Chapter 4

Crude Oil Safety Considerations, Potential Release Scenarios, and Impact Analysis

4.1 INTRODUCTION

The proposed Facility would be part of a crude oil delivery system comprising crude oil unit train deliveries, transloading of crude oil to onsite storage tanks, reloading of crude oil to vessels, and vessel transport to refineries along the US West Coast. Minor drips and leaks that would be expected to occur during normal system operations are addressed in Chapter 3. Larger uncontained crude oil releases that create environmental effects associated with the spread of crude oil on land, water, vegetation, and biota are addressed in this chapter. Depending on the composition and volatility of the crude oil being transshipped, crude oil releases could also result in fire and/or explosion.

Crude oil releases can result from a number of factors. These factors may act singly or in combination to create a condition that leads to a crude oil release, and they may represent risk to one or more elements of the crude oil transshipment system. Factors that could lead to a crude oil release include:

- Equipment malfunction or failure;
- Human error or fatigue;
- Terrorism, sabotage, or vandalism;
- Powerful natural forces (e.g., earthquakes, floods, storms, landslides, mudslides, ground settlement)
- Metallic corrosion and/or fatigue; and
- Navigational error and/or loss of power.

These factors acting singly or in combination could lead to one or more events resulting in a crude oil release, including:

- Pipeline, storage tank, or containment leak or rupture;
- Unloading and/or loading line rupture or failure;
- Automatic or manual valve failure;
- Train derailment and tank car rupture;
- Train collision with vehicular or other train traffic; and
- Vessel collision, allision (an event in which a moving object strikes a stationary object), or grounding.

This chapter addresses:

- System safety considerations to reduce the likelihood of a crude oil release;
- Existing and proposed system crude oil spill, fire, and explosion prevention and response plans;

- Estimates of potential spill sizes throughout the system, and statistical analyses of rail and vessel spill frequencies;
- physical, temporal, and environmental factors affecting a crude oil spill;
- Crude oil spill, fire, and explosion response; and
- Resource-specific impacts from accidental crude oil spills, fires, and explosions.

4.2 PROPOSED FACILITY, RAIL, AND VESSEL (SYSTEM) SAFETY CONSIDERATIONS

This section describes the federal, state, and local regulatory framework for crude oil spill prevention and response planning and relevant industry safety standards. A discussion of the prevention and response plans established to meet these regulations is provided in Section 4.3.

4.2.1 Crude Oil Handling Regulations Applicable to the Proposed Facility

4.2.1.1 Federal Regulations

The Oil Pollution Act of 1990 (OPA 90) expanded the Clean Water Act (CWA) existing liability provisions and became the first comprehensive law to specifically address the prevention, response, and associated liabilities for oil pollution of waterways and coastlines of the United States. OPA 90 also expanded the National Contingency Plan (NCP), which provides a framework for federal, state, and local collaboration in response to releases of hazardous substances regardless of the source, and outlines funding mechanisms for cost of cleanup through regional response plans.

The US Environmental Protection Agency (EPA) is the lead federal response agency for oil spills occurring in inland waters, and the US Coast Guard (USCG) is the lead response agency for spills in coastal waters and deepwater ports (EPA 2015a). Table 4-1 provides a summary of the federal spill prevention, preparedness, and response requirements applicable to proposed Facility operation and notes the regulatory authority.

Table 4-1. Federal Regulations Applicable to Crude Oil Handling at the Proposed Facility

Regulatory Requirement	Regulatory Authority	Application to the Proposed Facility and Operations
SPCC Plan	EPA *Oil Pollution Prevention* 40 CFR 112	Applies to proposed Facility construction and operation. To comply, a construction SPCC Plan and operations SPCC Plan would be prepared to describe secondary containment and preparedness measures to prevent the discharge of oil to surface water.
Facility Response Plan	EPA *Response Requirements* 40 CFR 112 Subpart D	To comply, the Applicant would develop contingency response plans for potential spill scenarios at the proposed Facility and implement associated training and drills.
Emergency planning and "community right-to-know" reporting	EPA *Emergency Planning and Community Right-to-Know Act* 40 CFR 350-72	The Applicant would determine the quantities of extremely hazardous substances stored onsite in relationship to the corresponding threshold planning quantities and would initiate applicable planning and reporting activities.

Table 4-1. Federal Regulations Applicable to Crude Oil Handling at the Proposed Facility

Regulatory Requirement	Regulatory Authority	Application to the Proposed Facility and Operations
Operations manual Response plans Equipment, operations, control system standards	USCG *Facilities Transferring Oil or Other Hazardous Materials in Bulk* 33 CFR 154	Requires the proposed Facility to have an agency-approved operations manual and response plans, and to adhere to equipment, operations, and control system standards.
Vessel Response Plan Vessel transfer, discharge, and cleanup requirements	USCG *Oil Or Hazardous Material Pollution Prevention Regulations For Vessels* 33 CFR 155	Vessels transporting crude oil from the proposed Facility would need an agency-approved spill response plan and must adhere to operations requirements.
Material transfer and lightering operation standards	USCG *Oil and Hazardous Material Transfer Operations* 33 CFR 156	Standards apply to any vessel serving the proposed Facility with a capacity of 250 barrels (bbl) or more

bbl = barrels, CFR = Code of Federal Regulations, EPA = US Environmental Protection Agency, SPCC = Spill Prevention, Control, and Countermeasures, USCG = US Coast Guard

4.2.1.2 Washington State and Local Regulations

In Washington State, the Department of Ecology (Ecology) has enforcement and approval authority over plans proposed by the Applicant to comply with state environmental standards. State regulations cover proposed Facility operations, including facility design and operation, personnel training and certification, prevention planning, security planning, and emergency and spill response planning (Washington Administrative Code [WAC] 173-180 and WAC 173-182).

All operations within the City of Vancouver (City) must be in compliance with the Vancouver Municipal Code (VMC). VMC 14.26 protects water resources in the City by establishing development regulations and minimum standards to reduce the risk of contaminants entering water resources. The City prohibits the discharge of contaminants to water resources and requires certain operations to use best management practices (BMPs). The City regulations also require the immediate containment and abatement of all released hazardous materials and proper recycling or disposal. The City has adopted BMPs from Ecology’s 2005 Stormwater Management Manual for the prevention and control of oil spills and leaks.

The Model Toxics Control Act ([MTCA] WAC 173-340) would control the cleanup requirements of a crude oil spill and residual effects from response activities (e.g., recontouring surfaces to remove response berms and trenches). Under recently passed state legislation (Engrossed Substitute House Bill [ESHB] 1449), the liability for oil spill costs and damages is unlimited. The proposed Facility would need to demonstrate the financial ability to compensate the state and local governments for damages arising from a worst-case spill, including oil spill removal costs, natural resource damages, and related expenses. Financial responsibility must be demonstrated to Ecology by providing evidence of insurance or surety bonding.

Washington’s Energy Facility Site Evaluation Council’s (EFSEC’s) governing statutes and rules preempt all aspects of certification and regulation of energy facilities approved under Revised Code of Washington (RCW) 80.50 (RCW 80.50.110 and RCW 80.50.120). As a result, at the discretion of EFSEC, otherwise applicable state and local regulatory permits, requirements, and standards may not be required of facilities issued Site Certification Agreements. EFSEC however does have the authority to require facility compliance with any state standard including those for facility operations and liability for spill costs and damages, for which other state agencies normally have enforcement and approval authority.

4.2.2 Regulations for Transportation of Crude Oil by Rail

The federal Surface Transportation Board has broad regulatory oversight of railroads, and the Federal Railroad Administration's (FRA's) Office of Railroad Safety has responsibility for all aspects of railroad safety, including the transportation of hazardous materials. Both agencies are included within the US Department of Transportation (DOT). Additionally, the Pipeline and Hazardous Material Safety Administration (PHMSA) has a responsibility to protect people and the environment from the risks of hazardous materials transportation, including transportation by rail. Finally, the National Transportation Safety Board (NTSB) investigates significant hazardous material transportation accidents and develops factual records and safety recommendations with the aim of ensuring that such accidents do not recur.

The federal requirements for the transportation of hazardous material by rail address track safety, grade crossings, rail equipment (including design of railcars), and operating practices. While safe operation and safety inspection is the primary responsibility of the railroad companies, the FRA has trained about 400 federal safety inspectors nationwide (FRA 2014, Ecology 2015a). The Washington Utilities and Transportation Commission (UTC) contributes inspectors to the FRA's rail safety inspection teams. In light of recent rail incidents involving crude oil, emphasis has been placed on increased planning and safety to decrease the risk of rail accidents. These efforts focus on improvements to safe rail operations, the proper classification of hazardous materials, rail safety communications and alerts, operational classification improvements, and design improvements to increase tank car survivability (PHMSA 2014a). Each railroad company's comprehensive spill plan must be approved by the FRA before it can transport more than 1,000 barrels (bbl) of oil (49 Code of Federal Regulations [CFR] Part 130A).

On May 7, 2014, DOT issued an emergency order pursuant to 49 US Code (USC) 5121 that all railroad carriers must provide certain information (e.g., volume and type of crude oil being shipped) in writing to each state Emergency Response Commission through which the railroad carrier operates trains transporting a million gallons or more of Bakken crude oil (FRA 2015a). This requirement was designed to enhance emergency response in the event of an accident that results in a release of crude oil.

On May 1, 2015, PHMSA, in coordination with the FRA, issued its final rule for trains with a continuous block of 20 or more tank cars transporting a flammable liquid, or 35 or more tank cars transporting a flammable liquid dispersed through a train. These trains are considered "high-hazard flammable trains" (HHFTs). The rule establishes a timetable for phased implementation of its requirements, including enhanced braking systems, enhanced standards for new and existing tank cars, location-based operating speed reduction, sampling and testing programs for transported product classification, and risk assessments for proposed rail routes. The new rule ensures that "railroads notify State and/or regional fusion centers, and that State, local and tribal officials who contact a railroad to discuss routing decisions are provided appropriate contact information for the railroad to request information related to the routing of hazardous materials through their jurisdictions" (FRA 2015b).[1]

As of December 2014, Bakken crude oil originating in North Dakota must be preconditioned before it can be transported by rail (North Dakota Industrial Council [NDIC] 2014). Shippers must implement conditioning methods intended to strip lighter hydrocarbons from crude oil to reduce volatility. The regulation also prohibits blending of crude oil with liquids recovered from gas pipelines or with natural

1 Fusion centers are designed to promote information sharing at the federal level between agencies such as the Central Intelligence Agency (CIA), Federal Bureau of Investigation (FBI), US Department of Justice, US military, and state- and local-level government.

gas liquids (NGLs) prior to custody transfer and requires rail facilities to notify NDIC of any crude oil tendered for shipment in violation of federal crude oil safety standards.

Washington's UTC has jurisdiction over key safety areas not preempted by federal law, including railroad-highway crossings, public crossing safety, railroad employee safety, citizen complaint responses, and technical assistance (Ecology 2015a). Washington recently completed a comprehensive Marine and Rail Oil Transportation Study, which includes 11 recommended measures to mitigate the risk of transporting crude oil by rail. These recommendations address safe rail transport, derailment prevention, personnel training, rail inspections on private properties, at-risk crossings, at-grade crossings, private crossings, railcar placarding, rail incident databases, and the establishment of a state railroad safety committee.

Washington state now requires that facilities provide Ecology a week's advance notice of crude oil rail shipments, including shipment route, schedule, location, volume, gravity, and originating region.[2] In addition, railroads that transport oil through Washington State must submit oil spill contingency plans and demonstrate their ability to pay for a worst-case spill response. Ecology is now required to submit to the state legislature a review of Geographic Response Plans (GRPs) that have been completed under federal and state contingency planning requirements.

4.2.3 Regulations for Transportation of Crude Oil by Vessel

Crude oil transportation vessel regulations are primarily based on the CWA as amended by the OPA 90. A crude oil tanker must submit a Vessel Response Plan (VRP) to the USCG and receive approval of the plan before it can handle, store, or transport crude oil. Response plans must identify the resources necessary to respond to the oil spill scenarios described in the regulations (33 CFR 155 Subpart D). The development of a response plan prepares the vessel owner, operator, and crew to effectively respond to an oil spill, including an accidental release of the vessel's entire cargo.

All vessels carrying crude oil must meet federal double-hull standards. Single-hull vessels are not allowed to carry bulk or residue crude oil cargo on waters of the United States. Therefore, all cargo vessels that would call at the proposed Facility would be double hulled. Double hulling has the effect of reducing the risk of oil spills resulting from vessel collision, allision, or grounding.

The USCG oversees and tests vessel spill response programs and shore-based vessel loading facilities. At the state level, Ecology and the Oregon Department of Environmental Quality (ODEQ) are tasked with preventing and responding to spills in cooperation with federal agencies. Ecology is responsible for vessel inspections, investigation of marine casualties, enforcement of state maritime standards, and approving vessel spill plans.

Additionally, Washington and Oregon laws have instituted financial liability to owners for operation of vessels carrying crude oil. Operators of vessels carrying crude oil from the proposed Facility and the owner of the crude oil would be strictly liable for any damage and the cleanup in the event of a spill and would be required to maintain adequate financial resources (including insurance) to respond to a potential oil spill regardless of fault. These liabilities create significant financial incentives for compliance with all required and any self-imposed risk mitigation measures that are available. In addition to civil liability,

2 Engrossed Substitute House Bill (ESHB) 1449, Oil Transportation Safety, was signed by the Washington State governor in May 2015.

there are also significant criminal liabilities. For example, 33 USC 309(c)(1) authorizes imprisonment and up to $25,000 per day fines for oil spills.

Finally, ESHB 1449 requires that Ecology evaluate vessel traffic management and safety within and near the mouth of the Columbia River. A draft evaluation and assessment of vessel traffic management and safety, including tug escort requirements, escort tug capabilities, and best achievable protection, must be submitted to the Washington state legislature by December 15, 2017, with a final report to be completed by June 30, 2018.

4.2.4 Industry Safety Standards

This section provides information on relevant safety-related industry design and operation standards for each segment of the system.

4.2.4.1 The Proposed Facility

Applicable industry design standards for the proposed Facility and other design commitments from the Applicant include, but are not limited to, the following:

- Transfer piping would be constructed consistent with American Standards Testing and Materials (ASTM) A53 or A106.
- Aboveground pipeline segments would be single walled to ensure ease of inspection and maintenance in accordance with the applicable requirements of WAC 173-180-340 and 49 CFR 195.246 through 49 CFR 195.254.
- Pipe segments welded together in the field would be inspected per applicable American Petroleum Institute (API) specifications (API Specification 5L) (API 2008).
- Where road or rail crossings occur, the piping would be housed in underground steel casings or raised aboveground using standard American Railway Engineering and Maintenance-of-Way Association (AREMA) clearances.
- The storage tanks would be constructed using welded carbon steel and erected in the field consistent with API Standard 650.[3] During the construction process, the various elements of the storage tank assembly would be tested according to API standards.
- The storage tanks would be constructed to meet the National Fire Protection Association (NFPA) 30 requirements of WAC 173-18-330 and associated manufacturing standards and would include the necessary measures to prevent tank overfill.
- The storage tank containment area would have a containment capacity at least equal to 110 percent of the API Standard 650 maximum capacity of the largest tank (approximately 375,000 bbl), plus the volume of water from a 24-hour, 100-year storm event.
- Tank inspections would be conducted in accordance with API Standard 653 (titled Tank Inspection, Repair, Alteration, and Reconstruction).

3 API. Requirements for Welded Tanks for Oil Storage. Available online at http://www.api.org/~/media/Files/Publications/Whats%20New/650%20e12%20PA.pdf.

- Boilers would be designed, installed, and operated in accordance with the applicable provisions of the Washington State Department of Labor and Industry Boiler and Unfired Pressure Vessel laws (RCW 70.79) and rules contained within WAC 296-104.

The seismic design of the various aboveground structures and components of the proposed Facility would use applicable codes and standards to protect against failure from ground motion including:

- The upland aboveground facilities, other than the oil storage tanks, would meet the provisions of the International Building Code (IBC) 2012, which incorporates the American Society of Civil Engineers (ASCE) 7-10 standard by reference, and
- The crude oil storage tanks would be designed to the seismic provisions in Annex E of the twelfth edition of API Standard 650, which is aligned with the ASCE 7-10 standard.

At the proposed Facility the liquefaction potential would be managed through ground improvements where crude oil storage and transfer facility elements would be located. These ground improvements are discussed in detail in Section 2.3.2.2.

The proposed Facility would be designed and operated according to federal, state, and local standards for the prevention of fire and explosion hazards, including:

- Fire suppression equipment and systems, including automatic and engineered controls, would be designed to NFPA and API requirements, the more stringent Factory Mutual Global insurance requirements, and state and local regulations.
- Electrical equipment would be designed to meet the conditions in WAC 296-24-95711, which address the requirements for electric equipment and wiring in specific locations based on the properties of flammable vapors, liquids or gases, or combustible dusts or fibers that may be present therein, and the likelihood that a flammable or combustible concentration or quantity is present.
- Storage tank design standards require that vapors in the storage tanks be isolated from possible ignition sources to reduce the potential for fire and explosion (API Standard 650, Welded Tanks for Oil Storage). All seams in the internal floating roof that are exposed to vapors or liquid are required to be vapor-tight (API Standard 650 H.4.3.1). Tanks are required to install systems such as pressure-vacuum and flame arrestor devices to provide protection from external spark (e.g., lightning) and to restrict the movement of air into the tank and volatile fumes out of the tank.

4.2.4.2 Transportation of Crude Oil by Rail

On May 1, 2015, PHMSA and FRA jointly issued new standards for the design and construction of rail tank cars to reduce vulnerability to breaching or failure during derailment (DOT Specification 117). The new standards require increased thickness of the tank shell, the addition of full height protection (head shields) at each end, improved protection for the top fittings and discharge valves, and reconfigured tank vents for automatic reclosing (Figure 4-1). The new standards require tank cars constructed after October 1, 2015, to meet enhanced DOT Specification 117 design or performance criteria for use in an HHFT. Existing tank cars must be retrofitted in accordance with the DOT-prescribed retrofit design or performance standard for use in an HHFT no later than May 1, 2025. Retrofits must be completed based on a prescriptive retrofit schedule depending on existing tank car type and packing group (Table 4-2).

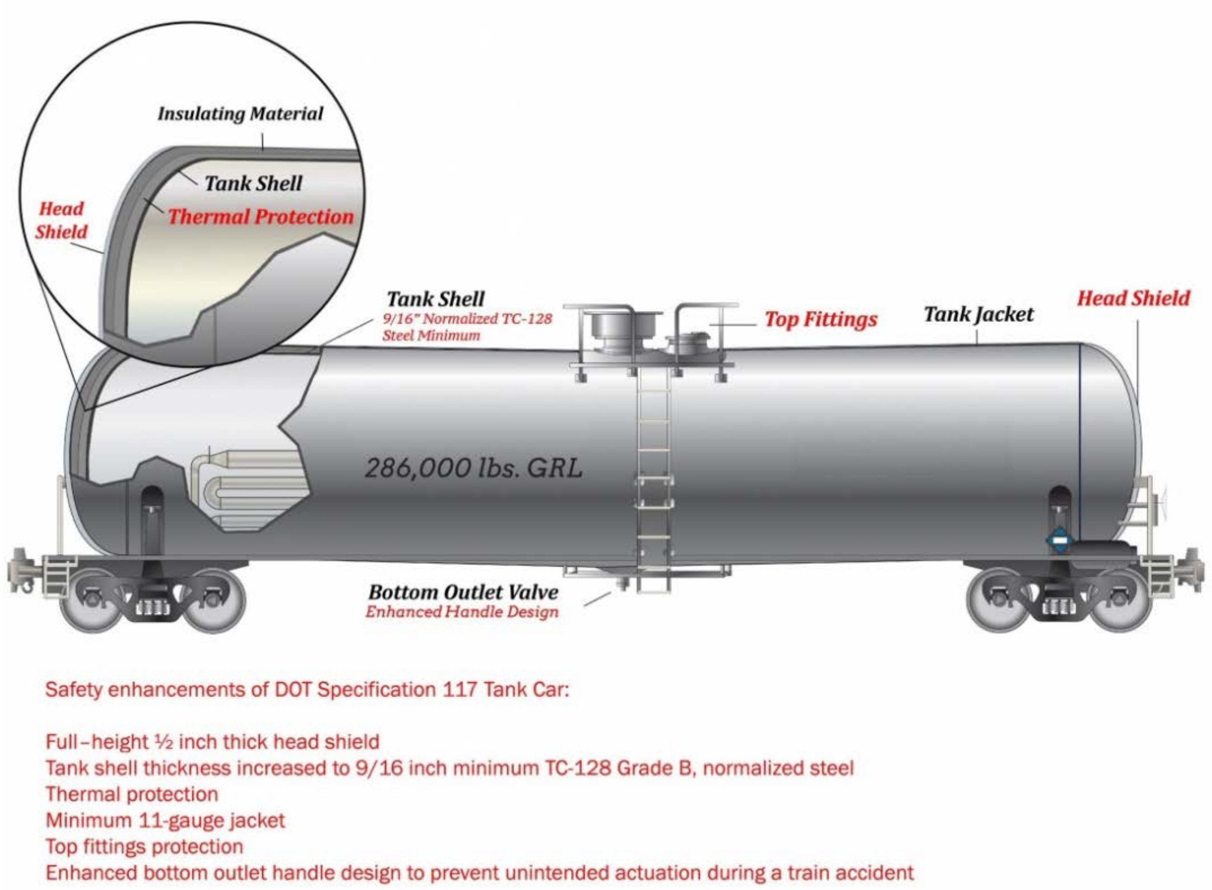


Figure 4-1. DOT Specification 117 Tank Car

Source: DOT 2015

Table 4-2. Timeline to Retrofit Tank Cars for Use in the United States

Tank Car Type/Service	Retrofit Deadline
Non Jacketed DOT-111 tank cars in Packing Group I service[1]	January 1, 2018
Jacketed DOT-111 tank cars in Packing Group I	March 1, 2018
Non Jacketed CPC-1232 tank cars in Packing Group I service	April 1, 2020
Non Jacketed DOT-111 tank cars in Packing Group II service[2]	May 1, 2023
Jacketed DOT-111 tank cars in Packing Group II service	May 1, 2023
Non Jacketed CPC-1232 tank cars in Packing Group II service	July 1, 2023
Jacketed CPC-1232 tank cars in Packing Group I and Packing Group II service and all remaining tank cars carrying Packing Group III[3] materials in an HHFT (pressure relief valve and valve handles).	May 1, 2025

Notes:

1 Packing Group I – High hazard level

2 Packing Group II – Moderate hazard level

3 Packing Group III – Low hazard level

HHFT = high-hazard flammable train

Burlington Northern Santa Fe (BNSF) has voluntarily adopted operating standards beyond federal requirements to improve the safety of transportation of crude oil by rail, including the following:

- Increased frequency of track inspections above FRA requirements on crude oil routes;
- At least two track geometry inspections each year on crude oil routes;
- Increased rail detection testing frequencies along critical waterways (2.5 times FRA requirements);
- Increased use of trackside safety technology;
- Use of additional hot bearing detectors (HBD) on crude oil routes (maximum 40-mile spacing, and 10-mile spacing on crude oil transportation routes that parallel critical waterways);
- Removal of affected car(s) stopped by HBD;
- Removal of affected car(s) in trains with a detected wheel impact load defect;
- Use of Rail Corridor Risk Management System (RCRMS) to determine the most safe and secure routes for crude oil trains of 20 or more loaded cars;
- Nationwide speed restrictions:
  - 50 miles per hour (mph) for all trains with 20 or more crude oil tank cars,
  - 40 mph for crude oil trains with DOT-111 tank cars moving through High Threat Urban Areas (HTUA),
  - 35 mph for all shale crude oil trains through municipalities with populations of 100 thousand people or more;
- Requiring trains experiencing an emergency brake application to undergo an inspection of the entire train before proceeding; and
- Ensuring crude oil trains left unattended have a specific job safety briefing between train crew and train dispatcher, have reverser removed, and locomotive cab doors locked.

In addition to these operating standards, BNSF provides emergency response training and community outreach including:

- Specialized Crude by Rail First Responder training at the Association of American Railroads Transportation Technology Center Inc. (TTCI) in Pueblo, Colorado;
- Tuition reimbursements to train emergency responders at TTCI; and
- A near real-time geographic information system (GIS)–based tracking application (SECURETRAK) that allows federal, regional, state, and local emergency responders to access crude oil unit train locations.

On January 15, 2010, the FRA published the final rule on Positive Train Control (PTC) requirements as part of the Rail Safety Improvement Act of 2008. PTC refers to train control technology systems developed by railway carriers to prevent train-to-train collisions, overspeed derailments, incursions into established work zone limits, and the movement of a train through a mainline switch in the improper position. PTC must be implemented across Class 1 railroad mainlines that handle any poisonous-inhalation-hazardous materials and any railroad mainlines over which regularly scheduled intercity passenger or commuter rail services are provided by December 31, 2015.

BNSF has developed a global positioning system (GPS)- and communications-based PTC system called the Electronic Train Management System, which has been Type Approved and Certified by FRA for restricted use (FRA 2015c). While BNSF has reportedly spent $1.5 million in testing, development, and installation of the PTC components, the railroad has indicated that it would not likely meet the December 31, 2015, deadline (Black 2015). Lawmakers in the US House and Senate have reached an agreement to extend the deadline for 3 years to require having PTC operational by the end of 2018 as part of a highway funding bill, which is known as the Surface Transportation Reauthorization and Reform Act of 2015 (H.R. 3763).

4.2.4.3 Transportation of Crude Oil by Vessel

A discussion of vessel operations in the Columbia River is provided in Section 2.7. The proposed Facility would implement BMPs for both terminal and vessel operations adhering to the standards of care established for the Lower Columbia River and Washington State for terminals handling crude oil. The proposed Facility would use the Tesoro Maritime proprietary vetting process for all vessels that would call at the marine terminal. This system, Tesoro Assessment and Ship Clearance, would be used to review and evaluate the vessel, vessel systems, management, company, and vessel crews to ensure all safety and environmental standards are met. Vessels would employ state-licensed pilots for vessel transits in the Lower Columbia Region. Loaded vessels would not be allowed to depart the terminal unless there is an unrestricted pathway to sea, and no vessels would be allowed to anchor in the river. Additionally, river pilots would use the LOADMAX River Level Forecasting Model and TV32 with the support of the Volpe Center and the US Army Corps of Engineers (USACE). TV32 is a Vessel Traffic Information System that was jointly developed by the Columbia River Pilots (COLRIP), the Columbia River Steamship Operators Association (CRSOA), and the DOT’s Volpe National Transportation Systems Center.

4.3 ACCIDENT PREVENTION AND RESPONSE PLANS

This section describes the crude oil accident prevention and response plans to contain and minimize damage to human health and the environment. Accidents resulting in spills can happen on land or in water, at any time of day or night, and in any weather condition. Volatile vapors from a spill can create a flammable atmosphere and explosion hazards. Preventing oil spills is the best strategy for avoiding potential damage to human health and the environment. However, if a spill occurs, the best approach for containing and controlling the spill is to respond quickly in a well-organized manner. A response will be most effective and organized if response measures have been planned ahead of time.

Spill prevention plans are designed to prevent accidental releases of crude oil into the environment. They are usually specific to a site or transportation mode. Essential elements of a prevention plan include:

- Regular facility and transportation systems equipment inspection, testing, and maintenance;
- Leak detection systems;
- Automatic and manual emergency shutdown capabilities;
- Maintenance of stable oil condition during storage/transport, including oil temperature and pressure;
- Secondary containment systems for oil-handling elements; and
- Monitoring, management, and operation by qualified and trained personnel.

A contingency plan outlines the actions necessary to ensure a rapid, aggressive, and well-coordinated response to an oil spill. Critical elements of these plans include:

- Notification and callout procedures to ensure response teams and resources are activated immediately;
- Identification of spill management teams necessary to manage a spill or incident response;
- Analysis of the planning standards and worst-case spill volume to assess the necessary response needs;
- Identification of crude oil types and properties that could be involved in a system spill;
- Contracts with primary responders to provide response equipment and personnel necessary to respond; and
- Commitment for drills to test the plan.

Response plans are designed to detail specific response actions for a range of spill scenarios, pre-identify sensitive resources at risk of injury from oil spills, and provide prioritized lists of tactical response strategies.

4.3.1 National Contingency Plan

The National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the NCP, is the federally established blueprint for responding to oil spills and hazardous substance releases in the United States. The NCP was created to provide a national response capability and promote coordination among the hierarchy of responders and contingency plans. The NCP established the federal National Response System (NRS), which can be activated to organize and support response activities. The NRS is made up of a cooperating network of federal, state, and local agencies. The major elements of the NRS are a National Response Team (NRT), Regional Response Teams (RRTs), and designated on-scene coordinators such as Federal On-Scene Coordinators (FOSCs). In addition, the NCP identifies Special Forces organizations with specialized skills and knowledge that can be called on to support a response. Other components of the NRS include the State Emergency Response Commissions, Local Emergency Planning Committees (LEPCs), Area Planning Committees, and the National Response Center (NRC).

The NRT is composed of representatives from 16 federal agencies to collectively provide a range of responsibilities and expertise to effectively respond to various effects of a spill. The NRT is responsible for ensuring that technical, financial, and operational information about responding to oil spills is available, and ensures that the roles of federal agencies on the team are clearly outlined in the NCP so an emergency response may be readily implemented. It also supports RRTs that maintain Regional Contingency Plans (RCPs) to respond to spills. An RRT consists of a standing team made up of representatives of federal agencies, state and local government representatives, and an incident-specific team. RRTs also provide oversight and consistency review for area plans in a given region. The RRTs may provide assistance when it is requested by FOSCs and respond on-scene with technical advice, equipment, or manpower to assist with a response.

FOSCs stationed across the country are federal officials responsible for directing response actions and coordinating all other efforts at the scene of a spill. FOSCs are designated by EPA for inland areas and by USCG for coastal areas. More than 250 EPA and USCG FOSCs are located throughout the United States. When a spill occurs in coastal waters, the local USCG Port Commander is the FOSC. When a spill occurs in an inland area, such as a spill from a pipeline or tank car, a regional EPA official is assigned as the

FOSC. The US Department of Energy and US Department of Defense also have designated FOSCs; however, the USCG and EPA have the greatest responsibility for responding to oil spill emergencies.

Special Forces unique expertise can be called upon to provide special assistance with difficult problems. The NCP designates five special force components:

- USCG National Strike Force
- USCG Public Information Assist Team
- EPA Environmental Response Team
- National Oceanic and Atmospheric Administration's (NOAA's) Scientific Support Coordinators
- National Resource Trustees

Lead agencies have been designated within the NRS to coordinate or direct spill response efforts. All waterways that mark the boundary between two states (e.g., the Columbia and Snake rivers separating portions of Washington and Oregon) are also the joint, shared responsibility of both bordering states. Spills affecting, or with the potential to affect, shared water must be reported to both states and both states will normally participate in the unified response.

4.3.2 Northwest Area Contingency Plan

The NCP also established subregions designated to maintain spill response plans tailored to the region. The Northwest Area Committee (NWAC) made up of regional and area groups in the Northwest accomplishes all regional planning and preparedness activities, and jointly published the Northwest Area Contingency Plan ([NWACP]; RRT and NWAC 2015a) To ensure all impacts of a potential release are understood and addressed, a wide variety of organizations participate in the NWACP's updates, including agencies, tribes, nongovernmental organizations, and industry and response contractors. The NWACP has been adopted as the state's Oil and Hazardous Substance Spill Prevention and Response Plan as required by statute (RCW 90.56.060). It defines roles and responsibilities, and gives a general overview of operational, planning, logistical, and financial considerations critical to a successful response (RRT and NWAC 2015a).

4.3.3 Geographic Response Plans

GRPs are part of the hierarchy of plans that guide responses to oil spills in Washington, Oregon, and Idaho, and are published and maintained separately as annexes to the NWACP. Each GRP is written for a specific area (for example, a river or a lake) and includes tactical response strategies tailored to a particular shore or waterway at risk of injury from oil spill. To date, existing Northwest-area GRPs have been developed in partnership with Ecology, ODEQ, USCG, and EPA. GRPs guide responders in the first 12 to 24 hours of an oil spill by providing prioritized lists of tactical response strategies including booming strategies that could minimize impacts to previously identified sensitive resources. GRPs have two main objectives: (1) to pre-identify sensitive resources at risk of injury from oil spills and (2) to help direct response actions related to sensitive resource protection during the initial hours of a response.

GRPs contain maps and descriptions of natural, cultural, and economic resources, and identify strategies to reduce harm to those resources. These plans include tables that describe the order in which strategies should be implemented based on the sensitivity of different resources and their proximity to locations where oil spills might occur. Along the Project rail corridor, GRPs include: the Spokane River GRP for the section of rail corridor between western Idaho through Marshall, Washington, and the Moses Lake/Crab Creek GRP for a short reach in Adams and Lincoln counties, Washington. The Spokane River

GRP identifies specific response strategy locations along the Spokane River in the Spokane Valley and lower Marshall and Latah creeks on the rail corridor. However, large areas of the inland rail corridor do not have applicable GRPs (i.e., Cheney to Pasco, Washington). The Lower Columbia River GRP specifically addresses response activities in the Lower Columbia River. As addressed in the GRP, the Lower Columbia River includes the portion of the river from Bonneville Dam to the estuary at its mouth, a distance of approximately 145 miles, and the Lower Willamette River from Willamette Falls to its confluence with the Columbia River, a distance of approximately 26 miles. The Lower Columbia portion of the GRP specifically addresses the Project vicinity where the proposed Facility would be located. The GRP would be updated to take into account the presence of the proposed Facility, and additional resources for spill control would be established as determined necessary by local, state, and federal responders, as is the case when other new facilities are established in the Lower Columbia River.

4.3.4 Washington State Emergency Response System

Ecology is designated as the state's lead agency "to oversee prevention, abatement, response, containment, and cleanup efforts with regard to an oil or hazardous substance spill to waters of the state" (Ecology 2015a). Washington State law has established Ecology as the predesignated State On-Scene Coordinator for all oil and hazardous substance spills in state waters. Ecology is also responsible for supporting federal response actions. The State of Washington has devised parallel statutes on water pollution and marine transportation safety that meet, or in some cases exceed, the standards set forth in federal legislation.

The Washington State Emergency Response System is designed to provide coordinated state agency response, in cooperation with federal agencies, for effective cleanup of oil or hazardous substance spills.

- Under the State Emergency Response System, the Washington State Patrol (WSP) assumes responsibility as Incident Commander and acts as the lead state agency responsible for cleanup activities when oil and hazardous substance spills occur on state highways. The WSP also assists local jurisdictions with law enforcement and evacuations and represents local jurisdictions as designated.
- The Incident Commander coordinates and maintains liaison with other state agencies involved with an incident, assists in receiving and disseminating warning information, provides communications and technical support to responders, provides radiological monitoring, provides aerial reconnaissance of the impacted area, coordinates fire resources when an emergency mobilization is authorized for a hazardous substance incident, and provides 24-hour, statewide communications support.
- The Washington Military Department's Emergency Management Division (EMD) maintains capabilities to make 24-hour notifications to Ecology, WSP, and other appropriate local, tribal, state, and federal agencies. The EMD also activates the state Emergency Operations Center when required; coordinates state agency response activities in the Emergency Operations Center, including procurement of state resources, as requested; provides public information officer support to the Joint Information Center or Incident Command Posts; and provides communication links on an ongoing basis. During oil spills, the Washington Department of Fish and Wildlife coordinates activities for the rescue and rehabilitation of wildlife injured during oil and hazardous substance spills and releases, assists in identification of fish and wildlife protection needs, and assists in reconnaissance and Natural Resource Damage Assessment efforts.
- The state Department of Health is responsible for handling environmental spills and releases involving radioactive substances and biological agents. The department assists in determining public health impacts to fish and shellfish harvesting and consumption.

- The state Department of Natural Resources assists in the identification of aquatic habitat/state lands protection needs. The state Department of Archaeology and Historic Preservation assists in the identification of historic/archaeological resource protection needs. The state Parks and Recreation Commission assists in response activities involving state park lands and property.
- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was amended by the Superfund Amendments and Reauthorization Act (SARA) on October 17, 1986. The Washington State Emergency Response Commission was created in accordance with SARA. Title III of SARA, the Emergency Planning and Community Right-to-Know Act, establishes requirements for federal, state, tribal, and local governments and industry regarding emergency response planning and the right to know about hazardous chemicals in a community. The Washington State Emergency Response Commission was established to implement the provisions of the Emergency Planning and Community Right-to-Know Act, designate and oversee LEPCs, and facilitate preparation and implementation of emergency planning and preparedness.

4.3.5 Washington Fire Services Resource Mobilization Plan

The Washington Fire Services Resource Mobilization Plan provides a process to quickly notify, assemble, and deploy fire service personnel and equipment to any local fire jurisdiction in the state that has expended or will expend all available local and mutual aid resources in attempting to manage fires, disasters, or other events that jeopardize the ability of a jurisdiction and/or region to provide for the protection of life or property (Washington State Fire Marshal's Office 2015).

Mutual aid agreements, at a minimum, encompass all adjacent fire jurisdictions in the vicinity of the initial response, potentially including jurisdictions in adjacent counties, regions, or states to meet the immediate requirements of an incident demanding resources beyond those available in the local jurisdiction. The mobilization plan acknowledges that incident responses start with local jurisdiction response, moving to mutual aid resource responses when necessary, and then moving to state mobilization when necessary, until incident control is gained. At that point, state and mutual aid resources are demobilized and incident control is returned to the local jurisdiction. The mobilization plan addresses many aspects of incident response, including

- mobilization awareness training,
- Incident Management Teams,
- responder benefits and compensation,
- recommended responder personal equipment, and
- recommended response team minimum equipment.

The mobilization plan was developed in support of Title 43.43 RCW, State Fire Service Mobilization, and consistent with Title 38.52 RCW, governing emergency management, Title 43.43 RCW, governing the WSP, Title 76.04 RCW, governing Washington State Department of Natural Resources (WDNR), Title 35, RCW governing cities and towns, and Title 52 RCW, governing fire protection districts. The plan is also consistent with the International Association of Fire Chiefs' Intrastate Mutual Aid Plan. It was developed at the direction of the Washington state legislature after the 1991 Spokane Firestorm, and is an appendix to the firefighting section of Washington's Comprehensive Emergency Management Plan (CEMP). As part of the plan, the State Fire Defense Committee was created with representatives from nine regions across the state; the committee reviews and modifies the plan as appropriate. The State Fire

Defense Committee includes members from WDNR, WSP, Washington Emergency Management Division, and the Washington Department of Fire and Emergency Services.

4.3.6 Local Plans

Local jurisdictions are usually the first responders to oil and hazardous substance spills and releases. Under Washington's State Emergency Response System, local jurisdictions must designate a local Incident Command agency, usually a fire department, or they may delegate that responsibility to the WSP.

The Vancouver Fire Department (VFD) follows Clark County's Hazardous Materials Emergency Response Plan (HMERP) to respond to spills of hazardous materials, including crude oil (Clark County LEPC 2014). In addition, VFD has indicated that they would develop a site-specific response guide for the proposed Facility (Eldred 2015). The HMERP is part of Clark County's CEMP, Emergency Support Function #10 – Hazardous Materials (ESF 10). The Clark County CEMP is consistent with the Washington State CEMP and applicable federal plans. The HMERP describes the procedures and responsibilities for responding to emergency threats to life, property, and the environment caused by an unintended release of hazardous materials within Clark County (Clark County LEPC 2014). The VFD has a limited mutual aid agreement with Portland Fire Department and mutual aid agreements with Clark County fire agencies for automatic response within certain areas and by request in other areas. In addition, the Lower Columbia Region Harbor Safety Plan, developed by the Lower Columbia Region Harbor Safety Committee, provides safety measures through clearly defined expectations for use of anchorages, towed barges, and navigation assistance (Ecology 2015b).

LEPCs are often involved with planning, training, and assisting with interagency coordination. They may activate their local Emergency Operations Center to support on-scene operations, make notifications, and respond to requests for resources and other assistance. Each county along the rail route from Williston, North Dakota, to the mouth of the Columbia River has LEPCs; currently available location and contact information for the LEPCs along the rail and vessel corridor in Washington is included in Table 4-3. These LEPCs, in concert with their respective local emergency management offices, conduct hazard identification, vulnerability analyses, and risk assessment activities for their jurisdictions. Federal and state statutes require LEPCs to develop and maintain emergency response plans based on the volumes and types of substances found in, or transported through, their districts.

Table 4-3. Washington LEPC Contact Information for the Rail and Vessel Corridor

Region		LEPC Contact Information		
County LEPC	Municipalities	Contact Person	Address	Contact Information
Spokane	• Spokane • Marshall • Cheney • Tyler	Bill Hansen	W 1121 Gardner Ave Spokane WA 99201	509-477-7609 bhansen@spokanecounty.org
Lincoln	• Sprague	Sheriff Wade Magers	PO Box 367 Davenport WA 99122	509-725-9273 wmagers@co.lincoln.wa.us
Adams	• Ritzville • Lind • Cunningham • Hatton	Jay Weise	2069 W Hwy 26 Othello WA 99344	509-488-3704 jayw@co.adams.wa.us

Table 4-3. Washington LEPC Contact Information for the Rail and Vessel Corridor

Region		LEPC Contact Information		
County LEPC	Municipalities	Contact Person	Address	Contact Information
Franklin	• Connell • Mesa • Eltopia • Pasco	Sean Davis	502 Boeing St Pasco WA 99301	509-545-3546 sdavis@co.franklin.wa.us www.franklinem.org
Benton	• Kennewick • Finley • Plymouth • Paterson	Jeremy Beck	651 Truman Ave Richland WA 99352-9104	509-628-8473 j.beck@bces.wa.gov
Klickitat	• Alderdale • Cliffs • Maryhill • Wishram • Dallesport • Lyle • Bingen • White Salmon	Ed Powell	228 W Main Street MS CH19 Goldendale WA 98672	509-773-2477 EDP@co.klickitat.wa.us
Skamania	• Hood • Carson • Stevenson • North Bonneville	John Carlson	PO Box 790 Stevenson WA 98648	509-427-8076 JohnC@co.skamania.wa.us http://www.skamania-dem.org
Clark	• Washougal • Camas • Vancouver	Cindy Stanley	710 W 13th St Vancouver WA 98666-2810	360-992-6285 cindy.stanley@clark.wa.gov www.cresa911.org
Cowlitz	• Kalama • Carrolls • Longview	Ernie Schnabler	312 SW 1st Kelso WA 98626	360-577-3130 www.co.cowlitz.wa.us DEM@co.cowlitz.wa.us
Wahkiakum	• Cathlamet • Skamokawa • Altoona	Beau Renfro	PO Box 65 Cathlamet WA 98612	360-795-3242 renfrob@co.wahkiakum.wa.us
Pacific	• Megler • Chinook • Ilwaco	Stephanie Fritts	PO Box 101 South Bend WA 98586	360-875-9340 sfritts@co.pacific.wa.us

Source: Ecology 2015c

LEPC = Local Emergency Planning Committee

4.3.7 Industry Response Plans

In addition to the resources made available by local, state, and federal agencies, two private organizations provide emergency and spill response services to the Lower Columbia River area: the Clean Rivers Cooperative (CRC) and Maritime Fire Safety Association (MFSA). Both of these organizations are financially supported by the industries they serve. Marine vessels berthing at the proposed Facility would participate in the MFSA, and the proposed Facility would become a member of the CRC.

