Terminal 6 Environmental Overlay Zone Code Amendment and Environmental Overlay Zone Map Amendment

Part 1: Environmental Overlay Zone Code Amendment

Proposed Draft

December 12, 2014

Bureau of Planning and Sustainability
Innovation. Collaboration. Practical Solutions.
City of Portland, Oregon
Charlie Hales, Mayor • Susan Anderson, Director

The Portland Planning and Sustainability Commission will hold a public hearing on this proposal on:

Tuesday, January 13, 2015 at 12:30 pm*
1900 SW 4th Avenue, Second Floor, Room 2500A

*please call (503) 823-7700 one week before the hearing for schedule time of this agenda item

The Bureau of Planning and Sustainability is committed to providing equal access to information and hearings. If you need special accommodation, please call 503-823-7700, the City's TTY at 503-823-6868, or the Oregon Relay Service at 1-800-735-2900.

For more information contact:

Tom Armstrong. Supervising Planner
Portland Bureau of Planning and Sustainability
1900 SW 4th Avenue, Suite 7100
Portland, Oregon 97201
Phone: (503) 823-3527
Email: Tom.Armstrong@portlandoregon.gov

A digital copy of this report can be found at:
www.portlandoregon.gov/bps/Terminal6

Acknowledgements

Portland City Council
Charlie Hales, *Mayor*
Nick Fish, *Commissioner*
Amanda Fritz, *Commissioner*
Steve Novick, *Commissioner*
Dan Saltzman, *Commissioner*

Portland Planning and Sustainability Commission
André Baugh (Chair)
Katherine Schultz (Vice Chair)
Howard Shapiro (Vice Chair)
Karen Gray
Don Hanson
Mike Houck
Gary Oxman
Michelle Rudd
Chris Smith
Teresa St. Martin
Margaret Tallmadge

Bureau of Planning and Sustainability
Charlie Hales, *Mayor, Commissioner-in-charge*
Susan Anderson, *Director*

Project Staff
Tom Armstrong, *Supervising Planner*
Shannon Buono, *Senior Planner*

Other Contributors
Roberta Jortner, Planning and Sustainability
Mindy Brooks, Planning and Sustainability
Nancy Hendrickson, Bureau of Environmental Services

Table of Contents

I. Introduction

Pembina Marine Terminals Inc. is proposing to construct and operate the Pembina Portland Propane Terminal, a marine terminal to export propane at Port of Portland Terminal 6. Port of Portland Terminal 6 (Terminal 6) is located on the southern bank of the Oregon Slough and the Columbia River, near the confluence with the Willamette River. The current primary uses of Terminal 6 are two auto terminals and a container terminal. The proposed project site is zoned Heavy Industrial (IH), and is subject to three overlay zones:

- Aircraft Landing overlay zone (h)
- Portland International Airport Noise Impact overlay zone (x)
- Environmental Conservation overlay zone (c) in areas of the site abutting the Columbia River and the Oregon Slough

The Pembina project is allowed within the IH zone subject to the regulations of the base and overlay zone. The IH zone currently allows the storage of propane, the Environmental Conservation "c" overlay zone allows for the transportation of propane by rail or by designated truck route, and shipping propane is allowed on the Willamette and Columbia Rivers. However, the "c" overlay regulations do not authorize transportation of propane through this overlay zone by other modes of transportation like piping (33.430.090.A).

In order to accommodate this project, this legislative proposal includes two parts:

1. A zoning code amendment to allow for the transportation of propane through the environmental overlay zones in limited circumstances.
2. An environmental overlay zone map amendment to add protections to some of the currently unprotected natural resources on Terminal 6.

This report presents Part 1 of the legislative proposal.

Summary of Proposals

The purpose of the proposed zoning code amendment is to allow for the transportation of propane through the environmental overlay zones on an IH zoned site that has a primary river-dependent industrial use. The proposed zoning code amendment is narrowly crafted to supplement the existing list of allowed transportation modes, while not expanding the exception to allow for transportation of hazardous substances other than propane. The proposed code amendment will not exempt the transporting of propane from the regulations of the environmental overlay zone. The amendment proposes only to allow propane to be transported subject to environmental overlay zone regulations.

This proposal also includes an environmental zone map amendment to add protections to some of the currently unprotected natural resources on Terminal 6. The existing environmental conservation overlay zone boundary does not correspond to the location of the significant natural resources identified in the 2012 Natural Resources Inventory.

The environmental conservation overlay zone was applied to Terminal 6 in 1989 when the *Columbia Corridor Industrial/Environmental Mapping Project* (the Columbia Corridor plan) was adopted by City Council (ORD. 161895). The Columbia Corridor plan included a natural resources inventory, an economic, social, environmental and energy analysis, and zoning map amendments. The environmental conservation zone was applied to inventoried resources in the Columbia River and along the bankline to protect the following values:

Riparian strip for wildlife habitat, visual amenity, erosion control and drainageway functions, including fish habitat, drainage, flood storage, desynchronization, erosion control, sediment trapping, and pollution and nutrient retention and removal (pg. 162; *Inventory and Analysis of Wetlands, Water Bodies and Wildlife Habitat Areas for the Columbia Corridor Industrial/Environmental Mapping Project*; January 1989).

In June 2012 the Portland City Council adopted the *Natural Resource Inventory Update: Riparian Corridors and Wildlife Habitat,* which is an updated citywide natural resources inventory that replaces the 1989 inventory (ORD. 185657). The 2012 inventory includes new natural resource feature data and resource rankings, and was built on Metro's approach and methodology used to produce an inventory of regionally significant fish and wildlife habitat.

Propane

Propane is derived from natural gas. When natural gas is produced it typically contains a variety of associated hydrocarbons, water and other associated impurities. Natural gas processing plants separate all of the various hydrocarbons and fluids from the pure natural gas, to produce what is known as "pipeline quality" dry natural gas. Among the natural gas liquids that are separated in this process is propane. Propane can be separated from the natural gas liquids by raising the temperature and separating the lighter ends (i.e., propane) from the heavier components. It is similar to boiling water and collecting the rising steam. This separation process will be completed before shipping the propane to the proposed facility in Portland.

Propane is colorless, odorless and flammable, and is a gas at atmospheric pressure. It freezes at -306 F and boils (evaporates) at -44 F. Propane when mixed with air is flammable at concentrations of 2.1 to 9.5 percent. It will auto-ignite at a temperature of 842 F. The vapor has a density of 1.6 (heavier than air). High concentrations of propane can displace oxygen in the air and cause effects such as dizziness, confusion and suffocation (as a result of oxygen deficiency). Contact with liquid propane or contact with vessels with liquid propane can cause frostbite (Reference from Center for Disease Control - http://www.cdc.gov/niosh/docs/81-123/pdfs/0524.pdf). In the presence of excess oxygen, propane burns to form water and carbon dioxide. However, if not enough oxygen is present for complete combustion, incomplete combustion occurs, allowing carbon monoxide and/or soot (carbon) to form as well.

The propane at the proposed facility, which will be of a commercial grade, will not contain an odorant (which is used in consumer propane to detect leaks). Odorant is not customarily added to commercial propane. Because one of the likely end uses of commercial propane is as an ingredient for producing plastic, the odorant would negatively affect the production processes. The facility will have sensors to detect potential leaks of propane with appropriately designed emergency handling equipment in the event a leak does occur.

Terminal Facility

The propane terminal facility will include rail spurs, propane and water storage tanks, tanks and equipment for refrigeration, an office/storage building with a small paved parking area, paved and unpaved access roads, and above-ground pipes supported by structures to carry the propane from the storage tanks to ships. The expected capital investment is approximately $500 million.

Only liquid propane will be handled at the facility. All processing will take place prior to the liquid propane being loaded onto rail cars for transportation to the terminal.

When the propane is transported by train, it is pressurized (like propane in a barbecue tank). It is a liquid, at approximately 10 times atmospheric pressure and 60 to 80 degrees F. The proposed facility will have an average daily capacity to handle 1.6 million gallons of propane per day. Propane will be unloaded from rail

cars arriving approximately one unit train every two days (a unit train carries a single commodity, in this case propane, and is approximately 100 cars in length). When the propane reaches the facility, it will be offloaded from railcars into the offload storage tanks (which will also be pressurized to keep the propane in liquid form). There will be eight offload tanks, each with a storage capacity of 125,000 gallons.

From the offload storage tanks, the liquid propane is refrigerated to -44 F, at which point it is a few pounds above atmospheric pressure. At these conditions, propane would look similar to water in a cup. Once refrigerated, the liquid propane is moved through aboveground piping into two large aboveground refrigerated storage tanks that collectively store approximately 33.6 million gallons.

The liquid propane will be stored, on average, for 15 days before it is loaded onto ocean-going ships. It will be pumped from the large storage tanks through aboveground piping to the ship's cargo hold. The advantage of transporting refrigerated propane is that the propane is at a pressure similar to atmospheric pressure, and the ships do not need to be designed with the same amount of steel as if propane were pressurized.

Liquid propane at the terminal is only transported through aboveground piping. When preparing for and loading ships, the aboveground piping will be cooled to transport the propane from the large storage tanks. At other times, the aboveground piping will be allowed to warm up, causing any residual propane left in the piping from the ship loading operation to go to a gas form, return to the refrigerated storage tanks and be cooled to liquid form to -44F and retained in the large storage tanks. Except for approximately six days per month when ships are at berth, the aboveground pipes will contain only trace amounts of propane vapor. This aboveground piping, however, will also be in a closed position when no loading is taking place with the use of valves and therefore will never be open to atmospheric conditions.

II. Environmental Overlay Zone Code Amendment

Background

The Bureau of Planning and Sustainability proposes to amend Zoning Code subsection 33.430.090.A to allow propane to be transported through the environmental overlay zone on sites that are zoned Heavy Industrial that also have a primary river-dependent industrial use.

Terminal 6 is located on the southern bank of the Oregon Slough and Columbia River, near the confluence with the Willamette River. The current uses include two auto terminals and a container terminal. It is anticipated that these uses will be ongoing along with the following:

- Ongoing berth maintenance activities occur on an annual basis along all berths at Terminal 6. This includes, but is not limited to, berths, wharves, piers, fendering systems, mooring points and dolphins.
- Vegetation management activities occur along the shoreline and bank of all Port of Portland properties along the Oregon Slough.

As described above, the propane terminal includes storage tanks, tanks and above ground pipes to carry the propane from the storage tanks to ships. The environmental conservation overlay zone prohibits the transporting of hazardous substances through the zone unless by rail or on designated truck route, or if shipped on the Willamette or Columbia Rivers. Propane is a hazardous substance according to the Portland Zoning Code. Therefore, the transportation of propane via pipe is prohibited under the current code language.

Legislative History

The environmental conservation overlay zone was applied to Terminal 6 in 1989 with the adoption of the Columbia Corridor plan (ORD. #161895). The Columbia Corridor plan followed the Statewide Planning Goal 5 inventory and ESEE processes, and the ESEE recommended applying the environmental conservation overlay zone to the "Columbia River and bankline" to protect identified natural resources. The adopted 1989 ESEE decision did not identify the transportation of hazardous substances as a conflicting use, and did not recommend a prohibition on hazardous substances.

The code provision prohibiting hazardous substances in environmental overlay zones was added to the Environmental Overlay zones chapter of the Portland Zoning Code (33.430) in 1991 when the Zoning Code was rewritten (ORD. 163608). The project report does not describe the legislative intent for adding the prohibition to the chapter. The prohibition was amended in 1992 with adoption of the Southwest Hills Resource Protection Plan (ORD. 165002). In this case, the amendment allowed the transportation of package use quantities of hazardous substances through the environmental zones. The project report states that the change was intended to "permit transportation of limited quantities of hazardous substances through protected areas". The provision was amended again in 1994 with adoption of the *Fanno Creek and Tributaries Conservation Plan* (ORD. 167293). The 1994 amendment recast the provision to allow the transportation of any quantity of hazardous substance through the environmental zones by rail or on designated truck route. The project report does not describe the legislative intent of the amendment.

Proposed Amendment

To accommodate the proposed propane export facility, an amendment to the environmental overlay zone code is necessary to allow propane to be transported via a pipe. The proposed code amendment only facilitates transporting propane via a pipe because transporting by rail, truck and ship is already allowed by the Zoning Code (33.430.090.A and 33.10.030.C).).

Proposed Code Language (changes are underlined)

33.430.090 Prohibitions
The following items are prohibited in all environmental zones. Prohibitions apply to both transition areas and resource areas:

A. The use, packaging, transportation, or storage of hazardous substances, except as follows:

1. Transportation of hazardous substances through environmental zones by rail or on designated truck routes is allowed; ~~and~~

2. The transportation of propane through environmental zones is allowed on a site that is:

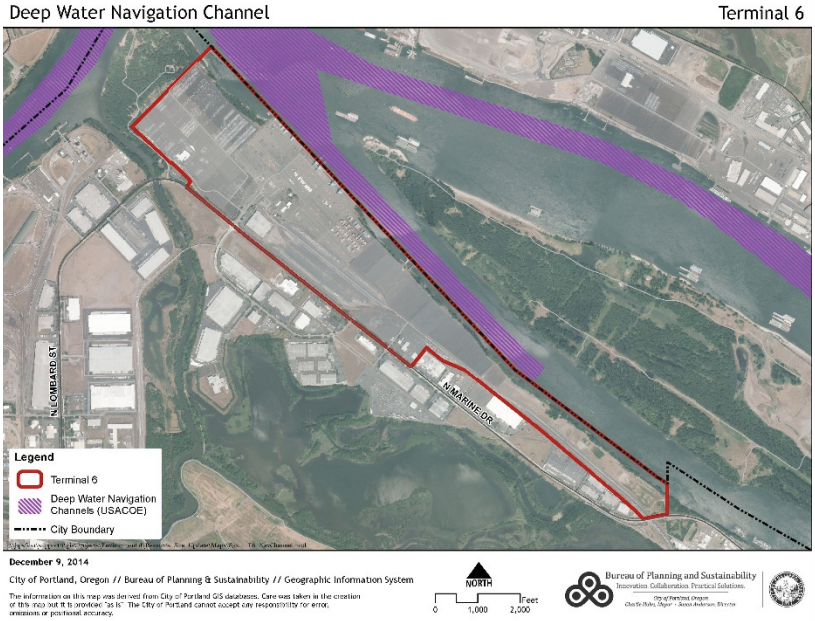
   a. Zoned Heavy Industrial; and

   b. Has a primary river-dependent industrial use; and

3. Use of consumer quantities of hazardous substances within environmental zones is allowed subject to the regulations of this Title. Consumer quantities of hazardous substances are packaged and distributed in a form intended or suitable for sale through retail sales outlets for consumption by individuals for purposes of personal care and household use.

The proposed amendment is narrowly construed to ensure that the amendment only applies to transporting propane, and only on Terminal 6.

There are approximately 22 lots zoned IH on the Columbia River that could have a river-dependent industrial use. However, only the lots owned by the Port of Portland (Terminal 6) have the capability of exporting propane because only the lots on Terminal 6 have access to a navigation channel that is deep enough to accommodate the ships that will be used to export the propane. The Port of Portland has the authority to maintain the channel adjacent to Terminal 6 to 43 feet deep, and does so up to and just past the dock at Berth 607. Therefore, Terminal 6 is the only area affected by this amendment.



Economic, Social, Environmental and Energy (ESEE) analysis

Under the Goal 5 administrative rules, an Economic, Social, Environmental and Energy (ESEE) analysis is needed to support the proposed code amendment (OAR 660-023-0250(1)). An ESEE analysis describes the economic, social, environmental, and energy consequences of allowing, limiting, or prohibiting a conflicting use. Within the context of Goal 5:

- Allow means that the conflicting use is allowed fully notwithstanding possible impacts on the resources;
- Limit means that the conflicting use is allowed in a limited way that protects the resources to a desired extent; and
- Prohibit means that the conflicting use is prohibited.

Goal 5 compliance involves the following steps:

- inventory natural resources;
- identify conflicting uses;
- define the impact area;
- analyze the ESEE consequences within the impact area that could result from (a) allowing the conflicting use fully, (b) limiting the conflicting use or (c) prohibiting it;
- based on this analysis, determine whether the conflicting use will be allowed, limited or prohibited;
- refine the e-zone regulatory program to implement an allow, limit or prohibit decision.

A. Inventory Natural Resources

The natural resources on Terminal 6 were first inventoried as part of the 1989 Columbia Corridor plan. In June 2012, the Portland City Council adopted the *Natural Resource Inventory Update: Riparian Corridors and Wildlife Habitat* (NRI). The 2012 NRI updates and replaces all of the natural resource inventory documents that were adopted over time to support application of the environmental overlay zones throughout the city. As such, the 2012 NRI updates and replaces the natural resource inventory for Terminal 6.

The proposed code amendment is written to limit its applicability to Terminal 6, therefore the resources site for this ESEE analysis is Terminal 6, including portions of the Columbia River and Oregon Slough within the city limits adjacent to Terminal 6. The significant natural resources identified within Terminal 6 are described in Appendix A.

B. Identifying Conflicting Uses

The conflicting use is "a land use, or other activity, reasonably and customarily subject to land use regulations, that could adversely affect a significant Goal 5resource." OAR 660-023-0010(1). The proposed zoning code amendment will allow propane to be transported through the environmental overlay zones via a pipe, subject to the base zone and overlay zone regulations. Therefore, the conflicting use in this case is the transporting of propane via pipe or pipeline. (Note: The proposed code amendment will not exempt the transporting of propane from the regulations of the environmental overlay zone. The amendment proposes only to limit the conflicting use by subjecting it to the existing environmental overlay zone regulations.)

The Goal 5 rule excludes water-dependent and water-related uses from being considered a conflicting use within riparian corridor resources (OAR 660-023-0090(7)(a)(A). The proposed code amendment requires that the transportation of propane be related to a river-dependent or river-related use, therefore, given the Goal 5 exclusion, this ESEE analysis does not consider potential impacts to the riparian corridor.

However, the Goal 5 rule does not exclude water-dependent and water-related uses from being considered a conflicting use within wildlife habitat resources. The 2012 NRI inventories both riparian corridor and

habitat resources at Terminal 6 and along the Columbia River and Oregon Slough, but in accordance with Goal 5 rules, this ESEE analysis only evaluates the consequences to wildlife resources of allowing, limiting or prohibiting the transportation of propane.

C. Impact Area

The impact area is the area in which the allowed use could adversely affect identified resources. The conflicting use (or the use that would be allowed) is the transportation of propane via piping. The identified resources are those resources inventoried within the Terminal 6 resource site shown in Appendix A. The piping is part of an operating propane export facility, and the piping will connect a propane storage tank, which is not allowed to be located in the environmental overlay zones, to a ship in the Columbia River. The proposed amendment will facilitate the development of a propane export facility on Terminal 6, therefore the impact area is Terminal 6.

D. Potential Adverse Impacts

Adverse impacts can be caused by:

- Impacts from development
- Impacts from operations and resulting air quality emissions
- Accidental release of propane (including fire and seismic risks)

Development Impacts

Development and disturbance activities associated with a conflicting use can cause the following adverse impacts to wildlife habitat resources:

- Clearing vegetation. Clearing vegetation removes food, cover, and nesting, perching and roosting opportunities. Clearing vegetation also causes fragmentation of habitats and can limit wildlife migration and access to water.
- Adding impervious surface and other structures. Adding impervious surface, fences and other manmade features (such as a linear pipeline structures) can cause fragmentation and create hazards or barriers to wildlife movement.
- Noise and light. Increasing the amount of outdoor noise and light can disrupt the competition, communication, reproduction and predation habits of wildlife.

The disturbance associated with development of a propane export terminal could involve any or all of these activities, however impacts associated with development are already allowed in the environmental conservation zone on Terminal 6, subject to the environmental overlay zone regulations. Significant detrimental impacts associated with development and disturbance are required to be minimized and mitigated. The proposed amendment will not introduce any new adverse impacts related to disturbance activities occurring within the wildlife habitat resource areas.

Operations

Adverse impacts can also be caused by the ongoing operations of the conflicting use. In this case, these operations involve transporting large quantities of propane at Terminal 6.

Basic properties of propane are key to assessing these potential adverse impacts:

- Propane is non-toxic and presents no threat to soil, surface water, or groundwater.
- Propane is listed as an approved clean fuel in the 1990 Clean Air Act
- Propane is not a criteria air pollutant, hazardous air pollutant, or greenhouse gas under the federal or state air quality programs.

- Propane is a gas at atmospheric pressure. When propane is compressed or refrigerated, it turns into a liquid. As propane vaporizes, it expands and draws heat from the surrounding area and remaining propane, making surfaces and remaining liquid propane very cold.
- Propane is highly flammable.
- Exposure to large of amounts of propane can decrease the amount of oxygen in the air causing dizziness, headache and passing out. (http://www.energy.gov/eere/energybasics/articles/propane-fuel-basics; http://www.oregon.gov/OMD/AGP/docs/safety/toolbox/dec2011-toolbox.pdf; http://nj.gov/health/eoh/rtkweb/documents/fs/1594.pdf;)

Air Quality Emissions

The terminal is designed as a closed loop system, meaning that under normal conditions all propane is retained within equipment, aboveground piping and on vessels; it is not vented to the atmosphere or burned at the site. The facility and process equipment (pumps, compressors, aerial coolers, etc) are powered by electricity which will be supplied most likely from Portland General Electric.

Under normal conditions, the types of releases of air emissions that may occur at a propane export facility are those typically associated with industrial uses:

- Small amounts of natural gas will be used to heat the office/ warehouse building and other purposes including hot water heating.
- Diesel-powered emergency backup equipment (see discussion below) will be tested monthly for 5 to 15 minutes.
- When at the berth, ships may plug-in to an onshore electrical source to power onboard ship power, lighting and refrigeration units. This "cold-ironing" or "ship hoteling" reduces emissions from ships that would otherwise need to burn bunker fuel (or other heavy fuel oil) when at port to power onboard systems. However, if onshore power is not incorporated into the design, the facility may release air emissions from berthed ships up to approximately six days per month.
- Minor emissions may occur from valves, flanges, etc. Sensors installed throughout the facility to detect leaks, as well as a program in place during operations to monitor and detect potential emissions. Typically, minor propane emissions would be quickly spotted (by 24/7 on-site operators) as icing on the equipment.
- In the event of a power outage, the diesel-powered emergency backup electrical generator system will activate.
- In the event of a fire, the facility fire water pumps will be diesel-powered.

Air emissions specific to the facility are associated with the flare stack, which is used to burn released propane in certain circumstances. The facility will have overpressure relief valves on equipment to route propane to the flare stack for any required safe, controlled combustion and release. For example, in in the event of a power failure, propane in the refrigerated storage tanks (either the large storage tanks or the offloading storage tanks) and refrigeration compression may warm up enough to increase the pressure in the tank. To relieve the pressure, propane is sent through aboveground piping to the flare to relieve the tank pressure. In addition, the flare will also be used during equipment maintenance; if equipment needs to be taken down for servicing, vapors within the equipment will be drawn down, and the remainder sent to flare prior to opening up the equipment.

Air quality impacts are not expected as a result of the infrequent flare stack operation. An Oregon Department of Environmental Quality Minor Source Air Quality Permit will be required because of the limited emissions from the facility.

Accidental Release

A propane release or explosion could cause the following adverse impacts:

- If propane is spilled onto the ground it will freeze organisms and vegetation potentially causing wildlife mortality and destruction of the vegetation that wildlife rely on for food, cover, nesting, and access to water and movement corridors.
- A propane explosion of a storage tank or pipe could similarly result in wildlife mortality and habitat destruction due to fire in the area directly adjacent to the facility.

Possible propane releases could occur from leaking valves or fittings, piping, valve or fitting failures, rail car derailment, during loading or unloading operations, or tank leaks. What happens in the case of a release depends on different factors including the volume of propane released, the temperature of the propane released, the outside temperature, and the presence of wind.

For small leaks, propane will evaporate and dissipate in the atmosphere due to wind and temperature effects. The propane is flammable only when within the narrow range of propane-air mix that contains 2.1 to 9.5 percent propane.

Propane vapor is heavier than air and can settle in low areas when there is little or no wind or warming of the earth. With time, pooled vapors will dissipate. The vapor will generally be non-flammable within the vapor cloud as there will not be adequate oxygen to ignite. However, at the edges of the propane vapor cloud, there will be areas where there is the appropriate ratio of oxygen and propane which could the lead to ignition.

In most instances, smaller propane leaks from pressured systems will quickly expand to a vapor, can mix more readily with air and not form a vapor cloud that would stay on the ground or take a long time to dissipate. Larger leaks could form a vapor cloud as could releases of refrigerated propane.

If propane is at a high enough concentration in the air it displaces the oxygen which can have health effects. Air with less than 19.5% oxygen is considered oxygen-deficient causing effects like dizziness, and less than 10% oxygen can result in loss of consciousness (http://www.airproducts.com/~/media/Files/PDF/company/safetygram-17.pdf). Propane, when initially released, is extremely cold and could freeze skin tissue upon direct contact in close proximity to the release point.

Measures to Limit Accidental Releases

1. Sensors: The facility will have sensors to detect changes in temperature, pressure, fire or propane release around the site and on equipment that will be monitored and to identify any potential releases. These sensors are a proven technology and various designs have been in use for decades; the sensors are regularly tested for correct operation.

   Pressure and temperature sensors will be placed at strategic points within the facility and equipment.

   Fire and gas sensors will be placed inside buildings where equipment handling propane will be located, in areas where there are many pipe connections, at the ship load berth and around the perimeters of the site.

2. Monitoring: The sensors are connected to computer monitoring systems to alarm and warn staff of smaller concentrations of propane, or in event of fire detection or larger amounts of propane to automatically shut down equipment and / or the facility and isolate it by use of emergency shutdown valves. Propane may be routed to flare for safe combustion. During vessel loading and rail unloading operations, personnel will also be present to manage and visually monitor the operations.

3. Shutdown valves: Various design features will be installed, such as emergency shutdown valves that would be activated automatically by sensors or manually by onsite personnel or by a control room operator in the event of a release to minimize the volume of propane that could be released.

   In the event of a release, installed fire and gas sensors will alarm and possibly shutdown equipment and activate emergency shutdown valves. Employees may also manually activate shutdowns of the facility or equipment as required.

4. Emergency Disconnects and Shut down valves: Various design features will be installed, such as emergency shutdown valves that would be activated automatically by sensors or manually by onsite personnel or by a control room operator in the event of a release to minimize the volume of propane that could be released. In the event of a release, installed fire and gas sensors will alarm and possibly shutdown equipment and activate emergency shutdown valves. Employees may also manually activate shutdowns of the facility or equipment as required.

   During loading, terminal employees will physically monitor propane loading operations both on the dock and in the control room, and will have the ability to initiate shut down of the propane loading operation by activating the onsite emergency shutdown valves and shutdown of all pumps sending propane to the ship. The ship's crew will also have the capability to shut down the propane loading should an incident occur on the ship; activating the onsite emergency shutdown valves and shutdown of all pumps sending propane to the ship.

   The load arms used to load propane on the ship are designed with quick close valves and emergency disconnects should the ship accidentally pull away from the dock. If there is an incident during propane loading of ship, the aboveground propane piping to the vessel will have emergency shutdown valves located on the berth, at the shoreline and at the storage tanks; these emergency shutdown valves will automatically activate in any perceived emergency situation when propane is being loaded to a vessel.

   Various aboveground pipe locations will have fire, gas and pressure detection equipment which will be tied into the monitoring and control system. The control system will automatically activate the emergency shutdown valves where required and shut down all pumps sending propane to the ship.

Emergency Response Plans

Emergency Response Plans (ERP) measures could include the following actions (taken from Pembina's corporate ERP):

- Assess the situation to determine the problem, extent and action required
- Evacuate all unnecessary personnel from the site, and eliminate any possible sources of ignition
- Initiate air monitoring for oxygen deficiency or explosive gas mixture
- Shut in the equipment that is the source of the leak when safe to do so.
- Initiate leak control procedures and shut down and/or de-pressurize facilities, as required.
- Allow liquids to evaporate and disperse

Depending on the size of the release and weather conditions, additional steps may include establishing roadblocks, notifying adjacent neighbors, or implementing shelter-in-place and/or evacuations of potentially affected areas. These additional requirements would only be required in the event of a significant release from the facility.

The vapor cloud or plume will move in the direction of the wind. Because of the mixing of air with the dispersing propane, propane concentration decreases continuously both with downwind distance as well as

in the crosswind direction. When the propane concentration in the air is between 2.1 and 9.5 percent by volume, this cloud or plume can be ignited at a distance downwind by an ignition source.

Ignition of a dispersing vapor cloud or plume may result in a flashback type of vapor fire. In extremely rare cases, and only when the physical conditions are conducive, with partial or full confinement of the propane-air mixture of proper concentration and its ignition, a vapor explosion can occur.

Because propane vapor at ambient pressure and temperature is heavier than air, it will tend to flow towards and accumulate in low-lying areas adjacent to the release location. If a building or other semi-confined area exists adjacent to the release location where the vapor can accumulate, a potential explosion hazard will result.

There can be high enough energy as a result of a failure for example in the piping that the propane will ignite from the failure. In the event of a fire, suppression of the fire by use of chemical suppressants or water is not effective. Instead, the key strategies are:

- to avoid or minimize propane release by isolating the affected equipment;
- limit the potential for other adjacent equipment to become affected by the fire through use of water (cool the adjacent equipment and exposures that contain propane that could also ignite with water); and
- manage the fire until the propane is consumed.

If propane ignites, response measures include (taken from Pembina's corporate emergency response plan):

- Ensure safety of response personnel and area residents / public
- Activate emergency shut-down valves and isolate affected area, if safe to do so
- Identify proximity to bullets and any flammable substances
- Discontinue any loading/unloading or processing work affected by, or impacted by, the emergency and initiate shut down procedures of plant operations
- Assess the emergency situation
- Following proper safety protocols, treat and evacuate any injured personnel
- Monitor the air for oxygen deficiency or explosive levels of gas mixture in affected and potentially affected areas of plume dispersion
- Isolate the area and restrict entry. Adjust and control perimeters as incident progresses.
- Evacuate non-essential personnel and residents from the potentially affected area
- Use water to cool equipment and adjacent exposures

Risk of a Large Explosion

Pembina is conducting modeling studies to assess the risk of different types of incidents associated with the facility and possible consequences. This modeling will then be used to inform detailed design of the facility, emergency response planning, and operating protocols and procedures for the facility and the vessels that will be reviewed as part of the development permit. The Portland Fire Bureau will require the applicant to pay the City to hire a third-party Oregon state certified professional fire protection engineer to evaluate the detailed modelling information.

The closest residential community is the houseboat community on the south side of the Oregon Slough located on the downstream side of the rail bridge. The closest houseboat residence is approximately 1.2 miles from the rail offload tanks, approximately 1.4 miles from the large refrigerated storage tanks, and approximately 1.8 miles from Berth 607.

Seismic Risks

An earthquake is one of the biggest risks to create a spill or explosion. Terminal 6 lies within the Willamette-Puget Sound lowland trough of the Cascadia convergent tectonic system (Blakely, et al. 2000). On a local scale, Terminal 6 lies within the Portland Basin. The site is located in relative close proximity to the inferred traces of the Portland Hills Fault and the East Bank Fault indicated on published geologic mapping (Personius, et al. 2003).

Earthquake loadings for upland building structures shall be based on the 2012 International Building Code ("IBC") and 2014 Oregon Structural Specialty Code, based on ground motions associated with the Maximum Considered Earthquake ("MCER"). The ground motion associated with the probabilistic MCER represents a targeted risk level of 1 percent in 50 years probability of collapse in the direction of maximum horizontal response with 5 percent damping, and is based on modifications to the USGS 2,475-year hazard level PSHA results. The design-level response spectrum is obtained by taking two-thirds of the MCER level ground motions.

With the design and mitigation requirements, the probabilistic hazard level for the facility considers earthquakes from the Magnitude 9 Cascadia Subduction Zone (which would originate near the Oregon coast) and the Magnitude 7 Portland Hills Fault Zone (which would originate less than 5 km away). At a minimum, the facility must be designed to withstand these levels of earthquakes. This means that post earthquake, the structures still support gravity load, damage that does occur doesn't prevent egress for occupants, and the tanks will retain containment capability.

As part of the development review and building permit process, an extensive geotechnical and seismic hazard investigation is required to provide recommendations to address the seismic hazards in the area and suitably support the proposed structures at the design-level earthquakes. This investigation includes over 40 explorations with some to over 150 feet in depth. The seismic hazards being evaluated as part of the study include ground shaking, soil liquefaction, lateral spreading and seiches. The geotechnical report will provide mitigation recommendations to address any seismic hazards at the site.

Consistent with many Port of Portland and waterfront sites in the area, mitigation for liquefaction-induced hazards is anticipated to limit the risks to structures associated with the vertical and lateral movements. Without mitigation, the risks to structures could include excessive or damaging vertical settlements or soil movements exerting very large lateral forces on structures.

For each of the structures, engineers will determine the acceptable horizontal and vertical settlements that will be required to meet safety performance for design level earthquake(s). The associated seismically induced settlement and horizontal movement is commonly mitigated in the area with ground improvement and/or deep foundations. For example, a combination of stone columns and jet grouting ground improvements was completed within the last five years for the marine facility just downstream. Deep foundations such as driven pipe piles are currently being considered as an alternative to support the tank.

E. Economic Analysis

The following economic impacts are considered:

- Employment and Income
- Tax Revenue
- Traded Sector Facilities
- Ecosystem Services

Employment and Personal Income

Not all economic development investments have the same impact on the regional economy. Some create more jobs and therefore pay more income tax, the majority of which then flows to the State. Others generate property taxes that flow to the City, county and school district. Projects that create more higher wage jobs can have a greater ripple effect through the regional economy. Creation of a new job with a high wage can lead to the creation of other secondary jobs, as some of those wages will be spent consuming other local products and services.

The employment and income impact of Portland Harbor: The Port of Portland is an important part of the state, regional and local economy. Periodically, the Port of Portland commissions Martin and Associates to produce a report called *The Local and Regional Economic Impacts of the Port of Portland*. The most recent report (March 2012) provides information for the 2011 calendar year. This report summarizes the economic impacts generated by maritime activity in the Portland Harbor, including public and private terminals, which comprise a significant percentage of the area of the Portland Harbor and Columbia Corridor.

