SeaPort
MIDSTREAM PARTNERS, LLC

May 31, 2024

Oregon Department of Environmental Quality (DEQ)
700 NE Multnomah Street
Portland, OR 97232

Re: Seismic Vulnerability Assessment, Seaport Midstream Partners, LLC, Portland Terminal

To Whom It May Concern,

Attached please find the Seismic Vulnerability Assessment for the SeaPort Midstream Partners, LLC Portland Terminal located at 9930 NW St. Helens Rd, Portland, OR 97231. This document is submitted in response to *Rule 340-300-0003 Seismic Vulnerability Assessment Requirements and Timeline*. This assessment has been prepared by SGH Consultants and has been reviewed by Seaport Midstream Partners LLC.

We look forward to working productively with Oregon DEQ on the *Fuel Tank Seismic Stability Rules* as we move into subsequent phases of the program.

Regards,

Karl H. Bernard
Vice President Terminal Operations
Seaport Midstream Partners, LLC

**SEAPORT MIDSTREAM PARTNERS LLC**
200 Mansell Court • Suite 600 • Roswell, GA 30076-4853 • 770-518-3500

# SEISMIC VULNERABILITY ASSESSMENT OF THE SEAPORT MIDSTREAM PARTNERS PORTLAND TERMINAL

**SeaPort Midstream Partners, LLC**
**Portland Terminal**
**Portland, OR**
**May 2024**

**SGH Project 247052**

REGISTERED PROFESSIONAL ENGINEER
87981PE
DIGITALLY SIGNED
OREGON
MAR. 12, 2013
GAYLE S. JOHNSON
EXPIRES: 06/30/25

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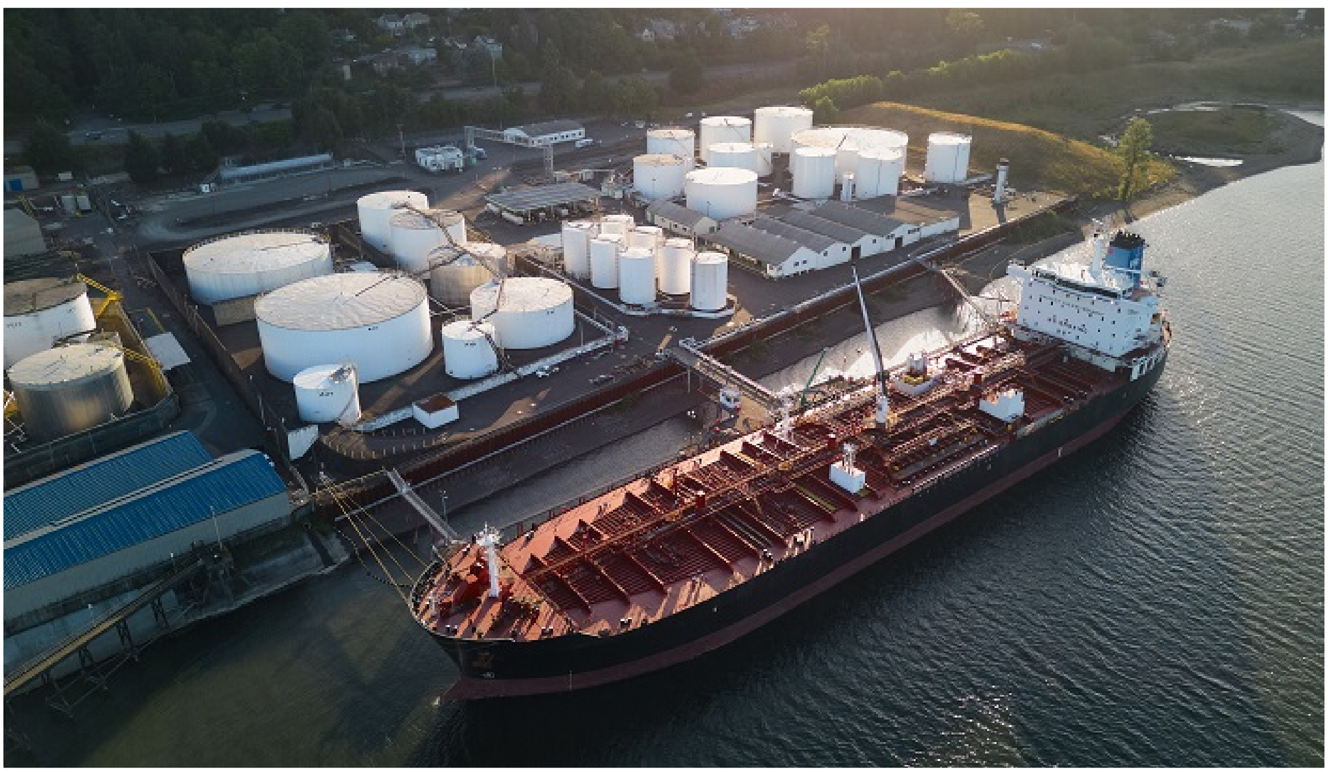
PE Stamp applies to Report Body and Appendix C



**PREPARED FOR**
**SeaPort Midstream Partners, LLC**
9930 N.W. St. Helens Rd.
Portland, OR 97231

**PREPARED BY**
**Simpson Gumpertz & Heger Inc.**
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**O:** 415.495.3700

## EXECUTIVE SUMMARY

SeaPort Midstream Partners, LLC (SMP) has contracted Simpson Gumpertz & Heger Inc. (SGH) to perform a Seismic Vulnerability Assessment of the SeaPort Midstream Partners Portland Terminal to comply with the new "Fuel Tank Seismic Stability Rules" (Rules) recently adopted by the Oregon Department of Environmental Quality (DEQ). This report presents the geotechnical, structural, and safety assessments performed. Key vulnerability findings are summarized below and discussed in further detail in this report.

Items are categorized as Moderate or High Risk based on the full consideration of hazards, including earthquake induced ground deformations. For High Risk items, mitigations should be considered using an As Low As Reasonably Practicable (ALARP) risk reduction philosophy. For Moderate Risk items, further evaluation is recommended to determine if mitigation is necessary. For example, this may include detailed engineering calculations to quantify the seismic capacity of specific, existing components.

**Table E-1 - Summary of High Risk Items**

| North Tank Farm | South Tank Farm | Biodiesel Tank Farm | Butane Storage, Water Separators, & Dock | Safety Systems & Buildings |
|---|---|---|---|---|
| Containment Walls | Containment Walls | Containment Walls | Sheet Pile Wall | Water Main |
| Tank Foam System | | | Dock | Foam System |
| | | | Dock Piping | Deluge System |
| | | | Oil Water Separator | |
| | | | Storm Water Separator | |

**Table E-2 - Summary of Moderate Risk Items**

| North Tank Farm | South Tank Farm | Biodiesel Tank Farm | Butane Storage, Water Separators, & Dock |
|---|---|---|---|
| Piping | Piping | Piping | Piping |
| Tank 1 | | | Fire Pump |
| Tank 5 | | | |
| Tank 6 | | | |
| Tank 8 | | | |
| Tank 11 | | | |
| Tank 24 | | | |
| Tank 25 | | | |

**<u>Geotechnical</u>**

We have determined a peak ground acceleration ($PGA_M$) of 0.49g for the ASCE 7-16 DLE event.

The sheet pile wall design estimates lateral displacements on the order 1½ ft, though the toe is in liquefiable material and the design does not appear to include inertial seismic forces. It is unclear at this time if the FLAC analysis considers the potential for deep-seated seismic deformations occurring below the wall. Future investigations should include a detailed review and validation of the sheet pile wall's FLAC analysis to understand the original assumptions, including considerations for global stability due to the deep-seated liquefiable soil and considerations for inertial seismic forces, and to confirm the sheet pile wall's expected lateral displacement.

The estimated seismically-induced vertical ground deformations vary from 2 in. to 18 in. at the site, with the potential for larger vertical deformations if large lateral deformations occur due to the performance of the sheet pile wall. Our structural and safety assessments considered these potential displacements.

## Structural

Many of the tanks in the North Tank Farm have a Moderate Risk due to their flammable contents and a higher Life Safety severity.  Additionally, Tank 1 is rivited, and Tanks 5, 6, 8, and 11 are Moderate Risk due to a higher Likelihood of damage driven by an over-constrained condition with stairs or piping, as shown in the example photos below. Tanks 24 and 25 are rated Moderate due to a high H/D ratio, even considering them half full.

Pipelines are rated Moderate throughout the terminal due to differential displacements from vertical settlement and the anticipated pipe stresses. At the dock, pipelines are rated High due to a higher consequence of damage and spill directly into the river. Additionally, the dock piping is likely to experience high stresses due to its supported condition on the wharf and the higher soil displacements estimated at the river front.

The containment walls are rated High due to their importance in containing spills and the uncertainty in their capacity to withstand seismic loads due to their age and construction.


**Figure E-1: Example Over-Constrained Conditions**

**Safety**

The water supply is rated as a High Risk seismic vulnerability. The facility relies on municipal water as its only source for firewater and for foam distribution. It is highly unlikely municipal water will be available following the DLE considered by the Rules.

Since the foam system, fire pump, and deluge systems are dependent on municipal water, which is unlikely to be available following the DLE, and the consequence of these systems being unavailable, these items are deemed a High Risk.

Power is needed for the electric fire / foam pump, MOVs, and facility lighting. However, the diesel fire / foam pump can continue operating even during a loss of municipal power . Since it is very likely that power will be lost following an earthquake, we determined that loss of power is a Medium Risk item.

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**APPENDIX**

# 1. INTRODUCTION

SeaPort Midstream Partners, LLC (SMP) has contracted Simpson Gumpertz & Heger Inc. (SGH) to perform a Seismic Vulnerability Assessment of the SeaPort Midstream Partners Portland Terminal to comply with the new "Fuel Tank Seismic Stability Rules" (Rules) recently adopted by the Oregon Department of Environmental Quality (DEQ). This report summarizes that assessment.

## 1.1 Background

The DEQ developed the Rules to address the risks related to a Cascadia Subduction Zone earthquake impacting large capacity fuel handling facilities in Columbia, Lane, and Multnomah counties in Oregon. Rule 340-300-0003 specifies the requirements and timeline to perform a Seismic Vulnerability Assessment. The Seismic Vulnerability Assessment is a detailed, facility-wide, site-specific evaluation of the risk of seismically induced damage and secondary effects to a facility and environment when subjected to a Design Level Earthquake (DLE). The Rules require that, for the purposes of this study, the DLE be determined in accordance with ASCE 7-16. This results in a very large earthquake (with a moment magnitude greater than 9.0) representing the Cascadia Megathrust fault, as described further in Section 3.2.

Rule 340-300-0002(18) defines the "Performance Objective" as limiting structural damage resulting in a spill exceeding the Maximum Allowable Uncontained Spill (MAUS) when the facility experiences DLE ground motions. Rule 340-300-0002 defines the maximum uncontained quantity of spill as one barrel (42 gal) or less for each tank or associated equipment, by reference to the reportable volumes in Oregon Law OAR 340-142.

Rule 340-300-0003 specifies the following elements be included in the Seismic Vulnerability Assessment:

- Description of facility components in terms of construction, age, inspection, maintenance, and operations.
- Summary of currently implemented spill prevention and mitigation measures and their ability to achieve the Performance Objective.

- Definition of the DLE.
- Evaluation of the potential for a spill exceeding the MAUS during the DLE for all components in the facility
- Evaluation of the potential for liquefaction, lateral spreading, and settlement seismically induced
- Evaluation of the safety of operating conditions, safe shutdown procedures, and potential spills
- Evaluation of the availability and integrity of automated sprinkler systems and sufficient supplies of firefighting foam and other emergency response equipment located in seismically resilient locations accessible after an earthquake to mitigate the risk of fire and explosions following an earthquake
- Evaluation of fire control measures such as firewalls surrounding the facility to limit fire spreading into surrounding communities
- Evaluation of the availability of day and night onsite personnel trained in emergency response and able to respond in the event of an earthquake

### 1.2 Scope of Work

The scope of work consisted of the following assessments consistent with Rule 340-300-0003(6)(a-c):

- Geotechnical Assessment including:
  - Site conditions assessment
  - Seismic hazard evaluation
  - Geotechnical evaluation
- Structural Assessment
- Safety Assessment including:
  - Fire control and suppression systems evaluation
  - Spill containment system evaluation
  - Evaluation of onsite emergency equipment, operational safety measures, and personnel availability

## 1.3 Assessment Boundaries

The team considered possible scenarios due to earthquakes that may realistically occur and result in an uncontained spill, uncontrolled fire, explosion, or toxic release at the terminal.

The following items were excluded from the scope of this study:

- Failures due to non-earthquake-related causes
- Life-safety considerations that are not directly caused by a spill that occurs due to an earthquake (e.g. life-safety concerns from occupants of a building that collapses)

## 1.4 Assessment Criteria

Rule 340-300-0002(4) lists codes and standards for use in this assessment. This list includes ASCE 7 for seismic design criteria, building structures, piping and pipe racks, and secondary containment, ASCE 41 for existing buildings, API 650 and API 653 for tanks, and ASCE 61 for piers, wharves, and waterfront structures. As permitted by Rule 340-300-0002(4)(h), the team considers "other applicable standards" to include:

- "Guidance for California Accidental Release Prevention (CalARP) Program Seismic Assessments," prepared for the Unified Program Agency (UPA) Subcommittee of the Region I Local Emergency Planning Committee (LEPC), January 2019, also referred to as the "CalARP Seismic Guidance Document".
- California Building Code (CBC) Chapter 34F, otherwise known as Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS), 2022.
- "Seismic Evaluation and Design of Petrochemical and Other Industrial Facilities, 3rd Edition, American Society of Civil Engineers (ASCE), 2020.

The CalARP Seismic Guidance Document has a long history, being widely used within the industry for assessing existing chemical and process facilities that contain hazardous materials. Further, MOTEMS is considered the most appropriate code document for assessment of operational procedures and seismic performance at existing oil terminals. Both of these documents also reference the ASCE document noted above. That document is widely used throughout the industry and is frequently accepted by building officials for its interpretation of building code provisions as specifically relevant to typical structures and systems found in petrochemical and industrial facilities.

### 1.5 Limitations

SGH has performed the professional services for this project using the degree of care and skill ordinarily exercised under similar circumstances by reputable engineers practicing in the structural and earthquake engineering fields in this or similar localities. SGH makes no other warranty, expressed or implied, as to the professional advice included in this report. We have prepared this report for SMP to be used solely for the purposes of satisfying the requirements of the DEQ Rules. We have not prepared the report for use by other parties and the report may not contain sufficient information for purposes of other parties or for other uses. The recommendations resulting from this assessment rely on information provided by SMP to SGH, including soils reports, drawings, and specifications. SGH makes no warranty as to the accuracy and correctness of any information provided by SMP.

Please note that addressing vulnerabilities identified in our report may reduce the risk, but does not guarantee or assure that a release will not occur in an earthquake. All parties should recognize the lack of complete assurance connected with seismic evaluations, especially of existing facilities. Uncertainties exist associated with material properties and structural behavior (uncertainties that are typically larger for existing facilities than new designs), as well as large uncertainties associated with earthquake motion in terms of amplitude, frequency content, direction, and duration. All parties should also recognize that seismic assessments such as those performed in this review require the significant application of professional experience and engineering judgment. Some amount of uncertainty and variation will always exist with respect to the interpretation of data, notwithstanding the exercise of due professional care.

This assessment emphasized identification of vulnerabilities and not conformance to building codes for new design. We further note that conformance to new design codes does not eliminate seismic risk, and industry standards for seismic evaluation of existing facilities consistently have been developed with the intent of reducing risk, and not for compliance with new design codes.

## 2. FACILITY DESCRIPTION

The SeaPort Midstream Partners Portland Terminal is located at 9930 NW St. Helens Road in Portland, Oregon. The terminal has a 125-foot dock with dolphins and catwalks along the Willamette River. The facility consists of three tank farms, the dock, a butane storage area, an offload area, loading racks, and several buildings. See Figure 2-1 for the vicinity plan of the SeaPort Midstream Partners Portland Terminal. See Figure 2-2 for the aerial plan of the facility.


**Figure 2-1: Vicinity Plan of SeaPort Midstream Partners Portland Terminal**

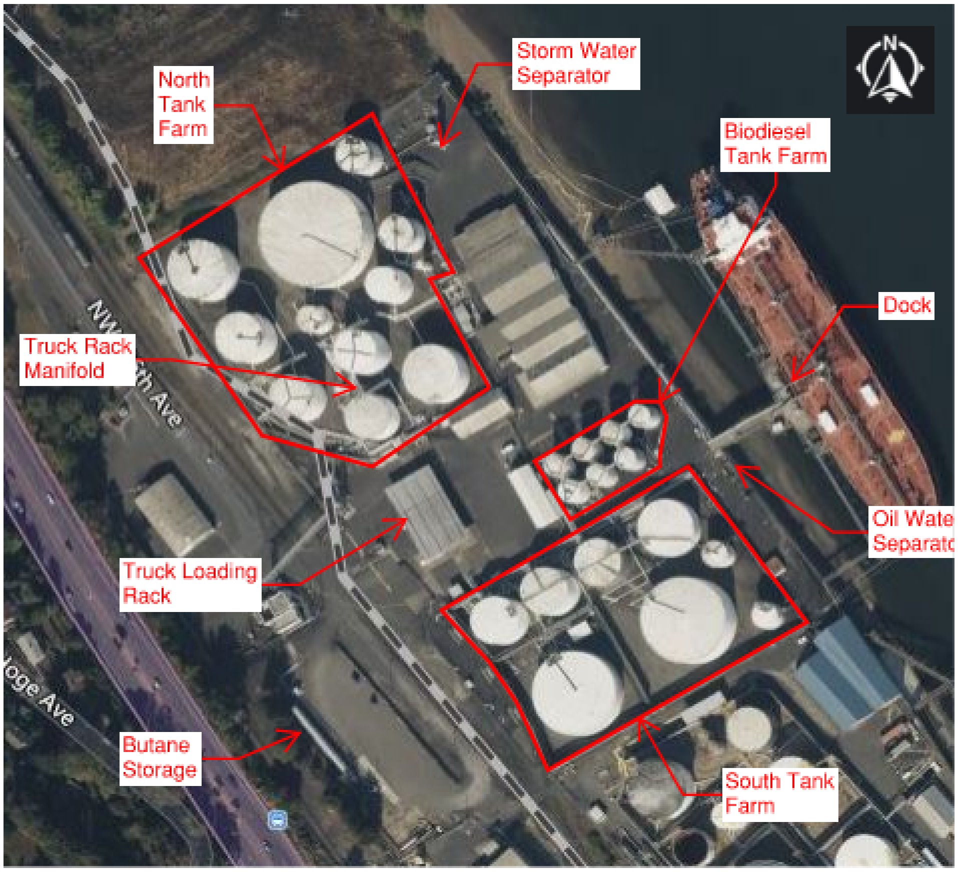



**Figure 2-2: Aerial Plan of SeaPort Midstream Partners Portland Terminal**

## 2.1 North Tank Farm

The North Tank Farm consists of one combustible fuel tank, seven flammable fuel tanks, four additive tanks, and one groundwater remediation tank. There are thirteen total tanks in the containment area. There is one tank with a diameter larger than 120 ft, while the remainder of tanks have a diameter less than 80 ft. The tanks vary from large-diameter squat tanks to small-diameter tanks with a high aspect ratio (height divided by diameter, H/D). Several pumps and the truck loading rack manifold are located within the tank farm. Pipes interconnect the tanks and penetrate the containment walls, leading to the adjacent truck loading racks. The containment consists primarily of reinforced concrete walls and one earthen ramp on the river side of the tank farm. The approximate gross area within the containment is 127,317 square ft. Containment volume of the North Tank Farm, per the SPCC, is about 6,947,712 gallons (about 165,400 barrels). See Figure 2-3 for an aerial view of the North Tank Farm.


**Figure 2-3: Aerial Plan of North Tank Farm**

## 2.2 South Tank Farm

The South Tank Farm consists of six combustible fuel tanks, one process water fuel tank, and two additive tanks. There are nine total tanks in the containment area. There is one tank with a diameter larger than 100 ft, while the remainder of the tanks have a diameter of less than 80 ft. The tanks vary from large-diameter squat tanks to small-diameter tanks with a high aspect ratio (height divided by diameter, H/D). Several pumps and other mechanical equipment are located within the tank farm. Pipes interconnect the tanks and penetrate the containment walls. The containment consists primarily of reinforced concrete walls and one earthen ramp on the river side of the tank farm. The approximate gross area within the containment is 99,992 square ft. Containment volume of the South Tank Farm, per the SPCC is 4,822,841 gallons (114,830 bbls). See Figure 2-4 for an aerial view of the South Tank Farm.

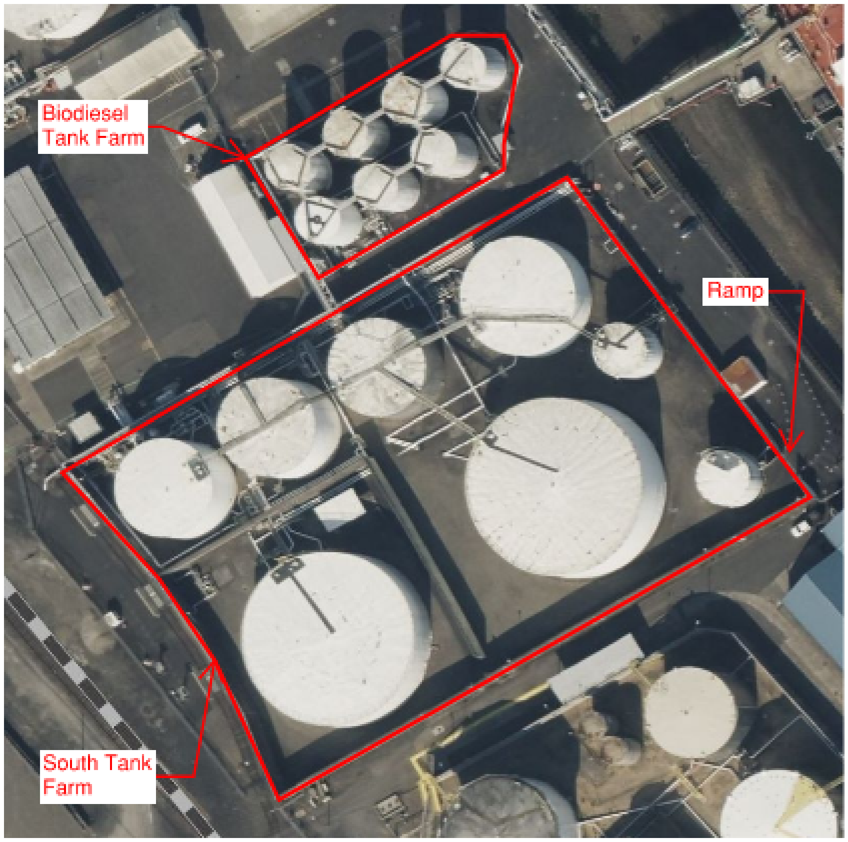



**Figure 2-4: Aerial of South Tank Farm and Biodiesel Tank Farm**

## 2.3 Biodiesel Tank Farm

The Biodiesel Tank Farm has four additive tanks, one combustible fuel, and two process water tanks within the containment area. All seven tanks have a diameter of 30 ft. All four additive tanks are out of service. Several pumps and other mechanical equipment are located within the tank farm. Pipes interconnect the tanks and lead out of the tank farm via pipe bridges over the containment walls. The containment consists primarily of reinforced concrete walls. The approximate gross area within the containment is 15,790 square ft. Containment volume of the Biodiesel Tank Farm, per the SPCC, is 335,165 gallons (7,980 bbls). See Figure 2-4 for an aerial view of the Biodiesel Tank Farm.