The CRC is a nonprofit oil spill response organization created to provide mutual aid to companies in the maintenance of an efficient and rapid response to marine spills (CRC 2015). CRC stages equipment at 32 environmentally sensitive locations along the Columbia and Willamette rivers (Table 4-4).

Table 4-4. Clean Rivers Cooperative Spill Response Equipment Staged along the Columbia and Willamette Rivers

Equipment	Description
Containment Booms	An oil spill containment boom is a floating barrier used to contain oil spilled into water. CRC has 12,400 feet of 12-inch boom, 2,000 feet of 14-inch boom, 57,100 feet of 20-inch boom, 700 feet of fast water 28-inch boom, 400 feet of 30-inch boom, and 7,000 feet of additional booms, totaling 79,600 feet of oil spill containment boom on the Columbia and Willamette rivers.
Workboats	Workboats and skiffs are functional vessels used to support oil spill response operations. CRC maintains three fast-response vessels for rapid response to spills. The vessels are often used in deploying containment booms and assisting in water recovery operations. CRC also maintains five additional workboats, two large skiffs, and six small support skiffs.
Oil Spill Response Vessels	CRC maintains four 34-foot and six 30-foot oil spill response vessels outfitted with skimming systems and storage capability for oil spill recovery operations.
Portable Skimmers	Portable skimmers are mechanical skimming systems used to remove oil from water, maximizing the amount of oil to water recovered. Oil skimmers come in three common types: weir, oleophilic, and drum. CRC maintains 40 portable skimming systems.
Storage Capacity	CRC has five shallow-water recovery barges, five 2,500-gallon and two smaller towable bladders, and two 2,000-gallon and 10 1,000-gallon portable fast tanks to store spilled product. CRC has by agreement two large, 12,000-bbl storage barges and fixed facility storage tanks along the Columbia and Willamette rivers.
Wildlife Response and Rehabilitation System	CRC's state-of-the-art wildlife care equipment is made up of a response and rehabilitation unit, transport unit, and rehabilitation shelter. International Bird Rescue serves as CRC's wildlife response contractor, with experts in wildlife rescue and rehabilitation.
Command and Communications Unit	CRC also maintains a 53-foot trailer outfitted with current technologies, for use as a mobile command post and communications center anywhere on the Columbia and Willamette rivers. The unit is equipped with a conference room that includes whiteboards, teleconference and projection capability, a workspace with computers, satellite phone and internet connections, and a radio communications room equipped with UHF, VHF, and air/ground frequencies among others.

Source: CRC 2015

CRC = Clean Rivers Cooperative, UHF = ultra-high frequency, VHF = very high frequency

The MFSA is currently made up of 25 ports and private facilities along the Lower Columbia and Willamette rivers (MFSA 2015). Its members have developed a system to respond to potential shipboard fires along the 110-mile shipping channel. MFSA's shipboard fire program is directed by the Fire Protection Agencies Advisory Council (F-PAAC), made up of 13 participating public fire agencies:

- Astoria Fire Department
- Clark County Fire District No. 6
- Clark County Fire & Rescue
- Clatskanie Rural Fire Protection District
- Columbia River Fire & Rescue
- Cowlitz Co. Fire District No. 1
- Cowlitz County Fire District No. 5
- Cowlitz 2 Fire & Rescue
- Longview Fire Department
- Portland Fire & Rescue
- Scappoose Rural Fire District
- VFD
- USCG - Sector Columbia River

All commercial vessels over 300 gross tons are required to have an oil spill contingency plan, and MFSA developed and maintains a state-approved VRP (known as the MFSA plan) that vessels can choose to adopt. It should be noted that the current MFSA spill contingency plan is not designed to address spills greater than 300,000 bbl, and is primarily focused on addressing spills of refined petroleum products rather than crude oil.

4.3.8 Proposed Facility Plans

This section describes the spill prevention and response capabilities specific to construction and operation of the proposed Facility. Operation of a large oil-handling facility requires implementation of state-approved plans demonstrating the operator's capability to prevent and respond to oil spills (WAC 173-182). These plans identify the prevention, containment, control, and response systems that would be used to address a range of possible spill sizes up to a defined "worst-case" scenario. Before beginning construction and operation, the proposed Facility would have the following approved spill and fire prevention and response plans in place:

- SPCC Plans
- Facility Response Plan (FRP)
- Oil Spill Contingency Plan (OSCP)
- Fire Prevention and Response Plans (FPRPs)

The proposed Facility would also have in place an Operations Facility Oil Handling Manual, which would include a Prebooming Transfer Plan. If a spill were to occur at the proposed Facility, the Applicant would be responsible for spill control, collection, and disposal of the resulting wastes. Section 4.3.8.5 provides additional information on the Applicant's preliminary Operations Facility Oil Handling Manual and Prebooming Transfer Plan.

4.3.8.1 Spill Prevention, Control, and Countermeasure Plans

An SPCC Plan is required for proposed Facility construction and an additional SPCC Plan is required for proposed Facility operation.

The construction SPCC Plan is a site-specific document that describes prevention and response actions for oil, hazardous substance, and hazardous waste releases resulting from construction activities. This SPCC Plan forms the basis of all construction contractor spill control and pollution prevention activities at the proposed Facility. The construction SPCC Plan addresses responsible personnel, spill reporting, preexisting contamination, potential spill sources, spill prevention and response training, spill report form(s), plan approval, and SPCC Plan acknowledgement forms to be signed by all Project personnel.

The proposed construction SPCC Plan has been submitted for EFSEC review and requires EFSEC approval prior to beginning construction (see Appendix D.1).

The Applicant has prepared a draft operations SPCC Plan (see Appendix D.2) that identifies potential release scenarios during proposed Facility operation and that provides measures to prevent or control these scenarios. The release scenarios represent a range of potential releases including a large spill event. Basic prevention measures included in the draft SPCC Plan include:

- Regular equipment inspection and testing,
- Automated leak monitoring systems,
- Automatic and manual emergency shutdown capabilities,
- Oil flow and pressure monitoring and maintenance,
- Secondary containment systems for all onsite oil handling elements,
- Qualified personnel for proposed Facility monitoring and management, and
- Regular proposed Facility personnel training.

The SPCC Plan addresses risks identified in a spill risk analysis of the proposed Facility oil-handling systems. The draft SPCC Plan has been submitted for EFSEC review and requires EFSEC approval prior to beginning operation.

4.3.8.2 Facility Response Plan

FRPs and SPCC Plans are different, and should be maintained as separate documents; however some sections of the plans may be the same (EPA 2015b). An FRP must demonstrate the preparedness of the proposed Facility to respond to small discharges and a "worst-case" crude oil spill scenario. The Applicant would need to develop an FRP in consultation with all potential spill responders and in consideration of the existing response infrastructure that could be called into action in the event of a spill. Through this process, agencies would determine whether additional regional spill response capability is needed and where it should be stationed.

A draft FRP is not currently available for review. When prepared, the FRP for the proposed Facility would need to:

- Be consistent with the NCP and the NWACP,
- Identify a qualified individual with authority to implement proposed Facility spill removal actions and to immediately communicate with federal authorities and responders,
- Identify and ensure availability of resources to remove, to the maximum extent practicable, a worst-case discharge (WCD),
- Describe training, testing, unannounced drills, and response actions of persons at the proposed Facility, and
- Be updated periodically and resubmitted for approval of each significant change.

4.3.8.3 Oil Spill Contingency Plan

An OSCP provides guidelines to respond to a spill that originates from the proposed Facility. This plan contains information designed to improve the responders' ability to select appropriate resources, control systems, and recovery methods, and to manage an effective response team. This plan was designed by the Applicant to satisfy OPA 90 and WAC 173-182 requirements. A preliminary OSCP was developed by the Applicant (included in Appendix D.4 of the Application) in accordance and conjunction with:

- NCP (40 CFR 300),
- Oil and Hazardous Pollution Contingency Plan for EPA Region 10,
- The NWACP and Lower Columbia River GRP, and
- WAC 173-182-310 through 173-182-450.

The OSCP provides the oil spill response actions that the Applicant would assume responsibility for in the case of a spill within a geographic boundary. For planning purposes, the geographic area at risk from a WCD (defined by the Applicant as an unabated release over 72 hours during maximum current speeds) extends from approximately 5 miles upriver from the proposed Facility (river mile [RM] 109) to the mouth of the Columbia River and approximately 100 miles in either direction (north or south) along the Washington and Oregon coastlines. The probable route of discharge off the proposed Facility property would follow natural drainage patterns to the south, past existing rail infrastructure, through the Terminal 4 stormwater pond located on Port of Vancouver (Port) property and into the Columbia River. All proposed Facility employees would have the authority to activate the Spill Response Team, activate spill response action contractions, and act as the Incident Commander if a designated or more senior manager is not available.

4.3.8.4 Fire and Explosion Prevention and Response Plans

The Applicant would develop and implement a construction and operations FPRP addressing the procedures for fire prevention and response. Both the construction and operations FPRPs would be submitted to EFSEC for review and approval prior to the beginning of construction or operation. These plans would address:

- A list of the major workplace fire hazards and their proper handling and storage procedures,
- Potential ignition sources (such as welding, smoking, and others) and control procedures, and the type of fire protection equipment or systems,
- Identification of site personnel responsible for maintenance of equipment and systems installed to prevent or control ignitions or fires, and
- Identification of personnel responsible for control of fuel source hazards.

The Applicant would consult with the Port, City fire officials, and other emergency responders to ensure that outside response is coordinated with the proposed Facility’s provisions for fire control. Fire prevention and control would include, but not be limited to:

- Ensuring that appropriate firefighting equipment (e.g., fire extinguishers) is in fixed locations or on mobile construction vehicles, as appropriate,
- Ensuring that highly flammable materials are identified, stored, and handled in accordance with applicable regulations,
- Managing combustible wastes,
- Implementing appropriate work procedures (e.g., hot work and welding),
- Limiting smoking to approved areas,

- Implementing procedures for equipment to be regularly and properly maintained,
- Providing fire safety training to all personnel, including the identification of ignition sources, the initiation of fire alarms, the use of established egress routes and locations, worker gathering locations, and procedures for notification of emergency responders, and
- Providing first responders with maps that identify primary and secondary site access locations in the event of a fire.

The Applicant has begun consultation with local responders to identify gaps in existing firefighting equipment and would provide training opportunities at the nationally recognized Texas A&M Engineering Extension Service's Emergency Training Services Institute. The operations FPRP would be developed in compliance with WAC 296-24-567. The written plan would be kept in the workplace and made available for employee review.

Fire and explosion prevention is an integral part of the proposed Facility design. Key fire protection systems currently in the preliminary proposed Facility design include (but are not limited to):

- Fire and smoke detection systems,
- Spill containment in select areas,
- Water and foam fire-suppression equipment,
- Life safety features (portable fire extinguishers, eye-wash stations, etc.),
- Electrical hazard protection,
- Automatic fixed-foam internal floating roof seal protection,
- Backflow prevention systems,
- Fire response access infrastructure, and
- Emergency pressure relief and shutdown valves (automatic and manual).

An independent evaluation of proposed fire protection systems has been conducted to assist EFSEC and local fire response jurisdictions in their review of the preliminary design. Depending on the result of EFSEC's and local fire jurisdiction review and determination of proposed Facility fire prevention system design adequacy, additional fire protection measures could be required for inclusion in the final design of the proposed Facility.

4.3.8.5 Operations Facility Oil Handling Manual

The Applicant has prepared a preliminary Operations Facility Oil Handling Manual to provide information and operational procedures for the transfer of crude oil at the proposed Facility consistent with the requirements in WAC 173-180-420 and Title 33 CFR Part 154, Subpart B (Appendix D.3). The manual includes a preliminary Prebooming Transfer Plan that addresses the deployment of booms in advance of each oil transfer to ensure that any materials discharged to surface water would be contained (Appendix D.3: Appendix M). As required by WAC 173-184-20, the Applicant has developed a preliminary Safe and Effective Threshold Determination Report to identify a proposed Facility-specific booming strategy that takes into account conditions such as currents, wind speeds, and vessel traffic (Appendix D.3: Appendix K). The Applicant would develop a final Safe and Effective Threshold Determination Report based on final proposed Facility design and submit the report for state review and approval prior to the first oil transfer operation at the proposed Facility. If it is not safe and effective to meet the prebooming requirements, vessel loading at the proposed Facility must be undertaken using, at a minimum, the alternative measures identified in WAC 173-184-115(7) (e.g., access to boom four times the length of the vessel). Additional information on the Applicant's preliminary Prebooming Transfer Plan is presented in Section 2.4.1.5.

4.3.9 Rail Transportation Plans

In the event of a crude oil spill, fire, or explosion along the rail transportation route, BNSF would implement its own System Emergency Response Plan. The System Emergency Response Plan defines roles and responsibilities of BNSF personnel, notification procedures, hazard identification and incident classification, incident management procedures and resource utilization, and health and safety procedures. The System Emergency Response Plan also incorporates relevant response plans addressed above. In the event of an incident, BNSF would inform appropriate federal, state, and local response agencies. As of February 2013, BNSF employs over 220 first responders and has positioned equipment at 60 locations across its rail network (BNSF 2013a; Figures 4-2 and 4-3). Six BNSF HAZMAT responder locations located along the rail route between North Dakota and the Port would be available to assist local emergency responders in the event of a crude oil spill, fire, or explosion.

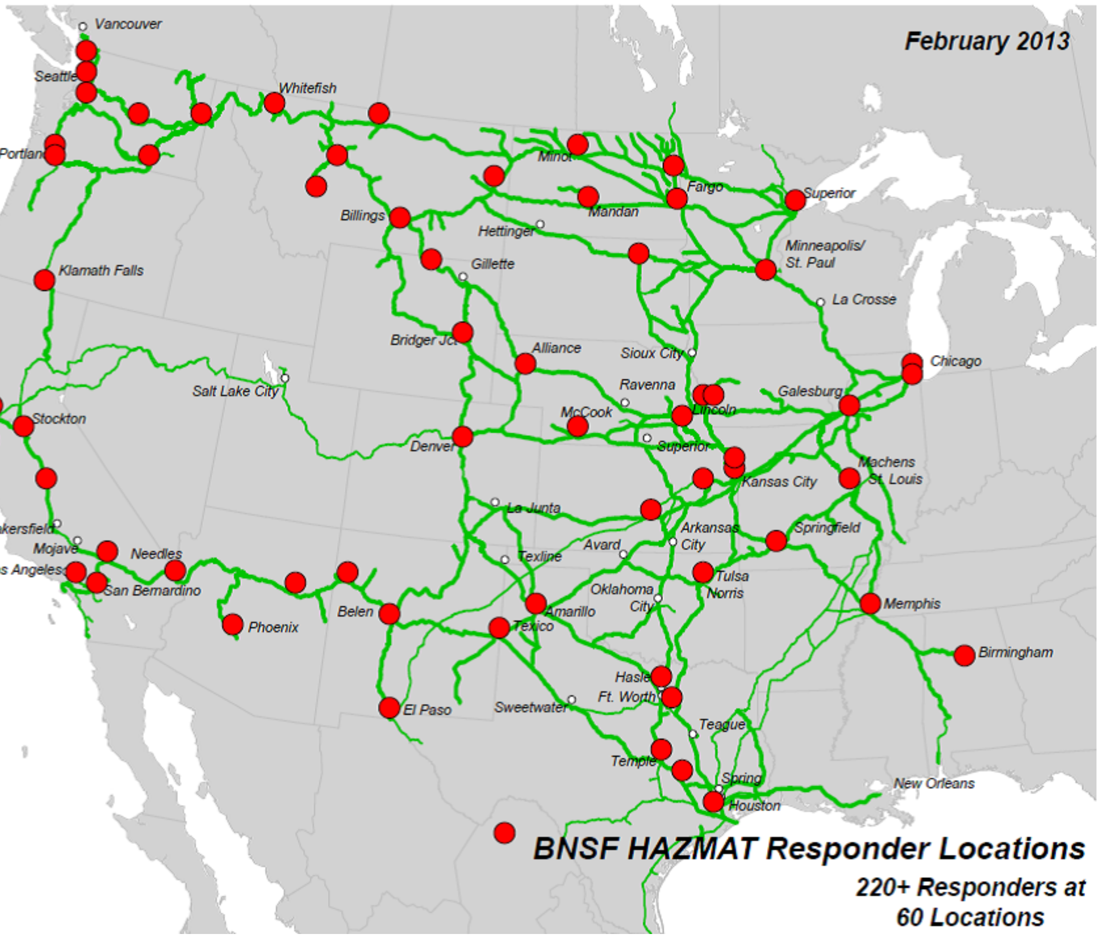


Figure 4-2. BNSF HAZMAT Responder Locations

Source: BNSF 2013a

BNSF emergency responders have completed initial 80-hour HAZMAT training and security and emergency response training at TTCI and receive an annual refresher training course related to tank cars, incident command, air monitoring, and advanced technologies (BNSF 2015). BNSF response equipment includes industrial firefighting foam trailers, emergency breathing air trailers, chlorine kits, midland kits, and air monitoring equipment (BNSF 2014). The BNSF system has 20 fire trailers to provide equipment and supplies to contract firefighters in response to an incident (BNSF 2014). A BNSF Tactical Toxicology Program could also be implemented to acquire real-time air quality monitoring data following an incident.

BNSF has partnered with Ecology to develop company control points for the track that runs along the Lower and Middle Columbia River from Pasco to Portland. The company control point plan identifies oil spill response strategy and implementation, safety notes, field notes, resources at risk, and recommended equipment and personnel at 48 response locations along the Columbia River (BNSF 2013b).

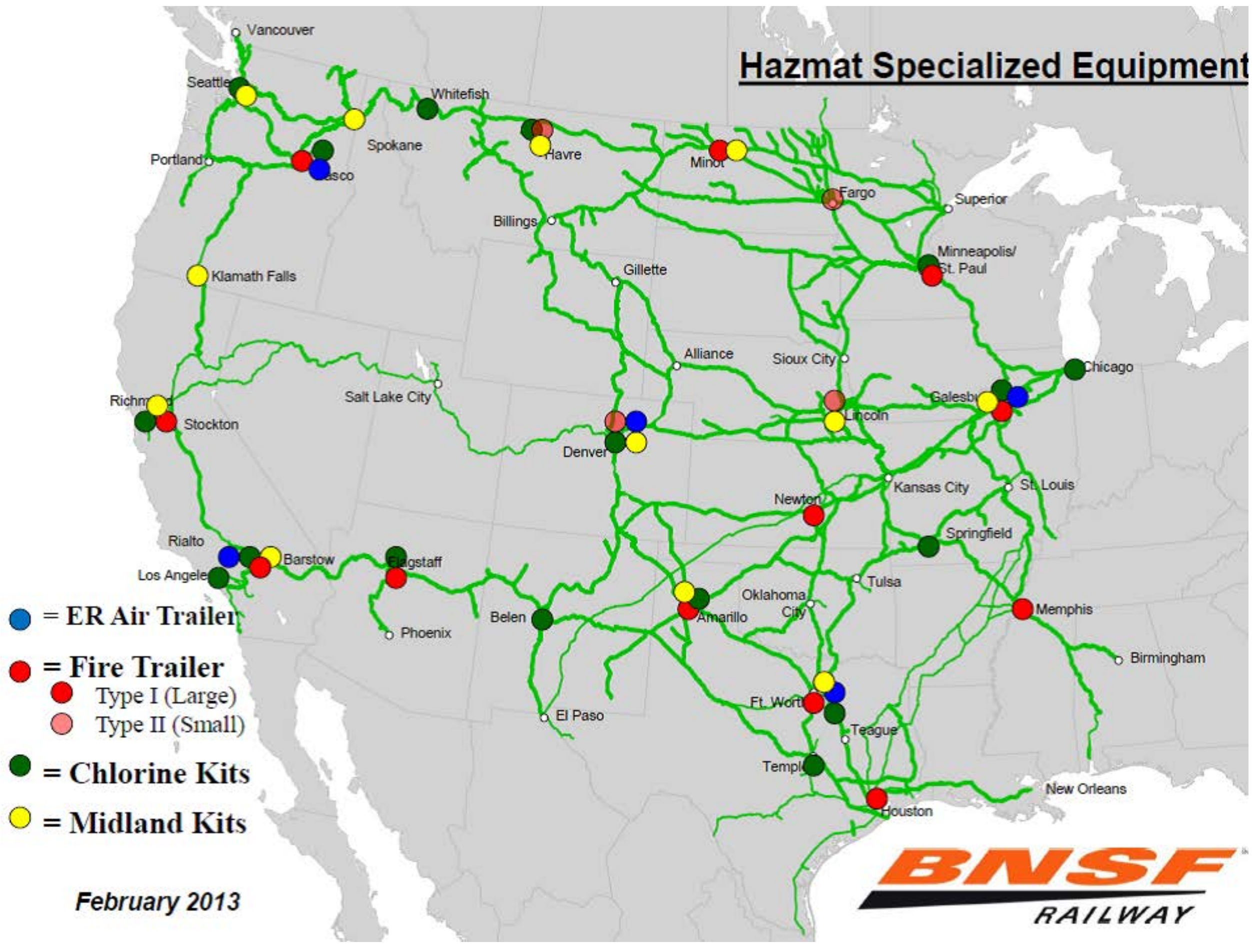


Figure 4-3. Location of BNSF HAZMAT Specialized Equipment

Source: BNSF 2013a

4.3.10 Vessel Transportation Plans

As described in Section 4.2.3, a vessel must submit a VRP to the USCG and receive approval of the plan before it can handle, store, or transport crude oil. A VRP is required to contain the following:

- Notification procedures,
- Shipboard spill mitigation procedures,
- Shore-based response activities,
- List of contacts,
- Training procedures,
- Exercise procedures,
- Plan review and update procedures, and
- Onboard notification checklist and emergency procedures (unmanned tank barges only)

The VRP also provides geographic-specific information to each Captain of the Port Zone[4] in which the vessel operates, including:

- Identification of salvage and marine firefighting services contractors,
- Salvage and marine firefighting services and response timeframes,
- Provisions on how the salvage and marine firefighting resource providers would coordinate with other response resources, and
- Location of firefighting equipment compatible with the specific vessel.

VRPs are required to include Shipboard Oil Pollution Emergency Plans designed to assist personnel in responding to a discharge of oil. The plans includes coastal state and port contacts in the region frequented by the vessel to ensure rapid coordination in the event of an oil spill. These plans are evaluated, reviewed, and updated regularly.

4.4 LIKELIHOOD OF INCIDENTS RESULTING IN A CRUDE OIL SPILL AND RANGE OF POTENTIAL SPILL VOLUMES

Concerns were raised during scoping about potential crude oil spills related to operations at the proposed Facility. With the exception of vessel loading incidents, there are insufficient data on spill frequency from terminals similar to the proposed Facility to support a meaningful statistical analysis of the likelihood for spills of various sizes resulting from its operations. As a result, a contingency planning spill volume consistent with WAC 173-182 for the storage tank area and contingency planning volumes estimated by the Applicant for four other elements of the proposed Facility are presented. In addition, spill size and frequency of vessel loading incidents determined as part of an independent analysis of the spill risk associated with the transportation of crude oil to and from the proposed Facility are presented. This study

4 A Captain of the Port Zone is a specific geographic area (Port Zone) over which a USCG officer is responsible. The officer is responsible for the protection and security of vessels, harbors, and waterfront facilities; anchorages; security zones; safety zones; regulated navigation areas; deepwater ports; water pollution; and ports and waterways safety.

was conducted by a lead consultant who participated in Washington State's 2014 Marine and Rail Oil Transportation Study to ensure consistency with that analysis (Appendices J and E).

The independent analysis also addressed concerns identified during scoping related to potential derailments and crude oil spills along the rail corridor and potential vessel crude oil spills along the vessel corridor. The independent analysis estimated the likelihood of incidents (derailments and vessel groundings, allisions, and collisions), the likely range of crude oil spill sizes that could result from these incidents, and the possible spread if a spill reached the water. These estimates have been used to assist in determining a range of potential spill scenarios for use in the impact analysis presented in Section 4.7. There is insufficient data on spill-related fires and explosions to support a meaningful statistical analysis of the likelihood of fire and/or explosion resulting from a spill or accident, and therefore fire and explosion risk was not addressed in the independent analysis. However, the response actions and potential impacts from such events are discussed in Sections 4.6 through 4.7.

The independent analysis also provided EFSEC with the likelihood of derailments along various geographic segments of the rail corridor based on track curvature, flash flood potential, detector spacing, and train speeds, presented in Appendix E. The results of this geographic analysis were not used in the impact analysis in Section 4.7; rather, it was conservatively assumed that impacts could occur at any location along the inbound rail corridor although potentially at different frequencies over time.

4.4.1 Proposed Facility

Spills at the proposed Facility could occur during railcar unloading, along transfer pipelines, at the storage tank area, and during vessel crude oil loading. Spills related to refueling (bunkering spills) would not occur at the marine terminal because the Applicant has committed not to allow bunkering at the proposed Facility. Vessels calling at the proposed Facility would likely bunker at the refineries receiving crude oil shipments in the Puget Sound and California, or at anchorages in Puget Sound, California, Alaska, or Hawaii, depending on the destination of the specific vessel involved (Appendix J). This assumption is consistent with findings reported in Ecology's (2015a) study that stated "tank ships probably will not bunker in the Columbia River due to their regular trade to California and Puget Sound." Since it is assumed that bunkering would occur at port locations or anchorages beyond the mouth of the Columbia River, bunkering-related spills were not considered in the independent analysis (Appendix J).

As stated previously, there is insufficient crude oil storage facility spill incident information to estimate a range of likely potential spill volumes for the proposed Facility. However, given the volume of crude oil that could be stored at the proposed Facility, the potential for spills from the storage tank area (Area 300) was considered. While the historical record indicates that major aboveground crude oil storage tank failures have occurred during tank repair or maintenance activities that generate ignition sources, the record also shows that properly designed, constructed, and maintained aboveground storage tanks are highly unlikely to fail (EPA 1997).

The potential for storage tank damage during a major earthquake associated with the Cascadia Subduction Zone is discussed in Section 3.1. In recognition of the potential for spills to occur at the proposed Facility as a result of soil liquefaction resulting from a seismic event, EFSEC commissioned an independent analysis to assess the liquefaction risk and the Applicant's proposed ground improvements to manage that risk, and to determine if additional measures could be implemented to manage that risk (Appendix C). A summary of the independent analysis and its findings is presented in Section 3.1.

For contingency planning purposes, WAC 173-182 defines "a worst case spill for an onshore facility to be the entire volume of the largest above ground storage tank on the facility site complicated by adverse weather conditions, unless Ecology determines that a larger or smaller volume is more appropriate given a particular facility's site characteristics and storage, production, and transfer capacity." Unless determined otherwise by Ecology, the contingency planning worst-case spill volume for the proposed Facility consistent with WAC 173-182 would be at least the entire capacity of the largest storage tank at the proposed Facility (~375,000 bbl). Therefore this spill volume is considered the WCD for the proposed Facility.

The secondary containment berm surrounding the storage tanks would be sized to contain a volume at least equal to 110 percent of the volume of one storage tank plus the volume of precipitation from a 24-hour, 100-year storm event. According to the Applicant, this capacity reflects the most stringent Washington spill prevention and control and NFPA requirements and exceeds the requirements for secondary containment under 40 CFR 112.7 – General requirements for Spill Prevention, Control, and Countermeasure Plans (BergerABAM 2014).

A massive earthquake could result in liquefaction and ground deformation. The Applicant has proposed soil improvements beneath the storage tank foundations to manage the risk associated with liquefaction. However, these ground improvements have not been proposed to extend under the secondary containment berm. The analysis of potential oil spills at the proposed Facility site assumes that in the unlikely event that a single storage tank were to fail during a large earthquake, the secondary containment berm would remain intact and contain all of the released oil. This assumption considers the strong likelihood that the additional ground improvements recommended in the independent analysis and presented in Section 3.1 are implemented during construction of the proposed Facility.

Potential WCD volumes for other elements of the proposed Facility were estimated in the Applicant's Hazard Evaluation/Risk Analysis (Application for Site Certification Appendix C.13: Appendix D). These Applicant-estimated WCDs by area are:

- 700 bbl[5] at the railcar unloading facility,
- 2,548 bbl along each railcar unloading transfer pipeline,
- 5,505 bbl along the marine transfer pipeline, and
- ≤100 bbl at the marine terminal.

An independent analysis of spill potential at the marine terminal during vessel loading was carried out using data gathered in previous studies involving transfer operations in Washington and California (Appendix J). The results confirm that typical spills during vessel transfer operations tend to be small: over 99 percent of these transfer-related spills would be less than 100 bbl. However, the independent analysis suggests that the most "effective" WCD in this area depends on both the vessel size and the crude oil density.[6] The effective WCD for Handymax vessel loading is 1,152 bbl, for Aframax is 2,212 bbl, and for Suezmax is 2,287 bbl. The estimated number of spills per year by size category for vessel loading operations, the average years between these spill events (return years), and the effective WCD for spills of Bakken crude oil and diluted bitumen (dilbit) are presented in Table 4-5.

5 The capacity of a single rail tank car is assumed to be 750 bbl, though actual carloads are limited by cargo weight, tank car weight, and by vapor space requirements. In actual practice, each tank car often holds from 650 to 690 bbl of crude oil. (Appendix E).

6 The "effective" WCD is the most credible or realistic volume for a WCD based on the amount of oil that would effectively be released in the event of a vessel impact accident (collision or grounding) based on maximum possible outflow as determining by modeling (Appendix J).

Table 4-5. Estimated Frequency of Transfer-Related Spills

Spill Volume*	Spills Per Year	Return Years
1 bbl (or less)	0.07118	14
10 bbl	0.01898	53
100 bbl	0.00411	243
1,000 bbl	0.00063	1,587
10,000 bbl	0	-
100,000 bbl	0	-
Effective WCD	0.00063	1,587
Bakken crude	Effective WCD: 2,626 bbl	
Diluted bitumen	Effective WCD: 2,287 bbl	

* Each category includes all volumes in that order of magnitude (1–9 bbl, 10–99 bbl, etc.).
bbl = barrels, WCD = worst-case discharge

4.4.2 Rail Transportation

The commissioned independent risk analysis assumes that crude oil unit trains would arrive and depart from Washington on the BNSF mainline east of Spokane, Washington.[7] It further assumes that loaded trains traveling westbound would use the Columbia River Alignment to the proposed Facility and returning empty trains would use the Central Return - Stampede Pass route, which is a more northern route over Stampede Pass in the Cascade Mountains and through the Yakima Valley. Events that could result in a crude oil release along the rail corridor are typically associated with derailments. Some derailments result in the puncture or failure of railcar shells. If the damaged railcar is partially or completely full at the time of derailment, a crude oil spill would likely occur.

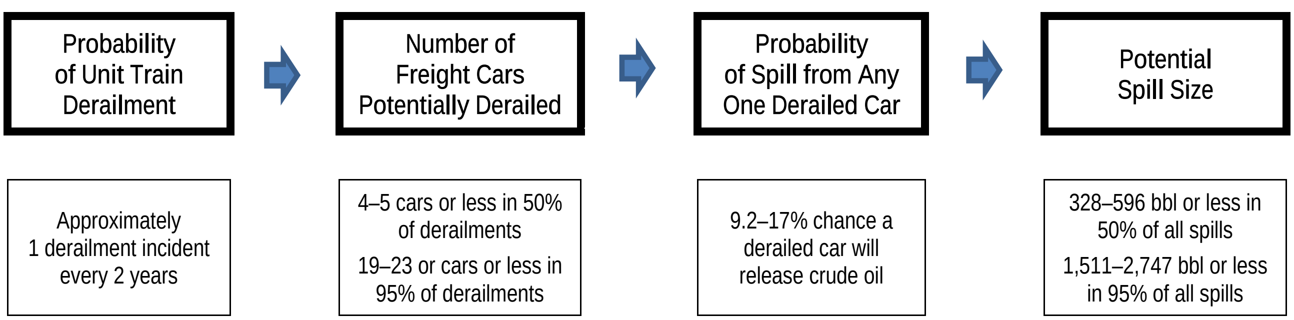


Figure 4-4. Steps in Data Analysis to Estimate Potential Spill Sizes from a Derailment

7 While rail transportation of mid-continent crude oil would extend to the crude oil source, the geographic scope of the rail transportation risk analysis (Appendix E) is confined to the portion of the rail system within Washington.

The four steps of the data analysis are shown in Figure 4-4 and described below:

- **Assess the likelihood that a derailment would occur.** Based on derailment rates calculated from FRA's statistical data on HAZMAT railcars[8] for the period of 1975 to 2014, a unit train in transit to the proposed Facility or returning to the mid-continent region might derail once every 2 years somewhere along the mainline within Washington state. FRA's data show that derailment rates declined significantly in the 1980s and have continued to decline but at a slower rate from 2000 to 2014. For the period of record, derailment rates in Washington are similar to national derailment rates.
- **Estimate the number of cars that could be derailed.** For the entire United States, statistics indicate that in 50 percent of all derailments, four to five or fewer cars derail and in up to 95 percent of all derailments, 23 or fewer cars derail. Statistics specific to Washington indicate that in up to 59 percent of all derailments no railcars derail, and in up to 95 percent of all derailments 19 or fewer railcars derail.
- **Assess the likelihood that a derailed railcar would spill its crude oil cargo.** Based on historical data,[9] not every derailed railcar carrying hazardous materials typically spills all or a portion of its cargo. National rail statistics show that a derailed railcar carrying cargo such as crude oil released part of its cargo 9 to 17 percent of the time. The remainder of the time (83 to 91 percent) a release from the derailed railcar did not occur. From 1978 to 2014, the percentage of HAZMAT cars that released a portion of their cargo was approximately 17 percent. However since 2000 this percentage has been reduced to 9 percent. The range of 9 to 17 percent was carried forward in the analysis.
- **Estimate the size of crude oil spill that could occur.** Estimating the size of spill that could occur includes determining the number of railcars derailed per incident, the probability that each car would release crude oil cargo, and the portion of the crude oil spilled per railcar. The analysis assumed that all railcars were loaded to approximately 700 bbl[10] (30,000 gallons).

This analysis estimated the following conservatively high frequencies of derailments and potential spill sizes from trains transiting to the proposed Facility:

- The estimated average number of years that would elapse between derailments (not necessarily resulting in a spill) is 2 years;
- The estimated average number of years that would elapse between derailments resulting in a spill of any size is 12.1 years;
- The estimated average number of years that would elapse between a derailment of one loaded car that results in a crude oil spill volume of 700 bbl or less is 27 years;
- The estimated average number of years that would elapse between a derailment of three loaded cars that results in a crude oil spill volume of 2,200 bbl or less is 121 years; and

8 Hazmat cars are tank cars that carry materials classified as hazardous materials which may be flammable or inflammable.

9 It is noted that this historical data includes DOT 111 and CTC 111 tank cars. There is no historical data for newer DOT-117 railcars.

10 The capacity of a single rail tank car is assumed to be 750 bbl, though actual carloads are limited by cargo weight, tank car weight, and vapor space requirements. In actual practice, each tank car often holds from 650 to 690 bbl of crude oil. (Appendix E).

- The estimated average number of years that would elapse between a derailment of 28 loaded cars that results in a crude oil spill volume of 20,000 bbl (WCD) or less is 21,959 years.

4.4.3 Vessel Transportation

The transportation of crude oil by vessel from the proposed Facility to various West Coast, Alaska, and Hawaiian refineries could result in spills in aquatic environments. This section presents required regulatory contingency planning spill volumes and summarizes the estimated likelihood of and potential spill sizes during vessel transit along the Columbia River from the independent analysis commissioned by EFSEC (Appendix J).

4.4.3.1 Regulatory Contingency Spill Planning Volumes

Federal and state regulations define the size of spills that must be considered when developing spill response plans for vessels (VRPs). For planning purposes the potential spill sizes for vessels transiting the Columbia River from the proposed Facility depend on:

- Vessel size (cargo capacity),
- The 43-foot draft restriction in the Columbia River, and
- The average specific gravity (weight per unit volume) of the crude oil being transported.

The Applicant has identified three vessel types of different size and draft that would serve the proposed Facility (Handymax, Aframax, and Suezmax) and two crude oil types with different average specific gravities that would be transported (Bakken crude oil and Alberta-sourced dilbit). The regulatory spill planning volumes for each of the three vessel types and both types of crude oil cargo are provided in Table 4-6.

Table 4-6. Planning Volumes by Vessel Type for Bakken Crude and Diluted Bitumen

Vessel	DWT	Bakken Crude Oil (bbl)				Diluted Bitumen (bbl)			
		Capacity	AMPD	MMPD	WCD	Capacity	AMPD	MMPD	WCD
Handymax	46,172	319,925	50	2,500	319,925	319,925	50	2,500	319,925
Aframax	115,000	667,777	50	2,500	667,777	667,777	50	2,500	667,777
Suezmax	165,000	729,560	50	2,500	729,560	635,220	50	2,500	635,220*

Notes:

* This volume is less than the WCD for Bakken crude oil because the 43-foot draft limitation of the Columbia River restricts the amount of dilbit that can be loaded into a Suezmax due to its specific gravity.

AMPD = average most-probable discharge: the lesser of 50 bbl or 1% of cargo during oil transfer operations to/from vessel (33 CFR 155.1020), bbl = barrels, DWT = deadweight tons, MMPD = maximum most-probable discharge: 2,500 bbl of oil capacity >=25,000 bb.; 10% of capacity if capacity <25,000 bbl (33 CFR 155.1020), WCD = discharge of vessel's entire cargo in adverse weather conditions (33 CFR 155.1020; WAC 173-182-030)

4.4.3.2 Estimates of Potential Crude Oil Spill Size and Frequency during Vessel Transportation

Spills associated with the transportation of crude oil by vessel could be caused by impact accidents including groundings, collisions, and allisions. Not every impact incident results in a spill. Additionally, allision incidents, such as a vessel striking a dock, would be expected to result in less oil outflow than groundings or vessel-to-vessel collisions. Therefore only groundings and collisions were considered in the risk analysis. Key factors used in the risk analysis include:

- **Vessel type.** The 43-foot draft limitation of the Columbia River navigation channel and the coastal trade for distribution of Bakken crude and dilbit limit the size of tank vessels that would call at the proposed Facility. Although these vessels may vary in cargo capacity within a size class (e.g., Aframax may range from 115,000 to 142,000 deadweight tons [DWT]), a representative size was assumed for each class for the analysis as shown in Appendix J. The Applicant estimates that 365 vessels would call at the proposed Facility, of which 80 percent would be the smaller-sized Handymax, 15 percent would be medium-sized Aframax, and 5 percent would be the larger Suezmax vessels.
- **Likelihood of impact incidents per year.** From 1990 to 2011, 14 incidents involving tank ships occurred on the Columbia River based on USCG Marine Information for Safety and Law Enforcement (MISLE) data (Worley Parsons and DNV GL Oil and Gas 2014). These incidents included collisions, allisions, groundings, and other incidents. Based on the number of transits on the river and the length of the transits, the likelihood of incidents involving vessels calling at the proposed Facility on an annual basis can be estimated. The likelihood that a specific size ship would be involved in an incident is based on its percentage of overall trips to the proposed Facility.
- **Likelihood of an impact incident resulting in a spill.** A computer model (HECSALV)[11] was used to generate a probability distribution for the potential of spills resulting from each vessel type after an impact incident.
- **Estimated spill frequency.** The estimated spill frequency on an annual basis was determined by combining the likelihood of an impact accident and the likelihood of a spill resulting from the impact incident. This spill frequency can be expressed as a “return interval” or the estimated average number of years that would elapse between spills of a particular size.

The risk analysis estimated the range of spill volumes likely to occur in a grounding or collision incident for each vessel type potentially calling at the proposed Facility. Table 4-7 presents two spill sizes resulting from groundings or collisions for each vessel type if either Bakken crude oil or dilbit were spilled. The spill sizes were estimated by simulations of oil outflow for each incident type, each vessel type, and both types of crude oil. The estimated spill sizes presented are:

- The fiftieth percentile spill—meaning that 50 percent of all likely spills would be smaller than this spill size and 50 percent would likely be larger than this spill size, and
- The effective WCD—or the likely (i.e., credible) worst-case spill volume.

The analysis estimated the following conservatively high frequencies of groundings or collisions for all vessel types, and the potential resulting spill sizes. The results are summarized below:

- The estimated average number of years that would elapse between groundings or collisions resulting in a spill of any size is 20 years;
- The estimated average number of years that would elapse between groundings or collisions resulting in a spill of 1,000 bbl is 34 years;

11 An engineering computer model used to estimate potential oil outflow given inputs such as vessel size, tank configuration, incident angle of collision, speed, etc. See Appendix J, HESCALV Model Approach.

- The estimated average number of years that would elapse between groundings or collisions resulting in a spill of 10,000 bbl is 2,018 years; and
- The estimated average number of years that would elapse between groundings or collisions resulting in a WCD of 189,845 bbl is 12,240 years.

The independent analysis confirms that large to very large spills are very uncommon but can occur, and the WCDs for such events can be substantial.

Table 4-7. Potential Spill Size by Vessel and Crude Oil Type from Groundings or Collisions

Incident Type	Crude Oil Type	Fiftieth Percentile Spill	Effective WCD
Handymax Vessel (85% of vessel calls)			
Grounding	Bakken crude oil	15,498	89,554
	Dilbit	14,919	84,384
Collision	Bakken crude oil	21,989	87,403
	Dilbit	22,014	87,403
Aframax Vessel (15% of vessel calls)			
Grounding	Bakken crude oil	28,983	171,888
	Dilbit	27,820	151,251
Collision	Bakken crude oil	46,815	189,845
	Dilbit	46,815	189,845
Suezmax Vessel (5% of vessel calls)			
Grounding	Bakken crude oil	38,506	184,380
	Dilbit	33,487	163,390
Collision	Bakken crude oil	55,130	220,678*
	Dilbit	48,046	192,144*

Source: Appendix J

Note: The risk analysis estimated the range of potential spill sizes both with and without spillage of bunker fuel (Tables 9–12). The largest spill volumes were selected, regardless of bunker fuel spillage, to present a conservative estimate of potential spill volumes.

* Suezmax collision values are presented here. It is unlikely there would be more than one Suezmax tanker in the Columbia River at the same time, and thus very unlikely that two Suezmax would collide. This effective WCD is highly improbable (Appendix J).