The Martin study estimated that 18,081 jobs in Oregon and Washington were generated by cargo and vessel activity at the public and private marine terminals in the Portland Harbor, with a total personal income of over $1.4 billion. Of these, 7,275 were generated specifically by the movement of cargo over the docks (direct jobs); 6,878 jobs were created to serve the purchasing demand of those employed in direct jobs (induced jobs like restaurants, retail and professional service, etc.); and 3,928 jobs were created by the firms related to the shipping of cargo (indirect jobs like suppliers, trade-related financial and brokerage services, maintenance, etc.). These values amount to about 1 percent of total employment and personal income in the Portland-Vancouver metropolitan area.

These direct, induced and indirect jobs also generated $1.5 billion in annual business revenue, and $140 million in tax revenue to state and local governments in Oregon and Washington.

The Martin study also provided data on employment in the public terminals. Within the public terminals, they counted 3,549 direct jobs, 3,476 induced jobs and 2,074 indirect jobs in 2011. Based on the 885 acres that the public terminals occupied at the time, the following job densities are estimated:

Direct jobs:	4.01/acre
Induced jobs:	3.93 acre
Indirect jobs:	2.34/acre

The estimated employment and income impact of the project: For the proposed project, Martin and Associates used the same methodology and applied similar information based on current data to arrive at a broad estimate of the economic effects of the proposed project:

JOBS	
Direct	153
Indirect	128
Induced	145
TOTAL	426
PERSONAL INCOME	
Direct	$7,832,000
Indirect	$5,748,000
Induced/Respending	$19,175,000
TOTAL	$32,756,000

Martin and Associates, 2014

The Martin economic impact assessment shows 153 direct jobs associated with the proposed project. This includes an estimated 30-40 employees that will be specific to the site operations. These employees are required for operation and maintenance of the facility and they include facility operators, rail operators, instrument technicians, mechanics, millwrights, administration and a few supervisory positions. The estimated value of these direct jobs is $7.8 million annually. Annual base salaries will vary based on position and experience, but are estimated to average $70,000 to $120,000.

The additional direct jobs will be created by services directly connected to terminal operations. Most of these jobs are related to railroad operations. Other direct employment will be in security, tug assist, pilotage, chandelling/bunkering, longshore laborers and ship's agency jobs, amongst others. According to the ECONorthwest report, *the Port of Portland's Marine Operations: The Local Economic Benefits of Worldwide Trade*, these additional direct jobs are predicted to average $65,000 to $75,000 per job in annual wages.

The Martin assessment also estimates that the project could produce an additional 145 induced jobs, which are jobs that result from the local expenditure of the additional income produced by the new direct employment, and 128 indirect jobs, which are jobs that result from the additional export activity in the local economy such as suppliers, trade-related financial and brokerage services, maintenance, etc.

Tax Revenue.

In the summer of 2014, the Port of Portland undertook a property tax impact analysis of capital intensive terminal developments. One example considered as part of the analysis was a bulk handling terminal like the proposed project at Terminal 6. The analysis assumed an investment of $500 million for construction of a new facility over two years. No new property taxes would be generated in the first two years.

	10-year Expected Property Taxes Revenue
City of Portland – General Fund	$26,670,000
Portland Public School District – General Fund	$24,819,000
Multnomah County	$19,135,000
City of Portland – Urban Renewal	$10,028,000
Portland Public School District – Bond	$3,750,000
Multnomah County ESD	$1,573,000
Portland Community College – Bond	$1,552,000
Portland Community College – General Fund	$964,000
Metro – Bond	$952,000
City of Portland – Bond	$755,000
Metro – General Fund	$668,000
Multnomah County Bond	$406,000
East/West Soil/Water Conservation District	$354,000
Port of Portland	$243,000
Total	**$91,870,000**

Port of Portland, 2014

The property tax revenue impact of a capital intensive project such as this is considerable. Over a 10-year period, nearly $92 million in property taxes would be paid, with $37 million would go to the City of Portland, $28.5 million to Portland Public School District and $21 million to Multnomah County. In the same time period over $17 million in non-property tax revenue would be generated.

These numbers are intended to provide an order-of-magnitude estimate of the tax impacts and are not a forecast of future tax revenue. The actual tax contribution from any new facility located on the harbor will vary based on a number of factors including: (1) the assessed value of the buildings and equipment; (2) any property tax abatements offered by local governments (Pembina has not requested any tax abatement); and (3) whether the proponent opts for a different form of property taxation, such as fee in lieu of taxes.

Economic Impact of Transportation- and Freight-Related Industries

Traded sector businesses are companies that sell many of their products and services to people and businesses outside the Portland region, nationally and globally. Examples include most manufacturing and many professional and business service companies, as well as smaller craft businesses with local and global customers.

Portland has a strong traded sector job base, largely based on freight distribution. In 2008, the Portland region's traded sector businesses brought $22 billion of export income into the regional economy, which was 21 percent of total regional economic output. Portland ranked second among U.S. metropolitan areas in export growth over five years.

Portland's transportation- and freight-related industries are concentrated in the Columbia Harbor which includes Terminal 6, due to the area's marine , rail and highway infrastructure.

The continued competiveness of Portland as a port and freight center depends on maintaining and increasing shipping uses and volumes. Competition for federal harbor maintenance funds is stiff, with ports up and down the West Coast and across the country competing for dollars. The greater the tonnage that moves on the Columbia River through "transport by water" the more competitive the Columbia River is for federal maintenance funds. This also applies to Class 1 railroad system investments. As volume increases on either side of the Columbia River rail corridor, the railroad companies spend more of their maintenance and expansion budget in the area. This benefits both existing freight customers and passenger rail.

The Columbia River is also the main shipping channel for goods transported by water. The Columbia River shipping channel was recently deepened from 40 to 43 feet, with the project completed in 2010. Since that time over $3.6 billion has been spent on or committed to goods-movement projects in the Columbia River system, taking full advantage of the deepened channel. (Pacific Northwest Waterways Association (2013), http://www.pnwa.net/new/Articles/Columbia_River_Channel_Deepening.pdf, Port of Portland 2014). Portland marine terminal investments constitute 24 percent of that investment, including the proposed project at Terminal 6.

Economic value of Ecosystem Services

The natural resources also have economic value that must be considered in evaluating development impacts. The type of ecosystem goods and services that could be provided by natural resources located on Terminal 6 includes the following:

Ecosystem Services

- water conveyance and purification
- flood control
- air cooling and purification
- carbon sequestration
- soil fertilization and pollination

Ecosystem Goods

- food
- fuel
- fisheries
- timber and minerals
- recreation and tourism

Ecosystem services have not been evaluated specifically for Terminal 6, however, the following information sources provide information relevant to this analysis:

- ECONorthwest, Economic Arguments for Protecting the Natural Resources of the East Buttes Area in Southeast Portland, 2009.
- Bergstom, Loomis and Brown, Defining, Valuing and Providing Ecosystem Goods and Services, Natural Resources Journal, 2007.
- Banzhaf and Boyd, What Are Ecosystem Services? The Need for Standardized Environmental Accounting Units, 2006.
- Anielski and Wilson, Counting Canada's Natural Capital: Assessing the Real Value of Canada's Boreal Ecosystems, Pembina Institute, 2005.
- Olewiler, N., The Value of Natural Capital in Settled Areas of Canada, Published by Ducks Unlimited Canada and the Nature Conservancy of Canada, 2004.

Below is a general description of the ecosystem services provided by wildlife habitat resources identified on Terminal 6:

- Water bodies and associated riparian areas are critical for survival of aquatic and terrestrial wildlife species. Riparian vegetation shades and cools the water contributing towards maintenance of dissolved oxygen levels and as required to meet Clean Water Act rules for temperature loading.

Riparian area are used by wildlife for foraging, nesting, breeding/rearing young, migrate and dispersal. Maintaining and enhancing habitat will help prevent further decline and support recovery of federal or state listed fish and wildlife species at risk, and will help the City meet federal and state regulations. Maintaining large structure riparian vegetation can reduce costs associated with regulatory compliance and maintenance costs associated with bank slumping and erosion.

- Wildlife habitat, including upland grasslands identified on Terminal 6, are utilized by species at risk for foraging, migration, dispersal, nesting and breeding. Maintaining habitat reduces the risk of further species listings and associated costs. Maintaining one habitat area alone may not prevent a listing; however, considered cumulatively, each habitat area plays a role in preventing future listings, and in recovery of listed species.
- Wildlife habitat resources contribute to the quality of neighborhoods, to local and regional recreation and trail systems, and also to the quality of views. Screening and buffering residential from industrial and commercial land uses can be provided by established trees and vegetation, and can improve the economic value of both uses (e.g. noise reduction). Other indirect "quality of life" values associated with wildlife habitat resources include labor force retention, attraction of new employees and reputation. Portland is generally known nationally and internationally as a green city and a desirable place to live, visit, work and play, which has a positive impact on aspects of the local and regional economy.
- Wildlife habitat resources can help mitigate the urban heat island effects. This can reduce energy costs to cool buildings located adjacent to vegetated areas (ECONorthwest, 2009; Anielski and Wilson, 2005). Reducing heat island can also contribute to more healthful air quality conditions. Reducing local air and water temperatures, maintaining flood area, sequestering carbon and other greenhouse gases, and supporting wildlife and plant diversity all help manage the local effects of global climate change.

Some benefits from wildlife habitat and Special Habitat areas occur beyond the immediate resource area. For example, the capacity of a natural area to help mitigate urban heat island may benefit an entire watershed. When benefits occur off-site, the property cannot capture the value of these benefits directly. As a result, the market price for natural resources, whether a wetland or a stand of trees, does not fully reflect a true exchange value relative to other goods. In fact, most natural resources are not priced because they are not bought and sold like other products. This makes establishment of value difficult.

Some of the benefits of natural resources take many years to be realized. For example, the potential climate-related values of an immature stand of trees may not be realized for 25-50 years when the trees have grown and matured and are providing maximum shade, carbon sequestration, rainwater interception and evapotranspiration functions. Another complicating factor when determining the economic value of natural resources is that many natural resources have "irreversibility" properties. If the resource is eliminated there may be little or no chance of regeneration in any meaningful timeframe, if ever. Therefore the cost of losing natural resources also includes the opportunity costs, or the cost of future choices foregone.

Analysis:

A decision to either "allow" or "limit" the conflicting use would have positive economic consequences.

- An allow or limit decision would facilitate the development of a propane export facility on Terminal 6, bringing with it the economic benefits associated with the predicted job growth and increased tax revenue.

- Development of a propane export facility would also support the city's working harbor and traded sector economy.
- Allowing or limiting the conflicting use could have negative economic consequences in terms of ecosystem services due to the increased risk of damage from a propane spill that result from an accident or disaster. However, safety measures required by state and local construction regulations can minimize the risk of either occurrence. Also, risk from transport of propane or other hazardous substances is present today since they are allowed to be transported through the resource area via rail, designated truck route, and ship.

A decision to continue to "prohibit" the transporting of propane via pipe or pipeline could would have the following consequences:

- POSITIVE: The risk of loss of ecosystem services and goods that could result from a large quantity of propane affecting or destroying the wildlife resource area would be greater.
- NEGATIVE: The opportunity for the economic benefits related to a propane export facility on Terminal 6 would not be realized.

F. Social Analysis

The following social impacts are considered:

- Employment
- Access to recreation
- Screening and buffering
- Historic and cultural values

Employment

As described above in the Economic Analysis, additional development on Terminal 6 will provide employment opportunities and additional tax revenue. Jobs and additional tax revenue can positively affect human health and welfare.

Income can influence health by its direct effect on living standards (e.g., access to better quality food and housing, leisure-time activities, and health-care services). In the United States the risk for mortality, morbidity, unhealthy behaviors, reduced access to health care and poor quality of health care increases with decreasing socioeconomic circumstances (CDC, 2011).

Maintaining and growing "family-wage" jobs is an important factor for Portland's future economic prosperity and equity. The Portland Harbor and Columbia Corridor have historically provided self-sufficient wage level jobs for underrepresented communities. The proposed code amendment, and subsequent development of the propane export terminal, will improve access to jobs with self-sufficient wage levels and career ladders for low-income people, and well as expand opportunities for middle and high wage jobs that do not require a 4-year college degree.

The Martin economic impact assessment shows 153 direct jobs associated with the proposed project. This includes Pembina's estimate of 30-40 employees that will be specific to the site operations and those jobs created by services directly connected to terminal operations, such as rail and tug boat operators. The Martin assessment estimates an additional 145 induced and 128 indirect jobs will be fostered by the new terminal with a total of 426 jobs created.

Access to recreation.

The Columbia River and Oregon Slough provide opportunities for water-based recreation such as sailing, kayaking, canoeing and motor boating. Recreation has multiple health benefits. Exercise improves overall health which reduces public and private health care costs, improves quality of life and may help people live longer (Sachs and Segal, 1994). And the Centers for Disease Control strongly recommends improving access to places for physical activities.

The exporting of propane from Terminal 6 may impact boating opportunities in the Oregon Slough during the time the ships are at berth. The U.S. Coast Guard (USCG) will conduct a Waterway Suitability Assessment (WSA) for the project, which will include characterization of the Port, the proposed facility, and the ship route within United States waters; a risk assessment for maritime safety and security; identification of risk management strategies and resource needs for safety; and security, response and risk mitigation measures that may be employed. Based on the WSA, the USCG makes recommendations as to the suitability of the shipping route and facility for handling the ships. Also considered are the characteristics of existing ship traffic, manmade obstructions on the ship route, and the characteristics of the area near the facility including water depths, sea conditions, natural hazards, underwater pipelines (which do not exist for this project), and the relationship of the berthed ship to the navigation channel. The WSA process for this proposed facility is expected to be completed by the end of 2015 or early 2016.

The USCG also may establish a security zone around a vessel in transit and during loading at a facility. The USCG has the authority to require a security zone around vessels carrying hazardous cargo on the Columbia River (33 CFR 165.1335). Specifically, the USCG may impose a security zone of 500 yards in all directions from the vessel but this zone is applied at the discretion of the USCG (not automatically). Entry into a security zone is allowed only with permission and at the discretion of the USCG. In the event a security zone is established under these regulations, the USCG will issue a local broadcast notice to mariners.

The USCG has established specific regulations for other similar facilities in other waterways. Common requirements in these regulations include the provision of advance notice of upcoming safety zones by the USCG to the mariner community and most allow for access through the zone if permission is requested and granted by the relevant Captain of a port or designate. The location and size of the zones in these regulations reflect the unique issues at these facilities and waterways.

Some examples of security zones for vessels carrying similar types of cargos in other locations are:

- In the Port Houston-Galveston area, there are a variety of security zones established under the regulations primarily as locations. (33 CFR 165.814 Security Zones; Captain of the Port Houston-Galveston Zone).
- In the Portland, Maine area, a security zone for liquefied petroleum gas vessel transits is established as one mile ahead, one mile astern and 1000 yards on either side. In the Piscataqua River in New Hampshire, however the zone is established as a 500 yard radius while the vessel is moored (33 CFR 165.103 Safety and Security Zones; LPG Vessel Transits in Portland, Maine, Captain of the Port Zone, Portsmouth Harbor, Portsmouth, New Hampshire). Propane is a liquefied petroleum gas.
- In the Tampa Bay area, a floating safety zone is established 1000 yards fore and aft of a loaded liquefied petroleum gas vessel and the width of the channel in specific areas. Loaded liquefied propane gas vessels heading to the Receiving Facility in Rattlesnake have a 500 yard security zone in all directions. While the loaded vessel is maneuvering in the Rattlesnake slip and until it is safely moored at the facility, the floating safety zone extends 150 feet fore and aft of the loaded vessel and the width of the slip. Once it is safely moored there is no floating safety zone. (33 CFR 165.704 Safety Zone; Tampa Bay, Florida)

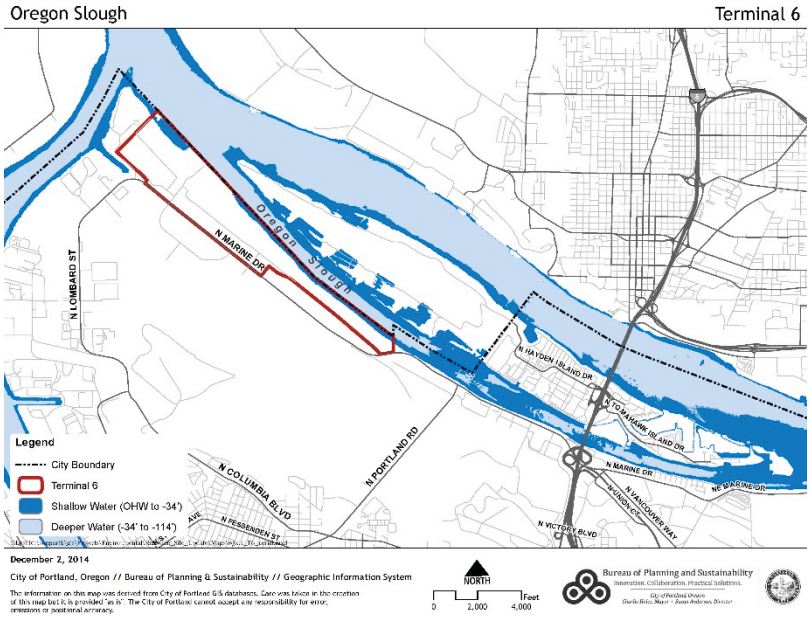
- In the Corpus Christi area, loaded incoming and outgoing liquefied propane gas vessels have a safety zone that is 500 yards in radius while transiting Corpus Christi Ship Channel, which is in effect until moored. (33 CFR 165.808 Corpus Christi Ship Channel, Corpus Christi, TX)

Security zones and other restrictions are common place on the Columbia and Willamette Rivers. Examples include restrictions around passenger vessels such as cruise ships, grain vessels and naval vessels and during specific activities such as the annual Rose Festival, firework shows and construction projects.

Depending on the outcome of the WSA and the USCG's recommendations for a security zone, recreational boaters and other boat traffic on the Oregon Slough may have limited access at certain times of the month while the ships are being loaded. Two to three ships per month are expected at the facility for up to two days each time, meaning in total, access may be limited in the Oregon Slough in proximity of Berth 607 up to six days per month.

Again, the USCG provides advance notice of any security zones to the marine community and most security zones allow for access through the zone if permission is requested. In addition, as shown on the map below, recreational boaters and other boat traffic may access Oregon Slough upstream of Berth 607 and have access to the Columbia River from the Oregon Slough via the upstream connection.

A 500 yard security zone for a vessel at Berth 607 would extend across the width of the Oregon Slough and into the forested area of West Hayden Island on the north side of the vessel. On the south side of the vessel, it would not extend as far as North Marine Drive and to the west, it would not extend as far as the container terminal.



Screening and buffering.

The wildlife habitat on Terminal 6 contains forested areas particularly upstream of Berth 607 that provide a visual buffer for recreational boater who use the Oregon Slough. The vegetation can also buffer noise and light.

Historic and cultural values.

The Columbia River and Columbia Corridor are important to the history, heritage and culture of the region. Portlanders place a high value on the environment and quality of life. The Oregon state symbols reflect this value. The Oregon state bird is the Western Meadowlark, which is currently a state-listed Species of Concern and uses habitat on Terminal 6. Portland's City Bird, the Great Blue Heron, is also found in the site. Fourteen runs of the state fish, the Chinook salmon, use the Columbia River and all fourteen are federally listed as Threatened or Endangered. The beaver is Oregon's state animal and still resides in many of Portland's waterways and is found in the site.

Analysis:

A decision to "allow" or "limit" the proposed use would have positive, negative and neutral consequences:

- POSITIVE: The proposed use would increase opportunities for family-wage jobs and tax revenue that will benefit local residents.
- NEGATIVE: The proposed use has safety risks related to a catastrophic failure that causes an explosion or fire at the propane terminal.
- NEGATIVE: The proposed use could limit boating access within portions of the Oregon Slough while propane is being loaded onto the ships.
- NEUTRAL: The proposed use has the same risk, under the current environmental conservation overlay zone, as other uses in terms of potential loss of trees and vegetation that provide screening and buffering, and the loss of natural areas that provide historic and cultural values.

A decision to continue to "prohibit" the transporting of propane via pipe or pipeline would have both positive and negative social consequences:

- POSITIVE: A prohibit decision would protect recreational boating access on the Oregon Slough.
- NEGATIVE : The social benefits associated with increased employment and tax revenue generated by a propane export facility would not be realized. However, it is possible that an alternative allowed use of the site could have similar benefits.

G. Environmental Analysis

Wildlife habitat and corridors provide important features and functions, and those features and functions provide environmental benefits. The 2012 *Citywide Natural Resources Inventory* details the environmental functions provided by wildlife habitat areas including the following:

- Vegetation, water bodies and associated landscape features (e.g. downed logs) provide wildlife habitat functions such as food, cover, breeding and nesting opportunities, and migration corridors.
- Native and non-native vegetation patches and corridors support local native wildlife and migratory species, some of which are listed by federal or state wildlife agencies.
- Vegetated corridors along waterways, between waterways and uplands, and between upland habitats allow wildlife to migrate and disperse among different habitat areas, and provide access to water.
- Vegetation creates a buffer between human activities and wildlife. Noise, light, pollution and domestic animals all impact wildlife and vegetation can reduce those impacts.

As stated in the economic section, wildlife habitat resources provide multiple services called ecosystem services. Below is a general description of the ecosystem services provided by wildlife habitat resources identified on Terminal 6:

- Water bodies and associated riparian areas are also critical for survival of aquatic and terrestrial wildlife species. Riparian vegetation shades and cools the water contributing towards maintenance of dissolved oxygen levels and as required to meet Clean Water Act rules for temperature loading. Riparian area are used by wildlife for foraging, nesting, breeding/rearing young, migrate and dispersal. Maintaining and enhancing habitat will help prevent further decline and support recovery of federal or state listed fish and wildlife species at risk, and will help the City meet federal and state regulations. Maintaining large structure riparian vegetation can reduce costs associated with regulatory compliance and maintenance costs associated with bank slumping and erosion.
- Wildlife habitat, including upland grasslands identified on Terminal 6, are utilized by species at risk for foraging, migration, dispersal, nesting and breeding. Maintaining habitat reduces the risk of further species listings and associated costs. Maintaining one habitat area alone may not prevent a listing; however, considered cumulatively, each habitat area plays a role in preventing future listings, and in recovery of listed species.
- The existence of trees, greenspaces and other natural resources have been positively correlated with residential property values in Portland (ECONorthwest, 2009). Natural resources contribute to the quality of neighborhoods, to local and regional recreation and trail systems, and also to the quality of views. Screening and buffering residential from industrial and commercial land uses can be provided by established trees and vegetation, and can improve the economic value of both uses (e.g. noise reduction). Other indirect "quality of life" values associated with natural resources include labor force retention, attraction of new employees and reputation. Portland is generally known nationally and internationally as a green city and a desirable place to live, visit, work and play, which has a positive impact on aspects of the local and regional economy.
- Wildlife habitat resources can help mitigate the urban heat island effects. This can reduce energy costs to cool buildings located adjacent to vegetated areas (ECONorthwest, 2009; Anielski and Wilson, 2005). Reducing heat island can also contribute to more healthful air quality conditions. Reducing local air and water temperatures, maintaining flood area, sequestering carbon and other greenhouse gases, and supporting wildlife and plant diversity all help manage the local effects of global climate change.

Non-developed areas that provide wildlife habitat resource functions can also play an important role in adapting to climate change in the region. Maintaining diverse habitats and habitat corridors will be critical for resident and migratory wildlife that may be required to adapt their behaviors and life cycles to changes in air and water temperature, weather patterns, habitat ranges, and food sources.

As described in the section on potential adverse impacts, a propane release or explosion could cause the following adverse impacts:

- If propane is spilled onto the ground it will freeze organisms and vegetation potentially causing wildlife mortality and destruction of the vegetation that wildlife rely on for food, cover, nesting, and access to water and movement corridors.
- A propane explosion of a storage tank or pipe could similarly result in wildlife mortality and habitat destruction due to fire in the area directly adjacent to the facility.
- If propane is at a high enough concentration in the air it displaces the oxygen which can have health effects. Air with less than 19.5% oxygen is considered oxygen-deficient causing effects like dizziness, and less than 10% oxygen can result in loss of consciousness

Analysis:

A decision to "allow" or "limit" the conflicting use would have neutral or negative environmental consequences.

- NEGATIVE: Operation of a propane terminal would increase the risk that valuable wildlife habitat resources and functions are lost in the event of an accident or disaster.
- NEUTRAL: The risk of propane or other hazardous substances adversely affecting the wildlife habitat resource area on Terminal 6 is present today to some degree, because hazardous substances are allowed to be transported through the resource area via rail, designated truck route, and ship.
- NEUTRAL: Safety measures required by state and local regulations minimize the risk to human health and the environment.

Continuing to "prohibit" the conflicting use would have positive environmental consequences.

- POSITIVE: The risk that valuable wildlife habitat resources and functions are lost in the event of an accident or disaster would be limited to the level of risk that is present today.

H. Energy Analysis

A propane export terminal can have both local and global impacts on energy use and carbon emissions.

Locally, a propane terminal can be an energy intensive operation. The refrigeration and compression necessary to liquefy the propane for transportation requires large amounts of electricity. Exporting approximately 46-69 million gallons of propane per month will require an estimated 8,000 MWh of electricity per month, which would put the facility among the largest electricity users in Portland, though not atypical for a major industrial facility. This electricity consumption would result in about 20,000 metric tons of carbon dioxide (CO2) emissions per year – about 0.7% of Portland's annual emissions.

Globally, a propane terminal can have both positive and negative consequences on greenhouse gas emissions. Propane typically has lower lifecycle carbon emissions than coal or oil, though when burned it releases 20% more carbon per unit of energy than natural gas. Propane is usually produced as a byproduct of other fossil fuel extraction efforts, and when it is captured it is either flared or transported and sold as fuel. Depending on the end use and the fuel type that it is replacing, it could result in a net increase or decrease in carbon emissions.

In terms of negative consequences, exporting large quantities of fossil fuels will result in CO2 released into the atmosphere when those fuels are burned, contributing to climate change. Exporting approximately 46-69 million gallons of propane per month represent 3 to 5 million metric tons of CO2 released into the atmosphere annually, which is about 0.01% of global CO2 emissions. Adding a large propane terminal will put slight downward pressure on the price of propane and its co-products (oil and/or natural gas). Lower prices tend to lead to higher consumption of these fossil fuels, but, as noted above, the net environmental impact of additional propane depends on what fuel it substitutes for.

Analysis:

A decision to "allow" or "limit" the proposed use would have positive or negative energy consequences.

- NEGATIVE: The energy consumption and carbon emissions will increase as result from the emissions related to the significant amount of electricity consumed by the operation.
- NEGATIVE: If the propane substitutes for natural gas or renewable energy resources, carbon emissions will increase as a result from the use of the propane overseas.

- POSITIVE: If the propane is a substitute for a more carbon intensive fuel such as coal or oil, carbon emissions will be reduced as a result from the use of the propane overseas.

A decision to "prohibit" the proposed use could have positive, neutral or negative energy consequences.

- NEUTRAL: Locally, the prohibition could result in less, the same or more energy consumption depending on the eventual industrial user of the site.
- POSITIVE: Globally, the prohibition could have positive consequences if it limits the amount of fossil fuel exports and encourages the development of low-carbon energy resources such as biogas, solar or wind.
- NEGATIVE: If the global energy demand is replaced by a dirtier, more carbon-intensive fuel, there will be higher carbon emissions.

I. Final ESEE Recommendation

On balance, the recommendation is to limit the conflicting use, which will allow for the transport of propane in a pipe, subject to the environmental conservation overlay zone. This recommendation to limit the conflicting use is based on the following reasons:

- Significant economic benefits in terms of employment, tax revenue and traded sector facilities.
- Positive social impacts related to jobs and personal income.
- The negative social consequences can be managed or mitigated to acceptable levels:
    - Boating access impacts due to a security zone around a ship can be mitigated through alternative routes or by requesting permission to pass through the security zone.
    - Safety risks can be managed through building code regulations, fire marshal inspections, and other regulatory oversight.
- The negative environmental consequences can be managed or mitigated to acceptable levels:
    - Direct disturbance or loss of habitat due to construction will be mitigated by the development standards in the environmental conservation zone.
    - Safety risks can be managed through building code regulations, fire marshal inspections, and other regulatory oversight.
- The local energy consequences are neutral because the facility operations are similar to other energy-intensive industrial uses.
- The global energy consequences are difficult to determine. The terminal facility will export a significant amount of fossil fuel that will ultimately release greenhouse gases into the atmosphere. These emissions could be significantly more when compared to renewable sources of energy like biogas, wind or solar. Net emissions would be lower, however, if the propane displaces more carbon intensive fuels or feedstocks like oil and coal.

Proposed Zoning Code Amendment

Commentary

Pembina Marine Terminals Inc. and its affiliates are proposing to construct and operate the Pembina Portland Propane Terminal, a marine terminal for the export of propane at Port of Portland Terminal 6 on the southern bank of the Columbia River near the confluence of the Columbia and Willamette rivers. The propane will be transferred from storage tanks located outside the environmental conservation overlay zone on Terminal 6, and transferred via pipe to ships docked at Berth 607. The Columbia River and shoreline adjacent to Berth 607 are within the environmental conservation overlay zone, and transporting propane via a mode other than rail or designated truck route is currently prohibited in the environmental overlay zones.

The code provision prohibiting hazardous substances in environmental overlay zones was added to Chapter 33.430 of the Portland Zoning Code in 1991 with the adoption and implementation of the Zoning Code Rewrite project (ORD. 163608). The project report does not describe the legislative intent for adding the prohibition to the environmental zones chapter of the zoning code (33.430). The prohibition was amended in 1992 with adoption of the *Southwest Hills Resource Protection Plan* (ORD. 165002). The amendment allowed the transportation of package use quantities of hazardous substances through the environmental zones. The project report states that the change was intended to permit limited quantities of hazardous substances to be transported through environmental zones. The provision was amended again in 1994 with the adoption of the *Fanno Creek and Tributaries Conservation Plan* (ORD. 167293). The amendment recast the provision to allow the transportation of any quantity of hazardous substance through the environmental zones by rail or on designated truck route. The project report does not describe the legislative intent of the amendment.

Because 33.430.090.A currently prohibits transporting hazardous substances through the environmental overlay zone by modes other than rail or designated truck route, an ESEE analysis was conducted to evaluate the consequences of allowing, limiting or prohibiting the transportation of propane through the environmental overlay zone via piping (the conflicting use). The ESEE recommendation supports a decision to limit the conflicting use. The proposed zoning code amendment implements the ESEE recommendation by removing the prohibition on transporting propane via mode other than rail or designated truck route. The proposed amendment is narrowly construed to limit its applicability to Port of Portland Terminal 6 by only allow the transporting or propane through environmental overlay zones on sites that are zoned Heavy Industrial (IH) that also have a primary river-dependent industrial use.

In addition to being consistent with the ESEE decision, the code amendment is also consistent with Comprehensive Plan policies that support:

- a strong working river (2.7),
- maximizing intermodal transportation linkages in Industrial sanctuary zones (5.1c),
- ensuring access to intermodal terminals and related distribution facilities to facilitate the local, national and international distribution of goods and services (5.4a), and
- a well-integrated freight system that includes truck, rail, marine, air and pipeline modes as vital to a healthy economy (6.29a).

33.430.090 Prohibitions

The following items are prohibited in all environmental zones. Prohibitions apply to both transition areas and resource areas:

A. The use, packaging, transportation, or storage of hazardous substances, except as follows:

1. Transportation of hazardous substances through environmental zones by rail or on designated truck routes is allowed; ~~and~~

2. The transportation of propane through environmental zones is allowed on a site that is:

   a. Zoned Heavy Industrial; and

   b. Has a primary river-dependent industrial use; and

3. Use of consumer quantities of hazardous substances within environmental zones is allowed subject to the regulations of this Title. Consumer quantities of hazardous substances are packaged and distributed in a form intended or suitable for sale through retail sales outlets for consumption by individuals for purposes of personal care and household use.

B. The planting or propagation of any plant listed on the Nuisance Plants List;

C. Exterior work activities, unless in conjunction with a river-related or river-dependent use. See Chapter 33.910, Definitions; and

D. Dumping of yard debris or trash.

Terminal 6 Environmental Overlay Zone Code Amendment and Environmental Overlay Zone Map Amendment

Part 2: Environmental Overlay Zone Map Amendment

Proposed Draft

December 19, 2014

Bureau of Planning and Sustainability
Innovation. Collaboration. Practical Solutions.
City of Portland, Oregon
Charlie Hales, Mayor • Susan Anderson, Director

The Portland Planning and Sustainability Commission will hold a public hearing on this proposal on:

Tuesday, January 13, 2015 at 12:30 pm*
1900 SW 4th Avenue, Second Floor, Room 2500A

*please call (503) 823-7700 one week before the hearing for schedule time of this agenda item

The Bureau of Planning and Sustainability is committed to providing equal access to information and hearings. If you need special accommodation, please call 503-823-7700, the City's TTY at 503-823-6868, or the Oregon Relay Service at 1-800-735-2900.