## 2.4 Butane Storage, Water Separators, and Dock

The dock was rebult in 1993 primarily using concrete. It consists of a 125 ft long loading platform with two breasting dolphins on either side. The loading platform and dolphins are connected by catwalks.  A 115 ft long trestle supporting pipelines connects the loading platform to land. Piping runs above and below the trestle deck to shore.

The Oil Water Separator is located south of the trestle. The Storm Water Separator is located adjacent to the northeast corner of the North Tank Farm.

The Butane Storage is located southwest of the Truck Loading Rack. The Butane Storage is an approximately 140-ft long horizontal tank supported on reinforced concrete piers constructed circa 2014. Piping from the tank runs to the north to the Truck Loading Rack. See Figure 2-5 for an aerial view of the dock, water separators, and Butane Storage.

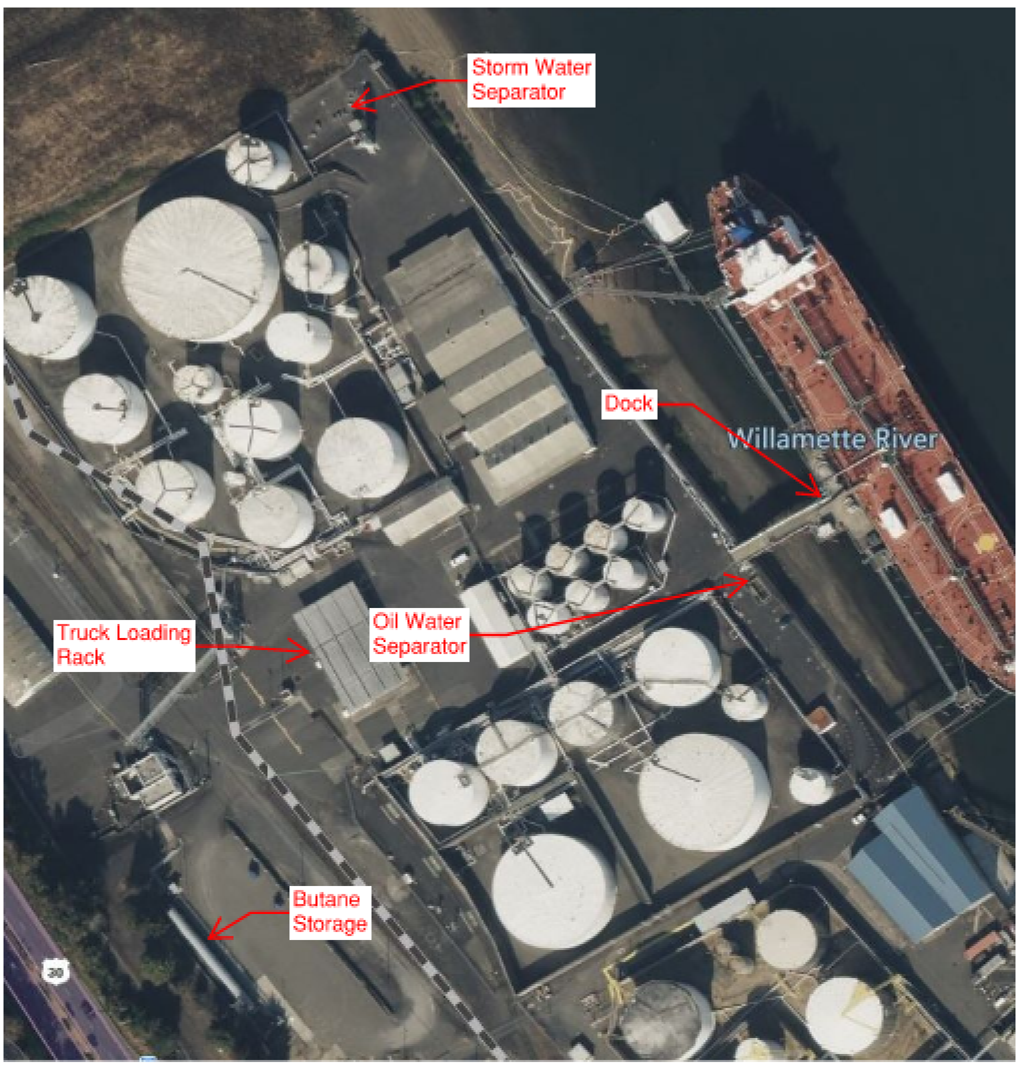



**Figure 2-5: Aerial of Water Separators, Butane Storage, and Dock**

## 2.5 Loading Racks

The SeaPort Midstream Partners Portland Terminal has one truck loading rack and one rail unloading rack. They are used for loading product on trucks and unloading rail cars. The rail unloading rack is southwest of the South Tank Farm. The truck loading rack is located between the tank farms. The loading racks consist of steel framed construction. See Figure 2-6 for an aerial view of the Loading Racks.


**Figure 2-6: Aerial of Loading Racks**

## 2.6 Buildings

The following lists the occupied buildings at the SeaPort Midstream Partners Portland Terminal.

- Guardshack
- Truck Shop
- Boiler House
- Office
- SIMOPS
- Warehouse
- QAQC

The primary construction for these buildings is concrete or masonry walls with light-framed roofs. None of these buildings, or the unoccupied buildings or structures, store or contain fuels. We have listed the buildings in the risk assessment (Section 6).

A plot plan and inventory are provided in Appendix A.

## 3. GEOTECHNICAL ASSESSMENT

A geotechnical assessment was performed to provide input for the Seismic Vulnerability Assessment. The assessment included consideration of existing site-specific geotechnical information and other existing data. The full geotechnical assessment, performed by Gannett Fleming Inc. (Gannett Fleming), is included in Appendix B.

### 3.1 Site Conditions

The terminal is located on the east side of NW St. Helens Road east of the foothills of the Tualatin Mountains along the western shoreline of the Willamette River as shown in Figure 1. The site is relatively flat at roughly elevation 35 ft (NAVD88). Bathymetric survey data collected by the United States Army Corps of Engineers indicate the waterfront slope is roughly 70 ft high.

An anchored sheet pile wall was constructed along the waterfront circa 2009 to replace a concrete cantilever seawall constructed in the 1940s due to progressive structural failure. Sheet pile wall drawings indicate the existing wall is located on the waterside of the 1940s seawall, with a pile tip elevation of about -7 ft (NAVD88) and two rows of tiebacks.

The site is underlain by various amounts of fill materials placed during site development. Regional geologic mapping indicates the site is underlain by young Quaternary alluvium comprised of river and stream deposits of silt, sand, clay, and peat of present flood-plains. The alluvium is largely confined to the ancient incised Willamette River channel, which includes the current channel and the adjacent alluvial plains. The mapping suggests the alluvium is underlain by Columbia River basalt at depth.

The previous borings by others indicate subsurface conditions which generally consist of fill, stream deposits, alluvial deposits, and bedrock, consistent with published geologic maps. The fill primarily consists of loose to dense sands with varying amounts of silt and gravel, often containing debris such as brick, asphalt, glass, and wood. The stream deposits are comprised of medium dense to dense sands interlayered with silts. Alluvial deposits underlying the stream deposits are comprised of fine-grained and sandy soils. Columbia River basalt was encountered in the west portion of the site at a depth of about 40 ft and at about 70 ft below the ground surface adjacent to the sheet pile wall.

Shallow groundwater was encountered in the onshore borings at depths ranging from about 1 to 13 ft ft. Groundwater evaluations at the site indicate the groundwater depth near the sheet pile wall is about 30 ft, which is likely influenced by the groundwater extraction wells at this location. Fluctuations in groundwater levels likely occur due to variations in the Willamette River water level, rainfall, underground drainage patterns, groundwater extraction, regional influence, and other factors.

### 3.2 Seismic Hazard Evaluation

We have evaluated seismic hazards including ground shaking, liquefaction, lateral spreading, and seismic densification. A summary of our conclusions regarding the potential for liquefaction and lateral spreading is provided below.

As required by the Rules, we developed seismic design parameters in accordance with the 2016 American Society of Civil Engineers (ASCE) Standard 7-16 (ASCE 7-16): Minimum Design Loads for Buildings and Other Structures (ASCE 2016) for the purposes of evaluating liquefaction potential and lateral spreading. Based on the existing geotechnical data, the site can be characterized as Site Class D in conformance with ASCE 7-16. Using the ASCE 7 Hazard Tool, we calculated a maximum considered earthquake geometric mean (MCEG) peak ground acceleration adjusted for site class ($PGA_M$) of 0.49g, corresponding to a moment magnitude (Mw) of 9.3 on the Cascadia Megathrust fault, which governs the seismic hazard at the site.

The results of our evaluation indicate the potential for liquefaction is high during the design earthquake. Related effects include ground surface settlements, sediment ejecta and settlement from ground loss. In addition to settlement from reconsolidation and sediment ejecta, liquefaction-induced foundation settlement can occur when shear-induced deformations driven by cyclic loading occur due to ratcheting and bearing capacity types of movement caused by soil structure interaction (SSI).

Liquefied soils will directly impact the sheet pile wall's seismic performance. Liquefied soils have a decreased shear strength and will increase the lateral loads on the sheet pile wall compared to their non-liquefied state. The decreased shear strength also may reduce the capacity of the tieback anchors.

Lateral spreading is a phenomenon where a soil mass moves laterally on liquefied soil down a gentle slope or toward a free face, such as the adjacent Willamette River channel. Displacement occurs in response to gravitational and earthquake-induced forces acting on soils within and above the liquefied layer. If the sheet pile wall is effective at limiting lateral deformations to this magnitude, we expect the ground deformation to reduce in magnitude with increasing distance from the waterfront slope.

During lateral spreading, surface layers commonly break into large blocks, which progressively migrate toward a free face. This development of ground fissures can promote ground loss for sediment ejecta and increase the likelihood of associated settlement.

### 3.3 Seismically-Induced Ground Deformations

We have developed preliminary estimates of vertical and lateral seismically-induced ground deformations to approximate the range of movements expected at the site.

The sheet pile wall designers used borings collected to conduct a two-dimensional analyses using the computer program FLAC (Fast Lagrangian Analysis of Continua). The FLAC analyses included static and post-seismic analysis of stresses and deformation of the sheet piles wall. The post-seismic analysis considered the reduced strength of the soils due to liquefaction, but did not appear to consider seismic inertial forces. The post-seismic stability analyses indicated up to about 1½ ft of horizontal displacement at the top of the sheet pile wall.

The sheet pile wall has a relatively shallow embedment below the riverbed and is underlain by liquefiable soils. It is unclear to what extent the previous FLAC analysis considered the potential for deep-seated seismic deformations occurring below the wall, which may result in the translation/rotation of the wall and tiebacks behaving as a unit. If this is the case, potentially larger deformations than previously estimated may be realized and extend to substantial distances landward of the sheet pile wall.

Future investigations should include a detailed review and validation of the sheet pile wall's FLAC analysis to understand the original assumptions, including considerations for global stability due to the deep-seated liquefiable soil and considerations for inertial seismic forces, and to confirm the sheet pile wall's expected lateral displacement.

Large deformations may be experienced on the waterside of the sheet pile wall as a result of flow-type failure. In this case, masses of ground may travel long distances (likely more than 5 ft) in the form of liquefied flows or blocks of ground riding on liquefied flows.

The primary mechanisms of liquefaction-induced settlement are reconsolidation (estimated as 2 to 6 in.), localized ejecta-induced settlements (up to 12 in.), and shear-induced foundation settlement (not estimated). Combined, the total estimated vertical ground deformation, with free-field conditions, ranges from 2 to 18 in. We note that this estimate does not incorporate any vertical deformations associated with lateral displacement of the sheet pile wall.

# 4. STRUCTURAL ASSESSMENT

Rule 340-300-0003(6)(b) identifies that a structural assessment is to be performed for all onsite structures where damage could result in a potential release of fuel.

The key structural assessment consisted of a walkdown evaluation of the entire facility, supplemented by limited reviews of available drawings and other documentation, such as tank inventory tables.

Our evaluation is based on the "expected" or "most likely" conditions at the time of an earthquake rather than the worst-case or conditions that might be considered for new design. This includes consideration of existing deterioration or damage and any modifications made since construction, as observed during the walkdown.

Considering the variability of tank operation (i.e., tanks are filled or emptied over days, weeks, or months) and input from SMP regarding the likely fill heights based on actual operating procedures, a reasonably conservative assumption for all tanks is that they are half full.

## 4.1 Walkdown Assessment

The walkdown assessment is a primarily visual review that considers the actual conditions of each installation in a systematic, methodical manner. The engineers performing the review investigate potential seismic vulnerabilities, focusing on proven failure modes from past earthquake experience, basic engineering principles, and engineering judgment. The walkdown review emphasizes the primary seismic load-resisting elements and the potential areas of weakness due to design, construction, modification practices, historical deterioration, or existing damage. A special emphasis is placed on details that may have been designed without consideration of seismic loads.

This walkdown assessment approach is widely used within industry, and in particular is used in California for assessing existing chemical and process facilities that contain hazardous materials. The approach is documented in the CalARP Seismic Guidance Document, which recommends that the walkdown follow the guidance provided by the American Society of Civil Engineers (ASCE) in their document, "*Guidelines for Seismic Evaluation and Design of Petrochemical Facilities*, 2nd Edition", published by ASCE, 2011. We also considered that document, as well as the 3rd Edition, published in 2020.

Our walkdown assessment considered the likely response due to ground shaking (inertial effects), as well as the likely damage due to liquefaction and lateral spreading associated with the DLE.

### 4.2 Likelihood of Spill from Seismic Structural Damage

We assigned a judgment-based, qualitative likelihood of spill to each structure, tank, and other installation within the terminal based on our walkdown assessment and associated document review.

For storage tanks, we have taken into consideration the historical performance of storage tanks regardless of whether designed to modern code requirements, emphasizing those details that have been proven by experience to increase the likelihood of damage that could lead to a spill. For this assessment, we considered criteria such as tank construction (i.e. riveted versus welded), whether the tank is anchored (anchored tanks historically perform very well), the aspect ratio of the tank (fill height to diameter ratio), and whether any piping, stairs, or other attachments are restrained in a manner that would over-constrain movement of the tank and cause stress concentrations or damage to attached piping.

For containment walls, the likelihood of structural failure in a seismic event is based on the type of containment (i.e. concrete wall versus soil berm), liner details, depth of wall foundations, geometries (i.e. width and toe), reinforcing details, and era of construction. We also considered the present condition as well as modifications made to containment walls, such as penetrations or reinforcing buttresses, if applicable.

For buildings and other building-like structures, we first considered whether damage to the structure would result directly in an uncontained spill, uncontrolled fire, or explosion or would damage a critical safety or control system, leading to the same effect. Buildings that do not store fuel products (such as the office building) or contain critical safety systems were screened from further assessment. For structures that contain products or critical systems within the scope of these rules, we considered the structure system, visible condition, and era of construction to determine a qualitative likelihood of damage that could lead to a spill.

We first determined a likelihood of spill due to earthquake-induced structural damage, without any consideration of the geotechnical ground displacements associated with liquefaction and lateral spreading. We then adjusted likelihood scores for individual elements, considering the estimated ground displacements within the geographic area where the equipment is located and the specifics of that structure (such as aspect ratio and foundation type). For example, significant ground displacement will increase the likelihood for overturning on unanchored tanks with a high aspect ratio, so we increased the Likelihood category accordingly.

## 5. SAFETY ASSESSMENT

We reviewed the fire systems and procedures, oil spill containment systems and procedures, and other emergency systems that would be affected by a major earthquake.

We also performed a walkdown of the site, met with the operators and held discussions, and participated in the risk assessment discussed in Section 6.

We considered realistic general earthquake effects that are likely to occur in the DLE, such as:

- Shaking of the entire facility simultaneously without prior warning.
- Lengthy duration of shaking (15 seconds or longer).
- Loss of grid power.
- Loss of municipal water.
- Off-site emergency services may not be available due to infrastructure problems (bridges and highways) or regional needs for the general community.
- Unpredictable human response.

### 5.1 Spill Containment Systems, Equipment and Procedures

This section addresses Rule 340-300-0003(6)(c)(B) and Rule 340-300-0003(1)(d).

**Primary Containment and Maintenance Procedures for Bulk Storage**

All bulk storage tanks in the facility are constructed of steel and meet American Petroleum Institute (API) standards for oil storage tank construction. In addition, bulk storage tanks are operated according to API 650 or 653 and are inspected in accordance with industry standards, including:

- API Standard 653 for atmospheric storage tanks with a capacity of 50,000 or more.
- Steel Tank Institute (STI) Standard SP001 for atmospheric storage tanks for storage tanks with a capacity of 50,000 or less.
- API Standard 510 for pressurized storage vessels.

Inspection intervals for all oil storage tanks have been established based on the referenced industry standards, including the daily inspection of each tank for signs of corrosion or leaks. Tank bottom inspections, including visual and ultrasonic inspections, are performed when a tank is removed from service.

Similarly, 55 gallon drums and totes are inspected regularly by terminal personnel.

There are no underground, partially underground or portable storage tanks in use at the terminal.

Double bottoms to provide secondary containment have been installed on gasoline Tanks 1, 2, 3, 4, 5, 8, 12, and 13. Tanks without double bottoms have been equipped with a cathodic protection system for corrosion control.

The Terminal has several design and operational measures in place to prevent spills caused by overfilling tanks. Operationally, the Terminal is always manned during any active cargo movement. In addition, all tank volume capacities are checked prior to start of transfer operations to ensure sufficient volume is available for receipt of cargo.

All gasoline and distillate tanks are equipped with electronic tank gauging systems set to trigger high level alarms at the Terminal control room as well as throughout the facility. The electronic gauging system is protected by UPS so it continues to monitor tank levels even in the case of loss of municipal power. The electronic gauging system and high level alarm is tested monthly.

**Maintenance and Operation of Terminal Piping**

The majority of the piping at the SMP Terminal is located above ground. Any piping located underground is placed inside concrete pipe trenches. All piping to be placed underground is wrapped, coated and protected by a cathodic protection system to mitigate corrosion. In addition, buried piping that is exposed is inspected for deterioration.

The Terminal follows API 570 standards for inspection and testing of piping systems, including the regular inspection of piping, valves and flanges for leaks or signs of deterioration. Any leaks are repaired immediately.

**Secondary Spill Containment Systems and Response Procedures**

Both the North Tank Farm and the South Tank Farm are protected by a secondary spill containment system composed of concrete walls and an earthen floor covered with gravel. In contrast, the secondary containment for the Biodiesel Tank Farm includes an impervious asphalt floor. According to the SPCC, the earthen floor for both the North Tank Farm and the South Tank Farm has been studied and determined adequately impervious to provide containment until clean up takes place.

The North Tank Farm, the South Tank Farm, and the Biodiesel Tank Farm all have sufficient secondary containment capacity to contain a spill from the largest tank inside the area, plus an allowance for a 25-year, 24-hour storm.

Rainwater in the North and South Tank Farms is collected and sent to the north Oil Water Separator (OWS) by way of catch basins. The catch basins are normally left closed except when discharging ponded stormwater.

The truck loading lane area is protected by a 6-in curb and is sloped to form a retention basin which drains to a lift station that pumps into the oily water tank. If the lift pump fails, the lift station is designed to overflow to the Oil Water Separator (OWS).

At the dock area, the hose connection manifold is protected by a curbed concrete area that forms secondary spill containment for the flexible hoses used to transfer cargo to vessels.

The Rail car unloading stations are all protected by drain pans that drain to a 10-inch drain header and then to a spur sump.

Most of the terminal piping is located aboveground and inside diked tank farm areas or in concrete lined, below grade pipeways. Underground piping to truck loading rack, dock and rail car unloading areas is either installed in a concrete trench or else equipped with protective wrapping and coating for corrosion control.

Terminal spill containment equipment includes a spill response boat and spill containment boom located in the terminal boathouse. This is in addition to the permanent boom located in-water. In addition, the terminal has 1,000 feet of stored containment boom as well as 10 bales of sorbent pads.

Lastly, the four out-of-service additive tanks in the Biodiesel Tank Farm could be available in short order if needed for emergency spill response.

**Summary of Current Spill Prevention and Mitigation Measures**

Tank design and maintenance is in accordance with industry standards. In addition, the terminal provides secondary storage for all oil stored on site.

The terminal Facility Response Plan (FRP) outlines spill response procedures. The first person on scene functions as the person-in-charge until relieved by an authorized supervisor who will assume position of Incident Commander (IC). Transfer of command takes place as more senior management responds to the incident.

The Initial Response Checklist Identifies the following steps:

- Treat all spill material as potentially hazardous.
- Notify Terminal Manager
- Sound alarm, warn other personnel.
- Stop product flows, if safe to do so. Activate Emergency Shutdown as appropriate.
- Remove potential ignition sources.

Terminal Management (Qualified Individual) Initial Response Checklist includes the following steps:

- Evaluate Severity, Impact, Safety Concerns and Response Requirements.
- Assume Role of Incident Commander
- Confirm Safety aspects at site, including need for special protective equipment, sources of ignition and potential need for evacuation.
- Activate local response team and primary response contractors and as the situation demands.
- Coordinate / activate additional spill response contractors as the situation demands.
- Make Internal Notifications
- Notify corporate contacts to complete regulatory agency notifications as needed.
- Proceed to spill site and coordinate response and clean-up operations.
- Complete USCG ICS 201 Incident Briefing Document is complete as soon as possible.
- Direct containment, dispersion and / or clean-up operations in accordance with the Product Specific Response Considerations provided inside the FRP.

The Local Response Personnel procedures are summarized below:

- Assigned personnel respond to discharge from Facility as situation demands
- Perform response / clean-up operations as directed or coordinated by the Incident Commander.
- Assist as directed at the spill site.

For the person acting as IC, the general Initial Response Actions are summarized as follows:

- Identify Hazards
- Sound Alarm

- Identify Hot Zones, Evacuate if Necessary
- Shut Down or Contain
  - **If transferring Tank Vessel to Terminal:** the terminal notifies vessel that the transfer is being shut down. The Terminal PIC will activate the emergency shutdown switch and close the valve closest to the dock.
  - **If transferring Terminal to Tank Vessel:** The Terminal PIC activates the shutdown switch at the dock, shutting down all operations at the Terminal. The PIC then shuts down the manual valves at the dock Valves on the interior of the tank farms are motorized, and will be closed remotely.

### 5.1.1 Seismic Vulnerabilities

Tanks are susceptible to damage following an earthquake from shaking or differential displacements.

Similarly, piping is susceptible to damage from differential displacements of supports and anchor points.

If tanks or piping are damaged in an earthquake, the concrete containment walls that form part of the secondary containment are critical in controlling the spill and its associated environmental and safety hazards. These walls are also susceptible to damage during an earthquake. From a safety standpoint, loss of containment for a spill would potentially spread the life safety hazards over a larger area, including fire and exposure to hazardous materials.

## 5.2 Fire Control and Suppression Systems

This section addresses Rule 340-300-0003(6)(c)(A) and Rule 340-300-0003(1)(i).

