water at the Site.
State	Soil	MTCA [RCW 70A.305; Chapter 173-340 WAC]	Yes	The MTCA soil cleanup levels are applicable.
State	Sediment	Sediment Management Standards (SMS) (RCW 90.48 and 70.105D; Chapter 173-204 WAC)	Yes	The SMS are applicable to the Site since the Site will be submerged for over six consecutive weeks in the future.
State	Groundwater	MTCA [RCW 70A.305; Chapter 173-340 WAC] and WAC 173-200	Yes	The MTCA groundwater cleanup levels are applicable.
State	Air	MTCA [RCW 70.305; Chapter 173-340 WAC]	No	The MTCA air cleanup levels are not applicable as indoor air is not a media of concern.
Action-Specific ARARs				
Federal	Air	Clean Air Act [42 USC § 7401 et seq.; 40 CFR Part 50]	Yes	The federal Clean Air Act (CAA) creates a national framework designed to protect ambient air quality by limiting air emissions.
State	Air	Clean Air Act and Implementing Regulations [RCW 70A.15; Chapter 173-400 WAC]	Yes	These regulations require the owner or operator of a source of fugitive dust to take reasonable precautions to prevent fugitive dust from becoming airborne and to maintain and operate the source to minimize emissions primarily during construction. These regulations are applicable to cleanup action alternatives involving construction.
Local	Air Emissions	Southwest Clean Air Agency (General Regulations for Air Pollution Sources SWCAA 400)	Yes	This requirement is similar to the CAA above but is more localized, addressing performance standards for land uses within the city. The Southwest Clean Air Agency regulations cover specific air quality issues within its regional jurisdiction. These air quality standards and pollution control regulations are applicable to cleanup action alternatives involving construction.
Federal	Solid Waste	Solid Waste Disposal Act (42 USC Sec. 6901-6992; 40 CFR 257-258) Federal Land Disposal Requirements (40 CFR 268)	Yes	Sets safety standards for landfills and regulates hazardous substance storage and disposal, ensuring cleanup sites meet federal requirements to protect health and the environment.
Federal	Solid Waste	RCRA [42 USC § 6901 et seq.], Subtitle D -- Managing Municipal and Solid Waste [40 CFR Parts 257 and 258]	Yes	Subtitle D of RCRA establishes a framework for management of non-hazardous solid waste. These regulations establish guidelines and criteria from which states develop solid waste regulations. These requirements are applicable to cleanup action alternatives that involve off-site disposal of impacted soil designated as non-hazardous waste.

DRAFT

TABLE 4
POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
FORMER KOSMOS MILL
MORTON, WASHINGTON

Authority	Resource	Implementing Laws/Regulations	ARAR?	Applicability
Action-Specific ARARs (Cont.)				
Federal/State	Solid Waste	U.S. Transportation of Hazardous Materials [49 CFR Part 105 to 177] Washington Transportation of Hazardous Materials [Chapter 446-50 WAC]	No	Transportation of hazardous waste or materials must meet state and federal requirements. These requirements are likely not applicable because soil will likely not be designated as hazardous waste.
Federal/State	Solid Waste	U.S. Land Disposal Restrictions [40 CFR Part 268] Washington Land Disposal Restrictions [Chapter 173-303-140 WAC]	No	Best management practices for dangerous wastes are required to meet state and federal requirements. These requirements are likely not appliable because soil will likely not be designated as hazardous waste.
Federal/State	Solid Waste	U.S. RCRA [42 USC § 6901 et seq.], Subtitle C -- Hazardous Waste Management [40 CFR Parts 260 to 262] Washington Dangerous Waste Regulations [Chapter 173-303 WAC]	No	Subtitle C of RCRA pertains to the management of hazardous waste. This requirement is likely not applicable because soil will likely not be designated as hazardous waste.
State	Solid Waste	Solid Waste Handling Standards [RCW 70A.205; Chapter 173-350 WAC] and Washington Solid Waste Handling Standards (RCW 70.95 and WAC 173-351 and 173-304)	Yes	Washington Solid Waste Handling Standards apply to facilities and activities that manage solid waste. The regulations set minimum functional performance standards for proper handling and disposal of solid waste; describe responsibilities of various entities; and stipulate requirements for solid waste handling facility location, design, construction, operation, and closure. These requirements are applicable to cleanup action alternatives that involve off-site disposal of impacted soil.
Federal/State	Remedy Construction	U.S. OSHA [29 CFR Parts 1904, 1910, and 1926] WISHA [RCW 49.17; Title 296 WAC]	Yes	Site worker and visitor health and safety requirements established by OSHA/WISHA are to be met during implementation of the cleanup action.
State	Remedy Construction	UIC Program [Chapter 173-218 WAC]	Yes	UIC regulations apply to cleanup action alternatives that include injection of biological or chemical oxidants into injection wells or trenches.
State	Remedy Construction	Accreditation of Environmental Laboratories (RCW 43.21A.230 and WAC 173-50)	Yes	Required persons or organizations submitting analytical data under the purview of Ecology, Department of Health, and other entities, to use environmental laboratories which are accredited.
State/ Local	Remedy Construction	SEPA [RCW 43.21C; Chapter 197-11 WAC; and LCC 17.110]	Yes	A SEPA review identifies and analyzes environmental impacts associated with the selected cleanup action alternative. A SEPA review is required for local permitting and pursuant to MTCA.

DRAFT

TABLE 4
POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
FORMER KOSMOS MILL
MORTON, WASHINGTON

Authority	Resource	Implementing Laws/Regulations	ARAR?	Applicability
Action-Specific ARARs (Cont.)				
Local	Remedy Construction	Lewis County Stormwater Management [LCC Chapter 15.45]	Yes	Guidelines for erosion control and construction stormwater management. These regulations are applicable to cleanup action alternatives involving construction.
State/ Local	Remedy Construction	Washington Noise Control [RCW 70A.20; Chapter 173-60 WAC] Public Disturbance Noise (LCC Chapter 1.23)	Yes	Potentially relevant, depending on construction activities and equipment selected. Construction activities will be limited to normal working hours, to the extent possible, to minimize noise impacts.
Local	Remedy Construction	General Provisions [LCC Chapter 17.05]	Yes	Provides the authority for and procedures to be followed in regulating the physical development of Lewis County.
Federal	Surface Water	Federal Water Pollution Control Act--Water Quality Certification [CWA; 33 USC § 1341, Section 401] and Implementing Regulations	Yes	Section 401 of the CWA provides that applicants for a permit to conduct any activity involving potential discharges into waters or wetlands shall obtain certification from the state that discharges will comply with applicable water quality standards. Stormwater discharged during construction activities for proposed cleanup action alternatives could potentially discharge into Rainey Creek.
Federal	Surface Water	U.S. Army Corps of Engineers (USACE): Section 10 of the Rivers and Harbors Act of 1899	No	USACE Section 10 of the Rivers and Harbors Act of 1899 regulates activities that could obstruct or alter navigable waters of the United States. Section 10 authorization is not anticipated for the Site because planned work will not occur in, over, or under a navigable water of the United States, and no in-water work is planned.
Federal	Surface Water	USACE: Section 404 of the Clean Water Act	Yes	USACE Section 404 of the Clean Water Act regulates the discharge of dredged or fill material into waters of the United States. Section 404 is potentially relevant to the Site because portions of the proposed cleanup construction work will occur below the ordinary high water mark.
Federal/State	Surface Water	U.S. Federal Water Pollution Control Act--NPDES [CWA; 33 USC § 1342, Section 402] and Implementing Regulations Washington Waste Discharge General Permit Program [RCW 90.48; Chapter 173-226 WAC]	Yes	The NPDES program establishes requirements for point source discharges, including stormwater runoff. These requirements would be applicable for any cleanup action alternatives involving point source discharge of stormwater during construction or following cleanup.
State	Surface Water	Hydraulic Code [RCW 77.55; Chapter 220-660 WAC]	Yes	The Washington Hydraulic Code requires a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife for construction activities that use, divert, obstruct, or change the natural bed or flow of state waters. Although the cleanup action alternatives are not expected to divert, obstruct, or change flow, some work may occur below the ordinary high water mark; therefore, an HPA is likely required.
State	Groundwater	Minimum Standards for Construction and Maintenance of Wells [RCW 18.104; Chapter 173-160 WAC]	Yes	Washington State has developed minimum standards for constructing water and monitoring wells, and for the decommissioning of wells. These regulations are applicable to all cleanup action alternatives involving decommissioning wells.

DRAFT

TABLE 4
POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
FORMER KOSMOS MILL
MORTON, WASHINGTON

Authority	Resource	Implementing Laws/Regulations	ARAR?	Applicability
Location-Specific ARARs				
Federal	Endangered Species; Critical Habitats	ESA [16 USC §§ 1531-1544] and Implementing Regulations	No	The ESA protects species of fish, wildlife, and plants that are listed as threatened or endangered with extinction. It also protects designated critical habitat for listed species. The ESA outlines procedures for federal agencies to follow, including consultation with resource agencies, when taking actions that may jeopardize listed species. No threatened or endangered species or habitat areas are expected to be impacted by the cleanup action alternatives.
Federal/State	Historic Areas	U.S. Archaeological and Historic Preservation Act [16 USC § 469, 470 et seq.; 36 CFR Parts 65 and 800] Washington Archaeological Sites and Resources [RCW 27.44, 27.48, and 27.53; Chapter 25-48 WAC]	Yes	Actions must be taken to preserve and recover significant artifacts, preserve historic and archaeological properties and resources, and minimize harm to national landmarks. There is the potential for historic or archaeological sites to be discovered on the Site.
State	Aquatic Lands	Aquatic Land Management [RCW 79.105; Chapter 332-30 WAC]	No	The Aquatic Lands Management law develops criteria for managing state-owned aquatic lands. Aquatic lands are to be managed to promote uses and protect resources as specified in the regulations. The cleanup action alternatives do not occur on state-owned aquatic lands.
State	Shorelines and Surface Water	Shoreline Management Act of 1971 [RCW 90.58] and Implementing Regulations	Yes	Actions are prohibited within 200 feet of shorelines of statewide significance unless permitted. The Site and cleanup action alternatives are located within 200 feet of Rainey Creek shoreline.
State	Wetlands	Shoreline Management Act of 1971 [RCW 90.58] and Implementing Regulations	No	The construction or management of property in wetlands is required to minimize potential harm, avoid adverse effects, and preserve and enhance wetlands. The cleanup action alternatives do not occur within a wetland.
State	Public Lands	Public Lands Management [RCW 79.02]	No	Activities on public lands are restricted, regulated, or proscribed. The cleanup action alternatives do not occur on state-owned public lands.
Local	Shoreline	Shoreline Use Policies and Regulations [Lewis County Shoreline Master Program]	Yes	Shoreline use and development shall be classified by the administrator and regulated under the Lewis County Shoreline Master Program. Unless otherwise stated, all use and development shall also comply with all of the general policies and regulations of the Shoreline Master Program.

DRAFT

TABLE 4
POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
FORMER KOSMOS MILL
MORTON, WASHINGTON

Authority	Resource	Implementing Laws/Regulations	ARAR?	Applicability

ABBREVIATIONS AND NOTES:

ARAR = Applicable or Relevant and Appropriate Requirement
CAA= Clean Air Act
CFR = Code of Federal Regulations
CWA = Clean Water Act
DAHP = Washington Department of Archaeology and Historic Preservation
DPD = Department of Planning and Development
Ecology = Washington State Department of Ecology
ESA = Endangered Species Act
LCC = Lewis County Code
MTCA = Model Toxics Control Act
NPDES = National Pollutant Discharge Elimination System
NRHP = National Register of Historic Places
OSHA = Occupational Safety and Health Act
RCRA = Resource Conservation and Recovery Act
RCW = Revised Code of Washington
SEPA = State Environmental Policy Act
UIC = Underground Injection Controls
USC = United States Code
WAC = Washington Administrative Code
WISHA = Washington Industrial Safety and Health Act

DRAFT

TABLE 5
CLEANUP ACTION TECHNOLOGY SCREENING
FORMER KOSMOS MILL
MORTON, WASHINGTON

Remediation Technology	Description	Implementability	Reliability	Relative Cost	Screening Comments	Technology Retained?
No remediation technology involved.	There in no intentional approach involved to remediate or monitor contamination.	Nothing to implement.	Not reliable, as contamination will not be addressed or monitoring.	No capital or O&M cost.	Although this action is the least costly, it is not considered an effective or responsible approach.	No
Monitoring	Monitoring to assure compliance with RAOs, to assess performance of cleanup action technology during operation, and to measure continued effectiveness over time.	Technically implementable.	Effective for assessing soil conditions at the site.	Negligible capital cost. Low O&M cost.	Applicable in combination with other technologies.	Yes
Monitored natural attenuation	Naturally occurring physical, chemical, and biological processes that reduce contaminant mobility or concentration.	Technically implementable. Cleanup time frame longer than for other remedial options for soil.	Long restoration time frame for site COCs as the sole remedy. Most effective when paired with other technologies.	Negligible capital cost. Low O&M cost.	Long cleanup time frame. Limited effectiveness for treatment of some Site COCs.	Yes
Governmental and proprietary controls; enforcement and permit tools; information devices	Physical and administrative measures to control access or exposure to contaminated soil. Placement of an environmental covenant on the affected property.	Technically implementable.	Reliable conventional administrative measures.	Low capital and O&M cost.	Applicable in combination with other technologies.	Yes
Capping	Placement of a surface cap over impacted soil areas to minimize water infiltration and mobilization of contaminants, and to minimize direct-contact risk for human and ecological receptors.	Technically implementable.	Effective for minimizing access, direct-contact risk, and mobility of contaminants. Less effective than source removal and does not provide treatment of contaminants.	Low to moderate capital and O&M cost.	Inadequate effectiveness for treatment of Site contaminants if the Site is submerged. Ineffective for contamination in groundwater.	No

DRAFT

TABLE 5
CLEANUP ACTION TECHNOLOGY SCREENING
FORMER KOSMOS MILL
MORTON, WASHINGTON

Remediation Technology	Description	Implementability	Reliability	Relative Cost	Screening Comments	Technology Retained?
Solidification, stabilization	Chemicals are introduced to physically bind or enclose contaminants, or to induce chemical reactions between the stabilizing agent and contaminants to reduce contaminants' mobility.	Technically implementable.	May be less effective for treatment of Site contaminants.	Moderate to high capital cost. Low O&M cost.	Inadequate effectiveness for treatment of Site contaminants.	No
In situ enhanced bioremediation	Enhanced biodegradation through addition of nutrients and electron acceptors to stimulate microbial growth and breakdown of contaminants. Moisture may need to be added to provide a medium where microbes can metabolize contaminants.	Technically implementable. Permitting and/or infrastructure required (e.g., injection wells for liquid-phase bioremediation or piping and blower for bioventing). Soil heterogeneities may interfere with consistent distribution of amendments. May require more than one application to attain cleanup action objectives (CAOs). Cleanup time frame longer than for other remedial options for soil.	Established technology. Effective for some site contaminants (TPH and SVOCs).	Moderate capital and O&M costs.	Applicable in locations where residual TPH and SVOC contamination may remain in place. The ISEB would be need to be used as an amendment to backfill to attain CAOs. Long cleanup time frame.	Yes
	Sorption / Immobilization. Injecting a carbon source into the subsurface to absorb dissolved-phase contaminants to retained them for biodegradation.	Technically implementable. Permitting and/or infrastructure required (e.g., injection wells). Long cleanup time frame.	Widely accepted technology, though full lifecycle success questionable. Effective for some Site COCs (TPH).	Moderate capital and O&M costs.	Limited effectiveness to ineffective for some Site COCs (SVOCs). Moderate cost.	Yes

DRAFT

TABLE 5
CLEANUP ACTION TECHNOLOGY SCREENING
FORMER KOSMOS MILL
MORTON, WASHINGTON

Remediation Technology	Description	Implementability	Reliability	Relative Cost	Screening Comments	Technology Retained?
In situ chemical treatment	Injection of chemicals to degrade or destroy contaminants in place.	Technically implementable. Requires handling large quantities of hazardous chemicals. Presence of organics in soil may increase required chemical application rates. May require multiple applications of chemical to attain CAOs. Regulatory concerns over injection of chemicals into subsurface, which may make permitting difficult.	Established technology. Effective for some Site contaminants (TPH and SVOCs).	High capital and O&M costs.	Long cleanup time frame. Ineffective for some Site contaminants (metals). Moderate to high cost.	Yes
Soil vapor extraction (SVE)	Removal of volatile contaminants through vacuum extraction in the vadose (unsaturated) zone of subsurface. Could be used in conjunction with other technologies including air sparging (AS), steam injection, or six-phase soil heating.	Technically implementable. Would require design and construction of subsurface infrastructure for SVE and AS system.	Moisture content, organic content, and air permeability of the soil will affect SVE effectiveness. Naturally occurring organic content in soil may reduce effectiveness. Effectiveness may be improved if SVE is combined with steam injection or six-phase soil heating. Oxygen introduced through the induced air flow by SVE may promote biodegradation of organic compounds. Limited effectiveness to ineffective for some Site contaminants (metals and SVOCs).	High capital cost for new system installation. Moderate to high O&M costs.	Long cleanup time frame. Not compatible with expected Site use (seasonal inundation). Ineffective for some Site contaminants (metals). Moderate to high cost.	No

DRAFT

TABLE 5
CLEANUP ACTION TECHNOLOGY SCREENING
FORMER KOSMOS MILL
MORTON, WASHINGTON

Remediation Technology	Description	Implementability	Reliability	Relative Cost	Screening Comments	Technology Retained?
Phytoremediation	Use growing plants to remove, transfer, stabilize, and destroy contaminants in soil. The mechanisms of phytoremediation include enhanced rhizosphere biodegradation, phyto-extraction, phyto-degradation, and phyto-stabilization.	Difficult to implement because of future Site use and limited accessibility. Cleanup time frame is typically long.	Potentially effective as a polishing step for Site contaminants in soil.	Low capital and O&M cost.	Long cleanup time frame. Not compatible with expected Site use (seasonal inundation).	No
Thermal treatment	Application of heat via subsurface steam injection, electrical resistive heating, or other method to remove strippable contaminants. Volatilized compounds captured and treated at surface.	Technically implementable. Requires off-gas capture and treatment.	Effective for some Site contaminants (TPH and SVOCs). Requires off-gas capture and treatment to be effective. Buried objects or debris may interfere with operation and effectiveness.	High capital and O&M costs.	Buried objects may interfere with treatment. Ineffective for some Site contaminants (metals). High cost.	No
Soil flushing	A surfactant or solvent solution is applied to soil in place to remove leachable contaminants. The solution and leached contaminants are recovered from the underlying aquifer and treated.	Difficult to implement. Requires capture and treatment of injected solution and leached contaminants. Regulatory concerns over complete capture of leached contaminants, which may make permitting difficult.	Effective for recovery of Site contaminants. Soil flushing is a developing technology; evidence supporting effectiveness is limited.	High capital and O&M costs.	High cost. Difficult to implement with regards to regulatory concerns and capture of injected solution.	No
Soil removal	Removal of impacted soil using common excavation techniques. Excavated soil treated on Site or sent off Site for disposal.	Technically implementable.	Effective for all Site soil contaminants.	Moderate capital cost. Negligible O&M cost.	Commonly used, established technology effective for all Site soil contaminants.	Yes

DRAFT

TABLE 5
CLEANUP ACTION TECHNOLOGY SCREENING
FORMER KOSMOS MILL
MORTON, WASHINGTON

Remediation Technology	Description	Implementability	Reliability	Relative Cost	Screening Comments	Technology Retained?
Land disposal	Disposal of impacted soil at an off-Site, lined, permitted landfill.	Technically implementable. Impacted soil requires profiling and must meet land disposal requirements. Soil treatment may be required if disposal requirements are not met.	Effective for Site soil contaminants.	Moderate capital cost, depending on type of contaminant. Negligible O&M cost.	Common and cost-effective disposal option for excavated soil.	Yes
Ex Situ bioremediation, thermal desorption, soil washing, chemical treatment, solidification/ stabilization, etc.	Treatment of excavated soil by enhancing biodegradation through modification of soil conditions and provision of substrate necessary for microbial growth, heating to volatilize contaminants, using water and surfactants to leach contaminants from soil, using chemicals to degrade contaminants, binding or enclosing contaminants, etc.	Difficult to implement. May require leachate or off-gas collection and treatment. Homogenization of heterogeneous soil and debris screening may be required. Presence of moisture or organics in soil may affect treatment.	Effective for some site soil contaminants (TPH and SVOCs) except solidification/stabilization may be less effective or ineffective for treatment of organic compounds.	Moderate to high capital and O&M costs.	Difficult to implement. Moderate to high cost. Not effective for all Site contaminants.	No

ABBREVIATIONS AND NOTES:

AS = air sparging
CAOs = cleanup action objectives
COC = contaminant of concern
EISB = enhanced in situ bioremediation
O&M = Operation and Maintenance
RAOs = remedial action objectives
SVE = soil vapor extraction
SVOC = semi-volatile organic compound
TPH = total petroleum hydrocarbons

DRAFT

TABLE 6
CLEANUP ACTION ALTERNATIVE 1 COST ESTIMATE
FORMER KOSMOS MILL
MORTON, WASHINGTON

Location:	Kosmos Mill Morton, Washington
Phase:	Feasibility Study (-35% to +50%)
Base Year:	2025
Date:	December 2025

Description: Alternative 1 consists of excavation and off-site disposal of contaminated soil and left in place pipes within the Site boundary and compliance monitoring. Groundwater encountered during excavation will be dewatered and treated on site. The estimate assumes that no institutional controls, such as a restrictive covenant, will be required. Costs have been estimated using RSMeans cost database and recent Haley & Aldrich experience for similar items on other projects.