For more information contact:

Tom Armstrong. Supervising Planner
Portland Bureau of Planning and Sustainability
1900 SW 4th Avenue, Suite 7100
Portland, Oregon 97201
Phone: (503) 823-3527
Email: Tom.Armstrong@portlandoregon.gov

A digital copy of this report can be found at:
www.portlandoregon.gov/bps/Terminal6

Acknowledgements

Portland City Council
Charlie Hales, *Mayor*
Nick Fish, *Commissioner*
Amanda Fritz, *Commissioner*
Steve Novick, *Commissioner*
Dan Saltzman, *Commissioner*

Portland Planning and Sustainability Commission
André Baugh (Chair)
Katherine Schultz (Vice Chair)
Howard Shapiro (Vice Chair)
Karen Gray
Don Hanson
Mike Houck
Gary Oxman
Michelle Rudd
Chris Smith
Teresa St. Martin
Margaret Tallmadge

Bureau of Planning and Sustainability
Charlie Hales, *Mayor, Commissioner-in-charge*
Susan Anderson, *Director*

Project Staff
Tom Armstrong, *Supervising Planner*
Shannon Buono, *Senior Planner*

Other Contributors
Roberta Jortner, Planning and Sustainability
Mindy Brooks, Planning and Sustainability
Nancy Hendrickson, Bureau of Environmental Services

Table of Contents

I. Introduction

Pembina Marine Terminals Inc. is proposing to construct and operate the Pembina Portland Propane Terminal, a marine terminal for the export of propane at Port of Portland Terminal 6. Port of Portland Terminal 6 (Terminal 6) is located on the southern bank of the Oregon Slough and the Columbia River, near the confluence with the Willamette River. The current primary uses of Terminal 6 are two auto terminals and a container terminal. The proposed project site is zoned Heavy Industrial (IH), and is subject to three overlay zones:

- Aircraft Landing overlay zone (h)
- Portland International Airport Noise Impact overlay zone (x)
- Environmental Conservation overlay zone (c) in areas of the site abutting the Columbia River and the Oregon Slough

The Pembina project is allowed within the IH zone subject to the regulations of the base and overlay zones. The IH zone currently allows the storage of propane, the Environmental Conservation "c" overlay zone allows for the transportation of propane by rail or by designated truck route, and shipping propane is allowed on the Willamette and Columbia Rivers. However, the "c" overlay regulations do not authorize transportation of propane through this overlay zone by other modes of transportation like piping (33.430.090.A).

In order to accommodate the project, this legislative proposal includes two parts:

1. A zoning code amendment to allow for the transportation of propane through the environmental overlay zones in limited circumstances.
2. An environmental overlay zone map amendment to add protections to some of the currently unprotected natural resources on Terminal 6.

This report present Part 2 of the legislative proposal.

Summary of Proposals

The purpose of the proposed zoning code amendment is to allow for the transportation of propane through the environmental overlay zones on an IH zoned site that has a primary river-dependent industrial use. The proposed zoning code amendment is narrowly crafted to supplement the existing list of allowed transportation modes, while not expanding the exception to allow for transportation of hazardous substances other than propane. The proposed code amendment will not exempt the transporting of propane from the regulations of the environmental overlay zones. The amendment proposes only to allow propane to be transported subject to environmental overlay zone regulations.

This proposal also includes an environmental zone map amendment to add protections to some of the currently unprotected natural resources on Terminal 6. The existing environmental conservation overlay zone boundary does not correspond to the location of the significant natural resources identified in the adopted 2012 *Citywide Natural Resources Inventory*.

The environmental conservation overlay zone was applied to Terminal 6 in 1989 when the *Columbia Corridor Industrial/Environmental Mapping Project* (the Columbia Corridor plan) was adopted by City Council (ORD. 161895). The Columbia Corridor plan included a natural resources inventory, an economic, social, environmental and energy analysis, and zoning map amendments. The environmental conservation zone was applied to inventoried resources in the Columbia River and along the bankline to protect the following values:

Riparian strip for wildlife habitat, visual amenity, erosion control and drainageway functions, including fish habitat, drainage, flood storage, desynchronization, erosion control, sediment trapping, and pollution and nutrient retention and removal (pg. 162; *Inventory and Analysis of Wetlands, Water Bodies and Wildlife Habitat Areas for the Columbia Corridor Industrial/Environmental Mapping Project*; January 1989).

In June 2012 the Portland City Council adopted an updated citywide natural resources inventory for riparian corridors and wildlife habitat (ORD. 185657). The 2012 inventory replaces the 1989 inventory. The updated inventory includes new natural resource feature data and resource rankings, and was built on Metro's Title 13 approach and methodology used to produce an inventory of regionally significant fish and wildlife habitat.

Propane

Propane is derived from natural gas. When natural gas is produced it typically contains a variety of associated hydrocarbons, water and other associated impurities. Natural gas processing plants separate all of the various hydrocarbons and fluids from the pure natural gas, to produce what is known as "pipeline quality" dry natural gas. Among the natural gas liquids that are separated in this process is propane. Propane can be separated from the natural gas liquids by raising the temperature and separating the lighter ends (i.e., propane) from the heavier components. It is similar to boiling water and collecting the rising steam. This separation process will be completed before shipping the propane to the proposed facility in Portland.

Propane is colorless, odorless and flammable, and is a gas at atmospheric pressure. It freezes at -306 F and boils (evaporates) at -44 F. Propane when mixed with air is flammable at concentrations of 2.1 to 9.5 percent. It will auto-ignite at a temperature of 842 F. The vapor has a density of 1.6 (heavier than air). High concentrations of propane can displace oxygen in the air and cause effects such as dizziness, confusion and suffocation (as a result of oxygen deficiency). Contact with liquid propane or contact with vessels with liquid propane can cause frostbite (Reference from Center for Disease Control - http://www.cdc.gov/niosh/docs/81-123/pdfs/0524.pdf). In the presence of excess oxygen, propane burns to form water and carbon dioxide. However, if not enough oxygen is present for complete combustion, incomplete combustion occurs, allowing carbon monoxide and/or soot (carbon) to form as well.

The propane at the proposed facility, which will be of a commercial grade, will not contain an odorant (which is used in consumer propane to detect leaks). Odorant is not customarily added to commercial propane. Because one of the likely end uses of commercial propane is as an ingredient for producing plastic, the odorant would negatively affect the production processes. The facility will have sensors to detect potential leaks of propane with appropriately designed emergency handling equipment in the event a leak does occur.

Terminal Facility

The propane terminal facility will include rail spurs, propane and water storage tanks, tanks and equipment for refrigeration, an office/storage building with small paved parking area, paved and unpaved access roads, and above ground pipes supported by structures to carry the propane from the storage tanks to ships. The expected capital investment is approximately $500 million.

Only liquid propane will be handled at the facility. All processing will take place prior to the liquid propane being loaded onto rail cars for transportation to the terminal.

When the propane is transported by train, it is pressurized (like propane in a barbecue tank). It is a liquid, at approximately 10 times atmospheric pressure and 60 to 80 degrees F. The proposed facility will have an average daily capacity to handle 1.6 million gallons of propane per day. Propane will be unloaded from rail

cars arriving approximately one unit train every two days (a unit train carries a single commodity, in this case propane, and is approximately 100 cars in length). When the propane reaches the facility, it will be offloaded from railcars into the offload storage tanks (which will also be pressurized to keep the propane in liquid form). There will be eight offload tanks, each with a storage capacity of 125,000 gallons.

From the offload storage tanks, the liquid propane is refrigerated to -44 F, at which point it weighs a few pounds above atmospheric pressure. At these conditions, propane would look similar to water in a cup. Once refrigerated, the liquid propane is moved through aboveground piping into two large aboveground refrigerated storage tanks that collectively store approximately 33.6 million gallons.

The liquid propane will be stored, on average, for 15 days before it is loaded onto ocean-going ships. It will be pumped from the large storage tanks through aboveground piping to the ship's cargo hold. The advantage of transporting refrigerated propane is that the propane is at a pressure similar to atmospheric pressure, and the ships do not need to be designed with the same amount of steel as if propane were pressurized.

Liquid propane at the terminal is only transported through aboveground piping. When preparing for and loading ships, the aboveground piping will be cooled to transport the propane from the large storage tanks. At other times, the aboveground piping will be allowed to warm up, causing any residual propane left in the piping from the ship loading operation to go to a gas form, return to the refrigerated storage tanks and be cooled to liquid form to -44F and retained in the large storage tanks. Except for approximately six days per month when ships are at berth, the aboveground pipes will only contain trace amounts of propane vapor. This aboveground piping, however, will also be in a closed position when no loading is taking place with the use of values and therefore will never be open to atmospheric conditions.

II. Environmental Overlay Zone Map Amendment

Background

The Bureau of Planning and Sustainability proposed to amend the boundaries of the environmental overlay zoning on the Terminal 6 site. The proposed map amendment is based on the updated natural resources inventory (NRI) and updated economic, social, environmental, and energy analysis (ESEE) included with this proposal.

Legislative History

The environmental conservation overlay zone was applied to Terminal 6 in 1989 with the adoption of the Columbia Corridor plan (ORD. #161895). The Columbia Corridor plan followed the Statewide Planning Goal 5 inventory and ESEE processes, and the ESEE recommended applying the environmental conservation overlay zone to the "Columbia River and bankline" to protect identified natural resources. Application of the environmental conservation overlay zone is typically the action the City uses to carry out a decision to limit conflicting uses within a resource site. The adopted 1989 ESEE decision did not identify the transportation of hazardous substances as a conflicting use, and did not recommend a prohibition on hazardous substances.

In June 2012, the Portland City Council adopted the *Natural Resource Inventory Update: Riparian Corridors and Wildlife Habitat* (ORD. 185657). The 2012 inventory includes new natural resource feature data, analysis of functions and resource rankings, and was built on Metro's approach and methodology used to produce an inventory of regionally significant fish and wildlife habitat. The 2012 NRI followed the Statewide Planning Goal 5 inventory process and was acknowledged by LCDC in June 2014.

The 2012 NRI updates and replaces all of the natural resource inventory documents that were adopted over time to support application of the environmental overlay zones throughout the city. As such, the 2012 NRI updates and replaces the natural resource inventory for Terminal 6.

Proposed Map Amendment

Goal 5 Context

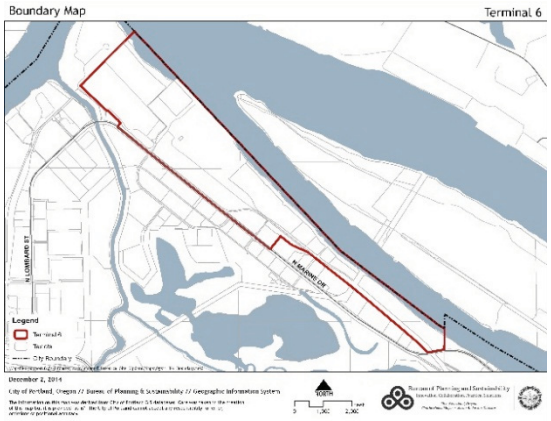
This proposal follows the Goal 5 process. Goal 5 establishes a requirement for local natural resource protection programs, and a process to achieve compliance. Goal 5 compliance involves the following elements:

- An inventory of significant natural resources;
- An analyze the economic, social, environmental, and energy (ESEE) consequences that could result from a decision to allow, limit or prohibit a conflicting use;
- A determination of whether to allow, limit or prohibit a conflicting use; and
- A program to implement the ESEE decision.

Terminal 6 Natural Resources Inventory

A summary and map of the combined relative ranks of significant natural resources identified within the Terminal 6 resource site is provided below. The full natural resource inventory for the Terminal 6 site is included in Appendix A. The Terminal 6 site includes Port of Portland Marine Terminal 6 and the portions of the Columbia River and Oregon Slough within the city limits adjacent to Terminal 6.

Summary Information



Watershed: Columbia River

Neighborhood: St Johns

USGS quadrangle and quarter section maps: 2N1W23, 2N1W24, 2N1W25, 2N1E19, 2N1E29, 2N1E30, 2N1E32

Site Size: 586 acres (including water)

Previous Inventories: *Inventory and Analysis of Wetlands, Water Bodies and Wildlife Habitat Areas for the Columbia Corridor: Industrial/Environmental Mapping Project* (City of Portland January 1989)

Zoning:

Industrial (IH)
Aircraft Landing zone (h)
Airport Noise Impact zone (x)
Environmental Conservation zone (c)

Existing Land Use: industrial; river-dependent industrial/marine terminal, railroad

General Description: This site includes the Columbia riverbank adjacent to Terminal 6 and a portion of the Lower Columbia River and Oregon Slough.

Resource Features: open water, shallow water; beaches; vegetated and non-vegetated river bank; vegetated flood area; wetlands; bottomland hardwood forest; woodland, shrubland and grasslands/ sparsely vegetated areas

Functional Values: microclimate and shade; stream flow moderation and water storage; bank function, and sediment, pollution and nutrient control; large wood and channel dynamics; organic inputs, food web and nutrient cycling; wildlife habitat; habitat connectivity/movement corridor

Special Habitat Areas:

- Columbia River, Oregon Slough and Shallow Water Habitat are designated SHA because they meet the following criteria:
  (C) – Wildlife connectivity corridor
  (M) – Migratory stopover habitat
  (S) – An *at-risk* species uses the habitat area or feature on more than incidental basis to complete one or more life history phases
- All wetlands are designated SHA because they meet the following criteria:
  (W) – Wetlands
- Forest and woodland vegetation is designated SHA because it meets the following criteria:
  (B) – Bottomland hardwood forests
  (M) – Migratory stopover habitat
  (S) – An *at-risk* species uses the habitat area or feature on more than incidental basis to complete one or more life history phases

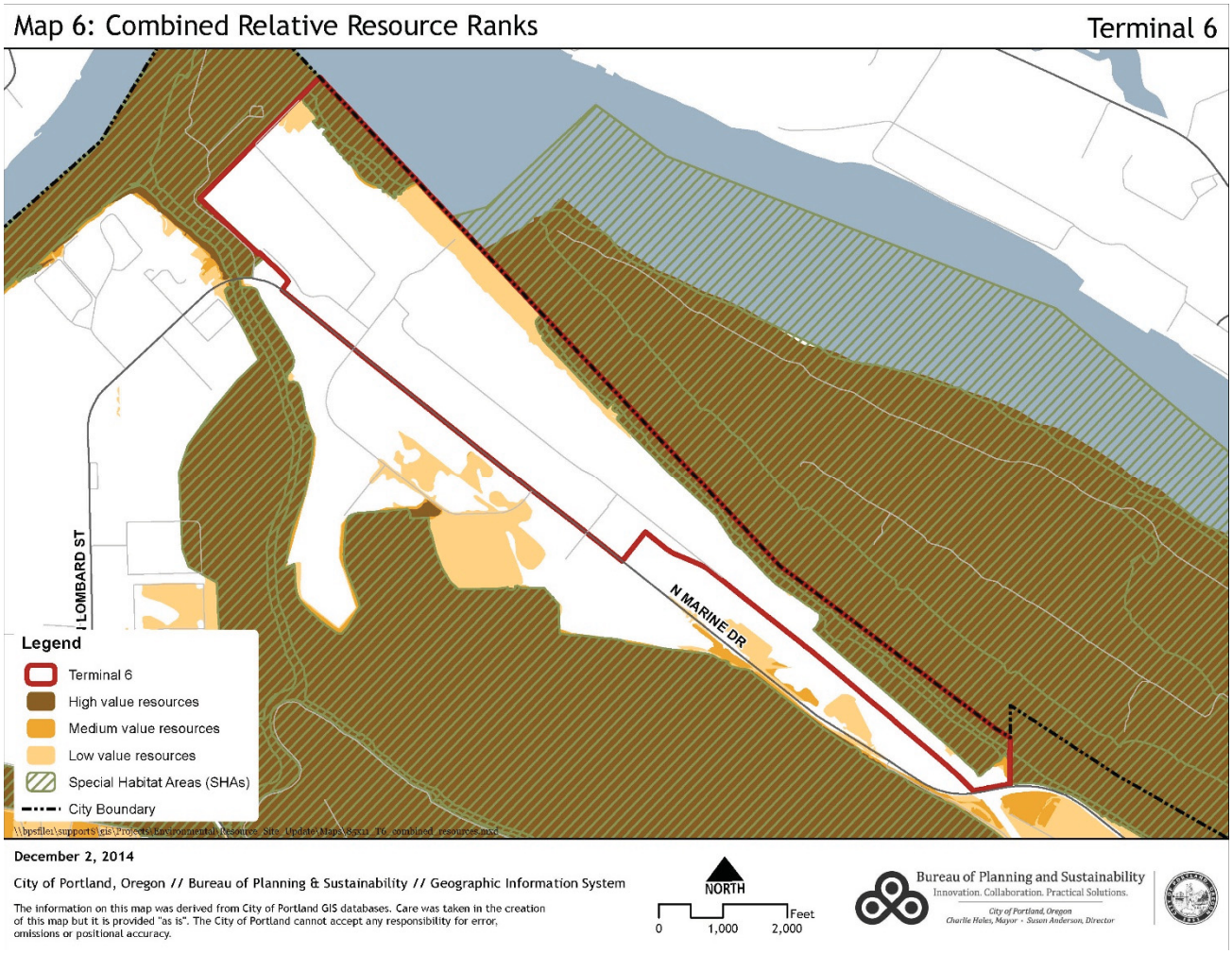
- The T6 Dredge Material Handling area is designated SHA because it meets the following criteria:
  (C) – Wildlife connectivity corridor habitat
  (G) – Feature important to individual grassland-associated species or assemblages of grassland-associated species on more than an incidental basis
  (S) – An *at-risk* species uses the habitat area or feature on more than incidental basis to complete one or more life history phases

Special Status Species:

- *Fish*: Chinook salmon, chum salmon, coho salmon, sockeye salmon, steelhead trout, bull trout, eulachon, Pacific lamprey, white sturgeon, coastal cutthroat trout, Oregon chub
- *Birds*: American kestrel, downy woodpecker, great blue heron, varied thrush, western meadowlark.
- *Mammals*: American beaver

Natural Hazards: flood area

Contamination: Yes



Economic, Social, Environmental and Energy (ESEE) analysis

Goal 5 compliance involves the following ESEE elements:

- identify conflicting uses;
- define the impact area;
- analyze the ESEE consequences within the impact area of allowing the conflicting use fully, limiting the conflicting use or prohibiting the conflicting use; and
- develop a program to achieve Goal 5.

Within the context of Goal 5:

- Allow means that the conflicting use is allowed fully notwithstanding possible impacts on the resources;
- Limit means that the conflicting use is allowed in a limited way that protects the resources to a desired extent; and
- Prohibit means that the conflicting use is prohibited.

Identifying Conflicting Uses

A conflicting use is "a land use, or other activity, reasonably and customarily subject to land use regulations, that could adversely affect a significant Goal 5 resource." OAR 660-023-0010(1). The Goal 5 rule directs local governments to "examine uses allowed outright or conditionally with the zones applied to the resource site and its impact area". OAR 660-023-0040(2)

Terminal 6 is zoned Heavy Industrial (IH). The IH zone is one of the three zones that implement the Industrial Sanctuary map designation of the Comprehensive Plan. The zone provides areas where industries may locate including those not desirable in other zones due to their objectionable impacts or appearance. The development standards associated with the IH zone are the minimum necessary to assure safe, functional, efficient, and environmentally sound development. Sites in the IH zone generally have large lots with high building and site improvement coverage. All industrial use categories are permitted by right, except for waste-related uses, which are either conditional or allowed with limitations. Other uses permitted by right are quick vehicle servicing, vehicle repair, self-service storage, parks and open areas, agriculture and rail lines and utility corridors. Household living is a conditional use, while group living is prohibited. Other limited or conditional uses are retail sales and service, office uses, commercial parking, commercial outdoor recreation, major event entertainment, basic utilities, community services, daycare, aviation and surface passenger terminals, detention facilities, mining and radio frequency transmission facilities. Temporary uses allowed are: parking lot sales; seasonal outdoor sales; fairs and carnivals; warehouse sales; temporary actions to respond to natural disasters and emergencies; and staging areas for public utility installation.

The current primary uses within the Terminal 6 site are two water-dependent auto terminals and a water-dependent container terminal. It is anticipated that these uses will be ongoing along with the following:

- Ongoing berth maintenance activities occur on an annual basis along all berths at Terminal 6. This includes, but is not limited to, berths, wharves, piers, fendering systems, mooring points and dolphins.
- Ongoing upland maintenance activities of terminal related equipment and infrastructure including container cranes; yard equipment; pavement; rail tracks and rail related equipment; driveways and roads; buildings, high mast lighting and utilities.
- Placement and management of dredge materials.
- Vegetation management activities occur along the shoreline and bank of all Port of Portland properties along the Oregon Slough.

- Exterior storage and processing of automobiles for import or export.
- Storage and movement of shipping containers.
- Storage and movement of bulk commodities such as steel slab.
- Regional electrical transmission (BPA)
- Transloading automobile, shipping containers and bulk commodities involving barge, rail and/or trucks.

The Goal 5 rule states that water-dependent and water-related uses are excluded from being considered a conflicting use within riparian corridor resources. (OAR 660-023-0090(7)(a)(A) The Goal 5 rule does not exclude water-dependent and water-related uses from being considered a conflicting use within wildlife habitat resources. The Terminal 6 site contains both significant riparian corridor resources and wildlife habitat resources. Given the Goal 5 exclusion, this ESEE analysis evaluates the consequences to wildlife habitatresources of allowing, limiting or prohibiting the conflicting uses.

Impact Area.

An impact area is the area surrounding natural resources that may impact the quality, quantity, functional or extent of those resources. Per the Goal 5 rule:

> Local governments shall determine an impact area for each significant resource site. The impact area shall be drawn to include only the area in which allowed uses could adversely affect the identified resource. The impact area defines the geographic limits within which to conduct an ESEE analysis for the identified significant resource [OAR 660-23-040 (3)].

Determining the impact area is complicated in an urban area. As documented in Metro's Title 13 natural resource inventory and the City's 2012 natural resources inventory reports, the effects of urbanization on the functions and values of fish and wildlife habitat are pervasive. Metro notes in their ESEE analysis adopted as part of Title 13 Nature in Neighborhoods:

> …a compelling case can be made for identifying the entire watershed as an impact area based on the cumulative impacts of urbanization, such as road density, impervious surfaces and altered hydrology, vegetation loss and alteration, and species depletion. However, doing so may necessitate an ESEE analysis for the entire watershed, which significantly encumbers the Goal 5 process.

Metro identified the impact area as the land extending 150 feet from a water body, and the land extending 25 feet from edge of inventoried wildlife habitat (includes Habitats of Concern). Metro's intent was to:

- Provide all fish and wildlife habitat with an impact area and provide the most sensitive habitat with wider impact areas (note: developed floodplains do not have an impact area)
- Provide an impact area to address tree root zones
- Address areas that are already degraded, but where development or disturbance could influence onsite and downstream water quality and key wildlife habitat (such as wetlands)
- Meet the requirements of the Goal 5 rule

For purposes of this ESEE Analysis, the City elects to use the same general methodology to define the impact area, specifically to include land within 25 feet of all ranked resources, including Special Habitat Areas, and land within 150 feet from rivers, streams, drainageways and wetlands. The intention is to provide an impact area around all existing natural resources that receive a rank as providing wildlife habitat and to provide a minimum impact area for water bodies, which are designated Special Habitat Areas.

The Goal 5 rule requires that these areas be considered along with the inventoried natural resource areas in conducting the ESEE analysis. These areas are considered as extensions of the resource areas and are therefore not addressed separately in the analysis of potential consequences.

Potential Adverse Impacts.

This section describes the common impacts associated with conflicting uses generally and within natural areas described in the Terminal 6 Natural Resources Inventory (Appendix A). The analysis begins with impacts that are common to the conflicting uses allowed by the IH zone. Following the discussion of common impacts is a description of impacts associated with uses allowed in the IH zone.

Common impacts of conflicting uses

Development and disturbance activities that can adversely affect natural resources occur within all of the City's base zones; however, the degree or intensity of the impacts may vary depending on the intensity of the land use, the form, layout or design of the development, construction protocols or ongoing operation and maintenance activities. Below is a description of activities associated with the conflicting uses generally, and related impacts on natural resources.

The following impacts are generally site specific and cumulative with respect to other impacts and conditions in the watershed.

Clearing vegetation

Rainwater is intercepted and taken up by vegetation. This function is impaired when vegetation is cleared, resulting in increased overland runoff. In turn this increases runoff volume and flows into receiving water bodies following storm events. Increased streamflow volume and rate can cause bank erosion, undercutting, and slumping, and flooding. Vegetation also filters surface stormwater flows removing pollutants and sediment.

Tree canopy and associated understory vegetation create shade and local microclimate effects that cool the air and water, and maintain humidity and soil moisture. Trees and vegetation also help capture carbon dioxide; carbon dioxide is a contributing factor to global warming. All of these functions are affected when the vegetation is removed.

Clearing vegetation also removes important structural features of the forest such as large trees and multiple canopy layers, snags and downed logs, large trees, and root systems that holds soils in place. This can result in soil erosion and impaired habitat for native wildlife. Vegetation removal reduces food, nesting opportunities, cover, and perching and roosting opportunities for wildlife. Removing shoreline vegetation also eliminates sources of leaf litter which provides food and nutrients for aquatic organisms, and woody debris that provides river habitat structure and food resources for fish. Wildlife affected by vegetation removal includes mammals, birds, reptiles, amphibians, fish and insects. Removal of vegetation can fragment riparian and upland wildlife movement corridors, isolate remaining vegetation patches, and limit wildlife access to water. These impacts impede wildlife migration and can limit recruitment from other areas, making wildlife populations more vulnerable to disease, predation and extirpation.

Some vegetation types have been declining in the Portland area due to clearing and grading for development and the use of ornamental vegetation in landscaping (not replacing cleared vegetation with like native species). Certain assemblages, such as native bottomland hardwood forests require specific soil, water and sun exposure to survive and are slow growing, taking many years to become established. These vegetation assemblages still exist including bottomland forest along the Columbia River and Oregon Slough. Removal not only reduces habitat functions as discussed previously, but also would contributes to the decline in these unique vegetation types and potentially extirpation within the city.

Grading, excavation, filling and soil compaction:

Grading activities and soil compaction can reduce the capacity of soil to support vegetation by disturbing the soil structure, accelerating erosion, and decreasing soil fertility, microorganisms, seeds and rootstocks. Soil porosity and stormwater infiltration can be reduced by grading, excavating, filling and soil compaction. This in turn can reduce groundwater recharge and in-stream summer and fall low flows, which adversely affects aquatic species. Grading, excavation, filling and compaction also affect wildlife habitat for some species.

It should be noted that historic floodplain resources benefit from periodic disturbance. Within the 100-year floodplain of the Columbia River, historic semi-regular flood events maintained areas of low structure, sparse vegetation and open areas of sand that supported many grassland-associated wildlife species. The Columbia River dams, dikes and fill within the floodplain have reduced flood events and the extent of flooding. In some instances, human activities can mimic historic natural disturbances caused by flooding.

Adding impervious surface (e.g. buildings, parking areas, roads):

Impervious surfaces alter the hydrologic cycle by preventing stormwater infiltration and concentrating overland flow. This results in increased stormwater runoff and decreased groundwater recharge. Increased stormwater runoff can result in increased volume and flows into receiving water bodies (see vegetation clearing). Decreased groundwater recharge can reduce in-stream summer low flows (see grading, excavation, filling and soil compaction). Impervious surfaces also contribute to urban heat island effect, which affects local air quality. Increased impervious surfaces can also cause wildlife habitat fragmentation and create hazards or barriers to wildlife movement (see vegetation clearing).

Modifying rivers and floodplains (e.g. filling, bank armoring):

Altering the natural configuration, geomorphology, and structure of river banks and the floodplain results in:

- increased in-stream flow velocity, which can cause bank erosion, undercutting and slumping on-site or at upstream or downstream locations
- a decrease in aquatic habitat area and simplified remaining habitat when side channels, wetlands and oxbows are disconnected from the main river channel
- a decrease in areas of wood deposit where side channels and wetlands are filled in
- reduced flood storage capacity and other benefits associated with active flood areas (e.g., nutrient transport, off-channel habitat)
- reduction in vegetation that attenuates flows and provides important fish habitat during flood events

Generating pollution:

Oil, gas, tar, antifreeze, dissolved metals, pesticides, herbicides, fertilizers and other contaminants degrade habitat and water quality. These pollutants are transported to water bodies in stormwater via runoff from streets, driveways, parking lots, farms, parks, golf courses and buildings. Dirt and sediments from eroded areas or deposited from vehicles can also be transported via stormwater to water bodies and degrade aquatic habitat. Pesticides, herbicides and fertilizers used in landscaping can pollute ground and surface waters and degrade habitat and harm fish and wildlife.

Landscaping with non-native and/or invasive vegetation:

The removal of native vegetation and establishment of cultivated landscapes can change or reduce food, cover and nesting opportunities for native wildlife. Manicured landscaped areas generally lack complex

vertical structure – little if any multi-layered canopy, large trees, snags, thick understory vegetation, and downed logs are retained in landscaped areas. The reduction in vertical structure impairs wildlife habitat and alters microclimate effects and hydrology. Some non-native plants used in landscaping are invasive (e.g. ivy, morning glory, holly and laurel) and can out-compete native plants reducing biodiversity. Non-native landscapes may also require irrigation and may be treated with chemical fertilizers and pesticides, which can run-off into local waterways and wetlands, or may be ingested by wildlife.

Building fences and other wildlife barriers:

Barriers to wildlife movement can include buildings, roads, rail lines, aboveground pipes, fences and other manmade features. These barriers fragment connectivity between wildlife habitats and reduce the ability of native wildlife species to thrive (see clearing vegetation). Some such barriers, such as roads and rail lines, may create hazards that increase the risk of wildlife mortality.

Other impacts:, light, noise, litter, etc.:

Human activities that create outdoor noise and light can disrupt the competition, communication, reproduction, and predation habits of wildlife (Brown, 1987). For example, night-time lighting can interrupt the navigation of migrating birds and bats.

Impacts specific to industrial uses

Industrial:

Industrial uses are allowed by right in the IH zone.

The entire impact area is zoned IH. The current primary uses within the Terminal 6 site are two water-dependent auto terminals and a water-dependent container terminal. It is anticipated that these uses will be ongoing along with the following:

- Ongoing berth maintenance activities occur on an annual basis along all berths at Terminal 6. This includes, but is not limited to, berths, wharves, piers, fendering systems, mooring points and dolphins.
- Ongoing upland maintenance activities of terminal related equipment and infrastructure including container cranes; yard equipment; pavement; rail tracks and rail related equipment; driveways and roads; buildings, high mast lighting and utilities.
- Placement and management of dredge materials.
- Vegetation management activities occur along the shoreline and bank of all Port of Portland properties along the Oregon Slough.
- Exterior storage and processing of automobiles for import or export.
- Storage and movement of shipping containers.
- Storage and movement of bulk commodities such as steel slab.
- Regional electrical transmission (BPA)
- Transloading automobile, shipping containers and bulk commodities involving barge, rail and/or trucks.

Development and disturbance activities in industrial areas generally includes clearing all vegetation and completely grading the site. Industrial development, including a marine terminal, is usually land intensive and requires a large percentage of the total area to accommodate facilities, resulting in large areas of impervious surfaces, compacted soils and ongoing impacts. Development geometry is often driven by the maneuvering requirements of rail lines, freight vehicles and loading equipment. Because

the unit of development is often relatively large, and in the case of a marine terminal, dependent on access to the river, there are relatively fewer opportunities to cluster development away from the resource areas. Development practices also generally retain few, if any, natural resources on-site. Industrial uses can diminish or eliminate open space, scenic and recreational values.

Some industrial uses require the use of water in manufacturing processes (e.g. cooling equipment) and draw substantial amounts of water from wells and public water sources. The resulting effluent, which is typically warm, may be discharge to receiving waters, such as a stream, and influence in-water temperature. Cool water temperature is a basic requirement for many aquatic species. Industries that discharge warm-water effluent are required to obtain a discharge permit through the Oregon Department of Environmental Quality.

Industrial areas can contribute high quantities of heavy metals and other toxic material to the soil, water and air. In addition, the use, storage and transport of hazardous materials, waste storage and recycling and similar activities requiring special permitting often occurs in industrial sites

Basic Utilities:

Basic utilities are infrastructure services such as water and sewer pump stations, electrical substations, and power line corridors that need to be located in or near areas where the utility service is provided. Basic utilities are allowed by right, with limitations or as conditional uses in all zones.

Construction and maintenance of utilities can have negative impacts on natural resources. Corridors cleared of vegetation can increase wind and light penetration into adjacent habitat areas and can provide opportunities for intrusion of invasive, non-native plant species. Construction of basic utility facilities often fragments wildlife habitat. Operation of existing facilities has few adverse impacts on natural resources, except in the case of overhead electrical lines which must be cleared of high structure vegetation and can entangle birds.

Radio and Television Broadcast Facilities:

Larger radio, television and cell phone broadcast facilities are allowed in all zones subject to limitations or as conditional uses. The impacts of these facilities are minimal as compared to other uses. Certain of these facilities can pose hazards to migratory birds. During bad weather birds fly lower and may be disoriented by the lights of the towers and may run into towers or guy wires. There may be a greater visual impact from these broadcast facilities.

Rail Lines and Utility Corridors:

Rail lines and utility corridors are allowed by right in industrial zones. Construction of rail lines can require substantial quantities of excavation and fills to meet a 0-3 percent slope standards. Generally, additional grading results in natural resource disturbance and degradation of soil, vegetation and wildlife habitat. Most rail corridors are maintained by extensive chemical vegetation treatment with a potential for ground and surface water impacts. Rail corridors can also create wildlife hazards or barriers to wildlife movement.

Rail and utility corridors can, pose additional risk of wildfire. Rail lines can cause sparks that can ignite dry vegetation. Utility corridors typically must be kept clear of tall vegetation that could harm overhead facilities. Topping or removal of trees is a common practice in utility corridors. Topped trees are more susceptible to disease and are less inhabitable by wildlife.

ESEE Analysis

This section presents the general ESEE analysis for the Terminal 6 site. This portion of the ESEE analysis is intended to outline the potential consequences of allowing, limiting, or prohibiting conflicting uses in areas containing significant natural resources—in this case, areas containing significant wildlife habitat resources including Special Habitat Areas (SHA). The significant wildlife habitat and SHA resources are identified and mapped in the inventory contained in Appendix A. The inventory assigns these resources scores and ranks to reflect the relative ecologic functions and values they provide.