The terminal fire control system includes a fire main fed from a municipal source that feeds a series of fire hydrants, hoses, nozzles, and fire monitors. The terminal has two booster pumps, both fed from a municipal connection, to increase water pressure throughout the terminal and to inject foam into specific tanks. One booster pump is electric and depends on municipal power, but the second is diesel and can continue to operate even with a complete loss of municipal power.

The terminal truck loading lanes are protected by an automatic foam deluge / sprinkler system that automatically dispenses foam over the truck lanes upon sensing a fire. The foam deluge / sprinkler system can also be manually actuated from locations near the loading lanes.

The terminal foam system can also supply a sub-surface foam injection system into terminal tanks.

In addition, the Terminal is equipped with handheld and wheeled extinguishers located throughout the facility.

The Biodiesel Tank Farm is protected by containment walls that are only 2.5 feet tall, which may not be tall enough to provide adequate protection from radiant heat due to a pool fire. However, most of the tanks inside the Lube Oil Tank Farm are either out of service or used to store process water, with only one tank used to store combustible cargo. For this reason, it was determined that there is a decreased chance of a pool fire and no concerns noted by the audit team.

The rest of the terminal is protected by containment walls that can function as firewalls to limit the spread of fire.

### 5.2.1 Seismic Vulnerabilities

The firewater system and foam distribution system rely on municipal water, which might not be available following an earthquake.

Containment walls, which can also act as firewalls, are susceptible to damage during an earthquake.

## 5.3 Emergency Response Equipment

This section addresses Rule 340-300-0003(6)(c)(C) and Rule 340-300-0003(1)(h).

**Automated Sprinkler Systems**

The tank truck loading lanes are protected by a sprinkler / deluge foam system that automatically starts upon detecting a fire. The deluge system can also be activated manually.

### Firefighting Foam

The terminal tank foam system includes 1,300 gallons of foam and can provide 1200 gpm of firewater / foam concentrate to the tank foam systems. The truck rack foam system is equipped with 600 gallons of foam and can deliver 1200 gpm of fire water / foam concentrate via the deluge system.

The foam system was reviewed and approved by the Authority Having Jurisdiction as part of a recent project.

The terminal is equipped with two booster pumps, one diesel and the other electric, to ensure adequate pressure and flow is available for the firewater and foam system.

### Spill Response Kits

The terminal has spill response kits strategically located throughout the Terminal, as well as storage containers to store spill waste.

### Power and Communications

The terminal is equipped with a radio repeater located on the Main Office that extends range and facilitates communication and emergency coordination by way of handheld, two-way radios. However, the radios can make direct radio-to-radio calls, and continue to function even if the repeater loses power.

In addition, the terminal is equipped with Emergency Shutdown stations at the Loading Rack, the Terminal Office and inside the Dock House which can all be used to secure a cargo transfer operation remotely and quickly.

### 5.3.1 Seismic Vulnerabilities

The firewater system and foam distribution system rely on municipal water, which might not be available following an earthquake.

Remotely actuated Emergency Shutdown systems, including the fire detection and automatic deluge system at the truck loading rack, depend on municipal power to operate, which may not be available following an earthquake.

## 5.4 Safety and Operating Conditions

This section addresses Rule 340-300-0003(1)(g).

Terminal operating conditions, safe shutdown procedures and preparedness for potential spills are consistent with industry best-practices, and no concerns were noted by the audit team.

The terminal is equipped with Emergency Shutdown actuation stations that can help secure transfers at the Loading Rack and at the Dock.

Yard lighting is not equipped with emergency backup power, and relies solely on municipal power.

### 5.4.1 Seismic Vulnerabilities

Remotely actuated Emergency Shutdown systems depend on municipal power to operate, which may not be available following an earthquake.

Terminal yard lighting depends on municipal power to operate, which may not be available following an earthquake.

## 5.5 Terminal Staffing, Monitoring, and Response

The terminal is staffed 24 hours a day, 7 days a week.

### 5.5.1 Seismic Vulnerabilities

None identified.

## 6. RISK ASSESSMENT

We used a critical systems risk assessment process to identify, prioritize, and assess the seismic vulnerabilities of critical equipment, structures, and procedures during a DLE event. This analysis considered the performance of critical systems during and after the DLE event, and how their seismic vulnerabilities impact the prevention and containment of oil spills.

This risk assessment was in the form of a workshop including terminal operations and safety specialists, along with structural/seismic engineering specialists who understand the historic seismic performance of systems in earthquakes. With this experience we can consider realistic damage and failure scenarios rather than assessing strict conformance to current codes for new design. See Appendix C for a list of attendees.

The team considered possible scenarios due to earthquakes that could realistically occur and result in an uncontained spill, uncontrolled fire, explosion, or toxic release at the terminal. The workshop was used to risk rank and prioritize the criticality of various structures and systems during and following a seismic event in terms of the likelihood and consequences of a potential release of fuel from a spill caused by a DLE event.

The risk ranking was done through a risk matrix approach, using the risk matrices shown in Figures 6-1 and 6-2 for Environmental and Life-Safety risks, respectively.

We assigned structures and equipment a Likelihood of damage in a DLE that could lead to a spill, with ratings of 1 to 5 from "Very Unlikely" to "Very Likely", as defined in Appendix C. During the workshop, we assigned a Severity rating from A to E, from the least severe environmental or life-safety consequences to the most severe.

The Severity rating considered potential spill volumes, secondary containment mechanisms, operational or other safeguards that are in place, type of contents (i.e. flammability or combustibility of contents), and criticality of the component in emergency response. The potential impact on public health and safety are also considered within the Life Safety severity. For example, the spill of a more volatile substance has a higher Life Safety consequence due to its fire potential.

We use the Severity and Likelihood to assign each item two risk ranking matrix scores. The environmental score relates to the quantity of spill and its impact on, or extent into, the neighboring community. The life-safety score relates to life-safety consequences that occur directly as a result of the spill.

For most items, the scores are specific to that item (e.g. based on an individual tank's Likelihood of structural failure and Severity of consequences). For secondary containment walls, the score considers all the tanks, piping, and other fuel storage within that area. If likelihood of structural failure is 'Possible' or more likely, then the severity score is based on the worst of any given tank or piping within that area. If the likelihood of structural failure is considered Very Unlikely or Unlikely, then the severity is based on the volume of potential overtopping using an expected probable volume of spill for tanks within that containment.

We also assigned two sets of scores, representing vulnerability with and without the considerations of geotechnical soil displacements. This is to inform the terminal of relative risks associated with the global liquefaction and lateral spreading hazard versus those associated with ground shaking.

We provide the complete risk assessment, including a table of all items and resulting risk assessment scores in Appendix C.

## Risk Assessment Matrix - Environmental

| SEVERITY | Environmental Consequences | LIKELIHOOD 1 Very Unlikely | 2 Unlikely | 3 Possible | 4 Likely | 5 Very Likely |
|---|---|---|---|---|---|---|
| A | No release. | A1 | A2 | A3 | A4 | A5 |
| B | Release within secondary containment and no offsite impact. | B1 | B2 | B3 | B4 | B5 |
| C | Release exceeds secondary containment, but no offsite impact. | C1 | C2 | C3 | C4 | C5 |
| D | Minor offsite release. | D1 | D2 | D3 | D4 | D5 |
| E | Major offsite release. | E1 | E2 | E3 | E4 | E5 |

High Risk -- Mitigations to be considered using ALARP (As Low as Reasonably Practicable)
Moderate Risk -- Further evaluation recommended to determine if mitigation is necessary
Low Risk -- No mitigations recommended

**Figure 6-1 – Environmental Risk Assessment Matrix**

## Risk Assessment Matrix - Life Safety

| SEVERITY | Life-Safety Consequences | LIKELIHOOD 1 Very Unlikely | 2 Unlikely | 3 Possible | 4 Likely | 5 Very Likely |
|---|---|---|---|---|---|---|
| A | Minor / First Aid Injury<br>No Impact on Public | A1 | A2 | A3 | A4 | A5 |
| B | Injury With Medical Treatment<br>No Impact on Public | B1 | B2 | B3 | B4 | B5 |
| C | Serious Injury / Partial Disability<br>Limited Impact on Public | C1 | C2 | C3 | C4 | C5 |
| D | Single Fatality / Serious Injury<br>Impact on Public | D1 | D2 | D3 | D4 | D5 |
| E | Multiple Fatalities / Serious Injuries<br>Significant Impact on Public | E1 | E2 | E3 | E4 | E5 |

High Risk -- Mitigations to be considered using ALARP (As Low as Reasonably Practicable)
Moderate Risk -- Further evaluation recommended to determine if mitigation is necessary
Low Risk -- No mitigations recommended

**Figure 6-2 – Life-Safety Risk Assessment Matrix**

## 7. FINDINGS

Based upon the geotechnical, structural, and safety assessments as described herein, we have identified the key vulnerability findings as summarized below.

Items are categorized as Moderate or High Risk based on the full consideration of hazards, including earthquake induced ground deformations. Although the Likelihood of a spill may increase as a result of ground deformations, severity of consequences are typically the same. Thus, the risk categorization (or color) does not necessarily change due to the addition of ground deformations. Where the with- and without- ground deformation score results in a difference in categorization, the without ground deformation categorization is also indicated.

For High Risk items, mitigations should be considered using As Low As Reasonably Practicable (ALARP) risk reduction philosophy. For Moderate Risk items, further evaluation is recommended to determine if mitigation is necessary. For example, this may include detailed engineering calculations to quantify the seismic capacity of specific, existing components.

**Table 7-1 - Summary of High Risk Items**

| North Tank Farm | South Tank Farm | Biodiesel Tank Farm | Butane Storage, Water Separators, & Dock | Safety Systems & Buildings |
|---|---|---|---|---|
| Containment Walls | Containment Walls | Containment Walls | Sheet Pile Wall | Water Main |
| Tank Foam System | | | Dock | Foam System |
| | | | Dock Piping | Deluge System |
| | | | Oil Water Separator[1] | |
| | | | Storm Water Separator[1] | |

1. These items are Moderate Risk without consideration of ground deformation and elevated to High with ground deformation due to increased Likelihood of damage.

**Table 7-2 - Summary of Moderate Risk Items**

| North Tank Farm | South Tank Farm | Biodiesel Tank Farm | Butane Storage, Water Separators, & Dock |
|---|---|---|---|
| Piping[1] | Piping[1] | Piping[1] | Piping[1] |
| Tank 1 | | | Fire Pump |
| Tank 5 | | | |
| Tank 6 | | | |
| Tank 8 | | | |
| Tank 11 | | | |
| Tank 24 | | | |
| Tank 25 | | | |

1. All piping (except at the dock) is Moderate with ground deformations due to Likelihood. Non-flammable product piping is Low Risk without ground displacements. Piping for flammable fuels are Moderate Risk with- or without- ground deformation due to Life Safety Severity.

## 7.1 Geotechnical

We have determined a peak ground acceleration ($PGA_M$) of 0.49g for the ASCE 7-16 DLE event.

The sheet pile wall design estimates lateral displacements on the order 1½ ft, though the toe is in liquefiable material and the design does not appear to include inertial seismic forces. It is unclear at this time if the FLAC analysis considers the potential for deep-seated seismic deformations occurring below the wall. Future investigations should include a detailed review and validation of the sheet pile wall's FLAC analysis to understand the original assumptions, including considerations for global stability due to the deep-seated liquefiable soil and considerations for inertial seismic forces, and to confirm the sheet pile wall's expected lateral displacement.

The estimated seismically-induced vertical ground deformations vary from 2 in. to 18 in. at the site, with the potential for larger vertical deformations if large lateral deformations occur due to the performance of the sheet pile wall. Our structural and safety assessments considered these potential displacements.

## 7.2 Structural

Many of the tanks in the North Tank Farm have a Moderate Risk due to their flammable contents and a higher Life Safety severity. Additionally, Tank 1 is riveted, and Tanks 5, 6, 8, and 11 are Moderate Risk due to a higher Likelihood of damage driven by an over-constrained condition with stairs or piping, as shown in the example photos below. Tanks 24 and 25 are rated Moderate due to a high H/D ratio, even considering them half full.

Pipelines are rated Moderate throughout the terminal due to differential displacements from vertical settlement and the anticipated pipe stresses. At the dock, pipelines are rated High due to a higher consequence of damage and spill directly into the river. Additionally, the dock piping is likely to experience high stresses due to its supported condition on the wharf and the higher soil displacements estimated at the river front.

The containment walls are rated High due to their importance in containing spills and the uncertainty in their capacity to withstand seismic loads due to their age and construction.


**Figure 7-1: Example Over-Constrained Conditions**

**Left: Short pipe run to u-bolt at Tank 5**

**Right: Anchored stair handrail at Tank 11**

### 7.3 Safety

The water supply is rated as a High Risk seismic vulnerability. The facility relies on municipal water as its only source for firewater and for foam distribution. It is highly unlikely municipal water will be available following the DLE considered by the Rules.

Since the foam system, fire pump, and deluge systems are dependent on municipal water, which is unlikely to be available following the DLE, and the consequence of these systems being unavailable, these items are deemed a High Risk.

Power is needed for the electric fire / foam pump, MOVs, and facility lighting. However, the diesel fire / foam pump can continue operating even during a loss of municipal power . Since it is very likely that power will be lost following an earthquake, we determined that loss of power is a Medium Risk item.

## 8. REFERENCES

1. API Standard 570 "Piping Inspection Code: Inspection, Repair, Alteration and Rerating of In-Service Piping Systems, American Petroleum Institute (API)," 5th Edition, 2024.

2. API Standard 650 "Welded Tanks for Oil Storage, American Petroleum Institute (API)," 13th Edition, 2020.

3. API Standard 653 "Tank Inspection, Repair, Alteration and Reconstruction, American Petroleum Institute (API)," 5th Edition, 2020.

4. ASCE 7-16 "Minimum Design Loads and Associated Criteria for Buildings and Other Structures, American Society of Civil Engineers (ASCE), Structural Engineering Institute (SEI)," 2016.

5. ASCE 41-17 "Seismic Evaluation and Retrofit of Existing Buildings, American Society of Civil Engineers (ASCE), Structural Engineering Institute (SEI)," 2017.

6. ASCE 61-14 "Seismic Design of Piers and Wharves, American Society of Civil Engineers (ASCE), Coasts, Oceans, Ports & Rivers Institute, (COPRI)," 2014.

7. California Building Code (CBC) Chapter 31F, "Marine Oil Terminal Engineering and Maintenance Standards" (MOTEMS), 2022.

8. "Fuel Tank Stability Rules," Division 300, State of Oregon Department of Environmental Quality (DEQ), 2023.

9. "Guidance for California Accidental Release Prevention (CalARP) Program Seismic Assessments." Prepared for the Unified Program Agency (UPA) Subcommittee of the Region I Local Emergency Planning Committee (LEPC) by the CalARP Program Seismic Guidance Committee, January 2019.

10. "Guidelines for Seismic Evaluation and Design of Petrochemical Facilities," Task Committee on Seismic Evaluation and Design of Petrochemical Facilities, American Society of Civil Engineers (ASCE), 1997, 2nd Edition, 2011, and 3rd Edition, 2020.

11. SeaPort Midstream Partners Terminal Portland SPCC, "Spill Prevention, Control, and Countermeasure Plan, Portland Terminal," AECOM, July, 2022.

12. STI Standard SP001 "Standard for the Inspection of Aboveground Storage Tanks, Steel Tank Institute (STI)," 6th Edition, 2018.

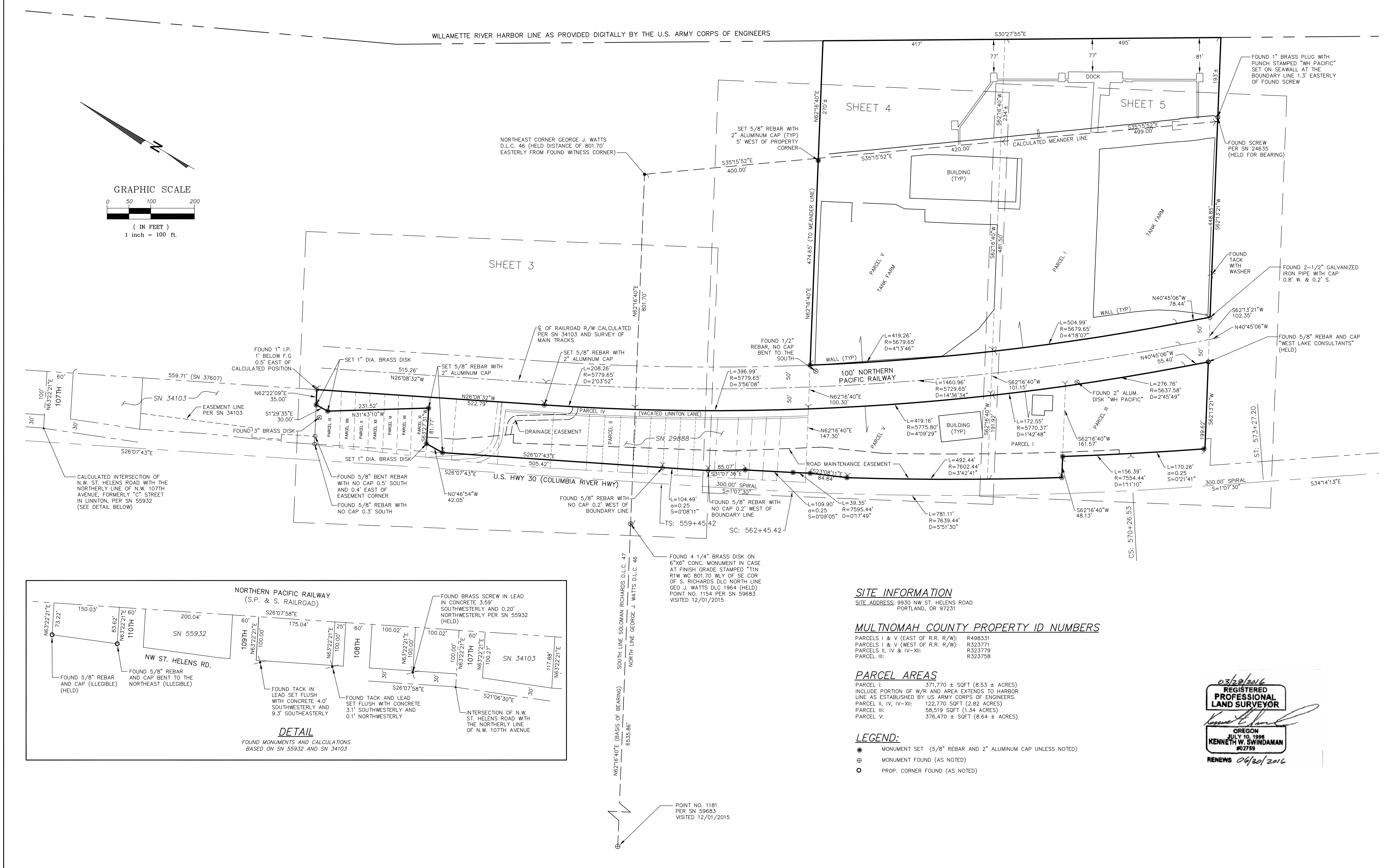
13. TLP Management Services LLC Portland Terminal FRC, “Facility Response Plan / Oil Spill Contingency Plan,” Response Management Associates Inc., July, 2021.

# Appendix A

Site Plans & Inventory

# ALTA/ACSM LAND TITLE SURVEY

SW 1/4, SEC. 2, T. 1 N., R. 1 W., W.M.
MULTNOMAH, OREGON




## SITE INFORMATION

SITE ADDRESS: 9930 NW ST. HELENS ROAD
PORTLAND, OR 97231

## MULTNOMAH COUNTY PROPERTY ID NUMBERS

| | |
|---|---|
| PARCELS I & V (EAST OF R.R. R/W): | R498331 |
| PARCELS I & V (WEST OF R.R. R/W): | R323771 |
| PARCELS II, IV & IV–XII: | R323779 |
| PARCEL III: | R323758 |

## PARCEL AREAS

PARCEL I: 371,770 ± SQFT (8.53 ± ACRES)
INCLUDE PORTION OF W/R AND AREA EXTENDS TO HARBOR LINE AS ESTABLISHED BY US ARMY CORPS OF ENGINEERS.
PARCEL II, IV, IV–XII: 122,770 SQFT (2.82 ACRES)
PARCEL III: 58,519 SQFT (1.34 ACRES)
PARCEL V: 376,470 ± SQFT (8.64 ± ACRES)

## LEGEND:

- ◉ MONUMENT SET (5/8" REBAR AND 2" ALUMINUM CAP UNLESS NOTED)
- ⊕ MONUMENT FOUND (AS NOTED)
- ○ PROP. CORNER FOUND (AS NOTED)

03/28/2016
REGISTERED PROFESSIONAL LAND SURVEYOR
OREGON
JULY 10, 1996
KENNETH W. SWINDAMAN
#02759
RENEWS 06/30/2016

## REVISIONS

| REV. | DESCRIPTION | BY | DATE |
|---|---|---|---|
| 1 | CLARIFIED THE DEPICTION OF STATE RIGHT-OF-WAY. REVISED SURVEY NOTE 10. | JNM | 03/28/2016 |


PACIFIC GEOMATIC SERVICES, INC.
LAND SURVEYING & MAPPING SERVICES
QUALITY SERVICE - CREATIVE SOLUTIONS
6608 216TH STREET SW, STE. 304
MOUNTLAKE TERRACE, WA 98043
PHONE:(425) 778-5620 FAX:(425) 775-2849
WEB: www.PacGeoInc.com
PGS INC


SHEET TITLE: ALTA/ACSM LAND TITLE SURVEY

CLIENT: BP PIPELINES & LOGISTICS
PORTLAND, OREGON

DRAWN BY: CMH
SCALE: 1" = 100'
DATE: 03/17/2016
JOB NUMBER: 15-045-01
CHECKED BY: KWS
DRAWING NAME: 1504501_ALTA.DWG

# ALTA/ACSM LAND TITLE SURVEY

SW 1/4, SEC. 2, T. 1 N., R. 1 W., W.M.
MULTNOMAH, OREGON

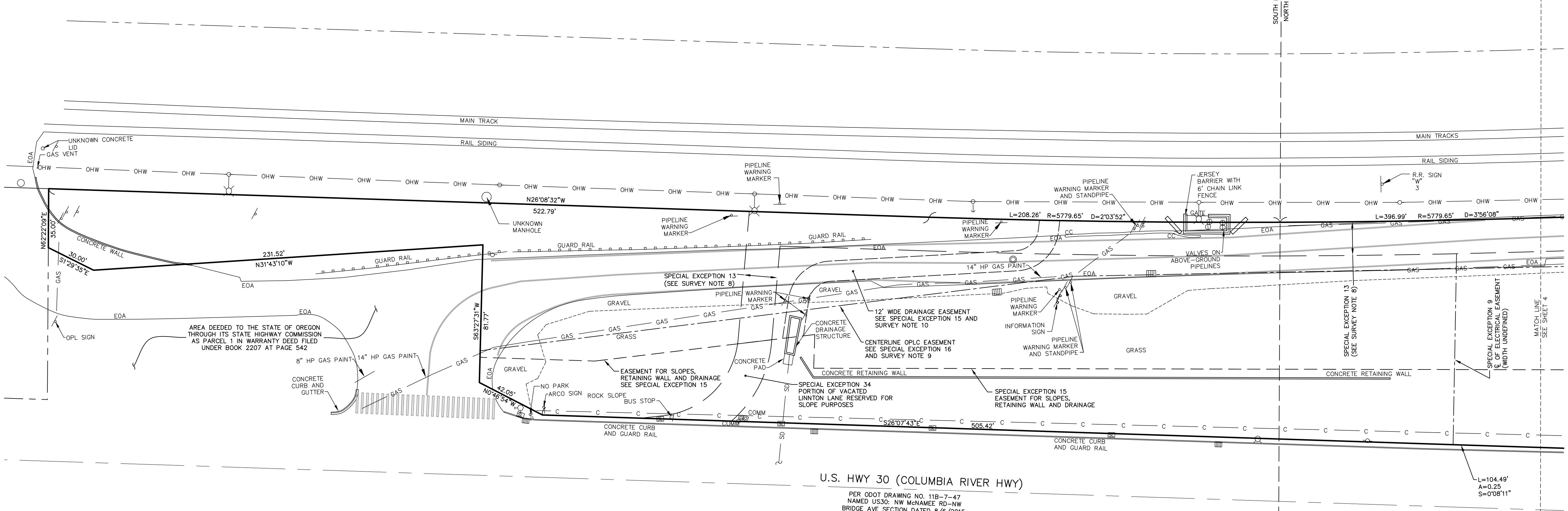
## LEGEND:

| | | | |
|---|---|---|---|
| ⊕ | MONUMENT FOUND (AS NOTED) | HH⊠ | ELECTRIC HANDHOLE |
| o | PROP. CORNER FOUND (AS NOTED) | JB⊠ | ELECTRIC JUNCTION BOX |
| R/W | RIGHT OF WAY | | LUMINAIRE |
| (M) | MEASURED DISTANCE | | YARD LIGHT |
| (C) | CALCULATED DISTANCE | | UTILITY POLE |
| (P) | PLAT DISTANCE | | GUY ANCHOR |
| ○ | SANITARY SEWER MANHOLE | — x — | FENCE |
| | CATCH BASIN (CB) | — C — | BURIED COMMUNICATION LINE |
| | STORM DRAIN MANHOLE | WCR | WHEELCHAIR RAMP |
| SDCO | STORM DRAIN CLEANOUT | CONC | CONCRETE |
| ⋈ | WATER VALVE | CC | CONCRETE CURB |
| | FIRE HYDRANT | EOA | EDGE OF ASPHALT |
| FDC | FIRE DEPARTMENT CONNECTION | • | BOLLARD |
| ⊞ | WATER METER | | SIGN POST |
| PIV | POST-INDICATOR VALVE | MW | MONITORING WELL |
| — GAS — | BURIED GAS LINE | | METAL STAIRCASE (TYP) |
| ⊘ | GAS VALVE | SE(#) | SPECIAL EXCEPTION (#) |
| COMM | COMMUNICATIONS VAULT | OHW | OVERHEAD WIRE |

GRAPHIC SCALE

0 15 30 60

( IN FEET )
1 inch = 30 ft.