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Soil Excavation and Compliance Monitoring					
Mobilization	1	LS	$30,000	$30,000	Engineer's estimate.
TESC measures	1	LS	$30,000	$30,000	Engineer's estimate.
Clearing and Grubbing	1.21	Acre	$2,045	$2,478	Cut & chip light trees to 6" diameter, RSMeans 311110100120
Excavation, loading, transportation, and disposal	26,500	TON	$150	$3,975,000	Cost based on similar project experience. Non-dangerous waste to Subtitle D landfill. Assumes conversion factor of 1.5 from bank cubic yards to tonnage.
Pipe demolition and removal	1	LS	$10,000	$10,000	Engineer's estimate. Removal of piping that is outside of the COC contaminated soil excavation area
Groundwater dewatering and treatment	1	LS	$100,000	$100,000	Engineer's estimate.
Backfill, compaction	26,550	TON	$60	$1,593,000	Engineer's estimate. Assumes conversion factor 1.5 from bank cubic yards to truck cubic yards and that clean soil will be reused as backfill, as appropriate.
Removal of IRA Cap	2,100	CY	$22.87	$48,027	Excavator, hydraulic, crawler mtd., 3.5 C.Y. cap = 300 C.Y./hr. RSMeans 312316420305.
Mobile Environmental Lab	1	LS	$82,311.25	$82,311	Analytical costs for NWTPH-Dx and NWTPH-Gx are included. Costs based on similar project experience. Includes expedited chemical analysis.
Performance sampling and analysis	1	LS	$86,634.10	$86,634	Cost based on similar project experience. Includes expedited chemical analysis.
Drilling and Installation of Shallow Groundwater Monitc	1	LS	$69,000.00	$69,000	Install five shallow monitoring wells with stickup monuments. Contractor quote.
Soil Excavation and Compliance Monitoring Subtotal				$6,026,451	
Contingency	10%	--	--	$602,645	EPA 540-R-00-002. Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					Costs exclude Ecology review fees.
Independent Cleanup Action Report	1	LS	$50,000	$50,000	Engineer's estimate.
Project management	5%	--	--	$301,323	EPA 540-R-00-002. Project management. Percentage of capital costs.
Remedial design	6%	--	--	$361,587	EPA 540-R-00-002. Remedial Design. Percentage of capital costs.
Construction oversight & management	6%	--	--	$361,587	EPA 540-R-00-002. Construction Management. Percentage of capital costs.
Permitting	1	LS	$25,000	$25,000	Engineer's estimate.
Post Remediation Groundwater Sampling	4	EA	$31,500	$126,000	Engineer's estimate. Assumes 5 wells without reporting
Professional/Technical Services Subtotal				$1,225,497	
TOTAL CAPITAL COSTS				**$7,854,592**	

PERIODIC COSTS (YEARS 2)

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Reporting	*1*	*EA*	*$20,000*	$20,000	Engineer's estimate. Year 2 site closure reporting.
Site Closure Groundwater Monitoring	*4*	*EA*	*$43,000*	$172,000	Engineer's estimate. Year 2. 4 quarters.
Professional/Technical Services	10%	--	--	*$19,200*	EPA 540-R-00-002. Year 2. Costs exclude Ecology review fees. Project management. Percentage of periodic cost and contingency.

PRESENT VALUE ANALYSIS

Discount rate 3.5%
Total years 2

COST TYPE	YEAR	TOTAL COST	ANNUAL COST	DISCOUNT FACTOR	NET PRESENT VALUE
Capital	0	$7,854,592	$7,854,592	1.00	$7,854,592
Periodic	2	$211,200	$211,200	0.93	$197,005
		$8,065,792			$8,051,598
TOTAL NET PRESENT VALUE					**$8,052,000**

NOTES

Present value analysis uses the U.S. Treasury 2-year discount rate of 3.54 percent. (WAC 173-340-360)
Cost estimate does not include sales tax.

NOTES:
Ecology = Washington State Department of Ecology
EPA = United States Environmental Protection Agency
LS = lump sum
O&M = Operation and Maintenance
SF = square feet
SY = square yards
TESC = Temporary Erosion and Sediment Control

DRAFT

TABLE 7
CLEANUP ACTION ALTERNATIVE 2 COST ESTIMATE
FORMER KOSMOS MILL
MORTON, WASHINGTON

Location:	Kosmos Mill Morton, Washington
Phase:	Feasibility Study (-35% to +50%)
Base Year:	2025
Date:	December 2025

Description: Alternative 2 consists of excavation (down to 15 ft below ground surface) and off-site disposal of contaminated soil and left in place pipes within the Site boundary, monitored natural attenuation for residual groundwater contamination, and compliance monitoring. Groundwater encountered during excavation will be dewatered and treated on site. The estimate assumes that institutional controls, such as a restrictive covenant, will be prepared and implemented. Costs have been estimated using RSMeans cost database and recent Haley & Aldrich experience for similar items on other projects.

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Soil Excavation and Compliance Monitoring					
Mobilization	1	LS	$30,000	$30,000	Engineer's estimate.
TESC measures	1	LS	$30,000	$30,000	Engineer's estimate.
Clearing and Grubbing	1.21	Acre	$2,045	$2,478	Cut & chip light trees to 6" diameter, RSMeans 311110100120
Excavation, loading, transportation, and disposal	25,500	TON	$150	$3,825,000	Cost based on similar project experience. Non-dangerous waste to Subtitle D landfill. Assumes conversion factor of 1.5 from bank cubic yards to tonnage.
Groundwater dewatering and treatment	1	LS	$80,000	$80,000	Engineer's estimate.
Pipe demolition and removal	1	LS	$10,000	$10,000	Engineer's estimate. Removal of piping that is outside of the COC contaminated soil excavation area
Backfill, compaction	25,500	TON	$60	$1,530,000	Engineer's estimate. Assumes conversion factor 1.5 from bank cubic yards to truck cubic yards and that clean soil will be reused as backfill, as appropriate.
Removal of IRA Cap	2,100	CY	$22.87	$48,027	Excavator, hydraulic, crawler mtd., 3.5 C.Y. cap = 300 C.Y./hr. RSMeans 312316420305.
Mobile Environmental Lab	1	LS	$82,311	$82,311	Analytical costs for NWTPH-Dx and NWTPH-Gx are included. Costs based on similar project experience. Includes expedited chemical analysis.
Performance sampling and analysis	1	LS	$86,634	$86,634	Cost based on similar project experience. Includes expedited chemical analysis.
Drilling and Installation of Shallow Groundwater Monitoring Wells	1	LS	$69,000	$69,000	Install five shallow monitoring wells with stickup monuments. Contractor quote.
Soil Excavation and Compliance Monitoring Subtotal				$5,793,451	
Contingency	10%	--	--	$579,345	EPA 540-R-00-002. Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					Costs exclude Ecology review fees.
Independent Cleanup Action Report	1	LS	$50,000	$50,000	Engineer's estimate.
Restrictive covenant and signage	1	LS	$25,000	$25,000	Engineer's estimate.
Project management	5%	--	--	$289,673	EPA 540-R-00-002. Project management. Percentage of capital costs.
Remedial design	6%	--	--	$347,607	EPA 540-R-00-002. Remedial Design. Percentage of capital costs.
Construction oversight & management	6%	--	--	$347,607	EPA 540-R-00-002. Construction Management. Percentage of capital costs.
Permitting	1	LS	$25,000	$25,000	Engineer's estimate.
Post Remediation Groundwater Sampling	4	EA	$31,500	$126,000	Engineer's estimate. Assumes 5 wells without reporting
Professional/Technical Services Subtotal				$1,210,887	
TOTAL CAPITAL COSTS				**$7,583,682**	

ANNUAL O&M COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Monitored Natural Attenuation	*2*	*EA*	*$43,000*	$86,000	Engineer's estimate. Assumes semi-annual sampling of 5 groundwater wells, including the collection of 1 duplicate sample. Includes Reporting
Contingency	20%	--	--	*$17,200*	EPA 540-R-00-002. Scope and bid contingency. Percentage of annual cost.
Professional/Technical Services	10%	--	--	*$10,320*	EPA 540-R-00-002. Costs exclude Ecology review fees. Project management. Percentage of annual cost and contingency.
TOTAL ANNUAL O&M COSTS				*$113,520*	

PERIODIC COSTS (YEARS 5)

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Reporting	*1*	*EA*	*$20,000*	$20,000	Engineer's estimate. Years 5. Five-year reviews and reporting.
Site Closure Groundwater Monitoring	*4*	*EA*	*$43,000*	$172,000	Engineer's estimate. Year 5. 4 quarters.
Professional/Technical Services	10%	--	--	*$19,200*	EPA 540-R-00-002. Year 5. Costs exclude Ecology review fees. Project management. Percentage of periodic cost and contingency.

PRESENT VALUE ANALYSIS

Discount rate 3.7%
Total years 5

Present value analysis uses the U.S. Treasury 5-year discount rate of 3.7 percent. (WAC 173-340-360)
Cost estimate does not include sales tax.

COST TYPE	YEAR	TOTAL COST	ANNUAL COST	DISCOUNT FACTOR	NET PRESENT VALUE
Capital	0	$7,583,682	$7,583,682	1.00	$7,583,682
Annual O&M	1-5	$567,600	$113,520	4.49	$509,658
Periodic	5	$211,200	$211,200	0.83	$176,117
		$8,362,482			$8,269,457
TOTAL NET PRESENT VALUE					**$8,270,000**

NOTES:
Ecology = Washington State Department of Ecology
EPA = United States Environmental Protection Agency
LS = lump sum
O&M = Operation and Maintenance
SF = square feet
SY = square yards
TESC = Temporary Erosion and Sediment Control

DRAFT

TABLE 8
CLEANUP ACTION ALTERNATIVE 3 COST ESTIMATE
FORMER KOSMOS MILL
MORTON, WASHINGTON

Location:	Kosmos Mill Morton, Washington
Phase:	Feasibility Study (-35% to +50%)
Base Year:	2025
Date:	December 2025

Description: Alternative 3 consists of the excavation and off-site disposal of hot spot soil contamination (down to 10 feet bgs). This also includes the placement of a demarcation layer and EISB products amended backfill, monitored natural attenuation for residual groundwater contamination, and compliance monitoring. The estimate assumes that institutional controls, such as a restrictive covenant and a soil management plan, will be prepared and implemented. Costs have been estimated using the RSMeans cost database and recent Haley & Aldrich experience with similar items on other projects.

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Soil Excavation, EISB Backfill, and MNA					
Mobilization	1	LS	$50,000	$50,000	Engineer's estimate.
TESC measures	1	LS	$30,000	$30,000	Engineer's estimate.
Clearing and Grubbing	1.21	Acre	$2,045	$2,478	Cut & chip light trees to 6" diameter, RSMeans 311110100120
Excavation, loading, transportation, and disposal	19,276	TON	$150	$2,891,375	Cost based on similar project experience. Non-dangerous waste to Subtitle D landfill. Assumes conversion factor of 1.5 from bank cubic yards to tonnage.
Pipe demolition and removal	1	LS	$10,000	$10,000	Engineer's estimate. Removal of piping that is outside of the COC contaminated soil excavation area
Demarcation layer	2,633	SY	$5	$13,167	Geotextile, non-woven 120 lb tensile strength. RSMeans 31321916155.
Backfill Common Fill, compaction	19,276	TON	$60	$1,156,550	Engineer's estimate. Assumes conversion factor 1.5 from bank cubic yards to tonnage and imported soil will be used as backfill.
ORC cost	96	TON	$10,000	$963,792	Engineer's estimate.
Removal of IRA Cap	2,100	CY	$22.87	$48,027	Excavator, hydraulic, crawler mtd., 3.5 C.Y. cap = 300 C.Y./hr. RSMeans 312316420305.
Mobile Environmental Lab	1	LS	$78,733	$78,733	Analytical costs for NWTPH-Dx and NWTPH-Gx are included. Costs based on similar project experience. Includes expedited chemical analysis.
Performance sampling and analysis	1	LS	$82,867	$82,867	Cost based on similar project experience. Includes expedited chemical analysis.
Drilling and Installation of Shallow Groundwater Monit	1	LS	$92,000	$92,000	Install 7 shallow monitoring wells with stickup monuments. Contractor quote.
Soil Excavation, EISB Backfill, and MNA Subtotal				$5,418,989	
Contingency	10%	--	--	*$541,899*	EPA 540-R-00-002. Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					Costs exclude Ecology review fees.
Independent Cleanup Action Report	1	LS	$50,000	$50,000	Engineer's estimate.
Restrictive covenant and signage	1	LS	$25,000	$25,000	Engineer's estimate. Includes revisions and discussions with Ecology.
Project management	5%	--	--	$270,949	Engineer's estimate.
Remedial design	6%	--	--	$325,139	Engineer's estimate.
Construction oversight & management	6%	--	--	$325,139	Engineer's estimate.
Permitting	1	LS	$25,000	$25,000	Engineer's estimate.
Post Remediation Groundwater Sampling	4	EA	$31,500	$126,000	Engineer's estimate.
Professional/Technical Services Subtotal				*$1,147,228*	EPA 540-R-00-002. Scope and bid contingency. Percentage of
TOTAL CAPITAL COSTS				**$7,108,115**	

ANNUAL O&M COSTS

Compliance Monitoring	1	EA	$20,000	*$20,000*	Engineer's estimate. Years 5, 10, 15, 20, 25, 30. Assumes minor erosion replacement needed, not extensive repairs.
Contingency	20%	--	--	*$4,000*	Engineer's estimate. Years 5, 10, 15, 20, 25, 30. Five-year reviews and reporting.
Professional/Technical Services	10%	--	--	*$2,400*	EPA 540-R-00-002. Scope and bid contingency. Percentage of periodic cost.
TOTAL ANNUAL O&M COSTS				**$26,400**	EPA 540-R-00-002. Costs exclude Ecology review fees. Project management. Percentage of periodic cost and contingency.

PERIODIC COSTS

Reporting	1	EA	*$20,000*	$20,000	Engineer's estimate. Years 5. Five-year reviews and reporting.
Site Closure Groundwater Monitoring	*4*	*EA*	*$43,000*	$172,000	Engineer's estimate. Year 5. 4 quarters.
Contingency (Years 5, 10, 15, 20, 25, 30)	20%	--	--	*$4,000*	
Professional/Technical Services (Years 5, 10, 15,	10%	--	--	*$19,600*	
TOTAL PERIODIC COSTS (YEARS 5, 10, 15, 20, 25, 30)				**$215,600**	

PRESENT VALUE ANALYSIS

Discount rate 4.84%
Total years 15

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	NET PRESENT VALUE
Capital	0	$7,108,115	$7,108,115	1.000	$7,108,115
Annual O&M	1-30	$792,000	$26,400	15.657	$413,341
Periodic	5	$215,600	$215,600	0.790	$170,221
	10	$215,600	$215,600	0.623	$134,394
	15	$215,600	$215,600	0.492	$106,107
	20	$215,600	$215,600	0.389	$83,774
	25	$215,600	$215,600	0.307	$66,141
	30	$215,600	$215,600	0.242	$52,220
		$8,762,515			$8,134,313
TOTAL NET PRESENT VALUE					**$8,135,000**

NOTES

Present value analysis uses the U.S. Treasury 30-year discount rate of 4.84 percent. (WAC 173-340-360)

NOTES:

Ecology = Washington State Department of Ecology
EPA = United States Environmental Protection Agency
LS = lump sum
O&M = Operation and Maintenance
SF = square feet
SY = square yards
TESC = Temporary Erosion and Sediment Control

DRAFT

TABLE 9
CLEANUP ACTION ALTERNATIVE 4 COST ESTIMATE
FORMER KOSMOS MILL
MORTON, WASHINGTON

Location:	Kosmos Mill Morton, Washington
Phase:	Feasibility Study (-35% to +50%)
Base Year:	2025
Date:	December 2025

Description: Alternative 4 consists of the excavation and off-site disposal of hot spot soil contamination (down to 10 feet bgs), placement of a demarcation layer, EISB products amended backfill, and installation of a permeable sorptive barrier. It also includes monitored natural attenuation for residual groundwater contamination and compliance monitoring. The estimate assumes that institutional controls, such as a restrictive covenant and a soil management plan, will be prepared and implemented. Costs have been estimated using the RSMeans cost database and recent Haley & Aldrich experience with similar items on other projects.

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Soil Excavation, EISB Backfill, Permeable Sorptive Barrier, and MNA					
Mobilization	1	LS	$50,000	$50,000	Engineer's estimate.
TESC measures	1	LS	$30,000	$30,000	Engineer's estimate.
Clearing and Grubbing	1.21	Acre	$2,045	$2,478	Cut & chip light trees to 6" diameter, RSMeans 311110100120
Excavation, loading, transportation, and disposal	19,276	TON	$150	$2,891,375	Cost based on similar project experience. Non-dangerous waste to Subtitle D landfill. Assumes conversion factor of 1.5 from bank cubic yards to tonnage.
Pipe demolition and removal	1	LS	$10,000	$10,000	Engineer's estimate. Removal of piping that is outside of the COC contaminated soil excavation area
Demarcation layer	2,633	SY	$5	$13,167	Geotextile, non-woven 120 lb tensile strength. RSMeans 31321916155.
Backfill Common Fill, compaction	19,276	TON	$60	$1,156,550	Engineer's estimate. Assumes conversion factor 1.5 from bank cubic yards to tonnage and imported soil will be used as backfill. Includes material to be used for the cap.
ORC cost	96	TON	$10,000	$963,792	Engineer's estimate.
Removal of IRA Cap	2,100	CY	$23	$48,027	Excavator, hydraulic, crawler mtd., 3.5 C.Y. cap = 300 C.Y./hr. RSMeans 312316420305.
Permeable sorptive barrier installation	1	LS	$474,888	$474,888	Vendor's quote; include both material and installation costs
Mobile Environmental Lab	1	LS	$78,733	$78,733	Analytical costs for NWTPH-Dx and NWTPH-Gx are included. Costs based on similar project experience. Includes expedited chemical analysis.
Performance sampling and analysis	1	LS	$82,867	$82,867	Cost based on similar project experience. Includes expedited chemical analysis.
Drilling and Installation of Shallow Groundwater Monit	1	LS	$80,500	$80,500	Install 7 shallow monitoring wells with stickup monuments. Contractor quote.
Soil Excavation, EISB Backfill, Permeable Sorptive Barrier, and MNA Subtotal				$5,882,376	
Contingency	10%	--	--	*$588,238*	EPA 540-R-00-002. Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					Costs exclude Ecology review fees.
Independent Cleanup Action Report	1	LS	$50,000	$50,000	Engineer's estimate.
Restrictive covenant and signage	1	LS	$25,000	$25,000	Engineer's estimate. Includes revisions and discussions with Ecology.
Project management	5%	--	--	$294,119	Engineer's estimate.
Remedial design	6%	--	--	$352,943	Engineer's estimate.
Construction oversight & management	6%	--	--	$352,943	Engineer's estimate.
Permitting	1	LS	$25,000	$25,000	Engineer's estimate.
Post Remediation Groundwater Sampling	4	EA	$31,500	$126,000	Engineer's estimate.
Professional/Technical Services Subtotal				*$1,226,004*	EPA 540-R-00-002. Scope and bid contingency. Percentage of
TOTAL CAPITAL COSTS				**$7,696,618**	

ANNUAL O&M COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Compliance Monitoring	1	EA	$5,000	*$5,000*	Engineer's estimate. Years 5, 10, 15, 20, 25, 30. Assumes minor erosion replacement needed, not extensive repairs.
Contingency	20%	--	--	*$1,000*	Engineer's estimate. Years 5, 10, 15, 20, 25, 30. Five-year reviews and reporting.
Professional/Technical Services	10%	--	--	*$600*	EPA 540-R-00-002. Scope and bid contingency. Percentage of periodic cost.
TOTAL ANNUAL O&M COSTS				**$6,600**	EPA 540-R-00-002. Costs exclude Ecology review fees. Project management. Percentage of periodic cost and contingency.