The ESEE analysis includes a section for each of the four factors evaluated: economic, social, environmental and energy. Each section includes a narrative that describes the issues and conflicting use impacts being assessed for each factor based on the primary use scenario. Following the narrative are two tables that summarize the consequences of allowing, limiting or prohibiting conflicting uses. The first table addresses consequences from the perspective of the conflicting uses and the second table addresses consequences from the perspective of the natural resources in the study area. For example, prohibiting conflicting uses (e.g. industrial development) within wildlife habitat resource area may have negative economic consequences as relates to the conflicting uses (e.g., no additional employment), as described in the first table. The same decision might have positive economic consequences relating to the natural resources (e.g., preserve ecosystem services), as described in the second table.

The consequences are presented using qualitative descriptions and simple ratings to show whether the net potential impacts are expected to be generally and relatively positive, negative, or neutral/negligible. In some instances a consequence may be assigned a positive and negative rating, reflecting that the policy choices may have a mix of advantages and disadvantages.

A. Economic Analysis.

This section examines the economic consequences of allowing, limiting or prohibiting conflicting uses for the Terminal 6 study area. The economic consequences are expressed as the qualitative and relative costs, benefits, and impacts of the three program choices – allow, limit or prohibit the conflicting use. This portion of the ESEE analysis relies on current information and specified assumptions relating to:

1) The economic goods and services provided by the conflicting uses (i.e. development and use-related activities); and

2) The ecosystem services provided by existing significant natural resources in the Terminal 6 study area.

The Port of Portland Terminal 6 is located on the southern bank of the Oregon Slough and Columbia River, at the confluence with the Willamette River. The current primary uses within the Terminal 6 site are two water-dependent auto terminals and a water-dependent container terminal, along with dredge material handling. It is anticipated that these uses will be ongoing along with the following:

- Ongoing berth maintenance activities occur on an annual basis along all berths at Terminal 6. This includes, but is not limited to, berths, wharves, piers, fendering systems, mooring points and dolphins.
- Ongoing upland maintenance activities of terminal related equipment and infrastructure including container cranes; yard equipment; pavement; rail tracks and rail related equipment; driveways and roads; buildings, high mast lighting and utilities.
- Placement and management of dredge materials.
- Vegetation management activities occur along the shoreline and bank of all Port of Portland properties along the Oregon Slough.

- Exterior storage and processing of automobiles for import or export.
- Storage and movement of shipping containers.
- Storage and movement of bulk commodities such as steel slab.
- Regional electrical transmission (BPA)
- Transloading automobile, shipping containers and bulk commodities involving barge, rail and/or trucks.

Goods and Services provided by conflicting uses within the Terminal 6 site

Generally, the conflicting uses provide local and regional economic benefits associated with industrial development, commerce, employment, and transportation infrastructure. Below is a summary of the economic goods and services that are be provided by marine terminal and industrial development in site.

Traded sector:

Traded sector businesses are companies that sell many of their products and services to people and businesses outside the Portland region, nationally and globally. Examples include most manufacturing and many professional and business service companies, as well as smaller craft businesses with local and global customers. Traded sector businesses may be locally owned and can be small, medium or large in size. Portland is considered a small- to medium-sized hub in the national and international business and trade community.

Traded sector businesses are important to the local economy. By selling to people and businesses outside Portland, locally based traded sector businesses bring new money into the local economy. The additional income brought in from exporting goods is further circulated within the local economy as these local firms purchase additional services. Traded sector productivity and market size tend to lead these businesses to offer higher wage levels. Jobs at traded sector companies help anchor the City's middle class employment base by providing stable, living wage jobs for residents. For these reasons, Portland's traded sector businesses have the power to drive and expand Portland's economy. The Portland Plan calls for retaining the competitive market as a West Coast trade gateway as reflected by growth in the value of international trade.

Portland has a strong traded sector job base. The EcoNorthwest *Evaluation of Economic Specialization* (2009) found that the City's second and fifth largest economic specializations are wholesale trade and transportation, which are the City's freight distribution industries. In 2008, the Portland region's traded sector businesses brought $22 billion of export income into the regional economy, which was 21 percent of total regional economic output. Portland ranked second among U.S. metropolitan areas in export growth over five years. The 118,700 jobs in Portland's industrial districts accounted for 30 percent of the City's employment, including 30,400 manufacturing jobs and 44,000 wholesale and transportation jobs (Bureau of Planning and Sustainability, 2012).

Portland's transportation- and freight-related industries are concentrated in the Columbia Harbor; this includes Terminal 6, trucking and warehousing companies, and manufacturing companies that take advantage of the area's proximity to marine shipping, rail and highway infrastructure. Portland has a strategy to support and expand a targeted set of business clusters: advanced manufacturing, athletic and outdoor, clean tech, software, and research and commercialization. The advanced manufacturing cluster is an important component of the Portland Harbor industrial base, and relies on the transportation infrastructure of that district. In particular, access to the rivers and railroads is important for shipping raw materials and products that either are too heavy to go by truck or travel longer distances than is economically feasible by truck.

The Columbia River is also the main shipping channel for goods transported by water regionally and internationally. The Columbia River shipping channel was recently deepened from 40 to 43 feet, with the project completed in 2010. Since that time over $3.6 billion has been spent on or committed to goods-movement projects in the Columbia River system, taking full advantage of the deepened channel. (Pacific Northwest Waterways Association (2013), http://www.pnwa.net/new/Articles/Columbia_River_Channel_Deepening.pdf, Port of Portland 2014). Portland marine terminal investments constitute 24 percent of that investment.

The industry sector "transport by water" contributes to the local, regional and national economies in numerous ways. It provides employment and income to individuals, tax revenue to local and state governments and revenue to businesses that handle freight. Given geographic and competitive challenges, Portland's role as a leading exporter is fragile because of the limits of the current transportation system. The system is burdened with many obsolete, end-of-life assets (e.g., the functional condition of many roadways and bridges). Maintaining a cutting-edge-built environment is an important aspect of sustaining the region's freight- and trade-dependent economy.

Employment:

The Columbia Harbor, which includes the Portland Harbor and the Columbia Corridor, has by far the largest share of employment with nearly 54,000 jobs, or 14.6 percent of the City's job base in 2010 (Hovee, 2012). The vast majority of jobs in the Columbia Harbor fall into the following categories: transport and warehousing, manufacturing, construction, and industrial services. There are also management and administrative jobs within the district, generally part of the above noted industrial uses, or in related headquarters offices.

The Port of Portland is an important part of the state, regional and local economy. Periodically, the Port of Portland commissions Martin and Associates to produce a report called *The Local and Regional Economic Impacts of the Port of Portland*. The most recent report (March 2012) provides information for the 2011 calendar year. This report summarizes the economic impacts generated by maritime activity in the Portland Harbor, including public and private terminals, which comprise a significant percentage of the area of the Portland Harbor and Columbia Corridor.

The Martin study estimated that 18,081 resident jobs in Oregon and Washington were generated by cargo and vessel activity at the public and private marine terminals in the Portland Harbor, with a total personal income of over $1.4 billion. Of these, 7,275 were generated specifically by the movement of cargo over the docks (direct jobs); 6,878 jobs were created to serve the purchasing demand of those employed in direct jobs (induced jobs like restaurants, retail and professional service, etc.); and 3,928 jobs were created by the firms related to the shipping of cargo (indirect jobs like suppliers, trade-related financial and brokerage services, maintenance, etc.). To place these values in context, these values amount to about 1 percent of total employment and personal income in the Portland-Vancouver metropolitan area.

These direct, induced and indirect jobs also generated $1.5 billion in annual business revenue, and $140 million in tax revenue to state and local governments in Oregon and Washington.

The Martin study also provided data on employment in the public terminals. Within the public terminals, they counted 3,549 direct jobs, 3,476 induced jobs and 2,074 indirect jobs in 2011. Based on the 885 acres that the public terminals occupied at the time, the following job densities are estimated:

Direct jobs:	4.01/acre
Induced jobs:	3.93 acre
Indirect jobs:	2.34/acre

Not all economic development investments have the same impact on the regional economy. Some create

more jobs and therefore pay more income tax, the majority of which then flows to the State. Others, such as those that are capital intensive developments, generate property taxes that flow to the City, county and school district. Some of the jobs created pay more than others, which means that they can have a greater ripple effect through the regional economy. Creation of a new job with a high wage can lead to the creation of other secondary jobs, as some of those wages will be spent consuming other local products and services. The table below shows the different job multipliers that economists use for economic sectors. A multiplier of 2.0 includes that every job in that sector generates 1 more job off-site through indirect or induced spending effects elsewhere in the region. All other things being equal, industrial and warehouse investments have a greater potential to create a beneficial ripple effect throughout the region.

Job Multipliers

Type of Building	Job Multiplier
Office	1.95
Institution	1.62
Flex/BP	2.19
Warehouse	2.36
General Industrial	3.15
Retail	1.64

(Source: ED Hovee, 2012)

Household self-sufficiency and economic equity:

As of 2012, approximately 77 percent of Portland households earn enough income to be considered economically self-sufficient (Bureau of Planning and Sustainability, 2012). This means more than 20 percent of Portlanders do not make enough money to cover their basic household needs. The Self-Sufficiency Index measures whether an income is sufficient to meet the basic needs of most adults, including the cost of housing, childcare, food, health care and transportation. Unlike the federal poverty measure, this standard looks at "real world" household costs, not just the cost of food. The index reflects the variation in the cost of these items by geography and the effects of taxes and tax credits on household income.

The annual income threshold of the federal poverty level for a household with an adult and infant was $14,840 (2008). In comparison, the Self-Sufficiency Index posits that an annual income of $35,711 is needed to meet the basic needs of the same family. Unfortunately, this income substantially exceeds the average 2008 earnings in Multnomah County. In 2008, annual income (2008) for workers in various employment sectors was:

- Retail worker - $27,300
- Food and drink service - $16,600
- Personal service workers - $25,360

Low-income residents have generally lost ground during the economic growth of recent decades. From 1979 to 2005, Oregon households in the bottom 20 percent of the income distribution have seen a 14 percent decline in their inflation-adjusted average income (Bureau of Planning and Sustainability, 2012). In particular, disproportionate income disparities persist for communities of color, residents with disabilities, young female householders and other groups. In 2010 the average household income for African Americans in Portland was only $26,449, which is well below what is necessary to maintain self-sufficiency (Bureau of Planning and Sustainability, 2012).

An important factor in Portland's future economic prosperity, and addressing economic equity concerns, will be maintaining and growing "family-wage" jobs. Manufacturing and distribution jobs are typically an important part of any long-term economic development strategy because often wages in these sectors are

significantly higher, and they are available to those with lower levels of education. Average wages of the direct jobs provided at public and private marine terminals in the Portland harbor is $50,392 (Local and Regional Economic Impacts of the Port of Portland, 2011, Martin Associates, March 2012). Although both in Portland and nationwide, manufacturing jobs have declined as more industrial processes have become automated, the Portland region has held onto a higher number of manufacturing jobs than most other US cities have. Portland has some comparative advantage in this sector (ED Hovee & Company).

Ecosystem goods and services provided by the wildlife habitat and Special Habitat areas within the Terminal 6 site

Natural resources provide ecosystem goods and services, which in turn provide economic and social value. Ecosystem services include water conveyance, purification, and flood control, air cooling and purification, carbon sequestration, soil fertilization and pollination. Ecosystem goods include commodities like food, fuel, fisheries, timber, minerals, etc. Ecosystem goods also include supporting recreation and tourism. Ecosystem services have not been evaluated specifically for the Terminal 6 site, however, the following information sources provide information relevant to this analysis:

- ECONorthwest, Economic Arguments for Protecting the Natural Resources of the East Buttes Area in Southeast Portland, 2009.
- Bergstom, Loomis and Brown, Defining, Valuing and Providing Ecosystem Goods and Services, Natural Resources Journal, 2007.
- Banzhaf and Boyd, What Are Ecosystem Services? The Need for Standardized Environmental Accounting Units, 2006.
- Anielski and Wilson, Counting Canada's Natural Capital: Assessing the Real Value of Canada's Boreal Ecosystems, Pembina Institute, 2005.
- Olewiler, N., The Value of Natural Capital in Settled Areas of Canada, Published by Ducks Unlimited Canada and the Nature Conservancy of Canada, 2004.

Below is a general description of the ecosystem services provided by wildlife habitat, including Special Habitat Areas identified in the Terminal 6 inventory.

- Water bodies (rivers, stream, and wetlands) and associated riparian areas and floodplains are critical for survival of aquatic and terrestrial wildlife species. Riparian vegetation shades and cools the water contributing towards maintenance of dissolved oxygen levels and as required to meet Clean Water Act rules for temperature loading. Riparian areas are used by wildlife for foraging, nesting, breeding/rearing young, migrate and dispersal. Floodplains provide nutrient cycling, off-channel habitat for fish, and habitat for wildlife such as waterfowl, shorebirds and terrestrial species. Maintaining and enhancing habitat will help prevent further decline and support recovery of federal or state-listed fish and wildlife species, and other at risk species, and will help the City meet federal and state regulations. Maintaining large structure riparian vegetation can reduce costs associated with regulatory compliance and maintenance costs associated with bank slumping and erosion.
- Wildlife habitat identified in the study area, including upland areas supporting at risk grassland-associated species, are, are utilized for foraging, migration, dispersal, nesting and breeding. Maintaining habitat reduces the risk of further species listings and associated costs. Maintaining one habitat area alone may not prevent a listing; however, considered cumulatively, each habitat area plays a role in helping to preventi future listings, and in the recovery of listed species.
- The existence of trees, greenspaces and other natural resources have been correlated positively with residential property values in Portland (ECONorthwest, 2009). Natural resources contribute to the quality of neighborhoods, to local and regional recreation and trail systems, and also to the quality of views. Screening and buffering residential from industrial and commercial land uses can

be provided by established trees and vegetation, and can improve the economic value of both uses (e.g. noise reduction). Other indirect "quality of life" values associated with natural resources include labor force retention, attraction of new employees and reputation. Portland is generally known nationally and internationally as a green city and a desirable place to live, visit, work and play, which has a positive impact on aspects of the local and regional economy.

- Natural resources, including wildlife habitat areas, can help mitigate the urban heat island effects. This can reduce energy costs to cool buildings located adjacent to vegetated areas, particularly where large trees shade a portion of the building (ECONorthwest, 2009; Anielski and Wilson, 2005). Reducing heat island can also contribute to more healthful air quality conditions. Reducing local air and water temperatures, maintaining flood area, sequestering carbon and other greenhouse gases, and supporting wildlife and plant diversity all help manage the local effects of global climate change.

There has been no valuation of the ecosystem services provided by natural resources within this resource site. However, ECONorthwest produced an ecosystem service valuation in 2012 for the different habitat types found in Terminal 6, and the valuation is illustrative and informative in the context of this analysis. The valuations are contained in Appendix B.

Some benefits from wildlife habitat and Special Habitat areas occur beyond the immediate resource area. For example, the capacity of a natural area to help mitigate urban heat island may benefit an entire watershed. When benefits occur off-site, the property cannot capture the value of these benefits directly. As a result, the market price for natural resources, whether a wetland or a stand of trees, does not fully reflect a true exchange value relative to other goods. In fact, most natural resources are not priced because they are not bought and sold like other products. This makes establishment of value difficult.

Some of the benefits of natural resources take many years to be realized. For example, the potential stormwater management and climate-related values of an immature stand of trees may not be realized for 25-50 years when the trees have grown and matured and are providing maximum shade, carbon sequestration, rainwater interception and evapotranspiration functions. Another complicating factor when determining the economic value of natural resources is that many natural resources have "irreversibility" properties. If the resource is eliminated there may be little or no chance of regeneration in any meaningful timeframe, if ever. Therefore the cost of losing natural resources also includes the opportunity costs, or the cost of future choices foregone.

Another topic of consideration is scarcity. As an area develops and natural resources are reduced, the function of the remaining resources become scare. This can increase the value of the remaining natural resources. On example are grasslands. In the Willamette Valley, grassland has been reduced to less than 2% of its historic extent. This means that the wildlife species that depend on grassland habitat to complete their life cycles have significantly less habitat areas to choose from. These scarcity of grasslands increases the value of the remaining habitat from a biodiversity standpoint and with regard to preventing future species listing under the federal Endangered Species Act. The extent of development in the site area affects the ecosystem services provided by the remaining natural resources. That said, these remaining natural resources continue to provide important ecosystem benefits, made that much more valuable due to limited resource supply.

Economic Consequences Analysis

To evaluate the potential economic consequences of different natural resource protection program options, three scenarios or policy choices are assessed: allowing, limiting and prohibiting conflicting uses that would adversely affect significant natural resources in the Terminal 6 site. The positive and negative consequences of these program choices are evaluated from the perspectives of both the conflicting uses and the significant

natural resources identified in the inventory for this site. As such, the program choices would result in different mixes of positive and negative economic consequences as indicated below.

In evaluating the consequences of allowing conflicting uses it is assumed that all significant natural resources would be subject to development allowed by regulations that apply in the base zone. It is also assumed that mitigation for impacts on natural resources would not be required.

In evaluating the consequences of limiting conflicting uses it is assumed that rules would be established to limit the impacts of allowable development in areas containing significant natural resources. Areas containing significant natural resources could still be subject to development, but development restrictions would exist in addition to base zone regulations. For example, the type, location or extent of development could be restricted. Another example, development could be required to avoid adversely affecting natural resources where practicable, and to mitigate for unavoidable impacts. Another example would be to restrict the type of development allowed.

The recommendation to limit conflicting uses can also be implemented by relying on the City's existing environmental program which uses conservation and protection overlay zones or the recommendation could be implemented through specific code provisions in a plan district. Plan Districts are area-specific zoning codes that may include provisions related to natural resource management and development. Another tool are master plans, such as the Comprehensive Natural Resources Plans (CNRPs) and Natural Resource Management Plans (NRMPs) which can be established for sites in environmental overlay zones, provide another mechanism to coordinate development, natural resource enhancement, mitigation, recreation and other activities.

In evaluating the consequences of prohibiting conflicting uses it is assumed that the regulations would preclude all allowable development in significant natural resource areas.

The following tables address the potential economic consequences associated with the three programmatic approaches. Consequences are described, and further represented by these symbols:

- (+) more substantial positive than negative consequences
- (-) more substantial negative than positive consequences
- (+/-) positive and negative consequences of development are generally balanced
- (o) consequences would be neutral or negligible

The first table outlines the consequences of allowing, limiting or prohibiting identified conflicting uses from the perspective of the conflicting uses. The second table provides an explanation of the natural resource consequences of these program choices by conflicting use.

Economic Consequences for Conflicting Uses

	Allow		Limit		Prohibit	
Industrial	1. Would support and maintain the local and regional economic benefits of marine industrial development in the Columbia Harbor (e.g. traded sector, employment). 2. Would support and maintain the economic benefits of the existing Columbia River shipping channel and existing railroad infrastructure. 3. Would support and maintain the supply of land for future industrial development and generation of employment opportunities. Would maintain undeveloped areas as reserves for marine terminal development. 4. Development would not incur additional costs to avoid, minimize or mitigate for a broad range of ecosystem services.	+	1. Would maintain the local and regional economic benefits of marine industrial development in the Columbia Harbor (e.g. trade commerce, employment). 2. Would support and maintain economic benefits of the existing Columbia River shipping channel and existing railroad infrastructure. 3. Would maintain the supply of land for future industrial development and generation of employment opportunities. Would maintain undeveloped areas maintained by the Port of Portland as reserves for marine terminal development. 4. Development could incur additional costs and time related to project design, ecosystem restoration, and other measures to avoid, minimize and mitigate for impacts to wildlife habitat. This could increase the time needed to realize marine terminal growth opportunities.	+/-	1. Would reduce the economic benefit derived from development of marine industrial development in the Columbia Harbor (e.g. trade commerce, employment). 2. Would reduce the supply of land for future industrial development and the generation of employment opportunities.	-

Economic Consequences for Natural Resources

Base Zone	Resource Ranks	Allow		Limit		Prohibit	
Industrial	**High, Medium Wildlife Habitat (including SHA)**	1. Would reduce the economic benefit derived from multiple ecosystem services. All ecosystem services would be affected by development of conflicting uses within areas of high and medium ranked wildlife habitat and Special Habitat Areas. 2. Could complicate efforts to comply with certain state and federal regulatory requirements (e.g., CWA, ESA) resulting in potential liability and associated costs. 3. Could increase chance for future ESA listings of at-risk fish and wildlife species in the study area, resulting in additional regulatory costs and liabilities.	-	1. Design and mitigation requirements would reduce the net impact and help maintain most of the economic benefit derived from multiple ecosystem services. 2. Would support efforts to comply with regional, state and federal requirements (e.g., Titles 13, ESA). 3. Would, by requiring mitigation, help reduce risk of future ESA listings of at-risk fish and wildlife species in the study area, and associated costs and liabilities.	+/-	1. Would support and maintain economic benefits derived from multiple ecosystem services provided by existing natural resources. 2. Would support efforts to comply with certain regional, state and federal requirements, preventing liability and associated costs. 3. Would, by preventing development encroachment, help reduce risk of future ESA listings of at-risk fish and wildlife in the study area, and associated regulatory costs and liabilities. However, prohibiting existing ground disturbing activities that maintain early succession low structure vegetation would negatively affect grassland-associated species using the site. 4. If marine terminal development is shifted to another vacant area along the Columbia River shipping channel, the impacts on natural resources would shift to that location as well.	+
	Low	There are no low ranked wildlife habitat resource areas within the site.	**0**	There are no low ranked wildlife habitat resource areas within the site.	**0**	There are no low ranked wildlife habitat resource areas within the site.	**0**

Recommendation Based on the Economic Analysis

There is a range of positive and negative economic consequences associated with allowing, limiting or prohibiting industrial development within significant wildlife habitat areas. The primary factors to consider are traded sector commerce, employment, proximity to existing infrastructure, ecosystem services, and regulatory compliance. The following economic recommendation optimizes economic values with the IH base zone:

Limit conflicting uses within high and medium ranked wildlife habitat areas including Special Habitat Areas. Limiting industrial development will provide the economic benefits of jobs, taxes and revenue while requiring future development to avoid, minimize or mitigate impacts to the wildlife resources and the ecosystem services provided by the resources. These resources, which include the river, floodplain, bottomland hardwood forests and woodlands, and grasslands, are important for wildlife, including at risk wildlife species.

B. Social Analysis

This section examines the social consequences of allowing, limiting or prohibiting conflicting uses for the Terminal 6 study area. The social analysis focuses on the following topics:

- Human Health and Welfare
- Heritage and Cultural Values

A general discussion of each topic is presented below, followed by an analysis of the social consequences of allowing, limiting, or prohibiting conflicting uses that would adversely affect significant resources.

Human Health and Welfare

Employment opportunity:

One of the most important factors in determining human health and welfare is household income, which is dependent on employment. Income can influence health by its direct effect on living standards (e.g., access to better quality food and housing, leisure-time activities, and health-care services). In the United States the risk for mortality, morbidity, unhealthy behaviors, reduced access to health care and poor quality of health care increases with decreasing socioeconomic circumstances (CDC, 2011).

Today, approximately 77 percent of Portland households earn enough income to be considered economically self-sufficient (City of Portland, 2012). This means more than 20 percent of Portlanders do not make enough money to cover their basic households needs (e.g. rent). The Self-Sufficiency Index measures whether an income is sufficient to meet the basic needs of most adults, including the cost of housing, childcare, food, health care and transportation. Unlike the federal poverty measure, this standard looks at "real world" household costs, not just the cost of food. The index reflects the variation in the cost of these items by geography and the effects of taxes and tax credits on household income.

An important factor in Portland's future economic prosperity, and addressing economic equity concerns, will be maintaining and growing "family-wage" jobs, especially for people without college degrees. Manufacturing and distribution jobs are typically an important part of any long-term economic development strategy because often wages in these sectors are significantly higher, and they are available to those with lower levels of education.

The Columbia Harbor, which includes the Portland Harbor and the Columbia Corridor, has by far the largest share of employment with nearly 54,000 jobs, or 14.6 percent of the City's job base in 2010 (Hovee, 2012). The vast majority of jobs in the Columbia Harbor fall into the following categories: transport and warehousing, manufacturing, construction, and industrial services. There are also management and administrative jobs within the district, generally part of the above noted industrial uses, or in related headquarters offices. Average wages of the direct jobs provided at public and private marine terminals in the Portland harbor is $50,392 (Local and Regional Economic Impacts of the Port of Portland, 2011, Martin Associates, March 2012).

Having a good job does more than supply the means to meet physical needs, it also provides opportunities to be creative, promotes self-esteem, and provides avenues for achievement and self-realization. Research has indicated that the effects of unemployment include impacts on psychological function, including anxiety and depression, and correlate with impacts on physical function as measured by increased utilization of health services. (Linn, Sandifer, and Stein, 1985). Research also points to financial strain as strong mechanism through which unemployment contributes to ill health. In addition it has been found that unemployment "compounds the effects of unrelated (stressful) life events" (Kessler, Turner, and House, 1988).

A 2012 informational piece published by the American Psychological Association states that "the current state of the economy continues to be an enormous stressor for Americans…Unemployed workers are twice as likely as their employed counterparts to experience psychological problems such as depression, anxiety, psychosomatic symptoms, low subjective well-being, and poor self-esteem (citing Paul and Moser, 2009). The piece continues, "Like unemployment, underemployment…is unequally distributed across the U.S. population, with women, younger workers, and African Americans reporting higher rates of involuntary part-time employment and low pay, as well as higher proportions of "discouraged" workers who have given up on searching for a job (McKee-Ryan et al, 2005).

Air quality:

Marine terminals, depending on the operation, can be a source for a significant amount of diesel particulates. This can be generated from berthed ships, truck loading and circulation, railroads and other diesel equipment located at the terminal. Diesel particulate matter is one of the top 10 toxins in Oregon which are associated with an increased risk of many health issues, including heart and lung disease and respiratory ailments such as asthma. There are strict state and federal regulations that govern allowable levels of diesel emissions. In 1996, refiners began to produce ultra-low sulfur diesel fuel, with sulfur levels at 15 ppm for use in heavy duty highway engines. Locomotives were required to meet low sulfur (500 ppm) in 2007 and ultra-low sulfur (15 ppm) requirements in 2012. Emission from large commercial marine vessels (e.g., container ships) will be phased in under the EPA Emission Control Area (ECA) rule approved in 2012. It is expected that by 2030 the engine fleet will be fully turned over and particulate matter will be reduced by 380,000 tons/year. (www.epa.gov/chleandiesel/reg-prog.htm)

A number of Ports across the US are implementing programs to reduce these emissions at their terminal facilities, such as:

- radio frequency identification system to reduce waiting times for trucks
- requiring berthed ships to plug into electric grid instead of using diesel engine
- creating an incentive program for off-site trucks that encourages "fleet modernization"
- providing lower emission diesel fuel or biofuel
- value-added approaches like on-dock rail loading to reduce cargo transfers and truck miles traveled

Also of concern are carbon emissions and the associated greenhouse effects that increase air temperature. In addition, increased impervious area would likely result in higher ground level air temperatures at and near a development site. This could contribute cumulatively to urban heat island effect generated by the City of Portland and land in the vicinity of the Portland Harbor. Increased air temperatures, particularly in the summer, can exacerbate air quality problems and associated health impacts. Vegetation areas and water bodies that comprise wildlife habitat resources identified in the inventory can help incrementally to maintain air quality by filtering the air and maintaining air temperature and humidity.

Water quality and quantity:

Water quality and quantity is important for human health and welfare. The Columbia River is currently water quality limited for multiple parameters. Impaired water quality can affect people recreating in the Columbia River (e.g. fishing, swimming).

Development can have a negative impact on both water quality and quantity. Point sources and non-point pollution are addressed through federal, state and local regulations and programs. Point source discharges of pollutants to rivers, streams and wetlands require permits and on-going monitoring. However, the cumulative effects of these discharges are not easily addressed through individual permits.

Development can also improve stormwater quality and quantity impacts to rivers, sloughs and other bodies of water. At Terminal 6, over 35 acres of exterior vehicle storage area have been built using porous pavement, avoiding the need for an outfall to the Columbia River.

In Portland, non-point source pollutants are addressed through the Stormwater Management Manual (SMM). The SMM applies to new development and redevelopment involving at least 500 square feet of impervious surface (e.g., roads, parking lots and building rooftops). Runoff from the impervious surfaces must be managed for flow into pipes and streams, and treated to maintain water quality. Preference is given to treatment types that utilize natural systems such as bioswales. In the urban context, another source of non-point source pollution is erosion from construction activities, which are addressed in the City Code Title 10.

Roads and rail infrastructure and activities can negatively affect water quality; for example, hydrocarbons and heavy metals coming from break dust. In addition, marine industrial uses could be associated with spills or leakage of toxic or hazardous materials such as deasil fuel or chemicals.

Wildlife habitat resources, such as vegetation and wetlands help maintain and improve the quality of water through filtration, uptake and cycling, and providing microclimate and shade.

Noise:

Marine terminals and industrial areas can be a source of noise, both from on-site loading operations, and from the associated rail and truck traffic generated by the cargo distribution. Noise pollution can have a number of negative consequences including reducing enjoyment of leisure activities; contributing to health effects such as hypertension, heart disease, sleep interruption, and hormonal changes; and affecting property values proximate to the noise source.

The closest residential community is the floating home community on the south side of the Oregon Slough located on the downstream side of the rail bridge. The closest houseboat residence is approximately 1.8 miles from the closest dock at Terminal 6.

The North Portland Noise Study, drafted by the City of Portland Bureau of Development Services in 2008, documented the main sources of noise and quantified specific levels of noise in North Portland Neighborhoods (Greenbusch Group, 2008). The main sources identified include:

- Portland International Raceway (PIR)
- Railways
- Arterial cargo truck noise in residential neighborhoods
- I-5 traffic
- Airplane activity at Portland International Airport (The Greenbusch Group, 2008).

A computer noise model isolated individual noise sources because the interaction of noises makes it difficult to study just one source at a time. The study also pointed out that wind and other atmospheric conditions can influence noise levels. The following present some of the findings of the North Portland Noise study for rail and vehicle traffic.

Starting in 2010 the Federal Railroad Administration (FRA) is implementing new regulations that establish minimum (96 dBA) and maximum (110 dBA) train horn levels. In addition, the FRA has established a new method for sounding train horns at public grade crossings to lessen the impact on surrounding communities.

Noise pollution also affects fish and wildlife; please refer to the environmental analysis section for additional information.

Light:

The International Dark-Sky Association (IDA) defines light pollution as: "Any adverse effect of artificial light including sky glow, glare, light trespass, light clutter, decreased visibility at night, and energy waste (International Dark Sky Association)." Marine terminals have large exterior work and storage areas that are often illuminated for safety and security reasons, as well as to allow 24-hour operation. This light can affect adjacent properties as well as wildlife in adjacent natural areas.

Wildlife habitat resource can reduce negative impacts associated with light by creating a buffer between sites or land uses. Other ways to control excess lighting include shielding lights, reducing light wattage, putting lights on timers, changing street light features and requiring light shields or redirection.

Light pollution also affects fish and wildlife; please refer to the environmental analysis section for additional information.

Screening and buffering:

Wildlife habitat resource areas create natural screens and buffers between incompatible land uses, separating them and reducing a broad array of impacts. For example, the US Department of Agriculture reports that a 100-foot wide and 45-foot tall patch of trees (approximately 1/10 an acre) can reduce noise levels by 50 percent (1998). Trees can also reduce the off-site impacts of lighting or visual impacts from intensive development.

As a result of noise mitigation efforts at Terminal 4 on the Willamette River, a recommended vegetation buffer of at least 100 feet can reduce noise and light impacts between terminal operations and residential development. Management at other ports rely on buffers to help mitigate noise, light and other effects of port operations on adjacent neighborhoods. For example, the Port of Tacoma purchased 31 acres as a noise, visual and light buffer between the port and neighboring residential areas.

Access to Nature:

Land and water located below the ordinary high water mark along the Oregon Slough is accessible to the public. Activities like canoeing and kayaking are physical activities that can yield health benefits. Exercise improves overall health which reduces public and private health care costs, improves quality of life, and may help people live longer (Nieman, 1998).

Vegetated landscapes, parks and scenic views each contribute a "sense of place" and personal attachment to particular locations. People are socially connected to the entirety of the built and natural environmental by walking, biking, boating and driving through areas with street trees, gardens, parks, streams, wetlands and other open spaces. Natural resources and open spaces create a sense of identity and visual variety in the city. Trees, open spaces and water bodies help define the visual appeal the Portland area. People also identify with urban landscapes including river harbors and marinas, airports, new and old structures, workplaces, museum, restaurants and stores, parks and golf courses, and other gathering spaces. Portland is often identified by pictures of the cityscape, Mt. Hood and the Columbia and Willamette rivers. This identification with nature has been demonstrated to improve mental health (Mult. Co. Health Department, 2012).

Heritage and Cultural Values

The Columbia River is important to the history, heritage and culture of the region.

Portlanders place a high value on the environment and quality of life. The Oregon state symbols reflect this value. The Oregon state bird is the Western Meadowlark, which is currently a state-listed Species of Concern and has been early extirpated from the city due to loss of native grasslands. Western Meadowlark use

habitat on Terminal 6. Portland's City Bird, the Great Blue Heron, is also found in the site. Fourteen runs of the state fish, the Chinook salmon, use the Columbia River and all fourteen are federally listed as Threatened or Endangered. The beaver is Oregon's state animal and still resides in many of Portland's waterways and is found on the site.

There is a long history of human inhabitance near the site. In the Portland area, Native American settlements were located on the north and south shores of the Columbia River and near the mouth of the Willamette River, with a population in the early 19th century of several thousand. While evidence of settlements has been documented or suggested in specific or possible areas on the Columbia River, there is no record of settlement by Native populations on Terminal 6. There is speculation among historians and archaeologists that believe that a number of Chinook tribes inhabited the area, and specific to this section of the south side of the Columbia and mouth of the Willamette were the Multnomahs. The Native population changed dramatically following European settlement and the subsequent malaria outbreak that devastated the population of many Native villages that had traditionally settled these rivers. This occurred in the early 1830s; following that time, different tribes began to populate the area from all directions, including the Clackamas, Cowlitz, and Klickitat, coming from tributaries of the Columbia.