03/28/2016
REGISTERED PROFESSIONAL LAND SURVEYOR
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JULY 10, 1996
KENNETH W. SWINDAMAN
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| REV. | DESCRIPTION | BY | DATE |
|---|---|---|---|
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REVISIONS


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6608 216TH STREET SW, STE. 304
MOUNTLAKE TERRACE, WA 98043
PHONE:(425) 778-5620 FAX:(425) 775-2849
WEB: www.PacGeoInc.com
PGS INC

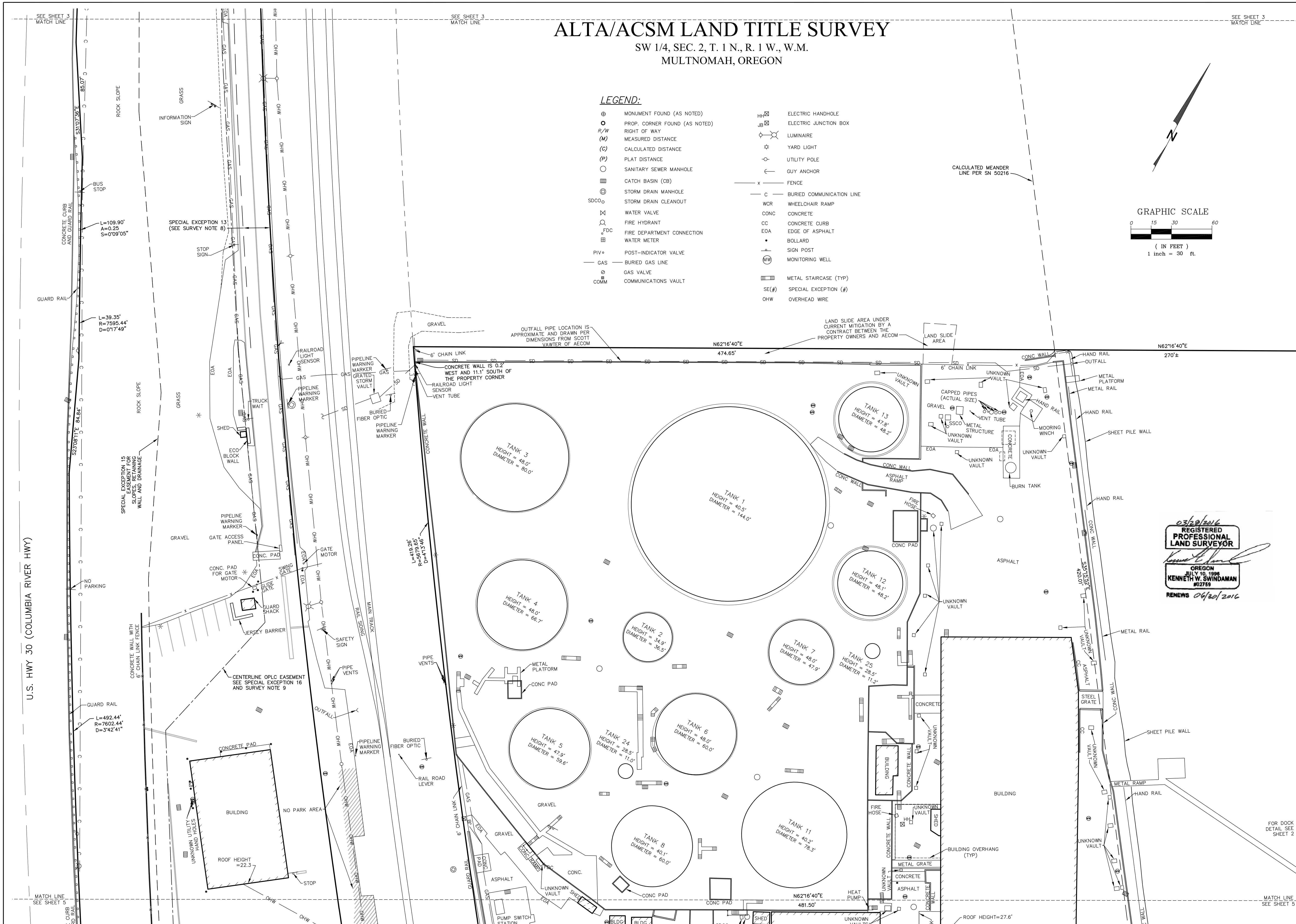

SHEET TITLE: ALTA/ACSM LAND TITLE SURVEY

CLIENT: BP PIPELINES & LOGISTICS PORTLAND, OREGON

DRAWN BY: CMH
CHECKED BY: KWS
SCALE: 1" = 30'
DRAWING NAME: 150450I_ALTA.DWG
DATE: 03/17/2016
JOB NUMBER: 15-045-01
SHEET: 3 OF 5

# ALTA/ACSM LAND TITLE SURVEY

SW 1/4, SEC. 2, T. 1 N., R. 1 W., W.M.
MULTNOMAH, OREGON




## LEGEND:

| | | | |
|---|---|---|---|
| ⊕ | MONUMENT FOUND (AS NOTED) | HH⊠ | ELECTRIC HANDHOLE |
| ○ | PROP. CORNER FOUND (AS NOTED) | JB⊠ | ELECTRIC JUNCTION BOX |
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| (C) | CALCULATED DISTANCE | | UTILITY POLE |
| (P) | PLAT DISTANCE | | GUY ANCHOR |
| | SANITARY SEWER MANHOLE | — x — | FENCE |
| | CATCH BASIN (CB) | — C — | BURIED COMMUNICATION LINE |
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| SDCO | STORM DRAIN CLEANOUT | CONC | CONCRETE |
| | WATER VALVE | CC | CONCRETE CURB |
| | FIRE HYDRANT | EOA | EDGE OF ASPHALT |
| FDC | FIRE DEPARTMENT CONNECTION | • | BOLLARD |
| | WATER METER | | SIGN POST |
| PIV | POST-INDICATOR VALVE | MW | MONITORING WELL |
| — GAS — | BURIED GAS LINE | | METAL STAIRCASE (TYP) |
| | GAS VALVE | SE(#) | SPECIAL EXCEPTION (#) |
| COMM | COMMUNICATIONS VAULT | OHW | OVERHEAD WIRE |

03/28/2016
REGISTERED PROFESSIONAL LAND SURVEYOR
OREGON
JULY 10, 1996
KENNETH W. SWINDAMAN
#02759
RENEWS 06/30/2016

## REVISIONS

| REV. | DESCRIPTION | BY | DATE |
|---|---|---|---|
| 1 | CLARIFIED THE DEPICTION OF STATE RIGHT-OF-WAY. REVISED SURVEY NOTE 10. | JNM | 03/28/2016 |


PACIFIC GEOMATIC SERVICES, INC.
LAND SURVEYING & MAPPING SERVICES
QUALITY SERVICE · CREATIVE SOLUTIONS
6608 216TH STREET SW, STE. 304
MOUNTLAKE TERRACE, WA 98043
PHONE:(425) 778-5620 FAX:(425) 775-2849
WEB: www.PacGeoInc.com
PGS / INC


SHEET TITLE: ALTA/ACSM LAND TITLE SURVEY

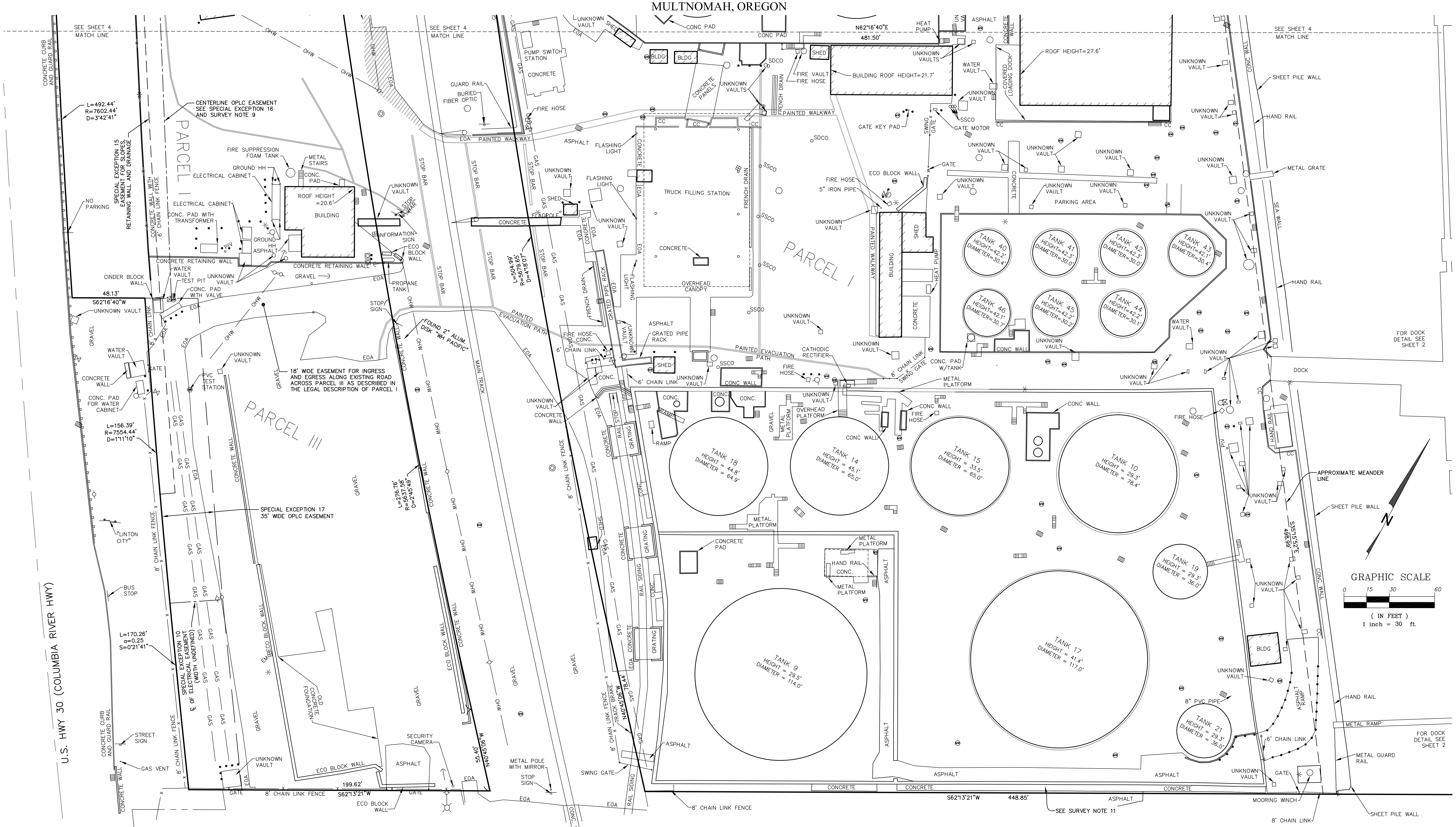
CLIENT: BP PIPELINES & LOGISTICS
PORTLAND, OREGON

DRAWN BY: CMH
SCALE: 1" = 30'
DATE: 03/17/2016
JOB NUMBER: 15-045-01

CHECKED BY: KWS
DRAWING NAME: 1504501_ALTA.DWG

# ALTA/ACSM LAND TITLE SURVEY

SW 1/4, SEC. 2, T. 1 N., R. 1 W., W.M.
MULTNOMAH, OREGON




## LEGEND:

| | |
|---|---|
| ⊕ | MONUMENT FOUND (AS NOTED) |
| o | PROP. CORNER FOUND (AS NOTED) |
| R/W | RIGHT OF WAY |
| (M) | MEASURED DISTANCE |
| (C) | CALCULATED DISTANCE |
| (P) | PLAT DISTANCE |
| | SANITARY SEWER MANHOLE |
| | CATCH BASIN (CB) |
| | STORM DRAIN MANHOLE |
| SDCO | STORM DRAIN CLEANOUT |
| | WATER VALVE |
| | FIRE HYDRANT |
| FDC | FIRE DEPARTMENT CONNECTION |
| | WATER METER |
| PIV | POST-INDICATOR VALVE |
| — GAS — | BURIED GAS LINE |
| | GAS VALVE |
| HH | ELECTRIC HANDHOLE |
| JB | ELECTRIC JUNCTION BOX |
| | LUMINAIRE |
| | YARD LIGHT |
| | UTILITY POLE |
| | GUY ANCHOR |
| — x — | FENCE |
| — C — | BURIED COMMUNICATION LINE |
| WCR | WHEELCHAIR RAMP |
| CONC | CONCRETE |
| CC | CONCRETE CURB |
| EOA | EDGE OF ASPHALT |
| • | BOLLARD |
| | SIGN POST |
| MW | MONITORING WELL |
| COMM | COMMUNICATIONS VAULT |
| | METAL STAIRCASE (TYP) |
| SE(#) | SPECIAL EXCEPTION (#) |
| OHW | OVERHEAD WIRE |

03/28/2016
REGISTERED PROFESSIONAL LAND SURVEYOR
OREGON
JULY 10, 1996
KENNETH W. SWINDAMAN
#02759
RENEWS 06/30/2016

CHECKED BY: KWS
DRAWING NAME: 1504501_ALTA.DWG
SHEET: 5 OF 5
DRAWN BY: CMH
SCALE: 1" = 30'
DATE: 09/17/2016
JOB NUMBER: 15-045-01

SHEET TITLE: ALTA/ACSM LAND TITLE SURVEY

CLIENT: BP PIPELINES & LOGISTICS
PORTLAND, OREGON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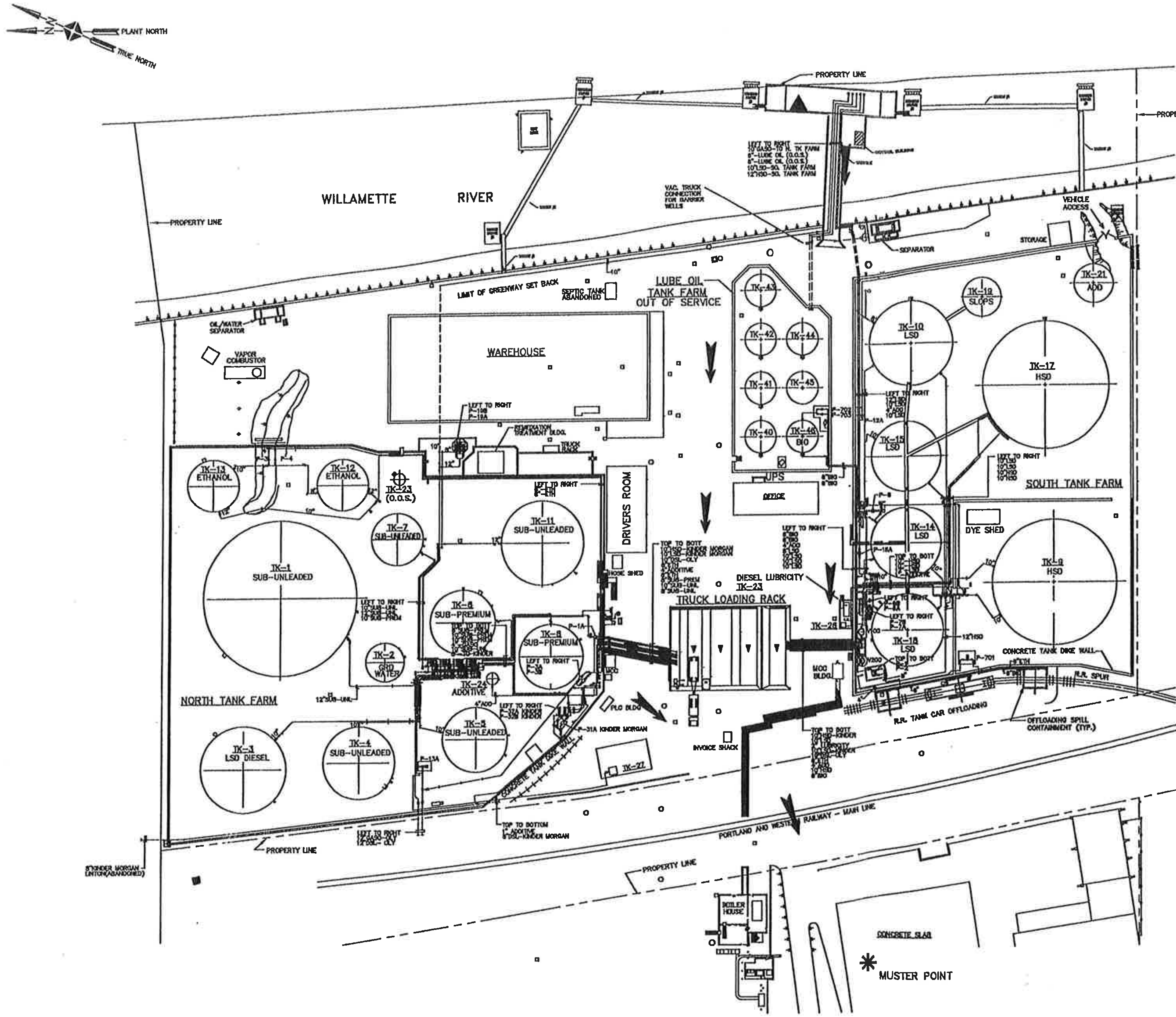
## REVISIONS

| REV. | DESCRIPTION | BY | DATE |
|---|---|---|---|
| 1 | CLARIFIED THE DEPICTION OF STATE RIGHT-OF-WAY. REVISED SURVEY NOTE 10. | JNM | 03/28/2016 |

# EVACUATION DIAGRAM




1. FOR PIPING SMALLER THAN 4" SEE ENLARGED PIPING PLANS
2. IN THE EVENT THE PRIMARY MUSTER POINT IS EITHER UNAVAILABLE OR INACCESBILE, THE DOCK MAY BE USED AS A SECONDAY MUSTER POINT.