PERIODIC COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Reporting	1	EA	$20,000	*$20,000*	Engineer's estimate. Years 5. Five-year reviews and reporting.
Permeable sorptive barrier installation (Year 15)	1	LS	$474,888	*$474,888*	Additional application of permeable sorptive barrier (Year 15).
Contingency (Years 5, 10, 15)	20%	--	--	*$98,978*	
Professional/Technical Services (Years 5, 10, 15,	10%	--	--	*$59,387*	
TOTAL PERIODIC COSTS (YEARS 5, 10, 15, 20, 25, 30)				**$653,252**	

PRESENT VALUE ANALYSIS

Present value analysis uses the U.S. Treasury 30-year discount rate of 4.84 percent. (WAC 173-340-360)

Discount rate 4.84%
Total years 15

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	NET PRESENT VALUE
Capital	0	$7,696,618	$7,696,618	1.000	$7,696,618
Annual O&M	1-30	$198,000	$6,600	15.657	$103,335
Periodic	5	$178,364	$178,364	0.790	$140,823
	10	$178,364	$178,364	0.623	$111,183
	15	$653,252	$653,252	0.492	$321,496
	20	$178,364	$178,364	0.389	$69,305
	25	$178,364	$178,364	0.307	$54,718
	30	$178,364	$178,364	0.242	$43,201
		$9,082,961			$8,540,679

TOTAL NET PRESENT VALUE **$8,541,000**

NOTES:
Ecology = Washington State Department of Ecology
EPA = United States Environmental Protection Agency
LS = lump sum
O&M = Operation and Maintenance
SF = square feet
SY = square yards
TESC = Temporary Erosion and Sediment Control

DRAFT

TABLE 10
ALTERNATIVES EVALUATION AND BENEFIT SCORING
FORMER KOSMOS MILL
MORTON, WASHINGTON

DCA Benefit Criteria	Criteria and Weighting(%)[a]	Alternative 1. Complete Excavation (down to 18 ft bgs) and Off-Site Disposal	Relative Degrees of Benefit[b]	Alternative 2. Excavation (down to 15 ft bgs), Off-Site Disposal, and MNA	Relative Degrees of Benefit	Alternative 3. Hot Spot and Surficial Soil Excavation and Off-Site Disposal, Enhanced *In Situ* Bioremediation, Institutional Controls, and MNA	Relative Degrees of Benefit	Alternative 4. Hot Spot and Surficial Soil Excavation and Off-Site Disposal, Enhanced *In Situ* Bioremediation, Permeable Sorptive Barrier, Institutional Controls, and MNA	Relative Degrees of Benefit
Protectiveness	30%	This alternative provides the highest level of protectiveness by assuming complete excavation and removal of all COC-contaminated soil (to approximately 18 ft bgs) across the Site, to the extent practical. This approach will achieve soil cleanup standards in the shortest timeframe.	9.0	This alternative includes a large excavation of source contamination (to approximately 15 ft bgs). However, there is less certainty that complete source mass reduction will occur to accelerate groundwater remediation; therefore, monitored natural attenuation (MNA) is incorporated into this approach. The time required to reduce risk is slightly longer than Alternative 1 but shorter than other alternatives.	8.0	This alternative includes source mass destruction through excavation and off-Site disposal of hot spots, combined with enhanced *in situ* bioremediation (EISB). However, there is less certainty that sufficient source mass reduction will occur to accelerate groundwater remediation. Institutional controls and MNA will be required. Therefore, this alternative is considered slightly less protective than the others.	6.0	This alternative includes source mass destruction through excavation and off-Site disposal of hot spots, EISB, and installation of a permeable sorptive barrier. However, there is less certainty that sufficient source mass reduction will occur to accelerate groundwater remediation. Institutional controls and MNA will be required. Therefore, this alternative is considered slightly less protective than Alternatives 1 and 2, but more protective than Alternative 3.	7.0
Permanence	20%	This alternative achieves the highest level of permanence by removing contaminated soil as much as practical and placing it in an off-Site engineered, lined, and monitored facility. This approach maximizes contaminant removal and minimizes reliance on additional treatment or controls.	9.0	This alternative reduces contaminant mobility by removing contaminated soil and placing it in an off-Site engineered, lined, and monitored facility. However, it is considered less permanent than Alternative 1 because some residual contamination will remain in place due to practical excavation limits.	8.0	This alternative reduces contaminant mobility by removing contaminated soil and placing it in an off-Site engineered, lined, and monitored facility. However, it is considered less permanent than Alternatives 1 and 2 because it removes less contamination through excavation and off-Site disposal and relies on additional measures such as EISB treatment, institutional controls, and MNA. Since Ecology does not allow ties in permanence scoring, this alternative is ranked as the least permanent.	6.0	This alternative reduces contaminant mobility by removing contaminated soil and placing it in an off-Site engineered, lined, and monitored facility. However, it is considered less permanent than Alternatives 1 and 2 because it removes a smaller amount of contamination through excavation and off-Site disposal and relies on additional measures such as EISB treatment and a permeable sorptive barrier, institutional controls, and MNA.	7.0
Long-term effectiveness	30%	This alternative provides the highest level of long-term effectiveness by removing COC-contaminated soil and disposing of it in an off-Site engineered, lined, and monitored facility. Landfills are a proven containment technology and are expected to remain effective over the long term, although they are less effective than methods that destroy contaminants.	9.0	This alternative involves off-Site disposal of contaminated soil in an engineered, lined, and monitored facility. Landfills are a proven containment technology and are expected to remain effective over the long term, although they are less effective than methods that destroy contaminants. This alternative is considered to achieve slightly less long-term effectiveness than Alternative 1 because some residual contamination will remain and be treated by MNA, which is slower and less reliable than landfill containment.	8.0	This alternative achieves less long-term effectiveness than Alternatives 1 and 2 because residual contamination will remain and be treated through EISB and MNA, which are slower and less reliable than containment or destruction. Institutional controls will also be required. It is considered slightly less effective than Alternative 4, which includes a permeable sorptive barrier for additional protection.	5.0	This alternative achieves less long-term effectiveness than Alternatives 1 and 2 because residual contamination will remain and be treated through EISB, a permeable sorptive barrier, and MNA, which are slower and less reliable than full removal or destruction. Institutional controls will also be required. It is considered slightly more effective than Alternative 3 due to the inclusion of the permeable sorptive barrier.	6.0
Implementation risks	10%	This alternative presents moderate short-term risks related to waste excavation, transport to a landfill, and import of backfill material. These risks can be mitigated through a Health and Safety Plan (HASP). It receives the lowest implementation risk score because it involves the largest volume of COC-contaminated soil excavation.	5.0	This alternative presents moderate short-term risks related to waste excavation, transport to a landfill, and import of backfill material. These risks can be mitigated through a HASP. It has slightly lower short-term risk than Alternative 1 because it involves less excavation and transport of COC-contaminated soil.	6.0	This alternative presents moderate short-term risks related to waste excavation, transport, backfill import, and application of the EISB product. These risks can be mitigated through a HASP. It has lower short-term risk than the other alternatives because it involves less excavation and transport of contaminated soil and does not include the permeable sorptive barrier injections.	8.0	This alternative presents moderate short-term risks related to waste excavation, transport, backfill import, application of the EISB product, and injections for the permeable sorptive barrier. There is a risk of injected materials daylighting (surfacing) into Rainey Creek due to excessive pressure or unpredictable flow paths, which could spread contamination beyond the target zone or create surface hazards. These risks can be mitigated through a HASP and a detailed injection work plan. This alternative has lower short-term risk than Alternatives 1 and 2 but slightly higher risk than Alternative 3 due to the additional injection activities.	7.0
Implementability	10%	This alternative uses typical construction practices and equipment for excavation, making it generally straightforward to implement. However, the potential need to remove scrap material and debris to fully excavate contaminated soils adds some complexity. Overall, it is considered more implementable than other alternatives because it requires less permitting, long-term monitoring, and administrative oversight after cleanup activities.	8.0	This alternative uses typical construction practices and equipment for excavation and cap construction, making it generally straightforward to implement. However, the potential need to remove scrap material and debris to fully excavate contaminated soils adds complexity. It also requires MNA over the long term. Overall, this alternative is considered more implementable than Alternatives 3 and 4 because it involves fewer permitting requirements, less long-term monitoring, and reduced administrative oversight.	7.0	This alternative uses typical construction practices and equipment for hot spot excavation and application of the EISB treatment. However, it may require additional permitting for subsurface treatment under Ecology's Underground Injection Control (UIC) program. Despite this added step, the alternative remains reasonably (but slightly less) implementable compared to Alternatives 1 and 2.	6.0	This alternative uses typical construction practices and equipment for hot spot excavation and application of the EISB treatment. However, it may require additional permitting for both the EISB product and the injected permeable sorptive barrier under Ecology's UIC program. Due to these added requirements, this alternative is considered the least implementable of the four.	5.0
Total weighted benefits score[c]	**100%**	**8.50**		**7.70**		**5.90**		**6.50**	
Estimated Cost[d]		$8,052,000.00		$8,270,000.00		$8,135,000.00		$8,541,000.00	

NOTES:

a. Weighting factors equal. See justification described in Section 3.5.2.
b. Ranking score based on relative ability to achieve criteria on 1 (lowest) to 10 (highest) scale.
c. Total weighted benefit score is obtained by multiplying the rating for each criterion by its weighting factor, and summing the results for the five criteria.
d. Net present value costs are estimated in 2025 dollars, and were calculated using a 4.97 percent discount rate. Itemized estimates are provided in Tables 6 through 9.
d. The benefit/cost ratio is obtained by dividing the alternative's MTCA benefits ranking by its estimated cost (in Millions).
% = percent
bgs = below ground surface
COC = contaminant of concern
DCA = disproportionate cost analysis
Ecology = Washington State Department of Ecology
EISB = enhanced in situ bioremediation
ft = foot/feet
HASP = Health and Safety Plan
MNA = monitored natural attenuation
MTCA = Model Toxics Control Act
UIC = Underground Injection Control

DRAFT

TABLE 11
DCA CALCULATIONS
FORMER KOSMOS MILL
MORTON, WASHINGTON

	Alternative	Cost ($ millions)	Degrees of Benefit	Permanence		alternatives in order of decreasing permanence ↓	DCA Order	Alternative	Permanence Score	Cost ($millions)	Degrees of Benefit	**Cost Effectiveness ($/B)**	Incremental Costs and Benefits					**Apparent PMEP Alternative**
				Score	Rank								ΔC	ΔCprop	ΔB	ΔBprop	ΔCprop/ ΔBprop	
Estimated costs and degrees of benefit from the FS	Alternative 1	8.052	8.5	9	1		1	Alternative 1	9	$8.05	8.5	$0.95	n/a	n/a	n/a	n/a	n/a	PMEP
	Alternative 2	8.27	7.7	8	2		2	Alternative 2	8	$8.27	7.7	$1.07	($0.22)	(0.03)	0.8	0.10	(0.25)	NO
	Alternative 3	8.135	5.9	6	4		3	Alternative 4	7	$8.54	6.5	$1.31	($0.27)	(0.03)	1.2	0.18	(0.17)	NO
	Alternative 4	8.541	6.5	7	3		4	Alternative 3	6	$8.14	5.9	$1.38	$0.41	0.05	0.6	0.10	0.49	NO

NOTES:

ΔC = Incremental costs

ΔCprop = Proportional change in costs

ΔB = Incremental benefit

ΔBprop = Proportional change in benefit

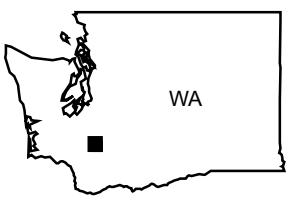
PMEP = Permanent to the Maximum Extent Practicable

DRAFT

FIGURES

DRAFT







MAP SOURCE: OPEN STREET MAP
SITE COORDINATES: 46°29'33"N, 122°11'26"W

HALEY ALDRICH

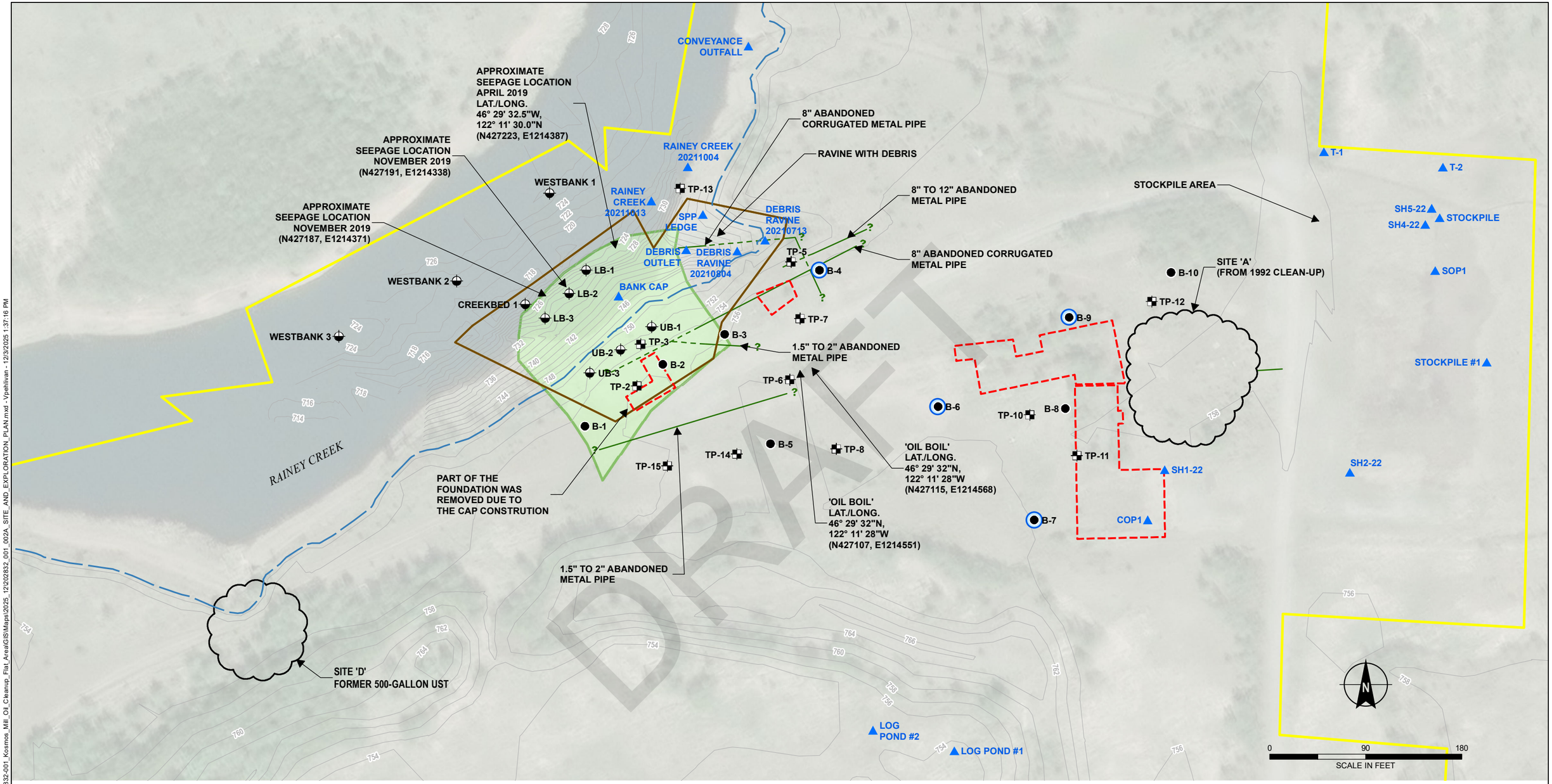
KOSMOS MILL
MORTON, WASHINGTON

VICINITY MAP

APPROXIMATE SCALE: 1 IN = 4000 FT
DECEMBER 2025

FIGURE 1

GIS: \\haleyaldrich.com\share\sea_projects\Notebooks\02202832-001_Kosmos_Mill_Oil_Cleanup_Flat_Area\GIS\Maps\2025_12\202832_001_0001_VICINITY_MAP.mxd - Vpehlivan - 12/3/2025 1:19:15 PM



LEGEND

- SOIL SAMPLE (2019)
- SONIC BORING (2019)
- TEST PIT (2019)
- SURFACE WATER SAMPLE (TACOMA POWER 2020-2022)
- GROUNDWATER SAMPLE (2019)
- CURRENT RESERVOIR'S FULL-POOL OPERATING ELEVATION, AT 749 FEET TCL (753 FEET NAVD 88)
- PIPE ENCOUNTERED, LEFT IN PLACE
- PIPE ENCOUNTERED, REMOVED
- ? UNKNOWN PIPE EXTENT
- AREA OF PROTECTIVE CAP
- APPROXIMATE EXTENT OF EXCAVATION
- OLD/ABANDONED BUILDING SLAB
- APE

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. APE = AREA OF POTENTIAL EFFECT
3. IRA = INDEPENDENT REMEDIAL ACTION.
4. TOPOGRAPHIC ELEVATION CONTOURS AND SITE FEATURES DATA SOURCE: CITY OF TACOMA PUBLIC UTILITIES (TPU)
5. TOPOGRAPHIC ELEVATION CONTOUR DATUM: TACOMA CITY LIGHT (TCL) DATUM
6. AERIAL IMAGERY SOURCE: ESRI, APRIL 22, 2024

HALEY ALDRICH

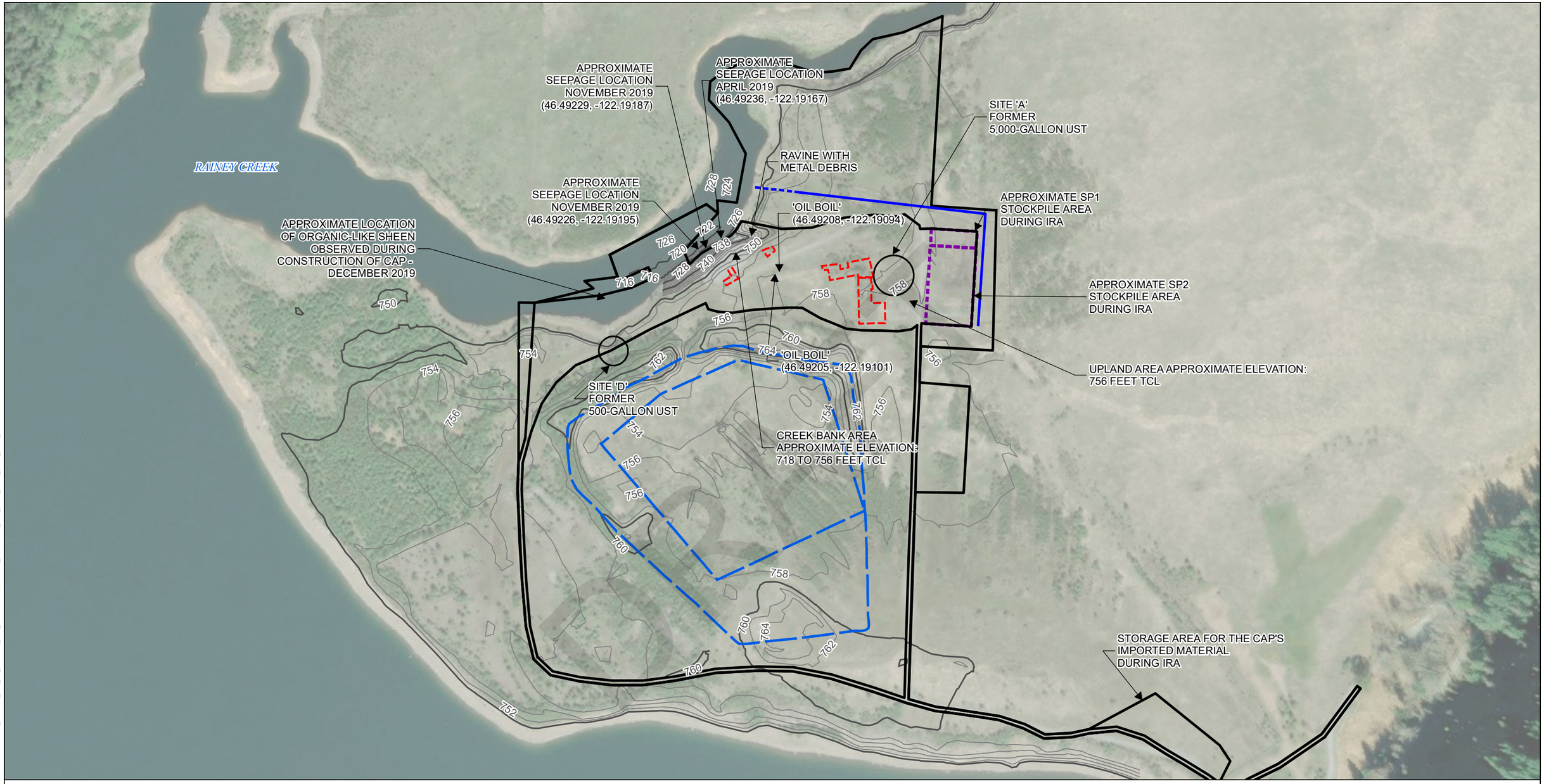
KOSMOS MILL
MORTON, WASHINGTON

2019 TO 2022 SITE AND EXPLORATION PLAN

DECEMBER 2025

FIGURE 2A

GIS: \\haleyaldrich.com\shared\sea_projects\Notebooks\0202832-001_Kosmos_Mill_Oil_Cleanup_Flat_Area\GIS\Maps\2025_12\202832_001_002A_SITE_AND_EXPLORATION_PLAN.mxd - Vpehlivan - 12/3/2025 1:37:16 PM



LEGEND

- SURFACE WATER DIVERSION TRENCH
- 2019-2020 AREA OF POTENTIAL EFFECT
- APPROXIMATE FORMER STOCKPILE AREA
- APPROXIMATE LOCATION OF FORMER LOG POND
- OLD/ABANDONED BUILDING CONCRETE SLAB

NOTES

1. ELEVATION CONTOURS, AERIAL PHOTOGRAPH, AND SITE FEATURES/LOCATIONS PROVIDED BY THE CITY OF TACOMA PUBLIC UTILITIES (TPU).
2. CONTOURS DERIVED FROM AERIAL 'FLYOVER' DONE APRIL 1998 WHEN RESERVOIR WAS AT ELEVATION 746.7 FEET TACOMA CITY LIGHT (TCL) DATUM. CONTOUR INTERVAL IS 2 FEET.
3. FEATURE LOCATIONS ARE APPROXIMATE.
4. THE EMERGENCY INTERIM REMEDIAL ACTION (IRA) BEGAN IN NOVEMBER 2019 AND WAS COMPLETED IN FEBRUARY 2020.
5. UST = UNDERGROUND STORAGE TANK.
6. AERIAL IMAGE SOURCE: ESRI, APRIL 22, 2024

N

0 300 600

SCALE IN FEET

HALEY ALDRICH

KOSMOS MILL
MORTON, WASHINGTON

2019 TO 2020 SITE FEATURES

DECEMBER 2025

FIGURE 2B

Document Path: \\haleyaldrich.com\share\sea_projects\Notebooks\02028332-001_Kosmos_Mill_Oil_Cleanup_Flat_Area\GIS\Maps\2025_12\202832_001_002B_2019_2020_SITE_FEATURES.mxd Date: 12/3/2025 User Name: Vpehlivan

PETROLEUM-IMPACTED MATERIAL OBSERVED BY TPU DURING PROTECTIVE CAP CONSTRUCTION

SOLIDIFIED PETROLEUM PRODUCT LEDGE (46.49243, 122.19147)

SOLIDIFIED PETROLEUM PRODUCT IN RAVINE (46.44238, 122.19113)

APPROXIMATE SP1 STOCKPILE AREA

APPROXIMATE SP2 STOCKPILE AREA

SITE 'A' FORMER 5,000-GALLON UST

SITE 'D' FORMER 500-GALLON UST

SH1-22

SH2-22

SH4-22

SH5-22

A

A'

B

B'

SS-1 SS-2 SS-3 SS-4 SS-5 SS-6 SS-7 SS-7-R SS-8 SS-9 SS-7A SS-10 SS-11 SS-12

SW-1 SW-2 SW-3

B-11 B-12 B-13 B-14 B-15 B-16 B-17

MW-1D MW-1S MW-2D MW-2S MW-3D MW-3S MW-4D MW-4S

TP-16 TP-17 TP-18 TP-19 TP-20 TP-21 TP-22 TP-23 TP-24 TP-25 TP-26 TP-27 TP-28 TP-29 TP-30 TP-31 TP-32 TP-33 TP-34 TP-35 TP-36 TP-36B TP-37 TP-38 TP-39 TP-40 TP-41 TP-42 TP-43 TP-44 TP-45 TP-46 TP-47 TP-48 TP-49 TP-50 TP-51 TP-52 TP-53 TP-54 TP-55 TP-56 TP-57 TP-58 TP-59 TP-60 TP-61