WCD = worst-case discharge, dilbit = diluted bitumen

4.5 PHYSICAL, TEMPORAL, AND ENVIRONMENTAL FACTORS AFFECTING CRUDE OIL SPILL IMPACTS

Planning for potential oil spills and responses to oil spills depends on the physical, temporal, and environmental factors that affect the behavior and impacts of oil released to the environment. This section addresses the different types of crude oil and their physicochemical properties; toxicity of different crude oils; processes influencing fate and transport of oil in the environment; and the potential impacts of releases to terrestrial, freshwater, and estuarine/marine environments. The potential consequences of fire and/or explosion resulting from an oil release are described in Section 4.7.

According to the Applicant, potential customers of the proposed Facility indicate that Bakken crude oil and dilbit would be the two most common crude oils transported to and from the proposed Facility. In addition, Bakken crude oil is typical of a light sweet crude oil and dilbit is representative of a heavy dense crude oil, and therefore these crude oils exemplify the range of crude oil types that could be transshipped through the proposed Facility. The impacts to environmental resources resulting from a release of either of these hazardous liquids would depend on the following factors:

- Physicochemical characteristics of the released oil, which can change over time due to weathering and response activities;
- Volume and duration of the release event;
- Location and nature of the release event;
- Physical conditions in the release area (e.g., currents), which vary in space and time;
- Weather (winds, light exposure, air temperature) affecting the oil's chemistry, particularly in water environments;
- Type of habitat (marine/estuarine, freshwater, terrestrial);
- Presence of environmental resources;
- Timing of biota breeding cycles and seasonal migrations;
- Locations of critical biologic habitats; and
- Effectiveness of response efforts to stop or slow the release of oil.

4.5.1 Characteristics of Crude Oil

4.5.1.1 Physicochemical Properties

Crude oil is composed of thousands of hydrocarbon compounds; elements such as sulfur, nitrogen, and oxygen; and trace metals such as nickel and vanadium (Fingas 2005). Hydrocarbons can be further divided into the following groups (API 1999):

- Alkanes, also called paraffins, which are made up of chains of carbon atoms with hydrogen atoms surrounding each carbon;
- Cycloalkanes, also called naphthenes, which are made up of simple closed rings of carbon atoms;
- Aromatics, including
  - Monoaromatic hydrocarbons, which are made up of a ring of six carbons (these compounds include benzene, toluene, ethylbenzene, and xylenes, collectively known as BTEX) and
  - Polycyclic aromatic hydrocarbons (PAHs), which consist of two or more benzene rings fused together; and
- Polar compounds, which have a molecular charge and include
  - Resins, which are small, polar compounds responsible for adhesion, and
  - Asphaltenes (so called because asphalt is primarily composed of these compounds), which are large polar compounds.

Different crude oils exhibit a wide range of properties based on the proportions of these chemicals within them. Crude oil chemical composition influences fate and transport in the environment as well as potential toxicity to human and other biologic receptors. Important physicochemical properties of crude oil include:

- API gravity (a measure of how dense an oil is compared to water);
- Vapor pressure, which indicates how quickly the crude oil will evaporate;
- Flash point, which is the lowest temperature at which the crude oil will vaporize and ignite in air;
- Viscosity, which determines how readily the crude oil would flow when released;
- Solubility, which represents the propensity of crude oil to dissolve in water; and
- Chemical constituents present in the oil (proportion and volume).

These characteristics influence the level of evaporation or volatilization of the released liquid in the environment, its persistence in the environment, and the amount of potentially toxic material that could dissolve or disperse into the aquatic environment. For instance, if a crude oil has an API gravity greater than 10, it indicates that the oil is lighter than water and will float; conversely, a crude oil with an API gravity less than 10 will sink in water.

An "average" crude oil contains approximately 84 percent carbon, 14 percent hydrogen, 1 to 3 percent sulfur, 1 percent nitrogen, 1 percent oxygen, and 0.1 percent minerals and salts (API 2011). Analytical studies indicate that similar hydrocarbons, heterocyclics, metals, and other constituents (e.g., hydrogen sulfide [H_2S]) are present in all crude oils but their proportions vary by crude oil source.

Bakken Crude Oil

Bakken crude oil originates from oilfields in North Dakota and Montana in the United States, and from Saskatchewan and Manitoba in Canada. Samples collected at different wells and rail terminals exhibit a range of characteristics (North Dakota Petroleum Council 2014). In general, Bakken crude oil is a light, sweet (meaning that it has a low sulfur content, generally 0.1 to 0.2 percent) crude oil. It is a low-viscosity oil, with an average API gravity of 40 to 43 degrees. It contains high quantities of volatile hydrocarbons and has a high vapor pressure; thus, it volatilizes quickly and is flammable (Ecology 2013, Andrews 2014, North Dakota Petroleum Council 2014). Bakken crude oil contains BTEX at levels comparable to other light crude oils, and is made up of approximately 5 percent natural gas liquids (NGL), including ethane, propane, butane, and pentane.

In 2014, PHMSA issued a safety alert reminding shippers and responders that Bakken crude oil, as a light, sweet crude oil, is more flammable than heavy crude oils (PHMSA 2014b). It is a Class 3 flammable liquid with a flash point ranging from −74 degrees Fahrenheit (°F) to 122°F (with a mean of −16.8°F), and it is classified as a DOT Packing Group I or II (most serious or moderate hazard) (American Fuel and Petrochemical Manufacturers 2014; 49 CFR Part 173, Subpart D). Other Group II oils include No. 2 fuel oil, jet fuels, West Texas Intermediate crude oil, and diesel.

Bakken crude oil is similar to other light crude oils (e.g., West Texas Intermediate) with a low sulfur content, low density, low persistence in the environment, and high volatility and flammability. Under certain conditions, volatile components of Bakken crude oil could potentially ignite explosively. Before being transported by rail, Bakken crude oil originating from North Dakota is preconditioned to have a vapor pressure no greater than 13.7 pounds per square inch (psi) and is not blended with liquids recovered from gas pipelines or with NGLs (NDIC Order No 25417).

Dilbit

Dilbit would be transported to the proposed Facility from the Alberta, Canada, oil sands. Bitumen is a heavy, sour (generally 3 to 5 percent sulfur), naturally occurring semisolid hydrocarbon with high concentrations of PAHs, resins, and asphaltenes (Ecology 2013, Environment Canada 2013). This chemical composition causes bitumen to be highly viscous and dense. Thus, to be transported via pipeline or rail, it is mixed with diluents, such as NGL, to become dilbit. The composition of dilbit varies between 25 to 30 percent diluent and 70 to 75 percent bitumen, depending on the viscosity of the bitumen and the density of the diluent (Ecology 2013). Dilbit has an API gravity of approximately 21.5 degrees (Ecology 2015a). The viscosity of dilbit is comparable to that of conventional heavy crude oil, and it has similar corrosivity to other heavy crude oils (API 2013, Tsaprailis 2014). Dilbit is similar to other denser and less volatile, potentially persistent heavier crude oils (e.g., South Louisiana and Alaska North Slope crude) (EPA 2015c).

4.5.1.2 Toxicity to Humans and Other Biological Receptors

The potential toxicity of different oil types to humans and other living species depends on chemical composition, amount and duration of receptor (organism) exposure, and receptor sensitivity. Receptor exposure can be either acute (≤96 hours) or chronic. Crude oil exposure can result in both lethal and sublethal impacts (e.g., reproductive impairments or immunotoxicity).

Human health hazards from crude oil can result from exposure to volatile organic compounds (VOCs), PAHs, and H2S. Acute inhalation hazard is primarily from H2S (API 2011). H2S gas could be emitted in small amounts, causing a wide range of health effects, primarily through inhalation (Centers for Disease Control 2015). Human health effects depend on the amount of H2S inhaled. Skin and/or eye contact with H2S can also affect human health. Symptoms of H2S gas inhalation or skin/eye contact include irritation of the eyes and/or respiratory system; apnea, coma, convulsions; conjunctivitis, eye pain, lacrimation (discharge of tears), photophobia (abnormal visual intolerance to light), corneal vesiculation; dizziness, headache, lassitude (weakness, exhaustion), irritability, insomnia; and gastrointestinal disturbance (Centers for Disease Control 2015).

Toxicity data are available for various aquatic and terrestrial organisms to several oil types and constituents (Table 4-8). Lethal effects from acute exposure to crude oil and its constituents have been demonstrated for an array of fish species at various life stages. The sensitivity of fish to the lethal effects of oil and its constituents is dependent on species and life stage. Embryos and larvae can be particularly susceptible to acute exposure (Billiard et al. 2008), and vertebrates (i.e., fish) tend to be more sensitive than invertebrates (e.g., shrimp, crab, oysters).

Mortality occurs over a range of doses and is highly dependent on duration of exposure. It is difficult to predict how different species are affected by chronic exposure to hydrocarbon compounds, but mortality resulting from chronic exposure often occurs at levels an order of magnitude or more lower than those that induce acute toxicity (McGrath and Di Toro 2009).

Table 4-8. Acute Toxicity Values (96-hour LC50) for Fish or Invertebrates Exposed to Oil or Individual Aromatic Hydrocarbons

Species	Common Name	Life Stage	Oil/MAHs/PAHs	LC50 (mg/L)
Oncorhynchus mykiss	Rainbow trout	Juvenile	Benzene	5.3
Cyprinodon variegatus	Sheepshead minnow	Juvenile	Ethylbenzene	280
Oncorhynchus gorbuscha	Pink salmon	Juvenile	Cook Inlet crude oil WSF	1.20 TPAHs
Platichthys stellatus	Starry flounder	Juvenile	Cook Inlet crude oil WSF	1.80 TPAHs
Melanotaenia fluviatilis	Crimson-spotted rainbowfish	Larvae	Bass Strait crude oil WAF	1.28 TPH
Oncorhynchus mykiss	Rainbow trout	Juvenile	Naphthalene	1.60
Pimephales promelas	Fathead minnow	Juvenile	Naphthalene	7.90

Table 4-8. Acute Toxicity Values (96-hour LC50) for Fish or Invertebrates Exposed to Oil or Individual Aromatic Hydrocarbons

Species	Common Name	Life Stage	Oil/MAHs/PAHs	LC50 (mg/L)
Melanotaenia fluviatilis	Crimson-spotted rainbowfish	Larvae	Naphthalene	0.51
Pimephales promelas	Fathead minnow	Juvenile	Acenaphthene	1.60
Ictalurus punctatus	Channel catfish	Juvenile	Acenaphthene	1.70
Oncorhynchus mykiss	Rainbow trout	Juvenile	Acenaphthene	0.670
Salmo trutta	Brown trout	Juvenile	Acenaphthene	0.580
Cyprinodon variegatus	Sheepshead minnow	Larvae	Phenanthrene	0.478
Menidia beryllina	Inland silverside	Juvenile	Fluoranthene	0.616
Callinectes sapidus	Blue crab	Larvae	Central Gulf oil	6.38 TPH
Emerita analoga	Sand crab	Larvae	Weathered oil	7.7 TPH
Crassostrea virginica	Eastern oyster	Juvenile	No. 2 fuel oil WSF	1.9 THC
Mysidopsis bahia	Mysid	Embryolarval	Kuwait crude oil	0.63 TPH
Crassostrea gigas	Pacific oyster	Embryolarval	Medium fuel oil	>1.14 TPH

Sources: Heitmuller et al. 1981, DeGraeve et al. 1982, Sigler and Leibovitz 1982, Holcombe et al. 1983, Moles and Rice 1983, Barron et al. 1999, Carls et al. 1999, Moreau et al. 1999, Spehar et al. 1999, Clark et al. 2001, Pollino and Holdway 2002, Fucik et al. 2005

LC50 = lethal concentration 50: the concentration of a chemical that causes death in 50 percent of the test population during the exposure time, MAH = monocyclic aromatic hydrocarbons, THC = total hydrocarbon, TPAHs = total polycyclic aromatic hydrocarbons, TPH = total petroleum hydrocarbon, WAF = Water-accommodated fraction of crude oil, WSF = Water-soluble fraction of crude oil

4.5.1.3 Flammability of Crude Oil

Several factors define the degree of flammability of a crude oil, including:

- Flash point—sustained burning occurs above the flash point temperature of the crude oil;
- Flammability limits, or the range of vapor concentration in the air that supports combustion;
- Auto-ignition temperature, or the minimum temperature at which a fuel-air mixture ignites;
- Minimum ignition energy, or the minimum energy required to ignite a flammable fuel-air mixture; and
- Burning velocity, or the velocity at which a fuel-air mixture issuing from a burner burns back to the burner (Sandia National Laboratories 2015).

A fuel with a lower flash point, wider range of flammability limits, lower auto-ignition temperature, lower minimum ignition energy, and higher maximum burning velocity is generally considered more flammable, although the energy generated from an accident may still cause crude oil that is considered less flammable to ignite (Sandia National Laboratories 2015). If an accident leads to the release of crude oil, possible crude oil fire and/or explosion events could include:

- Pool fire, which results from the burning of a liquid fuel pool;
- Boiling liquid expanding vapor explosion, or an explosion resulting from tank failure at a temperature significantly above the crude oil boiling point;

- Fireball, which refers to partially premixed diffusion flames that rapidly combust due to enhanced turbulent mixing and atomization;
- Flash fire, which refers to the burning of a fuel vapor cloud that is ignited at a location away from its release point; and
- Flare, which refers to the burning of fuel vapors at the source of a release (Sandia National Laboratories 2015).

Current regulations to improve the safety of crude oil transportation, such as the preconditioning requirements for North Dakota Bakken crude oil, are presented in Section 4.2.

4.5.2 Crude Oil Weathering in the Environment

When oil is released into the environment, it is altered by various chemical and biological processes that are collectively referred to as "weathering," including spreading/dispersion, evaporation, dissolution, emulsification, photo-oxidation, adsorption/sedimentation, and biodegradation. Weathering rates are highest immediately following release of crude oil into the environment and decrease over time. The degree to which an oil undergoes weathering depends on the oil characteristics and the environment into which it is released. Figure 4-5 illustrates the weathering processes that may occur in the environment following release of oil.

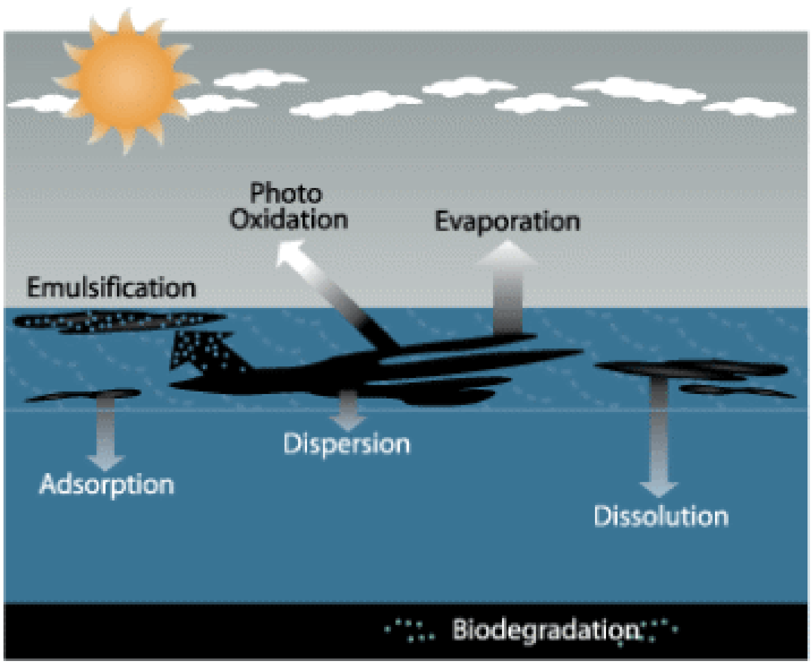


Figure 4-5. Crude Oil Weathering Processes

Source: NOAA 2015a

Spreading reduces the bulk quantity of oil present in the spill vicinity but increases the area over which adverse effects could occur. Thus, oil in flowing systems (e.g., rivers and creeks) rather than contained systems (e.g., wetlands, ponds, and lakes) would be less concentrated in any given location but could cause impacts, albeit reduced in intensity, over a larger area. Spreading and thinning of spilled oil also increases the surface area of the slick, enhancing surface-dependent fate processes such as evaporation, biodegradation, photo-oxidation, and dissolution. Spreading from the spill source is constrained by natural conditions in the release site vicinity.

Dispersion is the spreading of oil in water. This process increases when water surface turbulence increases, as caused by rain events, wind, and tidal currents. Oil may be dispersed as it adheres to particulate matter (including organic matter, silt and clay, and larger sediment particles) suspended in the water column.

Evaporation occurs when the lighter, more volatile compounds in oil change chemical state from a liquid to a vapor. These vapors are often highly flammable and may cause fire if they come into contact with an ignition source. The process of evaporation/volatilization occurs quickly following an oil release into the environment and is the primary process by which oil is removed from water. Light oils that contain a large proportion of volatile compounds will evaporate more quickly and to a greater extent than heavy oils. Following evaporation, the properties of the remaining oil are much different than the original oil: the hydrocarbons remaining are the heavier, more persistent fractions of oil, and both the density and viscosity of the remaining oil are higher.

Dissolution occurs as water-soluble components dissolve into the water column from the surface slick. Dissolution is usually not a primary driver of oil fate and transport; it is estimated that only 2 to 5 percent of oil in water undergoes natural dissolution following a spill because the compounds that most readily dissolve also most readily evaporate (e.g., BTEX) (Neff 1990). Dissolution increases with decreasing hydrocarbon molecular weight, increasing water temperature, decreasing salinity, and increasing concentration of dissolved organic matter.

Emulsification creates mixtures of small droplets of oil and water known as emulsions. Two types of emulsions, water-in-oil and oil-in-water, are formed by wave action. Emulsions are largely recalcitrant to other types of degradation, thus leading to increased persistence of oil in the environment. Water-in-oil emulsions are most likely to form with oils that contain high concentrations of asphaltenes and resins and with lighter oils, emulsifying following evaporation when asphaltenes are concentrated in the oil left behind (API 1999, Ecology 2015a). Emulsification occurs less frequently in fresh water than in salt water, and salt water produces more stable emulsions than does fresh water.

Photo-oxidation occurs when ultraviolet light present in sunlight breaks down the chemical bonds of the oil constituents. Thus, it increases with greater solar intensity, such as on sunny days and in summer months, and decreases on cloudy or wintry days. It can be a significant factor controlling the disappearance of a slick, especially of lighter constituents. Many photo-oxidized compounds tend to be more water-soluble than parent compounds and are also more available to further degradation processes.

Adsorption is the binding of oil to particles in soil, sediment, and water. Oil that is dispersed in soil or oil that reaches sediments in waterbodies would adsorb to soil/sediment particles. In water, PAHs and other higher molecular weight hydrocarbons may bind to suspended particulates, and this process can be significant in highly turbid or eutrophic waters (waters rich in phosphates, nitrates, and organic nutrients). Organic particles (e.g., biogenic material) in soils or suspended in water tend to be more effective at adsorbing oils than inorganic particles (e.g., clays). Adsorption and sedimentation decrease the concentration of hydrocarbons present in the water column but also make them less susceptible to further degradation, increasing persistence in the environment.

Biodegradation occurs when microorganisms, native or introduced, feed on oil hydrocarbons in the water column, soil, and sediments, and break down the oil, excreting water and carbon dioxide as waste products. Biodegradation of oil by native microorganisms, in the immediate aftermath of a spill, would likely not be a significant process controlling the fate of oil in waterbodies due to the slow nature of the process. Saturated alkanes are the most readily biodegraded components of crude oil while aromatics and asphaltenes biodegrade very slowly or not at all (Fingas 2005).

4.5.3 Releases of Crude Oil in the Terrestrial Environment

Oil released to inland areas is typically more easily contained than oil released to water. The rapid installation of containment features (e.g., dikes, impoundments, and physical barriers) around the spill area can deter spreading. The lighter the released oil, the greater the extent and rate of evaporation. Because dilbit contains a higher concentration of higher molecular weight hydrocarbons, it is not as prone to evaporation and is therefore more persistent in terrestrial environments. In laboratory analyses, six hours of evaporation reduced the mass of two types of dilbit (Access Western Blend and Cold Lake Blend) by 15.9 percent and 11.7 percent, respectively (Environment Canada 2013).

Heavier oil components (such as resins and asphaltenes) that do not evaporate can form crusts that prevent further evaporation of the oil and increase persistence of the oil in the environment (Fingas 2005). However, this also makes the oil largely not bioavailable. Any remaining BTEX and other lightweight constituents can enter soil and shallow groundwater. Water-soluble constituents can form a dissolved groundwater plume that would move in the direction of groundwater flow. Plume movement would depend on groundwater flow rate. Heavier components, such as PAHs, would move much more slowly because they are likely to be bound to soils. Depending on the type of oil and properties of the soil, some of the oil would likely adsorb to the soil, particularly to the organic fraction. Biodegradation and photolysis would also affect the persistence and spread of a crude oil spill.

The extent of spill dispersal would partially depend on the size and rate of release, topography and geology of the release site, vegetative cover, and speed and success of emergency spill containment and cleanup measures. Light crude oils would penetrate quickly through most soil matrices. Dilbit and other heavier crude oils would disperse more slowly than Bakken crude oil.

4.5.4 Releases of Crude Oil in the Freshwater Environment

Oil spill dispersal in freshwater habitats varies according to water flow and the habitat’s specific characteristics. Spills would tend to pool in standing or slow-moving water, such as marshes or lakes. Factors affecting the persistence and spread of crude oil in freshwater environments include evaporation, natural dispersion, dissolution, photo-oxidation, sedimentation, and biodegradation.

The density of fresh water is about 1 gram per cubic centimeter while that of heavy oils is 1.01 gram per cubic centimeter; therefore, heavy oils sink in rivers. The density of some oils is so similar to that of river water that spills sometimes spread partly underwater. Any spilled crude oil, including Bakken crude oil, can sink in water. Actual sinking, in the sense that the crude oil is permanently removed from the surface, occurs if the oil is denser than the surrounding water, if the buoyant rise of very small oil droplets is impeded by the friction of the water, or if the oil has been mixed with enough sediment (NOAA 1995). Both dilbit and Bakken crude oil will initially float. Experiments with two different types of dilbit (Access Western Blend and Cold Lake Blend) under differing environmental conditions determined that dilbits would float on the surface of fresh water but “could become submerged with the addition of sediment and negatively buoyant particulates” in the water column (Witt O’Brien’s 2013). Both dilbits became more viscous within 24 to 48 hours of the simulated spill event. Evidence from previous dilbit spills (in Marshall, Michigan, in 2010 and Burnaby, British Columbia, Canada) has shown that dilbits float on water until their density is altered by weathering and/or sediment uptake occurs (Polaris 2013).

In large rivers, waves can affect the movement and spreading of oil spills. Initially, the oil spreads to form a thin film called an oil slick, which appears smooth compared to the water around it. Small waves tend to push oil slicks in the direction of wave propagation, which makes oil slicks move slightly faster than the water surface on which they are floating. Short, relatively steep waves can result in a surface current that moves the oil in a downwind direction. As waves break, the resulting plunging water creates a turbulent wake, carrying particles of oil down into the water column (EPA 2014a). Increased agitation, caused by simulated wind and wave conditions, has been shown experimentally to cause BTEX to dissolve more quickly in water and increase depletion rates beneath an oil slick (Witt O'Brien's et al. 2013). When oil spills into a flowing river, the current acts as a natural dispersion mechanism (EPA 2014a). Currents tend to be the strongest along the outside edge of a bend in a river where the current flows into the outside bank before being deflected downstream, so oil can concentrate in this area.

Oil tends to stick to sediments and to the surfaces of cobbles and pebbles. It also migrates downward in the spaces between cobbles, pebbles, and sand grains, and accumulates in underlying sediment layers. Oil that adheres to sediment particles suspended in the water column or along the bank is exposed to sunlight and waves that increase degradation.

4.5.5 Releases of Crude Oil in the Estuarine/Marine Environment

Crude oils are generally less dense than seawater, and they float on or near the surface unless they are dispersed into the water by turbulence from breaking waves and tidal currents. Most of the compounds in oil are insoluble. However, BTEX compounds and some of the lighter PAHs are volatile and soluble in water. The smaller nonaromatic compounds evaporate rapidly. Light, medium, and heavy oils lose up to 75, 40, and 5 percent, respectively, of their initial volume in the 48 to 72 hours following an oil spill (Fingas 1997). Over time, spilled oil contains less volatile and soluble compounds, leaving a residual heavier material that can become sticky and tar-like (Applied Science Associates 2013). In some cases, the oil is heavier than water when it is spilled or becomes heavier than water after the lighter fractions evaporate, and the residue may sink to the bottom.

Floating oil tends to form slicks (0.1 millimeter thick) when first released, which thin out over time into sheens (0.0003 millimeter thick) (Appendix J). As the oil slick spreads, it begins to break up into patches. Wave action causes the oil to emulsify, increasing its density and reducing its surface flow characteristics. Water-in-oil emulsions occur more frequently in estuarine and marine systems. Though the exact processes of emulsification are not fully understood, it is known that oils containing a high amount of asphaltenes and resins are more likely to form emulsions than lighter crudes (Fingas 2005).

Environment Canada (2013) showed that fresh and moderately weathered dilbit sank in salt water when mixed with fine- and moderate-sized sediments; more weathered dilbit did not adsorb to the particles in the water, and resulted in floating heavy oil that eventually broke up into weathered tarballs. The tarballs are transported by currents. Onshore winds drive oil to shorelines where it is distributed over beaches (Applied Science Associates 2013). Sunken oil may settle into sediments but can also adsorb to particles in the water column. Estuarine and intertidal areas have higher concentrations of suspended particulates leading to more oil adsorption (Mosbech 2002), and resulting in oil sinking to the bottom.

In the open ocean, light crude oils, such as Bakken, may naturally disperse as a result of significant wave action. In estuarine environments that lack significant wave action, natural dispersion of oil is unlikely. The light range fractions tend to be rapidly removed from the water surface through evaporation, and through dissolution. On sandy beaches, oil can penetrate up to 2 meters (6.6 feet) (Mosbech 2002). Oil deposited on rockier shorelines is often reintroduced into open-water areas by wave action.

4.6 RESPONDING TO AN OIL SPILL, FIRE, OR EXPLOSION

This section describes how a spill response is triggered; what happens during response to a spill, fire, and/or explosion; the logistical and response responsibilities and capabilities of the proposed Facility, railroads, vessels, and local or regional first responders; and how a spill may be contained and recovered. As described in Section 4.2, the proposed Facility, railroads, and vessels are subject to state and federal regulations, including those that require the reporting and response to crude oil spills. During an oil spill incident, fire, or explosion, response activities are initiated by personnel at the proposed Facility, railroad or vessel industry responders, and local or regional first responders from appropriate agencies/departments in accordance with relevant emergency and contingency plans (see Section 4.3).

4.6.1 Emergency Response Notification

4.6.1.1 Crude Oil Spill

Once a spill is detected, responsible agencies must be notified so that a coordinated spill response can be started. Triggers for agency notification are summarized in Table 4-9. The requirements for notification vary by agency, spill size, and location. Washington has no minimum reporting quantity for a crude oil spill to water, meaning a spill of any size must be reported.

Table 4-9. Triggers for Notifications

Statute/Regulation	Description
40 CFR Part 110	Discharge of Oil regulations require any person in charge of a vessel or of an onshore or offshore facility to report to the NRC (or EPA regional office if reporting to NRC is not practicable) discharges of a harmful quantity of oil to US navigable waters, adjoining shorelines, or the contiguous zone, or in connection with activities under the Outer Continental Shelf Lands Act or Deepwater Port Act of 1974 that may affect natural resources under exclusive US authority. A harmful quantity is considered any quantity of discharged oil that violates state water quality standards, causes a film or sheen on the water's surface, or leaves sludge or emulsion beneath the surface.
40 CFR Part 112	Oil Pollution Prevention regulation, commonly referred to as the SPCC rule, states that discharges must be reported to EPA if the amount of oil that reaches navigable water or adjoining shorelines (not the total amount of oil spilled) is either: • More than 1,000 US gallons of oil in a single discharge to navigable water or adjoining shorelines or • More than 42 US gallons of oil in each of two discharges to navigable waters or adjoining shorelines occurring within any 12-month period.
WAC 173-182-264	Under 173-182-264 all spills are considered reportable except: (i) Spills known to be less than 42 gallons that do not impact surface or groundwater. (ii) Comprehensive Environmental Response, Compensation, and Liability Act releases. (iii) On-facility air releases to the atmosphere only. (iv) Releases from underground storage tanks regulated under WAC 173-360. (v) Preexisting sources of releases identified as Resource Conservation and Recovery Act solid waste management units. (vi) Spills contained within areas controlled by National Pollutant Discharge Elimination System permitted systems that are not likely to threaten groundwater and do not exceed applicable federal reportable quantities. (b) A spill is considered to have not impacted ground if it occurs on a paved surface such as asphalt or concrete. A spill to dirt or gravel is considered to have impacted ground and is reportable.
Oregon Administrative Rules 340-142-0040 and 340-142-0050	Reporting is required if the oil or hazardous material spilled or released, or threatening to spill or release, is spilled or discharged into waters of the state or in a location from which it is likely to escape into waters of the state any quantity of oil that would produce a visible film, sheen, oily slick, or oily solid, or coat aquatic life, habitat, or property with oil, but excluding normal discharges from properly operating marine engines. Additionally, any quantity of oil over 1 barrel (42 gallons) spilled on the surface of the land, and not likely to escape into waters of the state, must be reported. The quantity determination will be the quantity of oil spilled or released before contacting or mixing other material or substance. In the case of a threatened spill or release, applicable quantity is the amount in the container or tank from which a spill or release is likely and imminent.

CFR = Code of Federal Regulations, EPA = Environmental Protection Agency, NRC = National Response Center, SPCC = Spill Prevention Contingency and Countermeasure, WAC = Washington Administrative Code

Response to an oil spill requires the combined efforts of the owner or operator of the facility, rail carrier, or vessel that spilled the oil, the FOSC, and state and local government officials. The specific steps taken to respond to a spill depend on the type of oil discharged, the location of the discharge, the proximity of the spill to sensitive environments, and other environmental factors. Table 4-10 provides the required federal and state notifications.

Table 4-10. Required Notifications

Location[1]	Federal Notifications						State Notifications		
	National Response Center	NOAA Scientific Support Center[2]	Department of the Interior[3]	Sector Puget Sound	Sector Columbia River	EPA, Seattle	Washington State Emergency Division	Washington State Department of Ecology	Oregon Emergency Response System
Washington	x	x	x				x	x	
Oregon	x	x	x						x
Washington Coast north of the Queets River	x	x	x	x			x	x	
Navigable waters of Columbia River, Oregon Coast, Washington Coast South of Queets River	x	x	x		x		x	x	x
Inland waters of Washington and Oregon	x	x	x			x	x	x	X

Source: RRT and NWAC 2015b

Notes:

1 Spills into water shared by two states must be reported to the applicable agencies of both states.

2 Petroleum product spills, or other hazardous material discharges, greater than 500 gallons. Release or discharge impacts known marine sensitive resource. Any spill or release or threat of a spill release that could impact the Olympic Coast National Marine Sanctuary, Padilla Bay National Estuarine Research Reserve, and South Slough National Estuarine Research Reserve.

3 All oil spills greater than 500 gallons and all major potential incidents such as vessel groundings.

EPA = US Environmental Protection Agency, NOAA = National Oceanic and Atmospheric Administration

If the spill may impact or threaten to impact any resources on tribal lands or in areas that are the usual and accustomed hunting or fishing grounds of tribes in Washington, Oregon, and Idaho, tribal notification is also required.

4.6.1.2 Crude Oil Fire and/or Explosion

In the event of a fire or explosion at the proposed Facility, the Applicant would implements its FPRP. As described in Section 4.3.8.4, this plan includes coordination with the Port, local fire officials, and emergency responders. The proposed Facility would be equipped with fire-suppression equipment for the type and amount of flammable and combustible materials stored at the proposed Facility.

In the event of a fire or explosion in the rail corridor, BNSF would implements its FPRP in cooperation with local, state, and federal response teams. Response activities could include:

- Cooling containers, controlling vapors, and protecting personnel from exposures,

- Dry chemical firefighting in conjunction with Class B forms, and
- Constructing barriers to prevent runoff into water systems or waterbodies.

Depending on the size and location of the release, evacuation of the area may occur and the fire could be allowed to burn out (BNSF 2013a).

In the event of a fire or explosion on a vessel, the operator would implements its FPRP in conjunction with the guidance in the Marine Firefighting Contingency Plan found in Section 8000 of the NWACP (RRT and NWAC 2015b). Depending upon the location and extent of the fire, the response could include moving or scuttling the vessel to minimize damage to sensitive resources (RRT and NWAC 2015b).

4.6.2 Incident Command and Mobilization

Regardless of whether a spill occurs at the proposed Facility or during crude oil transportation, the Responsible Party (RP) is required to contact its emergency response contractors identified in its spill response plan (49 CFR Part 194.115). The response contractors typically consist of personnel trained in Hazardous Waste Operations and Emergency Response (HAZWOPER). The response organization would follow the approved industry and regulatory agency Incident Command System, and would typically consist of personnel both onsite and at an established remote or regional Emergency Operations Center. A spill in or potentially affecting the shared waters of the Columbia River must be reported to both Washington and Oregon state officials. Information on applicable response plans is presented in Section 4.3. The preliminary incident command notification system for the proposed Facility is presented in Figure 4-6.

The following response actions would be implemented as required by the relevant response plan(s):

- Notifying all private companies or government agencies that are responsible for the cleanup effort;
- Getting trained personnel and equipment to the site quickly;
- Defining the spill's size, position, and content; its direction and speed of movement; and its likelihood of affecting sensitive habitats;
- Ensuring the safety of all response personnel and the public;
- Stopping the flow of oil from the train, vessel, or storage facility, if possible, and preventing ignition;
- Containing the spill to a limited area;
- Removing the oil; and
- Appropriately disposing of the oil once it has been removed from the water or land.

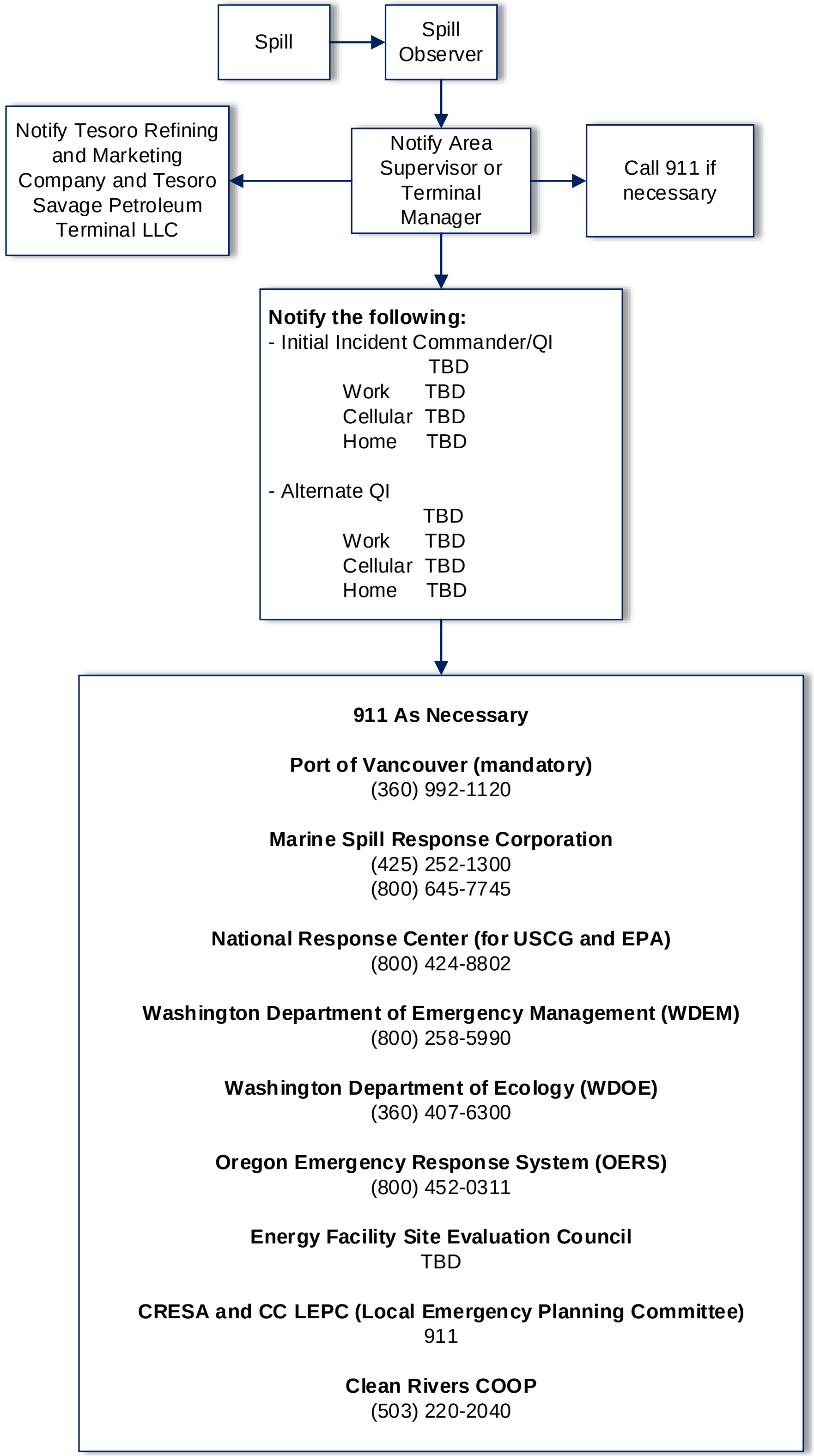


Figure 4-6. Preliminary Oil Spill Contingency Plan Notification Flow Chart

Source: Appendix D.4 (Oil Spill Contingency Plan)

4.6.3 Proposed Facility

4.6.3.1 Crude Oil Spill

Small onsite spills that remain within the site boundary would likely be responded to by proposed Facility personnel and/or contractors in accordance with the Applicant’s OSCP. At the proposed Facility, any spills captured within the secondary containment systems for the storage tank area, railcar unloading facility, and transfer pipelines would be removed by vacuum trucks and disposed at an approved offsite location. However, a release of a greater quantity than the reportable quantities listed in Table 4-9, a release with the potential to impact waters of Washington, or a spill beyond the capability of proposed Facility personnel and contractors would require notification of other responders. In the event that the VFD is dispatched to the proposed Facility, the interpretation by the emergency dispatcher of the information provided by the caller requesting response would determine the initial level of response and the resources required. As discussed in Section 4.3.6, VFD would follow Clark County’s HMERP to respond to spills of hazardous materials (including crude oil) at the proposed Facility.

VFD would serve as the on-scene Incident Commander for spills at the proposed Facility. For small spills and for spills without fire danger, it is unlikely that an evacuation of the proposed Facility would be warranted. VFD provides core staff and equipment and has the primary responsibility for providing special operations services to the region (Clark County LEPC 2014). In accordance with the HMERP, VFD’s responsibilities would include restricting or denying entry to the site of the spill; investigating and reporting the spill; coordinating activities with other jurisdictions, facilities, and responders; and requesting technical support from Hazardous Materials Response Teams (HMRTs) when necessary (Clark County LEPC 2014). If necessary, American Medical Response would transport workers exposed to crude oil or fumes to a local hospital.

VFD first responders would determine if the spill is contained, and if fire danger and/or additional leak potential exists. If VFD determines through interaction with proposed Facility response personnel that the spill is contained and no fire danger or additional leak potential exists, the HAZMAT team leader would interact with proposed Facility personnel to determine final mitigation and followup requirements (Eldred 2015). VFD would also determine if foam has been applied or needs to be applied and would confirm that the proposed Facility OSCP and/or FRP is activated and that all proposed Facility personnel are accounted for. The VFD HMRT would conduct air monitoring and work with the proposed Facility personnel to determine if any hazardous materials infrastructure has been degraded. If VFD determines that a spill poses a risk to the Columbia River, the USCG and Ecology would be notified. If VFD and its mutual aid resources require additional response resources, the Clark Regional Emergency Services Agency's Emergency Operations Center could be activated. The Incident Commander could request additional state, regional, and/or federal assistance through this center. For instance, personnel from other fire agencies that participate in the Washington State Homeland Security Region IV HAZMAT Team may be called upon to assist in the event of a large crude oil spill incident.

In the event of a spill, police and security services could be necessary to ensure public safety. In this event, and in accordance with the HMERP, the Vancouver Police Department (VPD) would

- Act as the lead agency for evacuation and site security,
- Participate in the Incident Command System,
- Provide crowd and traffic control,
- Investigate crimes related to a hazardous materials release incident,
- Assist with warning and emergency information dissemination,

- Warn the public about evacuation routes and locations or notify the public to shelter-in-place, and
- Provide a representative to the Clark Regional Emergency Operation Center.

The Port's security services would also assist the VPD in managing evacuation of the proposed Facility (if necessary) and assist in providing site security in the event of a hazardous materials release.

The Incident Commander would determine when individual fire department resources can be demobilized and initiate transition from an emergency response to a cleanup phase. The HMRT would remain on scene until the spill is contained and additional threats are eliminated, and would work with local, state, and federal agencies during cleanup if necessary (Eldred 2015).

4.6.3.2 Crude Oil Fire and/or Explosion

The design of the proposed Facility includes onsite fire suppression systems, and proposed Facility personnel would be trained in maintaining and operating those systems. However, the proposed Facility would not have a fire brigade, and would depend on fire response assistance from VFD. If response is required, VFD would respond consistent with the HMERP. Hazards the VFD may encounter during response include confined spaces, high angle rescues, entanglement, entrapment, water-related hazards, and fire. A fire and/or explosion confined to the site could require VPD and the Port's security services to evacuate the site. Explosion debris, fire, or smoke extending to offsite locations would pose a risk to the public and may require evacuation of a larger area, and may also require crowd and traffic control.

4.6.3.3 Fire Department/Medical Facility Response Preparedness

EFSEC held discussions with VFD managers during preparation of this Draft EIS to help determine the current preparedness of response personnel and equipment to respond to crude oil spills and fires at the proposed Facility and along the rail delivery route within the City of Vancouver. VFD identified the need for its staff to receive additional training on an annual basis in crude oil train derailment response, crude oil transshipment response at a marine terminal, industrial rescue, water response, industrial fire suppression, flammable liquids handling and fire suppression, and foam application in a live fire event.

VFD has further identified the need to fully identify and assess the risks involved in crude oil transportation and transshipment within the City and throughout their regional response area. They feel they have much work to do in this risk assessment and in response planning and personnel training. VFD is also concerned that the planning and training required to prepare for the development and operation of the proposed Facility could impact its ability to maintain its current service levels. VFD also stated that the need to attend training would create challenges in maintaining their regular minimum staffing and paying backfill and overtime for members to attend specialized training (Eldred 2015).

If a fire and/or explosion at the proposed Facility or along the rail route in the Vancouver area were to cause injuries, the Medical Resource Hospital at Oregon Health and Science University would, in accordance with the Clark County HMERP, coordinate distribution of patients to local hospitals and medical facilities if the impacted jurisdiction's hospitals are overwhelmed.