## LEGEND

- ABOVE GRADE GASOLINE LINE
- UNDERGROUND GASOLINE LINE
- ABOVE GRADE DIESEL LINE
- UNDERGROUND DIESEL LINE
- ABOVE GRADE ETHANOL LINE
- UNDERGROUND ETHANOL LINE
- ABOVE GRADE BIODIESEL LINE
- CHAINLINK FENCE
- EARTH DIKE

0 50' 100' 150' 200'

ENGINEERING CONTRACTOR:
ANVIL CORPORATION
BELLINGHAM, WA.
Anvil project: BE9561
AutoCAD file: 10110968
Last edit: 10/30/07 08:25

## LEGEND

- * MUSTER POINT
- EVACUATION ROUTE
- SECONDARY MUSTER POINT

Edited by: MJDS of RMA 2/4/08

REVISION SECTION

| REV. | DATE | REVISIONS | AFC | DIAG. NO. | BY | CHK | APR |
|---|---|---|---|---|---|---|---|
| 0 | 6/6/03 | ISSUED FOR 2003 COMPLIANCE | M833 | N/A | RR | PT | BM |
| 1 | 4/05 | UPDATED PER 2005 SPCC WALKDOWN | 1698 | N/A | PT | BM | JP |
| 2 | 9/06 | UPDATED PER 2006 SPCC WALKDOWN | 1733 | N/A | PT | BM | WN |
| 3 | 10/25/07 | UPDATED FOR BIODIESEL EQUIPMENT INSTALLATION | P5002L0 | N/A | DL | DA | MI |

**TLP Management Services LLC**

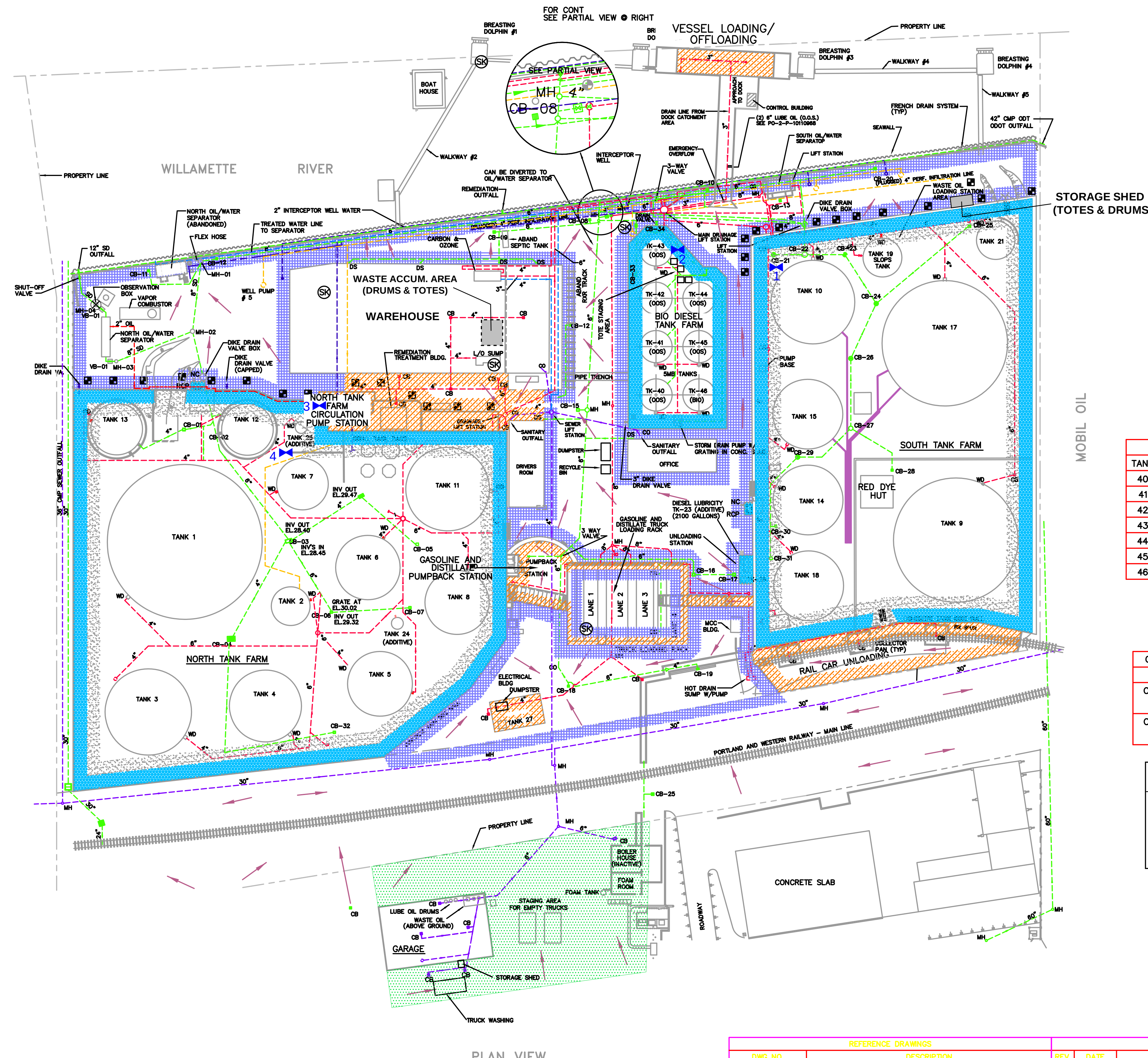
**PORTLAND TERMINAL**

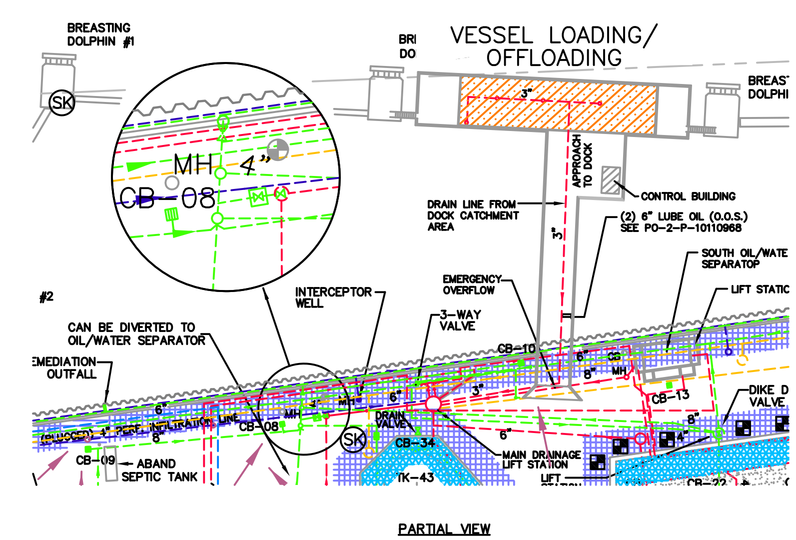
DRAWING NO. REVISION


SeaPort
MIDSTREAM PARTNERS, LLC
Portland, Oregon Terminal
Boat House
Dock House
Dock
Storm Water Separator
QAQC
Warehouse
Oil Water Separator
Storage
TK 43 WATER
TK 42 O O S
TK 44 WATER
TK 41 O O S
TK 45 O O S
TK 40 O O S
TK 46 BIO
Biodiesel Tank Farm
Tank 25 THIRD PARTY ADDITIVE
TK 13 ETH
TK 12 ETH
TK1 ULR 9# + RVP
TK 7 PREM
TK11 ULR H / L RVP
North Tank Farm
TK6 ULR 9# + RVP
TK 2 WATER
TK 8 PREM
TK 3 ULSD#2
TK 4 ULR H / L RVP
TANK 24 BP RACK ADDITIVE
TK5 ULR H / L RVP
TK 19 WATER
TK 21 Additive
TK10 ULSD #2
TK17 ULSD #2
TK 15 BIO
South Tank Farm
TK 14 ULSD #2
TK 9 ULSD #2
TK18 ULSD # 1 ULSD # 2
SIMOPS
Office
Truck Loading Rack
KINDER MORGAN 8" TO EUGENE
KINDER MORGAN 8" TRANSFER LINE
TO VALVES ALONG ENTRANCE ROAD
TO VALVES ALONG ENTRANCE ROAD
Truck Loading Rack Manifold
KINDER MORGAN 8" TO / FROM WILLBRIDGE PUMP STATION
Rail Unloading Rack
Boiler House
Truck Shop
Butane tank
OLY RECEIVING LINES
14" GASOLINE
14" DIESEL
Guardshack
© 2018 Google

# FIGURE 1.3

## SITE PLAN / DRAINAGE DIAGRAM




| BIO DIESEL TANK FARM | | |
|---|---|---|
| TANK | PRODUCT | SAFE FILL CAP(BBLS) |
| 40 | NOT AVAILABLE | NOT APPLICABLE |
| 41 | * | 4,983 |
| 42 | * | 4,983 |
| 43 | * | 4,983 |
| 44 | * | 4,983 |
| 45 | NOT AVAILABLE | NOT APPLICABLE |
| 46 | BIO DIESEL | 3273 |

* AVAILABLE FOR STORM WATER

| STORM WATER DISCHARGE | |
|---|---|
| DRAINAGE AREA | DESCRIPTION OF DRAINAGE |
| (orange hatch) | DRAINAGE TO TANK–19 |
| (blue hatch) | GRAVITY DRAINAGE TO NORTH OIL/WATER SEPERATOR |
| (light blue dots) | IMPOUNDED STORM WATER , RELEASED TO NORTH OIL/WATER SEPERATOR (AFTER OBSERVATION) |
| (grey stipple) | GROUND SURFACE IS PERVIOUS |
| (green dots) | DRAINAGE TO SANITARY SEWER SYSTEM |
| ⊗ | STORM WATER MONITORING LOCATION |
| (SK) | SPILL KIT |

| CATHODIC PROTECTION RECTIFIER | |
|---|---|
| LOCATION | VOLUME |
| OUTSIDE NORTH TANK FARM | 116 GALS |
| OUTSIDE SOUTH TANK FARM | 116 GALS |

| *MARINE TRANSFER PIPING/ VALVES DESIGNATION |
|---|
| 1 = DIESEL FUELS |
| 2 = BIODIESEL FUELS |
| 3 = GASOLINES |
| 4 = ETHANOL |

**LEGEND:**

MH = MANHOLE
CB = CATCH BASIN
BARRIER WELLS
WD = WATER DRAW
WP = WELL PUMP
RCP = OIL FILLED CATHODIC PROTECTION RECTIFIER
= USCG/EPA JURISDICTIONAL VALVE *

SURFACE DRAINAGE
STORM WATER
SANITARY SEWER
PROCESS OILY WATER
GROUND WATER
TREATED WATER

**NOTES:**

1.) ALL PIPING IS SHOWN UNDERGROUND. FOR ABOVEGROUND PIPING (SEE 10110968).
2.) ELEVATION DATUM IS CITY OF PORTLAND, BASED ON CITY OF PORTLAND BENCH MARKNo. 1426 = EL. 32.25' (SEE DWG PO–P–93T13).
3.) COORDINATES ARE BASED ON THE OUTSIDE OF THE NORTH WALL OF THE NORTH TANK FARMDIKE
WEST END N.6000.00 E.10000.00 EAST END N. 6000.00 E.374.99
(SEE DWG PO–P–93T12)

0 40 80 120
SCALE: 1"=40'–0"

| REFERENCE DRAWINGS | | REVISION SECTION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| DWG NO. | DESCRIPTION | REV. | DATE | REVISIONS | AFC | DIAG. NO. | BY | CHK | APR |
| | | 7 | 2/12 | UPDATED PER 2011 SPCC WALKDOWN | 3098 | N/A | DL | TA | TA |
| | | 8 | 11/20/12 | PER CITY OF PORTLAND STORMWATER INSPECTION | N/A | N/A | WM | TM | TM |
| | | 9 | 09/18/14 | UPDATED PER SWPCP | N/A | N/A | WMM | WS | WS |
| | | 3 | 9/06 | UPDATED PER 2006 SPCC WALKDOWN | 1733 | N/A | PT | BM | WN |
| | | 4 | 12/06 | IDENTIFIED OUTFALL AREAS | 1733 | N/A | PT | BM | BD |
| | | 5 | 5/08 | UPDATED PER 2007 SPCC WALKDOWN | N/A | N/A | BN | PT | TA |
| | | 6 | 2/22/11 | SWPCP UPDATES – AECOM ENVIRONMENTAL | N/A | N/A | AECOM | DV | TA |

OLD DWG NO:

**TLP Management Services LLC**

PORTLAND
ENVIRONMENTAL COMPLIANCE
TANK FARM – GENERAL SITE PLAN

SCALE: 1"=40' TYPE:3 SUBTYPE: 71
DRAWING NO. PO–2–G–10110969 REVISION 9

10110969

## HAZARD IDENTIFICATION TANKS
*(Tank = any container that stores oil)*

| Tank Number | Substance Stored *(Oil & Haz. Substance)* | Normal Working Capacity *(Gallons)* | Maximum Shell Capacity *(Gallons)* | Tank Type *(ie. floating roof, fixed roof, etc.)* | Year Built | Failure / Cause *(Record cause and date of any Tank failure which has resulted in a loss of tank contents)* | Containment Capacity *(Gallons)* |
|---|---|---|---|---|---|---|---|
| **NORTH TANK FARM** | | | | | | | |
| 1 | Gasoline | 4,184,712 | 4,479,168 | Internal Floating Roof | Pre-1940 | None | 5,443,801 |
| 2 | Groundwater (Remediation) | N/A | 1,231,000 | Internal Floating Roof | 1957 | None | |
| 3 | Diesel | 1,505,448 | 1,584,366 | Internal Floating Roof | 1957 | None | |
| 4 | Gasoline | 939,918 | 1,105,860 | Internal Floating Roof | 1957 | None | |
| 5 | Gasoline | 741,300 | 895,314 | Internal Floating Roof | 1957 | None | |
| 6 | Gasoline | 803,040 | 1,014,384 | Internal Floating Roof | 1957 | None | |
| 7 | Gasoline | 450,492 | 648,018 | Internal Floating Roof | 1957 | None | |
| 8 | Gasoline | 616,938 | 790,272 | Internal Floating Roof | 1957 | None | |
| 11 | Gasoline | 1,129,926 | 1,354,122 | Internal Floating Roof | Pre-1940 | None | |
| 12 | Ethanol | 561,204 | 605,346 | Internal Floating Roof | 1961 | None | |
| 13 | Ethanol | 559,482 | 602,994 | Internal Floating Roof | 1961 | None | |
| 24 | Gasoline Additive | 15,960 | 20,286 | Fixed Roof | 1970 | None | |
| 25 | Gasoline Additive | 15,960 | 20,241 | Fixed Roof | 1966 | None | |
| **SOUTH TANK FARM** | | | | | | | |
| 9 | Diesel | 2,161,404 | 2,295,636 | Fixed Roof | Pre-1940 | None | 3,622,080 |
| 10 | Diesel | 931,980 | 1,008,840 | Fixed Roof | Pre-1940 | None | |
| 14 | Diesel | 1,046,388 | 1,121,736 | Fixed Roof | Pre-1940 | None | |
| 15 | Biodiesel | 743,400 | 804,972 | Fixed Roof | Pre-1940 | None | |
| 17 | Diesel | 3,125,472 | 3,329,340 | Fixed Roof | Pre-1940 | None | |
| 18 | Diesel | 1,046,262 | 1,104,726 | Fixed Roof | Pre-1940 | None | |
| 19 | Oily Waste Water | 184,000 | 198,828 | Internal Floating Roof | 1961 | None | |
| 21 | Gasoline Additive | 204,960 | 220,080 | Fixed Roof | 1961 | None | |

| Tank Number | Substance Stored *(Oil & Haz. Substance)* | Normal Working Capacity *(Gallons)* | Maximum Shell Capacity *(Gallons)* | Tank Type *(ie. floating roof, fixed roof, etc.)* | Year Built | Failure / Cause *(Record cause and date of any Tank failure which has resulted in a loss of tank contents)* | Containment Capacity *(Gallons)* |
|---|---|---|---|---|---|---|---|
| **HAZARD IDENTIFICATION TANKS (Cont'd)** ***(Tank = any container that stores oil)*** | | | | | | | |
| **BIODIESEL TANKS** | | | | | | | |
| 40 | Unavailable | 0 | 209,286 | Fixed Roof | 1954 | None | 261,874 |
| 41 | Permanently Closed | 0 | 209,286 | Fixed Roof | 1954 | None | |
| 42 | Permanently Closed | 0 | 209,286 | Fixed Roof | 1954 | None | |
| 43 | Out of Service | 0 | 209,286 | Fixed Roof | 1954 | None | |
| 44 | Out of Service | 0 | 209,286 | Fixed Roof | 1954 | None | |
| 45 | Unavailable | 0 | 209,286 | Fixed Roof | 1954 | None | |
| 46 | Biodiesel | 125,571 | 221,970 | Fixed Roof | 1954 | None | |
| | | | | | | | |
| **OUTSIDE TANK FARM** | | | | | | | |
| 23 | Diesel Lubricity Additive | 2,100 | 2,100 | Horizontal Tank | 2005 | None | 2,148 |
| 26 | Diesel Conductivity Additive | N/A | 300 | Tote | NA | None | 2,148 |
| 27 | Diesel Conductivity Additive | N/A | 300 | Tote | N/A | None | N/A |
| T101 | Butane | N/A | 90,000 | Horizontal Tank | 2017 | None | N/A |
| N/A | Diesel Lubricity Additive | N/A | 300 | Tote in Storage Shed | N/A | None | 450 |
| N/A | Diesel Red Dye | N/A | 300 (2) | Tote in Storage Shed | N/A | None | 450 |

***(Note: Tanks 40 & 45 empty - open to provide SPCC required containment. Tanks 41 & 42 empty, slotted and permanently closed. Tanks 43 & 44 empty in reserve status for backup stormwater containment if needed.)***

# Appendix B

Geotechnical Assessment

155 Grand Avenue
Suite 504
Oakland, CA 94612
**P** 510.701.2266

gannettfleming.com

May 29, 2024

SGH Project No. 247052.00-TMPO / Gannett Fleming Project No. 078231

Julie A. Galbraith
Senior Project Manager
Simpson Gumpertz & Heger Inc.
1999 Harrison Street, Suite 2400
Oakland, CA 94612

**Re: Technical Memorandum**
**Preliminary Geotechnical Assessment**
**SeaPort Midstream Partners Portland Terminal – Seismic Vulnerability Assessment**
**Portland, Oregon**

Dear Ms. Galbraith:

At your request, Gannett Fleming, Inc. (Gannett Fleming) has prepared this technical memorandum summarizing our preliminary geotechnical assessment in support of the Seismic Vulnerability Assessment of the Seaport Midstream Partners Portland Terminal located at 9930 NW St. Helens Road in Portland, Oregon. We performed our assessment in general accordance with the scope of services per our agreement with Simpson Gumpertz & Heger Inc. (SGH) dated March 29, 2024. The following provides a summary of the results of our assessment based on an evaluation of existing geotechnical data for the site.

## PROJECT BACKGROUND

The site is located along the west shoreline of the Willamette River, with primary improvements comprised of over two dozen fuel storage tanks, a wharf, product transfer pipelines, and associated facilities. A Seismic Vulnerability Assessment of the terminal will be required in accordance with the State of Oregon Department of Environmental Quality (DEQ) Division 300 Fuel Tank Seismic Stability Rules, Oregon Administrative Rules 340-300-0000 (Rules). The Rules require a Seismic Vulnerability Assessment be performed to evaluate the risk of seismically-induced impacts including liquefaction, settlement, lateral spreading, and ground failures. The objective of such an assessment is to identify any risk mitigation measures that may be necessary. SGH is leading the Seismic Vulnerability Assessment with geotechnical input provided by Gannett Fleming.

## OBJECTIVE AND SCOPE OF SERVICES

The purpose of our geotechnical assessment is to provide input in support of the Seismic Vulnerability Assessment. In accordance with our agreement with SGH dated March 29, 2024, our assessment considers existing site-specific geotechnical information and other existing data. The scope of our services included the following.

- Review of existing information and subsurface characterization considering geotechnical data for the site.
- Preliminary seismic hazards evaluation considering liquefaction triggering/cyclic degradation based on existing geotechnical data.
- Preliminary assessment of mechanisms contributing to vertical and lateral ground surface deformations.
- Qualitative evaluation of the potential effects of ground deformations on fuel storage tanks and associated facilities.
- Preparation of this memorandum.

## SITE CONDITIONS

The terminal is located on the east side of NW St. Helens Road east of the foothills of the Tualatin Mountains along the western shoreline of the Willamette River as shown in Figure 1. The site is relatively flat at roughly elevation 35 feet (NAVD88). Terminal improvements include steel fuel storage tanks about 30 to 140 feet in diameter, a wharf, a waterfront sheet pile bulkhead wall (sheet pile wall), pumps, pipelines, secondary containment walls, a truck loading rack, and associated facilities. Bathymetric survey data collected by the United States Army Corps of Engineers indicate the waterfront slope is roughly 70 feet high. An aerial image of the terminal is presented in Figure 2.

We understand an anchored sheet pile wall was constructed along the waterfront circa 2009 to replace a concrete cantilever seawall constructed in the 1940s due to progressive structural failure. Sheet pile wall drawings prepared by URS dated March 2009 indicate the wall is located on the waterside of the 1940s seawall, with a pile tip elevation of about -7 feet (NAVD88) and two rows of tiebacks (URS 2009).

## PREVIOUS STUDIES

Several previous geotechnical investigations have been performed at the site. These included geotechnical borings completed by URS Corporation (URS) in July/August of 2003 and October/November of 2004 as summarized in a Final Geotechnical Report prepared by URS dated April 12, 2006 (URS 2006). Five soil borings were completed as part of the 2003 investigation, with nineteen soil borings completed for the 2004 investigation. The data from the URS geotechnical investigations were considered as part of our geotechnical assessment. Subsurface cross sections including Standard Penetration Test (SPT) blow count (N value) data presented in a Final Geotechnical Analyses Report by URS dated April 1, 2007, are included as Appendix A of this memorandum (URS 2007). These data were referred to as part of a two-dimensional analyses completed using the computer program FLAC (Fast Lagrangian Analysis of Continua) in support of the existing sheet pile wall design. The FLAC analyses included static and post-seismic analysis of stresses and deformation of the sheet piles wall. The post-seismic analysis considered the reduced strength of the soils due to liquefaction, but did not consider seismic inertial forces. The post-seismic stability analyses, indicated up to about 1 ½ feet of horizontal displacement at the top of the sheet pile wall.

In addition to previous geotechnical studies, we understand that several groundwater monitoring and extraction wells have been installed at the site as part of a groundwater capture system related to remedial measures.

## SUBSURFACE CONDITIONS

The site is underlain by various amounts of fill materials placed during site development. Regional geologic mapping indicates the site is underlain by young Quaternary alluvium comprised of river and stream deposits of silt, sand, clay, and peat of present floodplains (Schlicker, H.G., et al. 1967). The alluvium is largely confined to the ancient incised Willamette River channel, which includes the current channel and the adjacent floodplains. The mapping suggests the alluvium is underlain by Columbia River basalt at depth.

The previous borings by URS completed in July/August of 2003 and October/November of 2004 indicate subsurface conditions encountered that are generally consistent with site development and regional geology. The borings indicate subsurface soils are generally comprised of fill, stream deposits, alluvial deposits, and bedrock. The fill materials vary in thickness from about 15 to 35 feet, with greater thickness adjacent to the existing seawall and lesser thickness on the west side of the site. The fill primarily consists of loose to dense sands with varying amounts of silt and gravel, often containing debris such as brick, asphalt, glass, and wood. Stream deposits underlying the fill near the center of the site range in thickness from about 2 to 10 feet and are generally comprised of medium dense to dense sands interlayered with silts. These soils are interpreted to have been deposited in a historic stream channel originating from the adjacent Tualatin Mountains. Alluvial deposits underlying the fill and stream deposits are comprised of fine-grained and sandy sands. The fine-grained alluvium encountered is up to about 18 feet thick and generally consist of soft to very stiff silts and lean clays interlayered with sands deposited by successive historic flood events. The Sandy alluvium underlying the fine-grained alluvial and/or stream deposits primarily consist of loose to dense relatively clean to silty sands. The sandy alluvial deposits are up to about 20 feet thick and are underlain by basalt bedrock. Columbia River basalt was encountered in the west portion of the site at a depth of about 40 feet and at about 70 feet below the ground surface adjacent to the sheet pile wall.

### Groundwater

Shallow groundwater was encountered in the borings by URS at depths ranging from about 1 to 13 feet. Groundwater evaluations at the site indicate the groundwater depth near the sheet pile wall is about 30 feet, which is likely influenced by the groundwater extraction wells at this location. Fluctuations in groundwater levels likely occur due to variations in the Willamette River water level, rainfall, underground drainage patterns, groundwater extraction, regional influence, and other factors.

## SEISMIC HAZARDS ASSESSMENT

We have evaluated seismic hazards including liquefaction, lateral spreading, and seismic densification. As part of this, we have developed design earthquake ground motions for the purposes of our assessment. A summary of design earthquake ground motions and our conclusions regarding the potential for liquefaction and lateral spreading is provided below.

### Design Earthquake Ground Motions

We developed seismic design parameters in accordance with the 2016 American Society of Civil Engineers (ASCE) Standard 7-16 (ASCE 7-16): Minimum Design Loads for Buildings and Other Structures (ASCE 2016) for the purposes of evaluating liquefaction potential and lateral spreading. Considering the existing geotechnical data and depth to bedrock, the site can be characterized as Site Class D. Using the ASCE 7 Hazard Tool, we calculated a maximum considered earthquake geometric mean ($MCE_G$) peak ground acceleration adjusted for site class ($PGA_M$) of 0.49g, corresponding to a moment magnitude ($M_w$) of 9.3 on the Cascadia Megathrust fault, which governs the seismic hazard at the site. Note this dominant magnitude is slightly more conservative than the $M_w$ 9.0 scenario noted in Chapter 99 of the Oregon Laws; however, we expect the difference in results of liquefaction and lateral spreading analysis to not vary significantly given the high magnitude of either event.