As Portland has developed over the past 200 years, the Willamette and Columbia Rivers have played a key role. Beginning in the early 1800's, European settlement occurred at the confluence of the Willamette and Columbia rivers due to the abundant natural resources and opportunities for trade. In 1907, the Seattle Portland & Spokane Railroad excavation occurred next to Smith and Bybee Lakes and shortly afterward, the Swift Interests stockyard and meatpacking plant began to operate on the south side of the Columbia River's Oregon Slough. Other stockyard and meatpacking businesses followed.

Beginning in 1914, Oregon Slough depths were managed and dredged to allow for shipping lumber and cattle from the Monarch Lumber Company and Swift stock yards clustered on either side of the Burlington Northern Santa Fe (BNSF) rail bridge. In the 1920s, the U.S. Army Corps of Engineers altered the shoreline of Terminal 6 by constructing three rock and timber dikes or groins that further narrowed the Oregon Slough waterway and increased flows and depths to support additional industrial activity in the area. In the early portion of the 20th century, the Pittock-Leadbetter Company acquired 2,700 acres in this area, which were mostly used for recreational purposes such as duck hunting. The entire 2,700 acres was acquired by the Port of Portland in 1965 for development of the future Rivergate Industrial District, as well as future Marine Terminal 5 and Marine Terminal 6:

- Beginning in 1972, construction of the two-berth container terminal at Terminal 6.
- In 1974, Terminal 6 was dedicated as a two-berth, three-crane container facility with a Container Freight Station (CFS), on-dock rail facility, administration building and gear locker/electrical shop.
- Between 1976 and 1978, a 50-acre auto terminal was constructed on the upstream portion of Terminal 6 including moving a Liberty Ship floating dock from Terminal 4, Berth 417 to the new Berth 607 location and constructing a new rail car loading ramp for the auto facility. At the same time, the 202,400-square foot Container Distribution Center (CDC) was completed.
- In 1981-1982, the Berth 607 auto facility was expanded to 75 acres, and one container berth (Berth 603) and two cranes were add to service more container ships.
- In 1984, Kelley Point Park (immediately to the west of Terminal 6 at the confluence of the Willamette and Columbia Rivers) was transferred to the City.
- Building on Portland's rail advantage, a second intermodal yard was constructed in 1987 and further modernized in 1991.

- Portland's role as an auto import gateway was solidified with the construction of Berth 601 for Hyundai Motors America in 1989, including a 75-acre vehicle storage and processing facility followed by construction of a 33-acre processing facility for Honda near Berth 607 in 1990.
- In 2006, a 51-acre auto facility storage facility expansion for Auto Warehousing Corporation was completed at Berth 601.

Social Consequences Analysis

To evaluate the potential social consequences of different resource protection program options, three scenarios or policy choices are assessed: allowing, limiting and prohibiting conflicting uses that would adversely affect significant natural resources in the Terminal 6 study area. The positive and negative consequences of these program choices are evaluated from the perspectives of both the conflicting uses and the significant natural resources identified in the inventory for this site. As such, the program choices would result in different mixes of positive and negative social consequences as indicated below.

In evaluating the consequences of allowing conflicting uses it is assumed that significant natural resources would be subject to development allowed by regulations that apply in the base zone. It is also assumed that mitigation for impacts on natural resources would not be required.

In evaluating the consequences of limiting conflicting uses it is assumed that rules would be established to limit the impacts of allowable development in areas containing significant natural resources. Areas containing significant natural resources could still be subject to development, but development restrictions would exist in addition to base zone regulations. For example, the type, location or extent of development could be restricted. Another example, development could be required to avoid adversely affecting natural resources where practicable, and to mitigate for unavoidable impacts. Another example would be to restrict the type of development allowed.

The recommendation to limit conflicting uses can also be implemented by relying on the City's existing environmental program which uses conservation and protection overlay zones or the recommendation could be implemented through specific code provisions in a plan district. Plan Districts are area-specific zoning codes that may include provisions related to natural resource management and development. Another tool are master plans, such as the Comprehensive Natural Resources Plans (CNRPs) and Natural Resource Management Plans (NRMPs) which can be established for sites in environmental overlay zones, provide another mechanism to coordinate development, natural resource enhancement, mitigation, recreation and other activities.

In evaluating the consequences of prohibiting conflicting uses it is assumed that the regulations would preclude all allowable development in significant natural resource areas.

The following tables address the potential social consequences of associated with the three programmatic approaches. Consequences are described, and further represented by these symbols:

- (+) more substantial positive than negative consequences
- (-) more substantial negative than positive consequences
- (+/-) positive and negative consequences of development are generally balanced
- (o) consequences would be neutral or negligible

The first table outlines the consequences of allowing, limiting or prohibiting identified conflicting uses from the perspective of the conflicting uses. The second table provides an explanation of the natural resource consequences by of these program choices by conflicting use.

Social Consequences for Conflicting Uses

	Allow		Limit		Prohibit	
Industrial	1. Would support and maintain the local and regional employment, revenue and tax benefits of marine industrial development in the Columbia Harbor. 2. Would contribute to improved psychological and physical health of individuals; benefits that are associated with being fully employed and foster healthy families and communities. 3. Could reduce community health benefits associated with natural resources, such as air and water quality. 4. Could increase levels of light and noise, and reduce natural resource screening and buffering. 5. Could contribute to the current and historic cultural values of the industrial Portland Harbor, but would reduce the cultural values associated with natural resources at the confluence of the Willamette and Columbia Rivers	**+/-**	1. Would support and maintain the local and regional employment, revenue and tax benefits of marine industrial development in the Columbia Harbor. 2. Would contribute to improved psychological and physical health of individuals; benefits that are associated with being fully employed, and foster healthy families and communities. 3. Should, by requiring mitigation, maintain most of the health benefits associated with natural resources, such as air and water quality. Some of those benefits could be shifted elsewhere through off-site mitigation. 4. Could contribute to the current historic cultural values of the industrial Portland Harbor, but would reduce the cultural values associated with natural resources at the confluence of the Willamette and Columbia Rivers	**+**	1. Would eliminate the local and regional employment, revenue and tax benefits of marine industrial development in the Columbia Harbor. 2. Would not contribute to psychological and physical health benefits that are associated with being fully employed. 3. Would maintain community health benefits associated with natural resources, such as air and water quality. 4. Would maintain current levels of light and noise, and maintain natural resource screening and buffering. 5. Would retain the cultural values associated with natural resources at the confluence of the Willamette and Columbia Rivers	**+/-**

Social Consequence for Natural Resources

Base Zone	Resource Ranks	Allow		Limit		Prohibit	
Industrial	**High, Medium Wildlife Habitat (including SHA)**	1. Would contribute to the loss of the cultural values related to natural resources at the Willamette/Columbia Rivers confluence; including preserving natural resources of cultural importance to Native Americans. 2. Could complicate efforts to comply with certain regional, state and federal regulatory requirements (e.g., ESA), resulting in potential liability and associated costs. 3. Would reduce the benefits of natural screening and buffering between land uses.	**-**	1. Would contribute to the loss of the cultural values related to natural resources at the Willamette/Columbia Rivers confluence; including preserving natural resources of cultural importance to Native Americans. 2. Would support efforts to comply with certain regional, state and federal requirements (e.g. ESA, CWA). 3. Would, by requiring mitigation, help reduce risk of future ESA listings of at-risk fish and wildlife species in the study area, and associated costs and liabilities. 4. Design and mitigation requirements would help maintain the some of the benefits of natural screening and buffering between land uses.	**+/-**	1. Would maintain cultural values related to natural resources at the Willamette/Columbia Rivers confluence; including preserving natural resources of cultural importance to Native Americans. 2. Would support efforts to comply with certain regional, state and federal requirements (e.g., ESA, CWA). 3. Would not increase the risk of future ESA listings of at-risk fish and wildlife species in the study area, and associated costs and liabilities. 4. Would maintain the existing benefits of natural screening and buffering between land uses.	**+**
	Low	There are no low ranked wildlife habitat resource areas within the site.	**0**	There are no low ranked wildlife habitat resource areas within the site.	**0**	There are no low ranked wildlife habitat resource areas within the site.	**0**

Recommendation Based on the Social Analysis

There is a range of positive and negative social consequences associated with allowing, limiting or prohibiting industrial and marine terminal development within areas of significant wildlife habitat areas. The primary factors to consider are employment, public health, and cultural values. The following social recommendation optimizes social values within the IH base zones:

Limit conflicting uses within high and medium ranked wildlife habitat areas including Special Habitat Areas. Limiting conflicting uses would provide opportunities for industrial development and the associated social benefits (e.g. jobs, tax benefits, health insurance) while also requiring that adverse impact to natural resources and their contribution of social values be avoided, minimized or mitigated. Under an allow decision only some natural resource features and functions would require mitigation through state and federal permits. A limit decisions lets the City address a broad range of natural resource features and functions. This approach would advance the City's compliance with regional, state and federal regulations (Clean Water Act, Endangered Species Act) and reduce the risk of additional Endangered Species Act listing.

C. Environmental Analysis

This portion of the ESEE analysis outlines the environmental consequences of allowing, limiting or prohibiting conflicting uses. The natural environment in urban areas is altered and disturbed by human activities. However, human welfare depends in part on vital ecosystem services provided by wildlife habitat resources such as fresh air, clean water, slope stability, food supply, shade, and access to nature. Fish and wildlife also depend on having adequate quantity and quality of habitat, even in urban areas.

The Natural Resources Inventory shown in Appendix A details the natural resources and wildlife habitat areas within the Terminal 6 inventory site, as well as their functions and attributes. This narrative below describes the general environmental functions provided by wildlife habitat resources and the specific features and functions attributed to the Columbia River, the Oregon Slough and Terminal 6.

Terminal 6 is uniquely situated at the confluence of the Columbia and Willamette Rivers in the middle of a metropolitan area. This location provides access to the deep water shipping channel as well as other transportation infrastructure including rail lines, Interstate 5 and the Portland International Airport.

This location is also important for fish and wildlife. The Columbia River is the migration route for many fish species, including ESA-listed species. Terminal 6 is also located along the Pacific Flyway for migrating birds and provides habitat between other regional habitat areas including Smith/Bybee Lakes, Vancouver Lake, Shillapoo Wildlife Area, Ridgefield Wildlife Refuge to the north, and the Columbia River Gorge, Sandy River Delta and Sauvie Island to the east and west. This context is important to understanding the recommended decision.

The Columbia River is the deep water navigation channel and major transportation corridor for the region. The Columbia River is maintained by dredging to a depth of 43 feet, which is three feet deeper than the Willamette River resulting in larger ocean-going vessels being able to utilize marine terminals on Lower Columbia River.

Wildlife Resources Features and Functions

Below are descriptions of the individual habitats and hydrology within Terminal 6. The descriptions are from the Terminal 6 Natural Resource Inventory contained in Appendix A:

<u>Forest and Woodland Habitats:</u>
Forests are differentiated from woodlands at the 60 percent canopy cover mark, with woodlands having less canopy cover but still having a predominance of tree canopy as compared to lower structure vegetation. For the purposes of this summary, forests and woodlands are lumped together because they have similar vegetative composition and provide similar habitat functions.

The altered hydrology of the Columbia River has contributed to the reduction of bottomland hardwood forests throughout the lower river by reducing naturally disturbance caused by peak river flows and seasonal flooding. Historically, the seasonal flooding deposited new sediment allowing establishment of cottonwoods and associated understory plants in the floodplain. Today, only during high flood events or mechanical placement of sediments, do conditions allow for new stands of cottonwood to establish. Establishment of new cottonwood forests is different than the long term survival of existing cottonwood forests. Existing cottonwood forests have a natural regeneration mechanism that does not depend on newly formed sediment and intense flooding. Cottonwoods have a strong ability to re-sprout, recruit from runners (or root sprouts) and easily propagate from cuttings. Cottonwoods also grow quickly and roots seek moisture.

A narrow riparian corridor dominated by bottomland hardwood forest species extends for three miles along the southern bank of the Oregon Slough. Within the Terminal 6 site, this strip of forest provides a total of 32

acres of forest and woodland habitat which is largely within the flood area and hangs over the river's shoreline. This vegetated riparian area is typically 50 feet in width (one to four trees), but a few locations of canopy are up to 400 feet wide. The dominant tree species in this mainland forest are black cottonwood, Oregon ash and pacific willow. All six species of willow that are native to Portland are found on this beach. Common understory shrubs include red osier dogwood, snowberry, red elderberry and Armenian blackberry. Although it is a narrow riparian corridor, it provides important functions for the beach, shallow water areas and open water. The overhanging vegetation helps maintain cool water temperatures in the slough through provision of shade and the creation of a cool and humid microclimate. It also provides food resources for the aquatic ecosystem in the form of leaves, branches and terrestrial insects.

Undercut bank along Oregon Slough

The riparian corridor also provides resources that maintain bank functions, such as undercut rootwads, downed trees, large wood recruitment and wildlife passage. These riparian corridor functions are provided by both native and non-native vegetation; however, native vegetation provides more varied food sources and structural diversity, which supports a broader diversity of native wildlife species.

Forest and woodland habitats in the inventory site help mitigate water quality impacts by providing absorption and transpiration services. The wooded riparian corridor absorbs nitrogen in both surface and shallow groundwater, traps phosphorous-laden sediment, induces groundwater recharge, minimizes flood hazards and filters sediment, chemicals and nutrients upslope and atmospheric sources.

The riparian corridor in the Terminal 6 site also provides important habitat for birds, amphibians, mammals and bats, and supplies near shore aquatic communities with food and cover. Breeding and migratory bird densities in area riparian cottonwood forests are high. Large trees provide quality nesting habitat for larger birds that need big trees for their nests such as bald eagles, great-horned owls, and a number of colonial nesters including great blue herons. The combination of forest canopy along the banks of the Oregon Slough that have a direct relationship to the forests on West Hayden Island and the large stands of cottonwood-ash nearby at Smith and Bybee Wetlands creates an important habitat corridor in the Portland-Vancouver metropolitan area.

Bald eagles are not currently nesting in the forests or woodland habitat within the inventory site. However, there are three bald eagle nests located on Hayden Island, one in close proximity to the inventory site. Bald eagles typically maintain more than one nest and may choose to change their nesting location but stay

within the same range of the old nest. The forests in the inventory site provide an opportunity for future bald eagle nesting.

Bat surveys have been conducted on West Hayden Island and other nearby forest/woodland habitats. Bats use large cottonwood and ash trees for nesting. Although this inventory site was not included in the survey, the forest types is similar to other survey areas and it is reasonable to expect that bats are using the forests in this inventory site.

The riparian cottonwood forests located in the inventory site are designated as Special Habitat Areas because they meet the following criteria:

(B) – bottomland hardwood forests
(M) – Migratory stopover habitat
(S) – an *at-risk* species uses the habitat area or feature on more than incidental basis to complete one or more life history phases

<u>Grasslands and sparsely vegetated areas:</u>
Grasslands and sparsely vegetated areas have a predominance of grasses (in general graminoids), forbs and wildflowers, with woody vegetation comprising less than 25 percent of the area. Portions of Terminal 6 upland of the southern bank of the Oregon Slough are composed of grasslands or sparsely vegetated areas. The substratum in these locations is well-drained sandy soil, primarily comprised of materials dredged from the navigation channels of the lower Willamette and Columbia Rivers. The percent cover and species of vegetation varies greatly in these habitats, due to the frequency of disturbance by deposition and maintenance of dredge spoils. The vegetation ranges from areas dominated by tall grasses and forbs, to areas with low dense grasses, to areas with scattered forbs and grasses and bare ground. In the spring there are often dense patches of two colored lupine (Lupinus bicolor). These areas provide similar functions found in prairie, meadow or grassland habitats, and some locations support grassland-associated wildlife species.

Invasive plant species can be the biggest threat to grasslands and sparsely vegetated area, as can colonization by woody-stemmed plants and succession into shrubland. Grasslands are more limited in terms of food supply and cover for wildlife; however, several songbirds are known to forage and nest in this habitat type. Red-tailed hawks and owls use perch sites along the forest edge to located and feed on small mammals and ground feeding birds in grasslands.

Part of the sparsely vegetated area in this resources site is the T6 Dredge Material Handling Area. This area is located on the southern side of the Oregon Slough between the river and Marine Drive, just east of the Honda/AWC facility. This portion of Terminal 6 contains a dredge material deposit area and three earthen cells connected by drainage pipes, constructed for the purposes of handling, dewatering and removing dredge material. The cells were constructed to control vegetation encroachment in the cells. There is also a power line corridor that crosses the site.

While not a native grassland, the vegetation types, structure and density mimic a native grassland habitat. The T6 Dredge Material Handling Area is dominated with non-native grasses and mosses, with pockets of blackberry and scotch broom, cottonwood and willow. Bordering the grasslands, adjacent to the Oregon Slough, is a strip of mature cottonwoods, willows and ash with some native understory including snowberry, stinging nettle, red-osier dogwood and sword fern. Portions of this habitat type are within the flood area. The grassy and sparsely vegetated area functions in relation to adjacent habitats. The location along the Columbia River creates a unique habitat association in Portland. Grasslands associated with rivers, streams, or wetlands, serve as migratory stopovers for north-south and east-west flyways.

The placement of dredge materials and maintenance of the area mimics disturbance that once occurred naturally. The management of the area maintains early succession vegetation and areas of bare soil. This

disturbed grassland matrix offers a diversity of vegetation height and density, and provides habitat for various grassland birds including the at-risk songbird Western meadowlark.

Grassland-associated wildlife species documented to use the T6 Dredge Material Handling Area include American kestrel, savannah sparrow, and Western meadowlark. The western meadowlark is experiencing population decline, due in large part to declining grassland habitat availability and is an at-risk species. Western meadowlark migrate through the Columbia and Willamette River confluence area from Canada and eastern Oregon. A flock of Western meadowlarks were observed using the area during multiple site visits in fall and winter of 2011. However, no western meadowlarks were observed during surveys of the grassland and dredge spoils areas in spring and fall of 2012, or during surveys in winter, spring and fall of 2013 (PHS 2013, 2014). Western meadowlarks are most closely associated with native prairie communities, fallow fields, and pastures; cultivated grass fields and hayfields offer marginal habitat in the Willamette Valley (Altman 1999; Davis and Lanyon 2008). The Western meadowlarks are attracted to grasslands the T6 Dredge Material Handling Area because of its association with the Columbia River and Smith and Bybee Wetlands, its relative isolation from intense urban development, and patches of blackberry and scotch broom that provide singing perches.

Other wildlife observed at the T6 Dredge Material Handling Area include: six osprey nests (all located on structures), red-tailed hawk, varied thrush, yellow rumped warbler, scrub jay, American gold finch, bewick's wren, Lincoln's sparrow and downy woodpecker. Also seen were coyote scat, vole holes, deer mouse and evidence of deer browsing.

The T6 Dredge Material Handling Area is designated a Special Habitat Area because it meets the following criteria:

(C) - wildlife connectivity corridor habitat
(G) - feature important to individual grassland-associated species or assemblages of grassland-associated species on more than an incidental basis
(S) - an *at-risk* species (western meadowlark) uses the habitat area or feature on more than incidental basis to complete one or more life history phases

<u>Wetland:</u>

There is an approximate ¾ acre area within Terminal 6 with wetland vegetation characteristics. The site is to the north of the container dock in front of the Hyundai/Ford auto import/export facility that utilizes Berth 601.

The Berth 601 riparian area with wetland vegetation characteristics is non-jurisdictional and is based on a vegetative land cover classification that characterizes it as riparian wetland cottonwood, willow scrub-shrub. The area with wetland vegetation characteristics has not been delineated and therefore is described as having a characteristic of wetlands. The area was identified in the Port's Natural Resource Inventory dated in 2007, (the basis of the City's wetland inventory) as characterized by the presence of hydrophytic vegetation and is located within the flood area.

Scrub-shrub wetlands support persistent emergent wetland vegetation types and may have shrubs around the fringe. This wetland type provides a variety of food, cover and nesting for aquatic and terrestrial wildlife species; flood storage; and sediment, chemical and nutrient filtering and cycling services.

The wetland on Terminal 6 is designated a Special Habitat Area because it meets the following criteria:

(W) – Wetlands

<u>River bank and upper beach:</u>

The river bank along the south shoreline of Oregon Slough is a mix of primarily beach and vegetated banks. The gently sloped sand-to-mud beaches transition up into the mature but narrow cottonwood-dominated

riparian buffer. With rise in elevation, the beach transitions from seasonally and tidally inundated shallow water habitat into riparian forest. Areas with intact forest along the river bank periodically contribute large pieces of wood to the shoreline, creating complex wood structures that provide habitat for native fish.

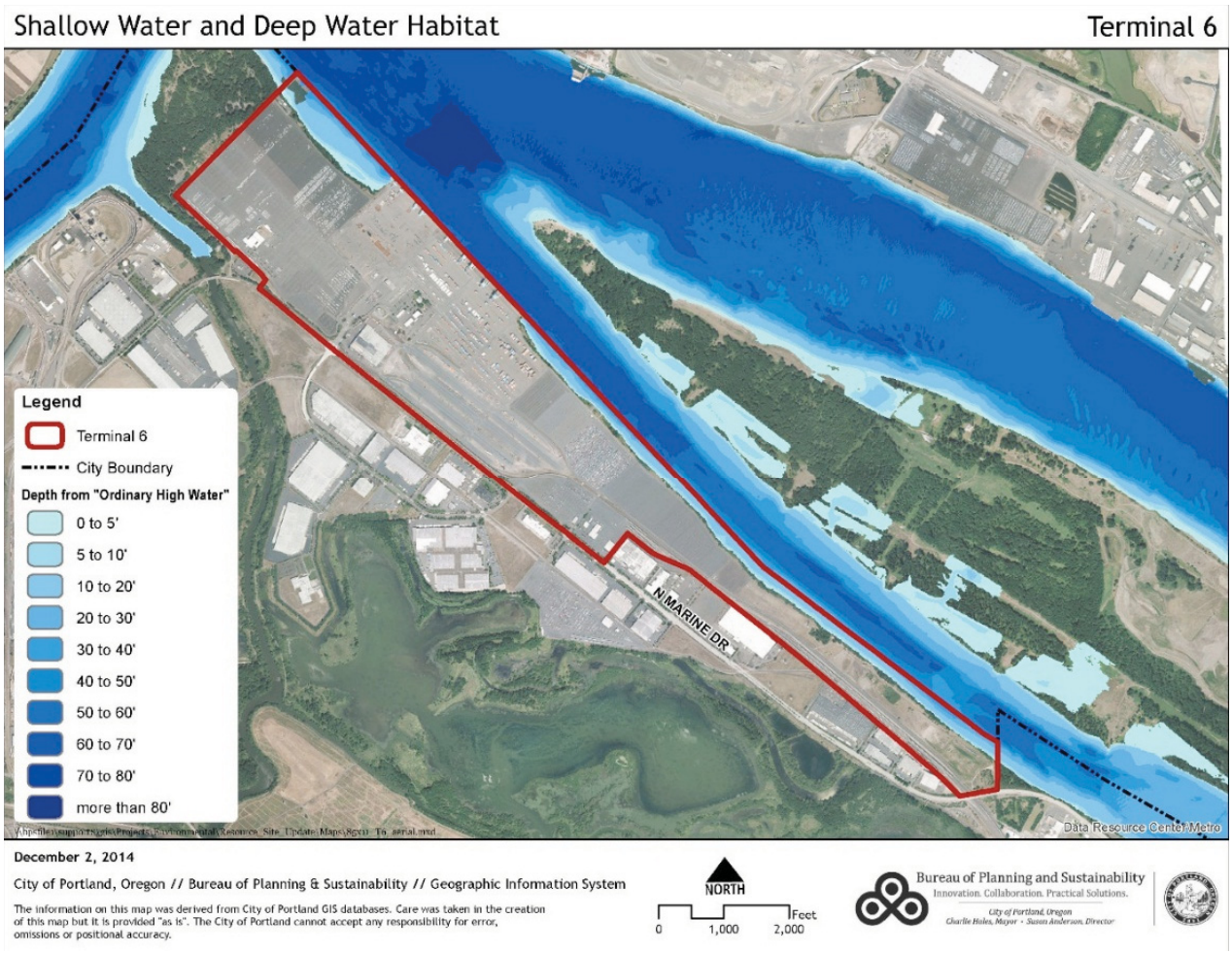
In addition, large wood may be recruited from elsewhere in the watershed and deposited on the beach. The logs and rootwads settle out of the river's water column and are left behind as water recedes, providing habitat structure for fish, bugs and wildlife. The large wood may also provide shoreline stabilization and food web (detritus and invertebrates) input for near-shore plant and animal species. During high water (November-June), the river inundates the beaches and up the roots and lower branches of the riparian forests along the shoreline. Along these areas an intricately undercut matrix of tree trunks and roots has formed that provides rearing habitat for juvenile salmon and trout.

During 2010 field visits birds observed in the upper beach and open water included yellow rumped warblers, scrub jay, American gold finch, bewick's wren, downy woodpecker, cormorant, common merganser, great blue heron, belted kingfisher, Canada geese.

The riverbank and beaches along the south shoreline of Oregon Slough near Terminal 6 are designated a Special Habitat Area because they meet the following criteria:

(C) - wildlife connectivity corridor habitat
(B) – bottomland hardwood forests
(M) – migratory stopover habitat

<u>Shallow water and open water:</u>
Shallow water habitat in the Lower Columbia River is characterized by shallow grade, sand and mudflat beaches that unite with undercut banks and vegetated riparian areas. This shallow water area provides important habitat functions such as velocity moderation and food production that support aquatic organisms. The shallow water habitat of the Lower Columbia River has been designated as *critical habitat* for federally listed ESA species. Critical habitat is defined as the area between ordinary high water ("OHW") and 34 feet below OHW (NAVD88 vertical datum), and includes river banks and floodplains that maintain depths from 0.3 to 6.6 feet during the lower river's tidal cycle. The elevation of OHW around the Terminal 6 site is approximately 20 feet in NAVD88.



The condition and function of the near-shore environment at Terminal 6 varies depending on geography. The exposure of the shoreline along the Oregon Slough side channel within the Terminal 6 site is subject to a lower volume of shipping traffic and associated wave energy as compared to other portions of the river; this results in less impacts to the river bank and allows the bank to maintain a smaller/softer substrate and deeper undercut bank features. Large wood is mostly recruited from the local shoreline's riparian zone rather than from elsewhere in the Columbia Basin; however, several very large pieces (48" + DBH) were inventoried recently, and were obvious transplants to the slough's beaches.

For salmonid juveniles migrating out of the Columbia River system, shallow water habitat is where they begin experiencing a lower energy and wider channel shaped by tidal action as they transition into the marine environment. These fish can have extended rearing and outmigration periods in the lower river prior to transitioning into their marine life history phase, both of which are advantageous to marine survival and life history diversity (Myers et.al. 1998). The longer these fish reside in and feed on the estuary's diverse food web, the larger and more robust they become, increasing their ability to escape predators and fend off parasites and bacteria that commonly impact their health in the ocean environment. For the eulachon, shallow water habitat is where spawning, incubation and rearing life stages are completed before these fish pass onto their ocean life phase.

Columbia River fish are known to use shallow water habitat for several survival strategies during their juvenile life stages. For instance, juvenile salmon and trout forage for prey in sand, gravel, woody debris, and submerged vegetation, as well as on the river's surface and in its water column for floating or swimming

prey. Juveniles also seek refuge from high flow events and predators by hiding in woody debris, undercut banks, and both overhanging and submerged vegetation, all vital requirements of functioning shallow water habitat. Shallow water habitat also plays an integral role in building and maintaining the aquatic food web by providing substrate on which detritus develops. The detritus supports invertebrates that hatch year-round and feed fish, amphibians, birds, and mammals.

Adult fish use shallow water habitats for several survival strategies as well. Although most anadromous species are not actively foraging during this life stage (salmon and eulachon in particular), they utilize shallow water habitat features such as woody debris, undercut banks, overhanging vegetation, and submerged vegetation to rest and recharge energy needed for long upstream migrations, and to avoid predators such as raptors, pinnipeds, and humans.

The distance between shallow water refugia is important to the health and survival of salmonids. Long periods of sustained swimming between refugia habitats deplete energy reserves. Fish with low energy resources caught migrating between refugia areas are more vulnerable to predation, as their flight response diminishes with a reduction in stamina. The more "pit stops" fish can make along their way up and downstream, the more likely they will complete migrations in good health. Therefore, salmonid productivity and survival is expected to be greater in locations with the shortest distance between refugia where the fish can rest, feed, and rebuild their energy supplies (C.L. Groot, 1995; M.B. Foreman, 1990; R.C. Eaton, 1991; Sauter, 2001; Sedell, 1990).

Fish abundance in rivers is correlated with the abundance and quality of riparian cover (Bjornn and Reiser 1991). While cover is an important aspect of salmonid habitat it is hard to define. Cover is vegetation and woody debris that is periodically inundated with water. The reduced abundance of high quality cover in the lower river, adequately spaced to facilitate predator avoidance and resting regimes, limits salmon and trout production.

Seasonal fish use studies were conducted by Ellis Ecological Services during the winter-spring seasons of 1997 - 1999. The study sampled 24 fish species in shallow water habitat at 19 sampling sites in Oregon Slough and Columbia River nearshore habitats (see map below). Electrofishing was the primary method of capture; however, in areas inaccessible to the boat-mounted electrofisher, alternative sampling techniques like beach seining and backpack electrofishing were employed.

All sites were characterized with sand and silt substrate; however, stream bank characteristics ranged from mature riparian canopy with complex cover, to rip rapped shorelines in industrial areas with vegetation dominated by Himalayan blackberry. The table below is a list of fish species observed during the two sampling events. All salmonids caught were yearling or sub-yearling juveniles.

Table 6: Partial List of Fish Species Caught at Hayden Island December 1997-April 1999 (Ellis, 1999

Winter – Spring 1998			Winter – Spring 1999		
Species	**#**	**% catch**	**Species**	**#**	**% catch**
Chinook Salmon	1153	25.5	Chinook Salmon	550	47.3
Coho Salmon	10	0.2	Coho Salmon	17	1.5
Chum Salmon	0	0	Chum Salmon	16	1.4
Steelhead Trout	45	1.0	Steelhead Trout	58	5.0
Cutthroat Trout	0	0	Cutthroat Trout	2	0.2
Mountain Whitefish	5	0.1	Mountain Whitefish	2	0.2

White Sturgeon	24	0.5	White Sturgeon	0	0
Sculpin, spp.	238	5.3	Sculpin, spp.	22	1.9
Largescale Sucker	1147	25.3	Largescale Sucker	348	29.9
Three-spine Stickleback	347	7.7	Three-spine Stickleback	10	0.9

* The results are inclusive of all sites around Hayden Island because the species individuals-by-site data were not available for analysis.

Sandy substrate in the Lower Columbia River are also important for Pacific and river lamprey. Adult lamprey spend up to one year in the Columbia River after returning from the ocean to overwinter. Adults use the channel margin and pool habitats to utilize cover from predators. Spawning takes place in low gradient river habitats with gravel and sand-dominant substrate. After broadcast dispersion, eggs incubate for two to three weeks on the substrate they attach to; thereafter, the young swim into low velocity habitats and burrow in muddy substrate for the next four to six years. Shallow water habitat in the Columbia River is characterized by low gradient, low velocity conditions and is likely used by Pacific lamprey in all life stages (PSMRC, 1997).

Waterfowl and shorebirds feed on exposed mudflats of shallow water habitat as they migrate along the river channel during periods of low tide and/or low flow. Soft substrate beaches are highly productive for invertebrates, a primary food source for large numbers of shorebirds and songbirds. During 2010 field visits birds observed in the upper beach and open water included yellow rumped warblers, scrub jay, American gold finch, bewick's wren, downy woodpecker, cormorant, common merganser, great blue heron, belted kingfisher, Canada geese.

The shallow and open water habitats within the inventory site are designated as a Special Habitat Area because they meet the following criteria:

(C) - wildlife connectivity corridor
M) - migratory stopover habitat
(S) - an *at-risk* species uses the habitat area or feature on more than incidental basis to complete one or more life history phases

Hydrology:

The Columbia River Basin is the most hydroelectrically developed river system in the world. More than 400 dams including 11 dams on the mainstem and hundreds of major and modest structures on its tributaries, block river flows and tap a large portion of the Columbia's generating capacity: more than 21 million kilowatts (Lang 2011). The Bonneville Dam, completed in 1938, is the most downstream dam on the Columbia River (RM 146).

Before the hydroelectric effects of dams impacted the river's hydrology, much of the floodplain were regularly inundated with water several times a year. In addition to sustaining bank habitat function and bottomland hardwood forests, these natural flood events contributed to the creation and maintenance of shoal and alluvial habitats. In effect, the dams have normalized river flows, thereby reducing peak flows and eliminating the smaller, more regular floods that historically shaped and maintained valuable river habitat resources. This has also modified the function of lower river habitat by shifting sediment budgets and food webs, changing habitat and food availability, and influencing the migratory patterns of estuarine fish and wildlife.

The hydrology within the study area is tidally-influenced. The tidal range in this reach of the Columbia River is between three to four feet, depending on the season and the lunar cycle. The natural rise and fall of the elevation maintains dynamic shoreline habitat along the Oregon Slough beach where the river is connected to its floodplain. The habitat includes embayments, pocket beaches, backwater slough and wetlands, undercut banks, embedded logs and rootwads, and a wrack line of woody debris accumulation. The daily water level fluctuations are a key habitat forming processes. The Columbia River hydropower system has impacted flow characteristics in relation to tidal ebb and flow dynamics, which negatively impacts habitat-forming processes. The elevating and fortifying of some portions of the river banks also impact habitat-forming processes by reducing the capacity of the river to inundate its floodplain.

The Lower Columbia River and Oregon Slough within the Terminal 6 site includes two periods of significant freshets (high flows). The winter (December-February) and spring (April-June) events provide conditions that serve Pacific salmon during rearing and migration life stages. For juvenile fish that pass through the estuary quickly, the increased outgoing flows facilitate transport through to the ocean. The regulation of flood flows by the Bonneville Dam has dampened the capacity of natural flood events, and affected the rearing and migratory life history strategies of the Columbia River's salmon and trout.