4.6.4 Rail Transportation

4.6.4.1 Crude Oil Spill

As described in Section 4.3.9, BNSF would respond to a crude oil spill along the rail corridor, using industry responders and appropriate federal, state, and local response agencies. In the event of a crude oil spill, the first arriving responders would determine the extent and quantity of the spilled oil and whether the release is continuing to occur. Responders would also determine if foam needs to be applied to the spill. Depending on the available resources and the specific circumstances of the incident, first responders may elect to begin spill containment operations (e.g., diking, damming, boom deployment) to limit the spread of the crude oil. The responding agency may apply foam to the oil spill and/or at-risk tank cars to prevent the ignition of flammable and combustible liquids, or apply water fog spray to the sides of at-risk tank cars for vapor suppression and cooling. If adequate manpower and air monitors are available, the first responders could conduct air monitoring to detect the presence of flammable gases and inhalation hazards. The fire chief, or other Incident Commander, may request mobilization of regional or statewide firefighting resources (Washington State Fire Marshal's Office 2015). BNSF's railroad police team also provides law enforcement services along the rail corridor. This railroad police team may be able to assist in the event of an incident along the rail corridor, which would reduce the burden on responding law enforcement agencies. However, information about the number and location of railroad police personnel is not sufficiently detailed/available to determine the extent to which the railroad's resources could reduce the burden on responding law enforcement agencies.

4.6.4.2 Crude Oil Fire and/or Explosion

In the event of a crude oil fire and/or explosion along the rail corridor, both BNSF response personnel and responding fire companies would evaluate hazards to human life, property/critical infrastructure, and the environment to determine immediate resource requirements and response options. BNSF resources include equipment, supplies, and contract firefighters who could respond in the event of an incident. The fire chief, or other Incident Commander, would make decisions related to the need for rescue, evacuation, and defensive operations. Depending on the circumstances, the Incident Commander could elect to let the fire burn, conduct structural firefighting, and use foam and/or water resources to extinguish the fire. If the response requires fire suppression, then sufficient foam concentrate and water supplies, as well as foam appliances, equipment, and properly trained personnel would be needed to effectively implement and sustain fire suppression and post-fire suppression operations (PHMSA 2014c).

The availability of large quantities of foam and water and the ability to quickly apply and reapply foam to a crude oil fire is critical to maintaining an adequate foam blanket. For example, a single tank car fire may require 600 gallons of foam concentrate and 38,000 gallons of water applied at a target rate of 660 gallons per minute (gpm) for 15 minutes, and must be reapplied as necessary to extinguish the fire. To extinguish a three–tank car fire, responders may require 1,500 gallons of foam concentrate and 80,000 gallons of water applied at a target rate of 1,680 gpm for 15 minutes, and must reapply the foam blanket as necessary (Office of Fire Prevention & Control 2014). DOT regulations (49 CFR 179) require that tank cars be manufactured to withstand a minimum of 100 minutes in an oil pool fire without failure. To prevent the spread of fire from one tank car to the next, sufficient equipment and enough trained personnel must begin applying foam to affected cars prior to that 100-minute mark. Given the distance of some rural communities from mutual aid resources and the time it would take for state mobilization to occur, in some situations there may not be sufficient personnel in place in time to stop the original fire from spreading to the surrounding tank cars. A larger fire would demand more fire protection resources to ensure the safety of human life, property, and the environment. Besides the manpower needed to operate the equipment and handle logistics, backup support would be required to handle an extended operation due to the physically intensive nature of a large crude oil fire response. Even if the fire chief, or other Incident Commander, requests state mobilization, the local fire jurisdiction(s) would remain on the scene throughout the duration of the emergency response effort.

4.6.4.3 Fire Department/Medical Facility Response Preparedness

The Washington State Military Department's EMD performed a survey of fire departments/districts in June 2014 for Ecology and found that "even the most metropolitan, best-equipped departments consider themselves ill prepared to respond to a crude-by-rail [incident] with related explosion and/or fire incident." That survey was sent to 236 fire departments/districts across Washington with rail traffic in their jurisdictions, and 14 percent responded (although EMD determined the survey was likely representative of statewide conditions). Ecology concluded that additional information sharing, specialized training, and purchase or sharing of equipment is necessary to adequately prepare for a crude-by-rail incident (Ecology 2015a).

To help determine current preparedness of response personnel and equipment in the vicinity of the proposed Facility and along the rail corridor, EFSEC conducted discussions and surveys with fire departments in these areas. Of the 34 fire departments/fire protection districts invited to participate in EFSEC's survey, 12 responded, resulting in a 35 percent response rate. Of the responding jurisdictions, the majority are volunteer agencies, where at least 75 percent of the agency's firefighters are unpaid members of the community. While the responding jurisdictions were evenly split in describing their service area as rural or urban, most (82 percent) answered that the railroad in their jurisdiction is located near populated areas. Despite this, the survey results indicate that less than half (42 percent) of responding jurisdictions currently have an ESF 10 plan that includes response to a train derailment with fire, and only 33 percent of jurisdictions currently have a plan for large-scale evacuations. Similar percentages were reported in Ecology's study (Ecology 2015a). One fire agency responding to EFSEC's survey noted that a plan to respond to a train derailment and associated fire is currently in development.

Ecology's report (2015b) states that "Bakken crude oil is a new hazard and more information is needed to give the average fire chief, and LEPC and TERC [Tribal Emergency Response Commission] coordinator knowledge and skills to adequately plan for a crude-by-rail incident." While participation in LEPCs provides an avenue for information sharing and planning, only half of jurisdictions that responded to the EFSEC survey stated that they participate in an LEPC. As reported by one responding fire agency, daytime LEPC meetings may not be accessible to volunteer firefighters who work another job.

At the time of the survey, less than half (42 percent) of the responding fire agencies reported having received at least some training from BNSF on handling rail incidents involving hazardous materials. As pointed out by the VFD, which sent 10 HAZMAT technicians to BNSF training on crude-by-rail unit train incident response, the need to attend specialized training creates challenges in maintaining regular minimum staffing and paying backfill and overtime to members (Eldred 2015). The same percentage of responding fire agencies (42 percent) reported having a Type 1 HMRT, or access to a Type 1 HMRT through mutual aid agreement. A Type 1 HMRT is appropriately equipped and trained to handle all known and unknown industrial chemical hazards and weapons of mass destruction including chemical and biological substances, whereas Type 2 and Type 3 HMRTs have more limited equipment and training. Of the three types of teams, only a Type 1 HMRT would have the appropriate equipment and staffing to fight a crude-by-rail incident that involves fire and/or explosion (Ecology 2015a).

Only 1 out of 12 fire agencies that responded to EFSEC's survey reported that its firefighters are trained and equipped to respond to a train derailment with resulting oil spill and fire. All responding jurisdictions indicated that they can contact the owners of a crude oil unit train by dispatch or other method if an incident were to occur. However, only half of the responding fire agencies are aware of the location of the BNSF railroad equipment cache closest to their jurisdiction. The survey results indicated that most fire departments/districts have indicated they could use additional information to assist in response planning.

Three-quarters of fire agencies responding to EFSEC's survey report having access to, either within their department/district or through mutual aid, personal protective equipment, aqueous film-forming (AFF) foam, and foam applicators. In addition, more than half of survey respondents reported having access to appropriate air monitors. However, only a quarter of responding jurisdictions reported having access to oil spill containment equipment (e.g., hard boom and/or sorbent boom).

In the EFSEC survey, each fire agency was asked whether the agency has sufficient personnel and equipment resources to respond to the potential small, medium, large, and very large spill event scenarios and associated fire and/or explosion along the rail corridor that are used in the resource-specific impact analyses in Section 4.7. Only one responding agency indicated that it had adequate personnel and equipment to respond to a hypothetical small spill scenario. The same agency reported that they would also be able to address a medium oil spill scenario with the assistance of mutual aid partners, nearby jurisdictions, and the railroad, but that they would require a subject matter specialist to deal with the operational and technical aspects of managing the incident.

All responding agencies indicated the need for additional resources to respond to one or more spill event scenarios, particularly the larger spill and associated fire and/or explosion scenarios. For example, seven responding jurisdictions reported that they would need additional AFF foam to adequately respond to a small oil spill scenario and still maintain the ability to respond to other calls for service in the community. For the medium to very large spill scenarios, most responding agencies would not have access to sufficient foam and foam applicators, and only VFD reports having its own high-volume pump and foam unit. In rural areas in particular, sufficient foam and water supplies may not be available to effectively implement and sustain fire-suppression strategies. Even in urban areas, such as Vancouver, foam supplies may be spread out geographically, require permission to be used, and take time to collect (Eldred 2015).

All responding jurisdictions identified this need for hypothetical large and very large spill event scenarios. For all spill scenarios, responding agencies most frequently cited the need for additional staffing to adequately respond to an incident and other calls for service within the community, closely followed by the need for additional logistical support (Table 4-11).

In the event of a crude oil spill resulting from a train derailment, one responding fire department reported that given their existing resources, the only mitigation they could implement to prevent the spread of a spill would be in situ burning. Another jurisdiction reported that neither they nor their mutual aid partners have waterway apparatus that could aid in spill response should the spilled crude oil enter the Columbia River. Another jurisdiction expressed concern about protecting wildlife and the Columbia River in the event of a spill, noting that the railroad in their service area is close to the river. However, as stated previously, other agencies including the USCG, ODEQ, and Ecology would participate in response efforts if a spill reaches the Columbia River.

The need for additional training and equipment for fire departments along the rail corridor is not unique to Washington. PHMSA’s Commodity Preparedness and Incident Management Reference Sheet for petroleum crude oil (PHMSA 2014c) states:

> Unit trains typically move from one location (e.g., shipper’s production facility or transloading facility) to a single destination (e.g., petroleum refinery). Given the usual length of these trains (over a mile long), derailments can cause road closures, create significant detours, and require response from more than one direction to access the scene of the incident. In the event of an incident that may involve the release of thousands of gallons of product and ignition of tank cars of crude oil in a unit train, most emergency response organizations will not have the available resources, capabilities or trained personnel to safely and effectively extinguish a fire or contain a spill of this magnitude (e.g., sufficient firefighting foam concentrate, appliances, equipment, water supplies). Responses to unit train derailments of crude oil will require specialized outside resources that may not arrive at the scene for hours; therefore it is critical that responders coordinate their activities with the involved railroad and initiate requests for specialized resources as soon as possible. These derailments will likely require mutual aid and a more robust on-scene Incident Management System than responders may normally use. Therefore, pre-incident planning, preparedness and coordination of response strategies should be considered and made

part of response plans, drills and exercises that include the shippers and rail carriers of this commodity."

Medical facilities along the rail corridor include acute care hospitals in Vancouver, White Salmon, Kennewick, Pasco, Ritzville, and Spokane (Washington State Department of Health [WDOH] 2013b). Acute medical care in the more rural areas along the rail corridor is less readily available. In particular, much of the western portion of Skamania County, the eastern portion of Klickitat County, and the southern portion of Benton County along the rail corridor is over a 30-minute drive from an acute care hospital (WDOH 2006).

Table 4-11. Resources Needed to Respond to Hypothetical Spill Scenarios

Resources Needed	Number of Responding Agencies Selecting the Resource[1]			
	Small Spill	Medium Spill	Large Spill	Very Large Spill
None[2]	1	0	0	0
Additional staff	8	10	10	10
Additional training	7	9	9	10
Logistical support	8	9	10	10
Personal protective equipment	5	8	10	10
Aqueous film-forming foam	7	9	10	10
Foam applicators	6	9	10	10
Appropriate air monitors	7	9	10	10
Hard boom	6	7	8	8
Sorbent boom	6	7	8	8
Fire apparatus	6	8	10	10

Notes:

The question posed in the survey was "Which of the following would your jurisdiction need above and beyond what is currently available through your department and through mutual aid to adequately respond to the incident and other calls for service within the community? Please consider in your response what would be required to respond to not only the incident but to also continue to respond to other calls for fire protection and emergency medical service in your jurisdiction at the same time. Select all that apply." The first column lists possible responses to that question, and subsequent columns show the number of responding agencies that selected each resource for each scenario.

1 Of the 12 survey respondents, 11 responded to the question about the small spill scenario. Ten out of 12 survey respondents responded to the questions about the medium spill scenario, large spill scenario, and very large spill scenario.

2 The capabilities available to the fire department and through mutual aid are adequate.

4.6.5 Vessel Transportation

4.6.5.1 Crude Oil Spill

The response to a crude oil spill in the vessel corridor would primarily be the responsibility of the USCG, Ecology, ODEQ, and CRC. The vessel owner would also respond through activation of the VRP. The RP(s) would be obligated to fund the response and pay for damages. For most spills, containment and recovery goals include:

- Protecting the safety of the public and the spill responder,
- Stabilizing the source to stop the release of additional oil into the environment,

- Protecting sensitive areas to limit the damage caused by the spilled oil,
- Collecting and recycling or disposing of oil,
- Rehabilitating wildlife, and
- Implementing an appropriate cleanup strategy for impacted areas.

The response techniques employed in a spill are based on the product spilled, quantity, location, response time, weather conditions, responder capability, and availability of response equipment. The response and contingency plans identify response resources, cleanup strategies, and resources at risk. Plans also identify the appropriate conditions for the various spill response techniques. To provide the most effective response under the widest range of conditions, oil spill response personnel may use multiple response techniques. Table 4-12 identifies key elements of each technique. Figures 4-7 to 4-9 illustrate common tools and techniques used in an oil spill response.

General spill response would be consistent with the requirements of the GRPs that define areas where the use of each response technique is recommended or approved. For example, the use of chemical dispersants is not approved in the Lower Columbia River and approval to conduct in situ burning would require special agency approval. The GRPs include booming strategy maps, locations of boat launches, and information on the locations of sensitive resources (EPA 2015d). The GRPs may include limitations on the use of particular equipment to minimize impacts to sensitive resources. For example, the use of helicopters to transport materials and obtain aerial views of the spill may be restricted during nesting seasons.

Table 4-12. Cleanup Response Techniques

Technique	Actions and Materials	Secondary Equipment Employed	Locations Used
Mechanical containment	Booms contain, deflect, or divert oil.	Trucks or vessels to install, reposition, and maintain the booms.	Open water
Removal of oil	Sorbent pads or rolls are placed in water to contain and remove floating oil.	Trucks or vessels to install, reposition, and maintain the sorbent materials.	Nearshore environments
	Mechanized skimmers collect oil from the surface into containers or storage tanks.	Vessels to position the skimmers. Decanters to separate water collected with the oil and return the water to the environment.	Open water and nearshore
	Barriers and booms prevent the entry of oil into a sensitive area.	Vehicles to transport equipment/personnel.	Shoreline/small waterbody
	Cutting kelp beds helps remove trapped oil.	Vessels to transport personnel for hand removal or mechanical kelp harvester.	Nearshore marine areas
Chemical dispersion[1]	Cleaning agents are sprayed onto the oil slick.	Airplane to spray dispersants.	Open water
In situ burning[2]	Oil is collected into a fire-resistant boom and burned.	Vessel to transport boom. Helicopters to ignite oil.	Open water and nearshore
Cleanup	Manual use of rakes, shovels, and other tools to collect oil into bags or containers.	All-terrain vehicles to transport personnel and equipment.	Sheltered rocky shorelines and human-made structures, sheltered rubble slopes

Table 4-12. Cleanup Response Techniques

Technique	Actions and Materials	Secondary Equipment Employed	Locations Used
	Passive collection of oil through sorbent materials.	All-terrain vehicles to transport personnel and equipment.	Sand beaches, gravel beaches, sheltered rocky shores and human-made structures, sheltered rubble slopes, sheltered vegetated low banks, and marshes
	Vacuum removal of oil.	Truck-mounted vacuums or trucks to place or remove containers and vacuums.	Exposed rocky shores, sand beaches, gravel beaches, sheltered rocky shores and human-made structures, sheltered rubble slopes, sheltered vegetated low banks, marshes
Natural removal	Oil is allowed to degrade.	None.	Areas where removal of oil could damage sensitive resources

Notes:

1 The use of chemical dispersants is not permitted on the Columbia River (RRT and NWAC 2015b).

2 No locations within the Lower Columbia River GRP area are preapproved for the use of in situ burning, with the exception of the Pacific Ocean >3 miles out from population centers. The NWACP contains the in situ burning policy (RRT and NWAC 2015b).

Figure 4-7. Manual Removal of Oil

Source EPA 2015d

Figure 4-8. Sorbent Applied to Absorb Oil
Source EPA 2015d

Figure 4-9. Booming and Vacuuming Oil
Source EPA 2015d

4.6.5.2 Crude Oil Fire and/or Explosion

In the event of a fire or explosion along the vessel corridor, the vessel operator would implements its FPRP in conjunction with the guidance in the Marine Firefighting Contingency Plan found in Section 8000 of the NWACP. The ultimate responsibility for fire prevention and control lies with the vessel owner and operator (RRT and NWAC 2015b). As described in Section 3.15, the MFSA is tasked with ensuring an adequate, timely, and coordinated response to ship fires along the Lower Columbia and Willamette rivers.

4.6.5.3 Fire Department/Medical Facility Response Preparedness

As stated previously, MFSA's shipboard fire program directed by F-PAAC and made up of 13 participating public fire agencies would respond to a crude oil fire and/or explosion along the vessel corridor. As discussed in Section 3.15, the City has acquired an all-hazard quick-response vessel through a Federal Emergency Management Agency (FEMA) Port Security Grant to help address regional marine emergency response capabilities along the Columbia River (City of Vancouver 2015). The vessel is moored at Christensen Shipyards at approximately RM 109, 6 miles upriver of the proposed Facility. The vessel is rated as an NFPA Type IV vessel with firefighting capability. The suppression crew from Station 1 cross-staffs both the vessel and Engine 1; Engine 1 is, therefore, out of service while the boat is responding and on a call (Eldred 2015). Twelve fire agencies, including VFD, have an agreement with the MFSA to provide one engine and three people for shipboard firefighting if the agency can provide these resources without impacting service within its jurisdiction (Eldred 2015). Clark County Fire & Rescue, Portland Airport Fire and Rescue, Portland Fire & Rescue, Scappoose Rural Fire District, and the VFD maintain vessels with emergency medical service capability to provide basic life support (RRT and NWAC 2015b). Fire agencies would only provide these resources if doing so would not impact their ability to respond to other calls for service within their jurisdiction.

4.7 RESOURCE-SPECIFIC IMPACTS

For each resource a discussion of potential impacts from accidental crude oil spills, fires, or explosions is provided, along with identification of particularly sensitive areas or resources that could experience greater impacts. The range of impacts considered for each resource includes the effects of the initial event and the effects of the likely response to that event. The level of impact is partially dependent on the adequacy of response plans; the volume of crude oil spilled or extent of fire and/or explosion; the physical, temporal and environmental factors affecting the event; and the level of response to the incident (see Sections 4.3 through 4.6).

The study areas described in Section 3.0 and affected environment descriptions provided in Chapter 3 for the proposed Facility and rail and vessel transportation corridors were also used for this resource specific potential impact discussion. Since the inbound rail line from Kennewick/Pasco to the Port runs in close proximity to the river, an additional study area was created to assess the potential impacts of a crude oil spill that reaches the Columbia River from a unit train derailment. This study area is termed the rail-Columbia River study area and includes approximately 216 river miles and extends 0.25 mile inland to the north and south banks of the Columbia River (Figures 3.0-3 and 3.0-4). The additional study area was established to consider potential impacts to resources present within the Columbia River and its shorelines that are outside the bounds of the rail transportation study area.

4.7.1 Potential Scenarios for Resource Impact Analysis

The proposed Facility, rail, and vessel safety considerations described in Section 4.2 and accident prevention plans described in Section 4.3 are designed to reduce the frequency of incidents and to reduce the likelihood of a crude oil spill in the event of an incident. Nonetheless, accidents could occur and the risk of a crude oil spill, fire, and/or explosion cannot be totally eliminated. Therefore, information presented in Section 4.4, the dispersion modeling data included in Appendix J, and information on potential fire and explosion hazards were used to select a range of representative spill scenarios to facilitate impact analysis. The representative scenarios presented in Table 4-13 include potential small to medium spills, large to very large spills (Table 4-14), small fires, and large fires and/or explosions.

Table 4-13. Potential Event Scenarios Used in Impact Analysis[1]

Event Scenario	Proposed Facility	Rail Transportation	Vessel Transportation
Small to medium crude oil spills	Contained within secondary containment on land and by booms in water. A spill of crude oil reaching the Columbia River is assumed to spread up to 1 RM.	Entire rail corridor study area (0.5 mile on each side of the rail line) is assumed to be potentially affected. A spill slick of crude oil on the Columbia River is assumed to spread 1 RM.	A spill slick of crude oil on the Columbia River is assumed to spread up to 2 RMs.
Large to very large crude oil spills	A large crude oil spill slick reaching the Columbia River is assumed to spread up to 7 RMs. It is assumed that the very large spill (1 storage tank: ~375,000 bbl) would be completely contained within a bermed area with an impermeable liner.[2]	Entire rail corridor study area (0.5 mile on each side of the rail line) is assumed to be potentially affected. A spill slick of crude oil on the Columbia River is assumed to spread up to 13 RMs.	A spill slick of crude oil on the Columbia River is assumed to spread 125 RMs (to or beyond the mouth of the Columbia River).
Small fire event	A small fire event is assumed to be controlled within the proposed Facility boundaries.	Derailment of one railcar with associated small fire is assumed to be controlled within the immediate area.	Accident resulting in an oil spill and associated small fire is assumed to be quickly controlled and would affect the immediate area surrounding the vessel.
Large explosion and fire event	A large fire and/or explosion not easily controlled could project debris or spread fire beyond the proposed Facility boundaries; a small wooded area to the northwest would be vulnerable to fire.	Derailment of multiple railcars could result in explosions of multiple railcars, with debris and large fire that spread beyond the immediate area.	An accident resulting in an oil spill and associated large fire that would not be easily controlled.

Notes:

1 All assumptions of spill slick spread along the Columbia River are rounded distances based on Table 41 in Appendix J.

2 This EIS identifies additional measures as mitigation to impose adequate factors of safety for berms surrounding the storage tanks to ensure that they remain intact during and after a Maximum Credible Earthquake and aftershock as discussed in Section 3.1.

bbl = barrels, RM = river mile

Table 4-14. Scenario Spill Volumes

Spill Scenario	Proposed Facility[1]	Rail Transportation[2]	Vessel Transportation[3]
Small to Medium Spill	250 bbl (storage tank overflow) *-to-* 700 bbl[4] (1 railcar unloading malfunction)	100 bbl (10% of 1 railcar spills) *-to-* 700 bbl[4] (1 railcar)	50 bbl *-to-* 2,500 bbl
Large Spill to Very Large Spill	5,505 bbl (breach/malfunction of marine transfer pipeline) *-to-* ~375,000 bbl (storage tank API 650 maximum capacity including overfill protection)	2,200 bbl[4] (3 railcars spill) *-to-* 20,000 bbl[4] (28 railcars spill)	55,181 bbl (Suezmax 50th percentile spill) *-to-* 192,144 bbl (effective WCD: Suezmax)

Notes:

1 Small, medium, and large spills from the Applicant's Hazard Evaluation/Risk Analysis (ASC Appendix C.13: Appendix D). The very large spill is the regulatory WCD equivalent to the capacity of the largest storage tank at the proposed Facility (WAC 173-182).

2 Spill volumes from the Rail Risk Analysis (Appendix P)

3 Small and medium spills are the regulatory AMPD and MMPD (33 CFR 155.1020). Large to very large spill volumes are from the Vessel Risk Analysis (Appendix J).

4 Volumes rounded to the nearest 100 bbl for consistency with the Rail Risk Analysis (Appendix P).

API = American Petroleum Institute, bbl = barrels, WCD = worst-case discharge

This section uses the following impact rating scheme to describe the magnitude, duration, and degree of potential environmental impacts (Figure 4-10):

- **Negligible.** Impacts that are extremely low in intensity and often not measurable or observed
- **Minor.** Impacts that are low in intensity, temporary, and local in extent, and do not affect unique/rare resources
- **Moderate.** Impacts of moderate intensity independent of duration, with significant or unique resources potentially affected, on either a local or regional scale
- **Major.** Impacts of high intensity and/or of long-term or permanent duration, of localized or regional extent, and/or impacts that affect culturally important, ecologically important, or unique/rare resources

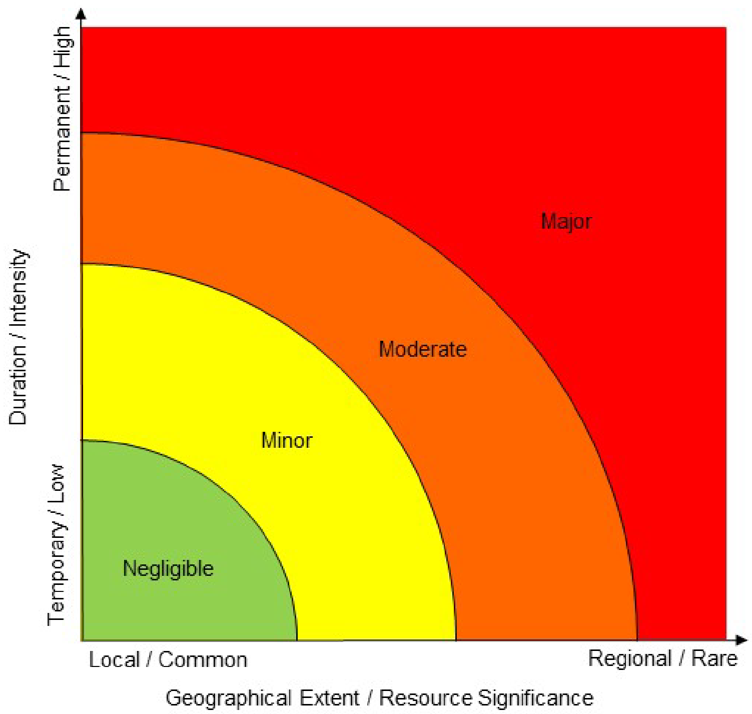


Figure 4-10. Schematic of Environmental Impact Ratings

4.7.2 Earth Resources

This section addresses potential impacts from crude oil spill, fire, and/or explosion to hard rock geology, soils, and topography.

4.7.2.1 Proposed Facility

Crude Oil Spill

The proposed Facility site has no bedrock outcrops. Therefore, no impacts from a small to large crude oil spill on bedrock geology would occur at the proposed Facility. Most areas at the proposed Facility where spills could potentially occur are overlain by impermeable liners and/or construction fill materials (e.g., railcar unloading area, storage tank area, and transfer pipeline areas); therefore, soil contamination would be negligible to minor in all spill scenarios, assuming bermed and lined secondary containment areas and trenches have sufficient volume to contain spills. An oil spill at the proposed Facility would not permanently impact local topography. If contaminated soils require removal, they would be replaced with clean fill and graded to match the surrounding landscape.

Crude Oil Fire or Explosion

Fire could result in burning or charring of the upper layers of soil/sediments. Soils at the proposed Facility site are largely composed of artificial fill. Charring of these soils would constitute a negligible impact. A crude oil fire at the proposed Facility would not impact local topography. A crude oil explosion could impact local topography depending on the elevation and size of the blast. A large explosion near the ground surface could create a localized crater. Impacts to topography from a large explosion event could be moderate. Explosion debris could be ejected into surrounding soil areas lacking impermeable liners, potentially contaminating these soils external to the proposed Facility. Potential impacts (e.g., contamination or disruption) to soils from explosion debris would be negligible to minor.

4.7.2.2 Rail Transportation

Crude Oil Spill

A crude oil spill could leave oil residue on affected bedrock outcrops occurring along the rail corridor in the vicinity of the spill. The oil residue could coat the bedrock for some time depending on local weather conditions. In the case of oil spilling onto very porous or permeable rock, such as a poorly cemented sandstone or heavily fractured granite, some crude oil penetration into the rock could occur. A small to large crude oil spill along the rail corridor is unlikely to have more than minor impacts to bedrock geology. However, oil spilled on hard rock could migrate downslope to soil areas or to surface water. Crude oil migrating in surface water could coat hard rock and soil areas farther from the spill source.

A crude oil spill to soils along the rail corridor could lead to soil contamination. The properties of oil affecting soil contamination are addressed in Section 4.5. Oil can be stranded in soil for extended periods, making soil contamination a potentially persistent environmental concern, especially if the oil migrates deep into the soil column or accumulates rapidly on shorelines during a depositional period (NOAA 2010a). Natural microbial action would biodegrade oil to some extent over long time periods, but this potential varies greatly with soil type, oil type, and climate. Oil stranded in the soil can eventually be released back into the environment, either directly at the surface or through ground and surface water, creating persistent contamination concerns. As a result, remediation of oil stranded in soil would likely be required, leading to potential excavation and disposal or in-place treatment. Oil spilled on surface soils would flow downslope. Heavier oil (dilbit) is more viscous, resulting in less surface spread and less vertical migration than lighter Bakken crude oil. The extent of soil contamination depends on several factors, including porosity, moisture content, soil type, and whether the soil is frozen or thawed. As a result, depending on the size of the original crude oil release and the location and environmental conditions in the area of the spill, the potential impacts to soils from a crude oil spill would range from minor to moderate. Oil spills along the rail corridor would have negligible impact to local topography unless excavation to create berms and holding ponds is used for spill response. Remediation of stranded soil contamination could require excavation leading to negligible to minor impacts to local topography.

Crude Oil Fire or Explosion

In most areas of the rail corridor, a fire or explosion is unlikely to impact hard rock geology. If the fire or explosion were to occur within a hard rock tunnel, or proximal to a hard rock outcrop, however, it is possible that that rock could fragment in the explosion, creating a potentially minor to major impact depending on the structural integrity of the bedrock. Impacts to soil and topography along the rail corridor would be similar to those previously discussed for the proposed Facility.

4.7.2.3 Vessel Transportation

Crude Oil Spill

A crude oil spill along the vessel corridor could coat some shoreline bedrock, leading to minor impacts. Contamination of shoreline soils and sediments could also occur, and if oil accumulates in or on the sediment, contamination could persist, resulting in minor to moderate impacts from small to medium spills and moderate to major impacts from large to very large spills. If remediation is required, contaminated shoreline soils could be excavated and removed, or treated in place, leading to moderate additional impacts. Depending on the density of the crude oil and the amount of time it is left to weather, some of the oil within the water column could sink to the bottom, and if highly weathered could form tarballs. Tarballs can be mobilized by tides and currents and wash up on shorelines, potentially contributing to further contamination of shoreline soils and sediments. Contaminated bottom soils and tarball cleanup efforts could lead to disruption of sediments on river or estuary bottoms, and some residual contamination could be left in place. These potential impacts to riverbed soils would likely be minor to moderate for small to medium spills and moderate to major for large to very large spills. Oil spills along the vessel corridor would not be anticipated to impact local shoreline or riverbed topography. If contaminated soil along the shoreline needs to be removed for remediation purposes, minor modifications to topography could occur as a result of small to medium crude oil spills and moderate modifications to topography could occur during response and remediation of large to very large spills. However, the cleanup action plan under MTCA (Section 4.2.1.2) would include appropriate backfilling with uncontaminated materials and recontouring to preexisting topographic conditions.

Crude Oil Fire or Explosion

A fire or explosion along the vessel corridor is not expected to impact hard rock geology. A fire or explosion along the vessel corridor is unlikely to cause fragmentation or collapse of bedrock on shorelines. A small fire event along the vessel corridor would not likely impact soils. In the event that a large fire or explosion occurred close to shore, some burning or charring of the upper layers of soil/sediments along the shoreline could occur. A large explosion from a vessel oil tank would not likely impact the river bottom or shallow ocean floor sediment or shoreline soils. Implementation of the required remediation and salvage in the VRP (see Section 4.3.10) would reduce the duration of impacts to the affected soils or sediments. Potential impacts to earth resources from a crude oil fire or explosion would be minor.

4.7.3 Air Quality

This section addresses potential impacts from crude oil spill, fire, and/or explosion to air quality.

4.7.3.1 Proposed Facility

Crude Oil Spill

As discussed in Section 4.5, the lighter VOCs within spilled oil separate from the heavier fraction and are released to the atmosphere through evaporation. Bakken crude oil has a higher VOC content, higher vapor pressure, lower flash point, and lower boiling point than dilbit, which correlates to increased ignitability and flammability (PHMSA 2014b). It is estimated that up to 50 percent of the lightweight components of Bakken crude oil may evaporate in the first 12 hours following a spill (Mosbech 2002). As discussed in Section 4.5, dilbit and other heavy crude oils contain more high-molecular-weight hydrocarbons and are less prone to evaporation.

VOCs exacerbate the formation of ground-level photochemical ozone in the presence of nitrogen oxides (NOx) in strong sunlight, light winds, and low-altitude temperature inversions. Although meteorological conditions conducive to ozone formation can be present at the proposed Facility in the summer, the area is currently in attainment with the ozone National Ambient Air Quality Standards (NAAQS) and is expected to remain so for the foreseeable future. It is therefore not anticipated that ozone formation from an oil spill at the proposed Facility would cause a violation of the NAAQS or Washington Ambient Air Quality Standards (WAAQS). However, since ozone is a greenhouse gas (GHG), a crude oil spill would indirectly present a minor contribution to GHG emissions.

BTEX and PAHs are classified as hazardous air pollutants (HAPs), which cause serious health effects, or adverse environmental and ecological effects (EPA 2013). Since HAP exposure times from a crude oil spill at the proposed Facility would likely be relatively short (days or weeks), the chronic public health risk would be negligible to minor. However, depending on weather conditions, short-term moderate impacts from larger crude oil spills may become apparent, such as acute olfactory and pulmonary irritation. Fuel-burning equipment used during emergency spill cleanup and recovery operations would create minor impacts from the release of air pollutants, as would in situ burning operations (if approved). If the spilled oil contained sulfur compounds (e.g., H_2S, mercaptans) an odor impact would occur. The impact would increase as a function of the spill size. Depending on wind speed and direction in relation to proximate receptors (i.e., populated areas), the impact would be minor to moderate.

Impacts to air quality from small to medium spills at the proposed Facility would be minor, and impacts to air quality from a large spill would be moderate due to the potential volume of air pollutants released to the atmosphere.

Crude Oil Fire or Explosion

Smoke plumes from fires or explosions would contain a mixture of hazardous emissions and particulate compounds including carbon dioxide, carbon monoxide, sulfur dioxide, NOx, VOCs, PAHs, H_2S, acidic aerosols, carbonyls (aldehydes and ketones), dioxins, and soot (i.e., particulate matter containing heavy metals such as nickel, vanadium, and arsenic).

The hazard posed by soot depends on particulate size and composition. Particulates (small pieces of solid materials including dust, soot, and fumes) of 10 micrometers diameter or smaller (PM_{10}) are considered to pose the greatest hazard as they have the potential for reaching deep inside the lungs and may even enter the bloodstream (EPA 2014c). It is anticipated that a large crude oil fire or explosion could directly cause a short-term violation of one or more particulate matter NAAQS from an estimated few hundred meters to up to 2 miles downwind of the fire (National Institute of Standards and Technology 1997, API 2004). Air pollution from a burn is usually short lived and, depending on wind speed, the smoke plume is often dispersed within 10 to 20 miles of the burn site (API 2004). Because exposure times would be relatively short (hours or days) chronic public health risk resulting from elevated levels of criteria pollutants and HAPs would be minor, although short-term acute effects could be major and could require evacuations of nearby downwind areas until air quality improves.

In addition, burning crude oil creates sulfur dioxide and NOx, and when they combine with moisture, acid rain is created. More of these compounds would be created from burning dilbit. Acid rain can damage lake, stream, and forest ecosystems (EPA 2014c). Depending on the size and intensity of a crude oil fire the impacts to air quality from acid rain creation would be minor to moderate. As stated previously, fuel-burning equipment used during crude oil fire or explosion response and recovery operations would release air pollutants, and combined with the emissions from the fire and/or explosion, a localized short-term NAAQS exceedance would likely occur.

The impacts to air quality from a small fire at the proposed Facility would be minor to moderate and from a large explosion and fire would be moderate to major due to the potential volume of air pollutants released to the atmosphere.

4.7.3.2 Rail Transportation

Impacts to air quality from spills, fires, and/or explosions along the rail route would be similar to those listed for the proposed Facility. Depending on the location of the event (e.g., in a highly populated area or Class I Wilderness Area), the impacts could be major.

4.7.3.3 Vessel Transportation

Impacts to air quality from spills, fires, and/or explosions along the vessel route would be similar to those listed for the proposed Facility. Depending on the location of the event (e.g., sensitive species presence areas or aquatic preserves), the impacts could be major.

4.7.4 Water Resources

This section addresses potential impacts of spills, fires, and/or explosions to the quality, use, and supply of surface water and groundwater, as well as potential impacts to wetlands and floodplains.

4.7.4.1 Proposed Facility

Crude Oil Spill

Surface Water Quality

Surface water quality could be impacted on a short-term or long-term basis depending on the location of the spill within the proposed Facility, the type and volume of crude oil released, and the length of time that crude oil remains in the environment. Crude oil released to surface water could disperse, become suspended in the water column, or sink and adhere to bottom sediments. As discussed in Section 4.5, nuisance foams and residues could result from the spill.

A spill reaching the Columbia River would temporarily impair water quality within the boomed area, or if outside of containment, within a relatively short upstream and potentially longer downstream distance (including the opposite bank at Hayden Island). Water quality degradation would include the physical presence of crude oil floating and/or partially submerged (depending on its relative density), the presence of toxic water-soluble or suspended fractions of crude oil and petroleum derivatives, and reduced dissolved oxygen concentration. The river conditions in the vicinity of the proposed Facility for the entire duration of the spill event would impact spill characteristics, appropriate response measures, and response effectiveness. Prebooming and immediate response would minimize the spill's spatial extent and the duration that oil would be in the water, and would decrease the potential for crude oil settling and adhering to streambed sediments. However, if a spill occurred outside of containment (e.g., in the river when prebooming is not feasible) the spatial extent of spill impacts, the duration of cleanup, and the potential for streambed sediment contamination would increase. A small spill during vessel loading (100 bbl) would likely produce minor, short-term impacts to surface water quality given the relative size of the spill to the streamflow in the Columbia River. A large spill during vessel loading (1,152 to 2,626 bbl) could produce longer-term moderate to major impacts to surface water quality. A large spill (2,458 bbl) from the rail unloading transfer pipeline or from the marine transfer pipeline (5,505 bbl) that does not release into secondary containment could produce similar levels of impact.

Impacts to surface water quality from small to medium spills at the proposed Facility would likely be minor to moderate depending on the location of the spill and the presence or absence of secondary containment. Impacts to surface water from a large spill at the proposed Facility could be moderate to major, again depending on the location of the spill and the presence or absence of secondary containment. However, the largest potential spill identified at the proposed Facility would be located within the bermed and lined secondary containment area surrounding the storage tanks. The secondary containment area would be capable of containing 110 percent of the API Standard 650 maximum capacity of the largest storage tank, plus precipitation from a 24-hour, 100-year storm event.

Groundwater Quality

Impact of a crude oil release on the quality of groundwater underlying the proposed Facility would vary based on several factors, including location, duration of spill-related contamination, presence or absence of impermeable surfaces and secondary containment, and possible preferential pathways for vertical migration of the crude oil in the subsurface. The Project would include extensive subsurface disturbance including the placement of permeable stone columns that could permanently alter vertical and/or lateral groundwater flow paths, and potentially serve as preferential pathways for spilled crude oil or dissolved crude oil components that could increase the possibility of groundwater contamination. Subsurface improvements in the vicinity of the marine terminal would also include the installation of a sheet pile wall near the ordinary high water mark of the Columbia River and a large number of impermeable jet grout columns and dry soil mix panels landward of the sheet pile wall. These ground improvements would tend to limit the lateral spread of unconfined groundwater contamination toward the river. Other factors influencing contaminant spread in the groundwater include water elevation in the Columbia River, nearby well pumping, and the amount of rainfall that occurs in the period following the spill event. If vertical migration of contaminated groundwater reaches deep aquifer units, pumping at large wells within the Port (including groundwater remediation wells) or other nearby wells could further extend groundwater contamination resulting from a spill.

Impacts to groundwater quality from small to medium spills at the proposed Facility would likely be minor to moderate depending on the location of the spill, the presence or absence of secondary containment, the presence of preferential contaminate migration pathways, and the presence or absence of subsurface impermeable barriers (e.g., sheet pile wall). Impacts to groundwater from a large spill at the proposed Facility could be moderate to major, again depending on the location of the spill, the presence or absence of secondary containment, the presence of preferential contaminate migration pathways, and the presence or absence of subsurface impermeable barriers. However, the largest potential spill identified at the proposed Facility would be located within the bermed and lined secondary containment area surrounding the storage tanks, which would be capable of containing 110 percent of the API Standard 650 maximum capacity of the largest storage tank, plus precipitation from a 24-hour 100-year storm event.

Water Supply

A small to medium crude oil spill that reaches the Columbia River would not impact water intakes, since no public surface water supply intakes are within 1 RM of the proposed Facility. Groundwater contamination resulting from a small to medium crude oil spill could produce minor impacts to Port water supply wells and other local wells if contamination migrates vertically into a portion of the unconfined Troutdale Aquifer System (TAS). A large crude oil spill that reaches the Columbia River could impact water intakes located within 7 RMs of the proposed Facility. Groundwater contamination resulting from a large spill could produce moderate to major impacts to Port water supply wells and other local wells if unconfined aquifer contamination or surface water contamination migrates vertically into a portion of the unconfined TAS. However, none of the effects would be expected to occur within the existing public wellhead protection areas designated by Clark County and the City for this sole source aquifer.

Wetlands, Floodplains, and Other Aquatic Environments

The potential for an oil spill to affect wetlands and floodplains depends on the spill size, location, proximity to and type of wetland, and the topography of the site. Existing wetlands, including a wetland mitigation bank, are located less than 1,000 feet from the transfer pipelines of the proposed Facility in a relatively flat, graded topography very gently sloping to the southwest. Small to medium spills would not likely spread across Lower River Road into these wetland areas. However, a large spill, particularly a spill from the rail unloading transfer pipeline, could spread into these wetlands.

A crude oil spill that reaches riverine wetlands and aquatic vegetation would produce impacts almost immediately (Overstreet and Galt 1995). Heavy crude oil could coat vegetation, preventing photosynthesis and impairing the assimilation of carbon used for growth and transpiration (Mendelssohn et al. 2012). The duration of this effect would depend on the extent of oil coverage of the foliage and oil penetration into the substrate. Recovery of vegetation could take anywhere from one to four growing seasons (Mendelssohn et al. 2012). The time of year in which a spill occurs influences effects on aquatic vegetation. Spills during colder months, when plants have a lower metabolism or are dormant, would have a reduced impact relative to oil exposure occurring in warmer months (Mendelssohn et al. 2012).