**Liquefaction**

Using the empirical procedure developed by Boulanger and Idriss (2014), we evaluated the potential for saturated soil deposits to liquefy. Field (uncorrected) Standard Penetration Test (SPT) blow counts within the various strata are shown on the geologic profile included in Appendix A. Our analysis accounts for the liquefaction potential of sands and post-cyclic behavior of silt-rich soil with consideration to data from published studies of Willamette River Silt (Dickenson, et al. 2022) as well as the potential for seismic densification (seismic settlement of sands above the groundwater table). We considered a $PGA_M$ of 0.49g and a moment magnitude ($M_w$) of 9.3.

The results of our evaluation indicate the potential for liquefaction is high considering the design earthquake. This is consistent with previous assessments by URS (URS 2007). Excess pore-water pressures generated during liquefaction will cause ground settlement as the pore pressures dissipate (referred to as reconsolidation). In addition, excess pore pressures will result in strength loss, which can lead to lateral spreading and other effects such as floatation of underground structures and increased lateral pressures on submerged retaining walls. The primary mechanisms of liquefaction-induced ground settlement are reconsolidation (seismic settlement of soils below the groundwater table), ejecta-induced, and shear-induced deformation. In addition, sands above the groundwater table can undergo seismic densification resulting in ground settlement. We summarize our assessment of seismic densification and the effects of liquefaction including ground settlement, floatation of underground structures, and increased lateral pressures below, which is followed by our evaluation of lateral spreading in a subsequent section of this memorandum.

Seismic Densification and Reconsolidation Settlement

Considering the generally shallow groundwater conditions at the site, the risk of seismically-induced settlement resulting from the densification of sands above the groundwater table is low. However, a considerable amount of liquefaction-induced settlement from reconsolidation can occur. The seismically-induced ground deformations summarized in a subsequent section of this memorandum are based on the approaches developed by Tokimatsu and Seed (1987) and Ishihara and Yoshimine (1992).

Ejecta-Induced Settlement

Based on our evaluation of the potential for surface effects, we conclude there is a high likelihood of ground surface disruption following liquefaction given the relatively thin non-liquefiable soil (crust) overlying relatively thick liquefiable soil. Surface effects can occur as water is forced to the ground surface when the dissipation of excess pore-water pressures in the liquefied soil exceeds the resistance of the overlying non-liquefiable crust. This can lead to sediment ejecta and settlement from ground loss as the expelled pore-water carries sand particles to the ground surface through volcano-like vents (referred to as sand boils). Ground surface disruption associated with lateral spreading tends to increase the likelihood of sediment ejecta. Our assessment of ejecta-induced settlement considers a review of case histories, such as those summarized by Mijic, et al. (2002), and professional experience including post-earthquake observations.

Shear-Induced Settlement

In addition to settlement from reconsolidation and sediment ejecta, liquefaction-induced foundation settlement can occur when shear-induced deformations driven by cyclic loading occur due to ratcheting and bearing capacity types of movement caused by soil structure interaction (SSI). The amount of foundation settlement in response to the design earthquake depends on the seismic bearing pressures imposed by the structure, foundation dimensions, and liquefied soil strengths. We anticipate settlement would be most significant where the thickness of non-liquefiable crust beneath the foundation is the lowest. While shear-induced foundation settlement is difficult to predict and would need to be evaluated on a case-by-case basis, we expect that up to about 1 foot or more of shear-induced foundation settlement could occur.

Floatation of Underground Structures

Underground structures including underground tanks, vaults, and manholes may be susceptible to floatation due to liquefaction. This can occur as the soil liquefies and loses shear resistance against the uplift force from the buoyancy of the underground structure. The magnitude of uplift displacement depends on the depth of the structure as well as the duration and intensity of earthquake ground motions and is difficult to predict. This would need to be further evaluated for specific underground structures if needed.

Increased Lateral Pressures on Retaining Walls

Liquefied soils will impose increased lateral loads on submerged retaining walls such as the existing sheet pile bulkhead wall. This is due to the reduction in shear strength resulting from liquefaction. Decreased shear strength may also reduce the capacity of tieback anchors. These effects will need to be considered as part of further evaluation of retaining walls.

**Lateral Spreading**

Lateral spreading is a phenomenon where a soil mass moves laterally on liquefied soil down a gentle slope or toward a free face, such as the adjacent Willamette River channel, due to reduced soil strengths and earthquake-induced forces acting on soils within and above the liquefied layer (seismic inertial loading). As noted in the 2007 URS report, relatively lateral ground deformations may be experienced following the liquefaction of soils behind the sheet pile wall, with estimates of up to about 1 ½ of horizontal wall displacement based on FLAC analyses (URS 2007). If the wall is effective at limiting lateral deformations to this magnitude, we would expect lower ground deformations with greater distance landward of the wall.

The sheet pile wall has a relatively shallow embedment below the riverbed and is underlain by liquefiable soils. It is unclear to what extent the previous FLAC analysis considered the potential for deep-seated (global) seismic deformations occurring below the wall. Slope deformation occurring below the wall may result in the translation/rotation of the wall and tiebacks behaving as a unit. If this is the case, potentially larger deformations than previously estimated may be realized and extend to substantial distances landward of the sheet pile wall. In any case, large deformations may be experienced on the waterside of the sheet pile wall as a result of unlimited strain development leading to flow-type failure. In this case, masses of ground may travel long distances (likely more than 5 feet) in the form of liquefied flows or blocks of ground riding on liquefied flows. Lateral spreading in this area will impose kinematic lateral loads on the wharf pile foundations where soil movements occur relative to the piles.

**Seismically-Induced Ground Deformations**
As indicated previously, the primary mechanisms of liquefaction-induced settlement are reconsolidation, ejecta-induced, and shear-induced deformation. In addition, sands above the groundwater table can undergo seismic densification resulting in ground settlement. We have developed preliminary estimates of vertical seismically-induced ground deformations to approximate the range of movements expected at the site as summarized Table 1 below. These estimates do not consider shear-induced foundation settlements discussed previously.

**Table 1: Seismically-Induced Vertical Settlement**

| Mechanism | Probable Approximate Vertical Settlement Range[1] (inches) |
|---|---|
| Densification | < ½ |
| Reconsolidation | 2 to 6 |
| Ejecta-Induced[2] | Up to 12 (locally near ejecta) |
| All the Above | 2 to 18 |

1. The estimated vertical ground deformations consider free-field conditions. Additional settlement of tanks and other structures may occur due to shear-induced foundation settlement as discussed previously.
2. Ground loss from sediment ejecta is highly variable and difficult to estimate.

It should be noted that lateral spreading also results in ground settlement, which can be as much as about one-third to one-half of the magnitude of lateral displacement. The vertical component of lateral deformation in the onshore portions of the site will depend on the seismic performance of the sheet pile wall, which will need to be evaluated further as discussed below. Large vertical deformations may be experienced on the waterside of the sheet pile wall due to flow slide failure.

**CONCLUSIONS**

As discussed herein, there are various liquefaction-induced mechanisms that could impact the terminal infrastructure. The most significant risk is related to lateral spreading on the waterside of the sheet pile wall, where the potential for flow slide failure exists. This can result in impacts on the facilities in this area including kinematic loading on piles supporting the wharf. Where seismically-induced ground deformations are not acceptable, potential mitigation measures could be considered. The potential for lateral spreading on the waterside of a shoreline buttress and potential kinematic load impacts on the existing wharf should be assessed as part of any remedial measures. Settlement and other foundation impacts could be mitigated by structural improvements/strengthening of shallow foundations, deep foundations, and/or ground improvement to make them less susceptible to vertical ground deformations.

An evaluation of the seismic performance of the sheet pile wall is critical to the understanding of the seismic hazard. Future investigations should focus on an assessment of lateral displacement considering the seismic performance of the wall including global stability. This would include a detailed review and validation of the FLAC model and analysis completed by URS, supplemented by simplified Newmark deformation and additional FLAC analyses. In addition, any future investigations should include the collection of data in support of developing remedial measures or further evaluating the performance of specific structures.

## LIMITATIONS

This report has been prepared for the sole use of SGH and SeaPort Midstream Partners, and is specific to the conditions at the site as described herein. The opinions, conclusions, and recommendations contained in this report are based upon information obtained from existing geotechnical data, experience, and engineering judgment, and have been formulated in accordance with generally accepted geotechnical practices at the time this report was prepared; no other warranty is expressed or implied. In addition, the conclusions and recommendations presented in this report are based on interpretations of the subsurface conditions encountered in widely spaced explorations. Actual conditions may vary. If subsurface conditions encountered in the field differ from those described in this report, Gannett Fleming should be consulted to determine if changes to the conclusions presented herein or supplemental recommendations are required.

The opinions presented in this report are valid as of the date of this report. Changes in the condition of a site can occur with the passage of time, whether due to natural processes or the works of man. In addition, changes in applicable standard of practice can occur, whether from legislation or the broadening of knowledge. Accordingly, this report may be invalidated, wholly or partially, by changes outside of Gannett Fleming's control. In any case, this report should not be relied upon after a period of three years without prior review and approval by Gannett Fleming.

## CLOSING

We appreciate the opportunity to collaborate with you on this important project. Please contact us if you have any questions.

Sincerely,

Gannett Fleming, Inc.

REGISTERED PROFESSIONAL ENGINEER
104139PE
OREGON
MAY 14, 2024
BENJAMIN SERNA
EXPIRES: 06/30/2026

05/29/2024

Benjamin Serna, PE
Principal Engineer

R. William Rudolph
Senior Consultant

Attachments: Figures
Appendix A – Existing Data

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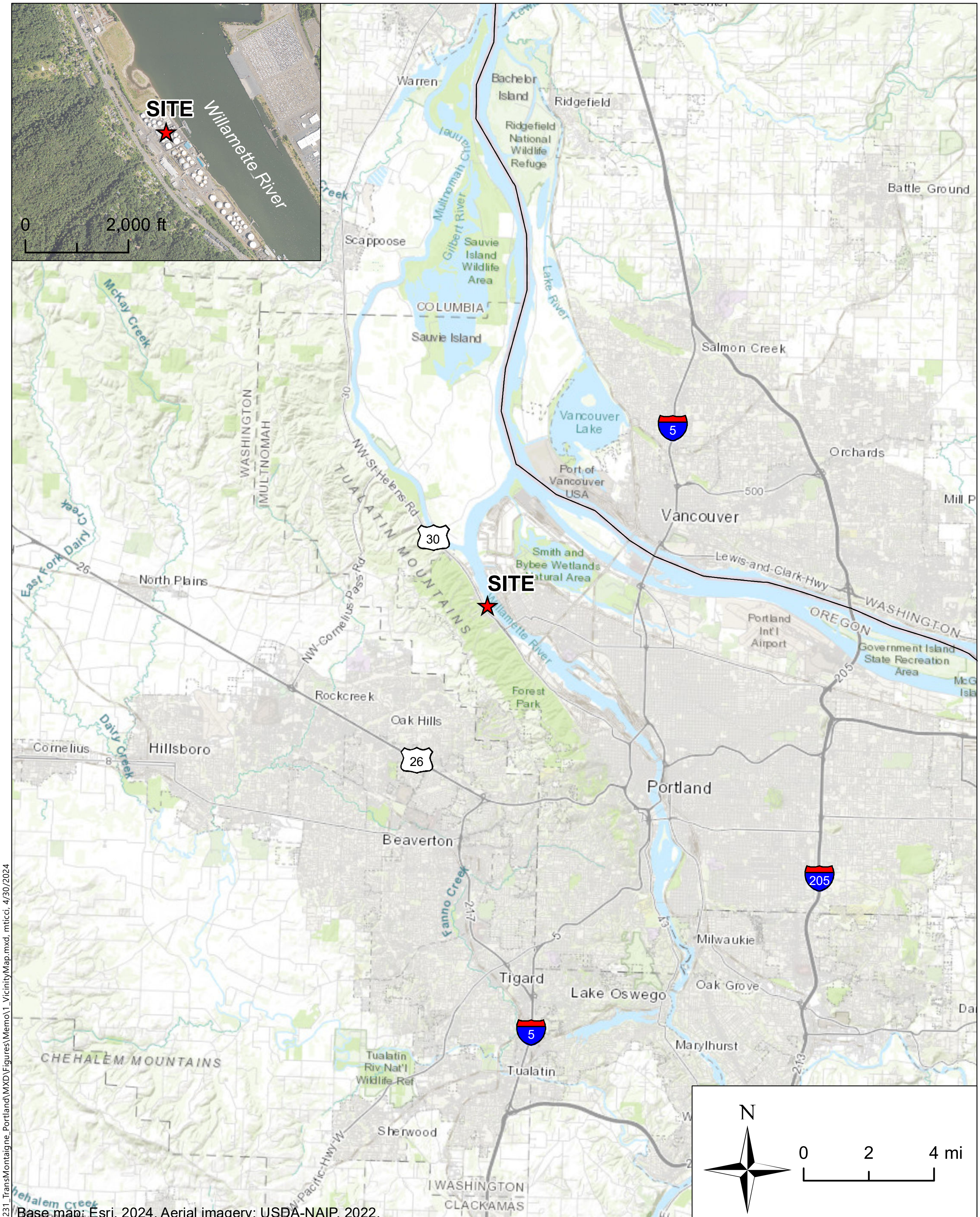
# FIGURES




GANNETT FLEMING

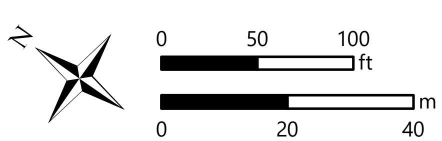
# SITE VICINITY PLAN

SeaPort Midstream Partners Portland Terminal
Preliminary Geotechnical Assessment
Portland, Oregon

FIGURE 1

| Date: 4/30/2024 | By: M. Ticci | Scale: 1:250,000 | Project No: 078231 |
|---|---|---|---|

\\cphfs23\EnvSci\Projects\07\078231_TransMontaigne_Portland\MXD\Figures\Memo\1_VicinityMap.mxd, mticci, 4/30/2024


Imagery: USDA-NAIP, 2022.

GANNETT FLEMING

SITE PLAN

SeaPort Midstream Partners Portland Terminal
Preliminary Geotechnical Assessment
Portland, Oregon

FIGURE 2

| Date: 5/2/2024 | By: M. Ticci | Scale: 1:1,200 | Project No: 078231 |
|---|---|---|---|

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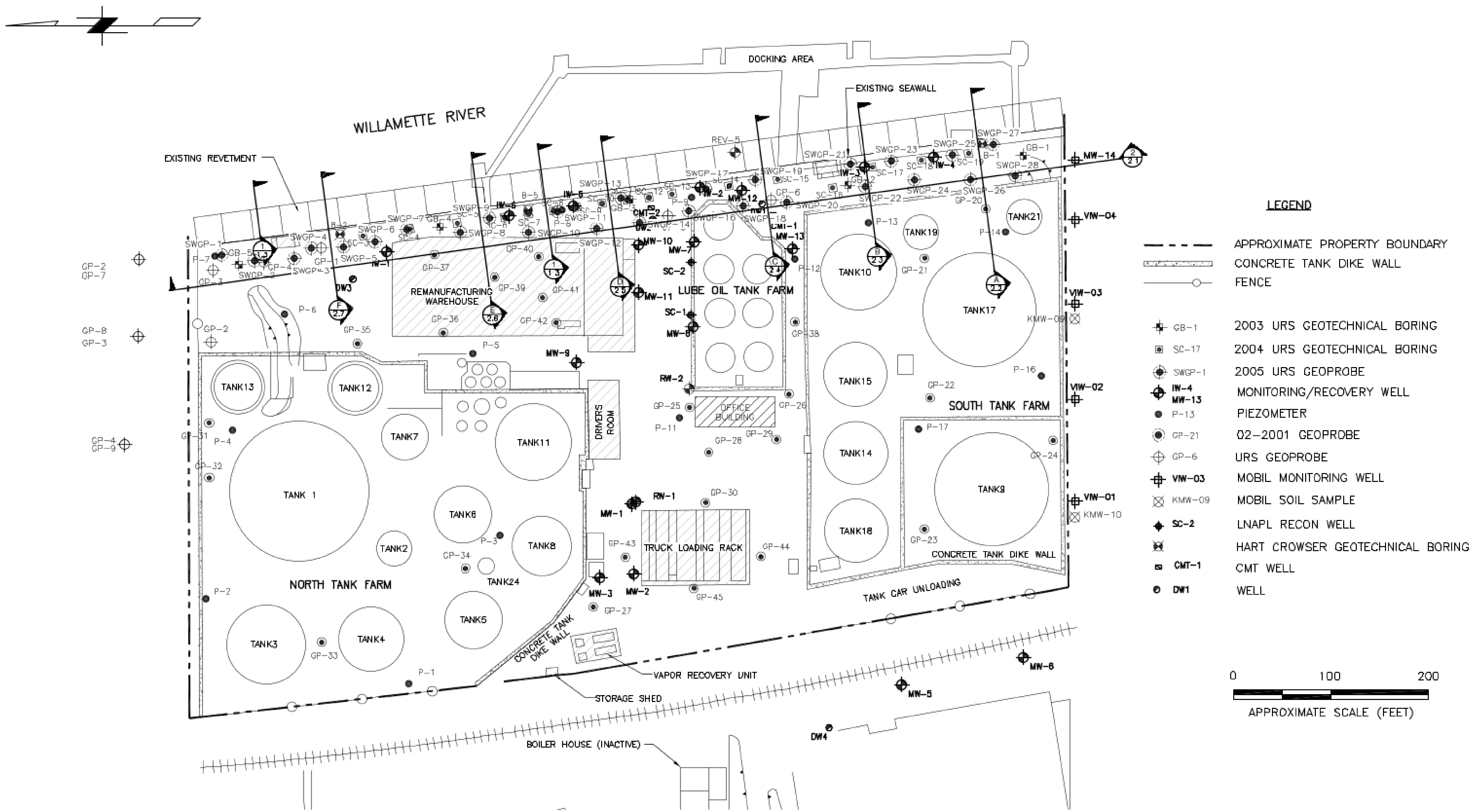
# APPENDIX A – EXISTING DATA



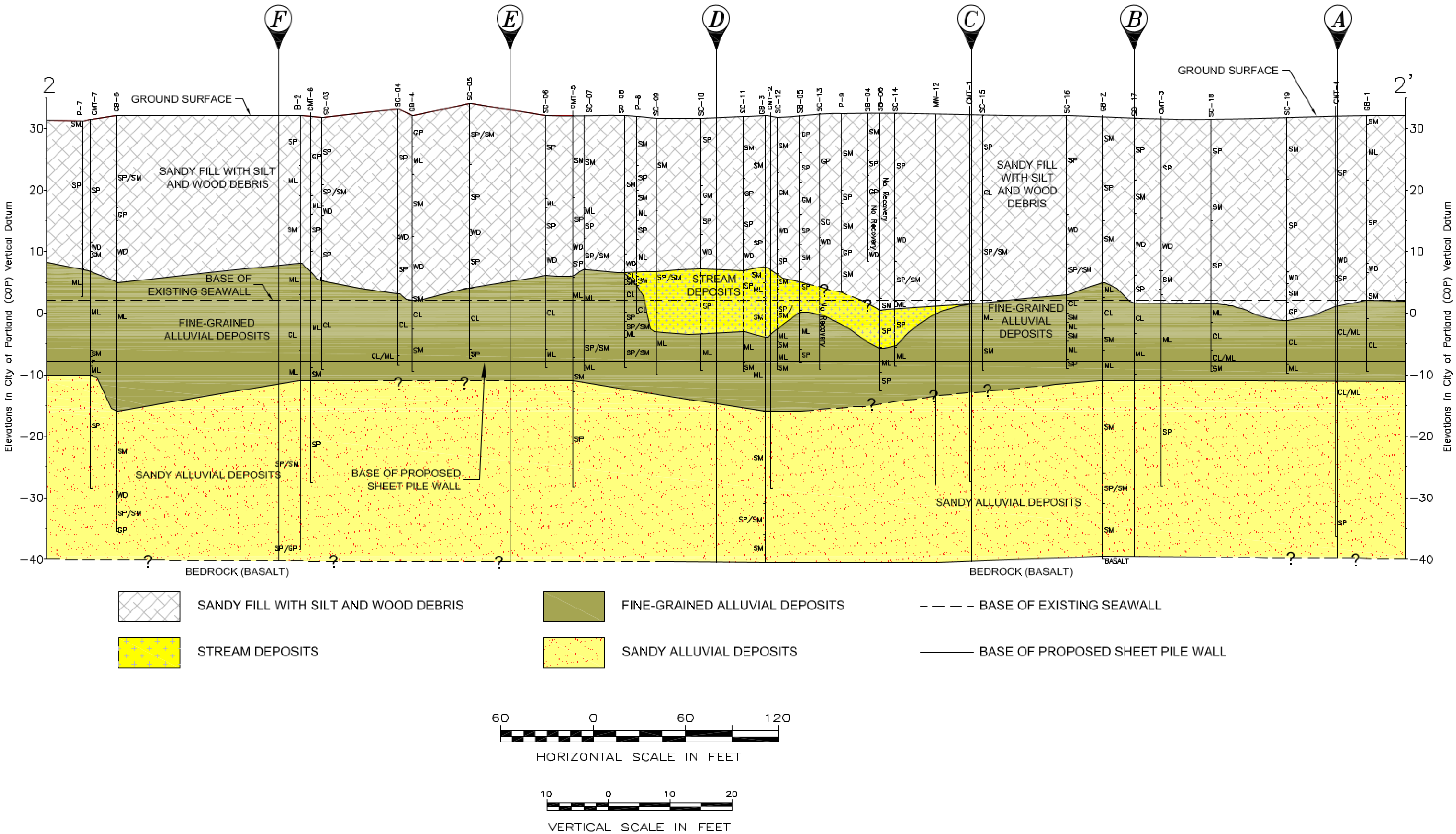

URS

**SITE PLAN**

APRIL 2007
38476256

BP
TERMINAL 22
LINNTON, OREGON

**FIGURE 1.2**




| No. | DATE | BY | REVISION | JOB No. 38478258 | DESIGNED | PROJ. MANAGER |
|---|---|---|---|---|---|---|
| | | | | SCALE: As Noted | DRAWN BY: SPB | APPROVED BY |
| | | | | | CHECKED BY | DATE: APRIL 2007 |