0 80 160
SCALE IN FEET

N

DRAFT

LEGEND

- MONITORING WELL (2022)
- BORING WITH GROUNDWATER SAMPLE (2022)
- TEST PIT (2022)
- SEDIMENT SAMPLE (2022)
- WATER SAMPLE (2022)
- CROSS SECTION
- SONIC BORING (2019)
- SOIL SAMPLE (2019)
- TEST PIT (2019)
- GROUNDWATER SAMPLE (2022)
- CURRENT RESERVOIR'S FULL-POOL OPERATING ELEVATION, 749 FEET TCL
- PIPE ENCOUNTERED, LEFT IN PLACE
- PIPE ENCOUNTERED, REMOVED
- TOPOGRAPHIC ELEVATION CONTOUR, 2-FT INTERVAL
- GPR AREA
- VISUAL INSPECTION AREA
- AREA OF PROTECTIVE CAP
- EXTENT OF IRA EXCAVATION
- FORMER STOCKPILE AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. UST = UNDERGROUND STORAGE TANK.
3. IRA = INDEPENDENT REMEDIAL ACTION.
4. GPR = GROUND PENETRATION RADAR
5. TOPOGRAPHIC ELEVATION CONTOURS AND SITE FEATURES DATA SOURCE: TPU
6. TOPOGRAPHIC ELEVATION CONTOUR DATUM: TACOMA CITY LIGHT (TCL) DATUM
7. AERIAL IMAGERY SOURCE: ESRI, APRIL 22, 2024

HALEY ALDRICH

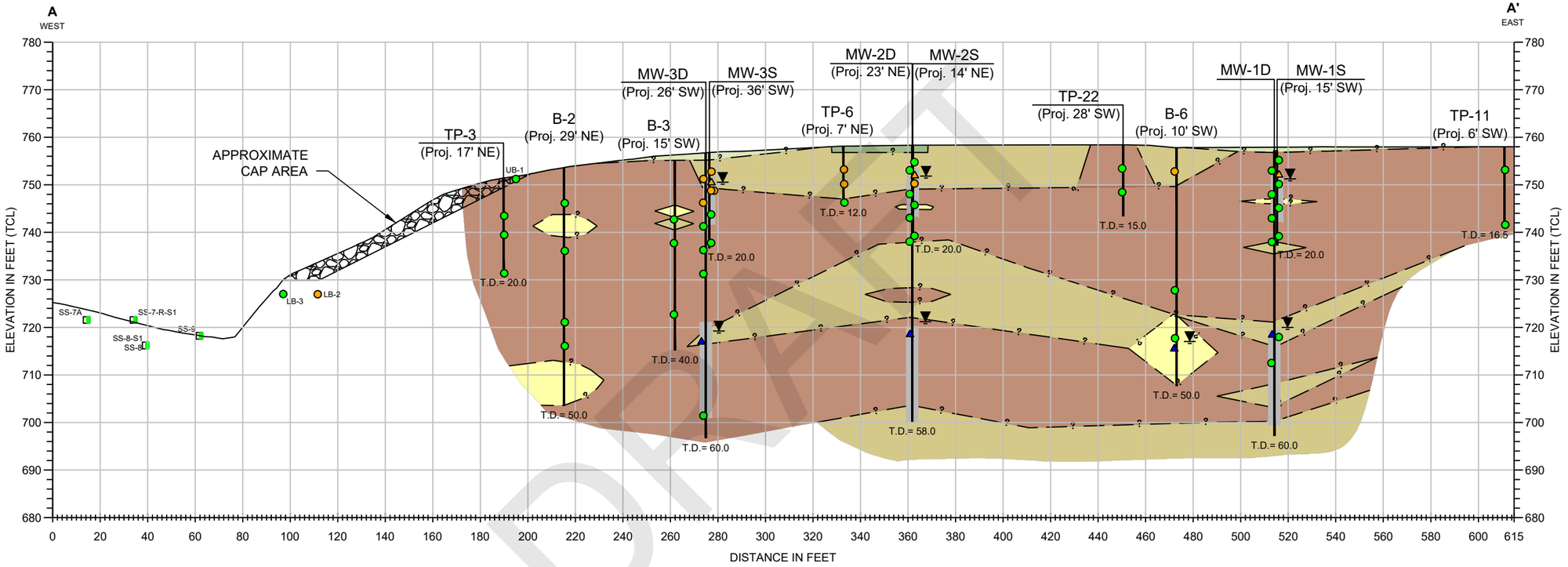
KOSMOS MILL
MORTON, WASHINGTON

REMEDIAL INVESTIGATION SITE AND EXPLORATION PLAN

DECEMBER 2025

FIGURE 3

GIS: \\haleyaldrich.com\shareisea_projects\Notebooks\0202832-001_Kosmos_Mill_Oil_Cleanup_Flat_Area\GIS\Maps\2025_12\202832_001_0003_REMEDIAL_INVESTIGATION_SITE_AND_EXPLORATION_PLAN.mxd - Vpehlivan - 12/3/2025 1:57:36 PM



DRAFT

LEGEND

BORING NAME WITH OFFSET — B-1 (Proj. 92' S)

BORING LOCATION

22 — WATER LEVEL

SCREEN INTERVAL

T.D.= 60.0

- TOP SOIL
- SILTY/CLAYEY SAND AND SILTY/CLAYEY GRAVEL
- SILT AND/OR CLAY WITH OR WITHOUT SAND
- CLEAN SAND AND/OR GRAVEL

- WATER SAMPLE - BELOW APPLICABLE SCREENING LEVELS
- SOIL SAMPLE - BELOW APPLICABLE SCREENING LEVELS
- SS-8 SEDIMENT SAMPLE - BELOW APPLICABLE SCREENING LEVELS
- SAMPLE ABOVE APPLICABLE SCREENING LEVELS

NOTES

1. THIS SUBSURFACE PROFILE IS GENERALIZED FROM MATERIALS OBSERVED IN SOIL BORINGS AND TEST PITS ADVANCED DURING THE 2019 SITE INVESTIGATION AND 2022 REMEDIAL INVESTIGATION. VARIATIONS MAY EXIST BETWEEN PROFILE AND ACTUAL CONDITIONS.
2. DECEMBER 2019 AND FEBRUARY 2022 GROUNDWATER DATA SHOWN.

HORIZ. 0 50 100
VERT. 0 25 50
SCALE IN FEET

HALEY ALDRICH

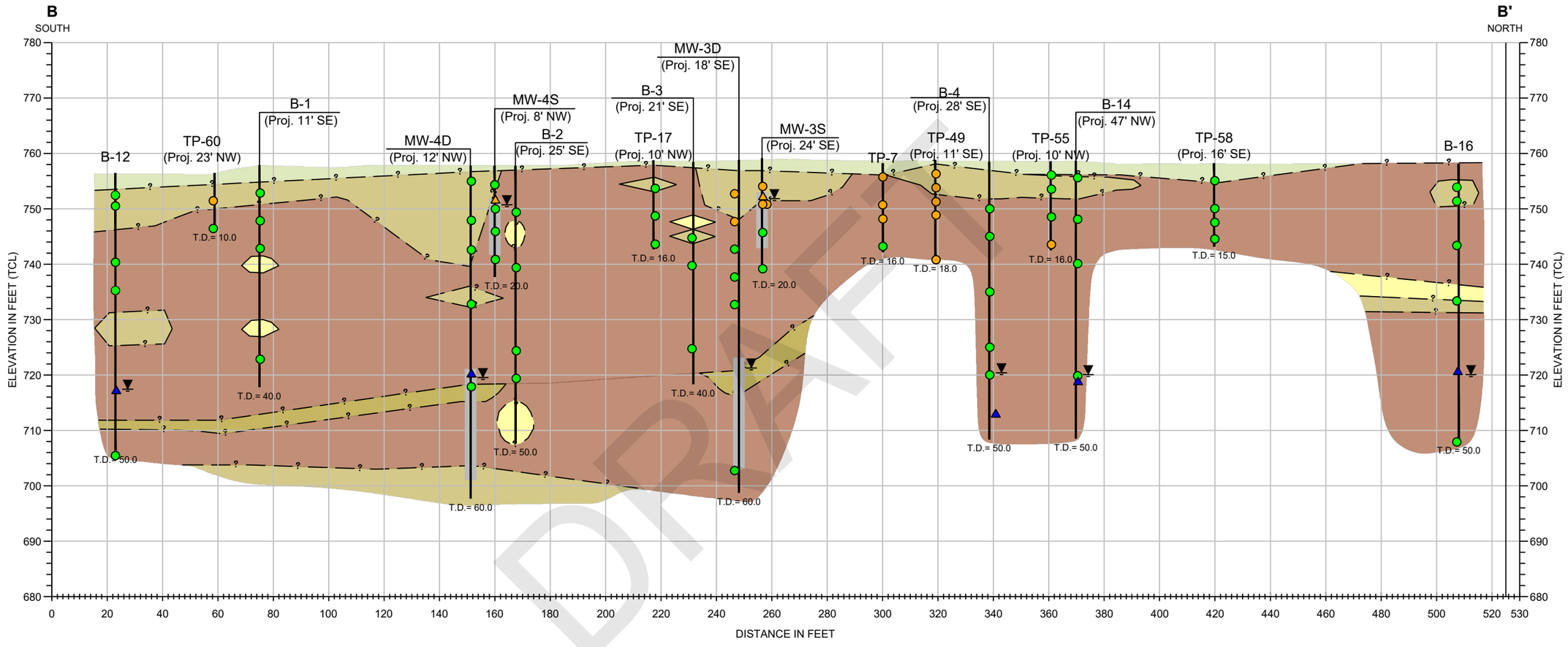
KOSMOS MILL
MORTON, WASHINGTON

CROSS SECTION A-A'

DECEMBER 2025

FIGURE 4

\\HALEYALDRICH.COM\SHARE\SEA_PROJECTS\NOTEBOOKS\202832-001_KOSMOS_MILL_OIL_CLEANUP_FLAT_AREA\CAD\202832_001_0002_CROSS_SECTIONS_JUNE2024.DWG
MSCHWEITZER Printed: 8/13/2025 4:37 PM Sheet: SECTION A



LEGEND

BORING NAME WITH OFFSET — B-1 (Proj. 92' S)

BORING LOCATION

22 — WATER LEVEL

SCREEN INTERVAL

T.D.= 60.0

TOP SOIL

SILTY/CLAYEY SAND AND SILTY/CLAYEY GRAVEL

SILT AND/OR CLAY WITH OR WITHOUT SAND

CLEAN SAND AND/OR GRAVEL

WATER SAMPLE - BELOW APPLICABLE SCREENING LEVELS

SOIL SAMPLE - BELOW APPLICABLE SCREENING LEVELS

SAMPLE ABOVE APPLICABLE SCREENING LEVELS

NOTES

1. THIS SUBSURFACE PROFILE IS GENERALIZED FROM MATERIALS OBSERVED IN SOIL BORINGS AND TEST PITS ADVANCED DURING THE 2019 SITE INVESTIGATION AND 2022 REMEDIAL INVESTIGATION. VARIATIONS MAY EXIST BETWEEN PROFILE AND ACTUAL CONDITIONS.
2. DECEMBER 2019 AND FEBRUARY 2022 GROUNDWATER DATA SHOWN.

HORIZ. 0 40 870

VERT. 0 20 40

SCALE IN FEET

HALEY ALDRICH

KOSMOS MILL
MORTON, WASHINGTON

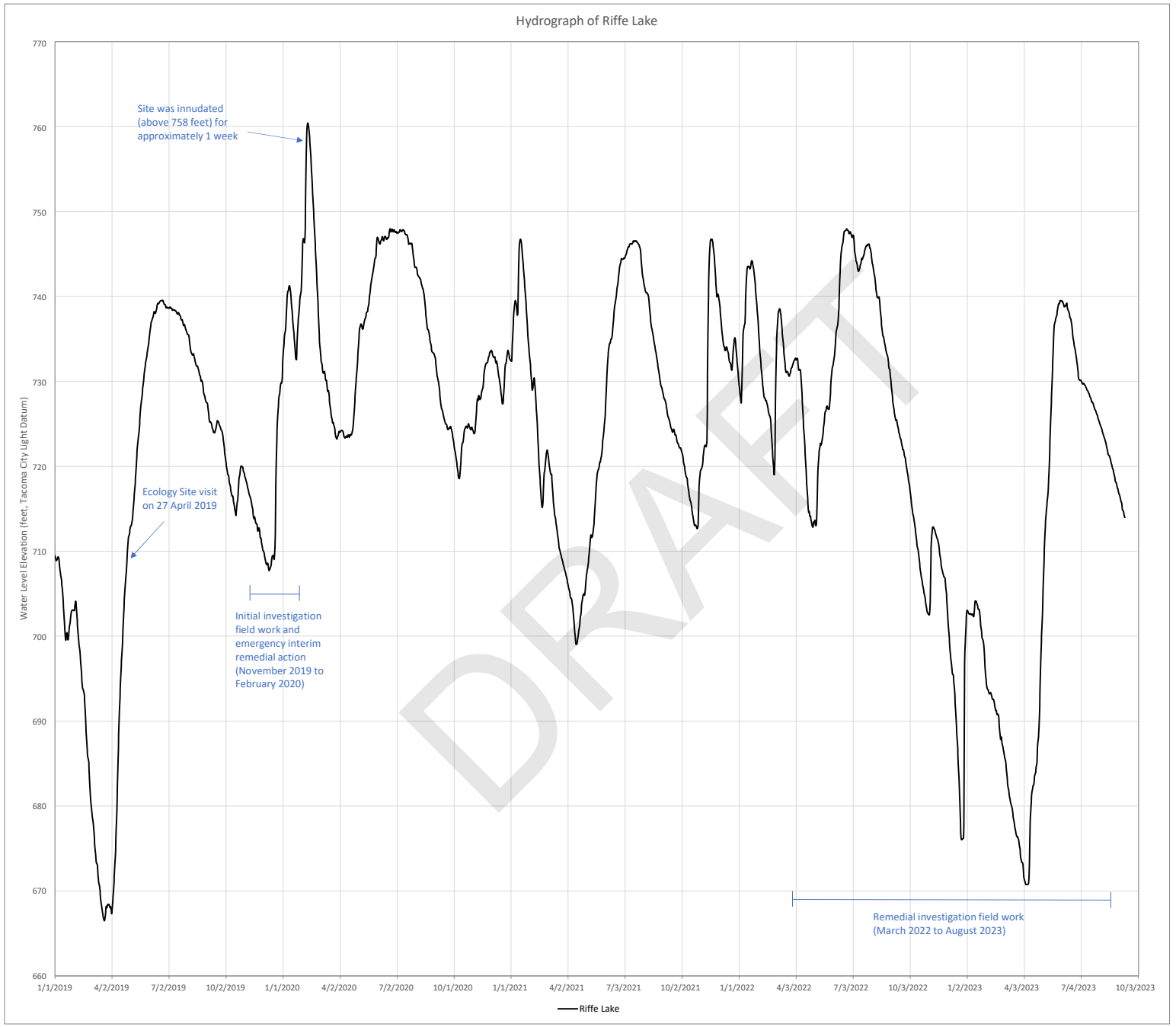
CROSS SECTION B-B'

DECEMBER 2025

FIGURE 5

DRAFT

\\HALEYALDRICH.COM\SHARE\SEA_PROJECTS\NOTEBOOKS\202832-001_KOSMOS_MILL_OIL_CLEANUP_FLAT_AREA\CAD\202832_001_0002_CROSS_SECTIONS_JUNE2024.DWG
MSCHWEITZER Printed: 8/13/2025 4:37 PM Sheet: SECTION B



Notes:
1. Riffe Lake levels downloaded from United States Geological Survey station 14234800 from January 2019 to current (through September 2023).

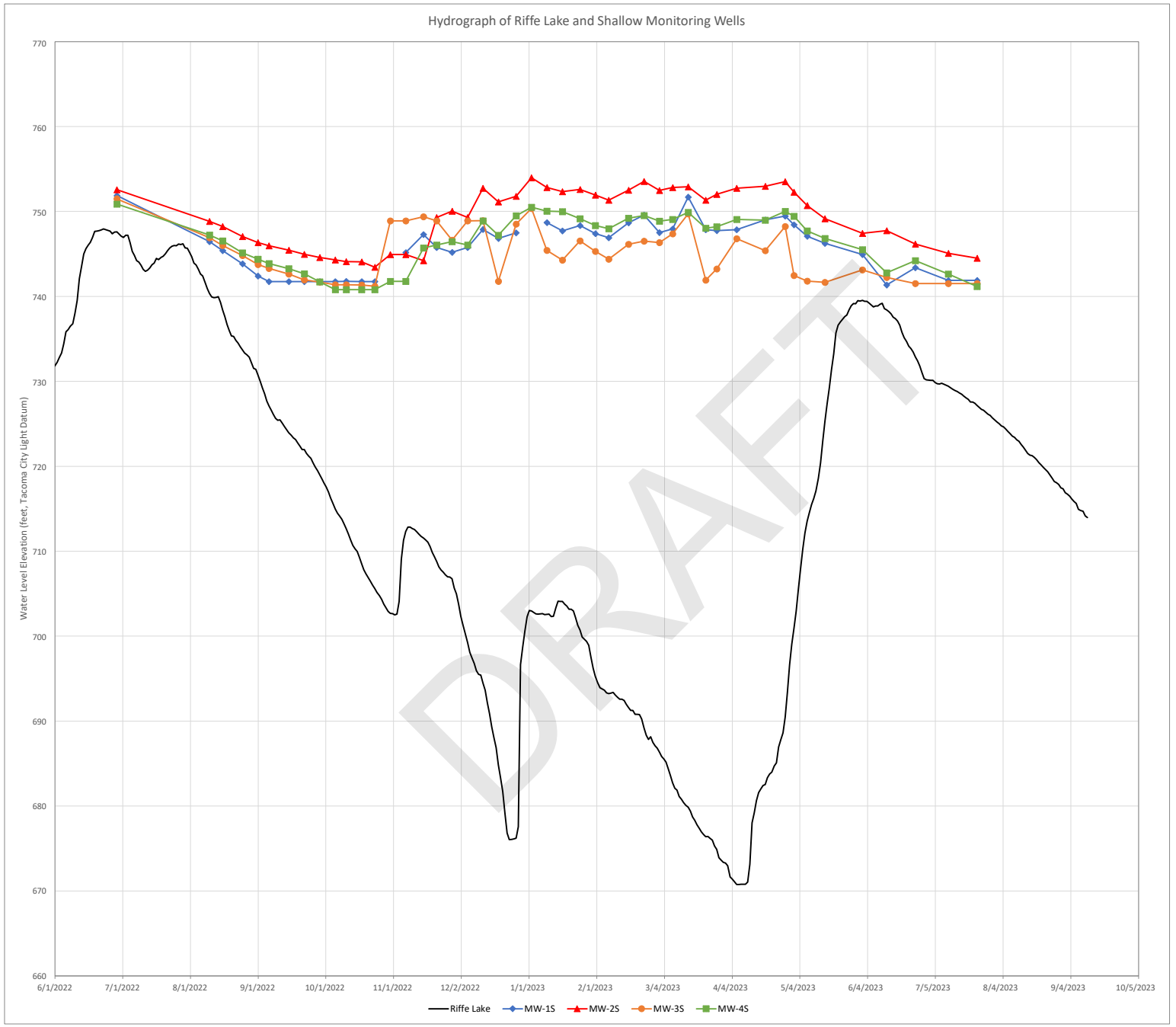
Kosmos Mill
Morton, WASHINGTON

HYDROGRAPH - RIFFE LAKE
DECEMBER 2025

HALEY ALDRICH

Figure
6

\\haleyaldrich.com\shared\ea_projects\Notebooks\0202832\001_Kosmos_Mill_Oil_Cleanup_Flat_Area\Workspace\RI Report



\\haleyaldrich.com\shared\ea_projects\Notebooks\0202\63.2-001_Kosmos_Mill_Oil_Cleanup_Flat_Area\Workspace\RI Report

Notes:
1. Riffe Lake levels downloaded from United States Geological Survey station 14234800 from January 2019 to current (through September 2023).