Terminal 6's surface and groundwater hydrology is most influenced by precipitation (average of 36.3 inches per year at the Portland International Airport), river elevation and, to a limited extent, tidal action (USACOE 2004). The Columbia River's flood conveyance and capacity are directly related to connectivity between its floodplain and flows. The Columbia River's floodplain plays a role in mitigating flood hazards because it moderates downstream flood peaks through temporary upstream storage of water. The vegetated floodplain also helps stabilize banks and reduce erosion. These floodplain functions are provided by both native and non-native vegetation; however, native vegetation provides more varied natural resource functions including wildlife food sources and nesting opportunities.

In the 1920s, the Port of Portland, in coordination with the U.S. Army Corps of Engineers, constructed spur dikes or rock and timber groins along the shoreline of the Oregon Slough in the vicinity of Terminal 6. These

structures trapped sediment, directed water flows and influenced beach development along Oregon Slough's shoreline. These changes affected Oregon Slough's hydrology through narrowing the channel and increasing the flow velocity.

In addition to building dikes along the Oregon Slough, the floodplain and side channels historically found the inventory site have been filled. The western half Terminal 6 is located on what was once a dynamic island. During the 1920's the US Army Corps of Engineers disposed of materials dredge from the Columbia River in this area as well as on West Hayden Island. By the 1940's the side channel was filled in.

Building dikes along the river bank and filling in the floodplain significantly decrease beach and bank area as well as flood storage. The southern bank of the Oregon Slough within the Terminal 6 site has been diked and/or otherwise elevated using dredge spoils over many years to just west of the railroad bridge. Dikes prevent overbank flow and affect the connectivity of the river and floodplain (Tetra Tech Inc. 1996); thus the diked floodplain is higher than the historical floodplain, and inundation of floodplain habitats only occurs during times of extremely high river discharge (Kukulka and Jay 2003). Elimination of overbank flooding can prevent the pulsed delivery of structural and energetic components to the rest of the estuary, including large wood, sediments, detritus, and prey organisms produced in adjacent riparian and floodplain habitats such as those found on nearby West Hayden Island.

Even with all of the changes to hydrology of the Columbia River and Oregon Slough and placement of fill within the floodplain, flooding still occurs on Terminal 6. In 1996, warm rains falling on melting snowpack within the entire region resulted in a large flood event. The undeveloped nature of much of the shoreline allowed high water to overflow bank and inundate the floodplain, providing some flood storage capacity in vacant, non-developed lands. The flood storage function in vacant areas can mitigate the impact of flooding in developed areas.

The floodplain-river connection is an important function for fish and wildlife for habitat maintenance. Floodplain inundation can also greatly increase the surface area of tidal estuarine and riverine habitats available to salmonids, allowing fish to explant their distribution into potentially more produce off channel habitat (Fresh et. al., 2005). For example, recent studies in the nontidal portion of the lower Sacramento River found that tagged juvenile Chinook salmon released in the seasonally inundated floodplain had better growth, higher consumption rates, and improved survival compared with others released into the main river channel (Sommer et. a., 2001)

Ecosystem Services Provided to Development

As stated in the economic and social sections, wildlife habitat resources provide multiple services to associated development; these are called *ecosystem services*. Examples of the ecosystem services provided by wildlife habitat resources include air purification, maintenance of water quality and quantity, cooling, aesthetics, and screening and buffering.

Development Impacts on Wildlife Habitat Resources

Development can have many negative impacts on wildlife habitat resources. Development often involves removing vegetation and increasing impervious area, reduces the overall size and complexity of existing resources features, and increasing habitat fragmentation, and exacerbating the decline of rare habitats such as bottomland hardwood forests and habitats that support at-risk grassland-associated species. Development can also involve filling wetlands and flood areas which also degrades habitat quality, quality, and functionality. River-dependent or river-related development can disturb or degrade sensitive beach and shallow water habitat areas. Often mitigation for these impacts is required through federal, state or local regulations; however mitigation actions rarely can replace all impacted features or functions in full (ECONorthwest, 2012).

Development also has negative impacts on adjacent remaining habitat. Reducing the size of the habitat increase the edge to interior habitat ratio. Noise, light, and vibration from the development penetrates into the edge of the remaining habitat. Impacts from actions like construction can last long-after the action is completed. Physical pollution, such as chronic noise, light and movement, have negative environmental impacts, including significant changes in migration, foraging, predator-avoidance behaviors, reproductive success, and community structure of many fish and wildlife species (Barber et.al., 2009). Light pollution can affect salmon migration (Tabor, 2011) and noise pollution can have impacts on bats. Chemical pollution from industrial accidents, effluent discharge, and particulate releases also disrupt similar behavior and life history strategies of fish and wildlife. Some species can adapt to such changes to their environment; however, many others cannot.

Large ships that berth at port facilities can also inadvertently transport invasive plants and wildlife. Regulations have been put in place to manage the dumping of bilge water so that non-native aquatic species and other pollutants are not introduced into rivers and streams. Also, rail infrastructure, particular heavy metals from brake dust, are of concern for water quality.

Climate Change Mitigation, Adaptation and Resiliency

Climate change impacts are already evident, both globally and in Oregon, and more impacts are inevitable, if uncertain. Portland has strong policies and plans both to reduce carbon emissions that contribute to global warming, and to prepare and adapt to the potential impacts of climate change. The City and County also engage in regional climate resiliency efforts, including collaborating with local jurisdictions in throughout the Willamette Valley.

To adapt successfully to climate change, the City and the region must understand and prepare. Portland's Climate Action Plan calls for a comprehensive review to better understand the possible and the likely impacts of climate change. The purpose is to assess climate-related vulnerabilities, and the strengths and resiliency of: local food, water and energy supplies, infrastructure, transportation and freight movement, floodplains, watersheds, public health, public safety, social services and emergency preparedness.

The City of Portland is monitoring the latest science and modeling efforts to help inform adaptation planning and resiliency efforts. The City adopted its first Climate Change Preparation Strategy in 2014 that presents the expected effects of climate change, Portland's vulnerabilities to these impacts, and priority actions to mitigate and adapt to those changes. The CCPS recognizes the importance of healthy natural systems, including rivers, wetlands, floodplains, and vegetated areas as key elements of the City's climate adaptation strategy. Maintaining diverse habitats and habitat corridors will be critical for resident and migratory wildlife that may be required to adapt their behaviors and life cycles to changes in air and water temperature, weather patterns, habitat ranges, and food sources.

It is also important to recognize that ocean marine and barge shipping produces less CO2 emissions than any other modes of transporting goods. Shipping by train results is the second least polluting transport modes. The location of Terminal 6 on the Columbia River shipping channel and with access to rail lines allows it to take advantage of these more efficient modes of transportation. From a regional standpoint, moving a greater number of goods via ship and rail uses less fossil fuel and can reduce the per ton carbon footprint, especially since a greater volume of goods can be transported by these modes.

Regulatory Compliance

Fourteen fish species use the Columbia River and shallow water habitats in the inventory site are listed under the federal Endangered Species Act. After the 1998 listing of steelhead trout in the Lower Columbia River, the City of Portland began developing a comprehensive, coordinated citywide response for City Council adoption (Resolution No. 35715). The City Council established an intent to avoid "take" of a listed

species (i.e., harming individuals or populations or their habitat), and to assist with recovery of listed fishes. The City has since taken actions such as identifying and prioritizing City programs that could affect listed species, providing technical support to bureaus, providing oversight for activities involving federal permitting or funding, and developing a watershed management plan to help guide city actions. The protection and enhancement of habitats critical to threatened and endangered species are important actions to aide in the recovery of listed species.

Several regulations address the types of wildlife resources that currently exist in the Terminal 6 site (e.g. Clean Water Act, ESA). Regulatory compliance is important for the City of Portland to avoid cost and liability, and because Portland values its role as a leader in sustainability and environmental protection and management. Non-compliance with environmental regulations results a greater loss of habitat and wildlife species.

Environmental Consequence Analysis

To evaluate the potential environmental consequences of different resource protection program options, three scenarios or policy choices are assessed: allowing, limiting and prohibiting conflicting uses that would adversely affect wildlife habitat resources in the Terminal 6 site. The positive and negative consequences of the program choices are evaluated from the perspectives of both the conflicting uses and the significant wildlife habitat resources identified in the inventory. As such, the program choices would result in different mixes of positive and negative environmental consequences as indicated below.

In evaluating the consequences of allowing conflicting uses it is assumed that significant natural resources would be subject to development allowed by regulations that apply in the base zone. It is also assumed that mitigation for impacts on wildlife resources would not be required.

In evaluating the consequences of limiting conflicting uses it is assumed that rules would be established to limit the impacts of allowable development in areas containing significant natural resources. Areas containing significant wildlife resources could still be subject to development, but development restrictions would exist in addition to base zone regulations. For example, the type, location or extent of development could be restricted. Another example, development could be required to avoid adversely affecting natural resources where practicable, and to mitigate for unavoidable impacts. Another example would be to restrict the type of development allowed.

The recommendation to limit conflicting uses can also be implemented by relying on or updating the City's existing environmental program which uses conservation and protection overlay zones or the recommendation could be implemented through specific code provisions in a plan district. Plan Districts are area-specific zoning codes that may include provisions related to natural resource management and development. Another tool are master plans, such as the Comprehensive Natural Resources Plans (CNRPs) and Natural Resource Management Plans (NRMPs) which can be established for sites in environmental overlay zones, provide another mechanism to coordinate development, natural resource enhancement, mitigation, recreation and other activities.

In evaluating the consequences of prohibiting conflicting uses it is assumed that rules would be established that preclude all allowable development in significant natural resource areas.

The following tables addresses the potential environmental consequences associated with the three programmatic approaches. Consequences are described, and further represented by these symbols:

- (+) more substantial positive than negative consequences
- (-) more substantial negative than positive consequences
- (+/-)positive and negative consequences of development are generally balanced
- (o) consequences would be neutral or negligible

The first table outlines the environmental consequences of allowing, limiting or prohibiting identified conflicting uses from the perspective of the conflicting uses. The second table provides an explanation of the natural resource consequences of these program choices by conflicting use.

Environmental Consequences for Conflicting Uses

	Allow		Limit		Prohibit	
Industrial	1. Would reduce functions provided by natural resources including air purification, maintenance of water quality and quantity, air and water cooling, organic inputs, wildlife habitat and connectivity, aesthetics, screening and buffering between land uses. 2. Would require replacement of some lost functions with hard infrastructure (e.g. erosion control) but would not need to replace a broader range of lost functions.	-	1. Would, by requiring mitigation, help maintain some or most functions provided by wildlife resources including air purification, maintenance of water quality and quantity, air and water cooling, wildlife habitat and connectivity, aesthetics, screening and buffering between land uses. 2. Would require replacement of some lost functions with hard infrastructure (e.g. erosion control) but would not need to replace a broader range of lost functions. Some impacts to function would require off-site mitigation.	+/-	1. Would maintain functions provided by natural resources including air purification, maintenance of water quality and quantity, air and water cooling, aesthetics, screening and buffering land uses. 2. Could reduce local transportation related carbon emissions associated with trips generated from Terminal 6. However, could increase carbon emission within the region if more goods are shipped by truck and/or air, rather than by water or train.	+/-

Environmental Consequences for Natural Resources

Base Zone	Resource Ranks	Allow		Limit		Prohibit	
Industrial	**High, Medium Wildlife Habitat (including SHA)**	1. Would result in loss of rare and declining habitat types significant wildlife habitat functions. All wildlife habitat functions would be affected by conflicting uses within area of high and medium ranked resources and Special Habitat Areas. 2. Could complicate efforts to comply with regional, state and federal requirements (e.g., ESA, CWA). 3. Could exacerbate declines in at-risk species and increase chance for future ESA listings of at-risk fish and wildlife species in the study area. 4. Could reduce, incrementally, the capacity of the region to adapt to climate change. 5. Would affect environmental functions in remaining, adjacent natural resource areas (e.g. noise, light).	-	1. Would, by requiring mitigation, maintain most wildlife habitat functions. Some of those benefits would be shifted elsewhere through off-site mitigation. Some functions, such as habitat patch size, shape, and location, cannot easily be mitigated for, so fully compensating for loss of resource functions will be difficult. 2. Limitations on development would support efforts to comply with regional, state and federal requirements (e.g., ESA, CWA). 3. Would, by requiring mitigation, help avoid increased risk of future ESA listings of at-risk fish and wildlife species in the study area. 4. Would, by requiring mitigation, help retain the region's capacity to adapt to climate change. 5. Would maintain the opportunity to require mitigation for development impacts on adjacent natural resource areas (e.g. noise, light).	+/-	1. Would not exacerbate decline of key habitat types and would maintain significant functions provided by high and medium rank wildlife habitat resources and Special Habitat Areas. 2. Would support efforts to comply with certain state and federal requirements. 3. Would not exacerbate declines in at-risk species and increase the risk of future ESA listings of at-risk fish and wildlife species in the study area. 4. Would not affect the capacity of the region to adapt to climate change.	+
	Low	There are no low ranked wildlife habitat resource areas within the site.	o	There are no low ranked wildlife habitat resource areas within the site.	o	There are no low ranked wildlife habitat resource areas within the site.	o

Recommendation Based on Environmental Analysis

There is a range of positive and negative environmental consequences associated with allowing, limiting or prohibiting industrial development within areas of significant wildlife habitat resources. The primary factors to consider are functions including water and air quality, wildlife habitat resources and functions; climate change; and regulatory compliance. The following recommendation optimizes environmental values within the IH base zones:

Limit conflicting uses within areas of high and medium ranked wildlife habitat including Special Habitat Areas, except strictly limit uses within water bodies and in areas within 50 feet of a water body. Limiting conflicting uses would result in most development needing to avoid, minimize, or mitigate for adverse impacts on the wildlife habitat resources. This approach would help reduce impacts of development on critical ecosystem services that contribute to public health and safety (e.g., air quality, water quality). Strictly limiting uses within water bodies and in areas within 50 feet of water bodies would prevent direct impacts from marine-industrial and other industrial uses on critical water resources and would advance the City's compliance with state and federal regulations (e.g., CWA, ESA).

D. Energy Analysis

This section of the ESEE analysis outlines the energy consequences of allowing, limiting or prohibiting conflicting uses. The analysis addresses the following topics: transportation, infrastructure, and on-site energy consumption, including heating, cooling, and lighting. The discussion will address both energy consumption and associated carbon footprint. A general discussion of these topics is provided below.

Transportation

Energy expenditures for industry-related transportation relate primarily to travel distances from origin to destination and the mode of transportation used. Both variables can be affected by natural resource protection in terms of the location of development and routing of transportation facilities. The marine terminal and industrial lands within the Terminal 6 site provide an energy-efficient location for businesses that move goods. Existing air, road, rail and water transportation infrastructure facilities are in close proximity to existing and proposed industries and businesses in the Terminal 6 site, which provides opportunity to optimize transportation options to manage energy consumption.

In addition, ocean marine and barge shipping produces less CO2 emissions than any other modes of transporting goods. Shipping by train results is the second least polluting transport modes. The location of Terminal 6 on the Columbia River shipping channel and with access to rail lines allows it to take advantage of these more efficient modes of transportation. From a regional standpoint, moving a greater number of goods via ship and rail uses less fossil fuel and can reduce the per ton carbon footprint, especially since a greater volume of goods can be transported by these modes.

The availability of jobs near housing reduces commuter miles and energy consumption. Terminal 6 provides employment opportunities within close proximity to neighborhoods in the cities of Portland and Vancouver. The regional availability of alternative modes of transportation, such as buses, light rail, and walking and cycling routes, can also help reduce transportation-related energy consumption.

Infrastructure

Infrastructure services require energy to construct, operate and maintain. Efficient site design enables the provision of adequate sewer, stormwater, and water services while reducing overall demand for infrastructure (e.g., shorter lines, more efficient stormwater and wastewater treatment). Efficient site design can also allow development to avoid significant wildlife resources.

Wildlife habitat resources are considered part of the infrastructure of the city and are referred to as “green infrastructure”. Wildlife habitat resources provide important services including stormwater management, water quality regulation and air purification. When these functions are eliminated they must be replaced with hard infrastructure such as pipes, erosion control, etc. Portions of Terminal 6 are providing such services.

Further development and intensification of Terminal 6 would require substantially less energy expenditure than similar development at a greenfield site, leveraging existing public investment in billions of dollars of infrastructure. Examples onsite include making use of existing rail, driveways, roads, Berths 601-607 and utility infrastructure.

Heating and Cooling

For many land use and development types, including some industrial development, the energy demand for heating and cooling structures can be affected by site design, building design and construction, and presence of trees, vegetation or water bodies. The orientation of buildings and vegetation to maximize solar heating in the winter and shading in the summer can reduce demand for supplemental heating and cooling. Retaining trees, vegetation and water bodies, and planting new trees and vegetation on development sites

can help reduce ambient air temperature and maintain local humidity. Vegetation can also create windbreaks that slow or divert cold winter winds and reduce heat loss. Construction techniques that reduce the surface to volume ratio of a building, and the use of insulation, energy-efficient building materials, daylighting, passive ventilation, and a variety of other strategies can also help reduce building energy needs.

In the case of heavy industrial sites, specifically marine terminals such as Terminal 6, it can be challenging to retain sufficient vegetation to affect heating and cooling needs for large buildings and facilities. Although site coverage and configuration may vary, marine terminal sites are generally developed with extensive impervious areas for structures, indoor and outdoor storage, cargo loading and unloading, and vehicle access and maneuvering. It is possible to design some sites to maintain large areas of grassy vegetation, which would not have a large impact on building heating and cooling but could reduce the heat island affect caused by large paved surfaces.

Lighting

Marine terminals such as Terminal 6 involve extensive lighting systems. In addition to indoor lighting needs, lighting is generally required for large expanses of work area outdoors and the possibility of loading and unloading operations continuing 24-hours a day. Worker safety regulations require a minimum amount of illumination. To reduce the energy consumption and relate costs of lighting, port operators can switch to newer technology bulbs that use energy more efficiently and install timers that turn off lights when not in use.

Energy Consequences Analysis

To evaluate the potential energy consequences of different resource protection program options, three scenarios or policy choices are assessed: allowing, limiting and prohibiting conflicting uses that would adversely affect significant wildlife habitat resources in the site. The positive and negative consequences of these program choices are evaluated from the perspectives of both the conflicting uses and the significant wildlife habitat resources identified in the inventory for this site. As such, the program choices would result in different mixes of positive and negative energy consequences as indicated below.

In evaluating the consequences of allowing conflicting uses it is assumed that significant natural resources would be subject to development allowed by regulations that apply in the base zone. It is also assumed that mitigation for impacts on natural resources would not be required.

In evaluating the consequences of limiting conflicting uses it is assumed that rules would be established to limit the impacts of allowable development in areas containing significant natural resources. Areas containing significant natural resources could still be subject to development, but development restrictions would exist in addition to base zone regulations. For example, the type, location or extent of development could be restricted. Another example, development could be required to avoid adversely affecting natural resources where practicable, and to mitigate for unavoidable impacts. Another example would be to restrict the type of development allowed.

The recommendation to limit conflicting uses can also be implemented by relying on the City's existing environmental program which uses conservation and protection overlay zones or the recommendation could be implemented through specific code provisions in a plan district. Plan Districts are area-specific zoning codes that may include provisions related to natural resource management and development. Another tool are master plans, such as the Comprehensive Natural Resources Plans (CNRPs) and Natural Resource Management Plans (NRMPs) which can be established for sites in environmental overlay zones, provide another mechanism to coordinate development, natural resource enhancement, mitigation, recreation and other activities.

In evaluating the consequences of prohibiting conflicting uses it is assumed that rules would be established that preclude all allowable development in significant natural resource areas.

The following tables addresses the potential energy consequences associated with the three programmatic approaches. Consequences are described, and further represented by these symbols:

- (+) more substantial positive than negative consequences
- (-) more substantial negative than positive consequences
- (+/-)positive and negative consequences of development are generally balanced
- (o) consequences would be neutral or negligible

The first table outlines the energy consequences of allowing, limiting or prohibiting identified conflicting uses from the perspective of the conflicting uses. The second table provides an explanation of the wildlife habitat consequences of these program choices by conflicting use.

Energy Consequences for Conflicting Uses

	Allow		Limit		Prohibit	
Industrial	1. Could increase energy consumption associated with additional shipping of goods but shipping by water or train would require less energy and have a smaller carbon footprint than shipping by truck and/or air. 2. Would reduce potential future regional transportation infrastructure needs by consolidating development near existing water, rail, and road infrastructure. 3. Would reduce potential future transportation energy demand by maintaining employment opportunities in close proximity to existing population centers. 4. Would require energy for lighting and building operations.	**+/-**	1. Could increase energy consumption associated with additional shipping of goods but shipping by water or train would require less energy and have a smaller carbon footprint than shipping by truck and/or air. 2. Would reduce potential future regional transportation infrastructure needs by consolidating development near existing water, rail, and road infrastructure. 3. Would reduce potential future transportation energy demand by maintaining employment opportunities in close proximity to existing population centers. 4. Would require energy for lighting and building operations.	**+/-**	1. Would reduce local transportation energy demand associated with trips generated in the study area. However, could increase energy consumption and carbon footprint if more goods are shipped by truck and/or air, rather than by water and train. 2. Would maintain benefits provided by existing natural resources, preventing the need for energy to construct required infrastructure. 3. Could increase future regional transportation infrastructure needs if future development is located further from existing rail, and road infrastructure. 4. Could increase transportation energy demand by moving employment opportunities further away from the population. 5. Would not increase energy demands related to additional on-site heating, cooling, lighting, and other operational needs.	**+/-**

Energy Consequences for Natural Resources

Base Zone	Resource Ranks	Allow		Limit		Prohibit	
Industrial	**High, Medium Wildlife Habitat (including SHA)**	1. Would reduce the energy benefits derived from wildlife habitat resources; some of those services would be replaced with infrastructure. 2. Additional carbon emissions could contribute incrementally to climate change.	**-**	1. Could, by requiring mitigation, maintain some of the energy benefits derived from wildlife habitat resources; some of those benefits would be shifted elsewhere through off-site mitigation. 2. Additional carbon emissions could contribute incrementally to climate change.	**+/-**	1. Would maintain benefits and functions provided by existing wildlife habitat resources, prevent energy demand associated with replacing those functions. 2. Would prevent additional carbon emissions in the study area, but could result in a net increase in carbon emissions if port facilities are sited further from major population centers.	**+**
	Low	There are no low ranked wildlife habitat resource areas within the site.	**0**	There are no low ranked wildlife habitat resource areas within the site.	**0**	There are no low ranked wildlife habitat resource areas within the site.	**0**

Recommendation Based on Energy Analysis

There is a range of positive and negative energy consequences associated with allowing, limiting or prohibiting industrial development within areas of significant wildlife habitat resources. The primary factors to consider are energy consumption and carbon footprint, and infrastructure. The following recommendation optimizes energy values within the IH base zones:

Allow conflicting uses within high and medium ranked wildlife habitat areas including Special Habitat Areas. Allowing conflicting uses would take advantage of the existing deep-water navigation channel and existing infrastructure of rail lines. It would reduce the need for additional regional transportation infrastructure and would support moving cargo via ship and rail, which uses less energy than transport by truck. It also takes advantage of the location of Terminal 6 near two dense population centers, which would reduce the energy consumption related to employee travel.

Summary and Final Recommendation

The analysis of the economic, social, environmental and energy consequences of different levels of resources protection results in a recommendations for each factor. The recommendations, summarized below, do not address low ranked wildlife habitat areas because none exist within the Terminal 6 site. The recommendations also do not address significant riparian resource areas because Goal 5 excludes water-dependent and water-related uses from being considered conflicting uses within riparian corridors. Terminal 6 is a river-dependent marine terminal and as such all of the uses within the site are water-dependent or water-related.

Economic recommendation:

Limit conflicting uses within high and medium ranked wildlife habitat areas including Special Habitat Areas.

Social recommendation:

Limit conflicting uses within high and medium ranked wildlife habitat areas including Special Habitat Areas.

Environmental recommendation:

Strictly limit conflicting uses within water bodies and land within 50 feet of water bodies.

Limit conflicting uses within high and medium ranked wildlife habitat areas including Special Habitat Areas located outside of water bodies.

Energy recommendation:

Allow conflicting uses within high and medium ranked wildlife habitat areas including Special Habitat Areas.

Final ESEE Recommendation

Considering the positive, negative, and neutral/negligible consequences associated with the conflicting uses within the Terminal 6 site, the recommended ESEE decision is:

> Limit conflicting uses within high and medium ranked wildlife habitat areas including Special Habitat Areas.

A limit decision provides the opportunity to continue utilizing of the Columbia River channel for transport of goods and services that require the deep-water access, while ensuring that negative impacts on significant wildlife habitat features and functions are avoided, minimized, and mitigated.

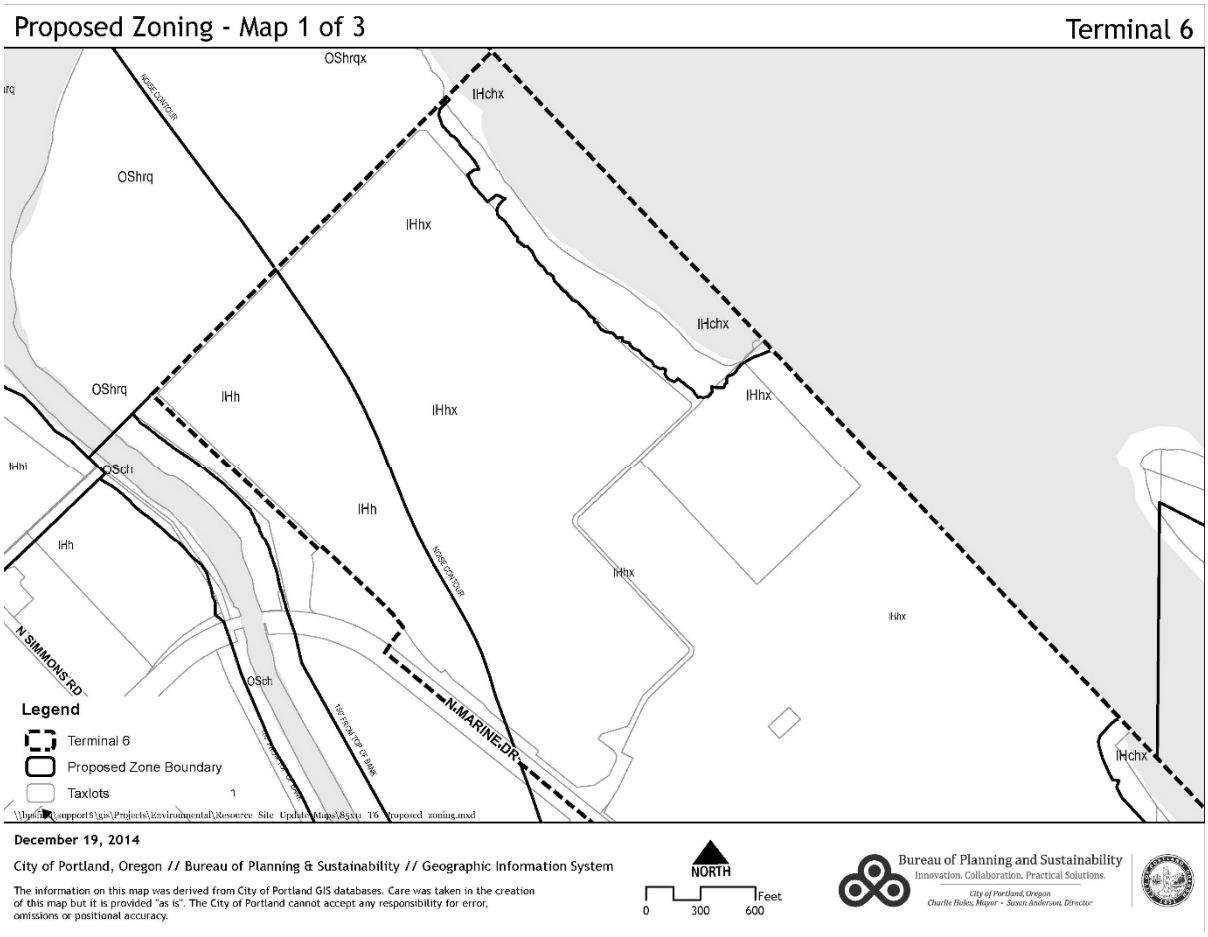
Implementation Tool

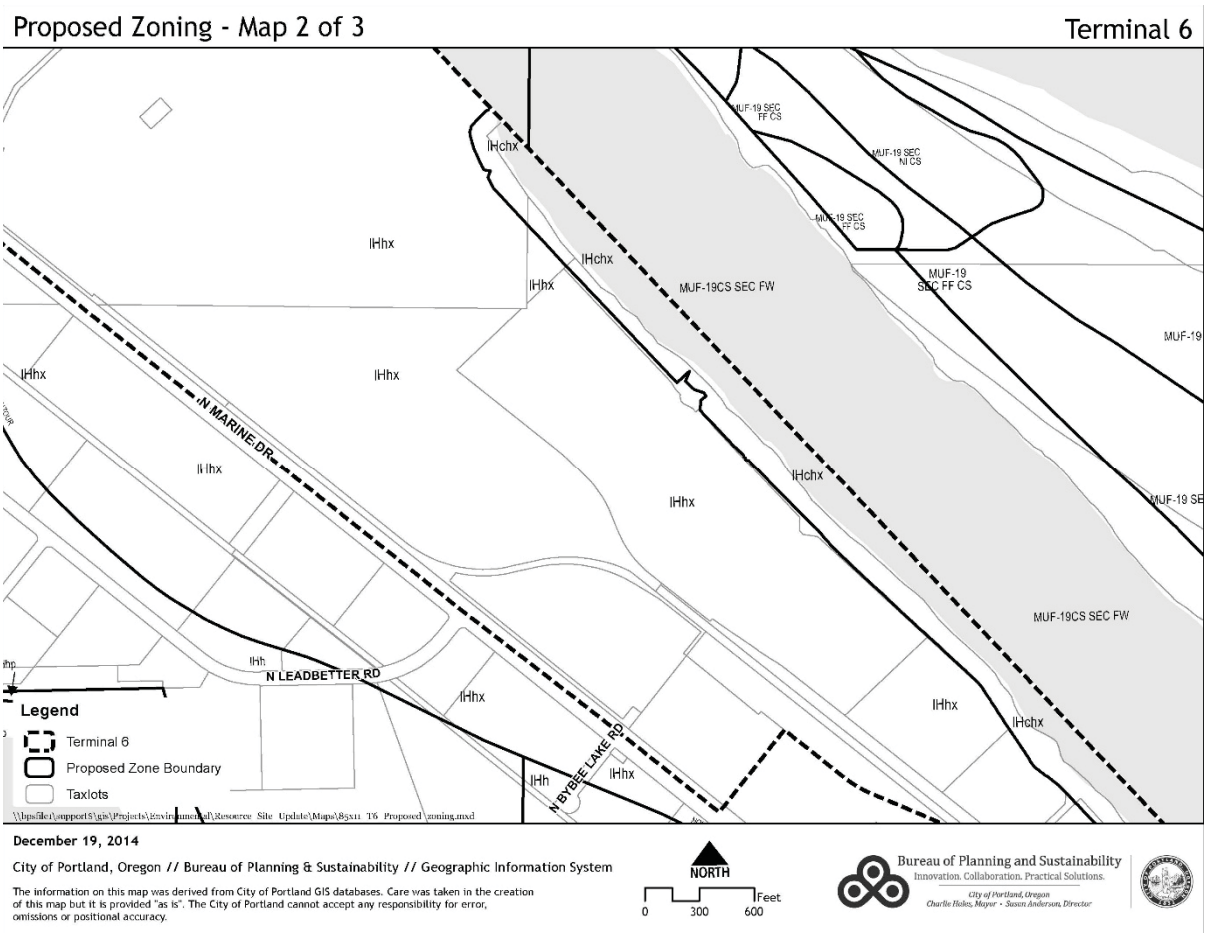
The ESEE decision is proposed to be implemented through application of the environmental conservation overlay zone to high and medium ranked wildlife habitat areas including Special Habitat Areas within the Terminal 6 site. The environmental conservation overlay zone is also proposed land within 25 feet of all high and medium ranked wildlife habitat areas in order to address the portion of the impact area that is not related to the riparian corridor.