Spilled crude oil that tends to stay on the water surface in inundated wetlands and floodplains could restrict the exchange of oxygen between the air and water. Impacts to wetland vegetation would depend on the type of vegetation impacted, with herbaceous vegetation being more vulnerable than shrubs and trees. If a spill event occurred at a time when the wetland or floodplain was not inundated, the release could contaminate soils within the spill area. Soils would remain impaired until they were removed to a treatment facility or microbes degraded the oil. As discussed in Section 4.5.2, microbial biodegradation is a long duration process. A crude oil spill that reaches wetlands, ponds, or small lakes could lower dissolved oxygen concentrations. In small, shallow waterbodies with limited water movement and high organic loading, increased biodegradation of spilled oil in the water column and the uppermost soil layer could further reduce oxygen levels. Increased microbial activity could deprive vascular and nonvascular plants of vital nutrients (McKendrick 1999). Plant recovery after spills would likely be better in wet habitats than in dry habitats, but effects could remain for years.

In summary, any wetlands or floodplains near the proposed Facility would not likely be impacted by a small to medium crude oil spill. However, wetlands or floodplains along the Columbia River less than 1 RM downstream of the proposed Facility could be affected by a small to medium crude oil spill with impacts ranging from moderate to major. Any Columbia River channel wetlands or floodplains within 7 RMs downstream of the proposed Facility could be affected by a large spill, and impacts could also range from moderate to major. Additionally, a large spill, particularly a spill from the rail unloading transfer pipeline, could spread into the wetland mitigation bank across Lower River Road.

Crude Oil Fire or Explosion

A crude oil fire or explosion could cause impacts to water resources if debris, burned residuals, or unburned crude oil were to reach waterbodies. Burned oil may leave heavier pyrogenic residuals. These heavier substances can linger in streambed or floodplain sediments and may become resuspended in the water column if disturbed. A crude oil fire or explosion at the proposed Facility could impact surface water by damaging stormwater systems. Heavier fire residuals could enter groundwater. The use of fire retardant foam chemicals could have effects on groundwater, and potentially on water supply if contaminated surface water entered the unconfined aquifer and then entered local water supply wells. However, since water would not be used to control a crude oil fire, there would be negligible impacts to water supply from firefighting response efforts. A fire or explosion could damage the protective caps installed over previously contaminated areas within the proposed Facility boundary, resulting in further transport of contaminants.

A fire that reached a wetland could destroy wetland vegetation and biologic communities by direct contact with heat. Native vegetative species destroyed by a fire could be replaced by nonnative or invasive species. An explosion could expel debris, which could enter surface waters, or it could alter floodways if enough material were removed from or added to a floodplain during the explosion. Debris could include metals or hazardous materials. In addition, firefighting water and foams could temporarily impact water quality.

Impacts to water resources from a small fire event at the proposed Facility could be negligible to minor because it would likely be controlled within the proposed Facility boundaries. Impacts to water resources from a large explosion and fire event would be moderate to major depending on the spread of the fire and the size of the explosion debris field.

4.7.4.2 Rail Transportation

Crude Oil Spill

Surface Water Quality

A crude oil spill from a unit train could adversely impact surface water quality if a release occurred directly over a waterbody crossing, or in terrain sloping toward waterbodies. Along most of the rail corridor, a small to medium rail spill would not directly impact surface water quality unless the spill occurred at or immediately adjacent to surface waterbody crossings. However, a large to very large spill along the rail corridor could directly impact surface water at waterbodies several hundred to a few thousand feet from the site of the spill. There are 549 unique waterbodies within the 1-mile-wide rail corridor in Washington (see Section 3.3), and some streams are crossed by the corridor more than once. Outside of Washington, the rail network crosses numerous waterbodies depending on the route. Inside the state, responses would be consistent with applicable GRPs (see Section 4.3). However, GRPs do not currently cover areas that include the Palouse (Water Resource Inventory Area [WRIA] 34), the Lower Crab (WRIA 41), and the Esquatzel Coulee (WRIA 35) watersheds.

There is greater potential for surface water impacts resulting from a rail spill along the 216 RMs along the rail-Columbia River portion of the rail corridor since the rail lines parallel the river, and in many sections are directly along the north bank of the Columbia River. A small to medium rail spill could reach the river in many locations, and a large to very large spill could reach the river in most locations. If a spill reaches the river, it could extend a considerable distance downstream and spread across the waterbody to the Oregon side of the channel. Water quality impacts would be similar to those discussed for a spill that entered a waterbody from the proposed Facility. If a derailment along the rail-Columbia River rail corridor led to one or more railcars entering the river, leaks from the railcar(s) could impact water quality.

Surface water impacts from a crude oil release along the rail corridor would be similar to those discussed for a release from the proposed Facility. The duration of impairment would vary based on the size of the spill, the characteristics of the impacted waterbody, and the timing and effectiveness of response and cleanup. Spills to a large, flowing river could spread rapidly and/or be difficult to completely remove. Impacts to surface water quality from small to very large spills along the inland portions of the rail corridor could be moderate to major, because potential spills could occur at locations immediately over or adjacent to surface water features, and the larger the spill the more likely it would be that the spill could reach a nearby waterbody. Spills along portions of the rail corridor adjacent to the Columbia River could produce moderate to major surface water quality impacts.

Groundwater Quality

A crude oil spill from a unit train could adversely impact groundwater quality if a release occurred over shallow, unconfined aquifers, particularly where soils have high infiltration rates and aquifers are overlain by porous alluvium, and during weather and moisture conditions favoring vertical migration. In eastern Washington, shallow groundwater may be encountered in various geologic and topographic settings. Major unconfined aquifers along the inland rail corridor are present near Spokane and Pasco. The remainder of the inland rail corridor traverses areas with deep, confined basalt aquifers hundreds of feet below the surface. Along the rail-Columbia River segment of the rail corridor, groundwater occurs within the unconfined alluvium along the main river channel and tributary confluence deposits, and also within deeper bedrock aquifers. In Washington, spill responses would be consistent with applicable GRPs (see Section 4.3). However, response planning and effectiveness may be limited in some remote rural sections of the rail corridor (e.g., Lincoln, Adams, and Franklin counties) that have discrete, shallow, unconfined groundwater bodies. Delayed response and/or incomplete cleanup of spills in any location with unconfined, shallow groundwater could allow contamination to enter soils and degrade groundwater quality, at least locally.

Impacts to groundwater quality from small to medium spills along the inland portions of the rail corridor would likely be minor to moderate in areas with GRP response strategies (along the Spokane River and rail-Columbia River), although response planning and effectiveness may be limited in remote rural areas. Impacts to groundwater quality from large to very large spills along the inland portions of the rail corridor would likely be moderate since larger volume spills would have greater spatial spread and temporal persistence. Implementation of GRP strategies along the Spokane and Columbia rivers would likely reduce damage to groundwater from spills of any size, but would not necessarily prevent contaminant migration into aquifers through overlying soils or through groundwater wells in poor repair.

Water Supply

Along the rail corridor in Washington, water supplies are drawn from numerous surface and groundwater sources. Water supply infrastructure includes surface water diversions and intakes and domestic, agricultural, and industrial groundwater wells. Outside of Washington, the rail network is in close proximity to numerous water withdrawal sources depending on the route. Surface water diversions, including intake structures, fish screens, filters, and other infrastructure for agricultural uses could be impacted by crude oil in the event of a spill over or adjacent to a waterbody crossing, including along the rail-Columbia River section of the rail corridor. Surface water supply impacts along the rail corridor could also include degradation of surface water quality and interruption of water deliveries. These impacts would likely be temporary, although the duration could vary. Diversion or filtration facilities/infrastructure could require repairs or replacement.

Drinking water supply from aquifers along the rail corridor include: two EPA-designated sole-source aquifers (the Spokane Valley-Rathdrum Prairie Aquifer straddling the Washington-Idaho border and the unconfined TAS at and upstream of the proposed Facility); potable water for several municipalities in the Columbia Basin Ground Water Management Area (GWMA); approximately 111 groundwater wells along the Washington side of the middle Columbia River; and designated groundwater drinking water source areas in Oregon adjacent to portions of the middle Columbia River (e.g., Umatilla, Morrow, Wasco, and Multnomah counties). A crude oil spill along the rail corridor near any unconfined aquifer could, if not completely cleaned up, allow contaminant migration into the unconfined aquifer and produce moderate to major localized impacts to drinking water quality. Along the inland rail corridor in the Columbia Basin GWMA most of the communities are dependent on deep, confined bedrock aquifers. Recent analyses of 124 municipal wells in this areas found 22 not in use, but not formally decommissioned, 26 without reported casing, and 65 without reported seals, conditions that increase their vulnerability to contamination from crude oil spills (Columbia Basin GWMA 2012). Strategies to meet future water supply demand in the Columbia Basin GWMA may increase the role of shallow groundwater sources.

Along the rail-Columbia River portion of the rail corridor (between the Tri-Cities area and Washougal), the rail line crosses the 5-year wellhead protection area for one or more wells serving the Washington communities of Bingen, North Bonneville, Plymouth, and Underwood, and also 43 designated groundwater source protection areas in Oregon that serve a broad mix of uses. The rail corridor along the Columbia River to the proposed Facility lies over the unconfined TAS, crossing public and private wellhead zones. A crude oil spill in this area could allow migration of contaminants into the groundwater immediately adjacent to the river and also into the unconfined TAS. A crude oil rail spill that reached the

Columbia River adjacent to this area could contaminate riverbed and bank sediments and ultimately pollutants could locally and/or seasonally migrate within groundwater toward the water supply wells.

Impacts to surface water supplies from small to very large spills along the inland portions of the rail corridor could be negligible to major depending on the location and duration of the spill. Impacts to surface water supplies along the rail-Columbia River portions of the rail corridor could also be negligible to major depending on location and persistence of spill-related contamination.

Wetlands and Floodplains

A spill during transport along the rail corridor could impact wetland and floodplain resources directly or indirectly from response vehicles, equipment, and operations that could impact wetland hydrology, vegetation, and soils. Spills into the river could impact wetland vegetation, including many wetland plant communities such as shrublands, grasslands, and aquatic vegetation (Table 3.4-1). Changes to hydrology and vegetation would likely be temporary, but soil compaction and/or contaminated soil removal could result in persistent impacts to the wetlands and/or floodplains. Flooding in the area of a crude oil spill could increase the rate and extent of spill spreading and could interfere with cleanup. Impacts to wetlands and floodplains from small to medium spills along the rail corridor would likely be minor to moderate depending on the location and duration of the spill and response event. Response effectiveness could be limited in remote rural sections of the rail corridor. Impacts to wetlands and floodplains from large to very large spills along the rail corridor would likely be moderate to major depending on the location and duration of the spill event and response activities.

Crude Oil Fire or Explosion

A crude oil fire or explosion along the rail corridor could lead to impaired surface water and groundwater quality, interruption or degradation of water supply, damage or loss of wetland vegetation, and altered floodway paths depending on the proximity of these resources to the fire or explosion and the unique circumstances of the event and environmental conditions at the time of the accident. A crude oil fire or explosion along the rail corridor could cause impacts to water resources in the event that debris, burned residuals, or unburned crude oil were to reach waterbodies, wetlands, or floodplains; these impacts would be similar to those from a crude oil fire and/or explosion that occurred at the proposed Facility. Impacts to water resources from a small fire event along the rail corridor would likely be minor assuming that it is controlled within a small area. Impacts to water resources from a large explosion and fire event along the rail corridor would be moderate to major depending on the spread of the fire and the size of the explosion debris field.

4.7.4.3 Vessel Transportation

Crude Oil Spill

Surface Water

In the event of a crude oil release from a vessel in the vessel corridor of the Columbia River, degradation of water quality would result within the area of surface spreading and lateral and vertical movement through the water column. Factors affecting the degree of spreading and movement within the water column include the type and amount of spilled oil, the location of the spill, river and tidal currents, wind waves, salinity, suspended sediment, and duration of the spill and response event. High river flow volume would tend to increase dispersion and reduce concentrations of contaminants associated with the spill event. Mainstem and tributary river flow patterns and volume could result in geographically complex patterns of oil spread or accumulation. Contamination could migrate some distance upstream within tributaries if the spill occurs during a high stage of the mainstem. Impacts to surface water quality would be similar to but likely more extensive than those described for the proposed Facility and the rail corridor.

Spill dispersion modeling (Appendix J) suggests that impacts to surface water quality along the Columbia River vessel corridor could extend up to 2 RMs for a small to medium vessel spill event, and could extend up to, or beyond, the mouth of the Columbia River for a large to very large vessel spill event. Depending on the location and duration of the spill event, impacts from a small to medium spill would likely be minor to moderate, and impacts from a large to very large spill would be major. A crude oil vessel spill at the mouth of the Columbia River or along the open ocean portion of the vessel corridor would also impact surface water quality in the marine and estuarine environments, as well as along affected shorelines. The area impacted and the duration of impacts could vary widely depending on the type and volume of crude oil spilled, the spill location, water temperature, waves/currents, weather conditions, and the timing and effectiveness of initial response. Depending on the location and duration of the spill event, impacts from a small to medium spill would likely be minor to moderate, and impacts from a large to very large spill would be major.

Groundwater

A vessel crude oil spill along the lower Columbia River could pose a risk to groundwater in the unconfined alluvium along the main river channel and tributary confluence. Impacts from a small to medium spill would likely be minor to moderate, and impacts from a large to very large spill would likely be moderate.

Water Supply

Along the vessel corridor in Washington, water supplies are drawn from numerous surface and groundwater sources. Water supply infrastructure includes surface water diversions and intakes and domestic, agricultural, and industrial groundwater wells. Surface water diversions, including intake structures, fish screens, filters, and other infrastructure could be impacted by a vessel crude oil spill. Surface water supply impacts along the vessel corridor could also include degradation of surface water quality and interruption of water deliveries. These impacts would likely be temporary, although the duration could vary. Diversion or filtration facilities/infrastructure could require repair. Impacts to surface water supplies along the Lower Columbia River vessel corridor from small to very large spills would likely be moderate to major depending on the number of water intakes affected, resulting interruptions of water diversions, and the persistence of water quality degradation.

Drinking water supply along the vessel corridor includes water drawn from 7 wellhead protection areas in Washington, including 3 wells at the Port and 10 designated groundwater source protection areas in Oregon. Impacts could occur to other groundwater wells along the vessel corridor that extract water for agricultural and industrial uses that lack specific protection zones. A crude oil vessel spill could contaminate riverbed and bank sediments and ultimately pollutants could locally and/or seasonally migrate within groundwater toward the water supply wells. In addition to the possibility of water quality degradation, some of the response and spill-control measures could require temporarily suspending groundwater pumping as part of oil containment strategies, which would interrupt water supply. Impacts to water supplies along the vessel corridor from small to very large spills could be minor to major depending on location and persistence of spill-related contamination.

Wetlands and Floodplains

A spill of crude oil along the vessel corridor could result in impacts to freshwater, estuarine, or marine wetlands, depending on the location of the spill. In the event of a spill from a vessel within the Columbia River, crude oil would likely move toward the edges of the river and downstream, carried by river currents. In the event of a crude oil release from a vessel located at the mouth of the Columbia River in the vicinity of estuarine and marine wetlands, estuarine and marine wetland vegetation may be impacted through smothering or oiling, soil contamination, or localized decreases in water quality. Impacts to wetland vegetation would likely be higher in the event of a spill in close proximity to land because wind, waves, and currents would likely move oil onshore and into wetland vegetation. The farther from shore, the more variable the wind, wave, and current forces are, and potential impacts to wetlands are correspondingly lower. If a vessel crude oil release were to occur during a flooding event, flooding could increase the rate and extent of spreading of oil and interfere with cleanup. In the case of a vessel grounding within a floodplain, floodway paths could be altered until the vessel is removed.

Impacts to wetlands and floodplains from vessel spills in the Lower Columbia River would be reduced by implementation of the VRP and GRP strategies to limit the spread and duration of spills; however, incomplete removal of oil from vegetation and residual contamination of channel bed and bank sediments could impact wetlands, and cleanup activities could impact floodplain and wetland hydrology. Impacts to wetlands and floodplains along the vessel corridor from small to very large spills could be minor to major depending on location and persistence of spill-related contamination.

Crude Oil Fire or Explosion

In the event of a vessel fire or explosion in the Columbia River, heavier pyrogenic products resulting from burning crude oil could sink into river sediments. Fire could increase water temperature in the short term until it was extinguished. Debris from an explosion could impact water quality if the debris contained toxic contaminants. A fire or explosion involving a vessel on the Columbia River would not likely impact groundwater resources. Impacts to wetlands are also unlikely since a fire or explosion event would likely be at a distance from such wetlands. However, in the event that a large fire and explosion event occurred close to shore, wetland vegetation could be destroyed by direct contact with heat, and expelled debris could alter floodway paths if enough material were removed from or added to a floodplain during the explosion. Debris could contaminate waterbodies or damage shoreline structures (such as docks and walkways), and could temporarily alter local flooding patterns until removal.

Impacts to water resources from a small fire event along the vessel corridor would likely be minor assuming that it is quickly controlled. Impacts to water resources from a large explosion and fire event along the vessel corridor could be moderate to major depending on the size of the fire and the extent of the explosion debris field. An explosion and fire could result in a small to very large oil spill. Impacts from a spill are addressed in previous sections.

4.7.5 Terrestrial Vegetation

This section addresses potential impacts of spills, fires, and/or explosions to terrestrial vegetation. The extent of potential oil spill impacts to terrestrial vegetation would depend on

- Spill size and oil type;
- Spill site topography and spill containment;
- Soil type, moisture, saturation, and temperature;
- Vegetation type, structure, and sensitivity;
- Spill timing (season), duration, and extent;
- Extent of surface and subsurface disturbance required for response; and
- Concurrent fire or explosions.

4.7.5.1 Proposed Facility

Crude Oil Spill

Crude oil acts as a contact herbicide that damage cells and tissues of plants that come into contact with it (Walker et al. 1978, McKendrick 1999). Crude oil can also coat the surface of plant leaves and stems, preventing normal gas exchange and leading to injury or death of the plant (McKendrick 1999). Herbaceous vegetation is most vulnerable to damage from crude oil, and contact with the stems may be sufficient to kill the whole plant (Walker et al. 1978). Shrubs have a protective bark layer and perennating[12] buds that store nutrients and energy from one season to the next. When oil penetrates soil, roots are damaged on contact and hydrophobic soils are created that limit water availability to plants. Microbial actions can imbalance carbon-to-nutrient ratios as microbes increase to consume the hydrocarbons using soil nutrients in the process. This increased microbial activity can deprive vascular and nonvascular plants of vital nutrients (McKendrick 1999). Oil reaching tree roots could lead to tree mortality over time (Collins et al. 1994). Lighter crude oils are generally more toxic to plants and mosses than heavier crude oils although damage may be reduced by wetter soil conditions that prevent the oil from reaching plant roots (Hutchinson and Freedman 1978, Walker et al. 1978, Holt 1987, Bay 1997). Heavier oils generally present the highest risk to vegetation because of higher persistence and mechanical injury from coating and fouling (Ecology 2015a).

The proposed Facility site has no special-status plants and impacts to vegetation from a crude oil spill of any size at the proposed Facility would be negligible if the spill is contained within the site boundaries. A spill during vessel loading could potentially reach the two populations of western ladies tresses located in wetlands less than 2 miles downriver from the proposed Facility (potential impacts to wetlands are also discussed in Section 4.7.6). Response activities may include ground disturbance and removal of surrounding vegetation as well as vehicle and foot traffic that could compact soil and hinder regrowth of vegetation. Spill response and cleanup activities could result in damage to existing shoreline vegetation if booms are deployed near sensitive resources. Natural sorbent materials such as straw or mulch could contain noxious or invasive weed seeds. Deployment of booms around the Vancouver Lake – Lake Flushing Channel Area could result in trampling of one or more of the populations of western ladies tresses near this location.

Impacts to terrestrial vegetation from small to medium spills at the proposed Facility would likely be negligible to minor because most potential spills would be contained and would not be likely to reach vegetated areas, and impacts to terrestrial vegetation from a large spill could be moderate because these spills and the associated response actions may reach and damage vegetation in surrounding areas.

Crude Oil Fire or Explosion

In the event of a fire or explosion, aboveground vegetation in close proximity to the event could be damaged or destroyed. Impact to vegetation from fire would partially depend on the heat generated by the fire and sensitivity of the affected vegetation. A fire that were not contained within the proposed Facility could reach vegetated habitats in the wetland mitigation sites to the north or east. If soils in these nearby habitats were lightly impacted, most herbaceous vegetation would likely reestablish within several years, whereas shrubs and trees would require longer periods. The small mixed stand of oak woodland located less than 1 mile northeast of the proposed storage tank area could be vulnerable to an uncontrolled fire if it were to spread to the northeast. An explosion at the proposed Facility could propel debris north into

12 In botany, perennation is the ability of plants to survive from one germinating season to another, especially under unfavorable conditions.

vegetated areas or south into the Columbia River. The extent of the area impact by debris would depend on the size of the explosion and prevailing wind and weather conditions.

Impacts to terrestrial vegetation from a small fire event at the proposed Facility would likely be negligible if the fire did not reach vegetated areas, and impacts to terrestrial vegetation from a large explosion and fire event would likely be moderate if the event and associated response activities extended into vegetated areas.

4.7.5.2 Rail Transportation

Crude Oil Spills

The terrestrial vegetation cover along the potentially affected rail corridor is presented in Table 3.4-1. As shown in the table, crude oil spills along the rail corridor could impact vegetation within:

- Agricultural lands,
- Forests and woodlands,
- Introduced or seminatural vegetation areas,
- Nonvascular and sparse vascular rock vegetation areas,
- Recently disturbed or modified areas,
- Semidesert areas, and
- Shrublands and grasslands.

Depending on the location and duration of the spill, impacts could occur to a variety of terrestrial vegetation types. Spills that reach agricultural vegetation would likely result in crop loss and reduced production and crop yields until affected soils are successfully remediated. The duration of required remediation would depend on the depth of soil contamination, amount of soil contaminated, and on the remediation method utilized. If a large amount of soil is contaminated, the time required to achieve remediation could be extensive, particularly if in-situ bioremediation is utilized. Spills that reach vegetation along the rail corridor could affect a total of 37 special-status plants that have been documented within the rail corridor, and more specifically 26 special-status plants that are within the rail-Columbia River portion of the rail corridor (Table 3.4-2). Outside of Washington, land type distribution along the rail corridor suggests that forests, woodlands, shrublands, and grasslands could be impacted in most spill events. Spills that reach native vegetation in Idaho or Montana could impact three threatened and one candidate plant and spills in North Dakota could impact one threatened plant (Table 3.4-4).

Response and containment activities could affect vegetation communities along the rail corridor by removal of contaminated vegetation and soils. In some cases, in situ burning could be used as a response measure and could destroy or damage vegetation. Cleanup activities could also result in direct removal of oiled vegetation or trampling/breakage caused by human and equipment disturbance (NOAA 1994).

Impacts to terrestrial vegetation from small to medium spills along the rail corridor would likely be negligible to minor because in most cases spills on land would not migrate extensively outside the immediate developed rail corridor, limiting potential exposure of sensitive vegetation communities. Impacts to terrestrial vegetation from large to very large spills would likely range from moderate to major because a potential exists for spills to produce both short-term and long-term effects on special-status plants and sensitive vegetation communities.

Crude Oil Fire or Explosion

In the event of a fire or explosion, aboveground vegetation in close proximity to the event could be damaged or destroyed. Impact to vegetation from fire would partially depend on the heat generated by the fire and sensitivity of the affected vegetation. If soils are lightly scorched, herbaceous vegetation would likely reestablish within 1 or 2 years. Shrubs and trees killed by fire would likely take longer to reestablish. Although sagebrush communities are adapted to periodic fires, full recovery could take from 20 to 40 years (Bates et al. 2013). The extent of damage to forest communities would depend on fire frequency, heat, soil and fuel moisture, concentration of natural fuels, and weather conditions (Fitzgerald 2005, Perry et al. 2011). Regrowth of forest communities after an intense and extensive forest fire could take decades to centuries. A fire along the rail corridor within Washington could spread to adjacent vegetated areas, and vegetation cover could be destroyed. Outside of Washington, the increased proportion of forest and woodland cover, particularly in Idaho and Montana, could lead to increased risk of oil spill–related forest fires. A large explosion and fire event in a remote location could lead to a delayed response, particularly during the peak of the wildfire season in late summer.

Impacts to terrestrial vegetation from a small ground fire or surface fire along the rail corridor would likely be negligible to minor assuming the fire could be controlled. The impacts to the most common vegetation covers would likely be short term. Impacts to terrestrial vegetation from a large rail explosion and fire event are anticipated to range from moderate to major because the event could result in a crown fire with extensive spread. This type of fire, and the associated fire-response activities, would likely extend into nearby land including forest and woodlands, and the potential damage to affected vegetation communities, including special-status plants and sensitive vegetation, would likely result in major impacts. However, under certain circumstances, forest fires can promote biological diversity and improve the health of some ecosystems by fostering new plant growth (Pacific Biodiversity Institute 2009).

4.7.5.3 Vessel Transportation

Crude Oil Spills

Spills from vessels could impact shoreline vegetation and wetlands (potential impacts to wetlands and floodplains are discussed in Section 4.7.6). Spill response and containment activities associated with a spill during vessel transportation could affect vegetation communities if removal of contaminated vegetation and soils were required. These and other cleanup activities could result in vegetation disturbance from removal of oiled vegetation or by trampling/breakage caused by human and equipment disturbance (NOAA 1994). Impacts to terrestrial vegetation from small to medium spills along the vessel corridor would likely be minor assuming these spills would be contained within a limited area and would not reach sensitive vegetation communities. Impacts to terrestrial vegetation from large to very large spills would likely be moderate to major since the spill could spread extensively and affect special-status plants and sensitive vegetation communities, resulting in short- and long-term effects on vegetation communities.

Crude Oil Fire or Explosion

A small vessel fire would likely produce negligible impacts to terrestrial vegetation. A large fire and/or explosion along the vessel corridor could damage or destroy some shoreline vegetation if the event occurred near shore, producing minor impacts. If a large fire and explosion occurred distant from shore, impacts to terrestrial vegetation would be negligible. However, an explosion and fire could result in a small to very large oil spill. Impacts from a spill are addressed in previous sections.

4.7.6 Terrestrial Wildlife

This section addresses potential impacts of spills, fires, and/or explosions to terrestrial wildlife. Potential impacts could include loss of wildlife, including sensitive species individuals, and wildlife habitat, including priority habitats.

4.7.6.1 Proposed Facility

Crude Oil Spills

Crude oil is toxic to terrestrial wildlife. Toxicity may be caused by contact, inhalation of fumes, or ingestion. Effects may be lethal or sublethal, or acute or chronic. They would vary with the exposure route, quantity, length of exposure, reproductive status, and sensitivity of the animal. External coating of fur, feathers, skin, or scales results in reduced water-repellency (buoyancy) and reduced thermoregulatory capacity (hypothermia or hyperthermia), and can lead to suffocation in amphibians. Oiled wildlife tend to groom or preen to remove the oil and ingest the oil in the process. Once ingested, oil generally causes hemolytic anemia, kidney damage, liver damage, and central nervous system damage (EPA 1999, Troisi et al. 2006).

Nonlethal effects of exposure to oil may include both physiological and ecological effects. Chronic exposure to PAHs can lead to physiological responses such as immunosuppression and mutagenic effects (Burns et al. 2014). Oil spills may affect wildlife through habitat degradation, changes in prey or forage availability, and contamination of prey or forage resources. Animals displaced from contaminated habitats may experience increased competition in new habitats. Changes in preferred prey or forage may lead to use of lower quality prey or forage, which can reduce survival and reduce reproductive fitness. These sublethal physiological and ecological effects of oil can persist long after cleanup activities have concluded and can have important consequences on individual and population fitness (Henkel et al. 2012, Burns et al. 2014).

Amphibians may absorb toxins from oil through their skin. Most studies of reptile exposure to oils have involved sea turtles, discussed in Section 4.7.7. Exposure to toxins that occurs during egg formation in reptiles and amphibians can lead to reduced productivity and teratogenic effects;[13] longer-lived animals, such as turtles, may be more susceptible to carcinogenic effects of PAHs compared to shorter-lived animals (Burns et al. 2014).

Birds are susceptible to toxic effects of oil through preening and ingesting contaminated prey. During preening, birds typically ingest oil from their feathers, which can lead to severe weight loss, hemolytic anemia, kidney damage, liver damage, foot problems, gut damage, and immunosuppression (Troisi et al. 2006). Ingestion of PAHs can cause teratogenic changes (embryo deformities) and changes in egg size and shell thickness (Vidal et al. 2011) and can reduce future reproductive success. Eagles and other raptors may become contaminated by feeding on oiled carcasses. Shorebirds are particularly vulnerable to oil spills because they spend much of their time foraging in shoreline habitat (Henkel et al. 2012), where spilled oil often accumulates through wave action. Nesting birds with external oiling can transfer oil to eggs during incubation, which can suffocate the egg or result in damage to the developing embryo, including cell damage, developmental abnormalities, and reduced survival (Burns et al. 2014).

Mammals may ingest oil from contaminated prey or forage or during grooming. Oil on fur or hair damages insulating properties and may lead to hypothermia. Breathing vapors or ingesting oil can cause

13 Teratogens are any agent that can disturb the development of an embryo or fetus.

lung damage, digestive tract bleeding, and liver and kidney damage (EPA 1999). Predators such as foxes and coyotes may be attracted to spill sites by carcasses. Mammals that spend time in or near contaminated sediments such as rodents or raccoons may inhale hydrocarbon vapors, which can result in lung and nerve damage and may contribute to behavioral abnormalities (EPA 1999). Toxins can be transferred to offspring through the placenta or milk (Burns et al. 2014). Stress from ingested oil can be additive to normal environmental stressors, such as low temperatures and metabolic costs of migration.

Spills at the proposed Facility could occur within containment areas or on graded fill or paved surfaces. In the immediate vicinity of the proposed Facility, industrial areas, wetland habitat, and the small patch of Westside Lowland Conifer-Hardwood forests (cottonwood stand) could come in contact by oil in the event of a spill that is external to secondary containment. Some wildlife could be exposed to spills captured in open secondary containment, including gulls, pigeons, songbirds, squirrels, mice, and voles. Eagles, gulls, crows, ravens, other raptors, and foxes could be attracted to carcasses of prey such as mice, squirrels, or small birds killed by the oil. Human activity in the spill area and removal of oiled carcasses or injured wildlife would tend to deter these predators. Molting and brood-rearing flightless waterfowl, and mammals in burrows or hibernating in dens, are particularly vulnerable to oil spills.

If released oil migrated outside of the proposed Facility, crude oil could reach wildlife habitats, including the Columbia River Wetland Mitigation Bank to the north, the Parcel 1A mitigation site to the east, or the Columbia River to the south. These locations include areas of priority riverine tidal and palustrine wetlands with amphibians, reptiles, birds, and mammals (Sheldon et al. 2005). Spills reaching these habitats during spring or summer could affect breeding great blue herons and cavity-nesting ducks. Spills into these habitats during fall and winter could affect postnesting, migratory, and winter vulnerable concentrations of shorebirds and waterfowl (Table 3.5-2).

No priority amphibians or reptiles have been documented in the vicinity of the wetland mitigation sites or the Vancouver Lake Wildlife Area (Table 3.5-3). Priority birds that occur in the area that are most likely to be affected by a large spill that escaped open secondary containment could include bald eagles, purple martins, and sandhill cranes (Table 3.5-3). These priority birds would be most vulnerable to potential spill impacts during the breeding season.

Spills that entered the Columbia River could impact priority riverine tidal wetland habitats at the proposed Facility site and downstream. While no special-status wildlife are documented to use habitats at the proposed Facility, spills could reach the nesting area for bald eagles located downriver. Spill effects on aquatic stages of insect prey could degrade foraging habitats for purple martins, Vaux's swifts, long-eared myotis bats, long-legged myotis bats, and Pacific Townsend's big-eared bats (Table 3.5-3).

Spill response and cleanup activities could result in damage to riverine tidal wetlands if booms were deployed near sensitive resources. Onsite burning is not preapproved within or near the proposed Facility to remove spilled oil, but if approved it could injure or kill amphibians, reptiles, and small mammals. Although cleanup operations would decrease the likelihood that wildlife would come into contact with oil or oiled-forage or prey, they would also temporarily disturb and displace some wildlife. The Clark/Cowlitz GRP specifies the use of the Port of Ridgefield as a staging area to protect the Ridgefield Management Area, and the GRP also identifies the Shillapoo Wildlife Area/Vancouver Lake area for protection in the event of a spill.

In summary, impacts to terrestrial wildlife from small to medium spills at the proposed Facility site would likely range from negligible to minor assuming the spills are contained within the proposed Facility, although any small to medium spill that reaches the Columbia River could produce moderate localized impacts to terrestrial wildlife and wildlife habitat up to 1 RM downstream. Impacts to terrestrial wildlife from a large spill would produce moderate to major impacts to terrestrial wildlife depending on the volume and location of the release, the season in which the release occurs, and whether the spilled oil migrates outside of the proposed Facility site.

Crude Oil Fire or Explosion

At the proposed Facility, an explosion and associated fire could result in injury or mortality to a variety of wildlife, including pigeons, gulls, songbirds, small mammals, amphibians, and reptiles. Most fires would likely be extinguished before they spread beyond the proposed Facility boundaries. However, if a fire were to spread to nearby habitats such as the Shillapoo Wildlife Area, additional wildlife injury or mortality would be expected. A fire that occurred when animals are nesting or have young with limited mobility (especially birds and small mammals) would likely cause loss of young. Secondary effects of habitat loss due to fire or explosion may include reduced forage or prey availability. Fire that reaches the small mixed stand of oak woodland located less than 1 mile northeast of the proposed storage tank area could affect a diversity of vertebrates and invertebrates (Larsen and Morgan 1998). An explosion at the proposed Facility could propel oil into priority palustrine wetlands north of the proposed Facility or into riverine tidal wetlands along the Columbia River, leading to minor to moderate localized terrestrial wildlife impacts. The extent of the area contacted by oil would depend on the size of the explosion and prevailing wind and weather conditions.

Impacts to terrestrial wildlife from a small fire event at the proposed Facility would likely be negligible to minor assuming the event were contained within the proposed Facility site. Impacts to terrestrial wildlife from a large explosion and fire event would be minor to moderate depending on the size of the explosion, extent of the fire, and the season in which the event occurred.

4.7.6.2 Rail Transportation

Crude Oil Spills

Depending on location and extent, spills along the rail corridor could impact important wildlife habitats, such as Wildlife Management Areas, National and State Parks, National and State Wildlife Refuges, and natural habitats managed for biodiversity. Spills that reach the Columbia River could reach both wildlife areas and priority wildlife habitats. For wildlife species that occur along the rail corridor and also occur at or near the proposed Facility, impacts from an oil spill would be similar to those described previously. Impacts to other species and habitats that occur along the rail corridor are addressed in this section.

Priority wildlife and wildlife habitats along the rail corridor include eastern Washington breeding areas of gulls and colonies of waterbirds including black-crowned night herons and great blue herons (Table 3.5-6). Deer and elk along the rail corridor would be most vulnerable to impacts from an oil spill that occurred during the birthing season, and particularly when lambs, fawns, or calves have limited mobility (Table 3.5-6). Between RMs 115 and 343 a total of 32 wildlife special areas have been identified that would receive special protection in the event of a spill in the Lower and Middle Columbia River (NWAC 2015a, 2015b).

As discussed in Section 3.5, 35 special-status wildlife species occur along the rail corridor in Washington state. Of these 35 special-status wildlife species, 23 are also considered sensitive by the US Forest Service (USFS) and Bureau of Land Management (BLM), 4 are state endangered, and 3 are state threatened (Table 3.5-7; USFS and BLM 2011, Washington Department of Fish and Wildlife [WDFW] 2015). Six special-status amphibians and reptiles have been documented along the rail corridor from the Washington-Idaho border to the Port, including the Larch Mountain salamander (a federal species of concern and state sensitive species) and the Pacific pond turtle (a federal candidate and state endangered species). Three of these special-status amphibian and reptile species occur along the Columbia River portion of the rail corridor (Table 3.5-7). Twenty special-status birds occur along the rail corridor, including federally protected bald eagles, Columbian sharp-tailed grouse, northern spotted owls, and streaked horned larks (Table 3.5-7). These special-status birds would be most vulnerable to potential spill impacts during the breeding season. Nine special-status mammal species have been documented along the rail corridor within Washington state. Three of these species, the pygmy rabbit, Washington ground squirrel, and western gray squirrel, are either already federally protected or are candidate species (Table 3.5-7), and a spill along the rail corridor could impact these mammals that use smaller habitat areas and burrows or warrens.

Outside of Washington, a greater proportion of the rail corridor is managed for natural habitats, and spills could reach natural habitats managed for biodiversity or multiple uses (Table 3.5-8). Special-status and sensitive wildlife species that may occur along this section of the rail corridor include one insect species, seven birds, and five mammals (Table 3.5-9). These 13 species include federally listed or candidate species, including Dakota skippers, greater sage-grouse, yellow-billed cuckoos, Canada lynx, grizzly bears, and woodland caribou (Table 3.5-9).

Impacts to terrestrial wildlife from crude oil spill containment and cleanup activities would be similar to those discussed for cleanup of spills at the proposed Facility. However, spill response in remote areas could require more mobilization time. Onsite burning to remove oil, if allowed, could create smoke plumes and particulates that could affect birds and mammals through inhalation. Disturbance effects from containment and cleanup activities are usually short term. Implementation of the BNSF Hazardous Materials Program would include measures to reduce impacts to sensitive animal habitats and endangered wildlife and plants, and measures that would maintain the railroad right-of-way to deter animals such as bears and eagles. Applicable GRPs along the rail corridor include measures to reduce wildlife disturbance, including flight restriction zones and avoidance of low-level flyovers that could disturb concentrations of birds and wildlife. If intentional hazing is conducted to deter wildlife from entering oiled areas, it would be performed under the authority and general supervision of WDFW, US Fish and Wildlife Service (USFWS), and/or National Marine Fisheries Service (NMFS).

Impacts to terrestrial wildlife from small to medium spills along the rail corridor would likely range from negligible to minor assuming the spills are quickly contained and do not spread beyond the immediate railbed, although any small to medium spill that reaches the Columbia River could migrate 1 RM downstream and produce moderate localized impacts to terrestrial wildlife and habitat, including priority habitats. Impacts to terrestrial wildlife from large to very large spills along the rail corridor would produce moderate to major impacts depending on the volume and location of the release, the season in which the release occurs, and whether the spilled oil migrates into priority habitats, such as Wildlife Management Areas.

Crude Oil Fire or Explosion

A fire or explosion along the rail corridor could spread and damage or destroy adjacent wildlife and habitats. The extent of wildlife and habitat losses would depend on many variables similar to those discussed for spills. For example, a large explosion and fire in a remote, undisturbed, forested portion of the rail corridor during peak wildfire season could spread very quickly, be very difficult to contain, and burn a large area. Outside of Washington, there is more forest and woodland cover along the rail corridor that could be vulnerable to fire. The habitats and priority and special-status wildlife species potentially affected if a fire and/or explosion occurred in these areas would be the same as those discussed for spills, but in the event of a spreading wildfire, additional habitats and wildlife farther from the rail corridor could be impacted.

Impacts to terrestrial wildlife from a small fire event along the rail corridor would likely be negligible to minor because the event would likely be contained, and effects to wildlife and wildlife habitats would likely be short term. Impacts to terrestrial wildlife from a large explosion and fire event could be moderate to major because the event and associated response activities may damage special-status wildlife and priority wildlife habitats and could result in long-term effects on wildlife habitats.

Impacts to terrestrial wildlife from a small ground fire or surface fire along the rail corridor would likely be negligible to minor and short term, assuming the fire could be controlled. Impacts to terrestrial wildlife from a large rail explosion and fire event could range from moderate to major if the event affected forest and woodland habitat, and developed into a crown fire with extensive spread or if the event developed into a large brush fire. These types of fires and associated fire-response activities could damage special-status wildlife and priority wildlife habitats, and could result in major impacts to local terrestrial wildlife populations and affected wildlife habitats. However, it should be noted that under certain circumstances, forest fires can promote biological diversity and improve the health of some ecosystems by fostering new plant growth, and some wildlife populations could expand as a result (Pacific Biodiversity Institute 2009).

4.7.6.3 Vessel Transportation

Crude Oil Spills

Spills from vessels could impact terrestrial wildlife by damaging or destroying affected shoreline habitats. Additionally, terrestrial wildlife could be directly exposed to oil or fuel spilled from vessels through contact either on the shoreline or in the water. These animals could be affected by ingestion while trying to remove oil from fur (e.g., river otter, beaver) or feathers (e.g., waterfowl, seabirds) through grooming or preening, by swallowing oil while drinking water or consuming contaminated prey, or by inhaling volatile fractions. Vessel spills within the Columbia River Estuary could impact identified natural habitat areas, the majority of which are managed for biodiversity, priority wildlife habitats, and wetlands (Table 3.5-5). GRPs that cover the vessel transportation corridor identify particularly sensitive habitats that would be a priority to protect in the event of a vessel spill. For example, the Lower Columbia River GRP identifies 15 wildlife special areas to protect between RMs 1 and 92 in the event of a spill (NWAC 2015b).

One special-status amphibian species, nine special-status bird species, and one special-status mammal species has been documented in the vessel corridor, including the state candidate Dunn’s salamander and the endangered and federally listed Columbian white-tailed deer (Table 3.5-7). Of the nine special-status birds that may occur in the vessel corridor, four are either federally listed for protection or candidates for federal protection, including the marbled murrelet and peregrine falcon (Table 3.5-7).

Disturbance to terrestrial wildlife and wildlife habitats could occur during oil spill response and cleanup actions. In the event that an oil spill reached important terrestrial wildlife areas, cleanup actions could impact protected birds and mammals. Applicable GRPs along the vessel corridor include measures to reduce wildlife disturbance, including flight restriction zones and avoidance of low-level flyovers that could disturb concentrations of birds and wildlife. If intentional hazing were conducted to deter wildlife from entering oiled areas, it would be performed under the authority and general supervision of WDFW, USFWS, and/or NMFS.

Impacts to terrestrial wildlife from small to medium spills along the vessel corridor could be minor to moderate if spills made contact with wildlife and wildlife habitats up to 2 RMs from the spill source. Impacts to terrestrial wildlife from large to very large spills could be moderate to major as numerous special-status wildlife and priority wildlife habitats could be affected from the spill source to beyond the mouth of the Columbia River.

Crude Oil Fire or Explosion

A small vessel fire would likely produce negligible impacts to terrestrial wildlife. A large fire and/or explosion along the vessel corridor could damage or destroy some terrestrial wildlife habitat if the event occurred near shore, producing minor impacts. If a large fire and explosion occurred distant from shore, impacts to terrestrial wildlife and wildlife habitat would be negligible. However, an explosion and fire could result in a small to very large oil spill. Impacts from a spill are addressed in previous sections.

4.7.7 Aquatic Species

This section addresses potential impacts of spills, fires, and/or explosions to aquatic species. Potential impacts could include loss of aquatic wildlife, including sensitive species individuals and wildlife habitat, including priority habitats.