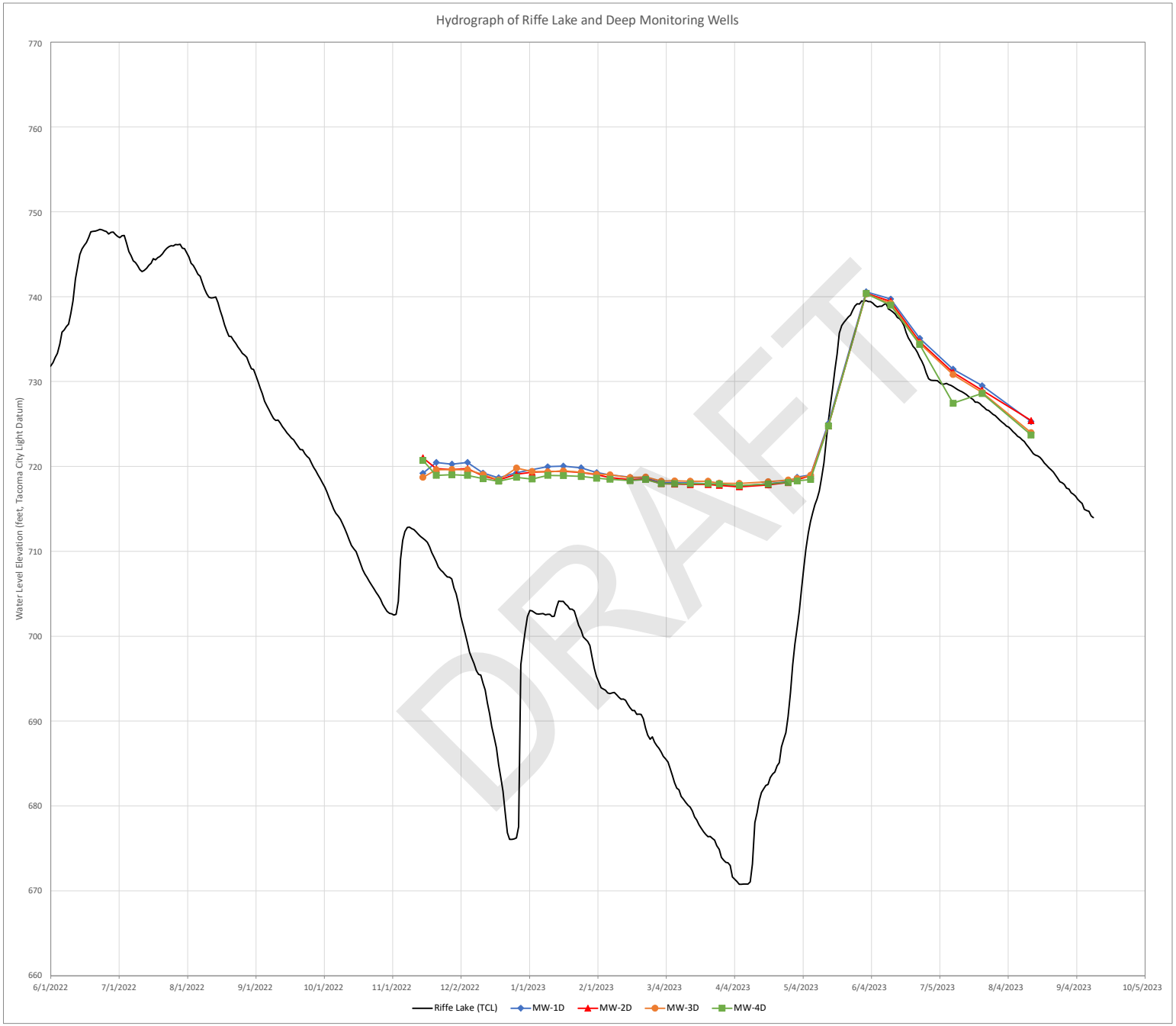
2. Water levels measured from the shallow monitoring wells from August 2022 to July 2023.

Kosmos Mill
Morton, WASHINGTON

HYDROGRAPH -
SHALLOW MONITORING WELLS
DECEMBER 2025

HALEY ALDRICH

Figure
7A



\\haleyaldrich.com\shareiea_projects\Notebooks\202263-001_Kosmos_Mill_OU_Cleanup_Flat_Areal\Workspace\RI Report

Notes:
1. Riffe Lake levels downloaded from United States Geological Survey station 14234800 from January 2019 to current (through September 2023).

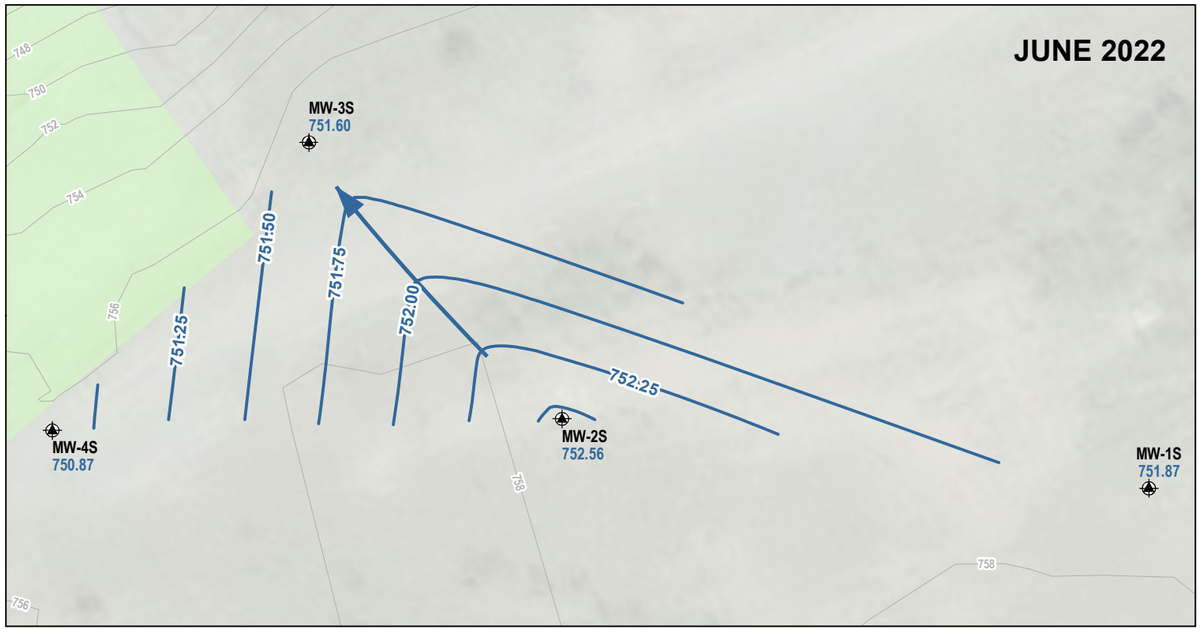
2. Water levels measured from the deep monitoring wells from November 2022 to August 2023.

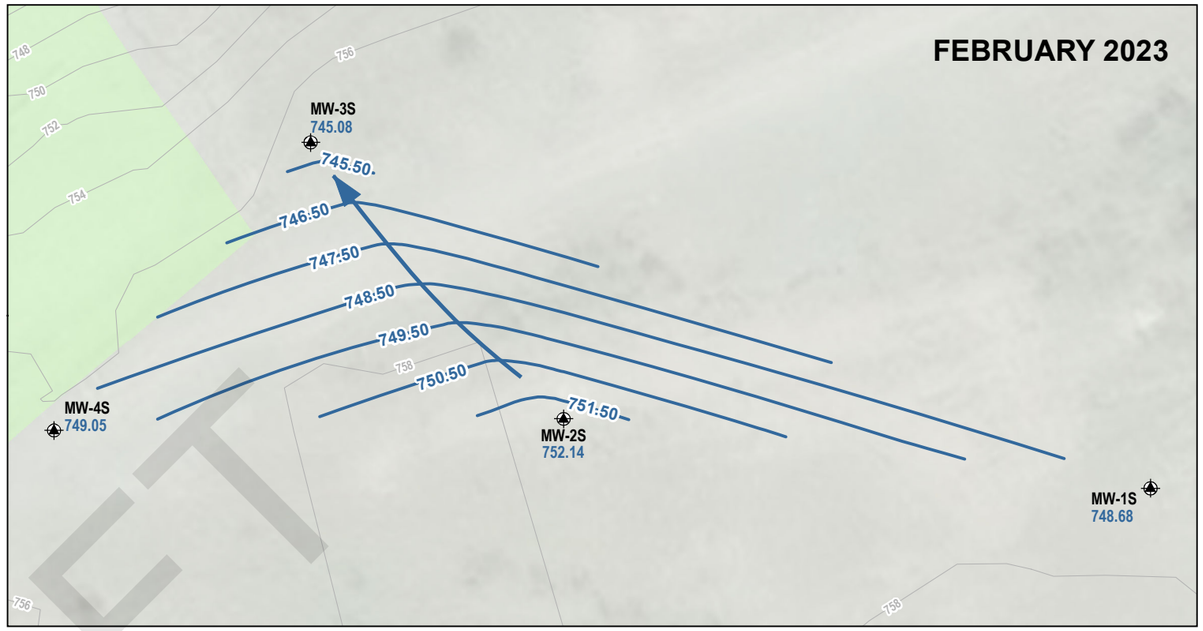
Kosmos Mill
Morton, WASHINGTON

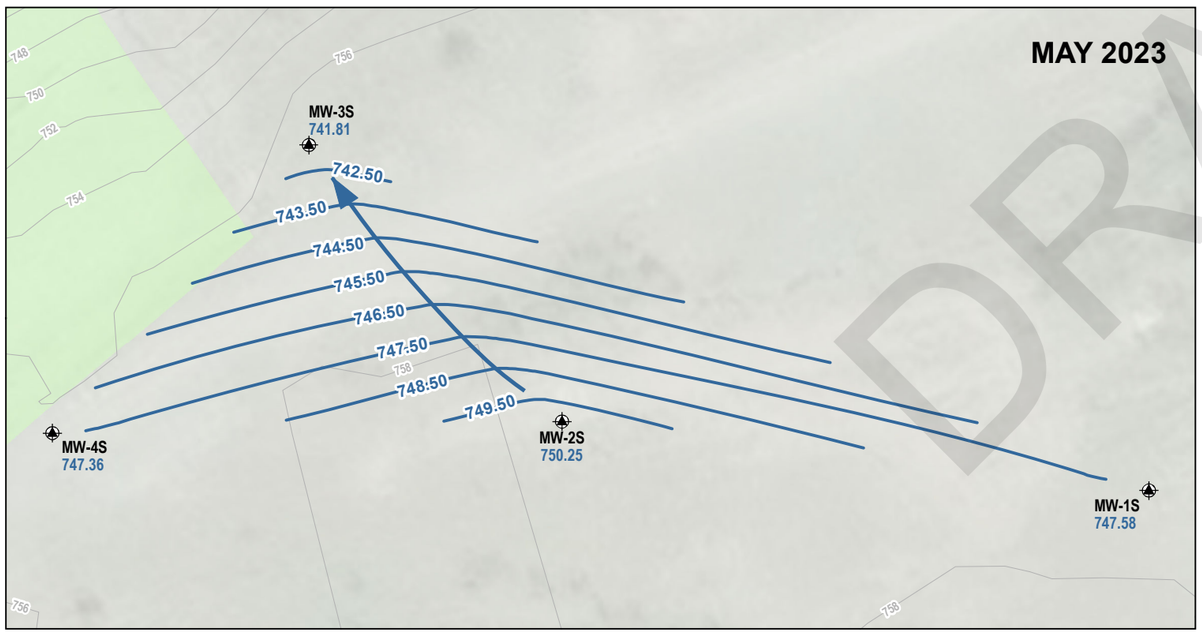
HYDROGRAPH -
DEEP MONITORING WELLS
DECEMBER 2025

HALEY ALDRICH

Figure
7B









DRAFT

LEGEND

- MONITORING WELL WITH ID AND **GROUNDWATER ELEVATION** INDICATED IN FEET (TCL)
- INTERPRETED SHALLOW GROUNDWATER ELEVATION CONTOUR, 1.0-FOOT INTERVAL (JUNE 2022 IS 0.25-FOOT INTERVAL)
- INTERPRETED GROUNDWATER FLOW DIRECTION
- TOPOGRAPHIC ELEVATION CONTOUR, 2-FOOT INTERVAL
- AREA OF PROTECTIVE CAP

NOTES

1. THE WELLS ON THIS MAP ARE ALL SCREENED IN THE SHALLOW AQUIFER. THEIR GROUNDWATER ELEVATIONS WERE USED TO INTERPRET GROUNDWATER FLOW DIRECTION.
2. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
3. TOPOGRAPHIC ELEVATION CONTOUR DATUM: TACOMA CITY LIGHT (TCL) DATUM
4. AERIAL IMAGERY SOURCE: ESRI, APRIL 22, 2024

N

0 40 80
SCALE IN FEET

HALEY ALDRICH

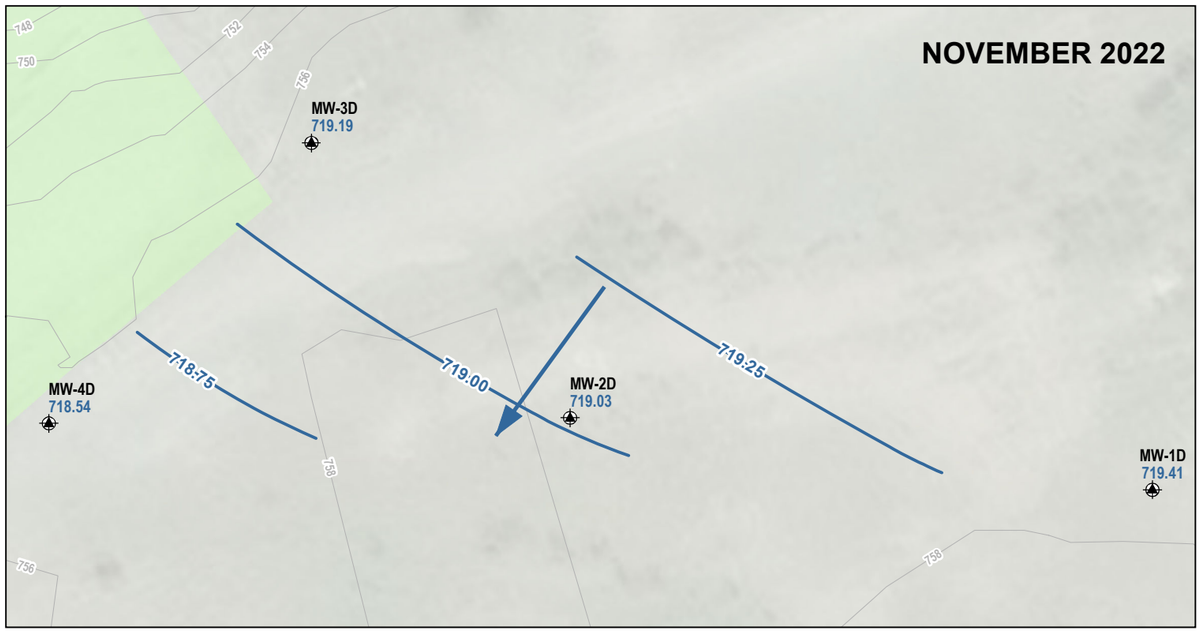
KOSMOS MILL
MORTON, WASHINGTON

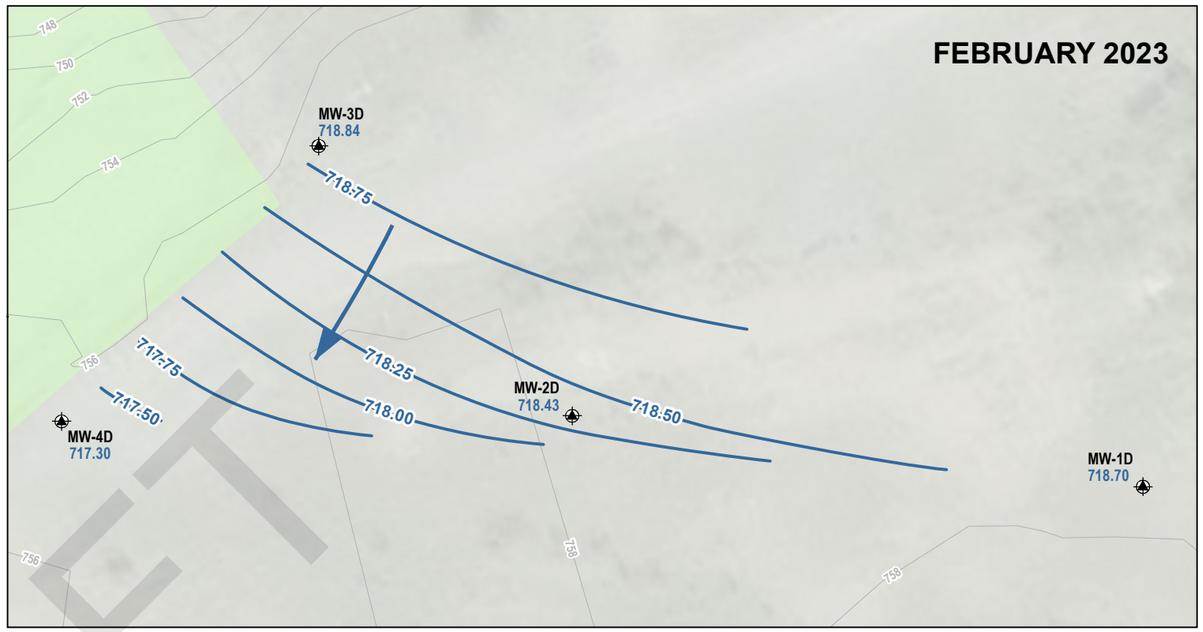
GROUNDWATER CONTOURS SHALLOW MONITORING WELLS

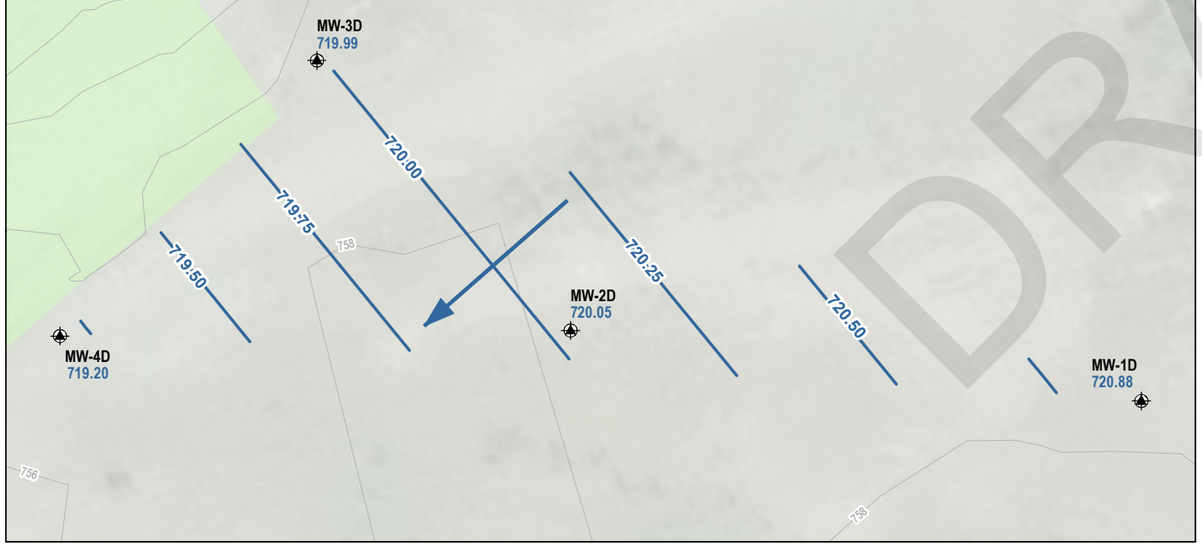
DECEMBER 2025

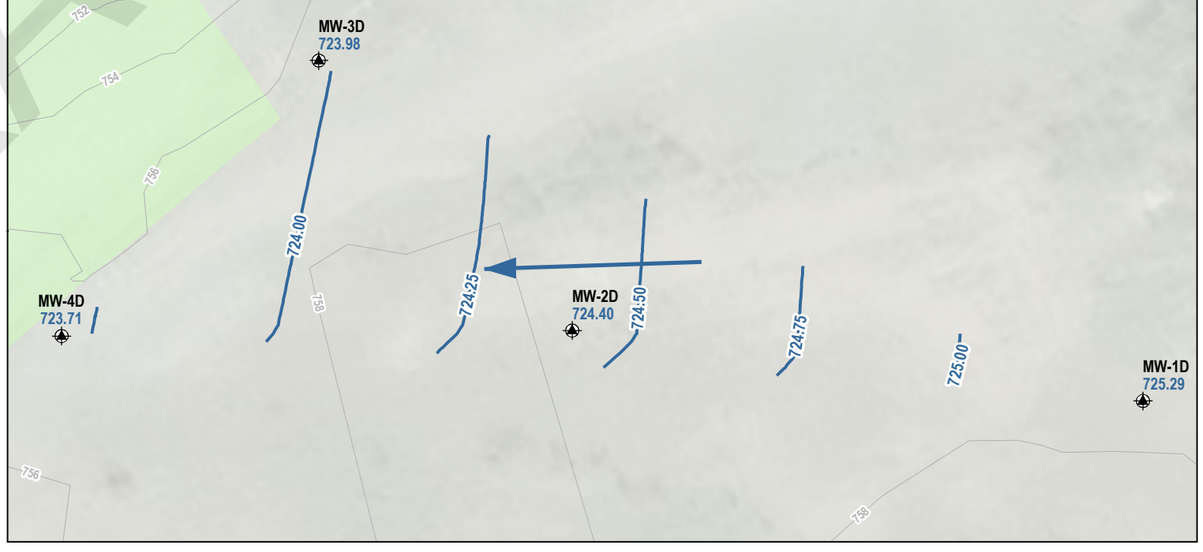
FIGURE 8

GIS: \\haleyaldrich.com\share\esa_projects\Notebooks\0202832-001_Kosmos_Mill_Oil_Cleanup_Flat_Area\GIS\Maps\2025_12\202832_001_0008_SHALLOW_GROUNDWATER_CONTOURS.mxd - Vpehlivan - 12/3/2025 2:00:00 PM









LEGEND

- MONITORING WELL WITH ID AND **GROUNDWATER ELEVATION** INDICATED IN FEET (TCL)
- INTERPRETED SHALLOW GROUNDWATER ELEVATION CONTOUR, 0.25-FOOT INTERVAL
- INTERPRETED GROUNDWATER FLOW DIRECTION
- TOPOGRAPHIC ELEVATION CONTOUR, 2-FOOT INTERVAL
- AREA OF PROTECTIVE CAP

NOTES

1. THE WELLS ON THIS MAP ARE ALL SCREENED IN THE DEEP AQUIFER. THEIR GROUNDWATER ELEVATIONS WERE USED TO INTERPRET GROUNDWATER FLOW DIRECTION.
2. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
3. TOPOGRAPHIC ELEVATION CONTOUR DATUM: TACOMA CITY LIGHT (TCL) DATUM
4. AERIAL IMAGERY SOURCE: ESRI, APRIL 22, 2024