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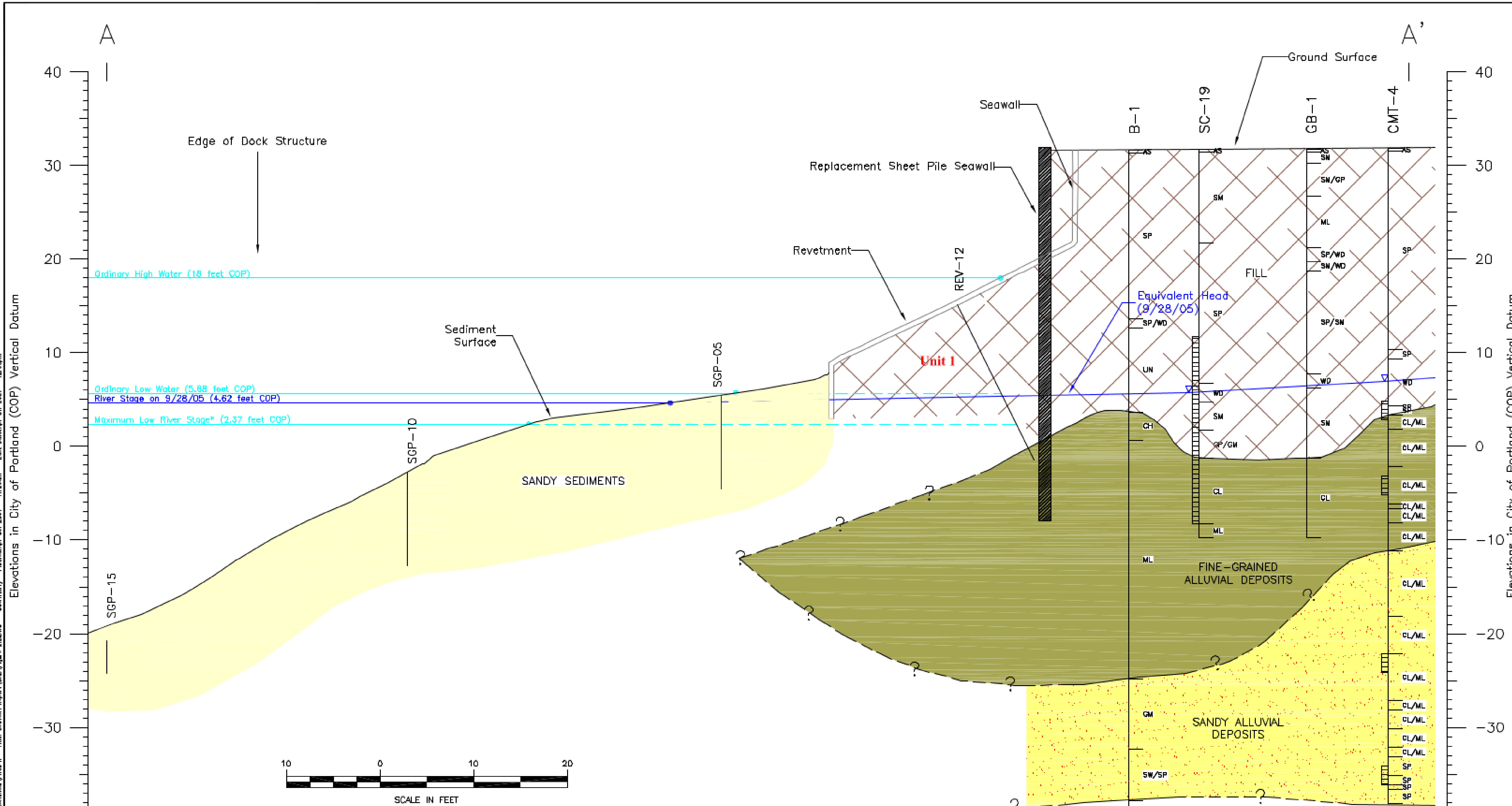
**BP TERMINAL 22T**

**9930 NW ST HELENS ROAD**
**PORTLAND, OREGON**

Geologic Cross Section
Profile 2–2'

DRAWING NUMBER: Figure 2.1
CAD FILE NUMBER:
SHEET: 1 OF 1
REV.: A




*Maximum Low River Stage Recorded at the Morrison Bridge from 1990–Present
(Measured on 9/21/03)

Revetment Toe Interpreted from Construction Drawings
(Not Field Verified)

| No. | DATE | BY | REVISION |
|---|---|---|---|

| | | |
|---|---|---|
| JOB No. 38476256 | DESIGNED: | PROJ. ENGINEER: |
| SCALE: As Noted | DRAWN BY SPB | APPROVED BY: |
| | CHECKED BY: | DATE: APRIL 2007 |

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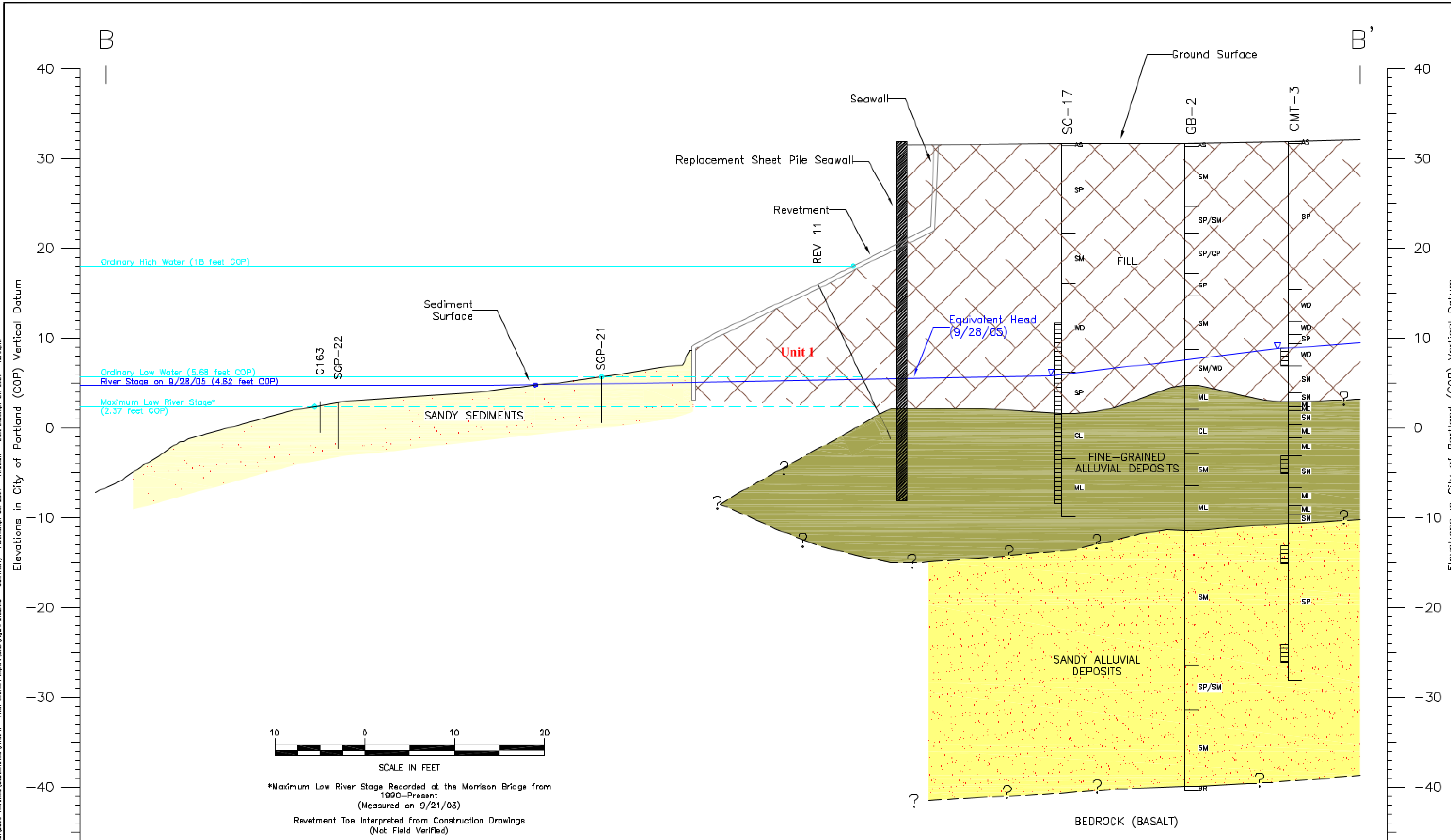
Cross Section A and
Potential Excavation Units

| | |
|---|---|
| DRAWING NUMBER: Figure 2.2 | |
| CAD FILE NUMBER: | |
| SHEET: 1 OF 1 | REV. A |




| No. | DATE | BY | REVISION |
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PROJ. ENGINEER:
APPROVED BY:
DATE: APRIL 2007

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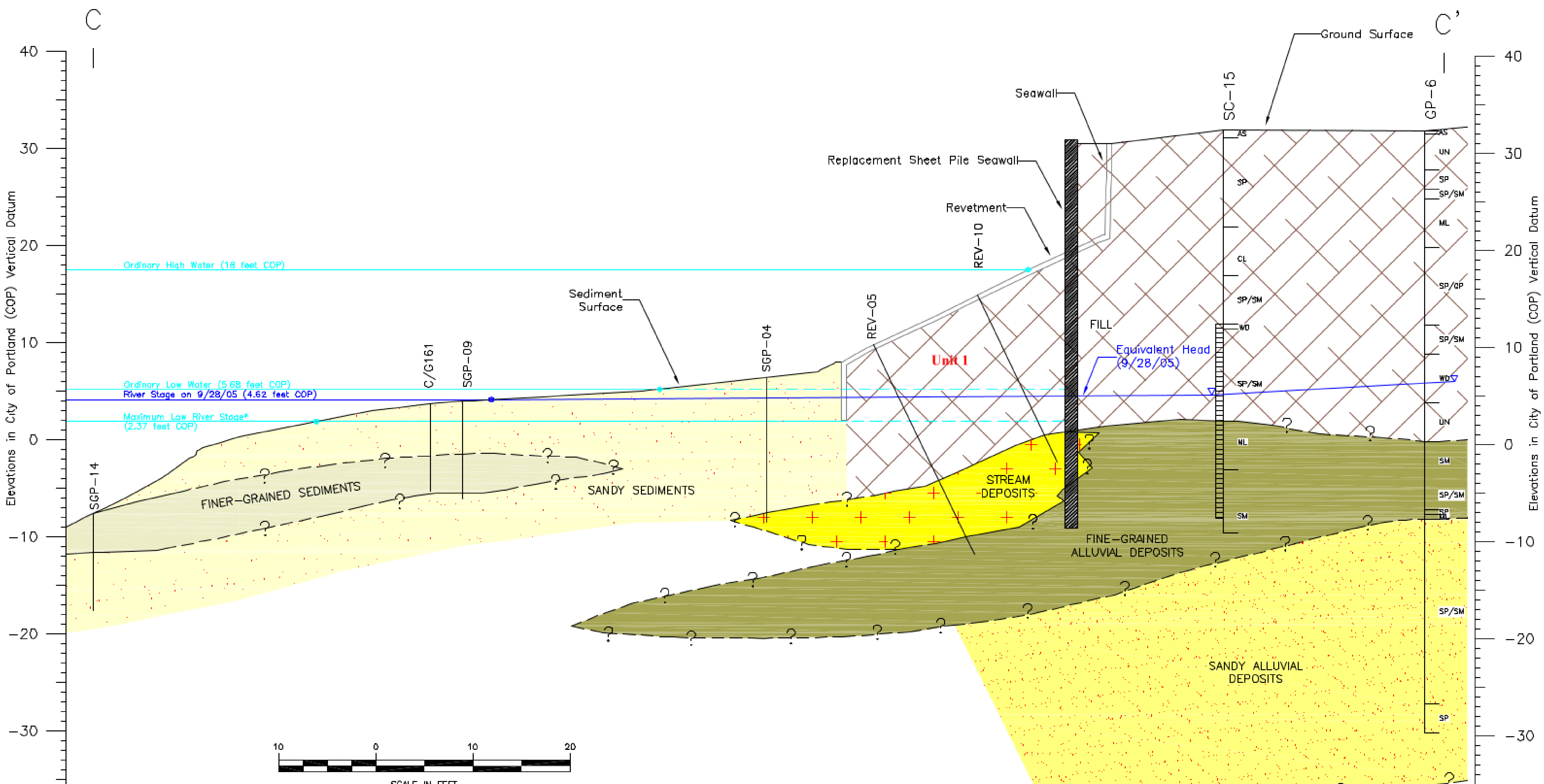
Cross Section B and Potential Excavation Units

DRAWING NUMBER: Figure 2.3
CAD FILE NUMBER:
SHEET: 1 OF 1
REV. A




*Maximum Low River Stage Recorded at the Morrison Bridge from 1990–Present (Measured on 9/21/03)

Revetment Toe Interpreted from Construction Drawings (Not Field Verified)

| No. | DATE | BY | REVISION |
|---|---|---|---|

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| JOB No. 38476256 | DESIGNED: | PROJ. ENGINEER: |
| SCALE: As Noted | DRAWN BY SPB | APPROVED BY: |
| | CHECKED BY: | DATE: APRIL 2007 |

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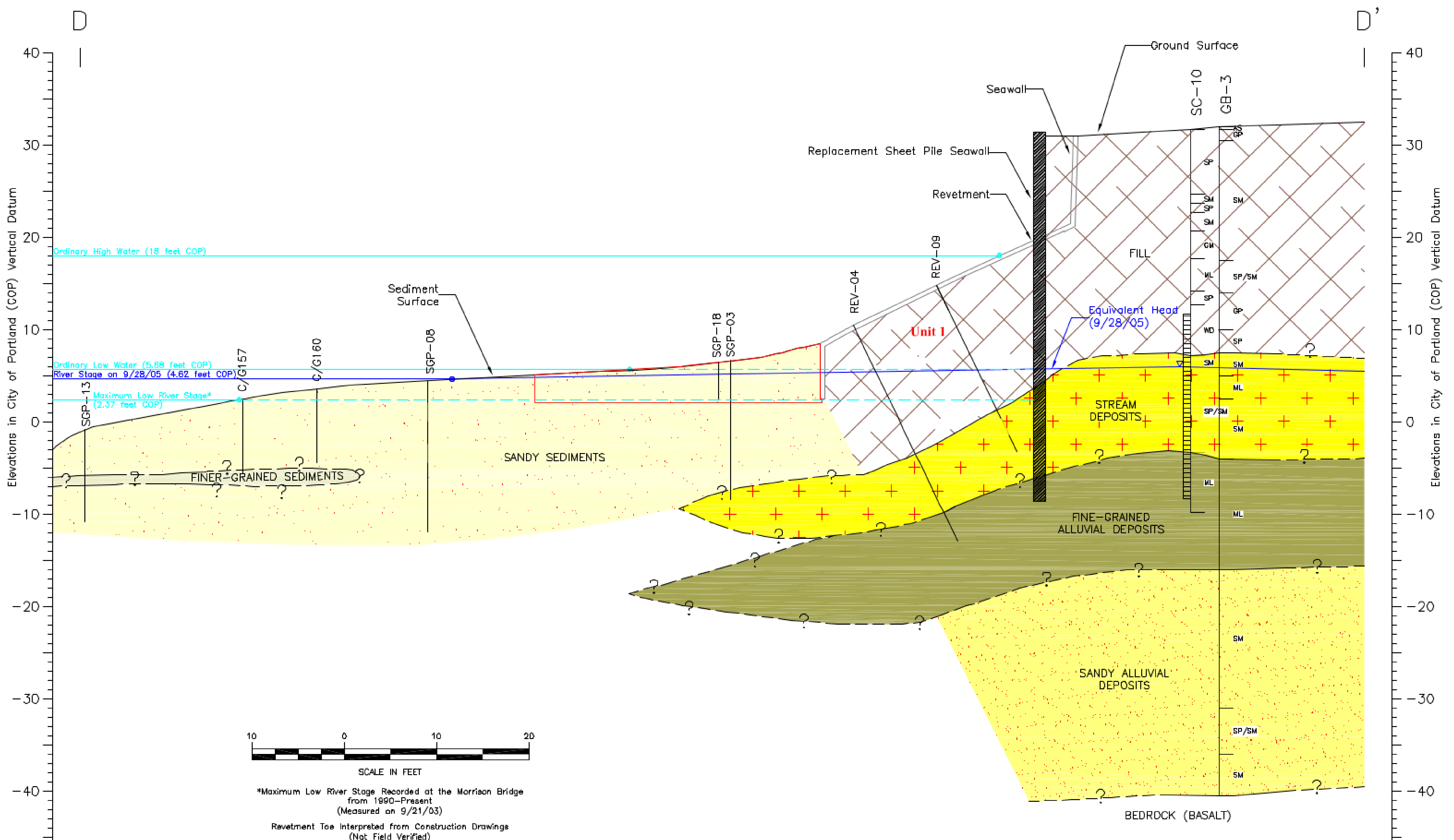
Cross Section C and Potential Excavation Units

DRAWING NUMBER: Figure 2.4
CAD FILE NUMBER:
SHEET: 1 OF 1
REV. A




*Maximum Low River Stage Recorded at the Morrison Bridge from 1990−Present (Measured on 9/21/03)

Revetment Toe Interpreted from Construction Drawings (Not Field Verified)

| No. | DATE | BY | REVISION |
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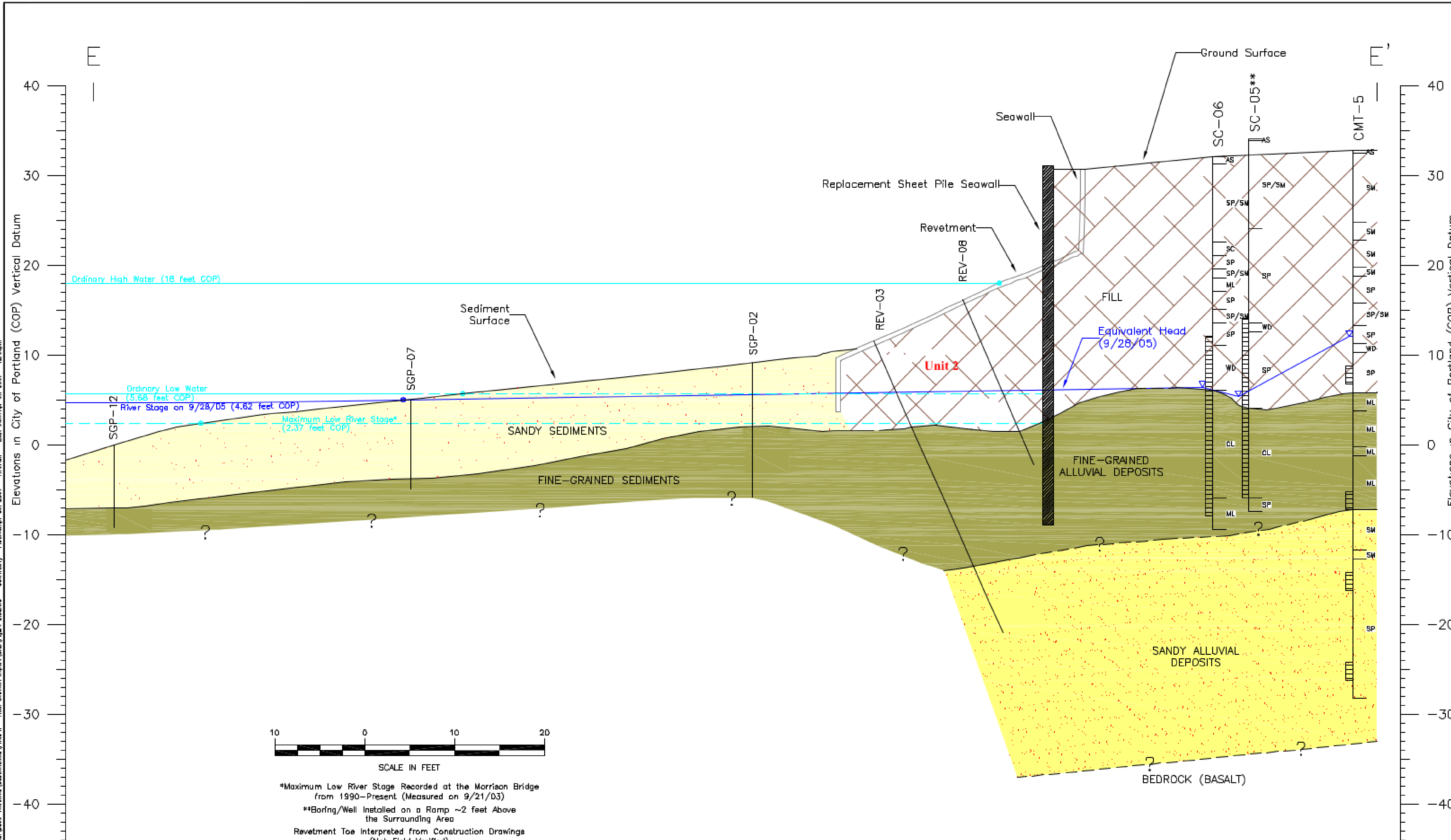
Cross Section D and Potential Excavation Units

DRAWING NUMBER: Figure 2.5
CAD FILE NUMBER:
SHEET: 1 OF 1 — REV: A

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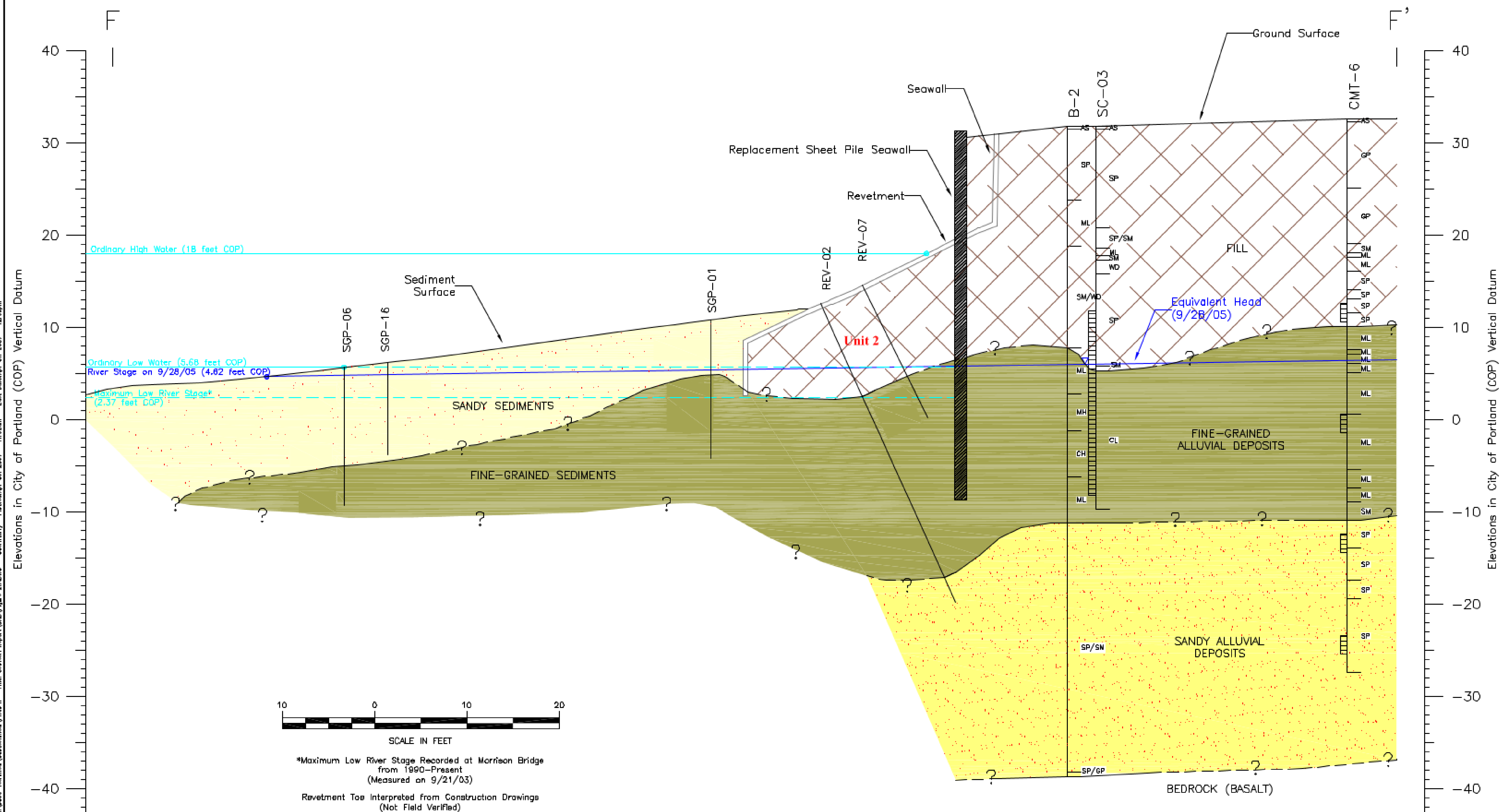
Cross Section E and
Potential Excavation Units