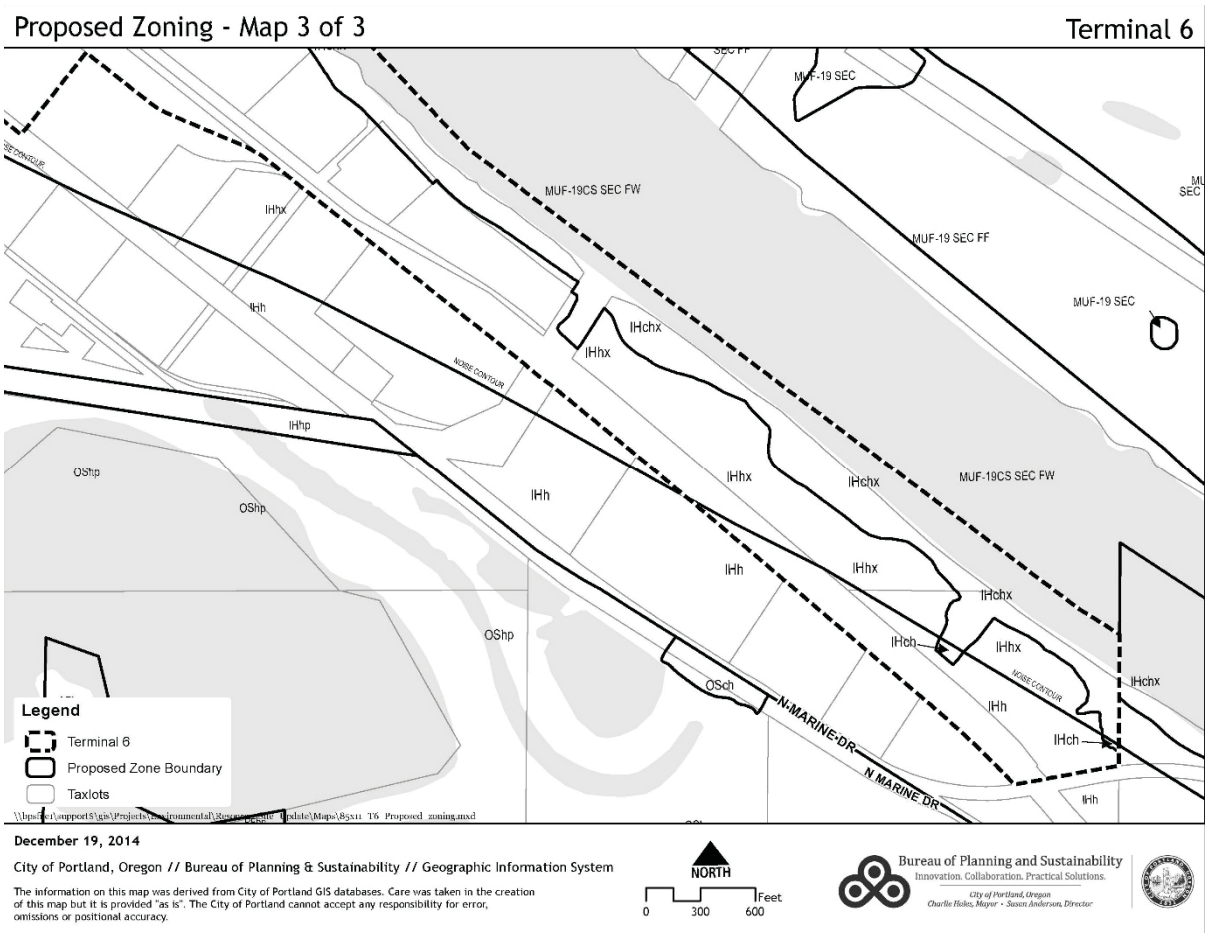
Statewide Planning Goal 9 requires that Portland provide an adequate supply of land for economic development and employment growth. An Economic Opportunities Analysis (EOA) is the tool used to assess whether Portland has an adequate supply. The City is currently in the process of updating its EOA, and the most recent draft shows a shortfall of industrial land. Environmental overlay zoning, along with physical constraints such as floodplain and wetlands, is presumed to reduce by 50 percent the development potential of vacant land, and therefore the capacity of the vacant land to provide employment opportunities. Developed land is not allocated employment capacity in the EOA. In order to ensure that the expanded environmental overlay zoning on Terminal 6 does not increase the shortfall, the environmental conservation overlay zone will be applied as follows:

- Vacant parcels. On vacant parcels the environmental conservation overlay zone will only be applied to high and medium ranked wildlife habitat areas that are currently within the environmental conservation overlay zone or within the FEMA 100-year floodplain. To comply with Goal 9 the City may not increase the existing shortfall of industrial land. The 2012 Buildable Lands Inventory methodology (a component of the EOA) reduced the development capacity of the FEMA 100-year floodplain by 50 percent, which is the same discount factor the BLI applied to represent the constraint associated with the conservation overlay zone. Therefore, applying the conservation overlay zone to the FEMA 100-year floodplain located outside of the existing conservation overlay zone will have no net impact on the industrial land capacity of the site. The environmental conservation overlay zone will not be applied to the impact area on the vacant parcels because that would increase environmental zoning in a way that would impact employment capacity and therefore increase the shortfall.
- Developed parcels. On developed parcels, the environmental conservation overlay zone will be applied to high and medium ranked wildlife habitat areas, and to the impact area. The application of the environmental conservation overlay zone in this manner on developed parcels does not reduce employment capacity because developed parcels are not allocated future employment capacity in the BLI.

Proposed Zoning Map

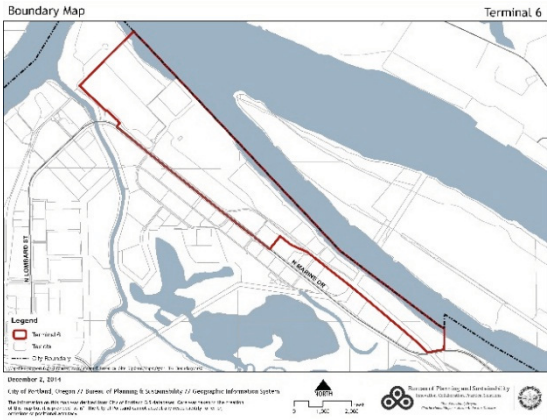



Proposed Zoning - Map 2 of 3
Terminal 6
IHchx
IHhx
MUF-19CS SEC FW
MUF-19 SEC FF CS
MUF-19 SEC NI CS
N MARINE DR
N LEADBETTER RD
N BYBEE LAKE RD
Legend
Terminal 6
Proposed Zone Boundary
Taxlots
December 19, 2014
City of Portland, Oregon // Bureau of Planning & Sustainability // Geographic Information System
The information on this map was derived from City of Portland GIS databases. Care was taken in the creation of this map but it is provided "as is". The City of Portland cannot accept any responsibility for error, omissions or positional accuracy.
NORTH
0 300 600 Feet
Bureau of Planning and Sustainability
Innovation. Collaboration. Practical Solutions.
City of Portland, Oregon
Charlie Hales, Mayor • Susan Anderson, Director


Proposed Zoning - Map 3 of 3
Terminal 6
MUF-19 SEC
MUF-19CS SEC FW
MUF-19 SEC FF
MUF-19 SEC
IHhx
IHh
IHchx
IHhx
NOISE CONTOUR
IHhp
OShp
IHh
IHhx
IHchx
MUF-19CS SEC FW
OShp
IHh
IHhx
IHchx
OShp
IHch
IHhx
NOISE CONTOUR
IHchx
OSch
N MARINE DR
IHh
IHch
N MARINE DR
Irh
Legend
Terminal 6
Proposed Zone Boundary
Taxlots
December 19, 2014
City of Portland, Oregon // Bureau of Planning & Sustainability // Geographic Information System
The information on this map was derived from City of Portland GIS databases. Care was taken in the creation of this map but it is provided "as is". The City of Portland cannot accept any responsibility for error, omissions or positional accuracy.
NORTH
0
300
600
Feet
Bureau of Planning and Sustainability
Innovation. Collaboration. Practical Solutions.
City of Portland, Oregon
Charlie Hales, Mayor • Susan Anderson, Director

Appendix A:

Natural Resource Inventory Site: Terminal 6



A. Summary Information

Watershed: Columbia River

Neighborhood: St Johns

USGS quadrangle and quarter section maps: 2N1W23, 2N1W24, 2N1W25, 2N1E19, 2N1E29, 2N1E30, 2N1E32

Site Size: 586 acres (including water)

Previous Inventories: *Inventory and Analysis of Wetlands, Water Bodies and Wildlife Habitat Areas for the Columbia Corridor: Industrial/Environmental Mapping Project* (City of Portland, January 1989)

Zoning:

Industrial (IH)
Aircraft Landing height overlay (h)
Airport Noise overlay (x)
Environmental Conservation overlay (c)

Existing Land Use: river-dependent industrial/marine terminal; railroad

General Description: This site includes the Columbia riverbank adjacent to Terminal 6 and a portion of the Lower Columbia River and Oregon Slough.

Resource Features: open water, shallow water; beaches; vegetated and non-vegetated river bank; vegetated flood area; wetlands; bottomland hardwood forest; woodland, and grasslands/ sparsely vegetated areas

Functional Values: microclimate and shade; stream flow moderation and water storage; bank function, and sediment, pollution and nutrient control; large wood and channel dynamics; organic inputs, food web and nutrient cycling; wildlife habitat; habitat connectivity/movement corridor

Special Habitat Areas:

- Columbia River, Oregon Slough and Shallow Water Habitat are designated SHA because they meet the following criteria:
  (C) – Wildlife connectivity corridor
  (M) – Migratory stopover habitat
  (S) – An *at-risk* species uses the habitat area or feature on more than incidental basis to complete one or more life history phases
- All wetlands are designated SHA because they meet the following criteria:
  (W) – Wetlands
- Forest and woodland vegetation is designated SHA because it meets the following criteria:
  (B) – Bottomland hardwood forests

(M) – Migratory stopover habitat
(S) – An *at-risk* species uses the habitat area or feature on more than incidental basis to complete one or more life history phases

- The T6 Dredge Material Handling is designated SHA because it meets the following criteria:
  (C) – Wildlife connectivity corridor habitat
  (G) – Feature important to individual grassland-associated species or assemblages of grassland-associated species on more than an incidental basis
  (S) – An *at-risk* species uses the habitat area or feature on more than incidental basis to complete one or more life history phases

Special Status Species:

- *Fish*: Chinook salmon, chum salmon, coho salmon, sockeye salmon, steelhead trout, bull trout, eulachon, Pacific lamprey, white sturgeon, coastal cutthroat trout, Oregon chub
- *Birds*: American kestrel, downy woodpecker, great blue heron, varied thrush, western meadowlark.
- *Mammals*: American beaver

Natural Hazards: flood area

Contamination: Yes

B. Site Description

The Terminal 6 site is situated in a unique location at the confluence of the Columbia and Willamette Rivers, the 2nd and 32nd largest rivers in the United States. The confluence of these two rivers is a regional nexus on the Pacific and Columbia flyways for migratory birds and on two major migration routes for Endangered Species Act-listed fish species. Over 200 bird species are found in the Portland area. Migrants pass through the region in large numbers, moving along both flyways, utilizing habitats along the Willamette and Columbia Rivers. Pisciverous diving birds use the near shore water for foraging: horned grebe, eared grebe, western grebe, surf scoter and common loon. Lesser Scaup occur in large flocks in the river feeding on aquatic invertebrates and other prey. Mudflats, shoals and beaches provides habitat for migratory shorebirds: least sandpipers, solitary sandpipers and semi-palmated plovers. Approximately 25% of North American bird species are currently experiencing significant long term population declines (US Fish and Wildlife Service, 2009). Many of these species occur in the Portland-Vancouver region, with most utilizing riverine and riparian habitats for some phase of their life cycle.

The Terminal 6 site is 586 acres in size. The site contains 130 acres of flood area including 52 acres of open water, 39 acres of vegetated flood area and 39 acres of non-vegetated flood area (Map 2). Vegetated areas at least .5 acre in size include approximately 8 acres of forest, 24 acres of woodland, and 26 acres of herbaceous cover (Map 3). The site also contains one 0.75 acre wetland.

The Port of Portland owns the majority of the land within the inventory site. The site includes industrial land uses adjacent to the Columbia River and Oregon Slough including the State's only container terminal, two auto import handling facilities, yard space, an intermodal rail yard, a dredge material handling area and miscellaneous undeveloped acreage allocated, zoned and serviced for future terminal expansion. Terminal 6 is near the confluence of the Willamette and Columbia Rivers and bordered by Marine Drive, a five-lane priority truck street with direct access to Interstate 5, and the BNSF mainline to the south and east, and the Oregon Slough, a channel of the Columbia River, to the north.

Map 1, located at the end of this appendix, shows an aerial view of the inventory site. Maps 2-6, also located at the end of this appendix, depict the natural resource features and relative ranks.

C. Natural Resource Description

The natural resource description for Terminal 6 is divided into two sections: hydrology and the individual habitat types within the site. The individual habitats within the Terminal 6 site include:

- Forest/woodland
- Grassland/sparsely vegetated areas
- Wetland
- Riverbank and upper beach
- Shallow water and open water

Hydrology:

The Columbia River Basin is the most hydroelectrically developed river system in the world. More than 400 dams including 11 dams on the mainstem and hundreds of major and modest structures on its tributaries, block river flows and tap a large portion of the Columbia's generating capacity: more than 21 million kilowatts (Lang 2011). The Bonneville Dam, completed in 1938, is the most downstream dam on the Columbia River (RM 146).

Before the hydroelectric effects of dams impacted the river's hydrology, much of the floodplain were regularly inundated with water several times a year. In addition to sustaining bank habitat function and bottomland hardwood forests, these natural flood events contributed to the creation and maintenance of shoal and alluvial habitats. In effect, the dams have normalized river flows, thereby reducing peak flows and eliminating the smaller, more regular floods that historically shaped and maintained valuable river habitat resources. This has also modified the function of lower river habitat by shifting sediment budgets and food webs, changing habitat and food availability, and influencing the migratory patterns of estuarine fish and wildlife.

The hydrology within the study area is tidally-influenced. The tidal range in this reach of the Columbia River is between three to four feet, depending on the season and the lunar cycle. The natural rise and fall of the elevation maintains dynamic shoreline habitat along the Oregon Slough beach where the river is connected to its floodplain. The habitat includes embayments, pocket beaches, backwater slough and wetlands, undercut banks, embedded logs and rootwads, and a wrack line of woody debris accumulation. The daily water level fluctuations are a key habitat forming processes. The Columbia River hydropower system has impacted flow characteristics in relation to tidal ebb and flow dynamics, which negatively impacts habitat-forming processes. The elevating and fortifying of some portions of the river banks also impact habitat-forming processes by reducing the capacity of the river to inundate its floodplain.

The Lower Columbia River and Oregon Slough within the Terminal 6 site includes two periods of significant freshets (high flows). The winter (December-February) and spring (April-June) events provide conditions that serve Pacific salmon during rearing and migration life stages. For juvenile fish that pass through the estuary quickly, the increased outgoing flows facilitate transport through to the ocean. The regulation of flood flows by the Bonneville Dam has dampened the capacity of natural flood events, and affected the rearing and migratory life history strategies of the Columbia River's salmon and trout.

Terminal 6's surface and groundwater hydrology is most influenced by precipitation (average of 36.3 inches per year at the Portland International Airport), river elevation and, to a limited extent, tidal action (USACOE 2004). The Columbia River's flood conveyance and capacity are directly related to connectivity between its floodplain and flows. The Columbia River's floodplain plays a role in mitigating flood hazards because it moderates downstream flood peaks through temporary upstream storage of water. The vegetated floodplain also helps stabilize banks and reduce erosion. These floodplain functions are provided by both native and non-native vegetation; however, native vegetation provides more varied natural resource functions including wildlife food sources and nesting opportunities.

In the 1920s, the Port of Portland, in coordination with the U.S. Army Corps of Engineers, constructed spur dikes or rock and timber groins along the shoreline of the Oregon Slough in the vicinity of Terminal 6. These structures trapped sediment, directed water flows and influenced beach development along Oregon Slough's shoreline. These changes affected Oregon Slough's hydrology through narrowing the channel and increasing the flow velocity.

In addition to building dikes along the Oregon Slough, the floodplain and side channels historically found the inventory site have been filled. The western half Terminal 6 is located on what was once a dynamic island. During the 1920's the US Army Corps of Engineers disposed of materials dredge from the Columbia River in this area as well as on West Hayden Island. By the 1940's the side channel was filled in.

Building dikes along the river bank and filling in the floodplain significantly decrease beach and bank area as well as flood storage. The southern bank of the Oregon Slough within the Terminal 6 site has been diked and/or otherwise elevated using dredge spoils over many years to just west of the railroad bridge. Dikes prevent overbank flow and affect the connectivity of the river and floodplain (Tetra Tech Inc. 1996); thus the diked floodplain is higher than the historical floodplain, and inundation of floodplain habitats only occurs during times of extremely high river discharge (Kukulka and Jay 2003). Elimination of overbank flooding can prevent the pulsed delivery of structural and energetic components to the rest of the estuary, including large wood, sediments, detritus, and prey organisms produced in adjacent riparian and floodplain habitats such as those found on nearby West Hayden Island.

Even with all of the changes to hydrology of the Columbia River and Oregon Slough and placement of fill within the floodplain, flooding still occurs on Terminal 6. In 1996, warm rains falling on melting snowpack within the entire region resulted in a large flood event. The undeveloped nature of much of the shoreline allowed high water to overflow bank and inundate the floodplain, providing some flood storage capacity in vacant, non-developed lands. The flood storage function in vacant areas can mitigate the impact of flooding in developed areas.

The floodplain-river connection is an important function for fish and wildlife for habitat maintenance. Floodplain inundation can also greatly increase the surface area of tidal estuarine and riverine habitats available to salmonids, allowing fish to explant their distribution into potentially more produce off channel habitat (Fresh et. al., 2005). For example, recent studies in the nontidal portion of the lower Sacramento River found that tagged juvenile Chinook salmon released in the seasonally inundated floodplain had better growth, higher consumption rates, and improved survival compared with others released into the main river channel (Sommer et. a., 2001)

<u>Individual Habitats:</u>
Terminal 6 is located at the juncture of the Willamette Valley and Puget Trough Physiographic Provinces (Franklin, 1988). The site includes several habitat types, including: forest/woodland, herbaceous and sparsely vegetated areas, upper beach and shallow water areas, and open water. The site's hydrology, which is a determining factor in several habitat types, has been modified by hydroelectric dams, river levees, pile dikes and rock groins along the shoreline, and placement of dredged materials but still provide important flood functions as described in the above section

- Forest and Woodland Habitats:
  Forests are differentiated from woodlands at the 60 percent canopy cover mark, with woodlands having less canopy cover but still having a predominance of tree canopy as compared to lower structure vegetation. For the purposes of this summary, forests and woodlands are lumped together because they have similar vegetative composition and provide similar habitat functions.

  The altered hydrology of the Columbia River has contributed to the reduction of bottomland hardwood forests throughout the lower river by reducing naturally disturbance caused by peak river flows and seasonal flooding. Historically, the seasonal flooding deposited new sediment allowing establishment of cottonwoods and associated understory plants in the floodplain. Today, only during high flood events or mechanical placement of sediments, do conditions allow for new stands of cottonwood to establish. Establishment of new cottonwood forests is different than the long term survival of existing cottonwood forests.

Existing cottonwood forests have a natural regeneration mechanism that does not depend on newly formed sediment and intense flooding. Cottonwoods have a strong ability to re-sprout, recruit from runners (or root sprouts) and easily propagate from cuttings. Cottonwoods also grow quickly and roots seek moisture.

A narrow riparian corridor dominated by bottomland hardwood forest species extends for three miles along the southern bank of the Oregon Slough. Within the Terminal 6 site, this strip of forest provides a total of 32 acres of forest and woodland habitat which is largely within the flood area and hangs over the river's shoreline. This vegetated riparian area is typically 50 feet in width (one to four trees), but a few locations of canopy are up to 400 feet wide. The dominant tree species in this mainland forest are black cottonwood, Oregon ash and pacific willow. All six species of willow that are native to Portland are found on this beach. Common understory shrubs include red osier dogwood, snowberry, red elderberry and Armenian blackberry. Although it is a narrow riparian corridor, it provides important functions for the beach, shallow water areas and open water. The overhanging vegetation helps maintain cool water temperatures in the slough through provision of shade and the creation of a cool and humid microclimate. It also provides food resources for the aquatic ecosystem in the form of leaves, branches and terrestrial insects.

Undercut bank along Oregon Slough

The riparian corridor also provides resources that maintain bank functions, such as undercut rootwads, downed trees, large wood recruitment and wildlife passage. These riparian corridor functions are provided by both native and non-native vegetation; however, native vegetation provides more varied food sources and structural diversity, which supports a broader diversity of native wildlife species.

Forest and woodland habitats in the inventory site help mitigate water quality impacts by providing absorption and transpiration services. The wooded riparian corridor absorbs nitrogen in both surface and shallow groundwater, traps phosphorous-laden sediment, induces groundwater recharge, minimizes flood hazards and filters sediment, chemicals and nutrients upslope and atmospheric sources.

The riparian corridor in the Terminal 6 site also provides important habitat for birds, amphibians, mammals and bats, and supplies near shore aquatic communities with food

and cover. Breeding and migratory bird densities in area riparian cottonwood forests are high. Large trees provide quality nesting habitat for larger birds that need big trees for their nests such as bald eagles, great-horned owls, and a number of colonial nesters including great blue herons. The combination of forest canopy along the banks of the Oregon Slough that have a direct relationship to the forests on West Hayden Island and the large stands of cottonwood-ash nearby at Smith and Bybee Wetlands creates an important habitat corridor in the Portland-Vancouver metropolitan area.

Bald eagles are not currently nesting in the forests or woodland habitat within the inventory site. However, there are three bald eagle nests located on Hayden Island, one in close proximity to the inventory site. Bald eagles typically maintain more than one nest and may choose to change their nesting location but stay within the same range of the old nest. The forests in the inventory site provide an opportunity for future bald eagle nesting.

Bat surveys have been conducted on West Hayden Island and other nearby forest/woodland habitats. Bats use large cottonwood and ash trees for nesting. Although this inventory site was not included in the survey, the forest types is similar to other survey areas and it is reasonable to expect that bats are using the forests in this inventory site.

The riparian cottonwood forests located in the inventory site are designated as Special Habitat Areas because they meet the following criteria:

(B) – bottomland hardwood forests

(M) – Migratory stopover habitat

(S) – an *at-risk* species uses the habitat area or feature on more than incidental basis to complete one or more life history phases

- Grasslands and sparsely vegetated areas:
  Grasslands and sparsely vegetated areas have a predominance of grasses (in general graminoids), forbs and wildflowers, with woody vegetation comprising less than 25 percent of the area. Portions of Terminal 6 upland of the southern bank of the Oregon Slough are composed of grasslands or sparsely vegetated areas. The substratum in these locations is well-drained sandy soil, primarily comprised of materials dredged from the navigation channels of the lower Willamette and Columbia Rivers. The percent cover and species of vegetation varies greatly in these habitats, due to the frequency of disturbance by deposition and maintenance of dredge spoils. The vegetation ranges from areas dominated by tall grasses and forbs, to areas with low dense grasses, to areas with scattered forbs and grasses and bare ground. In the spring there are often dense patches of two colored lupine (Lupinus bicolor). These areas provide similar functions found in prairie, meadow or grassland habitats, and some locations support grassland-associated wildlife species.

  Invasive plant species can be the biggest threat to grasslands and sparsely vegetated area, as can colonization by woody-stemmed plants and succession into shrubland. Grasslands are more limited in terms of food supply and cover for wildlife; however, several songbirds are known to forage and nest in this habitat type. Red-tailed hawks and owls use perch sites along the forest edge to located and feed on small mammals and ground feeding birds in grasslands

  The T6 Dredge Material Handling Area is located on the southern side of the Oregon Slough between the river and Marine Drive, just east the Honda/AWC facility. This portion of Terminal 6 contains a dredge material deposit area and three earthen cells connected by

drainage pipes, constructed for the purposes of handling, dewatering and removing dredge material. The cells were constructed to control vegetation encroachment in the cells. There is also a power line corridor that crosses the site.

While not a native grassland, the vegetation types, structure and density mimic a native grassland habitat. The T6 Dredge Material Handling Area is dominated with non-native grasses and mosses, with pockets of blackberry and scotch broom, cottonwood and willow. Bordering the grasslands, adjacent to the Oregon Slough, is a strip of mature cottonwoods, willows and ash with some native understory including snowberry, stinging nettle, red-osier dogwood and sword fern. Portions of this habitat type are within the flood area. The grassy and sparsely vegetated area functions in relation to adjacent habitats. The location along the Columbia River creates a unique habitat association in Portland. Grasslands associated with rivers, streams, or wetlands, serve as migratory stopovers for north-south and east-west flyways.

The placement of dredge materials and maintenance of the area mimics disturbance that once occurred naturally. The management of the area maintains early succession vegetation and areas of bare soil. This disturbed grassland matrix offers a diversity of vegetation height and density, and provides habitat for various grassland birds including the at-risk songbird Western meadowlark.

Grassland-associated wildlife species documented to use the T6 Dredge Material Handling Area include American kestrel, savannah sparrow, and Western meadowlark. The western meadowlark is experiencing population decline, due in large part to declining grassland habitat availability and are an *at-risk* species. Western meadowlark migrate through the Columbia and Willamette River confluence area from Canada and eastern Oregon. A flock of Western meadowlarks were observed using the area during multiple site visits in fall and winter of 2011. However, no western meadowlarks were observed during surveys of the grassland and dredge spoils areas in spring and fall of 2012, or during surveys in winter, spring and fall of 2013 (PHS 2013, 2014). Western meadowlarks are most closely associated with native prairie communities, fallow fields, and pastures; cultivated grass fields and hayfields offer marginal habitat in the Willamette Valley (Altman 1999; Davis and Lanyon 2008). The Western meadowlarks are attracted to grasslands the T6 Dredge Material Handling Area because of its association with the Columbia River and Smith and Bybee Wetlands, its relative isolation from intense urban development, and patches of blackberry and scotch broom that provide singing perches.

Other wildlife observed at the T6 Dredge Material Handling Area include: six osprey nests (all located on structures), red-tailed hawk, varied thrush, yellow rumped warbler, scrub jay, American gold finch, bewick's wren, Lincoln's sparrow and downy woodpecker. Also seen were coyote scat, vole holes, deer mouse and evidence of deer browsing.

The T6 Dredge Material Handling Area is designated a Special Habitat Area because it meets the following criteria:

(C) - wildlife connectivity corridor habitat

(G) - feature important to individual grassland-associated species or assemblages of grassland-associated species on more than an incidental basis

(S) - an *at-risk* species (western meadowlark) uses the habitat area or feature on more than incidental basis to complete one or more life history phases

- Wetland:
  There is an approximate ¾ acre area within Terminal 6 with wetland vegetation characteristics. The site is to the north of the container dock in front of the Hyundai/Ford auto import/export facility that utilizes Berth 601.

  The Berth 601 riparian area with wetland vegetation characteristics is non-jurisdictional and is based on a vegetative land cover classification that characterizes it as riparian wetland cottonwood, willow scrub-shrub. The area with wetland vegetation characteristics has not been delineated and therefore is described as having a characteristic of wetlands. The area was identified in the Port's Natural Resource Inventory dated in 2007, (the basis of the City's wetland inventory) as characterized by the presence of hydrophytic vegetation and is located within the flood area.

  Scrub-shrub wetlands support persistent emergent wetland vegetation types and may have shrubs around the fringe. This wetland type provides a variety of food, cover and nesting for aquatic and terrestrial wildlife species; flood storage; and sediment, chemical and nutrient filtering and cycling services.

  The wetland on Terminal 6 is designated a Special Habitat Area because it meets the following criteria:

  (W) – Wetlands

- River bank and upper beach:
  The river bank along the south shoreline of Oregon Slough is a mix of primarily beach and vegetated banks. The gently sloped sand-to-mud beaches transition up into the mature but narrow cottonwood-dominated riparian buffer. With rise in elevation, the beach transitions from seasonally and tidally inundated shallow water habitat into riparian forest. Areas with intact forest along the river bank periodically contribute large pieces of wood to the shoreline, creating complex wood structures that provide habitat for native fish.

  During high water (November through June), the river inundates the beaches and up the roots and lower branches of the riparian forests along the shoreline. Along these areas an intricately undercut matrix of tree trunks and roots has formed that provides rearing habitat for juvenile salmon and trout. In some locations there are inlets to the south bank wetlands that provide refugia for salmon and trout during high water. This complex of habitats is unique in the Portland-Metro area.

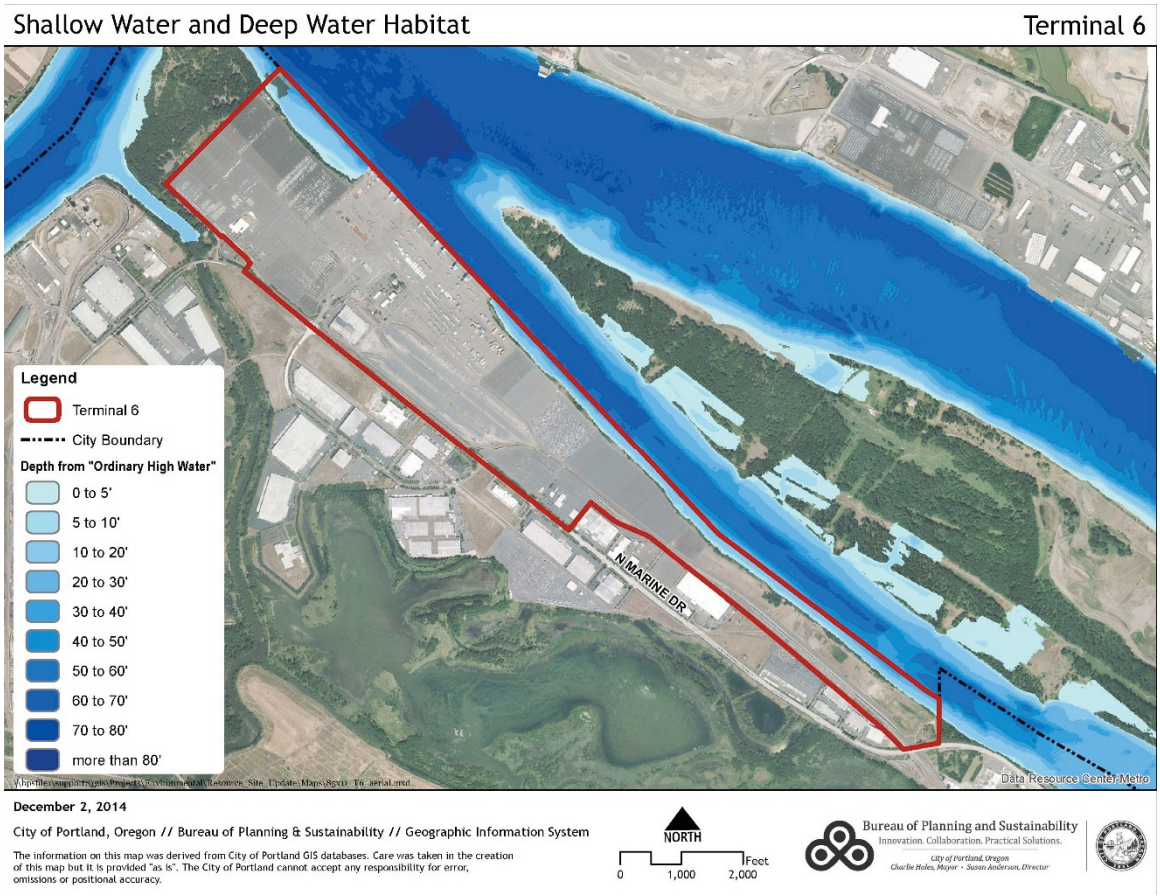
  In addition, large wood may be recruited from elsewhere in the watershed and deposited on the beach. The logs and rootwads settle out of the river's water column and are left behind as water recedes, providing habitat structure for fish, bugs and wildlife. The large wood may also provide shoreline stabilization and food web (detritus and invertebrates) input for near-shore plant and animal species. During high water (November-June), the river inundates the beaches and up the roots and lower branches of the riparian forests along the shoreline. Along these areas an intricately undercut matrix of tree trunks and roots has formed that provides rearing habitat for juvenile salmon and trout.

  During 2010 field visits birds observed in the upper beach and open water included yellow rumped warblers, scrub jay, American gold finch, bewick's wren, downy woodpecker, cormorant, common merganser, great blue heron, belted kingfisher, Canada geese.

  The riverbank and beaches along the south shoreline of Oregon Slough near Terminal 6 are designated a Special Habitat Area because they meet the following criteria:

(C) - wildlife connectivity corridor habitat
(B) – bottomland hardwood forests
(M) – migratory stopover habitat

- Shallow water and open water:
  Shallow water habitat in the Lower Columbia River is characterized by shallow grade, sand and mudflat beaches that unite with undercut banks and vegetated riparian areas. This shallow water area provides important habitat functions such as velocity moderation and food production that support aquatic organisms. The shallow water habitat of the Lower Columbia River has been designated as *critical habitat* for federally listed ESA species. Critical habitat is defined as the area between ordinary high water ("OHW") and 34 feet below OHW (NAVD88 vertical datum), and includes river banks and floodplains that maintain depths from 0.3 to 6.6 feet during the lower river's tidal cycle. The elevation of OHW around the Terminal 6 site is approximately 20 feet in NAVD88.



The condition and function of the near-shore environment at Terminal 6 varies depending on geography. The exposure of the shoreline along the Oregon Slough side channel within the Terminal 6 site is subject to a lower volume of shipping traffic and associated wave energy as compared to other portions of the river; this results in less impacts to the river bank and allows the bank to maintain a smaller/softer substrate and deeper undercut bank features. Large wood is mostly recruited from the local shoreline's riparian zone rather than from elsewhere in the Columbia Basin; however, several very large pieces (48" + DBH) were inventoried recently, and were obvious transplants to the slough's beaches.

For salmonid juveniles migrating out of the Columbia River system, shallow water habitat is where they begin experiencing a lower energy and wider channel shaped by tidal action as they transition into the marine environment. These fish can have extended rearing and outmigration periods in the lower river prior to transitioning into their marine life history phase, both of which are advantageous to marine survival and life history diversity (Myers et.al. 1998). The longer these fish reside in and feed on the estuary's diverse food web, the larger and more robust they become, increasing their ability to escape predators and fend off parasites and bacteria that commonly impact their health in the ocean environment. For the eulachon, shallow water habitat is where spawning, incubation and rearing life stages are completed before these fish pass onto their ocean life phase.

Columbia River fish are known to use shallow water habitat for several survival strategies during their juvenile life stages. For instance, juvenile salmon and trout forage for prey in sand, gravel, woody debris, and submerged vegetation, as well as on the river's surface and in its water column for floating or swimming prey. Juveniles also seek refuge from high flow events and predators by hiding in woody debris, undercut banks, and both overhanging and submerged vegetation, all vital requirements of functioning shallow water habitat. Shallow water habitat also plays an integral role in building and maintaining the aquatic food web by providing substrate on which detritus develops. The detritus supports invertebrates that hatch year-round and feed fish, amphibians, birds, and mammals.

Adult fish use shallow water habitats for several survival strategies as well. Although most anadromous species are not actively foraging during this life stage (salmon and eulachon in particular), they utilize shallow water habitat features such as woody debris, undercut banks, overhanging vegetation, and submerged vegetation to rest and recharge energy needed for long upstream migrations, and to avoid predators such as raptors, pinnipeds, and humans.