N

0 40 80
SCALE IN FEET

HALEY ALDRICH

KOSMOS MILL
MORTON, WASHINGTON

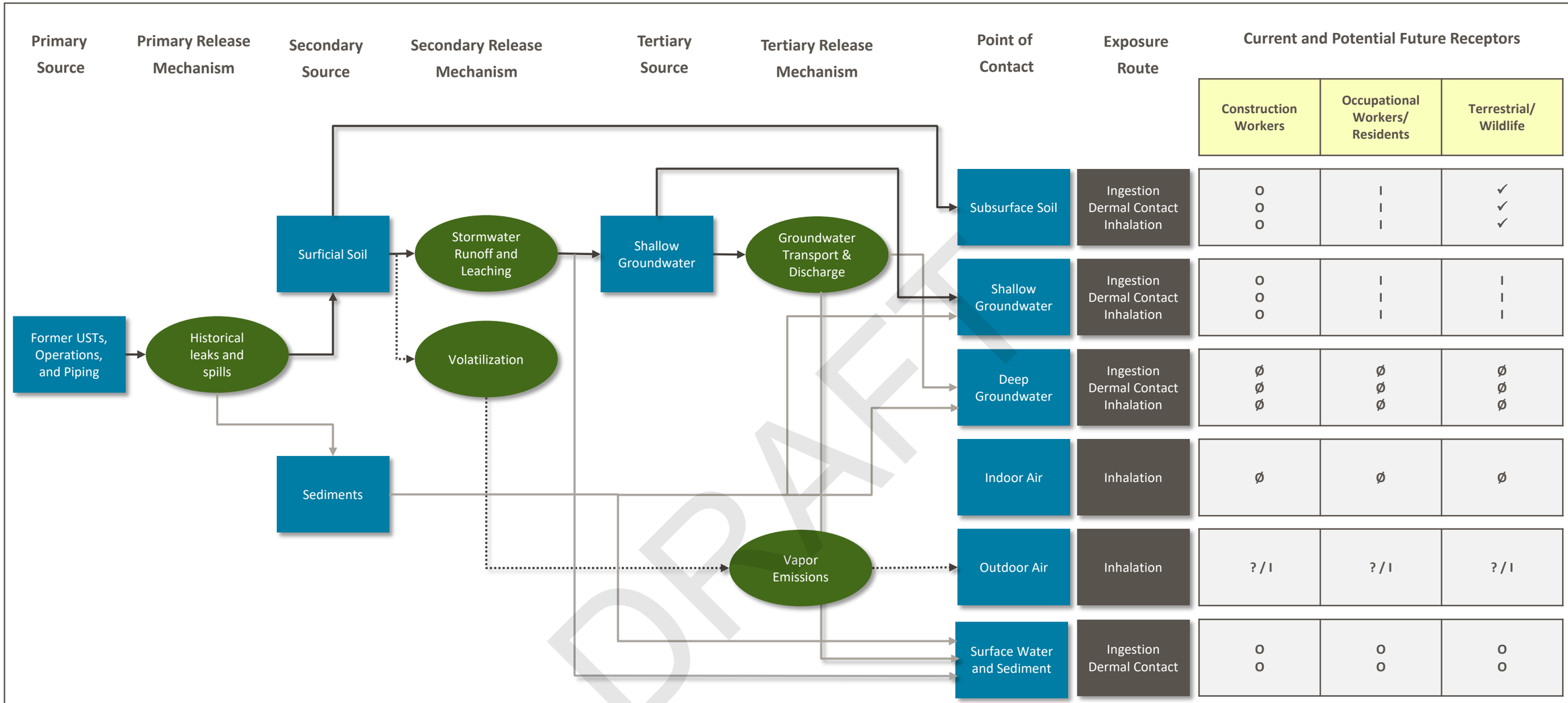
GROUNDWATER CONTOURS DEEP MONITORING WELLS

DECEMBER 2025

FIGURE 9

DRAFT

GIS: \\haleyaldrich.com\shared\sea_projects\Notebooks\0202832-001_Kosmos_Mill_Oil_Cleanup_Flat_Area\GIS\Maps\2025_12\202832_001_0009_DEEP_GROUNDWATER_CONTOURS.mxd - Vpehlivan - 12/3/2025 2:00:12 PM



LEGEND

- POTENTIALLY COMPLETE PATHWAY
- UNKNOWN PATHWAY
- CURRENTLY INCOMPLETE, BUT POTENTIAL FUTURE PATHWAY
- ✓ POTENTIALLY COMPLETE EXPOSURE ROUTE
- Ø INCOMPLETE EXPOSURE ROUTE
- I INSIGNIFICANT EXPOSURE ROUTE
- ? UNKOWN EXPOSURE ROUTE
- O CURRENTLY INCOMPLETE, BUT POTENTIAL FUTURE EXPOSURE ROUTE

NOTES

1. FT BGS = FEET BELOW GROUND SURFACE.
2. UST = UNDEGROUND STORAGE TANK.
3. COCS = CONTAMINANTS OF CONCERN
4. THE VAPOR INSTRUSION PATHWAY IS INCOMPLETE AS THERE ARE NO BUILDINGS LOCATED ON THE SITE.
5. A PLUME WAS NOT OBSERVED IN DEEP GROUNDWATER; THEREFORE, THE EXPOSURE PATHWAYS IN DEEP GROUNDWATER ARE CURRENTLY INCOMPLETE.
6. THE SITE WILL BE SEASONALLY SUBMERGED IN THE FUTURE, POTENTIALLY CREATING A PATHWAY FOR EXPOSURE AND RELEASE THROUGH SEDIMENT
7. RECREATIONAL FISHER AND AQUATIC BIOTA RECEPTOR EXPOSURE PATHWAYS ARE CONSIDERED INCOMPLETE: COCS WERE NOT DETECTED AT CONCENTRATIONS ABOVE APPLICABLE SCREENING LEVELS IN SAMPLES COLLECTED FROM THE SURFACE WATER AND SEDIMENT IN RAINEY CREEK.

DRAFT

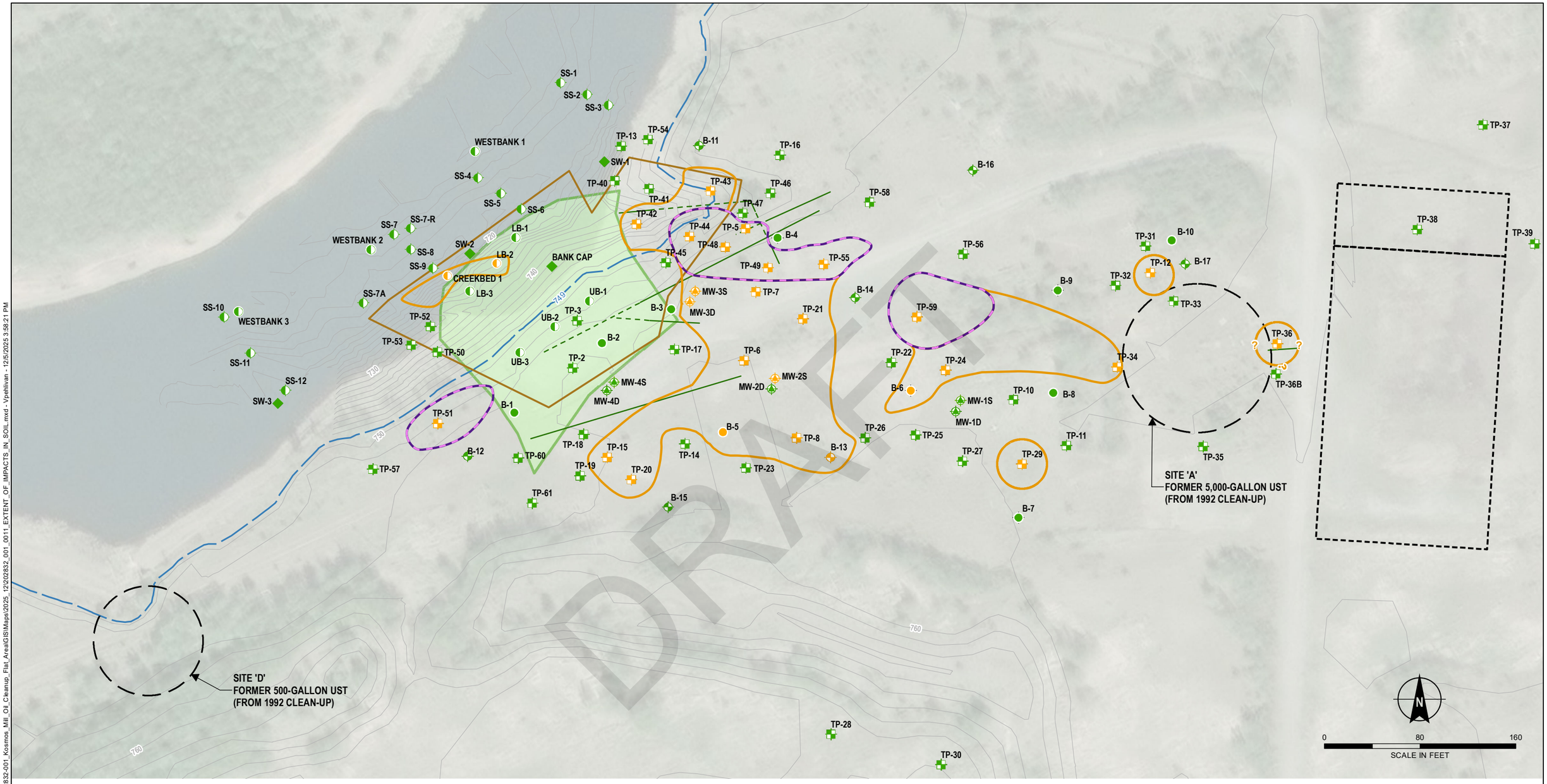
HALEY ALDRICH

FORMER KOSMOS MILL
KOSMOS FLATS AREA
MORTON, WASHINGTON

CONCEPTUAL SITE MODEL

DECEMBER 2025

FIGURE 10



LEGEND

- MONITORING WELL
- BORING (2022)
- TEST PIT
- SEDIMENT SAMPLE
- SONIC BORING (2019)
- WATER SAMPLE
- CURRENT RESERVOIR'S FULL-POOL OPERATING ELEVATION, 749 FEET TCL
- PIPE ENCOUNTERED, LEFT IN PLACE
- PIPE ENCOUNTERED, REMOVED
- TOPOGRAPHIC ELEVATION CONTOUR, 2-FT INTERVAL
- INFERRED EXTENT OF GASOLINE RANGE PETROLEUM CONTAMINATED SOIL
- INFERRED EXTENT OF SITE COC CONTAMINATED SOIL
- AREA OF PROTECTIVE CAP
- EXTENT OF IRA EXCAVATION
- FORMER STOCKPILE AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. **GREEN SYMBOLS** INDICATES CONTAMINANTS OF CONCERN ARE BELOW APPLICABLE SCREENING LEVELS IN SOIL
3. **ORANGE SYMBOLS** INDICATES CONTAMINANTS OF CONCERN ARE DETECTED ABOVE APPLICABLE SCREENING LEVELS IN SOIL
4. IRA = INDEPENDENT REMEDIAL ACTION
5. DATA COLLECTED DURING PREVIOUS INVESTIGATIONS WAS ALSO USED TO CREATE THE APPROXIMATE EXTENT OF CONTAMINATION
6. TOPOGRAPHIC ELEVATION CONTOURS AND SITE FEATURES DATA SOURCE: TPU
7. TOPOGRAPHIC ELEVATION CONTOUR DATUM: TACOMA CITY LIGHT (TCL) DATUM
8. AERIAL IMAGERY SOURCE: ESRI, APRIL 22, 2024

HALEY ALDRICH

KOSMOS MILL
MORTON, WASHINGTON

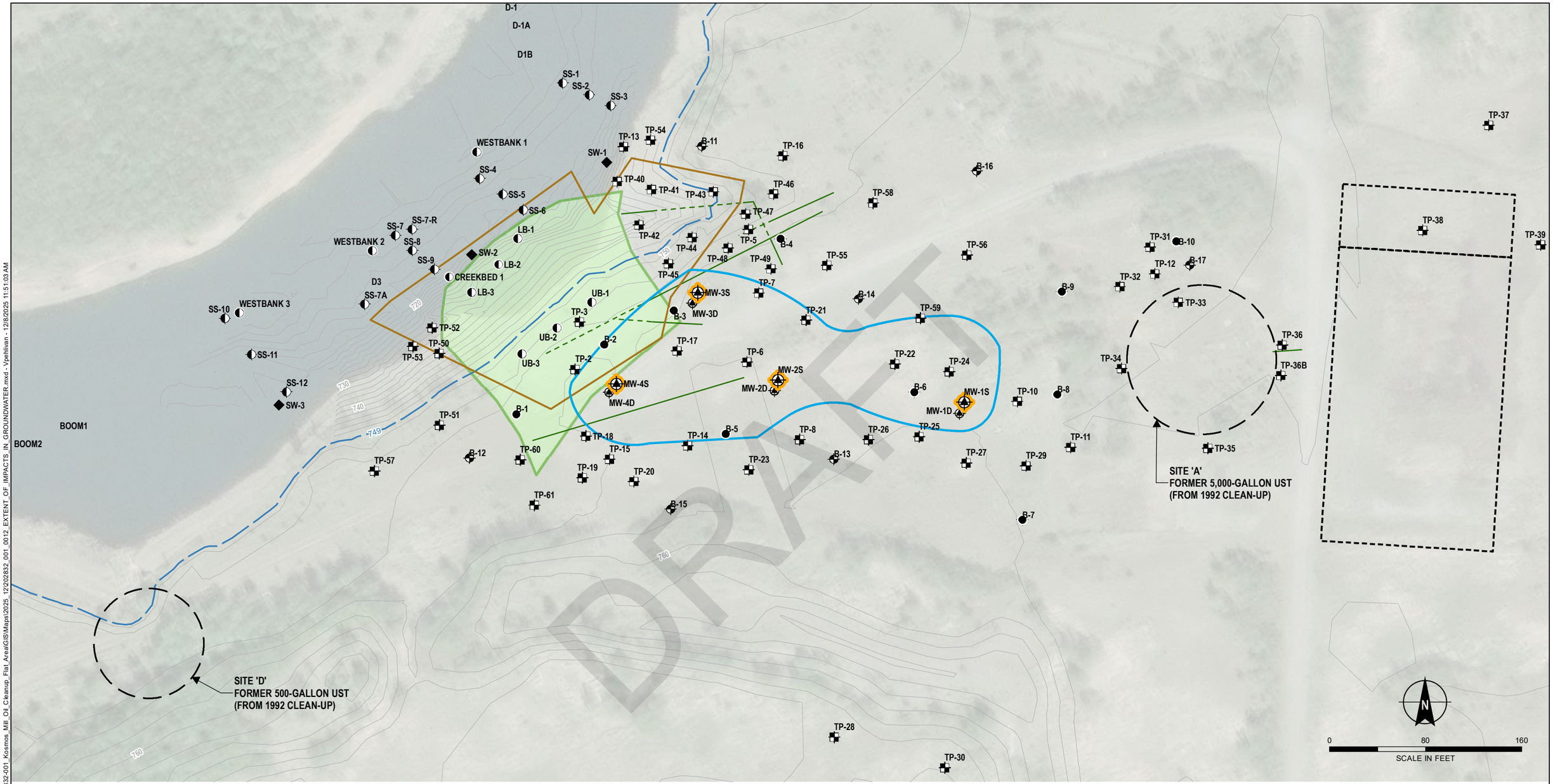
EXTENT OF IMPACTS IN SOIL

DECEMBER 2025

FIGURE 11

DRAFT

GIS: \\haleyaldrich.com\sharelsea_projects\Notebooks\0202832-001_Kosmos_Mill_Oil_Cleanup_Flat_Area\GIS\Maps\2025_12\202832_001_0011_EXTENT_OF_IMPACTS_IN_SOIL.mxd - Voehlkvan - 12/5/2025 3:58:21 PM



LEGEND

- MONITORING WELL
- BORING (2022)
- TEST PIT
- SEDIMENT SAMPLE
- SONIC BORING (2019)
- WATER SAMPLE
- CURRENT RESERVOIR'S FULL-POOL OPERATING ELEVATION, 749 FEET TCL
- PIPE ENCOUNTERED, LEFT IN PLACE
- PIPE ENCOUNTERED, REMOVED
- TOPOGRAPHIC ELEVATION CONTOUR, 2-FT INTERVAL
- INFERRED EXTENT OF PETROLEUM CONTAMINATED SHALLOW GROUNDWATER
- AREA OF PROTECTIVE CAP
- EXTENT OF IRA EXCAVATION
- FORMER STOCKPILE AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. ORANGE HALOS INDICATES CONTAMINANTS OF CONCERN ARE DETECTED ABOVE APPLICABLE SCREENING LEVELS IN SHALLOW GROUNDWATER
3. IRA = INDEPENDENT REMEDIAL ACTION.
4. DATA COLLECTED DURING PREVIOUS INVESTIGATIONS WAS ALSO USED TO CREATE THE APPROXIMATE EXTENT OF CONTAMINATION
5. TOPOGRAPHIC ELEVATION CONTOURS AND SITE FEATURES DATA SOURCE: TPU
6. TOPOGRAPHIC ELEVATION CONTOUR DATUM: TACOMA CITY LIGHT (TCL) DATUM
7. AERIAL IMAGERY SOURCE: ESRI, APRIL 22, 2024

HALEY ALDRICH

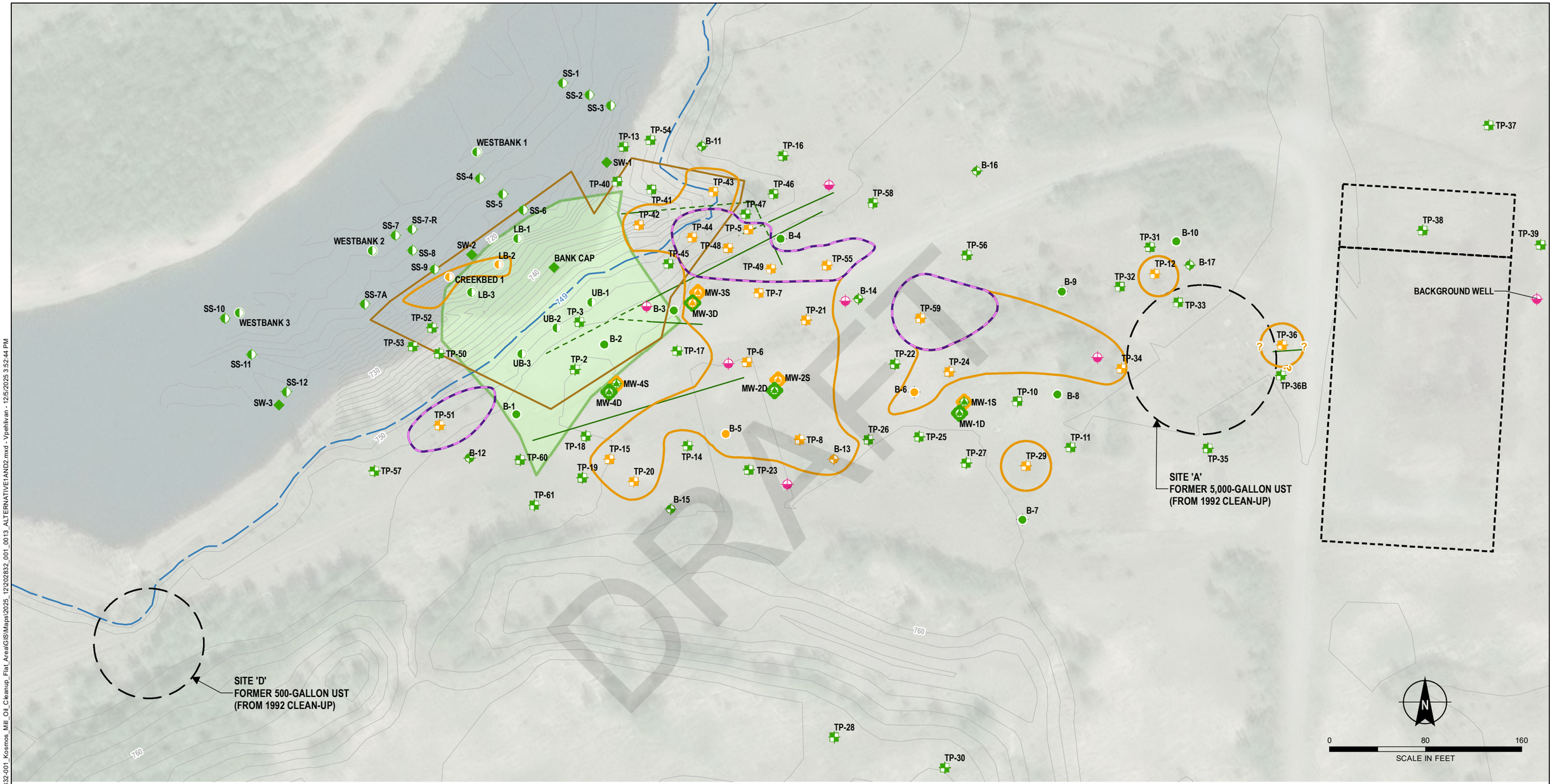
KOSMOS MILL
MORTON, WASHINGTON

EXTENT OF IMPACTS IN SHALLOW GROUNDWATER

DECEMBER 2025

FIGURE 12

GIS: \\haleyaldrich.com\sharelsea_projects\Notebooks\0202832-001_Kosmos_Mill_Oil_Cleanup_Flat_Area\GIS\Maps\2025_12\202832_001_0012_EXTENT_OF_IMPACTS_IN_GROUNDWATER.mxd - Vpehlivan - 12/8/2025 11:51:03 AM