4.7.7.1 Proposed Facility

Crude Oil Spill

Impacts to aquatic species from a crude oil spill of any size at the proposed Facility would be negligible if the spill is contained within the site boundaries and does not reach the Columbia River.

Habitat Impacts

Impacts to the water and substrate in aquatic habitats would be similar to impacts described for wetlands, floodplains, and other aquatic environments (Section 4.7.6). The behavior of oil spilled in a freshwater environment, such as the Columbia River or associated wetlands, is described in Section 4.5.4.

Oil present at the water's surface and in the water column could affect the aquatic organisms present. Organisms that would be the most vulnerable to exposure and effects would be poor or passive swimmers present in the surface layer (Dicks 1998). Crude oil that sinks (dilbit, or heavily weathered Bakken crude oil) could affect bottom-dwelling organisms and feeders, and crude oil that accumulates along river banks or in stagnant areas could impact organisms in those areas. Crude oil suspended or dissolved within the water column could affect any organisms present in the water column.

Response activities to remove spilled oil from aquatic environments are discussed in Section 4.6.5. If dispersants were approved to remove oil beyond the mouth of the Columbia River, it would increase the amount of oil that physically mixed into the water column, thus increasing the exposure of organisms within the water column. Dispersed oil within the water column could be consumed by plankton and enter the food chain (National Academy of Sciences 2010). In situ burning, if approved, could convert spilled oil into sinkable residues that would disperse into the water column and benthic environments. Use of other cleanup methods such as booms and skimming would not result in direct effects on the water column; however, marine organisms in the vicinity of the cleanup activities could be indirectly affected through disturbance. If weathered crude oil were to mat or tarballs were to accumulate on water bottom sediments, physical removal could become necessary (NOAA 2010a). Mechanical removal could disturb large areas of habitat and associated aquatic communities.

Areas designated as Pacific salmon freshwater essential fish habitat (EFH) occur near the proposed Facility site (see Section 3.6) and would be impacted in the event of a spill in that area. Effects to salmon EFH would be similar to those described above for spills to other aquatic habitats.

Impacts to aquatic habitats from small to medium spills at the proposed Facility that reached the Columbia River would likely be minor assuming the spill were contained within secondary containment booms. If a small to medium spill escaped secondary containment it could impact aquatic habitats within

1 RM downstream of the proposed Facility. Impacts to aquatic habitats from a large spill would be moderate to major depending on the location of the spill and on the volume of oil, if any, that escaped containment systems. An uncontained large spill from the proposed Facility could impact aquatic habitats within 7 RMs downstream of the proposed Facility.

Species Impacts

Fish

Since under most circumstances, oil spilled to aquatic environments tends to float as a slick or sheen on the water surface, direct contact with adult fish would be less likely to occur. Fish that have been exposed to oil may suffer a range of effects including changes in heart and respiratory rates, enlarged livers, reduced growth, fin erosion, deformities, and a variety of effects at biochemical and cellular levels (USFWS 2010). Oil may also affect the reproductive capacity of fish and may result in deformed fry (United Nations Environment Programme 2011). Sublethal effects to adult fish are more likely to occur than direct or indirect mortalities depending on the species and their life-history stage during a spill event. Observed near-surface contaminant concentrations within the water column beneath previous oil spill slicks and sheens have typically been lower than acute toxicity levels for fish, macroinvertebrates, and plankton, and the concentrations of contaminants have typically diminished quickly with depth. For example, extensive sampling following the *Exxon Valdez* oil spill (approximately 11,000,000 gallons in size) revealed that hydrocarbon levels were well below those known to be toxic or to cause sublethal effects in fish and plankton (Neff 1991).

Larval/juvenile fish are generally more sensitive to toxicity than adults (Hose et al. 1996). Mortality of larval/juvenile fish would be expected to be greater than for adult fish because larval/juvenile life stages are often found at the water’s surface, where contact with oil is most likely. In addition, larvae/juveniles are relatively immobile, whereas adult fish would be able to swim away from the spill. Heavier crude oil spills can cause detrimental effects to fish in egg and larval stages from smothering if the crude oil sinks (NOAA 2011). Resident fish species, eggs, and larvae would be more affected by an oil spill in the Columbia River than adult pelagic fish, as multiple life stages of resident fish could be affected.

Indirect effects on fish from an oil spill include interference with movement to feeding, overwintering, or spawning areas; localized reductions in food resources, including prey; and consumption of contaminated prey (Morrow 1974, Brannon et al. 1986, Purdy 1989). Floating oil can contaminate plankton, which includes algae, fish eggs, and the larvae of various fish and invertebrates.

Response activities could include use of dispersants (if approved). While dispersants would likely reduce the potential impact of an oil spill on surface-dwelling animals, they could introduce a large volume of oil into the water column. Dispersant chemicals mixed with oil could sink and come into contact with fish and eggs at the bottom surface or buried in the bottom sediment, resulting in increased toxicity to these organisms. Dispersed oil could accumulate in more stagnant areas or could be consumed by plankton in the water column and enter the food chain (National Academy of Sciences 2010). Other methods of cleanup that could produce direct or indirect effects on fish include extensive use of vessels and aircraft, booming, skimming, manual or mechanical removal, application of sorbents, vacuuming, removal of debris, sediment reworking, in situ burning, and pressure washing. These response actions could potentially disturb fish and fish prey, and could displace them from important feeding or reproductive grounds.

Invertebrates

In the event of a spill, direct exposure to oil may cause mortality to invertebrates residing in the vicinity of the proposed Project. Many invertebrate species are relatively immobile and often indiscriminate filter-feeders, and may not be able to avoid exposure to oil. Floating oil and volatile compounds can contaminate plankton, including the larvae of various invertebrates. Effects to invertebrates are magnified since they ingest a large quantity of water relative to their body size. Contamination can produce long-term effects on respiration, mobility, digestion, growth, and reproduction (Earth Gauge 2011). Sinking oil can affect invertebrates occupying the river bottom, contaminating or smothering these species. If mobility is reduced, invertebrates can become more vulnerable to predators or more susceptible to currents.

Oil that aggregates in shallow areas could trap or incapacitate invertebrates by exposure to dissolved fractions of crude oil. Many invertebrates cannot metabolize PAHs, which instead accumulate in body tissues (Earth Gauge 2011). Filter-feeding bivalve animals (e.g., introduced Pacific oysters and native Olympia oysters; native littleneck, butter, and horse clams; and introduced Manila and softshell clams) easily ingest dispersed oil droplets and oiled particles suspended in the water column. Bivalves do not metabolize hydrocarbons, which remain in the tissues for extended periods. Crabs (Dungeness and red rock crabs) may be affected for a short time but they, like most crustaceans, tend to metabolize hydrocarbons and quickly eliminate them as body waste. Some stress-tolerant organisms, including polychaete worms, snails, and mussels, have been found to be more abundant at oiled sites—possibly due to the species benefiting from organic enrichment from the oil, or from reduced competition or predation from more sensitive species.

Response activities could harm invertebrates in the nearshore environment through the use of chemical cleaning, hot water/high-pressure hoses, and manual and mechanical treatments. If use of dispersants is approved, invertebrates that might normally be unaffected by floating oil could become contaminated through exposure to oil droplets suspended in the water column, resulting in increased toxicity.

Marine Mammals

Steller sea lions, California sea lions, and Pacific Harbor seals (pinnipeds) are present in the Columbia River and could be directly or indirectly affected by an oil spill in the vicinity of the proposed Project. Oil that comes into contact with marine mammals can cause irritation or ulceration of skin, mouth, or nasal cavities. Marine mammals breathe air at the surface, potentially exposing them repeatedly to floating oil and volatile chemicals during inhalation (NMFS 2013). Oil may cause damage to the airways and lungs of marine mammals and may cause congestion, pneumonia, emphysema, and even death from breathing in droplets of oil or vapors (Australian Maritime Safety Authority [AMSA] 2011). Oil or products entering the eyes can cause ulcers, conjunctivitis, and blindness. Accidental ingestion of oil may cause kidney damage, altered liver function, and digestive tract irritation. Marine mammals could also accumulate toxins in their bodies through eating contaminated prey. Damage to and suppression of marine mammal immune systems may occur, which could cause secondary bacterial or fungal infections.

Oil can coat the fur of sea otters and seals, reducing insulating capacity and potentially leading to death from hypothermia, particularly in young pups with little blubber (AMSA 2011). Some marine mammals may drown or become easy prey if oil sticks to their flippers and bodies, preventing full movement and escape from predators. Depending on the time of year in which a spill occurred, young could be poisoned by absorbing oil through the mother’s milk (AMSA 2011). Seal pups could be affected by disguise of the scent that pups and mothers rely on to identify each other, leading to rejection, abandonment, and starvation.

The use of dispersants, if approved, would reduce the tendency of oil to adhere to marine mammals. However, the surfactants in dispersants could remove the natural oils present in the hair of marine mammals, reducing their insulation properties and causing hypothermia (Battelle Memorial Institute 1988, Marine Research Specialists 2002, NMFS 2013). Dispersed oil in the water column could come into contact with marine mammals or be consumed through contaminated prey. While the Marine Mammal and Sea Turtle Stranding Networks have protocols and procedures in place for responding to live animals that are exposed to oil spills (NMFS 2013), there are only two terrestrial wildlife rehabilitation facilities in the Northwest, which rehabilitate limited types of marine animals—however, neither facility can hospitalize large pinnipeds such as the Steller sea lion (Soundside Marinelife Rescue Center 2015).

Other methods of cleanup that could produce direct or indirect effects on marine mammals include extensive use of vessels and aircraft, booming, skimming, manual or mechanical removal, application of sorbents, vacuuming, removal of debris, sediment reworking, in situ burning, and pressure washing. These response actions could potentially disturb marine mammals and prey, and could displace them from important feeding or reproductive grounds.

In summary, impacts to aquatic species and habitat from small to medium spills at the proposed Facility would be negligible if the spilled oil did not reach the aquatic environment. However, impacts to aquatic species from these spills would be minor to moderate depending on the time of year if the spilled oil were to reach the Columbia River. Impacts to aquatic species from a large spill would be moderate to major in the event that the spilled oil reached the Columbia River and spread to aquatic habitats up to 7 RMs downstream from the proposed Facility.

Crude Oil Fire or Explosion

The impacts of a fire or fire and explosion event at the proposed Facility would depend on the magnitude of the event and its proximity to aquatic habitats. Localized increased water temperatures could cause fish to temporarily avoid the area. Fire could temporarily displace nearshore juvenile fish and invertebrates, potentially making them more vulnerable to predators. Steller sea lions, California sea lions, and Pacific Harbor seals would likely vacate the area in the event of fire. However, an explosion could be damaging to foraging pinnipeds as the sound pressure levels resulting from an explosion could exceed behavioral or injury thresholds. In the event of a large fire and explosion, expelled debris or oil could degrade water quality and injure aquatic species present in the vicinity of the event.

Impacts to aquatic species from a small fire event at the proposed Facility would likely be negligible as it would not likely reach aquatic habitats or species. Impacts from a large explosion and fire event would likely be minor to moderate as debris could enter the Columbia River and cause short-term, localized degradation of water quality (e.g., water temperature and quality) and species injury or disturbance.

4.7.7.2 Rail Transportation

Crude Oil Spill

Depending on location and extent, spills along the rail corridor could impact surface waters and potentially impact aquatic habitats and species, including special-status species and their designated or proposed critical habitats. Spills in close proximity to waterways could result in crude oil directly entering surface waters or could contaminate influent groundwater. Effects to aquatic habitat and species from a crude spill and response activities would be similar to those described above in Section 4.7.7.1.

Impacts to aquatic species from small to medium spills along the rail corridor are anticipated to be minor to moderate depending on the location of the spill. If the spill did not reach a waterbody, aquatic species would not be affected. If a spill occurred near a waterbody, aquatic habitats could experience degradation and aquatic species could be adversely affected. Impacts to aquatic species from large to very large spills would be moderate to major, with widespread and long-lasting effects depending on the amount of oil that entered the aquatic ecosystem.

Crude Oil Fire or Explosion

Depending on its location and magnitude, a crude oil fire or explosion along the rail corridor could impact aquatic species. Impacts to aquatic species from fire or explosion would be similar to those described in Section 4.7.7.1. Fire could destroy shoreline habitat, potentially leading to reduced streambank stability. It could also increase water temperatures of nearby streams and introduce fire debris into the streams. Debris from an explosion could enter waterbodies, leading to potential injuries to aquatic organisms or introduction of toxic materials to the water column.

Impacts to aquatic resources from a small fire event along the rail corridor would likely be minor due to the limited area affected, unless the fire were to occur adjacent to a pristine stream that is fish bearing and is functioning as spawning or rearing habitat at the time of the event. Impacts to aquatic species from a large rail explosion and fire event would be moderate to major, depending on the location of the event.

4.7.7.3 Vessel Transportation

Crude Oil Spill

Habitat Impacts

Depending on location and extent, spills along the vessel corridor could impact mudflats and sandflats, estuaries, and marine waters, and impact species that use these habitats, including special-status species and their designated or proposed critical habitats and EFH.

Oil spills that reach mudflats and sandflats can cause deterioration of aquatic communities. Oil covering intertidal muds prevents oxygen transport to the substrate and can produce anoxia in aquatic biota that could result in the death of species inhabiting those areas. Crude oil would not necessarily penetrate water-saturated sediments but could penetrate burrows and desiccation cracks in muddy sediments. Oil does typically move across sheltered tidal mudflats and accumulates at the high-tide line. However, oil could accumulate on tidal mudflats during a falling tide. As described in Section 4.5.2, sedimentation/adsorption could occur, leading to contamination of mudflats. Pollutants that penetrated fine sediments could persist for many years, increasing the likelihood of longer-term effects (NOAA 2010a, International Tanker Owners Pollution Federation Limited [ITOPF] 2011). Impacts to sandflats from an oil spill would be less than impacts to mudflats. However, if dispersants were approved for use during cleanup operations, greater penetration of sandy sediments could result. Wave action could also lead to oil mixing with sandy sediment (UK Marine 2013). Stranded oil in sandflats and mudflats may become a persistent source of oil contamination that could rerelease into the water column. The intertidal zone is characterized by soft sediments, which likely would limit cleanup options to low-pressure flushing, vacuuming, and deployment of sorbents from shallow draft boats. As a result, the residual oil from a spill in such areas is often left to weather and degrade naturally (ITOPF 2011).

In estuaries, currents make spills and slicks particularly difficult to contain since the spilled oil can rapidly migrate to shorelines, marshes, and flats. In the confines of an estuary, relatively small oil spills can affect large populations of some organisms, potentially leading to persistent food chain disruption. As discussed in Section 3.6.2.1, estuaries often function as nursery areas and habitat for numerous nearshore and offshore fish and shellfish species. Oil and oil sediment mixtures that sink could exert immediate toxic and smothering effects on bottom-dwelling species and potentially penetrate animal burrows, although they are unlikely to deeply penetrate into water-saturated sediments (Dicks 1998, NOAA 2010a). Stranded oil in nearby shorelines could become a persistent source for oil rerelease to the water column. Cleanup activities in an estuary could result in habitat disruption and alteration of the ecological balance.

As described in Section 4.5.2, dispersion of spilled oil in the marine water column is influenced by wind, waves, and ocean current. Dispersed oil at the surface and in the water column could affect marine organisms. Organisms that would be most vulnerable to exposure and effects would be poor or passive swimmers present in the surface layer (Dicks 1998), and species that use deeper layers of the water column would be less vulnerable than those at the surface (NOAA 2010a, ITOPF 2011). Marine open-water oil spill response activities would be similar to those discussed above for a spill at the proposed Facility.

Pacific salmon, groundfish, and pelagic species EFHs occur within the vessel corridor from the mouth of the Columbia River to 3 nautical miles, at the start of the Exclusive Economic Zone (Section 3.6.2). Impacts to EFHs within the vessel corridor would be similar to those described above for aquatic habitats in the vessel corridor.

Impacts to aquatic habitats from small to medium spills along the vessel corridor would likely be moderate to major, and impacts to aquatic habitats from large to very large spills would likely be major. In both cases, the level of impact would depend on the location, quantity, extent, duration, and timing of the spill event.

Species Impacts

Impacts to fish, invertebrates, and pinnipeds from a crude oil spill in the vessel corridor would be similar to those described above for oil that reached the Columbia River at the proposed Facility site (see Section 4.7.7.1). Impacts to other potentially impacted marine species are addressed below.

<u>Marine Mammals</u>

A spill from a vessel that reached the mouth of the Columbia River or beyond could impact whales or porpoises (cetaceans). Marine mammals surfacing in the vicinity of a crude oil spill could be exposed to volatile chemicals while breathing (NMFS 2013). Potential impacts resulting from exposure are discussed above for spills at the proposed Facility. Oil or refined petroleum products can cause damage to the airways and lungs of marine mammals and may cause congestion, pneumonia, emphysema, and even death from breathing droplets of oil or vapors (AMSA 2011).

Whales have no fur that can be oiled and do not depend on fur for insulation—as a result, they are not susceptible to hypothermia caused by oil coating (NMFS 2013). However, oil can foul baleen whales' filter-feeding mechanisms, affecting their ability to eat, and contact with crude oil could result in irritation or ulceration of skin, mouth, or nasal cavities. Baleen whales could also be affected by contamination of their food sources. Oil could damage airways and lungs of baleen whales, causing congestion, pneumonia, emphysema, and even death (AMSA 2011), and oil ingestion could cause kidney damage, altered liver function, and digestive tract irritation. Killer whales migrating near the mouth of the Columbia River could be impacted by crude oil spills. The effect of vapor or oil inhalation on killer whales ranges from death to sublethal damage/mild irritation, depending on the concentration and length of exposure. Consumption of oiled prey could lead to ingestion of a large quantity of oil over time (Matkin et al. 2008). Effects to cetaceans from oil cleanup activities would be similar to those described above for pinnipeds.

<u>Sea Turtles</u>

Sea turtles are air breathers and surface frequently to breathe. Sea turtles surfacing in the vicinity of a crude oil spill could be exposed to volatile chemicals while breathing (NMFS 2013). Oil may cause damage to the airways and lungs of turtles, and may cause congestion, pneumonia, emphysema, and even death from inhalation of oil or oil vapors. Dermal contact with oil would cause irritation or ulceration of skin, mouth, or nasal cavities. Oil that contacts turtle eyes can cause ulcers, conjunctivitis, and blindness, making it difficult to find food and potentially leading to starvation (AMSA 2011). No sea turtles breed on beaches in the vessel corridor vicinity, so a spill would not affect turtle breeding.

Cleanup operations involving a large number of vessels and aircraft in coastal and pelagic habitats have the potential to disturb sea turtles, possibly displacing them from important habitats. While the Marine Mammal and Sea Turtle Stranding Networks have protocols and procedures in place for responding to live animals that are exposed to oil spills (NMFS 2013), there are only two terrestrial wildlife rehabilitation facilities in the Northwest, which rehabilitate limited types of marine animals (Soundside Marinelife Rescue Center 2015).

Impacts to aquatic species from small to medium spills along the vessel corridor would likely be moderate to major, and impacts to aquatic habitats from large to very large spills would likely be major. In both cases the level of impact would depend on the location, quantity, extent, duration, and timing of the spill event.

Crude Oil Fire or Explosion

Depending on location and extent of the event, a crude oil fire and/or explosion in the vessel corridor could potentially damage shoreline habitat and localized water quality. In the event of a large explosion, debris released could degrade water quality and potentially injure aquatic species present in the blast zone. Sound pressure levels resulting from a large explosion could exceed behavioral thresholds and injury thresholds for some aquatic species.

Impacts to aquatic species from a small fire event along the vessel corridor would likely be negligible to minor due to the limited area affected. Direct impacts to aquatic species from a large explosion and fire event could be minor to moderate depending on species presence, noise, and ejected debris. However, the explosion and fire could result in a small to very large oil spill. Impacts from a spill are addressed in previous sections.

4.7.8 Energy and Natural Resources

This section addresses potential impacts of spills, fires, and/or explosions to energy and natural resources. Potential impacts could include loss in the ability to exploit in-place natural resources, disruption of energy supplies and services, and energy and natural resource consumption during response efforts.

4.7.8.1 Proposed Facility

Crude Oil Spills

A small to large oil spill at the proposed Facility would not result in loss of the ability to exploit in-place natural resources. However, a very small percentage of oil is fully recovered following an oil spill. As a result, the loss of spilled oil would produce a slight short-term reduction in the total amount of oil destined for refineries on the West Coast from the original crude oil source. Additionally, equipment potentially required for response efforts, including backhoes, trucks, and vessels, would likely lead to consumption of fuels derived from petroleum. Oil reserves in the United States are abundant and as a result, unrecovered crude oil and the fuel required to respond to spills would produce a negligible impact to energy and natural resources.

A small to large oil spill at the proposed Facility would not likely affect energy supply since natural gas and electric utilities are typically buried underground in pipes or are located overhead as wires. Small to medium oil spills would not likely directly contact these structures. However, if response to an oil spill required excavation activities or temporary shutdown of electric power, negligible to minor impacts to local energy supply could occur.

Crude Oil Fire or Explosion

A small crude oil fire at the proposed Facility would result in the loss of burned crude oil. This loss could produce a slight short-term reduction in the total amount of oil destined for refineries on the West Coast from the original crude oil source. Additionally, a small fire could damage some overhead powerlines, leading to a short-term disturbance in local energy supply. Both of these potential impacts would be negligible.

A large explosion or fire at the proposed Facility could result in substantial damage to onsite crude oil storage and transfer infrastructure, potentially leading to minor to moderate short-term reduction in the total amount of oil destined for refineries on the West Coast from the original crude oil source. Additionally, a large fire and/or explosion could produce substantial damage to onsite energy infrastructure, potentially leading to temporary shutdowns of natural gas pipelines and some local electrical power supply. As a result, a large fire and/or explosion at the proposed Facility could produce moderate, short-term impacts to energy and natural resources.

4.7.8.2 Rail Transportation

Crude Oil Spill

A crude oil spill from a unit train along the rail corridor would produce similar impacts to energy and natural resources as those discussed for a spill at the proposed Facility. However, consumption of fuel could be more substantial if response were required in a remote area. Other natural resources in freight transport along the rail corridor, or along nearby roads, could be temporarily delayed in reaching their destinations. Natural resources (e.g., soil, gravel) excavated during response, if any, could be oiled and require remediation and could be permanently displaced. Local borrow materials (e.g., gravel) used during response would not be available for other beneficial uses. However, local borrow pits would likely have sufficient supply to provide required natural resources without impacting other uses since the replacement quantities would be small compared to the available supply. Impacts to natural resources from a crude oil spill along the rail corridor would likely be minor, depending on the location, extent, and response activities. Since a crude oil spill along the rail corridor would likely result from a derailment, nearby elevated powerlines could be impacted if the derailed cars damaged or destroyed power transmission structures. This could result in minor energy impacts from short-term interruptions in electricity supply.

Crude Oil Fire or Explosion

A small crude oil fire along the rail corridor would have similar impacts to energy and natural resources as a small crude oil fire at the proposed Facility. A large fire and/or explosion along the rail corridor could damage powerlines, railroad tracks, substations, or other infrastructure within or adjacent to the rail corridor, leading to the use of replacement materials originating from natural resources (e.g., wood, steel, borrow materials, asphalt, concrete). A large fire and/or explosion along the rail corridor could result in disruptions to local energy supply. The derailment and explosion of a train carrying Bakken crude oil through West Virginia resulted in electrical outages for about 800 residents, whose powerlines were damaged by the explosion. The electrical system was restored about 24 hours later (Marks 2015). Impacts to energy and natural resources resulting from a large fire and/or explosion could be minor to moderate depending on the location of the event and the spread of the fire.

4.7.8.3 Vessel Transportation

Crude Oil Spill

A small to medium or large to very large crude oil spill along the vessel corridor would result in expenditure of energy and natural resources for response and cleanup vehicles and equipment including tugs, skimmers, and other watercraft. A variety of types and sizes of water-based vehicles would likely be used to transport personnel and to deploy booms, skimmers, and vacuums. Land-based vehicles and equipment would be needed to transport cleanup workers to and from affected sites and to perform cleanup along shorelines. While these vehicles would require fuel, the amount required would be minor compared to available fuel resources, resulting in negligible overall impacts to energy supply. A small to medium or large to very large crude oil spill along the vessel corridor is unlikely to directly impact natural gas or electric utilities.

A small to medium spill from a vessel would have a negligible impact to energy and natural resource supplies. A large to very large crude oil spill from a vessel could result in the permanent loss of 6 percent to 52 percent of the crude oil required for a single-day throughput of the largest existing refinery on the West Coast (Tesoro's Los Angeles Refinery) (Tesoro Corp. 2015). This could produce a minor to moderate short-term impact on the refinery or refineries that would have received the crude oil. The impact to refining operations throughout the West Coast would be negligible.

Crude Oil Fire or Explosion

A small crude oil fire within the vessel corridor would have negligible to minor impacts to energy and natural resources. A large crude oil fire and/or explosion in the vessel corridor would, for the most part, result in similar impacts to energy and natural resources as from cleanup of a spill. Since any vessel fuel lost during a fire and/or explosion was already destined for combustion, no additional net loss of fuel would occur. However, repair or replacement of a damaged vessel would lead to the consumption of energy, natural resources, and products made from natural resources. The amounts of fuel, electricity, and mineral resources required to respond to a crude oil fire or explosion would increase with the severity of the event. An explosion and fire event of any size along the vessel corridor is unlikely to damage natural gas or electrical supply infrastructure, although if a nearby powerline were damaged or destroyed, impacts would be similar to those described for fire and/or explosions along the rail corridor.

4.7.9 Environmental Health

This section addresses the potential impacts of spills, fires, and/or explosions to human health. Potential impacts could result from direct exposure to crude oil or crude oil vapor compounds, and injury or fatality caused by the accident that resulted in the crude oil spill, fire, or explosion.

4.7.9.1 Proposed Facility

Crude Oil Spill

A crude oil spill at the proposed Facility could potentially expose onsite personnel, nearby Port facility personnel, and residents/workers at the Clark County Jail Work Center (JWC) and Fruit Valley neighborhood to released oil and its vapors. Health effects could result from direct exposure to crude oil or crude oil vapor compounds. Workers and spill responders would be at risk for exposure in the event of a crude oil spill. The potential human toxicity resulting from exposures is described in Section 4.5.1.2.

Enforceable and recommended occupational exposure limit standards exist for numerous volatile constituents typically found in crude oil. The largest potential human health hazard from spilled oil is H_2S inhalation by unprotected workers in enclosed spaces for prolonged periods of time. The National

Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit is 10 parts per million (ppm) H_2S gas (15 mg/m^3) for 10 minutes (Centers for Disease Control 2015). The Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (enforceable) are (OSHA 2015a):

- General Industry Ceiling Limit: 20 ppm,
- General Industry Peak Limit: 50 ppm (up to 10 minutes if no other exposure during shift),
- Construction 8-hour Limit: 10 ppm,
- Shipyard 8-hour limit: 10 ppm and 20 ppm to 50 ppm for 10-minute maximum peak.

The NIOSH Immediately Dangerous to Life and Health level (the level that interferes with the ability to escape) is 100 ppm (OSHA 2015a). Personal protection in the event of a release of H_2S is a gas-tight chemical protection suit including self-contained breathing apparatus (Centers for Disease Control 1994). H_2S emissions would tend to accumulate if the release occurred in an enclosed space (e.g., pump vaults). Potential exposure to PAH represents the highest worker dermal exposure risk. The dermal hazard from a single exposure to crude oil is minor (API 2011).

An environmental awareness training program would be implemented at the proposed Facility to inform personnel at all responsibility levels, including subcontractors, of the components of the SPCC Plan. The draft SPCC Plan (Vancouver Energy 2015a) states that all proposed Facility personnel (including refueling personnel and subcontractors) would be trained in spill prevention, containment, response, and the location of spill response kits to reduce the opportunity for exposure in the event of a spill. However, as discussed in Section 4.6.3.3, VFD considers itself in need of additional training and equipment to effectively respond to a crude oil spill at the proposed Facility.

Impacts to environmental health from a small to medium crude oil spill at the proposed Facility would likely be minor, since hazardous material spill response would be implemented by appropriately trained onsite personnel. Contractors would follow a written Hazard Communication Program and would ensure that their employees and subcontractors are trained in accordance with Washington Department of Safety and Health requirements. All employees would use approved safety equipment and maintain equipment in accordance with OSHA and Project-specific requirements. The public would not have access to the proposed Facility and would, therefore, not be exposed to spilled crude oil.

Impacts to environmental health from a large crude oil spill would likely be minor if the spill were contained onsite. Onsite personnel would also be trained in the use of personal protective equipment (PPE) to prevent harmful vapor inhalation or dermal contact. Potential inhalation of H_2S and VOCs in harmful concentrations could occur in enclosed spaces if personnel are not using PPE. Inhalation of harmful levels of these vapors would be unlikely in open areas, or areas with high ventilation. If a large spill migrated outside of the proposed Facility boundary, impacts could be minor to moderate since other persons could be affected in the release area and some short-term dermal exposures to crude oil could occur.

Crude Oil Fire or Explosion

In the event of a crude oil fire, workers or members of the public could be at risk of injury or death. The extent of risk would depend on the unique circumstances of the event and size of the fire. Any workers or responders in the vicinity of the fire would be at risk of injury or death from heat and/or burns. Burning crude oil generates substantial amounts of combustion byproducts, mainly carbon dioxide, water, and particulates, and generally reduces the volume of toxic vapor. Burning crude oil emits carbon dioxide, lead, NO_x, particulate matter, PAHs, sulfur dioxide, and VOCs. Human health hazards from burning crude oil are described below.

- Carbon monoxide chemically displaces oxygen from the blood and causes oxygen deprivation in the cells of the body.
- Sulfur dioxide is toxic and irritates eyes and the respiratory tract by forming sulfuric acid on these moist surfaces.
- NO_2 is a strong irritant to the eyes and respiratory tract and is less soluble than sulfur dioxide; therefore, it may reach the deep portions of the lungs so that even low concentrations may cause pulmonary edema.
- Some PAHs, while only present in low concentration, are known or suspected to be carcinogens targeting the skin (from chronic skin contact with oils) and/or lungs from inhalation.
- Particulates or liquid material (e.g., mists, fogs, sprays) could be inhaled and could be deposited in the bronchi and alveoli.

Other crude oil constituent chemicals are of less concern in a fire event. For instance, carbonyls released from burning crude oil are generally below health concern levels even for those in close proximity to the fire, and VOCs are only present in potentially harmful concentrations very close to the fire. Exposure to burning crude oil could also harm the passages of the nose, airways, and lungs and cause shortness of breath, breathing difficulties, coughing, itching, red/watery eyes, and black mucous (Centers for Disease Control 2015).

Particulates are a health concern close to the fire and within smoke plumes. High temperatures from a crude oil fire could cause smoke plumes to rise several hundred to several thousand feet and travel with prevailing winds. However, well-developed seabreeze systems could draw smoke plumes toward the ground. Particulate concentrations in the center of smoke plumes could create a high-level health concern for populations in the affected area.

Impacts to human health from a small fire at the proposed Facility would be negligible if there were no resulting injuries or harmful levels of exposure. If the small fire did result in severe injury, fatality, or chronic illness from harmful levels of exposure, the impacts would be major.

In the event of a large fire and/or explosion at the proposed Facility, workers, members of the public, and nearby residents of the JWC and Fruit Valley neighborhood could be at risk of injury or death. The extent of risk would depend on the unique circumstances of the event, including the spread of fire and the severity of the explosion. Impacts from the fire would be similar to those described above, although the extent and severity of those impacts would likely be greater. In an explosion, blast wind could lead to injury or death from violent blunt force trauma from impact with facility infrastructure or explosion debris. The public could be affected if impacts from the large fire and/or explosion affected offsite locations. In that event, other Port tenants or the public could be at risk of injury or fatality. Evacuation procedures for proposed Facility workers have been developed as described in the Operations Facility Safety Program (Vancouver Energy 2015b). Evacuation of the JWC, if required, would follow the Clark County CEMP. People external to the proposed Facility would likely initially follow emergency and evacuation plans in place for either the Port or other specific Port tenants. Upon the arrival of first responders, areas identified to be at risk of exposure would likely be evacuated under the direction of the first response team, and consistent with relevant response plans. Response personnel would also be trained and equipped with PPE. However, as stated by the Firefighter Life Safety Research Center at the University of Illinois at Urbana-Champaign (2008), “increased rate of fatigue, reduction in flexibility and mobility, and changes in a firefighter’s center of gravity due to wearing firefighting personal protective equipment and carrying firefighter tools can be linked to slip, trip and fall injuries as well as overexertion/strain injuries." As discussed in Section 4.6.3.3, VFD considers itself in need of additional training and equipment to effectively respond to a crude oil fire and/or explosion at the proposed Facility.

Impacts to human health from a large fire and/or explosion at the proposed Facility would be negligible if there were no resulting injuries or harmful levels of exposure. If the large fire and/or explosion did result in severe injury, fatality, or chronic illness from harmful levels of exposure, the impacts would be major.

4.7.9.2 Rail Transportation

Impacts to human health could occur if a train derailment blocked or delayed entrances and exits of an area requiring evacuation or other emergency response. VFD identified areas within their jurisdiction along the railroad corridor where a stopped or derailed train could block or delay emergency response services (Figures 4-11 and 4-12). Single-family residences, a residential neighborhood and marina, a lumber mill, and a public park (Winter Park) have been identified as being accessible by only one at-grade crossing.[14] In addition, VFD identified residences with multiple at-grade crossings spaced closely together (i.e., all within 0.3 mile of each other) that could be simultaneously blocked by a stopped or derailed unit train. Emergency service vehicle access and evacuation from these areas could be difficult or impossible. Some residential areas are accessible by grade-separated crossings with height-restrictions that could prevent fire engines and possibly ambulances from accessing the area. However, evacuation by foot or by vehicles under the height limit could still occur through the grade-separated crossings, and the VFD has identified alternative access to areas with these height restrictions via an over-the-track roadway.

Similar conditions appear elsewhere along the rail corridor throughout the state of Washington. For example, residences and a commercial complex south of the railroad tracks in the City of Stevenson could become inaccessible to emergency services if height restrictions of the grade-separated crossings prevented access. Evacuation by foot or by vehicles under the height limit could still occur through the grade-separated crossings. In other areas along the rail corridor in Washington, residences, industrial complexes, and farms can only be accessed through at-grade crossing(s), and emergency service vehicle access and evacuation from these areas could be difficult or impossible. Some residential, commercial, industrial, and recreation areas along the rail corridor that are accessible via at-grade crossings could remain accessible by alternate grade-separated crossings if a stopped or derailed train blocked the usual crossing. For example, grade-separated crossings on SR-14, US Route 97, and Hwy 395 could be used to evacuate some populated areas normally accessed by at-grade crossings. However, emergency response and evacuation could be delayed by the greater travel distance to an accessible crossing.

Delays in emergency response along the rail corridor caused by a derailed or stopped unit train blocking access could result in major impacts to human health, especially if evacuation or time-sensitive emergency response is required.

Crude Oil Spill

A crude oil spill that occurred along the rail corridor would have the potential to affect unit train operators and the general public in the vicinity of an accidental spill. The likelihood of general public exposure would depend on the location and extent of the spill. Spills in heavily populated areas would be more likely to result in exposure risk. Collisions or derailments could result in direct injury or fatality, and

14 At-grade crossings are road/path crossings on the same surface level as the railway. Grade-separated crossings provide access across the railway via bridge or tunnel.

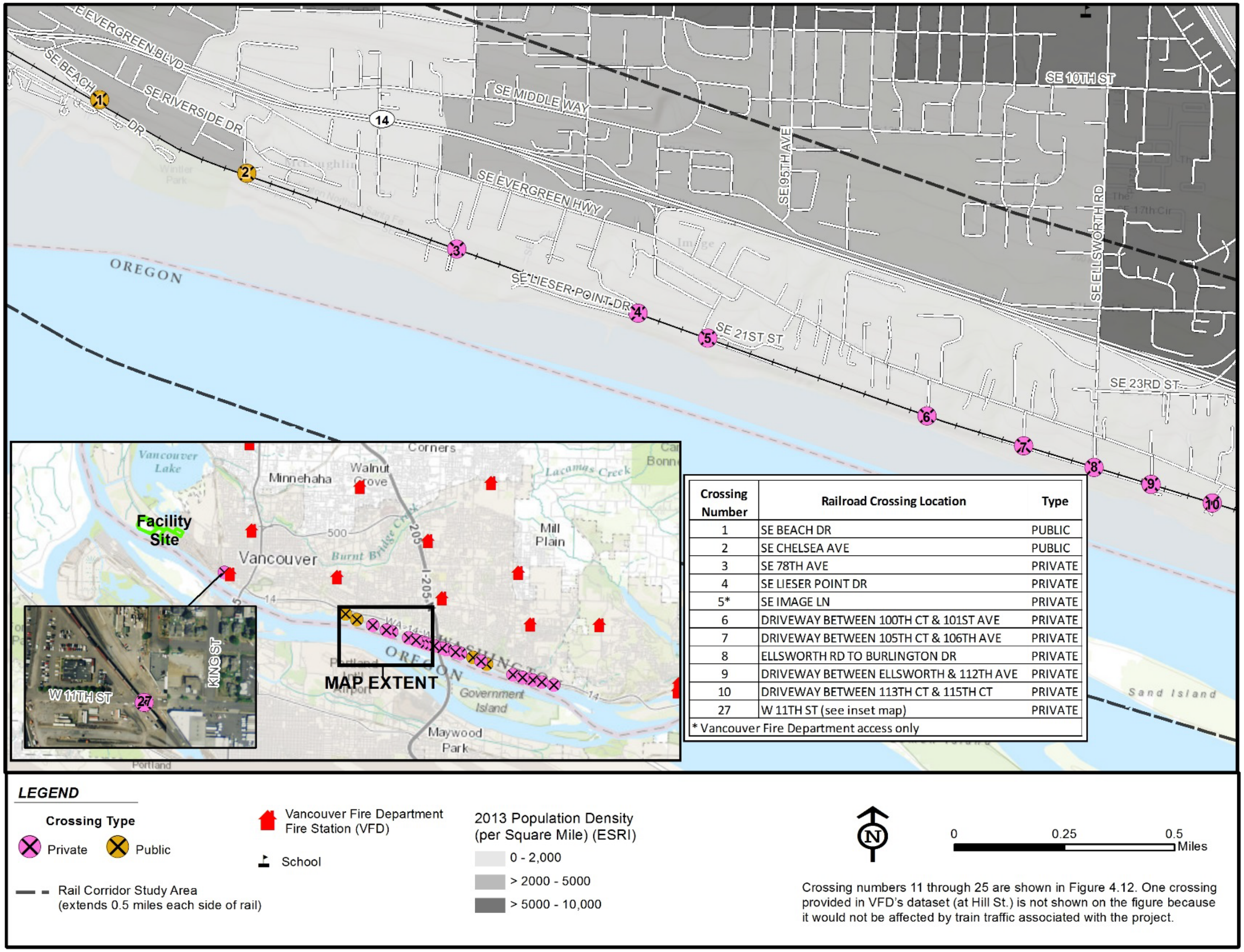
spills associated with collisions or derailments could result in exposures to crude oil dermal and inhalation hazards. Twenty reported derailments have occurred in the United States and Canada from February 15, 2013, through July 23, 2015. In three of these derailments it is known that no spill occurred. In five of these derailments crude oil was spilled but there were no associated fires, explosions, or injuries reported. In the other 12 derailments fires were reported, and in three of these 12 fires there was also an explosion reported. As with the proposed Facility, inhalation hazards would be more severe in any enclosed spaces along the rail corridor (e.g., tunnels or structures near the incident site). If a crude oil spill led to contamination of drinking water supply, there would be potential for human ingestion of the contaminated water. However, total petroleum hydrocarbons (TPHs) in drinking water are detectable by human taste and odor at concentrations below levels of concern for human health effects. As a result, even short-term human exposure to TPH in drinking water is highly unlikely, and water supplies in the vicinity of an oil spill are often temporarily shut off to prevent contamination (World Health Organization 2004).

Impacts to human health from a small to medium crude oil spill along the rail corridor would likely be negligible to minor, except for incidents that led to direct injury or fatality. Impacts to human health from a large to very large crude oil spill along the rail corridor would likely be negligible to moderate, depending on the location and extent of the spill, with greater impact in more heavily populated areas.

Crude Oil Fire or Explosion

Impacts to human health from a small fire along the rail corridor would be negligible if there were no resulting injuries or harmful levels of exposure. If the small fire did result in severe injury, fatality, or chronic illness from harmful levels of exposure, the impacts would be major. Similarly, impacts to human health from a large fire and/or explosion along the rail corridor would be negligible if there were no resulting injuries or harmful levels of exposure. If the large fire and/or explosion did result in severe injury, fatality, or chronic illness from harmful levels of exposure, the impacts would be major. As discussed in Section 4.6.4.3, emergency responders in the vicinity of the rail corridor expected to be used by unit trains delivering crude oil to the proposed Facility consider themselves in need of additional training and equipment to effectively respond to a crude oil fire and/or explosion.