DRAWING NUMBER: Figure 2.6
CAD FILE NUMBER:
SHEET: 1 OF 1
REV: A

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Cross Section F and Potential Excavation Units

DRAWING NUMBER: Figure 2.7
CAD FILE NUMBER:
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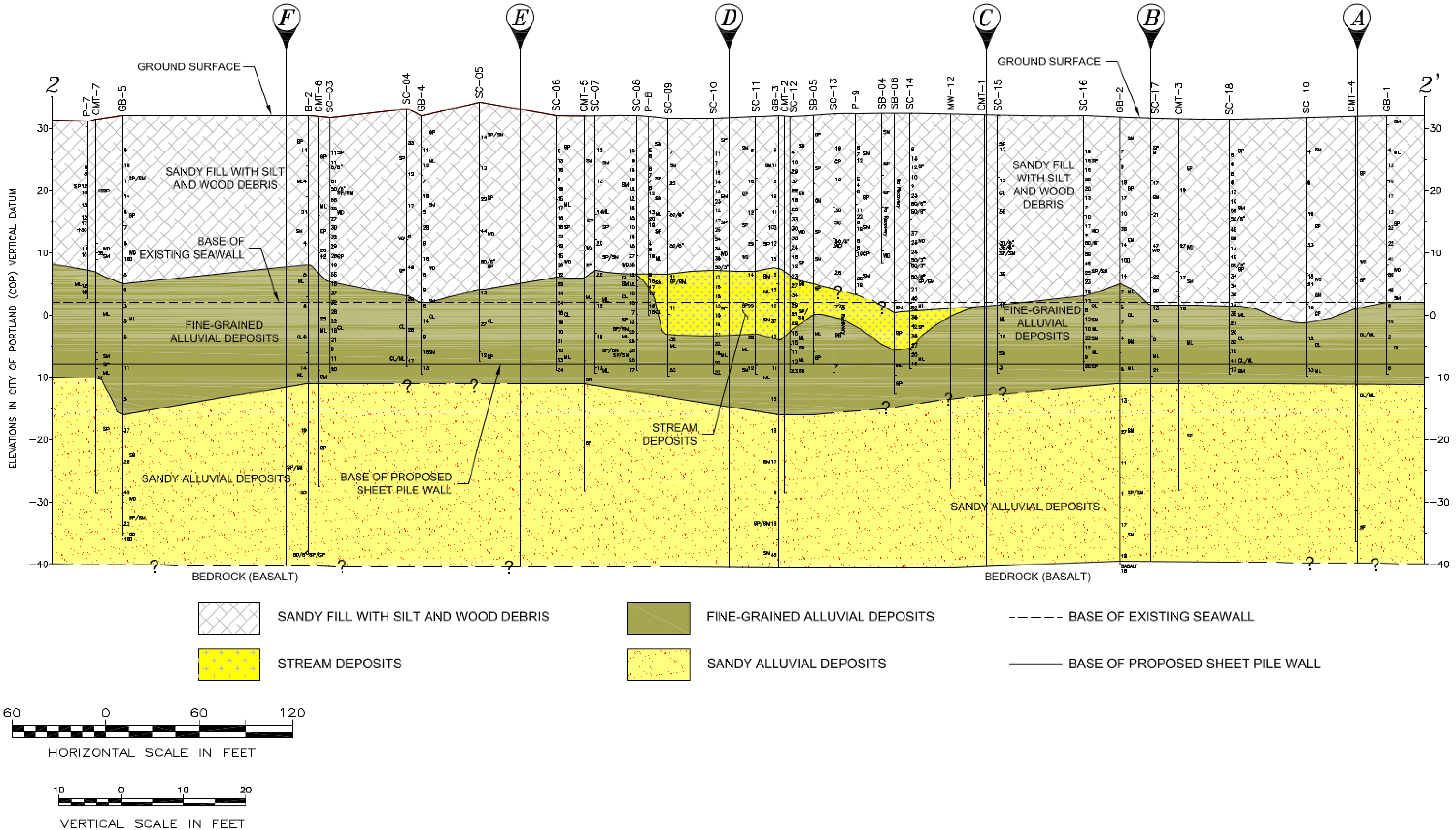
REV: A

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Plot of Field SPT(N) Values Along Geologic Profile 2-2'

DRAWING NUMBER: Figure 2.8
CAD FILE NUMBER:
SHEET: 1 OF 1
REV. A

# Appendix C

Risk Assessment

# CRITICAL SYSTEMS RISK ASSESSMENT

| | |
|---|---|
| **Purpose:** | To identify and prioritize critical structures, equipment, tanks, and systems and the performance requirements during and following an earthquake with regards to prevention and containment of oil spills. |
| **Scope:** | This study will address all facility components covered by the Rules. |
| **Boundaries:** | The team will consider possible scenarios due to earthquakes that may realistically occur and result in an uncontained spill, uncontrolled fire, explosion, or toxic release at the terminal.<br><br>The following items will be excluded from the scope of this study:<br>• Failures due to non-earthquake related causes<br>• Life-safety considerations that are not directly caused by a spill that occurs due to an earthquake (e.g. life-safety concerns from occupants of a building that collapses) |
| **Process:** | ***Before the Risk Assessment Session***<br>• Prepare the charter for the risk assessment.<br>• Prepare a draft assessment based on known industry and terminal practice and knowledge of this specific terminal gained through review of terminal documentation<br>• SGH engineers will perform a structural "walkdown" review of the facility<br>• SGH will prepopulate the risk matrix based on the walkdown review, preliminary geotechnical review, and other factors<br>***During the Risk Assessment Session***<br>• Review the risk assessment process and techniques to be used.<br>• Present an overview of the risk assessment matrix.<br>• Review the pre-developed list of systems and components |

| | |
|---|---|
| | • Identify additional systems and components<br>• For each physical area of the terminal, identify the following:<br>  ◦ Key components or systems that require documentation according to the Rules<br>  ◦ Which components or systems contain hydrocarbons covered by the rules where spill is a concern<br>  ◦ Safety systems that are being relied on for mitigation or response following an earthquake as related to the scope of the Rules<br>• For each critical system, identify key components of that system and for each component perform the following:<br>  ◦ Identify the possible nature of earthquake performance as related to the Rules (e.g. collapse, damage resulting in spill, functional failure)<br>  ◦ Identify the **likelihood** of possible failure / unacceptable performance, consistent with the risk matrix, based on known properties of the system and visual reviews. (Note: this is subject to revision based on more detailed evaluation or additional data)<br>  ◦ Identify the **severity** of possible safety or environmental consequences, consistent with the risk matrix<br>  ◦ Assign a risk level consistent with the risk matrix<br>• Document team findings<br>***After the Risk Assessment Session***<br>• Update the findings of the risk assessment as appropriate based on further evaluation or additional data<br>• Use the risk assessment results as needed in development of the facilities mitigation plan, as required by the Rules |

# Risk Assessment Matrix - Environmental

| SEVERITY | Environmental Consequences | 1 Very Unlikely | 2 Unlikely | 3 Possible | 4 Likely | 5 Very Likely |
|---|---|---|---|---|---|---|
| A | No release. | A1 | A2 | A3 | A4 | A5 |
| B | Release within secondary containment and no offsite impact. | B1 | B2 | B3 | B4 | B5 |
| C | Release exceeds secondary containment, but no offsite impact. | C1 | C2 | C3 | C4 | C5 |
| D | Minor offsite release. | D1 | D2 | D3 | D4 | D5 |
| E | Major offsite release. | E1 | E2 | E3 | E4 | E5 |

LIKELIHOOD: columns 1–5.

High Risk -- Mitigations to be considered using ALARP (As Low as Reasonably Practicable)
Moderate Risk -- Further evaluation recommended to determine if mitigation is necessary
Low Risk -- No mitigations recommended

| | |
|---|---|
| Very Unlikely | Designed to recent standards / No significant, obvious, spill-related deficiencies |
| Unlikely | Not designed to recent standards / **No** specific deficiencies that could lead to spill in **large** earthquakes |
| Possible | Not designed to recent standards / Has **potential** deficiencies that could lead to spill in **large** earthquakes |
| Likely | **Major** deficiencies present that would likely lead to spill in **large** earthquakes |
| Very Likely | **Major** deficiencies present that could lead to spill in **low or moderate** earthquakes |

# Risk Assessment Matrix - Life Safety

**LIKELIHOOD**

| **SEVERITY** | Life-Safety Consequences | 1 Very Unlikely | 2 Unlikely | 3 Possible | 4 Likely | 5 Very Likely |
|---|---|---|---|---|---|---|
| A | Minor / First Aid Injury<br>No Impact on Public | **A1** | **A2** | **A3** | **A4** | **A5** |
| B | Injury With Medical Treatment<br>No Impact on Public | **B1** | **B2** | **B3** | **B4** | **B5** |
| C | Serious Injury / Partial Disability<br>Limited Impact on Public | **C1** | **C2** | **C3** | **C4** | **C5** |
| D | Single Fatality / Serious Injury<br>Impact on Public | **D1** | **D2** | **D3** | **D4** | **D5** |
| E | Multiple Fatalities / Serious Injuries<br>Significant Impact on Public | **E1** | **E2** | **E3** | **E4** | **E5** |

High Risk -- Mitigations to be considered using ALARP (As Low as Reasonably Practicable)
Moderate Risk -- Further evaluation recommended to determine if mitigation is necessary
Low Risk -- No mitigations recommended

| | |
|---|---|
| Very Unlikely | Designed to recent standards / No significant, obvious, spill-related, life-safety deficiencies |
| Unlikely | Not designed to recent standards / **No** specific deficiencies that could lead to spill-related, life-safety concerns in **large** earthquakes |
| Possible | Not designed to recent standards / Has **potential** deficiencies that could lead to spill-related, life-safety concerns in **large** earthquakes |
| Likely | **Major** deficiencies present that would likely lead to spill-related, life-safety concerns in **large** earthquakes |
| Very Likely | **Major** deficiencies present that could lead to spill-related, life-safety concerns in **low or moderate** earthquakes |

# Risk Assessment Report

**Date:**
April 8, 2024

**Location:**
Virtual

**Attendees:**

**Attendees:**

Gayle S. Johnson, P.E., SGH, Senior Principal (Facilitator)
Julie A. Galbraith, P.E., SGH, Senior Project Manager
Luis H. Palacios, P.E., SGH, Senior Technical Manager
Justin D. Reynolds, P.E., SGH, Senior Project Manager
Jun O. Tucay, P.E., S.E., SGH, Senior Consulting Engineer
Wesley Steffy, TMS, Project Engineer
Brian Hoyman, TMS, Terminal Manager
Vivian Rupe, TMS, Administrative Assistant

| Location | Item Type | Identification | Contents | Out of Service? | Risk Assessment Rankings: Likelihood WITHOUT Soil Displacements | Severity: Environmental | Severity: Safety | Risk Score | Likelihood WITH Soil Displacements | Risk Score | Item or Score Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **North Tank Farm** | | | | | | | | | | | |
| North Tank Farm | Tank | 1 | Flammable Fuel | | 3. Possible | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C3 | 3. Possible | C3 | flammability increases severity |
| | Tank | 2 | Groundwater Remediation | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | |
| | Tank | 3 | Combustible Fuel | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | |
| | Tank | 4 | Flammable Fuel | | 2. Unlikely | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C2 | 2. Unlikely | C2 | flammability increases severity |
| | Tank | 5 | Flammable Fuel | | 3. Possible | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C3 | 3. Possible | C3 | piping constrained |
| | Tank | 6 | Flammable Fuel | | 3. Possible | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C3 | 3. Possible | C3 | piping constrained |
| | Tank | 7 | Flammable Fuel | | 2. Unlikely | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C2 | 2. Unlikely | C2 | flammability increases severity |
| | Tank | 8 | Flammable Fuel | | 3. Possible | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C3 | 3. Possible | C3 | piping constrained |
| | Tank | 11 | Flammable Fuel | | 3. Possible | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C3 | 3. Possible | C3 | piping constrained |
| | Tank | 12 | Non-Combustible Petroleum | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | |
| | Tank | 13 | Non-Combustible Petroleum | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | |
| | Tank | 24 | Non-Combustible Petroleum | | 5. Very Likely | B. Release within secondary containment | B. Injury With Medical Treatment | B5 | 5. Very Likely | B5 | |
| | Tank | 25 | Non-Combustible Petroleum | | 5. Very Likely | B. Release within secondary containment | B. Injury With Medical Treatment | B5 | 5. Very Likely | B5 | |
| | | Total | | | | | | | | | |
| | Piping | Flammable Fuels | | | 3. Possible | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C3 | 4. Likely | C4 | |
| | Piping | Non-flammable fuels | | | 3. Possible | B. Release within secondary containment | B. Injury With Medical Treatment | B3 | 4. Likely | B4 | |
| | Process Eqiupment | Truck Loading Rack Manifold | | | 1. Very Unlikely | B. Release within secondary containment | A. Minor / First Aid Injury | B1 | 1. Very Unlikely | B1 | |
| | Fire Suppresion System | Tank Foam (x2) | | | 5. Very Likely | A. No Release | E. Multiple Fatalities | E5 | 3. Possible | E3 | Relies on municipal water |
| | Secondary Containment Walls | | | | 3. Possible | E. Major offsite release | C. Serious Injury / Limited Impact on Public | E3 | 4. Likely | E4 | |
| **South Tank Farm** | | | | | | | | | | | |
| South Tank Farm | Tank | 9 | Combustible Fuel | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | |
| | Tank | 10 | Combustible Fuel | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | |
| | Tank | 14 | Combustible Fuel | | 3. Possible | B. Release within secondary containment | B. Injury With Medical Treatment | B3 | 3. Possible | B3 | |
| | Tank | 15 | Combustible Fuel | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | |
| | Tank | 17 | Combustible Fuel | | 3. Possible | B. Release within secondary containment | B. Injury With Medical Treatment | B3 | 3. Possible | B3 | |
| | Tank | 18 | Combustible Fuel | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | |
| | Tank | 19 | Flammable Fuel (Process Water) | | 2. Unlikely | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C2 | 2. Unlikely | C2 | flammability increases severity |
| | Tank | 21 | Non-Combustible Petroleum | | 3. Possible | B. Release within secondary containment | B. Injury With Medical Treatment | B3 | 3. Possible | B3 | |
| | Tank | Red Dye Tote Tank | Non-Combustible Petroleum | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | |
| | | Total | | | | | | | | | |
| | Piping | Flammable Fuels | | | 3. Possible | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C3 | 4. Likely | C4 | |
| | Piping | Non-flammable fuels | | | 3. Possible | B. Release within secondary containment | B. Injury With Medical Treatment | B3 | 4. Likely | B4 | |
| | Secondary Containment Walls | | | | 3. Possible | E. Major offsite release | B. Injury With Medical Treatment | E3 | 4. Likely | E4 | |

| | | | | | Risk Assessment Rankings | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Severity | | | | | |
| Location | Item Type | Identification | Contents | Out of Service? | Likelihood WITHOUT Soil Displacements | Environmental | Safety | Risk Score | Likelihood WITH Soil Displacements | Risk Score | Item or Score Notes |
| **Biodiesel Tank Farm** | | | | | | | | | | | |
| Biodiesel Tank Farm | Tank | 46 | Combustible Fuel | | 3. Possible | B. Release within secondary containment | B. Injury With Medical Treatment | B3 | 3. Possible | B3 | |
| | Tank | 40 | Non-Combustible Petroleum | Yes | 2. Unlikely | A. No Release | A. Minor / First Aid Injury | A2 | 2. Unlikely | A2 | Out of Service |
| | Tank | 41 | Non-Combustible Petroleum | Yes | 2. Unlikely | A. No Release | A. Minor / First Aid Injury | A2 | 2. Unlikely | A2 | Out of Service |
| | Tank | 42 | Non-Combustible Petroleum | Yes | 2. Unlikely | A. No Release | A. Minor / First Aid Injury | A2 | 2. Unlikely | A2 | Out of Service |
| | Tank | 43 | Flammable Fuel (Process Water) | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | flammability increases severity |
| | Tank | 44 | Flammable Fuel (Process Water) | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | flammability increases severity |
| | Tank | 45 | Non-Combustible Petroleum | Yes | 2. Unlikely | A. No Release | A. Minor / First Aid Injury | A2 | 2. Unlikely | A2 | Out of Service |
| | | Total | | | | | | | | | |
| | Piping | Flammable Fuels | | | 3. Possible | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C3 | 4. Likely | C4 | |
| | Piping | Non-flammable fuels | | | 3. Possible | B. Release within secondary containment | B. Injury With Medical Treatment | B3 | 4. Likely | B4 | |
| | Secondary Containment Walls | | | | 3. Possible | E. Major offsite release | B. Injury With Medical Treatment | E3 | 4. Likely | E4 | |
| **Butane Area** | | | | | | | | | | | |
| | Tank | 101 | Flammable Fuel | | 1. Very Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B1 | 1. Very Unlikely | B1 | |
| | Piping | Flammable Fuels | | | 3. Possible | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C3 | 4. Likely | C4 | |
| | Piping | Non-flammable fuels | | | 3. Possible | B. Release within secondary containment | B. Injury With Medical Treatment | B3 | 4. Likely | B4 | |
| **Loading Racks** | | | | | | | | | | | |
| | Tank | 23 | Non-Combustible Petroleum | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | |
| | Tank | 26 | Non-Combustible Petroleum | | 2. Unlikely | B. Release within secondary containment | B. Injury With Medical Treatment | B2 | 2. Unlikely | B2 | |
| | Loading Rack Structure | Truck Loading Rack | | | 2. Unlikely | B. Release within secondary containment | A. Minor / First Aid Injury | B2 | 3. Possible | B3 | |
| | Underground Vault | Pipeline Vault | | | 2. Unlikely | B. Release within secondary containment | A. Minor / First Aid Injury | B2 | 3. Possible | B3 | |
| | Loading Rack Structure | Rail Loading Rack | | | 2. Unlikely | B. Release within secondary containment | A. Minor / First Aid Injury | B2 | 3. Possible | B3 | |
| | Piping | Flammable Fuels | | | 3. Possible | B. Release within secondary containment | C. Serious Injury / Limited Impact on Public | C3 | 4. Likely | C4 | |
| | Piping | Non-flammable fuels | | | 3. Possible | B. Release within secondary containment | B. Injury With Medical Treatment | B3 | 4. Likely | B4 | |
| **Dock Area** | | | | | | | | | | | |
| | Marine Structure | Dock | | | 3. Possible | E. Major offsite release | B. Injury With Medical Treatment | E3 | 4. Likely | E4 | |
| | Building | Dock House | | | 2. Unlikely | A. No Release | B. Injury With Medical Treatment | B2 | 4. Likely | B4 | |
| | Piping | Flammable Fuels | | | 3. Possible | E. Major offsite release | C. Serious Injury / Limited Impact on Public | E3 | 4. Likely | E4 | |
| | Piping | Non-flammable fuels | | | 3. Possible | E. Major offsite release | B. Injury With Medical Treatment | E3 | 4. Likely | E4 | |
| | Marine Structure | Boat House | | | 2. Unlikely | A. No Release | A. Minor / First Aid Injury | A2 | 2. Unlikely | A2 | |
| | Process Equipment | Oil Water Separator | | | 2. Unlikely | E. Major offsite release | C. Serious Injury / Limited Impact on Public | E2 | 4. Likely | E4 | |

Critical Systems Risk Assessment
May 2024


| | | | | | Risk Assessment Rankings | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Severity | | | | | |
| Location | Item Type | Identification | Contents | Out of Service? | Likelihood WITHOUT Soil Displacements | Environmental | Safety | Risk Score | Likelihood WITH Soil Displacements | Risk Score | Item or Score Notes |
| **Other Buildings/Structures (not in yards)** | | | | | | | | | | | |
| | Process Equipment | Storm Water Separator | | | 2. Unlikely | E. Major offsite release | C. Serious Injury / Limited Impact on Public | E2 | 4. Likely | E4 | |
| | | | | | | | | | | | |
| | Building | Guardshack | | | 2. Unlikely | A. No Release | A. Minor / First Aid Injury | A2 | 3. Possible | A3 | |
| | Building | Truck Shop | | | 2. Unlikely | A. No Release | A. Minor / First Aid Injury | A2 | 3. Possible | A3 | |
| | Building | Boiler House | | | 2. Unlikely | A. No Release | A. Minor / First Aid Injury | A2 | 3. Possible | A3 | |
| | Building | Office | | | 2. Unlikely | A. No Release | A. Minor / First Aid Injury | A2 | 3. Possible | A3 | |
| | Building | SIMOPS | | | 2. Unlikely | A. No Release | A. Minor / First Aid Injury | A2 | 3. Possible | A3 | |
| | Building | Storage | | | 2. Unlikely | A. No Release | A. Minor / First Aid Injury | A2 | 3. Possible | A3 | |
| | Building | Warehouse | | | | | | | | | |
| | Building | QAQC | | | 2. Unlikely | A. No Release | A. Minor / First Aid Injury | A2 | 3. Possible | A3 | |
| | | | | | | | | | | | |
| **Overall Terminal** | | | | | | | | | | | |
| | Emergency Response | Operator Staffing | | | 1. Very Unlikely | A. No Release | A. Minor / First Aid Injury | A1 | 1. Very Unlikely | A1 | 24/7 Coverage |
| | Emergency Response | Power | | | 3. Possible | A. No Release | B. Injury With Medical Treatment | B3 | 3. Possible | B3 | Power needed for lighting and ESD. Diesel booster pump still works |
| | | | | | | | | | | | |
| | Fire System | Water Main | | | 5. Very Likely | A. No Release | D. Single Fatality / Impact on Public | D5 | 5. Very Likely | D5 | Water main needed for firewater and foam |
| | Fire System | Foam System | | | 5. Very Likely | A. No Release | D. Single Fatality / Impact on Public | D5 | 5. Very Likely | D5 | Relies on municipal water |
| | Fire System | Fire Pump | | | 2. Unlikely | A. No Release | D. Single Fatality / Impact on Public | D2 | 2. Unlikely | D2 | Can run only on diesel booster pump but relies on municipal water |
| | Fire System | Deluge System | | | 5. Very Likely | A. No Release | D. Single Fatality / Impact on Public | D5 | 5. Very Likely | D5 | Relies on municipal water |
| | | | | | | | | | | | |
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