DRAFT

LEGEND

- PROPOSED SHALLOW MONITORING WELL
- MONITORING WELL
- BORING (2022)
- TEST PIT
- SEDIMENT SAMPLE
- SONIC BORING (2019)
- WATER SAMPLE
- CURRENT RESERVOIR'S FULL-POOL OPERATING ELEVATION, 749 FEET TCL
- PIPE ENCOUNTERED, LEFT IN PLACE
- PIPE ENCOUNTERED, REMOVED
- TOPOGRAPHIC ELEVATION CONTOUR, 2-FT INTERVAL
- INFERRED EXTENT OF GASOLINE RANGE PETROLEUM CONTAMINATED SOIL
- INFERRED EXTENT OF SITE COC CONTAMINATED SOIL
- AREA OF PROTECTIVE CAP
- EXTENT OF IRA EXCAVATION
- FORMER STOCKPILE AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. **GREEN SYMBOLS** INDICATES CONTAMINANTS OF CONCERN ARE BELOW APPLICABLE SCREENING LEVELS IN SOIL.
3. **GREEN HALOS** INDICATES CONTAMINANTS OF CONCERN ARE NOT DETECTED AT OR ABOVE APPLICABLE SCREENING LEVELS IN DEEP GROUNDWATER.
4. **ORANGE SYMBOLS** INDICATES CONTAMINANTS OF CONCERN ARE DETECTED ABOVE APPLICABLE SCREENING LEVELS IN SOIL.
5. **ORANGE HALOS** INDICATES CONTAMINANTS OF CONCERN ARE DETECTED ABOVE APPLICABLE SCREENING LEVELS IN SHALLOW GROUNDWATER.
6. IRA = INDEPENDENT REMEDIAL ACTION
7. DATA COLLECTED DURING PREVIOUS INVESTIGATIONS WAS ALSO USED TO CREATE THE APPROXIMATE EXTENT OF CONTAMINATION.
8. TOPOGRAPHIC ELEVATION CONTOURS AND SITE FEATURES DATA SOURCE: TPU
9. TOPOGRAPHIC ELEVATION CONTOUR DATUM: TACOMA CITY LIGHT (TCL) DATUM
10. AERIAL IMAGERY SOURCE: ESRI, APRIL 22, 2024

HALEY ALDRICH

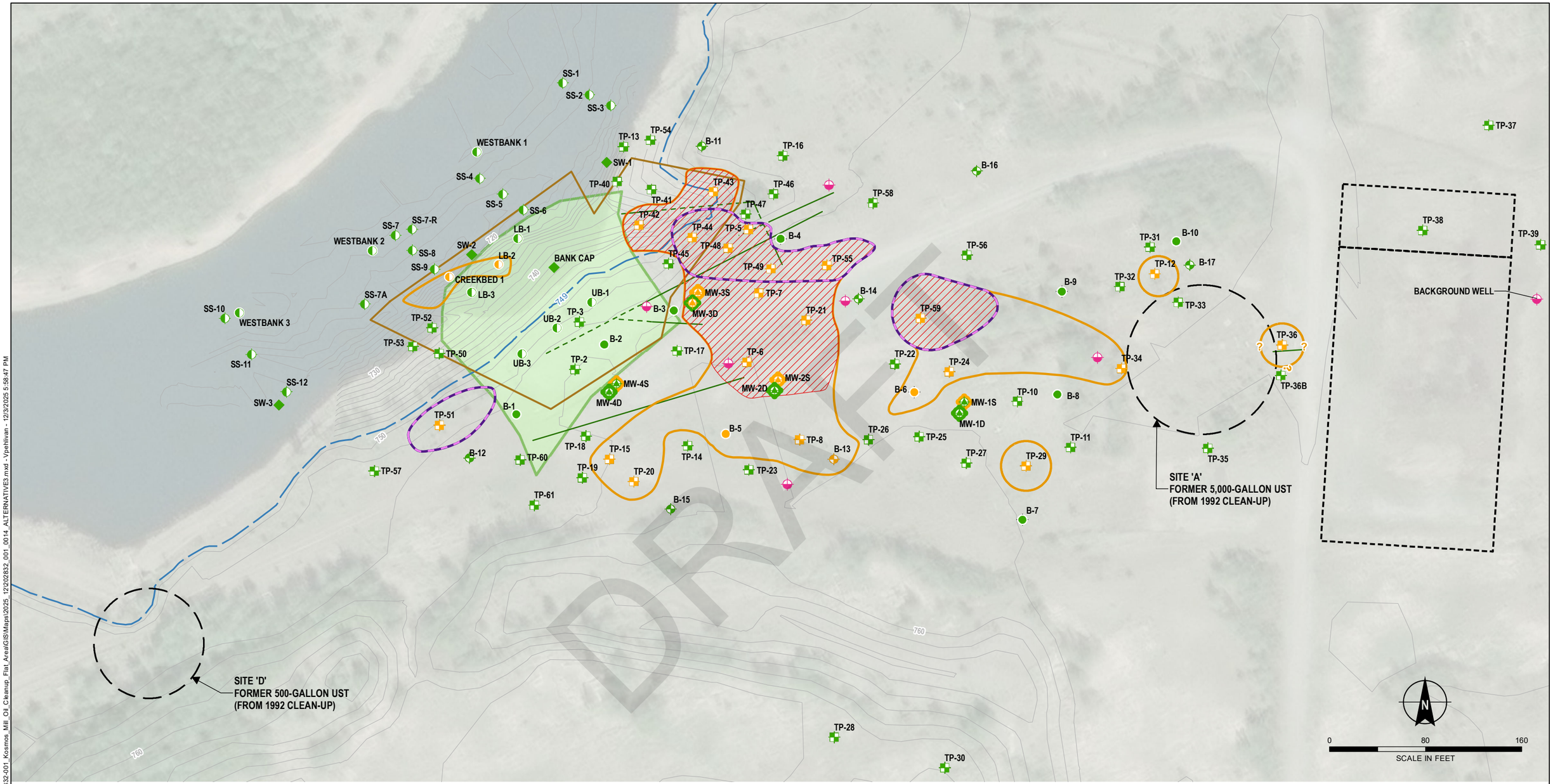
KOSMOS MILL
MORTON, WASHINGTON

ALTERNATIVE 1 AND 2

DECEMBER 2025

FIGURE 13

GIS: \\haleyaldrich.com\sharelsea_projects\Notebooks\0202832-001_Kosmos_Mill_Oil_Cleanup_Flat_Area\GIS\Maps\2025_12\202832_001_0013_ALTERNATIVE1AND2.mxd - Vpehlivan - 12/5/2025 3:52:44 PM



LEGEND

- PROPOSED SHALLOW MONITORING WELL
- MONITORING WELL
- BORING (2022)
- TEST PIT
- SEDIMENT SAMPLE
- SONIC BORING (2019)
- WATER SAMPLE
- CURRENT RESERVOIR'S FULL-POOL OPERATING ELEVATION, 749 FEET TCL
- PIPE ENCOUNTERED, LEFT IN PLACE
- PIPE ENCOUNTERED, REMOVED
- TOPOGRAPHIC ELEVATION CONTOUR, 2-FT INTERVAL
- AMENDED BACKFILL AREA
- INFERRED EXTENT OF GASOLINE RANGE PETROLEUM CONTAMINATED SOIL
- INFERRED EXTENT OF SITE COC CONTAMINATED SOIL
- AREA OF PROTECTIVE CAP
- EXTENT OF IRA EXCAVATION
- FORMER STOCKPILE AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. **GREEN SYMBOLS** INDICATES CONTAMINANTS OF CONCERN ARE BELOW APPLICABLE SCREENING LEVELS IN SOIL.
3. **GREEN HALOS** INDICATES CONTAMINANTS OF CONCERN ARE NOT DETECTED AT OR ABOVE APPLICABLE SCREENING LEVELS IN DEEP GROUNDWATER.
4. **ORANGE SYMBOLS** INDICATES CONTAMINANTS OF CONCERN ARE DETECTED ABOVE APPLICABLE SCREENING LEVELS IN SOIL.
5. **ORANGE HALOS** INDICATES CONTAMINANTS OF CONCERN ARE DETECTED ABOVE APPLICABLE SCREENING LEVELS IN SHALLOW GROUNDWATER.
6. IRA = INDEPENDENT REMEDIAL ACTION
7. DATA COLLECTED DURING PREVIOUS INVESTIGATIONS WAS ALSO USED TO CREATE THE APPROXIMATE EXTENT OF CONTAMINATION.
8. TOPOGRAPHIC ELEVATION CONTOURS AND SITE FEATURES DATA SOURCE: TPU
9. TOPOGRAPHIC ELEVATION CONTOUR DATUM: TACOMA CITY LIGHT (TCL) DATUM
10. AERIAL IMAGERY SOURCE: ESRI, APRIL 22, 2024

HALEY ALDRICH

KOSMOS MILL
MORTON, WASHINGTON

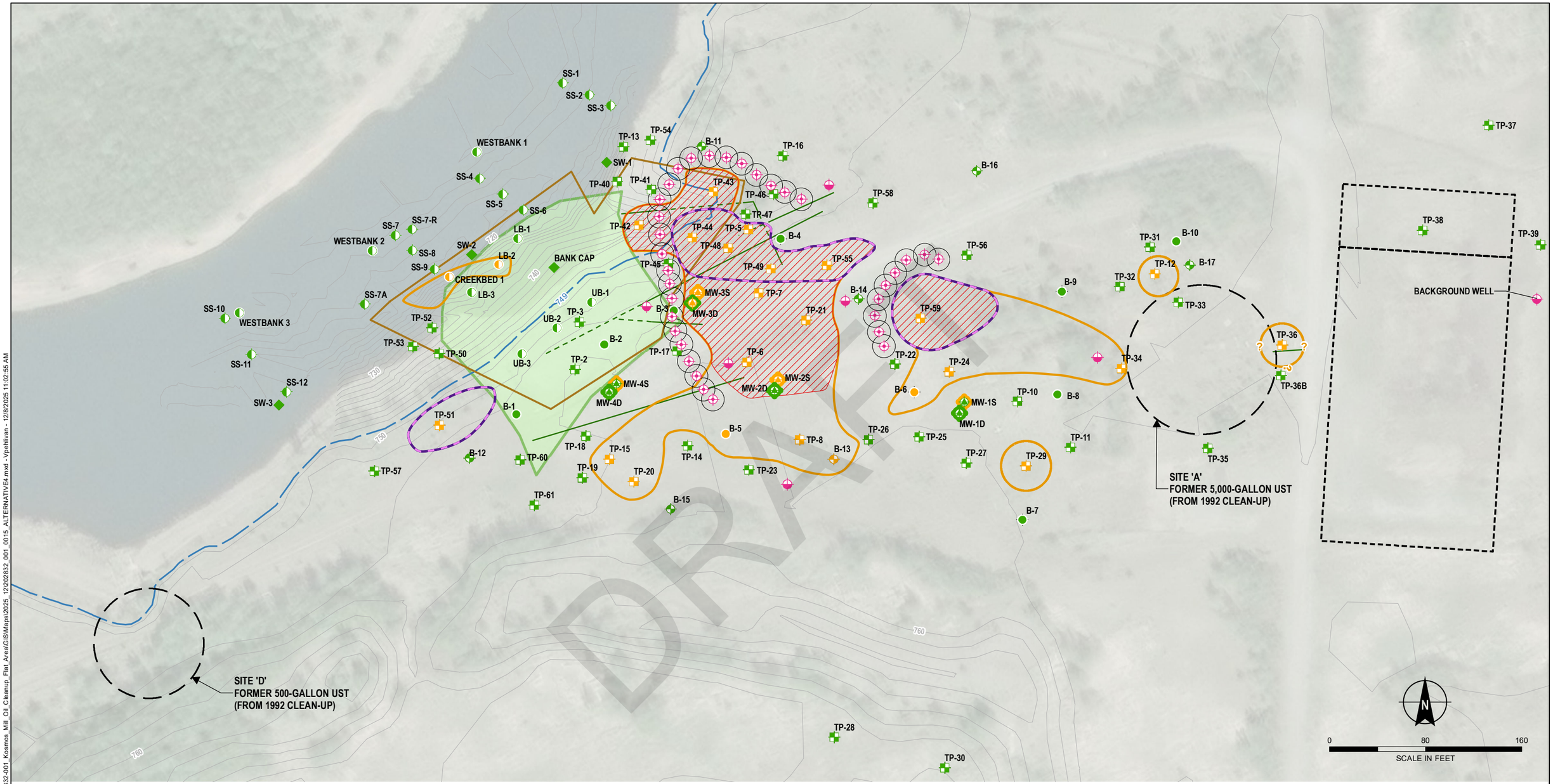
ALTERNATIVE 3

DECEMBER 2025

FIGURE 14

DRAFT

GIS: \\haleyaldrich.com\sharelsea_projects\Notebooks\0202832-001_Kosmos_Mill_Oil_Cleanup_Flat_Area\GIS\Maps\2025_12\202832_001_0014_ALTERNATIVE3.mxd - Vpehlivan - 12/3/2025 5:58:47 PM



DRAFT

LEGEND

- PROPOSED INJECTION POINT
- PROPOSED SHALLOW MONITORING WELL
- MONITORING WELL
- BORING (2022)
- TEST PIT
- SEDIMENT SAMPLE
- SONIC BORING (2019)
- WATER SAMPLE
- CURRENT RESERVOIR'S FULL-POOL OPERATING ELEVATION, 749 FEET TCL
- PIPE ENCOUNTERED, LEFT IN PLACE
- PIPE ENCOUNTERED, REMOVED
- TOPOGRAPHIC ELEVATION CONTOUR, 2-FT INTERVAL
- RADIUS OF INFLUENCE FOR THE PERMEABLE SORPTIVE BARRIER
- AMENDED BACKFILL AREA
- INFERRED EXTENT OF GASOLINE RANGE PETROLEUM CONTAMINATED SOIL
- INFERRED EXTENT OF SITE COC CONTAMINATED SOIL
- AREA OF PROTECTIVE CAP
- EXTENT OF IRA EXCAVATION
- FORMER STOCKPILE AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. **GREEN SYMBOLS** INDICATES CONTAMINANTS OF CONCERN ARE BELOW APPLICABLE SCREENING LEVELS IN SOIL.
3. **GREEN HALOS** INDICATES CONTAMINANTS OF CONCERN ARE NOT DETECTED AT OR ABOVE APPLICABLE SCREENING LEVELS IN DEEP GROUNDWATER.
4. **ORANGE SYMBOLS** INDICATES CONTAMINANTS OF CONCERN ARE DETECTED ABOVE APPLICABLE SCREENING LEVELS IN SOIL.
5. **ORANGE HALOS** INDICATES CONTAMINANTS OF CONCERN ARE DETECTED ABOVE APPLICABLE SCREENING LEVELS IN SHALLOW GROUNDWATER.
6. IRA = INDEPENDENT REMEDIAL ACTION
7. PERMEABLE SORPTIVE BARRIER MATERIAL WILL BE ADDED AT THE BOTTOM OF THE EXCAVATED AREAS.
8. DATA COLLECTED DURING PREVIOUS INVESTIGATIONS WAS ALSO USED TO CREATE THE APPROXIMATE EXTENT OF CONTAMINATION.
9. TOPOGRAPHIC ELEVATION CONTOURS AND SITE FEATURES DATA SOURCE: TPU
10. TOPOGRAPHIC ELEVATION CONTOUR DATUM: TACOMA CITY LIGHT (TCL) DATUM
11. AERIAL IMAGERY SOURCE: ESRI, APRIL 22, 2024

HALEY ALDRICH

KOSMOS MILL
MORTON, WASHINGTON

ALTERNATIVE 4

DECEMBER 2025

FIGURE 15

GIS: \\haleyaldrich.com\sharelsea_projects\Notebooks\0202832-001_Kosmos_Mill_Oil_Cleanup_Flat_Area\GIS\Maps\2025_12\202832_001_0015_ALTERNATIVE4.mxd - Vpehlivan - 12/8/2025 11:02:55 AM

APPENDIX A
Permeable Sorptive Barrier Case Studies

REGENESIS®

Petroleum Plume Mitigated to Protect Flathead Lake

PetroFix Barrier Stops Benzene and Other Hydrocarbons From Entering The Lake





Background

WCEC Uses High-Resolution Site Characterization to Delineate Hydrocarbon Plume

Polson, Montana is a small town located south of Glacier National Park and situated on the southern shore of Flathead Lake, the largest natural freshwater lake west of the Mississippi River. Popular with outdoorsmen for fishing, boating, swimming, and other recreational activities, the area has become a prime destination for many wanting to enjoy the surrounding natural environment's majesty.

In the 1990s, environmental investigations of a legacy petroleum hydrocarbon (PHC) release in downtown Polson identified a large undefined light non-aqueous phase liquid (i.e., LNAPL) plume, with benzene and other contaminants migrating toward Flathead Lake. WCEC, a prominent full-service environmental firm with offices in Montana, North Dakota, and Minnesota, was hired to develop and implement a remediation plan to protect the lake.

"There were four primary release sources converging at a (street) intersection. Our investigations provided us with a good conceptual site model, showing that within the overall fine-grained lake bed sediment was a gravel layer, 12 to 18 inches thick, where groundwater and contaminant transport was occurring."

Jim Rolle
Director of Environmental Services, WCEC

Before the remediation plan could be developed, further plume characterization was necessary to develop a conceptual site model (CSM) detailing the contamination's extent and migration pathways in the subsurface. As part of the CSM development, WCEC performed high-resolution site characterization (HRSC), including deploying the Ultra Violet Optical Screening Tool (UVOST) technology to delineate the three-dimensional extent of the LNAPL plume. Additionally, WCEC further delineated the contaminant flux zone within the dissolved phase plume threatening Flathead Lake to accurately target the remedy.

Figure 1

Benzene Plume Extents

Benzene plume prior to PetroFix PRB installation.

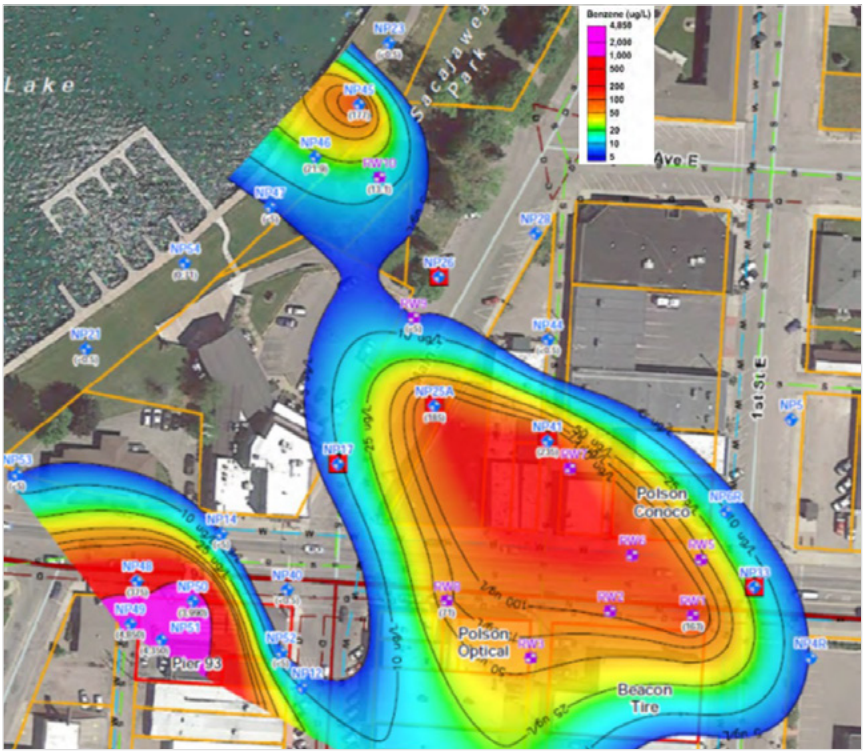
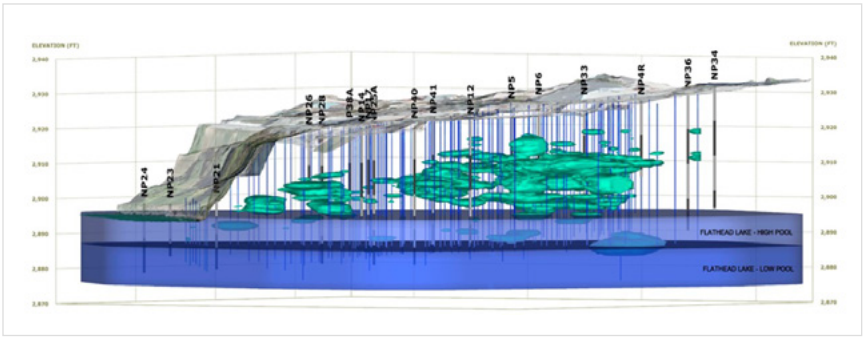


Figure 2

3-D Plume Extents

UVOST data visualization depicting the LNAPL plume's three-dimensional extent relative to Flathead Lake.





Remediation

PetroFix Permeable Reactive Barrier Chosen as Most Viable Solution to Protect Lake

Upon completing the conceptual model, WCEC began developing a remedial plan to protect the lake from the migrating PHC contaminants. Numerous regulatory agencies were involved in the plan's development and review, including the Montana Department of Environmental Quality (MTDEQ), the City of Polson, Lake County, the Confederated Salish and Kootenai Tribes, and the US EPA.

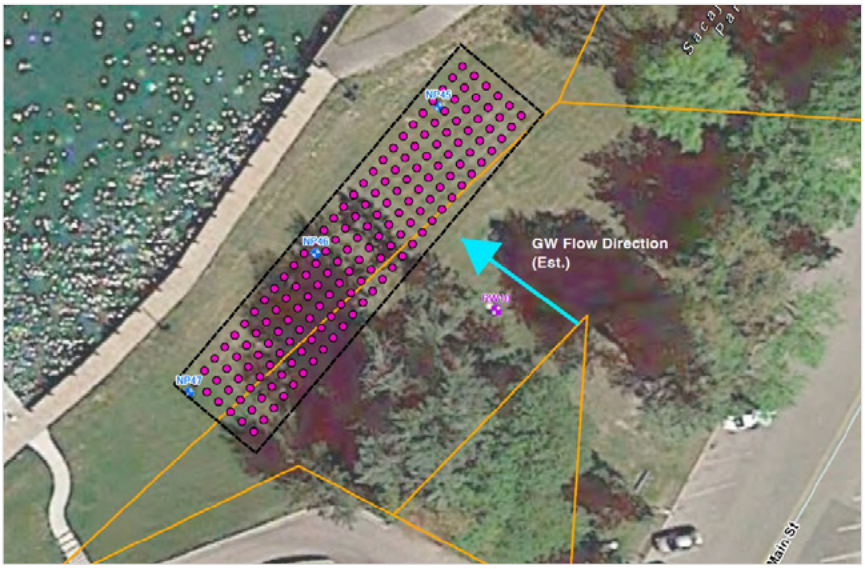
Following a comprehensive review of remedial alternatives, WCEC determined that installing a permeable reactive barrier (PRB) using PetroFix® Remediation Fluid would be the most viable and cost-effective strategy to quickly halt the dissolved phase plume's movement toward the lake. The PRB functions as an underground filtration treatment that removes PHC contamination from impacted groundwater, often below the laboratory detection levels.