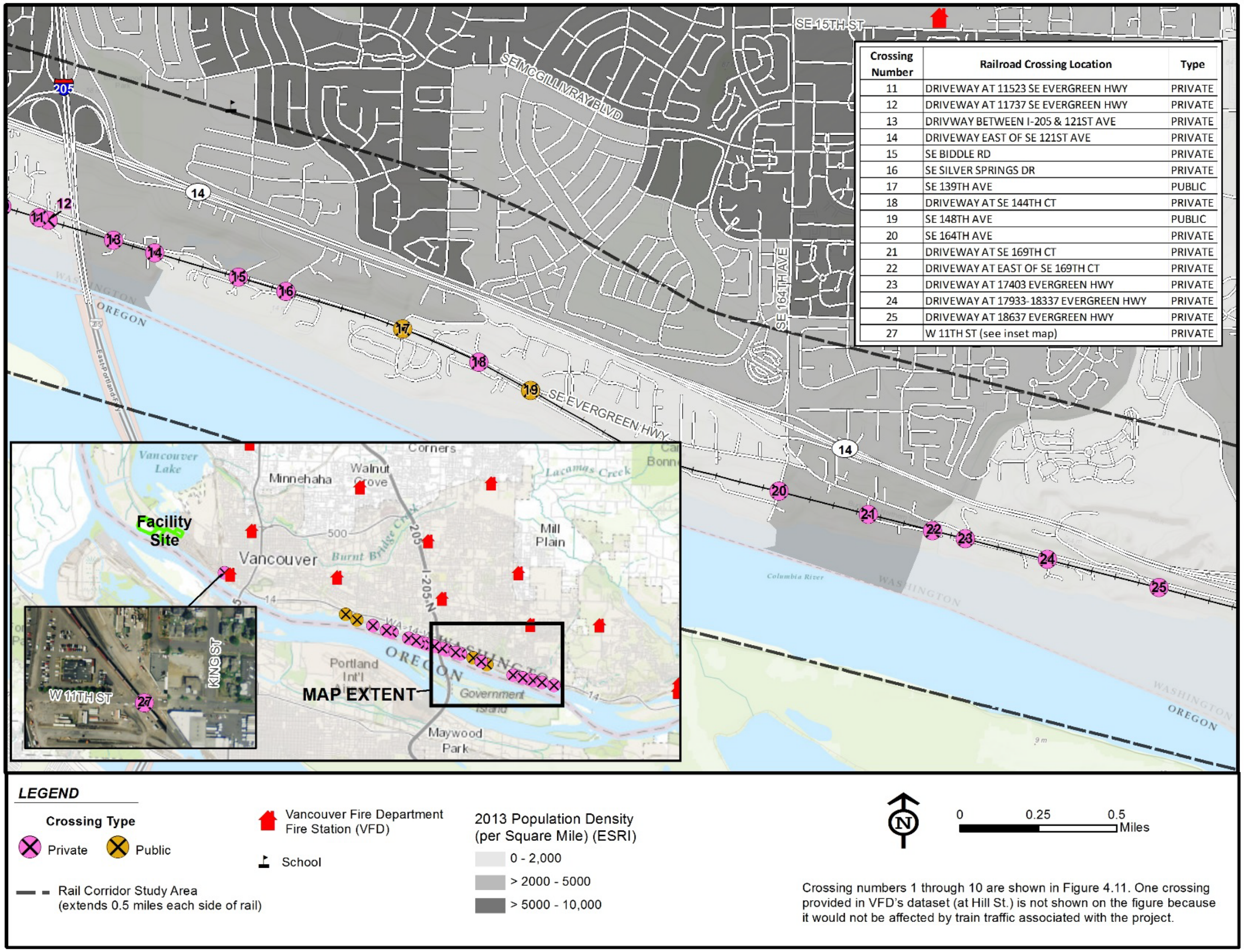
Acute care hospitals near the rail corridor are located in Vancouver, White Salmon, Kennewick, Pasco, Ritzville, and Spokane (WDOH 2013b). However, much of the western portion of Skamania County, the eastern portion of Klickitat County, and the southern portion of Benton County along the rail corridor is over a 30-minute drive from an acute care hospital (WDOH 2006).



Crossing Number	Railroad Crossing Location	Type
1	SE BEACH DR	PUBLIC
2	SE CHELSEA AVE	PUBLIC
3	SE 78TH AVE	PRIVATE
4	SE LIESER POINT DR	PRIVATE
5*	SE IMAGE LN	PRIVATE
6	DRIVEWAY BETWEEN 100TH CT & 101ST AVE	PRIVATE
7	DRIVEWAY BETWEEN 105TH CT & 106TH AVE	PRIVATE
8	ELLSWORTH RD TO BURLINGTON DR	PRIVATE
9	DRIVEWAY BETWEEN ELLSWORTH & 112TH AVE	PRIVATE
10	DRIVEWAY BETWEEN 113TH CT & 115TH CT	PRIVATE
27	W 11TH ST (see inset map)	PRIVATE

* Vancouver Fire Department access only

Figure 4-11. At-Grade Railroad Crossings Identified by VFD (Map 1 of 2)



Crossing Number	Railroad Crossing Location	Type
11	DRIVEWAY AT 11523 SE EVERGREEN HWY	PRIVATE
12	DRIVEWAY AT 11737 SE EVERGREEN HWY	PRIVATE
13	DRIVWAY BETWEEN I-205 & 121ST AVE	PRIVATE
14	DRIVEWAY EAST OF SE 121ST AVE	PRIVATE
15	SE BIDDLE RD	PRIVATE
16	SE SILVER SPRINGS DR	PRIVATE
17	SE 139TH AVE	PUBLIC
18	DRIVEWAY AT SE 144TH CT	PRIVATE
19	SE 148TH AVE	PUBLIC
20	SE 164TH AVE	PRIVATE
21	DRIVEWAY AT SE 169TH CT	PRIVATE
22	DRIVEWAY AT EAST OF SE 169TH CT	PRIVATE
23	DRIVEWAY AT 17403 EVERGREEN HWY	PRIVATE
24	DRIVEWAY AT 17933-18337 EVERGREEN HWY	PRIVATE
25	DRIVEWAY AT 18637 EVERGREEN HWY	PRIVATE
27	W 11TH ST (see inset map)	PRIVATE

Figure 4-12. Railroad Crossings Identified by VFD (Map 2 of 2)

In the event of a crude oil fire or explosion along the rail transportation corridor, train operators and the general public in the vicinity of the accident could be at risk of injury or fatality. As stated previously, 12 derailments in the United States and Canada between February 15, 2013, and July 23, 2015 had fires reported, and three of these also had an explosion reported. One incident (Lac-Mégantic, Quebec) resulted in a crude oil spill, explosion, and fire causing injuries and 47 fatalities. Another incident (Mount Carbon/Boomer Bottom, West Virginia) resulted in a crude oil spill and fire with one reported injury. Impacts to human health from a large fire and/or explosion along the rail corridor would be similar to those discussed for a large fire and/or explosion at the proposed Facility. Rail operators and the general public in close proximity to an explosion would be at greater risk of injury or fatality than people farther from such an event. A derailment resulting in fire or explosion would likely have greater potential for human health impacts in densely populated areas as opposed to more rural environments. A discussion of demographics along the rail corridor is presented in Section 3.16.2.2.

4.7.9.3 Vessel Transportation

Crude Oil Spill

In the event of a crude oil spill along the vessel corridor, vessel operators, other river users (e.g., commercial fisherman, commercial boaters, recreationists), and people along the shoreline in the vicinity of the incident could be at risk of exposure to crude oil. However, crude oil vapors on open water would likely rapidly dissipate and pose a minimal threat to human health. Dermal exposure to spilled crude oil along the vessel corridor would be unlikely but could occur in recreation areas or during spill response. As discussed previously, the dermal hazard from a single exposure to crude oil is minor (API 2011). Dermal and inhalation health hazards resulting from a crude oil spill along the vessel corridor would be similar to those discussed for a spill at the proposed Facility. As with the proposed Facility, inhalation hazards would be more severe in any enclosed spaces within affected vessels or shoreline structures. Response actions would likely include access restrictions to areas affected by the crude oil release.

Impacts to environmental health from a small crude oil spill from a vessel would likely be minor assuming the spill were contained within a small area. If a large to very large spill from a vessel occurred, impacts could be moderate to major depending on the location and duration of the incident.

Crude Oil Fire or Explosion

In the event of a small fire along the vessel corridor, vessel operators and crew could be at risk of injury or death. The extent of risk would depend on the unique circumstances of the event and size of the fire. Any workers or responders in the vicinity of the fire would be at risk from heat and/or burns, and inhalation of hazardous concentrations of combustion materials or products. In the event of a large fire and/or explosion along the vessel corridor, vessel operators and crew would be at extreme risk of injury or death if the fire and/or explosion occurred on the vessel. Responders, other river users in the vicinity of the incident, and people along the shoreline could also be at risk of injury or death.

Impacts to human health from a small fire along the vessel corridor would be negligible if there were no resulting injuries or harmful levels of exposure. If the small fire did result in severe injury, fatality, or chronic illness from harmful levels of exposure, the impacts would be major. Impacts to human health, particularly the health of the vessel crew, from a large fire and/or explosion along the vessel corridor could be major if the event occurred on the vessel and resulted in severe injury, fatality, or chronic illness.

4.7.10 Noise

This section addresses potential noise impacts of spills, fires, and/or explosions to human receptors in the vicinity of the event. Impacts to wildlife from potential noise disturbances are addressed in Sections 4.7.6 and 4.7.7.

4.7.10.1 Proposed Facility

Crude Oil Spill

Noise resulting from small to very large crude oil spills would likely be associated with emergency response efforts and equipment (e.g., trucks, helicopters, response vessels). Noise levels from these efforts would be short term and would range from negligible to moderate depending on receptor sensitivity and distance from the noise source. In addition to workers at the proposed Facility and responders to the incident, nearby sensitive noise receptors include inhabitants of and workers at the Clark County Jail Work Center (JWC) that is located just over 400 feet from the proposed Facility and residents of the Fruit Valley community that is located approximately 3,000 feet from the proposed Facility. Noise from emergency crew vehicles and operations would likely cause short-term minimal to moderate noise disturbance at the JWC depending on the equipment used in and duration of the response effort. Short-term noise disturbances would not likely impact residents of the Fruit Valley community. Noise impacts from small to very large spills at the proposed Facility would be short term and negligible.

Crude Oil Fire or Explosion

Noise resulting from a small crude oil fire would include the sounds of the fire and sounds associated with emergency response and firefighting efforts (e.g., fire alarms, sirens, response equipment). The noise impacts from a small fire at the proposed Facility would be short term and negligible. Potential noise impacts resulting from a large fire and/or explosion would include sounds associated with the fire, sounds and vibrations resulting from the explosion, and sounds associated with emergency response efforts. Large explosions would result in moderate- to high-intensity noise impacts, particularly to nearby receptors at the proposed Facility, the JWC, and the Fruit Valley community. Ground vibration could also be felt in the immediate vicinity during explosion. These noise events would be short term, but depending on the proximity of receptors, could cause temporary or chronic hearing damage. Auditory injuries are among the most common primary injuries resulting from blast exposure; however, hearing loss may be overlooked in the midst of more urgent concerns (American Speech-Language-Hearing Association 2014). Impacts from a large fire would likely be minor; however, impacts from an explosion event at the proposed Facility would be moderate to major depending on the size of the explosion and the severity of auditory injuries.

4.7.10.2 Rail Transportation

Crude Oil Spill

Noise associated with a crude oil spill of any size along the rail corridor could include sounds and vibrations emanating from trains braking and/or a derailment, and noise associated with spill response efforts (e.g., trucks, backhoes, helicopters). In areas with a higher ambient noise level, such as large urban or industrial areas, the addition of noise from cleanup response would be less perceptible. In areas with lower ambient noise levels, such as rural areas, the noise generated from cleanup response may be more intrusive to local noise receptors. No vibration impact would be expected from a crude oil spill or subsequent response actions. Noise impacts from small to very large spills along the rail corridor would be short term and negligible, although the sounds associated with a derailment could produce minor, temporary impacts to noise receptors in the immediate vicinity.

Crude Oil Fire or Explosion

Noise impacts resulting from a small crude oil fire along the rail corridor would be similar to those describe above for a crude oil spill along the rail corridor, short term and negligible. Noise impacts associated with a large fire and/or explosion along the rail corridor would be similar to those addressed for a large fire and/or explosion at the proposed Facility. Based on FTA/FRA noise impact criteria for rail transportation, a very large explosion could produce major noise impacts to sensitive receptors within 1.5 miles of the blast.[15]

4.7.10.3 Vessel Transportation

Crude Oil Spill

Impacts from a crude oil spill along the vessel corridor would be associated with spill response activities and would be similar to those described for a spill at the proposed Facility. However, a large to very large spill from a vessel could result in cleanup activities from the location of the incident to beyond the mouth of the Columbia River, resulting in potential noise impacts throughout the response area. Noise impacts from small to very large spills from a vessel would be short term and negligible.

Crude Oil Fire or Explosion

A small fire along the vessel corridor would not likely cause loud noises or vibrations. Additional noise from emergency response vehicles and equipment would increase sound levels of the existing ambient noise. Fire response would generally not involve loud noise-generating equipment or vehicles. In areas with a higher ambient noise level, such as large urban or industrial areas, the addition of noise from cleanup response would not likely result in noticeable noise impacts as the existing sound levels in these areas are already high. However, in areas with low ambient noise levels, such as rural and natural areas, the noise generated from cleanup response would be more noticeable. Noise impacts from a large fire and/or explosion along the vessel corridor would be similar to those described for a large fire and/or explosion along the rail corridor.

4.7.11 Land and Shoreline Use

This section addresses potential impacts of spills, fires, and/or explosions to land and shoreline use.

4.7.11.1 Proposed Facility

Crude Oil Spill

Impacts to land and shoreline use from a crude oil spill of any size at the proposed Facility would be negligible if the spill were contained within the site boundaries and did not reach the Columbia River. A small to medium crude oil spill at the proposed Facility site would not alter industrial land use in the affected area. However, if the spill reached the Columbia River it could produce short-term, minor impacts to land and shoreline use on Hayden Island assuming a short duration of the spill and response incident, and assuming the spill did not occur during a high recreation or fishing season. If the spill incident duration were longer and/or occurred in or extended into these seasons, the impacts would be

15 Equivalent distances are calculated based on the following most conservative assumptions: ambient noise level at sensitive receptor = 50 dBA (from nighttime WAC noise limit) and explosion noise level = 110 dBA (OSHA permissible noise level exposure for 0.5 hour, reference distance of 50 feet), using the equation: $dBA_2 = dBA_1 + 20Log_{10}(D_1/D_2)$, where dBA_1 = noise level at a distance D_1 from the point source and dBA_2 = noise level at distance D_2 from the same point source. Impact levels are based on the FTA/FRA noise impact criteria shown in Figure 3.7-2.

moderate. These impacts would primarily be restrictions to public access for the duration of the incident. A large crude oil spill at the proposed Facility could reach the Columbia River and produce short-term, minor to moderate impacts to land and shoreline uses up to 7 RMs downstream. Land uses along this reach of the river are primarily industrial, agricultural, forest, and open space. The impacts would primarily be restrictions to public access for the duration of the incident, although some shoreline function could be impaired for some time after the cleanup efforts. Impacts to land and shoreline use from a large spill at the proposed Facility would likely be minor to moderate depending on duration and season of occurrence.

Crude Oil Fire or Explosion

Land use impacts due to crude oil fires or explosions could include physical damage to land uses in the vicinity of the proposed Facility from fire or debris from explosions. The extent of impacts would depend on the extent of the fire and the size of the explosion. Impacts to land and shoreline use from a small fire at the proposed Facility would be short term and negligible. Impacts to land and shoreline use from a large fire and/or explosion would likely be minor to moderate, and short term (until completion of response and restoration efforts).

4.7.11.2 Rail Transportation

Crude Oil Spill

The impact of an oil spill along the rail corridor would be heavily influenced by the location, size, extent, and timing of the spill as well as the types of land affected. The predominant land uses surrounding the rail corridor in Washington state are agriculture, timber, and open space. An oil spill could directly affect agricultural activities by smothering crops and contaminating soils. Removal of contaminated soil during cleanup processes could temporarily reduce the quality of agricultural land and, in extreme cases, could permanently alter the type of agriculture that could occur. Recreational land uses also occur along the rail corridor. These uses would be impacted by a crude oil spill for at least the duration of response activities, and potentially much longer. Crude oil spills in residential areas could also result in physical damage to land, particularly if crude oil came into contact with unpaved areas such as yards where soil adsorption would be higher and cleanup more difficult. In the event of evacuation, the residential land uses would be disrupted until residents were allowed to return. Impacts to other urban and industrial land uses along the rail corridor could also be disrupted by evacuations and response activities. Impacts to land and shoreline use from a small to medium spill along the rail corridor would likely be short term and minor to moderate depending on the location and timing of the incident. Impacts to land and shoreline use from a large to very large spill along the rail corridor would likely be moderate to major depending on the size, location, timing of the incident, and the length of time required to restore previous land and shoreline uses (if possible).

Crude Oil Fire or Explosion

Impacts to land and shoreline use from a small fire along the rail corridor would depend on the location and duration of the fire. Even small fires have the potential to require evacuations and access restrictions that would temporarily disrupt local land and shoreline uses. Impacts to land and shoreline uses from a small fire along the rail corridor would likely be negligible to minor.

Impacts from a large crude oil fire and/or explosion along the rail corridor would depend on the location, duration, and extent of the fire and the size of the explosion. A large fire and/or explosion in urbanized areas could damage or destroy residential, commercial, and industrial structures, require evacuations for extended periods of time, and produce long-term alterations in perceptions of appropriate land uses. In nonurbanized land use areas, crude oil fires and debris from explosions could lead to ignition of and damage to nearby vegetation, resulting in temporary or permanent changes in land uses and extensive and long-lasting response and restoration efforts. Impacts to land and shoreline use from a large fire and/or explosion along the rail corridor would be moderate to major depending on the location of the event, extent of the fire, and the size of the explosion.

4.7.11.3 Vessel Transportation

Crude Oil Spill

A small to medium crude oil spill along the vessel corridor could produce minor to moderate impacts to land and shoreline uses up to 2 RMs downstream from the source, depending on the duration of the incident and season of occurrence. Impacts would be similar to those described for a small to medium crude oil spill at the proposed Facility that reached the Columbia River. A large to very large spill along the vessel corridor could impact land and shoreline uses from the proposed Facility to beyond the mouth of the Columbia River. Response efforts for a large to very large crude oil spill in the Columbia River would likely require the use of tugboats, harbor craft, and other response equipment on the river. Land-based equipment would also be necessary to gain access to the river and to support shoreline cleanup, resulting in potentially heavy foot and vehicle traffic along shorelines. Impacts to land and shoreline uses from a large to very large spill along the vessel corridor could be moderate to major depending on the location and duration of the spill and response efforts, the timing of the spill, and the specific land and shoreline uses impacted.

Crude Oil Fire or Explosion

Impacts to land and shoreline use from a small fire along the vessel corridor would be negligible. Impacts to land and shoreline use from a large fire and/or explosion in the vessel corridor could be moderate to major if the event occurred close to shore, leading to damage or destruction of nearby shoreline facilities and short-term disruption of land and shoreline uses.

4.7.12 Visual Resources/Aesthetics

This section addresses potential impacts of spills, fires, and/or explosions to visual resources/aesthetics. Impacts to visual resources from accidental releases related to the proposed Facility are analyzed based on impacts to the Key Observation Points (KOPs) identified in Section 3.11. Impacts to visual resources from accidental releases in the rail or vessel corridors are discussed based upon the types of visual resources and sensitive viewers found in the corridors.

4.7.12.1 Proposed Facility

Crude Oil Spill

If a crude oil spill extended beyond the proposed Facility site, particularly into the Columbia River, visual impacts could include slicks or sheens on the water and oiled vegetation. Visual resource impacts at the proposed Facility site could also result from response and cleanup actions. Vehicles, equipment, and personnel present during spill cleanup and recovery operations, including on land containment berms and response vessels in the water, could alter the visual environment in the proposed Facility vicinity. Glare from equipment and the presence of emergency crew vehicles and operations would be visible at times from KOPs 1, 2, and 5 and would most likely cause minor to moderate but short-term impacts (hours to days) depending on volume of crude oil spilled. The presence of equipment and personnel from emergency response crew activities would not likely impact the views from KOPs 3 and 4 due to the distance of the proposed Facility elements from these areas and the similarity of the equipment to that used on a regular basis at the proposed Facility.

A small- to medium-sized spill at the proposed Facility site would likely have negligible impacts to visual resources as the level of contrast created by the spill and the response would be minimal. A large to very large spill at the proposed Facility site would likely produce longer duration response activities and would require more personnel and equipment, likely producing minor visual impacts due to the existing visual quality of the area and the potential to be observed from more distant sensitive visual resources.

Crude Oil Fire or Explosion

A small fire could produce minor impacts to visual resources in the vicinity of the proposed Facility. These impacts could include smoke, glare, and other visual effects in the immediate area and the presence of emergency vehicles on routes from emergency response stations.

A major fire and/or explosion at the proposed Facility would likely produce short-term moderate to major visual impacts that could be observed a considerable distance from the site. Flames and the destruction of property from a large fire and/or explosion would be visible at KOPs 1, 2, and 5 and, depending on the severity, could also be visible from KOPs 3 and 4. Smoke could spread to adjacent areas or create a haze that would limit visibility at nearby recreation areas or residences. Changes to the visual setting would last until the area were fully restored. If damaged Facility elements were rebuilt and the landscape restored, long-term visual impacts from a large fire and/or explosion would be minor and of a limited duration. Most fires would likely be extinguished before they spread beyond the proposed Facility boundaries. However, if the fire and/or explosion spread to nearby areas such as the Fruit Valley neighborhood or the Shillapoo Wildlife Area, impacts to visual resources could be major.

4.7.12.2 Rail Transportation

As a crude oil spill, fire, or explosion could occur anywhere along the rail corridor, distances to sensitive visual resources would vary. Sensitive viewpoints would include recreation areas, particularly areas in the Columbia River Gorge; residential areas of Vancouver, Pasco, and Spokane; and SR 14, a Washington Scenic Byway and National Scenic Area. Sensitive viewers include recreationists, residents, motorists, and workers at facilities along the rail corridor. Other sensitive viewers include Indian tribes with traditional use areas along the corridor.

Overall, impacts to visual resources from small to medium spills or fires along the rail corridor are anticipated to be minor because the change from the current conditions would only last for a short duration and be confined to the corridor. A large to very large spill could result in minor to moderate impacts because the response time would be longer and the spill or fire could be observed by a larger number of sensitive receptors in a larger geographic area.

Crude Oil Spill

The visual impacts of an oil spill along the rail corridor would be heavily influenced by the location, size, extent, and timing of the spill as well as the types of land affected. Short-term changes in the visual setting could arise from a crude oil spill, including visible oil slick, sheen, or pool, and oiling of vegetation, buildings, and/or structures. Small to medium spills along the rail corridor could be seen by sensitive viewers up to 0.5 mile on either side of the rail corridor and up to 1 RM if oil reached the Columbia River, resulting in minor to moderate impacts that would last for the duration of cleanup response. Depending on the location, a large to very large spill could be observed by a greater number of sensitive viewers and require a longer response and restoration period. Impacts to visual resources from large to very large oil spills along the rail corridor could be moderate to major depending on the location and duration relative to sensitive viewsheds.

Impacts to visual resources could also result from response activities, including the presence of vehicles and equipment (including helicopters, if needed). In urban or industrial areas, the presence of additional vehicles or crews from cleanup response would be minor as the presence of vehicles, work crews, and other equipment in these areas is a regular occurrence. However, in rural and natural areas, the impacts could be moderate.

Crude Oil Fire or Explosion

A small fire along the rail corridor could result in smoke and flames observable by nearby sensitive receptors, and depending on the location and extent, could impact sensitive visual resources (e.g., historical bridges), resulting in minor to major visual impacts. A large fire and/or explosion along the rail corridor could produce moderate to major visual impacts depending on the location and extent of the fire and/or explosion. For instance, if a fire and/or explosion occurred in the viewshed of recreation areas along the Columbia River Gorge, residential areas in and adjacent to Vancouver, Pasco, and Spokane, near important buildings or structures such as Maryhill Museum of Art in Goldendale, or in the traditional use areas of Indian tribes, impacts would be major. Visual impacts associated with response would last the length of the fire and/or explosion event and would be minor to moderate depending on the location.

4.7.12.3 Vessel Transportation

Crude Oil Spill

Impacts to visual resources from a crude oil spill could include observable oil slicks or sheens on water surfaces, oiling of vegetation or sediment along shorelines and adjacent floodplains and wetlands, and oiling of structures along the vessel corridor. The level of impacts to visual resources would depend on the location and spread of the oil. Particularly sensitive areas for visual resources along the vessel corridor include residential areas, commercial areas, and agricultural/parks/open spaces. The portions of the vessel corridor near Kalama and Vancouver, Washington, and near Hood River and Astoria, Oregon, have high concentrations of historically important visual resources, residential neighborhoods, and recreation areas. Visual impacts from small to medium spills could be minor to moderate depending on the number of sensitive receptors in the spill area and depending on the presence of nearby important visual resources. Visual impacts from large to very large oil spills could be moderate to major depending on the spread of the oil slick or sheen and the extent of damage to natural areas, parks, or significant/historically important buildings and structures requiring an extended cleanup and restoration process.

Response activities along the vessel corridor would result in the use of tugboats, harbor craft, and other response equipment. Spill cleanup and recovery operations would create temporary visual impacts along the vessel corridor. In urban or industrial areas, the presence of additional vehicles or crews from cleanup response would be a minor impact as vehicles, work crews, and other equipment in these areas are a regular occurrence. However, in rural and natural areas, the impacts could be moderate.

Crude Oil Fire or Explosion

A small fire along the vessel corridor could result in smoke and flames observable by nearby sensitive receptors, which, depending on the location and extent, could impact sensitive visual resources (e.g., historical bridges), resulting in minor to major visual impacts. A large fire and/or explosion event along the vessel corridor could alter the viewshed of sensitive visual resources by destroying important buildings, residential neighborhoods, or recreation areas alongside the shoreline. Impacts to visual resources could be major if damage occurred to natural areas, parks, or significant buildings and structures that required an extended cleanup and restoration process.

Impacts of response activities from a large fire and/or explosions would be similar to those described for these events along the rail corridor.

4.7.13 Recreation

This section addresses potential impacts of spills, fires and/or explosions to recreation sites and activities.

4.7.13.1 Proposed Facility

Crude Oil Spill

Impacts to recreation from a crude oil spill of any size at the proposed Facility would be negligible if the spill were contained within the site boundaries and did not reach the Columbia River. Impacts to recreation sites and recreational activities, particularly recreational fishing, from a small to medium crude oil spill not contained within the boundaries of the proposed Facility could include prevention of access to recreation areas and reduction in the real and/or perceived value of the recreational resource (e.g., loss of recreational fish, real or perceived reduction in recreational fish value, damage to swimming water quality). Recreational use could decrease due to changes in the visual setting, concerns over water contamination, or reduced populations of fish or other wildlife impacts. Impacted areas could become less attractive to recreationists. Impacts would be particularly noticeable to kayakers or other small craft users. A crude oil spill that reached the Columbia River would lead to sheens or slicks on the water surface, shoreline beach/vegetation oiling, closures, access restrictions, odors, and unsightly or unpleasant conditions. Particularly sensitive recreational sites near the proposed Facility include Hayden Island and Shillapoo Wildlife Area/Vancouver Lake area. Depending on the spread of a small to medium spill at the proposed Facility, impacts to recreational sites and activities could be minor to moderate.

Impacts to recreation from a large crude oil spill at the proposed Facility would likely range from moderate to major for up to 7 RM downstream of the proposed Facility site. The types of impacts would be similar to those described for a small to medium crude oil spill that reached the Columbia River, although the level of impact could be greater and of longer duration. Recreational sites that could be impacted include Hayden Island, Shillapoo Wildlife Area/Vancouver Lake area, Fort Vancouver (upriver), and the Sauvie Island Wildlife Area (downriver).

Response activities associated with a spill of any size at the proposed Facility could impact recreationists in the vicinity, particularly bicyclists or pedestrians using NW Lower River Road or boaters and recreational fishers on the Columbia River and visitors to the Shillapoo Wildlife Area/Vancouver Lake area. Impacts to recreationists could occur during spill response from road or boat launch closures required for response crews. Response activities would likely cause moderate impacts for the duration of the response activities.

Crude Oil Fire or Explosion

Impacts from a small fire at the proposed Facility to the use of nearby recreational sites could result from smoke and debris that deters recreationists. Impacts would likely be short term and negligible to minor.

Impacts from a large fire and/or explosion to the use of recreational sites could result from heat, smoke, ejected debris, noise, blast force, and disruption of recreational wildlife resources. Depending on the size and extent of the fire and/or explosion, recreational users of the NW Lower River Road trail, the Columbia River, and other nearby recreation areas could be affected, and vegetation and wildlife could be damaged or destroyed at nearby recreational sites if a fire spread to these areas. These impacts would likely range from moderate to major, depending on the duration and extent of the fire and/or explosion.

Response activities from a small fire or a large fire and/or explosion would likely cause short-term minor noise (e.g., sirens) and visual impacts in the immediate area that could temporarily affect the recreational use of the NW Lower River Road trail, Columbia River, and other nearby recreation areas. These events could also result in restricted or limited access to nearby recreation areas.

4.7.13.2 Rail Transportation

Crude Oil Spill

The impact of a small to very large crude oil spill and associated response efforts to recreational sites and activities along the rail corridor would be similar to those described for spills at the proposed Facility, and would be minor to major, the extent of impact being heavily influenced by the location, size, extent, and timing of the spill and the types of recreation areas/uses affected. Short-term damage to vegetation, trails, campgrounds, and support structures at recreational sites could occur from response or cleanup activities. Longer-term impacts to hunting and sport fishing could occur if a crude oil spill reduced local populations of wildlife, waterfowl, or fish.[16] Of particular concern would be spills that affected recreation areas such as the Columbia River Gorge National Scenic Area, Gifford Pinchot National Forest, Mt. Hood National Forest, and the Lower Deschutes Wild and Scenic River.

Crude Oil Fire or Explosion

Impacts to the use of and access to nearby recreational sites could occur from a small fire and response along the rail corridor, depending on the location of the fire. These impacts could deter recreationists and damage buildings and facilities in recreation areas, including boat launches, trails, and campgrounds. Hunting and fishing could be affected by impacts to wildlife and fish habitats from a small fire. These impacts could range from minor to major depending on the sensitivity and recreational value of the area damaged (e.g., Bonneville Dam, Pacific Crest National Scenic Trail) and could lead to permanent damage to or destruction of the affected site. A large fire and/or explosion and associated response efforts would produce similar minor to major impacts and could also lead to more extensive damage from ejected debris, noise, and blast force or larger and faster spreading fires. The presence of emergency response vehicles and equipment (including helicopters, if needed) could cause short-term impacts from increased noise or limitations on access from road, beach, or river closures.

4.7.13.3 Vessel Transportation

Crude Oil Spill

The impacts to recreational sites and activities from a small to very large crude oil spill and associated response efforts along the vessel corridor would be similar to those described for spills at the proposed Facility and along the rail corridor. The impacts would be minor to major and the extent would depend on the location, size, and timing of the spill and response activities, as well as the types of recreation areas/uses affected. In the event of a very large spill along the vessel corridor, the spill could extend beyond the mouth of the Columbia River. Recreation areas that could be affected include wildlife refuges such as the Lewis and Clark National Wildlife Refuge and historic districts including areas in Astoria, Oregon, and the Lewis and Clark National and Historical Park in both Oregon and Washington.

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16 The estimated per-day, trip-related expenditures specific to fishing in the Columbia River are estimated to be $91.92 (2014$) per trip (NOAA 2014). As provided in Section 3.12.2.2, an average of 507,080 annual Chinook, coho, and steelhead fishing trips were taken within the mainstem over the 2002–2009 period from the mouth of the Columbia River to the Highway 395 Bridge in Pasco/Kennewick, Washington.

Crude Oil Fire or Explosion

Impacts to recreational sites and activities from a small fire along the vessel corridor would depend on whether the fire is discrete to the vessel, or affects areas in the vicinity. A small fire affecting only the vessel would likely produce negligible impacts to recreation. If a small vessel fire occurred near the shore, nearby shoreline recreational sites and uses could be impacted. These impacts would be similar to those described for a small fire at the proposed Facility or along the rail corridor, and would range from minor to major depending on the sensitivity and recreational value of the resource(s) damaged. Impacts from a large fire and/or explosion event along the vessel corridor would be similar to those from an event at the proposed Facility or along the rail corridor and would range from moderate to major, again depending on the sensitivity and recreational value of the resource(s) affected.

4.7.14 Historic and Cultural Resources

This section addresses potential impacts of spills, fires, and/or explosions to historic and cultural resources.

4.7.14.1 Proposed Facility

Crude Oil Spill

Direct impacts to archaeological resources from a crude oil spill of any size at the proposed Facility are unlikely since no recorded archaeological resources exist at the proposed Facility site. In the unlikely event of an inadvertent discovery of archaeological resources during spill response, the final approved version of the Applicant’s draft Cultural Resources Inadvertent Discovery Plan (Archaeological Investigations Northwest, Inc. 2015) would be followed. In the event a spill at the proposed Facility activated the NRS (see Section 4.3), the Compliance Guide for the National Historic Preservation Act during an Emergency Response, which is part of the NWACP, would be followed. If a spill of any size reached the Columbia River from the proposed Facility, the spilled crude oil could produce minor to major impacts to submerged archaeological resources and those located along the river banks from 1 to 7 RMs downstream. Impacts could be produced by altering the chemical and physical composition of archaeological resources and would vary depending on the type of archaeological resource, the type of shoreline the resource was located on, and the cleanup response actions. No known Traditional Cultural Properties (TCPs) have been located within the proposed Facility site.

No historic resources are located at the proposed Facility site, and as a result no impacts would occur to historic resources from a spill of any size contained on the proposed Facility site. Impacts to historic resources located near the proposed Facility could occur from increased noise or changes in the visual setting from the presence of equipment, vehicles, and personnel associated with cleanup response. These impacts would be short term and negligible. If a spill of any size reached the Columbia River from the proposed Facility, impacts could occur to historic resources located on the shoreline from 1 to 7 RMs downstream. These impacts could include contamination of the resource with oil and physical damage from response actions, and could be minor to major depending on the severity of the contamination and/or damage.

Since the proposed Facility has no known Indian tribal Usual and Accustomed (U&A) uses under treaty rights, no direct impacts would occur to these uses from a crude oil spill contained onsite. However, if a spill of any size reached the Columbia River from the proposed Facility, U&A fishing and hunting areas for several treaty tribes could be impacted from 1 to 7 RMs downstream. Oil spill damages on U&A fishing, hunting, and culturally important tribal lands could produce short-term or long-term impacts. Impacts could include oil contamination of fish and shellfish, and damages to fisheries that could have a moderate to major impact to cultural, traditional, and economic uses of fish for many tribes, depending on the extent and duration of the crude oil spill and response event.

Crude Oil Fire or Explosion

A small fire at the proposed Facility would have no impacts to recorded archaeological resources or historic resources since none exist at the proposed Facility. However, in the event that a large fire and/or explosion ejected debris beyond the proposed Facility or extended beyond the proposed Facility site, direct impacts to surrounding archaeological and historic resources could range from minor to major depending on the amount of physical damage and/or destruction. Access to historic sites and buildings located in the vicinity of the proposed Facility, such as the Great Western Malting Plant approximately 1.7 miles away, could be temporarily limited by cleanup and response activities. In the unlikely event of an inadvertent discovery of archaeological resources during the response effort, the final approved version of the Applicant’s draft Cultural Resources Inadvertent Discovery Plan (Archaeological Investigations Northwest, Inc. 2015) would be followed. In the event a spill at the proposed Facility activates the NRS, the Compliance Guide for the National Historic Preservation Act during an Emergency Response would be followed.

Since the proposed Facility site has no known Indian tribal U&A uses under treaty rights, no direct impacts would occur to these uses from a fire and/or explosion contained onsite. However, in the event that a large fire and/or explosion debris spread beyond proposed Facility boundaries, impacts to surrounding U&A resources could be major and include physical destruction of U&A resources. Temporary minor impacts to U&A uses could also occur from cleanup and response activities.

4.7.14.2 Rail Transportation

Crude Oil Spill

As described in Section 3.13, previously recorded archaeological sites and isolated finds occur within the rail corridor study area; however, it is likely that some archaeological resources that have not been recorded also exist. Figures in Appendix E.7 display the density of archaeological resources. Five TCPs were identified within the rail corridor study area during the literature review, three of which are associated with oral traditions, one with ethnographic land use, and one with an ethnographic village. Four of the TCPs are recorded as archaeological sites. Previously recorded National Register of Historic Places–eligible and Washington Heritage Register–eligible historic resources also occur within the rail corridor study area (Figures in Appendix E.8 display the densities). Some of these resources may no longer exist and other resources that have not been recorded likely exist within the rail corridor study area. Historic resources are scattered throughout the study area, with the highest concentration occurring in urbanized areas near Spokane and Vancouver. A small to very large crude oil spill along the rail corridor could impact historic and cultural resources and TCPs along the rail corridor. For example, the research potential of an archaeological site could be affected by any size spill that inhibited the ability to perform radiocarbon and isotope analyses. Coating by crude oil could result in minor to major damage to archaeological and historic resources and TCPs, depending on the sensitivity of the resource, and the presence of crude oil could have adverse effects on the setting of the resource.

Cleanup activities for a spill of any size within the rail corridor would likely be coordinated with Ecology, Washington Department of Archaeology and Historic Preservation (DAHP), and Oregon State Historic Preservation Office, as applicable. In the event that a FOSC is involved, during an emergency response, the Compliance Guide for the National Historic Preservation Act During an Emergency Response would be followed. Nonetheless, cleanup activities have the potential to permanently damage archaeological resources and TCPs through the use of hand tools, heavy machinery, and site remediation efforts. For example, compression of subsurface archaeological resources caused by heavy equipment could damage site stratigraphy and artifacts. Cleanup crews could inadvertently affect archaeological sites and TCPs through stomping, crushing, scraping, and shoveling these resources (Borrell 2010). Methods used to clean cultural resources would require approval by Ecology and DAHP prior to use and would require close monitoring during use. Cleaning cultural resources may not be appropriate in some archaeological or culturally sensitive areas, such as subsurface midden deposits, petroglyphs, and burials (RRT and NWAC 2013) where cleanup activities could disturb or further damage cultural resources. Response activities could temporarily limit or restrict access to archaeological resources and TCPs. In addition, there could be temporary odor, noise, and visual changes to surrounding resources.

If an oil spill reached the Columbia River, additional resources could be impacted. In the event that cultural or historic resources are present within 1 to 13 RMs from the spill source, a small to very large spill could produce moderate to major impacts to these resources.

Direct impacts to historic resources could occur from a small to very large crude oil spill along the rail corridor by soiling of a historic structure, the foundation, or accidental damage during cleanup activities. Historic resources in the rail corridor include bridges, depots, and segments of the BNSF track. Elements of the National Historic Landmark Bonneville Historic District (including the Bonneville Dam) could be coated by oil or damaged by response activities if a spill occurred within 13 RMs upstream of this location. Major impacts could occur if character-defining features of historic resources were irreparably damaged during response activities. Impacts to historic resources from a spill of any size could produce minor to major impacts depending on resource fragility and the ability to repair damage to rare or historic elements of the resource. Short-term, minor impacts to historic resources from a small to medium spill could include the introduction of odor, additional noise, or changes in the visual setting from the presence of equipment, vehicles, or response teams, as well as access limitations during response activities. A large to very large spill requiring a more extensive operation or in a remote area could produce moderate to major impacts to historic resources.

A crude oil spill of any size and associated cleanup activities could impact U&A uses within and adjacent to the rail corridor. The extent and duration of the impacts would depend on the location, size, and spread of the crude oil spill, and if a spill reached the Columbia River impacts could extend up to 13 RMs downstream of the spill site. Impacts from a crude oil spill and cleanup activities could include resource damage or destruction, access limitations or restrictions, and temporary odor, noise, and visual changes. A spill of any size that affects a U&A area could produce moderate to major impacts to U&A uses depending on the use area’s sensitivity to environmental disturbance.

Crude Oil Fire or Explosion

The impacts to historic and cultural resources from a small fire along the rail corridor would depend on the location of the small fire event. Direct impacts to nearby archaeological resources, TCPs, historical resources, and U&A uses could be major, including physical damage or destruction of resources from fire and damage from response activities, including the use of firefighting foams. Access to cultural resources could be temporarily restricted. Indirect temporary impacts to these resources could result from noise and visual changes resulting from the small fire itself and from response activities.

In the event of a large fire and/or explosion, historic and cultural resources could experience moderate to major impacts depending on the location, extent of fire, and force of explosion. The number of historic resources in close proximity to the event could be high in urbanized areas with historic districts and individually listed historic properties (e.g., Spokane, Pasco, or Vancouver). Historic structures could be physically damaged or destroyed by fire, force of explosion, or explosion debris. Damage to the physical structure, windows, or other features of a historic resource could alter its defining character and if the elements were not restorable, the damage could be irreparable. Minor short-term impacts to nearby historic and cultural resources could result from dust or fire debris, or from increased noise or visual changes. Access to these resources could be limited or restricted temporarily, or for even longer if structural damage resulted in safety concerns. Potentially affected historic and cultural resources along the rail corridor are identified in Appendix E.9 and E.10.

If a large fire and/or explosion affects U&A uses along the rail corridor, moderate to major impacts to tribal culture, tribal community subsistence harvest, and tribal treaty rights could occur. These impacts could include physical destruction of U&A areas and resources from fire or explosion debris and access restrictions to U&A fishing, hunting, and culturally important tribal lands. Temporary minor impacts to U&A uses could also occur from response activities.

4.7.14.3 Vessel Transportation

Crude Oil Spill

Impacts to submerged and shoreline historic and cultural resources from a small to medium crude oil spill along the vessel corridor would be similar to those described for a spill from the proposed Facility that reached the Columbia River, and could occur up to 2 RMs downstream from the source. Impacts to submerged and shoreline historic and cultural resources from a large to very large crude oil spill along the vessel corridor would also be similar to those described for a spill from the proposed Facility that reached the Columbia River, and could occur from the source of the spill to the mouth of the Columbia River. For example, a historic resource that is docked in the Columbia River at Astoria (National Historic Landmark Lightship WAL-604) could be affected by temporary oiling. Archaeological resources and TCPs could be impacted by chemical and physical damage caused by the spill and response activities. Impacts to U&A uses from a small to very large crude oil spill along the vessel corridor would be similar to those described for a spill from the proposed Facility or along the rail corridor that reached the Columbia River. Impacts to historic and cultural resources from small to very large crude oil spills along the vessel corridor would have moderate to major impacts depending on the location of the spill and the sensitivity of affected resources. The distribution of potentially affected historic and cultural resources along the rail corridor is identified in Appendices E.9 and E.10.

Crude Oil Fire or Explosion

Impacts to historic and cultural resources from a small fire along the vessel corridor would be negligible assuming the fire were confined to the vessel and not immediately adjacent to the shore. If a large fire and/or explosion event occurred close to shore, impacts to nearby historic and cultural resources would be similar to those described for a large fire and/or explosion along the rail corridor. The distribution of potentially affected historic and cultural resources is identified in Appendices E.9 and E.10.

4.7.15 Transportation

This section addresses potential impacts of spills, fires, and/or explosions to roadway, rail, and maritime transportation systems.

4.7.15.1 Proposed Facility

Crude Oil Spill

A small to medium spill would not likely spread across the Lower River Road (SR 501) north of the proposed Facility; however, it could necessitate the temporary closure of onsite roadways and rail loops. Since some of the rail loops may be used by other Port tenants, the transportation impact could be short term and minor. A small to medium crude oil spill that reached the Columbia River could temporarily impact vessel traffic if the spill escaped containment booms. Response efforts to clean up the spill could temporarily limit or close vessel access to other Port berths and/or a portion of the Columbia River navigation channel. These impacts to vessel traffic would likely be short term and minor.

A large to very large spill would also impact onsite roadways and rail loops, and could result in the full or partial closure of a portion of Lower River Road (SR 501), particularly if the spill originated from one or more of the transfer pipelines on the north end of the proposed Facility. In the event of these closures, it would be necessary to temporarily detour and/or delay vehicular and rail traffic, which would result in increased congestion on the roadway and rail networks. Closures of the onsite roadways would directly impact transportation for other Port users. The impact to Lower River Road and alternate roadways would be most pronounced during peak commuting hours, and traffic congestion would increase due to the influx of emergency response vehicles. A large to very large spill from the proposed Facility that reached the Columbia River would not likely be completely contained by booms, and could result in closures to the Columbia River navigation channel that would delay or disrupt vessel traffic in both directions for the duration of the spill and response effort requiring closures. Depending on the location, timing, and duration of the spill and response effort, the impact to transportation from a large to very large spill at the proposed Facility would likely be minor to moderate and short term (a couple of hours to a couple of days).