The PetroFix PRB design consisted of several rows of closely spaced injection borings placed perpendicular to groundwater flow, upgradient of the lakeshore. The injection depths were matched to the contaminant flux zones identified during the HRSC activities.

Figure 3

PetroFix PRB Layout

Photograph depicting PetroFix permeable reactive barrier injection point layout and surrounding area.



Injection Details

PetroFix PRB Length:	160 ft
Injection Depth:	6 - 12 ft bgs
Injection Points:	168
Spacing:	5 ft
PetroFix Applied:	5,600 lbs



PetroFix is observed in a soil core spanning the contaminant flux zone.

With the aid of the PetroFix Design Assistant and REGENESIS' technical support, WCEC completed the PetroFix injection in April 2020, ensuring the proper equipment was on hand, including the multi-port injection tooling, flow meters, and pressure gauges needed to effectively apply PetroFix.

During the injection, WCEC collected soil core samples to confirm that PetroFix was adequately distributed throughout the target injection zone. Based on visual observation of these samples, the field crew adjusted the injection tooling, volumes, and flow rates in real-time to ensure the PetroFix distribution goals were met.





Results

"The barrier has remained effective for three-and-a-half years. We sample the groundwater along the lake shore on both sides of the barrier. So, we know what concentrations are getting to the barrier, and we know there are no concentrations on the down gradient side of the barrier."

Jim Rolle
Director of Environmental Services, WCEC

Benzene Concentrations Remain Non-Detect for 3.5 Years, Thus Far

Following the installation of the PetroFix PRB, the threat of dissolved phase contaminant migration into the lake was immediately mitigated, with these results sustained for over 3.5 years thus far, as performance monitoring continues. The remedy remains in place to protect against further contaminant migration due to the residual PHC plume remaining upgradient. LNAPL recovery activities are still being implemented in the plume body to remove the source mass contributing to the PHC plume.

Besides protecting Flathead Lake, WCEC has successfully applied PetroFix on several other sites in the region to quickly reduce levels cost-effectively and accelerate their clients' site closures.

Figure 4

Pre-Application Plume Extents

Northern extent of benzene plume in March 2018 before installing the PetroFix barrier.

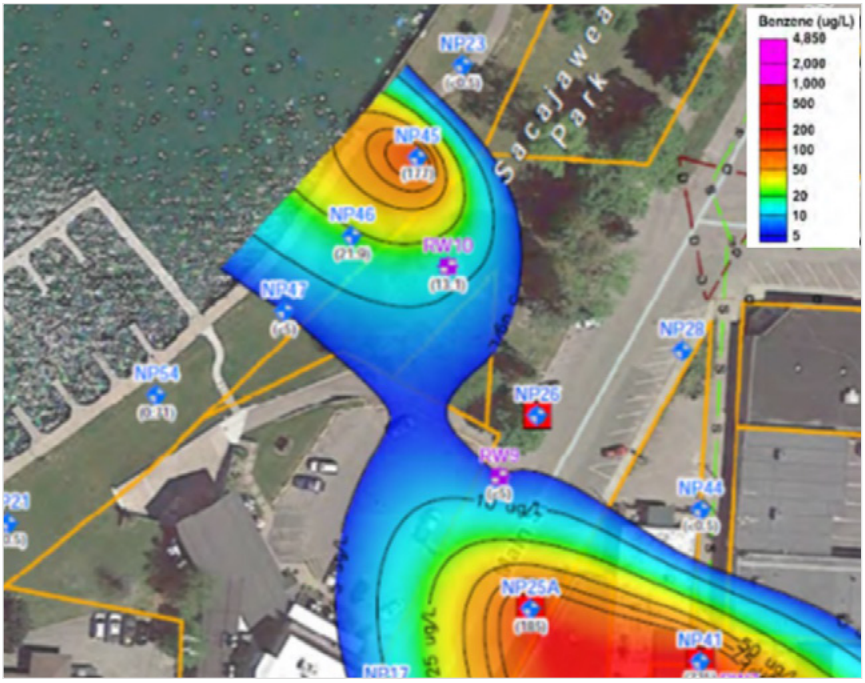
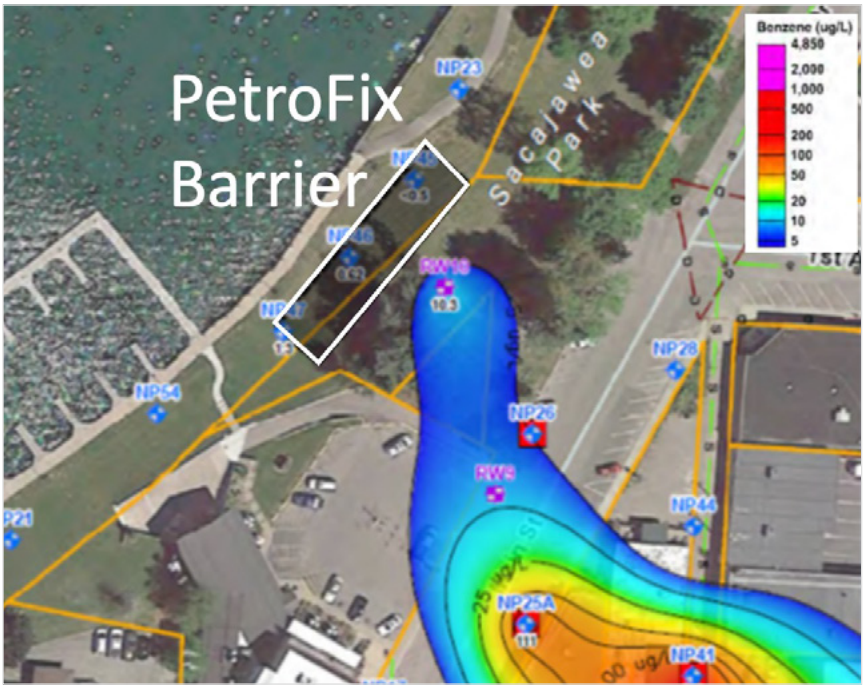


Figure 5

Post-Application Plume Extents

Northern extent of benzene plume in December 2020, eight months after installing the PetroFix barrier. Benzene concentrations continue to remain non-detect in the barrier treatment zone through 3.5 years of monitoring completed.



© 2024 All rights reserved. PetroFix and REGENESIS are registered trademarks of REGENESIS Bioremediation Products. All other trademarks are property of their respective owners.

REGENESIS®
www.REGENESIS.com

NON-DETECT ACHIEVED AT FLORIDA SPILL SITE

CASE STUDY:
PetroFix Applied at Site to Reach Target Goals Within 60 Days



REGENESIS®



HIGHLIGHTS

IN SITU APPROACHES NOT AFFECTED BY SEVERE WEATHER
As a passive system, PetroFix was not affected by power outages or storm damage from Category 5 Hurricane Michael

MET TARGETS WITHIN 60 DAYS
Unlike other approaches applied onsite, PetroFix met targets within 60 days and has remained below this target level for a year

EFFECTIVELY DEGRADES CONTAMINANTS
PetroFix was able to degrade the petroleum contaminants within a fast-moving, 150-yard plume

FULL-SCALE APPLICATION PLANNED
Due to the successful pilot test results, AET LLC has applied for a full-scale application through the FDEP

OVERVIEW

A multi-use convenience store site located in Panama City Beach, Florida was impacted by contamination from a leaking underground storage tank (UST). A 2007 report determined that 1,000 gallons of fuel were discharged from this tank and subsequently contaminated the soil and water table. From 2012 to 2015 two firms conducted various remedial actions at the site prior to Advanced Environmental Technologies, LLC (AET) taking over the remedial project. Prior actions included the removal of the three USTs, a bioremediation system and soil excavation. In 2016, AET took over remediation efforts onsite under a pay-for-performance agreement and prepared a remedial action plan (RAP) modification. The first treatment approach involved injecting hydrogen peroxide and nutrients into existing wells using direct push injections. While the approach was initially successful reducing contaminant levels during the first 30 days, it did not sustain contaminant reduction. As of October 2017, the groundwater concentrations remained above cleanup levels.

Interested in applying a more effective solution, AET sought out a technology that was affordable and would be guaranteed to lower the contaminant levels below the target levels. AET partnered with REGENESIS to conduct a pilot test using its new PetroFix activated carbon amendment. PetroFix is successful in high concentration source areas because it provides a permanent, *in situ* sorptive and biologically permeable reactive barrier (PRB). AET chose this technology because it offered a cost-effective solution that would quickly address the groundwater concentrations.

Just 60 days after the PetroFix pilot test injection, the contaminant concentrations were below detection and have remained so after one year post-injection. AET is pleased with these results and has applied for a full-scale application through the Florida DEP.

60 days after PetroFix was applied, contaminant concentrations dropped to below detection and have remained so after 1 year

BACKGROUND

This site formerly dispensed gasoline and had three 6,000 gallon USTs in use at the facility. During an annual storage tank site inspection in 2007, the report noted that the middle tank (UST-2) failed a tightness test and exhibited product loss. A further report determined that 1,000 gallons of fuel was discharged from this tank which was then taken out of service. Further assessments determined that free product was present in the water table.

Following this conclusion, soils were excavated during tank removal and a bioremediation system was installed and operated from 2012 to 2015. During the 1st quarter of 2015, this system was removed and groundwater monitoring began in preparation for a remedial action plan (RAP) modification. The RAP modification called for an injection of hydrogen peroxide and nutrients into existing wells using direct push drilling technology injections which took place from February 29, 2016 through March 4, 2016. Post Application Remedial Monitoring (PARM) sampling has been conducted quarterly since then. As of quarter 6 in October 2017, the groundwater concentrations remained above cleanup target levels. MW-8 was particularly concerning because it is offsite and downgradient with some of the highest contaminant levels. Following this remediation attempt, AET partnered with REGENESIS to treat the ongoing contamination.

REGENESIS

PROJECT TIMELINE

January 15, 2007

Annual storage tank facility site inspection report indentified UST 2 as leaking UST

March 19, 2007

Assessment activities conducted including soil sampling

June 5-8, 2007

The 3 USTs were removed and soil excavations took place. It was concluded that free product was present at the water table

July 2012-April 2015

A bioremediation system operated

February 29-March 4, 2016

Hydrogen peroxide and nutrients were injected using direct push drilling technology injections

October 12, 2017

PARM sampling indicates groundwater concentration remains above cleanup target levels

February, 2018

Baseline sampling was conducted in preparation for PetroFix injection

March 26-29, 2018

1,700 lbs PetroFix and electron acceptors were injected in 13 DPT points around MW-8

PetroFIX™ Remediation Fluid

April 4, 2019

Concentrations remain below cleanup target levels





TREATMENT

The PetroFix pilot test injection was applied at MW-8 which had the highest contamination. This well is located in a vacant lot across the road from the convenience store. Prior to the injection, baseline sampling was conducted at MW-8 and downgradient well MW-16 for BTEX, PAHs, and TRPH. Because this was a pilot test using a new innovative technology, samples were measured for additional parameters such as microbial counts, alkalinity, total organic carbon, and chemical oxygen demand.

Over three days, 1,700 pounds of PetroFix and electron acceptor salts were injected into 13 points around MW-8. The injections were completed using direct push technology and started at 20 feet below ground surface (bgs) and stopped at 10 feet bgs. The direct push rod was driven to the terminus depth of 20 feet and a pump was used to inject the chemical through the drill rod as the rod was removed from the ground. The injections were most commonly completed at pressures of approximately 50 PSI and almost entirely under 100 PSI due to fine, compacted sands, and had even distribution as verified through soil cores (see upper right image). After the injection, the boreholes were filled with cement grout to land surface. Active groundwater monitoring was conducted quarterly following the pilot test.

PetroFIX™ Remediation Fluid



TECHNOLOGY

PetroFix Remediation Fluid is a concentrated, water-based, activated carbon suspension specifically designed to remediate petroleum spills and provide immediate results for gas station and UST sites. Safe, fast, effective, and easy-to-apply, PetroFix is designed to first remove hydrocarbons from the dissolved phase by adsorbing them onto activated carbon particles and then stimulating hydrocarbon biodegradation by adding electron acceptors. PetroFix offers an *in situ* remediation approach designed specifically for sites where PHC levels are above regulatory standards for complete remediation at the lowest total cost-to-closure. This safe and effective technology is paired with the PetroFix Design Assistant, an online design tool that enables users to individually tailor their site designs and self-apply PetroFix.

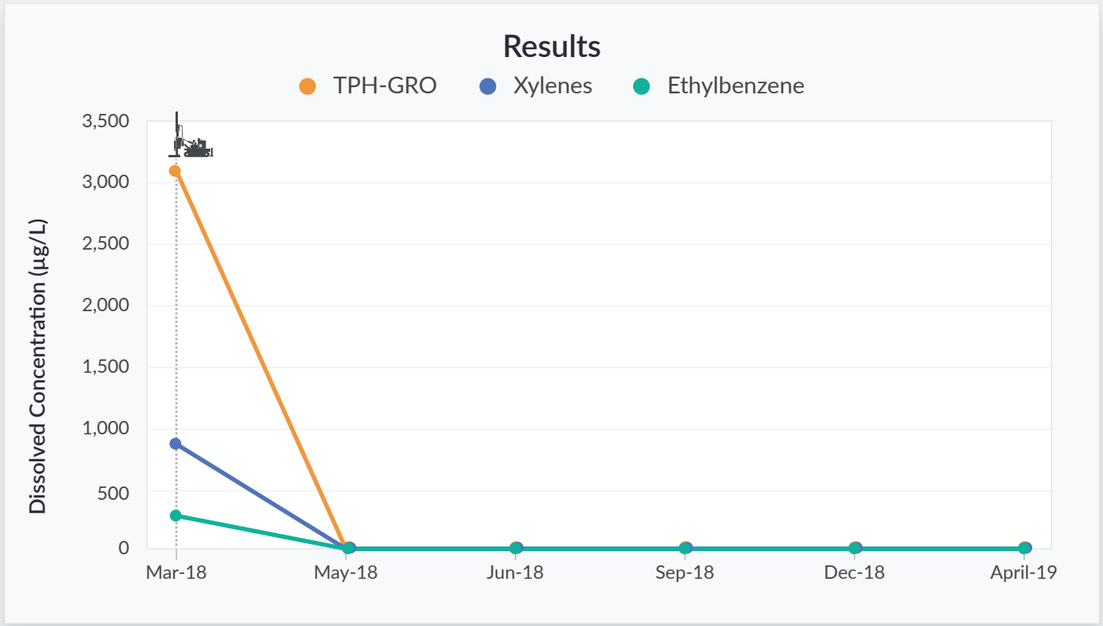
PetroFIX™ Remediation Fluid

Key Benefits:

- Affordable and reliable
- Applied under low pressure
- Tailored site design
- Simple online design assistant







All groundwater results post-injection are non detect.

RESULTS

In just 60 days after the injection, the petroleum contaminants were below detection. After one year, no exceedances of petroleum groundwater and surface water cleanup target levels (GCTLs) were observed in MW-8. Of further interest was documenting that hydrocarbon-degrading bacteria were thriving at the site which is evidence that hydrocarbons were being biodegraded from the PetroFix. QuantArray Petro analysis from Microbial Insights verified that microbes associated with petroleum hydrocarbon degradation maintained robust populations following application, including total bacteria, sulfate degraders and PM-1 which degrades for MTBE and other hydrocarbons. AET is impressed by the remarkable results in such a short period of time and in September, 2018 the firm applied for an Innovative Technologies Acceptance Letter.

> ***The results were amazing. Total petroleum contaminant concentrations hit cleanup target levels in 60 days and have remained below target levels for over a year. This is the most exciting remediation technology that I have seen in my 36 years of practice.***

Advanced Environmental Technologies, LLC

– Gordon Dean
Vice President, AET, LLC



ABOUT THE CONSULTANT

As the Vice President of the largest petroleum assessment and remediation company in Florida, Mr. Dean provides senior engineering support for remedial actions and consulting services for clients purchasing environmentally distressed properties nationwide. Mr. Dean is a Professional Engineer (PE) in multiple states with more than 36 years of experience in the assessment and remediation of hazardous waste and petroleum contaminated sites. Mr. Dean has been the seller/doer responsible for procurement and management of more than $750 million in total contracts. Mr. Dean holds a B.S. in Chemical Engineering from the University of Florida and has spoken at numerous environmental conferences on effective approaches in petroleum assessment and remediation approaches.



Gordon Dean
Vice President
Advanced Environmental
Technologies, LLC

ABOUT AET

Advanced Environmental Technologies, LLC (AET) is a nationally recognized provider of comprehensive environmental solutions. Experts at environmental science and engineering AET offers the ability to translate proven experience into on-site construction and field logistics.

Established in 1998, AET offers a complete range of environmental services from initial site reconnaissance through site remediation and closure. In today's business climate of increasingly complex environmental issues, regulations, and requirements, as well as increasing public and private sector awareness of environmental issues, AET provides a unique alternative in meeting the diverse environmental service needs of our clients.

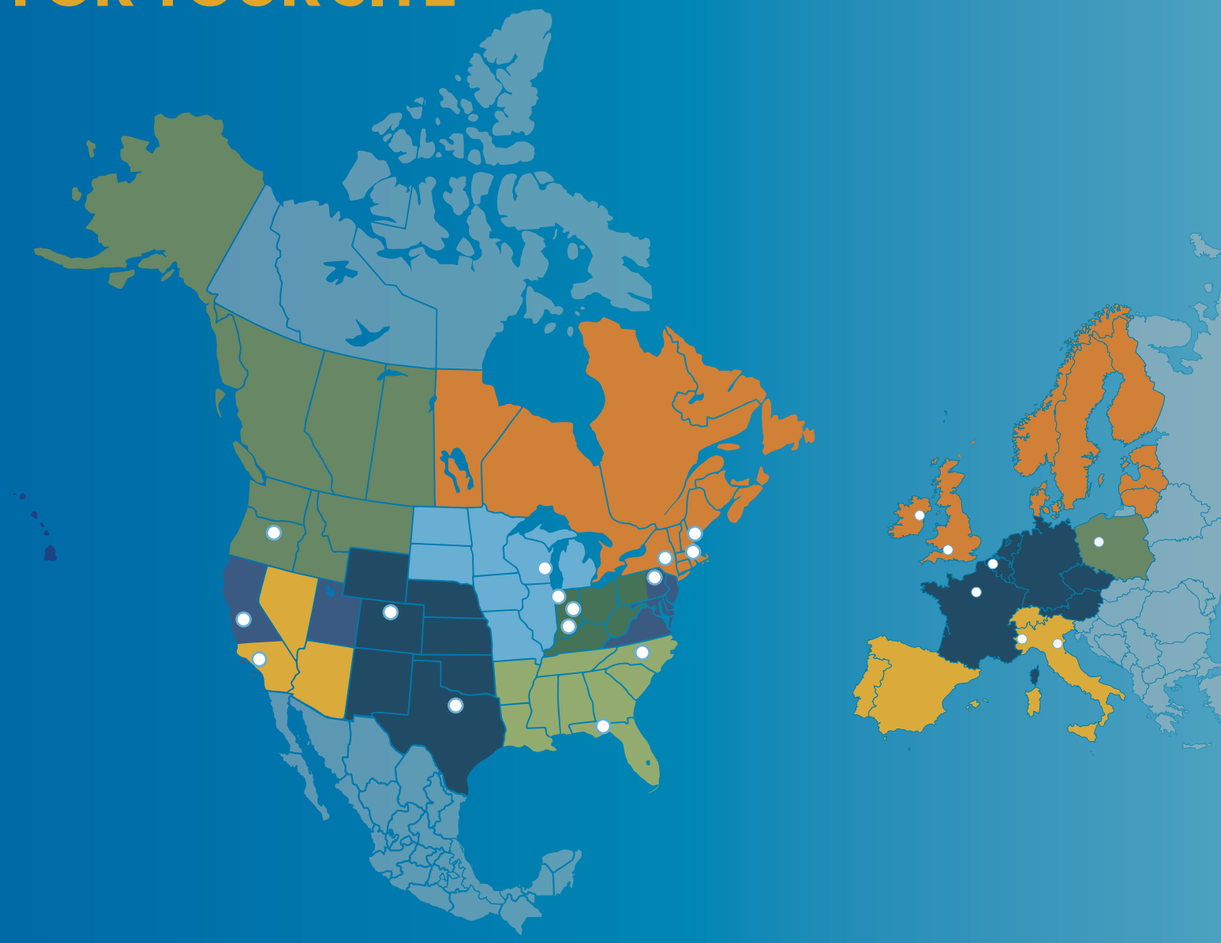
AET staff provides practical, hands-on experience treating the full range of environmental contaminants in multiple media. This includes solving problems involving hydrocarbons, solvents, pesticides, toxic metals, and other chemicals that may be present in soils, sediments, sludge, groundwater, surface water, and air. AET's streamlined structure supports a proactive project management style to control schedules and costs and provides efficient and equitable service to our clients.

Advanced Environmental Technologies, LLC

4864 Corlett Street
Talahassee, FL 32303
Ph: (850)-385-2010

REGENESIS®

WE'RE READY TO HELP YOU
FIND THE RIGHT SOLUTION FOR YOUR SITE



Global Headquarters

1011 Calle Sombra
San Clemente, CA 92673 USA
Ph: (949) 366-8000
Fax: (949) 366-8090

Europe

Bath, United Kingdom
Ph: +44 (0) 1225 731 447

Dublin, Ireland
Ph: +353 (0) 1 9059 663

Torino, Italia
Ph: +39 (0) 11 19781549

Ieper, België
Ph: +32 (0) 57 35 97 28



www.REGENESIS.com

REGENESIS®

©2019 All rights reserved. REGENESIS, PetroFix is a registered trademarks of REGENESIS Bioremediation Products. All other trademarks are the property of their respective owners.