Crude Oil Fire or Explosion

A small crude oil fire at the proposed Facility would have similar impacts to transportation as a small to medium crude oil spill at the proposed Facility. A large fire and/or explosion at the proposed Facility could damage onsite transportation infrastructure (roads, railways), and ejected debris could also damage nearby offsite transportation infrastructure (such as SR 501). The temporary reduction in roadway and rail capacity, and the diversion of vehicle and rail trips to other routes, would likely result in temporary increases in congestion on the roadway and rail networks and would constitute a moderate impact to traffic until the infrastructure were cleared or repaired.

4.7.15.2 Rail Transportation

Crude Oil Spill

A derailment and associated small to medium crude oil spill along the rail corridor would temporarily disrupt rail traffic and could also impact at-grade roadway crossings and parallel roadways in a variety of development contexts (e.g., urban, suburban, and rural). For much of its length, the rail corridor runs parallel to existing highways (e.g., SR 290 in Spokane Valley, Washington, and SR 904 in Cheney, Washington). Within developed areas, and depending on the volume of crude oil released, some grade-separated roadway crossings could be temporarily impacted. The impacts to transportation from a small to medium crude oil spill would likely be short term, and negligible to minor.

A large to very large crude oil spill along the rail corridor would likely result from an incident involving the derailment of many railcars. The derailment and spill could result in longer closures of the rail corridor (days to weeks), and could cause damage that leads to the closure of affected transportation infrastructure including bridges and highways. Closures of nearby roads and highways could also occur during incident response, even if these roadways were not damaged. Long-duration track closures would require rerouting of rail traffic around affected track segments, which could increase shipping times. At-grade roadway crossings could also experience long-duration closures requiring detours and longer travel times for affected drivers and emergency response vehicles. The duration of transportation disruption would depend on the time necessary to clean up the spill, repair infrastructure, and reopen the transportation corridor(s).

The impacts to transportation from a large to very large spill along the rail corridor would likely be minor to major, depending on the extent and duration of damage to the transportation system. If a large to very large spill were to reach the Columbia River, the impacts would be similar those described for a similarly sized spill at the proposed Facility.

Crude Oil Fire or Explosion

A small fire along the rail corridor would be associated with, and likely produce similar impacts to, a small to medium spill along the rail corridor. A large fire and/or explosion along the rail corridor would require the closure of the rail corridor and nearby roadways, and potentially cause closure of nearby waterways. A large fire and/or explosion along the rail corridor could also damage bridges, tunnels, and nearby vessel infrastructure (piers and berths) that could lead to lengthy closures and transportation disruptions. The impacts to transportation from a large fire and/or explosion could be moderate to major depending on the location, spread of fire, size and force of the explosion, and duration of the response and repair efforts.

4.7.15.3 Vessel Transportation

Crude Oil Spill

The impacts of a small to medium crude oil spill along the vessel corridor would be similar to those from a small to medium spill at the proposed Facility that reached the Columbia River. Impacts from a large to very large crude oil spill along the vessel corridor could include temporary closure of marine terminal facilities, anchorages, and/or portions of the navigation channel for the duration of emergency response and cleanup operations. These closures would be expected to increase river traffic congestion and congestion outside the mouth of the Columbia River, resulting in short-term, moderate to major impacts to vessel traffic for the duration of response efforts.

Crude Oil Fire or Explosion

A small crude oil fire along the vessel corridor would have minor, temporary impacts to vessel traffic in the vicinity of the event, depending on the distance of the burning vessel from shoreline infrastructure and nearby vessels. A large fire and/or explosion along the vessel corridor would result in severe damage to and grounding or sinking of the vessel, and a requirement for salvage to clear the navigation channel during or after response efforts. A large fire and/or explosion could also damage nearby vessels and shoreline or in-river infrastructure (e.g., marine terminal facilities, anchorages) and cause closures of portions of the navigation channel during emergency response operations. The impacts from a large fire and/or explosion along the vessel corridor would be similar to those described for a large to very large spill along the vessel corridor.

4.7.16 Public Services and Utilities

This section addresses potential impacts of spills, fires, and/or explosions to public services and utilities.

4.7.16.1 Proposed Facility

Crude Oil Spill

A small to medium crude oil spill at the proposed Facility could require response by the VFD, but the immediate response would be handled by trained proposed Facility personnel and contractors. The VFD response would not likely require large numbers of personnel, resulting in minor impacts to VFD’s capacity to address other emergencies in their jurisdiction. A large to very large spill at the proposed Facility could result in delays in the provision of emergency medical services and fire protection to other parts of VFD’s service territory. As discussed in Section 4.6.3.3, emergency responders in the vicinity of the proposed Facility consider themselves undertrained and underequipped to address a response to a crude oil spill.

The impact of a large to very large spill on emergency medical and fire protection services could be moderate if it strained or exceeded the resources of the providers. The impact of a large to very large spill on police and security services could be moderate because it could require personnel for crowd and traffic control and emergency evacuations and decrease their availability to serve other needs in the short term. As discussed in Section 3.15, the International City/County Management Association (ICMA) found VPD’s response times to be higher than the benchmark “considered acceptable” of 5.0 minutes for high-priority calls; VPD had an average response time of 15.0 minutes for all calls. The ICMA report also found that while the VPD provides a high level of service to the City with the resources it has, VPD is understaffed and faces challenges resulting from budget cuts and personnel reductions (ICMA 2013). Therefore, a spill at the proposed Facility requiring response by the VPD has the potential to delay police response to other calls while VPD is involved in spill response. Medical services would be required in the event of a medical emergency such as worker exposure to crude oil or fumes.

A small to very large crude oil spill at the proposed Facility would likely have a negligible to minor impact to the availability of medical services since three major hospitals are within approximately 10 miles of the proposed Facility and could provide the level of service needed with minimal disruption to other community needs. There would likely be no impact to phone and internet services from a crude oil spill of any size at the proposed Facility.

Crude Oil Fire or Explosion

Small fires that remain within the proposed Facility site and are not determined to be at risk of spreading could have minor to moderate impacts to VFD’s capability to respond to other emergencies.

A large fire and/or explosion at the proposed Facility could place a high demand on VFD’s resources. Depending on the complexity of the incident, a large fire and/or explosion at the proposed Facility may require multiple engines, trucks, and special response equipment supporting rope rescue, hazardous materials response, and marine fire response (Eldred 2015). A large fire and/or explosion event could also result in human injury and would result in a potentially high demand for emergency medical response services. A sharp increase in the demand for fire protection and emergency medical services could result in moderate to major impacts to the provision of emergency medical services and fire protection to other parts of VFD’s service territory. As discussed in Section 4.6.3.3, emergency responders in the vicinity of the proposed Facility consider themselves undertrained and underequipped to address a response to a crude oil fire and/or explosion.

A large fire and/or explosion requiring response by the VPD would have impacts to police services similar to those described for a large to very large spill at the proposed Facility. Impacts to medical services from a large explosion and fire event could be moderate because these events could result in many people requiring treatment, including employees and members of the public, and could strain the capacity of medical facilities and personnel in the short term. In accordance with the HMERP, the Medical Resource Hospital at Oregon Health and Science University would coordinate distribution of patients to local hospitals and medical facilities if the impacted service area’s hospitals are overwhelmed (Clark County LEPC 2014).

4.7.16.2 Rail Transportation

Crude Oil Spill

In the event of a small to medium crude oil spill along the rail corridor, impacts to public services and utilities could range from minor to major depending on the location of the spill and the available resources of the responding service agencies. Impacts would be greater in areas where the mutual aid partners of a service agency are located farther away (rural areas), in areas where the derailment and/or associated crude oil spill restrict responder access to other parts of the service area, and in areas with denser population. Impacts would also be greater to service agencies with lower levels of training and existing response equipment needs. Major impacts to the City's fire protection services could occur in the event of a medium-sized or greater spill because of the proximity of the rail corridor to residences, commercial and industrial areas, and transportation corridors.

Impacts to emergency fire, police, and medical services could occur if a derailed or stopped unit train blocked areas only accessible by at-grade crossings (see Section 4.7.9.2). In the event of a large to very large crude oil spill along the rail corridor, EFSEC survey results suggest that responding fire agencies would consider additional resources beyond current personnel and equipment levels and additional responder training important to allow them to appropriately respond to the event while still maintaining capacity to respond to other potential calls for service within their service area. A large to very large crude oil spill in any location along the rail corridor would have major impacts to responding service agencies (Figure 3.15-1). While the local fire chiefs or other Incident Commanders would likely request state mobilization under these scenarios, the local fire jurisdiction(s) would remain on the scene throughout the entire duration of the incident. Because the local fire agency's resources would be engaged in an extended response operation, extended delays to response to service calls could occur, resulting in major service impacts.

A crude oil spill of any size could require the use of police resources to secure the site and protect public safety. The level of impact to police services would depend upon the availability of police resources and other demands for service within the community during the incident. For instance, a large to very large oil spill, particularly in or near a municipality or public roads, could result in moderate to major impacts to the ability of the police to respond to the incident, while still responding to other calls for service. If a train derailment and/or associated spill restricted or delayed access to other areas, short-term minor to moderate impacts to the provision of law enforcement services in these areas could occur. The need for emergency response, with or without reported injuries, could affect fire department response to other needs in the service area. Minor to major impacts to emergency medical services could occur depending on the location of the event, response equipment needs, and the number of injuries (e.g., crude oil vapor inhalation or crude oil dermal exposure) to rail personnel, responders, or members of the public. There would likely be no impact to phone and internet services from a crude oil spill of any size along the corridor, unless a derailment damages communication lines and causes short-term service interruptions.

Crude Oil Fire or Explosion

A small fire along the rail corridor could have a minor to moderate impact to public services and utilities. Short-term delays or interruptions to service in other areas could occur as fire departments, police departments, and medical personnel work to control the fire, protect public safety, and treat any injuries related to the fire.

As described in Section 4.6.4.2, a large fire and/or explosion along the rail corridor could require extensive response, resulting in moderate to major impacts to public services and utilities depending on the location, extent of the fire, force of the explosion, potential for additional fire and/or explosions, need for evacuation, and number of injuries requiring medical services. If the local fire agency's resources are engaged in an extended response operation, delays to fire protection and emergency medical response for other needs in the service area could occur, resulting in major temporary service impacts. Similarly, if local police are required to coordinate an evacuation and maintain a restricted area, delays in response to other needs in the service area could occur, resulting in major temporary service impacts. If a train derailment occurred in an area that restricted or delayed access to other areas potentially requiring fire, police, or medical services, moderate to major temporary impacts to service provision could occur in these areas. Minor to major short-term impacts to phone and internet services could occur if a fire and/or explosion damaged communication lines.

4.7.16.3 Vessel Transportation

Crude Oil Spill

If a crude oil spill of any size occurred along the vessel corridor, the response would primarily be the responsibility of the USCG, Ecology, ODEQ, and CRC. As a result the impact to fire protection and police services would likely be negligible.

The need for medical assistance to treat exposures to a crude oil spill along the vessel corridor would likely be minor, resulting in negligible impacts to emergency medical services. Given the presence of three major hospitals within 10 miles of the proposed Facility and a large hospital in Longview (PeaceHealth St. John Medical Center, with 346 licensed beds and Level III trauma support; PeaceHealth nd), it is anticipated that the availability of medical services would likely be negligibly affected if a crude oil spill occurred along the vessel corridor near Portland, Vancouver, or Longview. Although a crude oil spill farther downriver would be farther from major hospitals, impacts to the availability of medical services in those areas would likely be negligible since the needs for medical services would likely be minor.

A crude oil spill along the vessel corridor is unlikely to impact communications infrastructure (i.e., phone and internet service) as this infrastructure is located in upland areas and is typically buried underground in pipes or is located overhead as wires. As a result, the impact to phone and internet service would be negligible.

Crude Oil Fire or Explosion

As discussed in Section 4.6.5.3, 12 fire agencies, including VFD, have an agreement with the MFSA to provide one engine and three people for shipboard firefighting if the agency can provide these resources without impacting service within its jurisdiction (Eldred 2015). Because the fire agencies would only provide these resources if doing so would not impact their ability to respond to other calls for service within their jurisdiction, the impact to fire agencies in the event of a crude oil fire or explosion would be minor. Depending on the level of need for emergency medical services resulting from a large fire and/or explosion along the vessel corridor, the impact to emergency medical services could be minor to major. Any required movement of other vessels at-risk or access restrictions required on the Columbia River would be the responsibility of the USCG. Any local shoreline access restrictions or evacuations would be the responsibility of local and/or state police agencies. Depending upon the location and size of the area affected, along with the level of risk to human safety, impacts to police and security services could be negligible to moderate.

Given the presence of three major hospitals within 10 miles of the proposed Facility and a large hospital in Longview, it is anticipated that negligible to minor impacts to the availability of medical services would occur due to a crude oil fire or explosion along the vessel corridor near Portland, Vancouver, or Longview. A fire or explosion that occurred farther downriver would be farther from major hospitals and would have the potential to impact healthcare facilities with fewer resources to respond to the incident.

For example, Astoria's Columbia Memorial Hospital is a Level IV trauma center with 25 beds (Columbia Memorial Hospital 2015), compared to Oregon Health and Science University's Level I trauma center and 576 licensed beds located in Portland (Oregon Health and Science University 2015). Therefore, a fire or explosion that occurred far from a major hospital and resulted in multiple human injuries could strain the ability of smaller hospitals and healthcare facilities to respond to the incident and other demands for service from the community. In that case, the impact to the availability of medical services could be moderate to major. There would likely be negligible impacts to phone and internet services from a crude oil fire and/or explosion along the vessel corridor, unless the event occurred near and damaged communication lines resulting in short-term service interruptions.

4.7.17 Socioeconomics

This section addresses potential socioeconomic impacts of spills, fires, and/or explosions to population and housing, employment and income, property values, and environmental justice.

4.7.17.1 Proposed Facility

Crude Oil Spill

Socioeconomic impacts from a crude oil spill of any size at the proposed Facility would be negligible if the spill were contained within the site boundary.

Population and Housing

If a large crude oil spill at the proposed Facility escaped secondary containment and extended beyond the site boundary, some evacuation and relocation of nearby populations could be necessary. This could produce minor, short-term impacts to nearby population and housing.

Employment and Income

A crude oil spill of any size from the proposed Facility that reached the Columbia River could have adverse impacts to employment and income of fishermen if fishing in the vicinity were temporarily restricted. It is estimated that approximately 17,900 Chinook (king) salmon fishing trips occur annually in close proximity to the proposed Facility (from Light #40 to Lower Lemon Island) (Sall, pers. comm., 2015). The estimated per-day, trip-related expenditures specific to fishing in the Columbia River are $91.92 (2014) per trip for a total of approximately $1.6 million in annual expenditures (NOAA 2014). A temporary (a few hours to a few days) restriction/closure of fishing in the area could result in short-term minor impacts to employment and income, whereas a longer (months) fishing restriction/closure could result in longer-term moderate to major impacts to employment and income of fishermen. If a small to large spill from the proposed Facility reached the Columbia River, vessel diversions could potentially occur from 1 to 7 RMs downstream, producing moderate to major short-term impacts to business profit and wages for workers on vessels and at ports affected by the diversions. For example, a 2005 study estimated that the average daily expenditures for vessel and petroleum product movements through the Columbia River to Portland was $138,000 per day (Ecology 2005).[17] The study also determined that the daily additional business costs to ports resulting from vessel delays in the event of an oil spill would range between $4,000 and $18,000, and estimated that the collective lost income to Port of Portland and Port of Vancouver employees could total $1.0 million and $1.3 million, respectively. Short-term minor

17 Dollar amounts have been adjusted to 2014 dollar value.

impacts could also result from lost incomes of crews for vessels delayed or unable to leave port for the duration of the event and response.

The impact of a crude oil spill on marinas (e.g., Hayden Island marina) could include the cost of lost income from moorage fees, fuel fees, and other retail activities, and costs of cleanup to boats and berths. Ecology (2005) estimated that the daily moorage fees and other marina income lost due to a spill event would be approximately $26 per berth, while the cost of cleaning crude oil from boats and marina property would be $386 per boat. Positive, short-term impacts could include increases in retail sales for businesses offering boat cleaning and repair services. Depending on the location, timing, and duration of the spill event, the impact of a spill to marinas could be minor to major.

Property Values

A crude oil spill of any size from the proposed Facility that extended beyond the boundary of the proposed Facility could have moderate impacts to industrial land within and near the Port. If the crude oil spill reached the Columbia River, minor to moderate shoreline property value impacts could occur from 1 to 7 RMs downstream, although the duration of property value effects resulting from contamination has been generally found to be temporary (Jackson 2001). However, property values for residents within 1,000 feet of a ruptured petroleum product pipeline have decreased by 0.2 to 4.6 percent within the first 6 months following an event, and the mean sale prices within 100 feet of a ruptured pipeline have remained between 2 and 3 percent lower approximately 5 years following the event (Hansen et al. 2006).[18] The nearest landward residential property to the proposed Facility is approximately 3,000 feet distant and is unlikely to be affected by a small to large crude oil spill.

Environmental Justice

Two census tracts within 0.5 mile of the proposed Facility have meaningfully greater concentrations of minority and low-income residents: the Fruit Valley neighborhood (Census Tract 410.05) in Vancouver and Hayden Island (Census Tract 72.01), located in northern Portland (see Section 3.16.2.1). These populations could experience some short-term minor impacts from a crude oil spill at the proposed Facility (e.g., odor, noise, air quality, evacuations) depending on the size and extent of the crude oil spill.

Crude Oil Fire or Explosion

Population and Housing

A small fire at the proposed Facility would have negligible impacts to population and housing assuming the fire were contained within the proposed Facility boundary. A large fire and/or explosion could produce minor, short-term impacts to nearby populations including temporary evacuation and relocation. A large fire and/or explosion at the proposed Facility could also produce major impacts to nearby populations and housing. These impacts could include injury to or death of local residents, and housing damage or destruction.

Employment and Income

A small fire at the proposed Facility would have negligible impacts to employment and income assuming the fire were contained within the proposed Facility boundary. A large fire and/or explosion at the

18 Hansen et al. (2006) evaluated the impacts to properties in Bellingham, Washington, resulting from a rupture of a 19-inch-diameter gasoline pipeline (the Olympic Pipeline) that spilled 229,000 gallons of gasoline into Whatcom Creek, which led to an explosion and fire.

proposed Facility could necessitate the closure of recreational fishing grounds or the delay/diversion of vessels around the proposed Facility, leading to similar impacts as those described for a spill from the proposed Facility that reached the Columbia River.

Property Values

A small fire at the proposed Facility would have negligible impacts to property values assuming the fire were contained within the proposed Facility boundary. A large fire and/or explosion would produce similar impacts as those described for a spill from the proposed Facility that reached the Columbia River.

Environmental Justice

The two meaningfully higher minority or low-income populations in the Fruit Valley neighborhood and Hayden Island could be affected by a fire or explosion at the proposed Facility. Impacts to these residents could range from moderate to major depending on the extent of the fire and the force of the explosion. If fire or explosion debris reached their neighborhoods, major impacts could include injury, death, and property damage or destruction. Minor to moderate impacts include air quality concerns from smoke and particulates if prevailing winds blow toward their neighborhoods. The Fruit Valley neighborhood population is to the northeast and the Hayden Island population is to the southeast of the proposed Facility. Other impacts to these populations would be similar to those described for a crude oil spill at the proposed Facility.

4.7.17.2 Rail Transportation

Crude Oil Spill

Population and Housing

A small to medium spill along the rail corridor could necessitate some temporary evacuation and relocation of nearby populations, leading to minor, short-term impacts to nearby population and housing.

A large to very large crude oil spill along the rail corridor could require a large response effort including the mobilization of nonlocal response workers who would temporarily relocate to the spill area. Major, long-term impacts to population and housing could result from a large to very large crude oil spill that required a prolonged response effort. The impacts could include the provision of housing for a number of nonlocal response personnel, leading to an increase in the local population for the duration of the response effort. Potentially negative impacts could also include increased traffic and demand for services. Potentially positive impacts could include increased expenditures at local restaurants, retail establishments, and other businesses.

Employment and Income

A small to medium crude oil spill along the rail corridor would produce similar impacts to employment and income as those described for a crude oil spill at the proposed Facility that extended beyond the proposed Facility boundaries and also reached the Columbia River.

A large to very large crude oil spill along the rail corridor could produce major impacts to recreation- and tourism-related employment and income. The tourism industry is a major source of direct and indirect employment and wages within the rail corridor study area. The tourism industry includes land and water touring, and retail and service firms, including lodging providers, restaurants, automobile service stations, and other businesses. Economic damages could persist if a diminished public perception of an area occurred (Change et al. 2014).

A large to very large oil spill within the Columbia River Gorge would likely produce major impacts to employment and income as it would decrease tourist-generated revenue. For example, it is estimated that tourists in the Mt. Hood/Gorge area spend $857,500 per day.[19] This tourist expenditure supports $232,900 of daily income in the Mt. Hood/Gorge area and approximately 3,980 annual jobs (Oregon Tourism Commission 2014). Tax revenues could also be negatively impacted by the drop in tourist revenue. For example, it is estimated that Columbia River Gorge tourism contributes $24,100 in state taxes and $11,200 in local tax revenue per day.

A large to very large oil spill in the rail corridor along the Columbia River mainstem could also produce major impacts to employment and income by jeopardizing some of the estimated $46.6 million of annual expenditures by recreational salmon and steelhead fishermen in that reach of the Columbia River,[20] and by adversely affecting commercial and subsistence fishing and fish populations. The Columbia River mainstem commercial salmon and steelhead fishery is divided into a nontribal commercial fishery and a tribal commercial fishery. The nontribal commercial fishery is located downstream of Bonneville Dam, while the tribal commercial and subsistence fishery is located upstream of Bonneville Dam (NOAA 2014). Over the 2002–2009 period, the average annual catch for nontribal commercial fisheries within the Lower Columbia River mainstem was 97,451 Chinook and coho, with an estimated value of $2.0 million (NOAA 2014).[17] The average annual tribal commercial, ceremonial, and subsistence catch for the rail-Columbia River mainstem is 161,447 Chinook, coho, and steelhead, with an estimated value of $2.7 million.[17] Other impacts from a large to very large crude oil spill along the rail corridor would be similar to those discussed for a similar spill at the proposed Facility.

Property Values

A small to very large crude oil spill along the rail corridor would produce similar impacts to affected property values as those described for a similar-sized crude oil spill at the proposed Facility that extended beyond the proposed Facility boundaries and also reached the Columbia River.

Environmental Justice

A small to very large crude oil spill along the rail corridor could produce minor to major impacts to nearby low-income/disadvantaged and minority populations depending on the size and extent of the crude oil spill. Impacts would be similar to those described for a similar size crude oil spill at the proposed Facility that extended beyond the proposed Facility boundaries and also reached the Columbia River. Of the 96 census tracts located within the rail corridor study area, 79 have meaningfully greater concentrations of minority or low-income populations

Crude Oil Fire or Explosion

The socioeconomic impacts from a small fire along the rail corridor would be negligible assuming the fire were controlled within railroad property. The potential impacts to population, housing, property values, and environmental justice from a large crude oil fire and/or explosion along the rail corridor would be

19 Mt. Hood/Gorge area is defined as east Clackamas County, east Multnomah County, Hood River County, and Wasco County.

20 The estimated per-day, trip-related expenditures specific to fishing in the Columbia River are estimated to be $91.92 (2014$) per trip (NOAA 2014). As provided in Section 3.12.2.2 (Recreation), an average of 507,080 annual Chinook, coho, and steelhead fishing trips were taken within the mainstem over the 2002–2009 period from the mouth of the Columbia River to the Highway 395 Bridge in Pasco/Kennewick, Washington.

similar to those for a large crude oil spill along the rail corridor, and a large crude oil fire and/or explosion at the proposed Facility.

4.7.17.3 Vessel Transportation

Crude Oil Spill

The socioeconomic impacts from a small to medium crude oil spill along the vessel corridor would be similar to the impacts described previously for a small crude oil spill that reached the Columbia River either along the rail corridor or from the proposed Facility. The potential socioeconomic impacts from a large to very large crude oil spill along the vessel corridor would be similar to those for a large crude oil spill at the proposed Facility that reached the Columbia River and a large to very large crude oil spill along the rail corridor that reached the Columbia River. However, these impacts could be felt by populations (including low-income/minority populations), businesses, and property owners along the vessel corridor from the location of the spill to beyond the mouth of the Columbia River.

Crude Oil Fire or Explosion

The socioeconomic impacts from a small fire along the vessel corridor would be negligible assuming the fire were controlled within the affected vessel. The potential socioeconomic impacts from a large crude oil fire and/or explosion along the vessel corridor would be similar to the impacts described for a large crude oil fire and/or explosion at the proposed Facility or along the rail corridor that occurred near the Columbia River shoreline. However, these impacts could be felt by nearshore populations (including low-income/minority populations), businesses, and property owners along the vessel corridor near the location of the vessel fire and/or explosion.

4.8 REMEDIATION AND LIABILITY

In the event of a crude oil spill of any size, or in the event of a crude oil fire and/or explosion, remediation of the effects of the event would be required once emergency responders stabilized the immediate effects of the event. This section addresses the regulations that would guide the remedial activities and also addresses the fiscal responsibility for cleanup and remediation costs.

A list of applicable statutes and regulations related to remediation of crude oil spill contamination at the federal and state level is provided in Table 4-15. Required mitigation and remediation for crude oil spill impacts are determined by state and federal agencies responsible for the implementation of these regulations, including EFSEC through its regulatory authority to enforce compliance with state laws and the conditions in the Site Certification Agreement. State, tribal, and federal natural resource trustee agencies could require a Natural Resource Damage Assessment under either OPA 90 or CERCLA, depending on the spill locations and types of materials spilled, to assess the magnitude of the impacts and the type/amount of suitable restoration actions needed to offset the loss of natural resource services resulting from the spill (Department of the Interior 2015; NOAA 2015b). The liability for all costs associated with the cleanup and restoration would depend on the RP as defined by OPA 90 or state statutes.

Table 4-15. Potentially Applicable Cleanup Regulations

Statute/Regulation	Description
Resource Conservation and Recovery Act (RCRA), 42 USC 6973	EPA may issue an order or bring a suit in district court against any person who has contributed or who is contributing to the handling, treatment, storage, transportation, or disposal of solid or hazardous waste that may present an imminent and substantial endangerment to health or the environment. Persons who violate an order are subject to civil penalties of up to $7,500 per day. RCRA Section 7003(a, 42 USC 6973(a), authorizes EPA "upon receipt of evidence that the past or present handling, storage, treatment, transportation or disposal of any solid waste or hazardous waste may present an imminent and substantial endangerment to health or the environment," to "bring suit in district court or to issue an administrative order to any person who contributed or is contributing to that handling, storage, treatment, transportation" to restrain or take any other action in response. Oil released from the Facility, railcar, or vessel would constitute solid or hazardous waste, and the authority allows EPA to require action even if the spill "may present an imminent and substantial endangerment."
Safe Drinking Water Act (SDWA), 42 USC 300f et seq.	EPA may issue orders to any person in circumstances where "contaminant" is present in or is likely to enter a public water system or an underground source of drinking water (defined broadly to include almost all groundwater), which may present an imminent and substantial endangerment to the health of persons and states (to whom primary responsibility is granted under the SDWA) that are not acting. The orders may require that person to take such actions as EPA deems necessary to protect health (42 USC 300i (a)). Civil penalties are available for failure to comply with such an order.
	SDWA Section 1431(a), 42 USC 300i(a), authorizes EPA "upon receipt of information that a contaminant which is present in or is likely to enter a public water system or an underground source of drinking water, which may present an imminent and substantial endangerment to the health of persons," to take "such actions as [it] deems necessary," including issuance of orders and civil judicial actions. Again, this authority is quite broad. An underground source of drinking water is virtually any underground water that has the potential to be used for drinking water, and a "contaminant" is any biological, chemical, or physical substance in water.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601 et. seq.	This act is similar to OPA 90, but addresses releases of hazardous substances and specifically *excludes* oil and petroleum. It provides for liability for response costs and natural resource damages against owners or operators of a vessel or facility and persons who arranged for disposal of hazardous substances. The act contains similar defenses as the OPA 90, as well as contribution rights. It also provides EPA authority to issue administrative orders requiring response actions.
Oil Pollution Act of 1990 (OPA 90), 33 USC 2701 et seq.	OPA 90 established a program of prevention, response, liability, and compensation to address vessel and facility-caused oil pollution to US navigable waters. Section 1002(a) provides that the RP for a vessel or facility from which oil is discharged, or which poses a substantial threat of a discharge, is liable for (1) certain specified damages resulting from the discharged oil and (2) removal costs incurred in a manner consistent with the National Contingency Plan. Section 1018(a), the CWA, does not preempt state law. States may impose additional liability (including unlimited liability), funding mechanisms, requirements for removal actions, and fines and penalties for RPs.
Oregon Revised Statute 468 (ORS) B.305	This statute establishes strict liability for the damages to persons or property caused by the entry of oil into the waters of the state.
Model Toxics Control Act (MTCA), Revised Code of Washington 70.105D	MTCA creates a comprehensive regulatory process to identify, investigate, and clean up contaminated properties that are, or may be, a threat to human health or the environment.
Washington Revised Code of Washington 88.40	This code defines financial responsibility requirements for vessels that transport petroleum products as cargo or fuel and for facilities that store, handle, or transfer oil or hazardous substances in bulk on or near navigable waters.
Washington Administration Code 173-183-300	This statute establishes procedures for Natural Resource Damage Assessments and provides a compensation schedule as an alternative to completing detailed resource damage assessment studies. The compensation schedule includes a methodology for assessing damages to public resources from oil spills into fresh, marine, and estuarine waters of the state. The schedule uses an established ranking of severity of effects of classes of oil and a ranking of the vulnerability of habitats within the state.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act, CWA = Clean Water Act, EPA = Environmental Protection Agency, OPA 90 = Oil Pollution Act of 1990, ORS = Oregon Revised Statute, MTCA = Model Toxics Control Act, RCRA = Resource Conservation and Recovery Act, RP = Responsible Party, SDWA = Safe Drinking Water Act, USC = US Code

OPA 90 Section 1001(32) (A) states that in the case of a vessel, any person owning, operating, or demise chartering the vessel is the RP. In the case of a vessel, the term RP also includes the owner of the oil being transported in a tank vessel with a single hull. OPA 90 Section 1001(32) (B) states that in the case of an onshore facility, any person owning or operating the facility is the RP (under OPA 90 an onshore facility includes a railcar). Additionally, under OPA 90 Section 1002, the RP would also be liable for any discharge of oil (or threat of discharge) to navigable waters of the United States and adjoining shorelines. The term “navigable waters” is defined in OPA 90 as “the waters of the United States, including the territorial sea.” In Rice v. Harken Exploration Co. (2001) the Fifth Circuit confirmed a lower court ruling that groundwater is not within OPA 90’s scope unless a direct connection to surface waters can be affirmed. OPA 90’s liability provisions for a fire or explosion would only apply if the release would occur in the navigable water or adjoining shorelines.

Therefore, if an accidental release could affect surface water, regardless of the reason, the RP would be liable for all costs associated with cleanup and restoration as well as other compensations. OPA 90 provides for periodic adjustments of the liability limits by up to a maximum of $350,000,000. However this statutory liability limit does not apply where the incident was proximately caused by (1) gross negligence or willful misconduct or (2) violation of an applicable federal safety construction or operating regulation by the RP or a person acting pursuant to a contractual relationship with the RP.

Additionally, under the CWA, the RP would be liable for up to $50,000,000 for removal costs of harmful quantities of oil discharged unless the discharge was caused solely by an act of God, an act of war, negligence by the United States, or the act or omission of a third party. The limit does not apply if the discharge resulted from willful negligence or willful misconduct. The RP would also be liable for damages to natural resources, to real or personal property, for the loss of subsistence use of natural resources, for the net loss of taxes, royalties, rents, fees, or net profit shares from injuries to real or personal property or natural resources, for loss of profits or impairment of earning capacity by any claimant, or for net cost of providing increased or additional public services. These liabilities have no limits. CWA civil and criminal penalty provisions would also apply as would Rivers and Harbors Act penalty provisions. However, if a release were caused by negligent or willful acts of others, the RP may ultimately recover costs from those committing the acts as individuals are not automatically protected from liability associated with negligent acts or willful misconduct leading to property destruction and environmental damage.

Certain costs may also be recovered through the Oil Spill Liability Trust Fund (NOAA 2015c). This fund, created by Congress as part of OPA 90, is administered by the USCG. The money comes from a 5-cent-per-barrel tax on oil and can be used to pay for removal costs or damages resulting from discharges of oil into US waters. Up to one billion dollars from this fund may be expended on a spill incident (USCG 2006).

Under Washington State law, liability is unlimited in the event of oil spilled from a facility, vessel, or pipeline. Washington State and third-party claimants are able to recover cleanup costs and damages beyond the federal limits. Washington State requires that operators provide proof that an RP is able to pay for the costs and damages of a spill up to a specified amount. Insurance policies or protection and indemnity club documents typically are used to demonstrate financial responsibility. Washington has recently established a level of financial responsibility for oil handling facilities, including rail in ESHB 1449 Oil Transportation Safety. Under Oregon State law 468B.305, any person owning or having control over any oil or hazardous materials spilled or released or threatening to spill or release is strictly liable for the spill or release or threatened spill or release. This liability does not apply where the incident was (1) an act or war or sabotage or an act of God, or (2) negligence on the part of the United States or the State of Oregon, or (3) an act or omission of a third party without regard to whether any such act or omission was or was not negligent. Remediation and liability claims can lead to extensive and lengthy settlement arbitrations.

4.9 ADDITIONAL MITIGATION MEASURES TO ADDRESS THE RISKS OF AND IMPACTS FROM A CRUDE OIL SPILL, FIRE, AND/OR EXPLOSION

Industry standards and measures committed to by the Applicant to avoid and minimize the risk of a crude oil spill, fire, and/or explosion are presented in Section 4.2.4. Because EFSEC has made no final decisions regarding the adequacy of the current mitigation proposals from the Applicant, additional mitigation could be identified during the site certification process, permitting activities, or further environmental review. EFSEC has identified the following additional mitigation measures for consideration by the state legislature, and other federal, state, and local agencies and private organizations to address the risk of and impacts from a crude oil spill, fire, and/or explosion.

4.9.1 Legislative Actions

- Implement the recommendations on prevention-based mitigation of crude-by-rail risks, prevention-based mitigation of crude oil marine transportation risks, and prevention-based mitigation of crude oil terminal facility risks included in the 2014 Washington State Marine and Rail Oil Transportation Study.

4.9.2 Mitigation Measures for the Applicant to Implement

- Provide secondary containment for aboveground crude oil transfer pipelines at the proposed Facility to reduce the risk of spills to the environment.
- Implement the mitigation measures identified in Section 3.1.5 to further reduce risks from seismically induced soil liquefaction.
- Require all tank cars used to transport crude oil to the proposed Facility to meet or exceed DOT-117 (or newer) specifications developed by PHMSA, FRA, or other appropriate regulatory authorities for the life of the Project.
- Coordinate with potentially affected first responder agencies and contribute support to implement a plan that would facilitate:
  - Training for full-time and voluntary first responders with jurisdiction along the delivery rail route in Washington and in the vicinity of the Port in the appropriate methods for combating volatile crude oil fires and explosions. Training should be modeled after or coordinated with similar training programs to be developed by the University of Findlay, the International Association of Fire Chiefs, and the Center for Rural Development (in cooperation with the Security and Emergency Response Training Center in Pueblo, Colorado) using Assistance for Local Emergency Response Training (ALERT) grants awarded by PHMSA.
  - Purchase of additional crude oil spill and crude oil fire and explosion response equipment to be stationed at appropriate locations along the delivery rail route and at the Port.
- Provide comprehensive instruction and training for VFD in the design, operation, and interaction with the proposed Facility’s fire protection system. Additional specific training needs include: annual training in crude oil transshipment response at a marine terminal, industrial rescue, water response, industrial fire suppression, flammable liquids handling and fire suppression, and foam application in a live fire event.

- Provide support for additional research, technology, and equipment for responding to spills of heavy crude, such as dilbit.
- Develop appropriate response strategies for cleaning up spills of heavy crude oil prior to transporting dilbit on the Columbia River.
- Contribute to all updates of the Lower Columbia River GRP and other applicable Northwest GRPs in partnership with Ecology, ODEQ, USCG, and EPA for the lifetime of the proposed Facility to address the type and amount of crude oil moving to and from the proposed Facility.
- Work with Ecology, ODEQ and others to develop response strategies for environmentally sensitive areas on the Lower Columbia River and along the rail corridor within the state for inclusion in the Lower Columbia River GRP and reference in the Applicant's oil spill contingency plan.
- Retain a licensed engineer to perform an independent engineering analysis and feasibility study to improve oil recovery in the case of a spill during vessel loading at the dock. The study would determine the number of days it is safe and effective to preboom oil transfers and would identify site-specific improvements to maximize successful prebooming. The Applicant should submit this study to EFSEC. If improvements to allow for prebooming are determined to be unfeasible, the Applicant would be required to implement alternative measures including but not limited to the following measures to mitigate the absence of preventative boom in the water during transfers: stage an appropriate number of dedicated response vessels, deploy additional containment and cleanup equipment, and station trained personnel at the terminal dock and/or at a nearby staging area during oil transfers.
- Conduct a study to identify an appropriate level of financial responsibility for the potential costs of response and cleanup of oil spills, natural resource damages, and costs to state and affected counties and cities for their response actions to reduce the risks and impacts from an oil spill. The study should be conducted prior to commencing operations and address the factors in RCW 88.40.025, Evidence of Financial Responsibility for Onshore or Offshore Facilities, including a reasonable worst-case spill volume, the cost of cleaning up the spilled oil, the frequency of operations at the Facility, prevention measures employed by the Facility that could reduce impact through spill containment, immediate discovery and shutoff times, and the damages that could result from the spill (including restoration). The study should identify any constraints related to the commercial availability and affordability of financial responsibility. Based on the study, EFSEC shall determine the appropriate level of financial responsibility and require the Applicant to demonstrate their financial responsibility to the satisfaction of EFSEC. Proof of financial responsibility would be included as documentation in the Applicant's contingency plan.

4.9.3 Mitigation Measures Involving EFSEC, the Applicant, and Other Agencies and/or Private Organizations

- Ecology should verify that the appropriate regulatory contingency spill planning volume used to develop appropriate spill containment at the proposed Facility is "the entire volume of the largest aboveground storage tank on the facility site complicated by adverse weather conditions…" (the largest aboveground storage tank capacity at the proposed Facility is 375,000 bbl) or if "…a larger or smaller volume is more appropriate given a particular facility's site characteristics and storage, production, and transfer capacity" (WAC 173-182).
- The Applicant should coordinate with EFSEC and the City of Vancouver to ensure that an independent technical review of the proposed Facility's fire protection systems is conducted at the 100 percent (final) design stage, consistent with the recommendations in Appendix B.

- The MFSA, with assistance from the Applicant, should update the existing MFSA VRP to:
  - Address a Handymax regulatory WCD volume of 319,925 bbl (Appendix J, Table 3)
  - Expand the plan's current focus on vessel shipments of refined petroleum products to include shipments of crude oil of various types on the Columbia River.
  - Mandate that all vessels loading at the proposed Facility adopt the MFSA VRP.
- The Applicant and EFSEC should coordinate with the USCG, Lower Columbia River Harbor Safety Committee, Ecology, ODEQ, Columbia River Bar Pilots, and Columbia River Pilots to ensure that existing safety procedures and vessel traffic management systems are adequate to accommodate 365 additional crude oil vessels per year, primarily of the Handymax vessel size. These procedures should address at minimum:
  - Safe speeds for laden tank vessels carrying crude oil and other vessels while in the traffic lane.
  - Appropriate capacities with regard for the Columbia River channel for laden tank vessels carrying crude oil.
  - Minimizing of vessel traffic and anchorage maneuvers during outbound transits.
- EFSEC should coordinate with Ecology, the Applicant, and vessel operators to revise Project-related vessel operation requirements based on the findings of Ecology's upcoming Columbia River vessel traffic risk assessment, required by ESHB 1449, as appropriate.
- EFSEC and the Applicant should communicate with LEPCs along the rail corridor and in the vicinity of the proposed Facility to determine or update the following information: LEPC contact information (phone, email, and website), county/cities included in the LEPC plans, date of last LEPC plan update, regularity of LEPC meetings, LEPC funding status, LEPC emergency response training status, and components of LEPC emergency plan including dangers and/or responses specifically affecting low-income or minority populations in the LEPC area.
- EFSEC and the Applicant should coordinate with the State Fire Defense Committee to update the Washington State Fire Services Resource Management Plan to ensure that the plan can facilitate the provision of adequate mobilization of personnel trained to address crude oil spill, fire, and/or explosion incidents anywhere along the rail and vessel corridors and at the proposed Facility, and to ensure that the plan can facilitate the provision of adequate mobilization of personal protective equipment and response equipment for these incidents.
- EFSEC, the Applicant, and the rail transporter of crude oil should coordinate with the State Fire Defense Committee, LEPCs, and local emergency responders along the rail corridor to ensure the development of specific evacuation plans for each residential community of greater than 50 residents within 0.25 mile of the rail route and within 1 mile of the proposed Project at the Port. This plan should include written instructions to all residents and emergency communication protocols for them to follow in the event of a crude oil spill, fire, or explosion event.

4.10 POTENTIAL SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

A large crude oil spill, fire, and/or explosion could result in significant adverse impacts, depending on the size, location, and extent of the incident. The range of potential impacts to the built and natural environment resulting from a crude oil spill, fire, and/or explosion are described in Section 4.7. Some of the mitigation measures listed previously are intended to reduce the likelihood of a spill (and spill-related fire or explosion), which is the best form of mitigation—avoidance. Some or all of the other mitigation measures listed previously, if implemented, are intended to reduce the extent (e.g., duration, intensity, geography) of significant adverse impacts in the event of a crude oil spill, fire, and/or explosion. However, an uncontained large to very large spill and/or associated fire and/or explosion, even with mitigation, could result in significant adverse impacts to one or more environmental resources.

The potential for major unanticipated events resulting from factors occurring alone or in combination as described in Section 4.1 cannot be totally eliminated. Although extremely unlikely, an unprecedented event could potentially cause one or more crude oil storage tanks and the secondary containment berm to be significantly damaged, which could result in a very large crude oil spill at the proposed Facility. Such a spill could spread inland to other Port facilities, nearby wetlands and neighborhoods and could reach the Columbia River. Impacts from such an event could result in significant adverse impacts to environmental resources and would require a major response effort.

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