The distance between shallow water refugia is important to the health and survival of salmonids. Long periods of sustained swimming between refugia habitats deplete energy reserves. Fish with low energy resources caught migrating between refugia areas are more vulnerable to predation, as their flight response diminishes with a reduction in stamina. The more "pit stops" fish can make along their way up and downstream, the more likely they will complete migrations in good health. Therefore, salmonid productivity and survival is expected to be greater in locations with the shortest distance between refugia where the fish can rest, feed, and rebuild their energy supplies (C.L. Groot, 1995; M.B. Foreman, 1990; R.C. Eaton, 1991; Sauter, 2001; Sedell, 1990).

Fish abundance in rivers is correlated with the abundance and quality of riparian cover (Bjornn and Reiser 1991). While cover is an important aspect of salmonid habitat it is hard to define. Cover is vegetation and woody debris that is periodically inundated with water. The reduced abundance of high quality cover in the lower river, adequately spaced to facilitate predator avoidance and resting regimes, limits salmon and trout production.

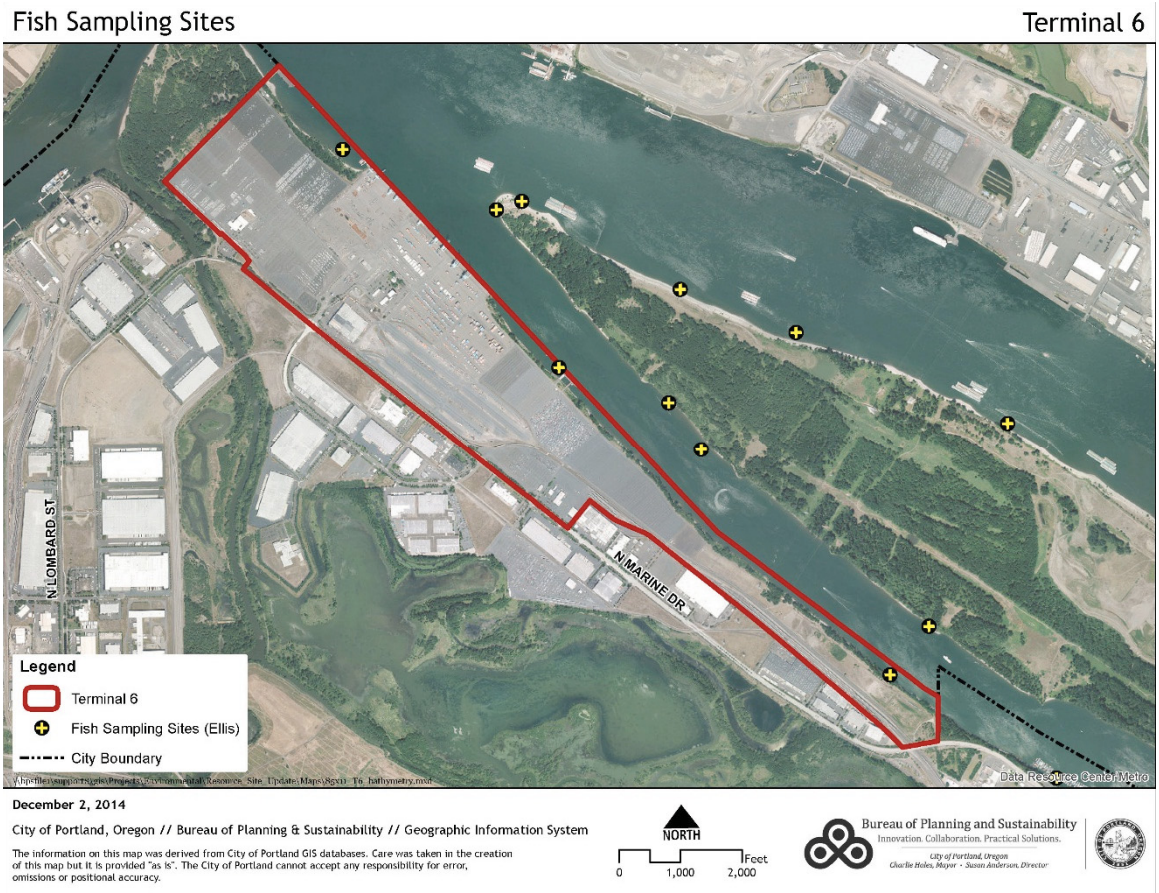
Seasonal fish use studies were conducted by Ellis Ecological Services during the winter-spring seasons of 1997 - 1999. The study sampled 24 fish species in shallow water habitat at 19 sampling sites in Oregon Slough and Columbia River nearshore habitats (see map below). Electrofishing was the primary method of capture; however, in areas inaccessible to the boat-mounted electrofisher, alternative sampling techniques like beach seining and backpack electrofishing were employed.

All sites were characterized with sand and silt substrate; however, stream bank characteristics ranged from mature riparian canopy with complex cover, to rip rapped shorelines in industrial areas with vegetation dominated by Himalayan blackberry. The table below is a list of fish species observed during the two sampling events. All salmonids caught were yearling or sub-yearling juveniles.

Table 6: Partial List of Fish Species Caught at Hayden Island December 1997-April 1999 (Ellis, 1999

Winter – Spring 1998			Winter – Spring 1999		
Species	**#**	**% catch**	**Species**	**#**	**% catch**
Chinook Salmon	1153	25.5	Chinook Salmon	550	47.3
Coho Salmon	10	0.2	Coho Salmon	17	1.5
Chum Salmon	0	0	Chum Salmon	16	1.4
Steelhead Trout	45	1.0	Steelhead Trout	58	5.0
Cutthroat Trout	0	0	Cutthroat Trout	2	0.2
Mountain Whitefish	5	0.1	Mountain Whitefish	2	0.2
White Sturgeon	24	0.5	White Sturgeon	0	0
Sculpin, spp.	238	5.3	Sculpin, spp.	22	1.9
Largescale Sucker	1147	25.3	Largescale Sucker	348	29.9
Three-spine Stickleback	347	7.7	Three-spine Stickleback	10	0.9

* The results are inclusive of all sites around Hayden Island because the species individuals-by-site data were not available for analysis.



Sandy substrate in the Lower Columbia River are also important for Pacific and river lamprey. Adult lamprey spend up to one year in the Columbia River after returning from the ocean to overwinter. Adults use the channel margin and pool habitats to utilize cover from predators. Spawning takes place in low gradient river habitats with gravel and sand-dominant substrate. After broadcast dispersion, eggs incubate for two to three weeks on the substrate they attach to; thereafter, the young swim into low velocity habitats and burrow in muddy substrate for the next four to six years. Shallow water habitat in the Columbia River is characterized by low gradient, low velocity conditions and is likely used by Pacific lamprey in all life stages (PSMRC, 1997).

Waterfowl and shorebirds feed on exposed mudflats of shallow water habitat as they migrate along the river channel during periods of low tide and/or low flow. Soft substrate beaches are highly productive for invertebrates, a primary food source for large numbers of shorebirds and songbirds. During 2010 field visits birds observed in the upper beach and open water included yellow rumped warblers, scrub jay, American gold finch, bewick's wren, downy woodpecker, cormorant, common merganser, great blue heron, belted kingfisher, Canada geese.

The shallow and open water habitats within the inventory site are designated as a Special Habitat Area because they meet the following criteria:

(C) - wildlife connectivity corridor
M) - migratory stopover habitat

(S) - an *at-risk* species uses the habitat area or feature on more than incidental basis to complete one or more life history phases

D. Natural Resource Evaluation

The natural resources located within this site have been evaluated for relative riparian and wildlife habitat quality. Relative quality is presented in the form of relative functional value ranks for riparian corridors, wildlife habitat, and riparian/wildlife habitat value combined. The relative ranks are produced using GIS models and information on Special Habitat Areas. The model criteria are not sensitive to the species of vegetation present or whether vegetation is native or non-native. However, the model criteria do assign different riparian functional values to cultivated, heavily manicured and managed landscapes and semi-natural and natural vegetation. Additional detail about the approach used to generate the relative ranks is provided 2012 *Natural Resource Inventory Update: Riparian Corridors and Wildlife Habitat* (http://www.portlandonline.com/portlandplan/?a=400492&).

All of the ranked resource areas provide at least some important riparian and habitat value, recognizing that current condition and function levels may vary considerably.

Riparian Areas

The site contains portions of the Columbia River, Oregon Slough and river bank, vegetated and non-vegetated flood area, riparian forests and woodlands, as well as other types of vegetation, that contribute to the riparian functions. These features contribute to the riparian functions, specifically:

- Microclimate and shade
- Stream flow moderation and water storage
- Bank functions, and sediment, pollution and nutrient control
- Large wood and channel dynamics
- Organic inputs, food web and nutrient cycling
- Riparian wildlife movement corridor

High relative functional ranks are generally assigned to the Columbia River, Oregon Slough, vegetated river banks and forest and woodland vegetation. Medium relative functional ranks are generally assigned to flood area vegetated with shrubs or grasses. Low relative ranks are generally assigned to non-vegetated flood area and hardened, non-vegetated river banks

Wildlife Habitat

Within the context of this inventory model, a wildlife habitat patch is defined as forest and/or wetland areas two acres in size or greater, and including adjacent woodland vegetation (note Special Habitat Areas may be smaller and may contain different types of vegetation or other resource features).

The site contains vegetated forested patches, one wetland and corridors that provide wildlife habitat and connectivity between habitat patches. Forested areas and wetlands provide nesting, breeding and foraging habitats for a diverse range of bird and mammal species, as well as amphibians, reptiles, and invertebrate species.

Special Habitat Areas contain unique features and provide critical wildlife habitat. SHAs receive a high relative rank for wildlife habitat. The SHA ranking supersedes lower rankings generated by the GIS model. Portions of the Terminal 6 site are designated Special Habitat Area for a variety of criteria, as described below:

- Columbia River, Oregon Slough and Shallow Water Habitat are designated SHA because they meet the following criteria:
  (C) – Wildlife connectivity corridor
  (M) – Migratory stopover habitat
  (S) – An *at-risk* species uses the habitat area or feature on more than incidental basis to complete one or more life history phases
- The T6 Vacant Industrial Lands is designated SHA because it meets the following criteria:
  (C) – Wildlife connectivity corridor habitat
  (G) – Feature important to individual grassland-associated species or assemblages of grassland-associated species on more than an incidental basis
  (S) – An *at-risk* species uses the habitat area or feature on more than incidental basis to complete one or more life history phases
- The T6 Dredge Material Handling Area is designated a Special Habitat Area because it meets the following criteria:
  (I) – Islands or the portions of riverine islands that provide habitat for river/island-associated resident and/or migrating wildlife species
  (C) –Wildlife connectivity corridor habitat
  (G)- Feature important to individual grassland-associated species or assemblages of grassland-associated species on more than an incidental basis
  (S) – An at-risk species uses the habitat area or feature on more than incidental basis to complete one or more life history phases

Combined Relative Riparian/Wildlife Habitat Ranking

Where areas that are mapped as riparian corridors and wildlife habitat overlap, and their relative ranks differ, the combined relative rank will be the higher of the two ranks. For example, an area that ranks medium for riparian function and low for wildlife habitat will receive a medium combined relative rank.

C. Inventory Maps

Map 1: 2013 Aerial Photography — Terminal 6

December 2, 2014

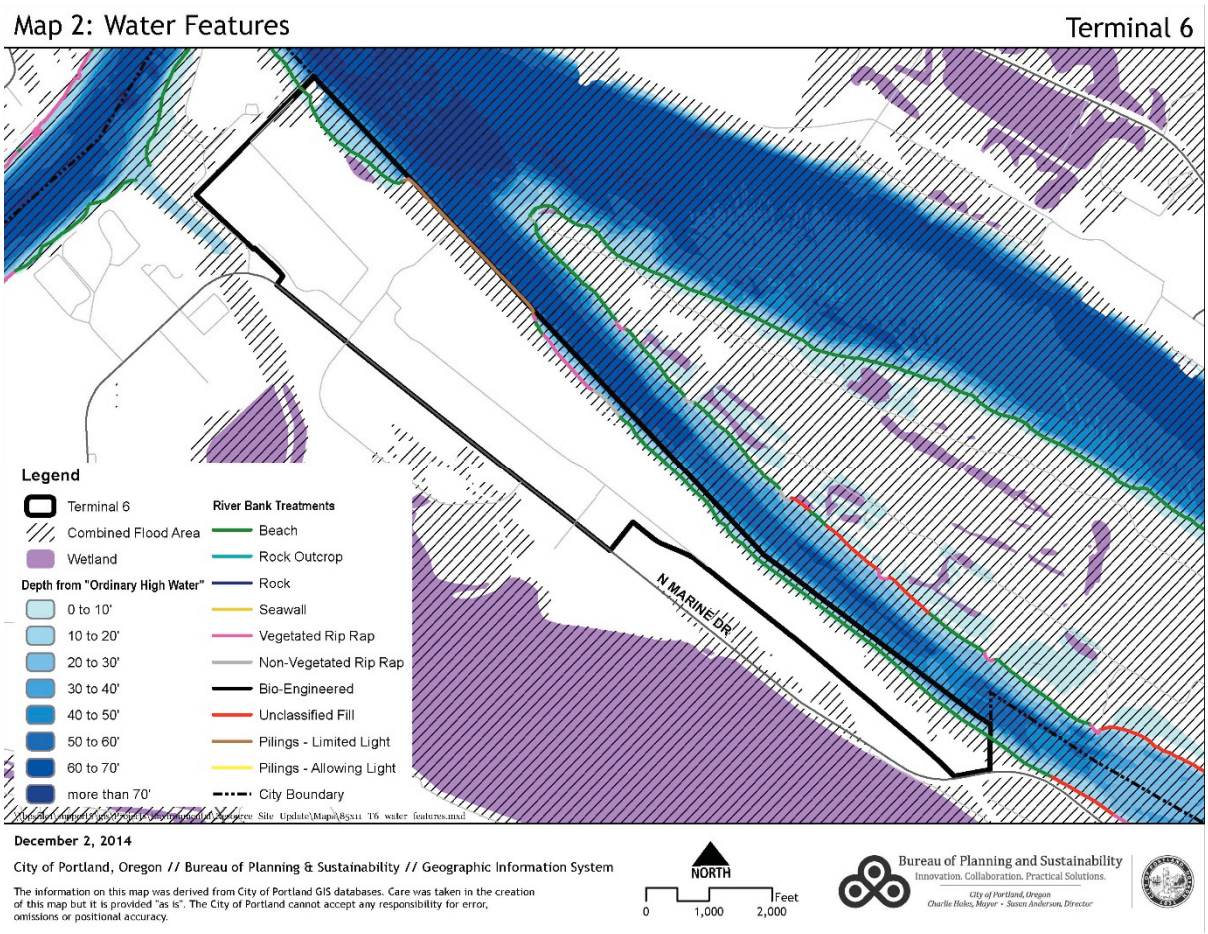
City of Portland, Oregon // Bureau of Planning & Sustainability // Geographic Information System

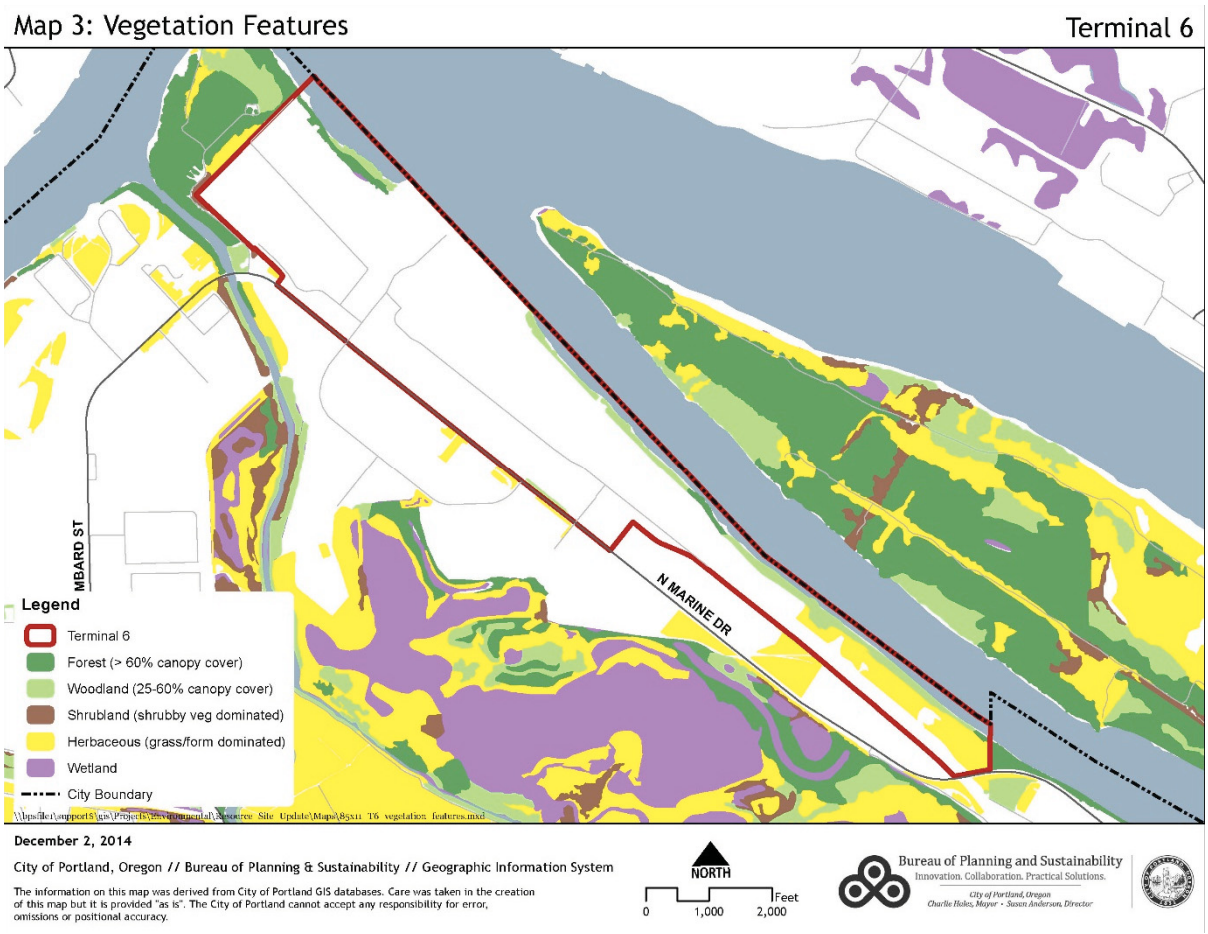
The information on this map was derived from City of Portland GIS databases. Care was taken in the creation of this map but it is provided "as is". The City of Portland cannot accept any responsibility for error, omissions or positional accuracy.

NORTH

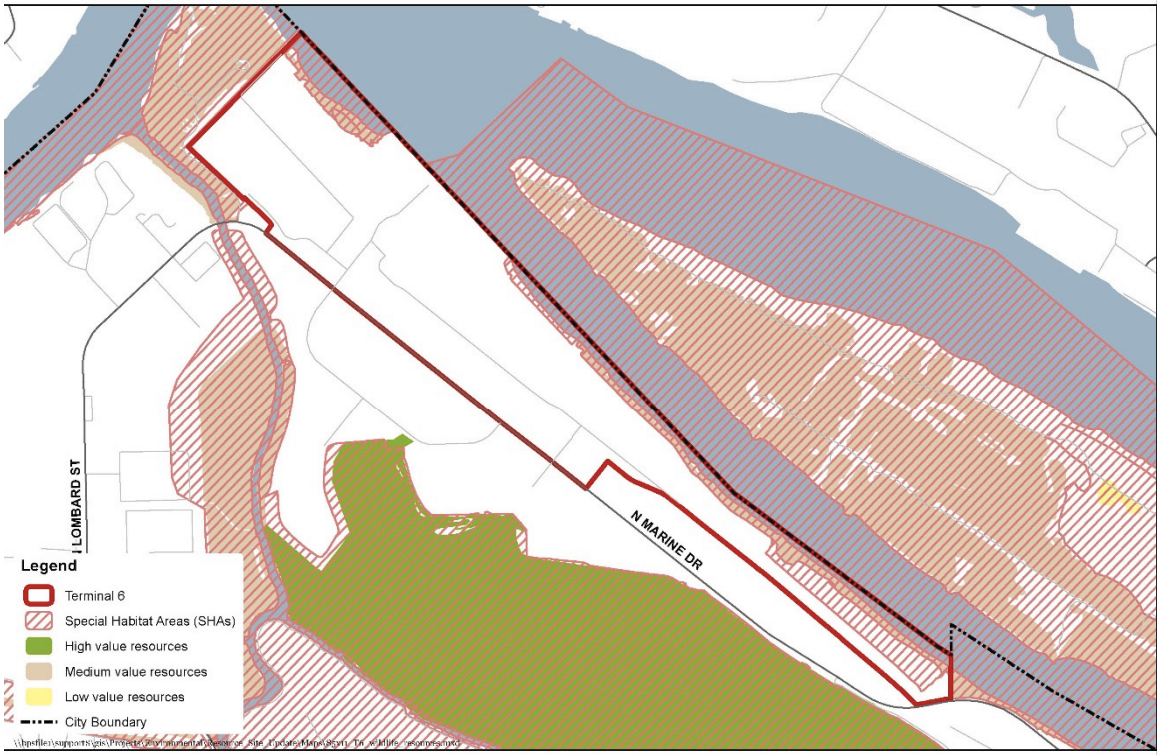
0 1,000 2,000 Feet

Bureau of Planning and Sustainability
Innovation. Collaboration. Practical Solutions.
City of Portland, Oregon
Charlie Hales, Mayor • Susan Anderson, Director


Map 2: Water Features
Terminal 6
Legend
Terminal 6
Combined Flood Area
Wetland
Depth from "Ordinary High Water"
0 to 10'
10 to 20'
20 to 30'
30 to 40'
40 to 50'
50 to 60'
60 to 70'
more than 70'
River Bank Treatments
Beach
Rock Outcrop
Rock
Seawall
Vegetated Rip Rap
Non-Vegetated Rip Rap
Bio-Engineered
Unclassified Fill
Pilings - Limited Light
Pilings - Allowing Light
City Boundary
N MARINE DR
December 2, 2014
City of Portland, Oregon // Bureau of Planning & Sustainability // Geographic Information System
The information on this map was derived from City of Portland GIS databases. Care was taken in the creation of this map but it is provided "as is". The City of Portland cannot accept any responsibility for error, omissions or positional accuracy.
NORTH
0
1,000
2,000
Feet
Bureau of Planning and Sustainability
Innovation. Collaboration. Practical Solutions.
City of Portland, Oregon
Charlie Hales, Mayor • Susan Anderson, Director


Map 3: Vegetation Features
Terminal 6
MBARD ST
N MARINE DR
Legend
Terminal 6
Forest (> 60% canopy cover)
Woodland (25-60% canopy cover)
Shrubland (shrubby veg dominated)
Herbaceous (grass/form dominated)
Wetland
City Boundary
December 2, 2014
City of Portland, Oregon // Bureau of Planning & Sustainability // Geographic Information System
The information on this map was derived from City of Portland GIS databases. Care was taken in the creation of this map but it is provided "as is". The City of Portland cannot accept any responsibility for error, omissions or positional accuracy.
NORTH
0
1,000
2,000
Feet
Bureau of Planning and Sustainability
Innovation. Collaboration. Practical Solutions.
City of Portland, Oregon
Charlie Hales, Mayor • Susan Anderson, Director

Map 4: Wildlife Habitat — Terminal 6



December 2, 2014

City of Portland, Oregon // Bureau of Planning & Sustainability // Geographic Information System

The information on this map was derived from City of Portland GIS databases. Care was taken in the creation of this map but it is provided "as is". The City of Portland cannot accept any responsibility for error, omissions or positional accuracy.

NORTH

0 1,000 2,000 Feet

Bureau of Planning and Sustainability
Innovation. Collaboration. Practical Solutions.
City of Portland, Oregon
Charlie Hales, Mayor · Susan Anderson, Director

Map 5: Riparian Corridor Resources — Terminal 6

Map 6: Combined Relative Resource Ranks — Terminal 6

December 2, 2014

City of Portland, Oregon // Bureau of Planning & Sustainability // Geographic Information System

The information on this map was derived from City of Portland GIS databases. Care was taken in the creation of this map but it is provided "as is". The City of Portland cannot accept any responsibility for error, omissions or positional accuracy.

NORTH

0 1,000 2,000 Feet

Bureau of Planning and Sustainability
Innovation. Collaboration. Practical Solutions.
City of Portland, Oregon
Charlie Hales, Mayor • Susan Anderson, Director

Appendix B:

Ecosystem Service Valuation (ECONorthwest, 2012)

Forests and woodlands provide air quality benefits from purification and pollutant removal. The table below shows the kilograms of pollutant removal by forests and woodland per acre, per year and the economic value of those pollutants in avoided health care costs.

Annual Quantity and Value of Pollutant Removal by Forests and Woodlands (2011$)

Pollutant	Annual Kilograms Removed per Acre	Annual Value per Ton	Annual Value per Acre
CO	2.03	$1,403	$3
NO^2	3.65	$4,039—$9,875	$15—$36
O^3	14.57	$2,019—$9,875	$29—$144
PM^{10}	10.53	$6,593	$69
SO^2	2.83	$2,418—$9,546	$7—$27
Source: ECONorthwest, 2012			

The table below provides estimated values for key ecosystem services that wetlands provide. The table presents values associated with wetlands that were assumed to provide only a single type of service. The range of values associated with single-service wetlands is about $2–$9,669 per acre per year. In many cases wetlands provide multiple services; however, the values cannot simply be added up and an estimate for multiple services was not made.

The next set of rows estimates the values associated with ecosystem services provided by both native and restored wetlands. The way the ecosystem services are combined in this section combine more of the single-services into larger categories. For example, recreation can include fishing, bird hunting, bird watching, amenity, etc. The values in the second set of rows are additive.

Value of Ecosystem Services Associated with Wetlands (2011$/Acre/Year)

Single-Service Wetlands		
Single-Service Wetland Type	**Mean Value**	**Range of Values**
Flood	$676	$153-$3,007
Quality	$718	$2,177-$2,372
Quantity	$219	$10-$4,425
Recreational Fishing	$614	$163-$2,310
Commercial Fishing	$1,339	$186-$9,669
Bird Hunting	$120	$43-$339
Bird Watching	$2,086	$909-$4,788
Amenity	$5	$2-$24
Habitat	$527	$163-$1,688
Storm	$408	$19-$8,850
Ecosystem Service	**Native Wetlands**	**Restored Wetlands**

Gas regulation	$128	$93
Disturbance regulation	$15,300	$15,300
Water supply	$1,424	$1,424
Nutrient cycling	$7,706	$5,780
Commodities	$2,907	$2,907
Biodiversity	$185	$163
Recreation	$1,744	$1,744
Total	**$29,394**	**$27,410**

Source: Woodward, R., and Y. Wui. 2001. "The Economic Value of Wetland Services: A Meta-Analysis." *Ecological Economics* 37: 257-270; Dodds, W. K. Wilson, R. Rehmeier, et al. 2008. "Comparing Ecosystem Goods and Services Provided by Restored and Native Lands." *BioScience* 58(9):837-845.

Shrublands and grasslands provide air quality benefits from purification and pollutant removal. The table below shows the annual per acre pollutant removal by shrublands and grasslands and a range of economic values of those pollutants in avoided health care costs.

Annual Quantity and Value of Pollutant Removal by Shrubland and Grassland (2011$)

Pollutant	Annual Kilograms Removed per Acre	Annual Value per Ton	Annual Value per Acre
CO	0.79	$0—$1,403	$1
NO^2	1.45	$4,039—$9,875	$6—$14
O^3	6.05	$2,019—$9,875	$12—$60
PM^{10}	4.34	$0—$6,593	$29
SO^2	1.18	$2,418—$9,546	$3—$11

Source: ECONorthwest

Economic research has shown that people place a considerable value on the continued survival of sensitive species, such as those listed as threatened or endangered. Such studies also suggest that the value associated with protecting threatened, endangered, and rare species ranges from an annual payment of $11 per household to a one-time payment of nearly $400 per household.

Willingness to Pay to Protect Threatened, Endangered, and Rare Species

Studies Reporting Annual Values		
	Average Value	**Range of Values**
Bald eagle	$43.51	$23.43-$50.21
Owl	$72.52	$43.51-$145.05
Salmon/Steelhead	$90.38	$11.16-$155.09
Whooping Crane	$62.48	$49.09-$76.99
Woodpecker	$17.85	$14.50-$22.32
Studies Reporting Lump Sum Values		
	Average Value	**Range of Values**
Arctic grayling	$25.66	$22.32-$29.01
Bald eagle	$331.38	$273.36-$390.52
Falcon	$35.70	-

Source: ECONorthwest, 2012 (taken from Richardson and Loomis,. 2009)

It is important to note that willingness to pay a different measure than estimating the economic value associated with maintaining individual species and biodiversity. For example, the courts have interpreted Congress to say that the value of threatened and endangered species is incalculable (TVA v. Hill).

Appendix C:
REFERENCES

Anielski and Wilson. 2005. Counting Canada's Natural Capital: Assessing the Real Value of Canada's Boreal Ecosystems. Pembina Institute.

Air Products and Chemical Inc. Dangers of oxygen deficient atmospheres. Website: http://www.airproducts.com/~/media/Files/PDF/company/safetygram-17.pdf

Barber, J., K. Crooks, and K. Fristrup. 2009. "The costs of chronic noise exposure for terrestrial organisms." Trends in Ecology and Evolution 25(3): 180-189.

Banzhaf and Boyd. 2006. What Are Ecosystem Services? The Need for Standardized Environmental Accounting Units.

Bergstom, Loomis and Brown. 2007. Defining, Valuing and Providing Ecosystem Goods and Services. Natural Resources Journal.

Bjornn, T.C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. American Fisheries Society Special Publication 19:83-138.

Business 21 Publishing. 2011. Safety ToolBox Talks: Safe handling, storage of propane. Website: http://www.oregon.gov/OMD/AGP/docs/safety/toolbox/dec2011-toolbox.pdf

CDC. 1978. Occupational health guide for propane. Website: http://www.cdc.gov/niosh/docs/81-123/pdfs/0524.pdf

CDC Health Disparities and Inequalities Report, Morbidity and Mortality Weekly Report, Vol. 60, January 14, 2011.

City of Portland Bureau of Planning and Sustainability, 2012. Portland Plan, Recommended Draft Report.

C.L. Groot; Margolis, L.; W.C. Clarke. 1995. *Physiological Ecology of Pacific Salmon*. UBC Press, Vancouver, B.C., Canada.

ECONorthwest. 2009. Economic Arguments for Protecting the Natural Resources of the East Buttes Area in Southeast Portland.

ECONorthwest. 2013. The Port of Portland's marine operations: The local economic benefits of world trade.

Foreman, M.B. and R.C. Eaton. 1990. EMG and kinematic analysis of the stages of the Mautner-initiated escape response. Society for Neuroscience Abstracts. 16:1328.

Franklin, Jerry F. and C.T. Dyrness. 1988. Natural vegetation of Oregon and Washington. Corvallis, OR: Oregon State University Press.

Fresh, K.L., E. Casillas, L.L. Johnson, and D.L. Bottom. 2005. Role of the estuary in the recovery of Columbia River basin salmon and steelhead: an evaluation of the effects of selected factors on Salmonid population viability. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-69, 105 p.

The Greenbusch Group, Inc. and Paul Van Orden, City of Portland. June 2008. City of Portland, North Portland Noise Study (Draft).

Hovee, E.D. April 2012. Economic Opportunities Analysis Update Draft.

Internation Dark Sky Association. Website.
http://www.darksky.org/mc/page.do?sitePageId=55060&orgId=idsa

Kukulka, T., and D. A. Jay. 2003. Impacts of Columbia River discharge on salmonid habitat; changes in shallow-water habitat. J. Geophys. Res. 108:3294.

Lang, B. 2011. Introduction to the Columbia River. Center for Columbia River History's website. http://www.ccrh.org/river/history.htm Accessed November 2, 2011.

Martin and Associates. 2012. The local and regional economic impacts of the Portland harbor.

Multnomah County Health Department. 2012. West Hayden Island Health Report.

Myers, J.M., et.al. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

New Jersey Department of Health. 2010. Hazardous substance fact sheet. Website:
http://nj.gov/health/eoh/rtkweb/documents/fs/1594.pdf

Nieman, D.C. 1998. The exercise-health connection. Chapaign, IL: Human Kinetics Publishers.

Olewiler, N. 2004. The Value of Natural Capital in Settled Areas of Canada. Ducks Unlimited Canada, and the Nature Conservancy of Canada.

Pacific Northwest Waterways Association. Website:
http://www.pnwa.net/new/Articles/Columbia_River_Channel_Deepening.pdf

Pacific States Marine Fisheries Commission (PSMRC). 1997. Pacific Lamprey facts. Website: http:// www.psmfc.org/habitat/edu_lamprey_fact.html

R.C. Eaton and D.S. Emberley. 1991. How stimulus direction determines trajectory of the Mautner-initiated escape response in teleost fishes. Journal for Experimental Biology. 161:469-487.

Sachs and Segal. 1994. Mind and Body. New Woman. December 1994, pg 50.

Sauter, S. T., J. McMillan, and J. Dunham. 2001. Salmonid Behavior and Water Temperature. Issue Paper 1 to the United States Environmental Protection Agency. EPA-910-D-01-001. 38pp

Sedell, J. R., G. H. Reeves, F. R. Hauer, J. A. Stanford, and C.P. Hawkins. 1990. Role of Refugia in Recovery from Disturbances: Modern Fragmented and Disconnected River Systems. Environmental Management. 14: 711-724.

Sommer, T. R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. 2001. Floodplain rearing of juvenile Chinook salmon: Evidence of enhanced growth and survival. Can. J. Fish. Aquat. Sci. 58:325–333.

Tabor, Roger A., et. al. 2011. Habitat Use by Juvenile Chinook Salmong in the Nearshore Areas of Lake Washington: Effects of Depth, Lakeshore Development, Substrate and Vegetation. North American Journal of Fisheries Management. 31:700-713.

Tetra Tech, Inc. 1996. The Health of the River 1990-1996. Integrated Technical Report to the Lower Columbia River BiState Water Quality Program.

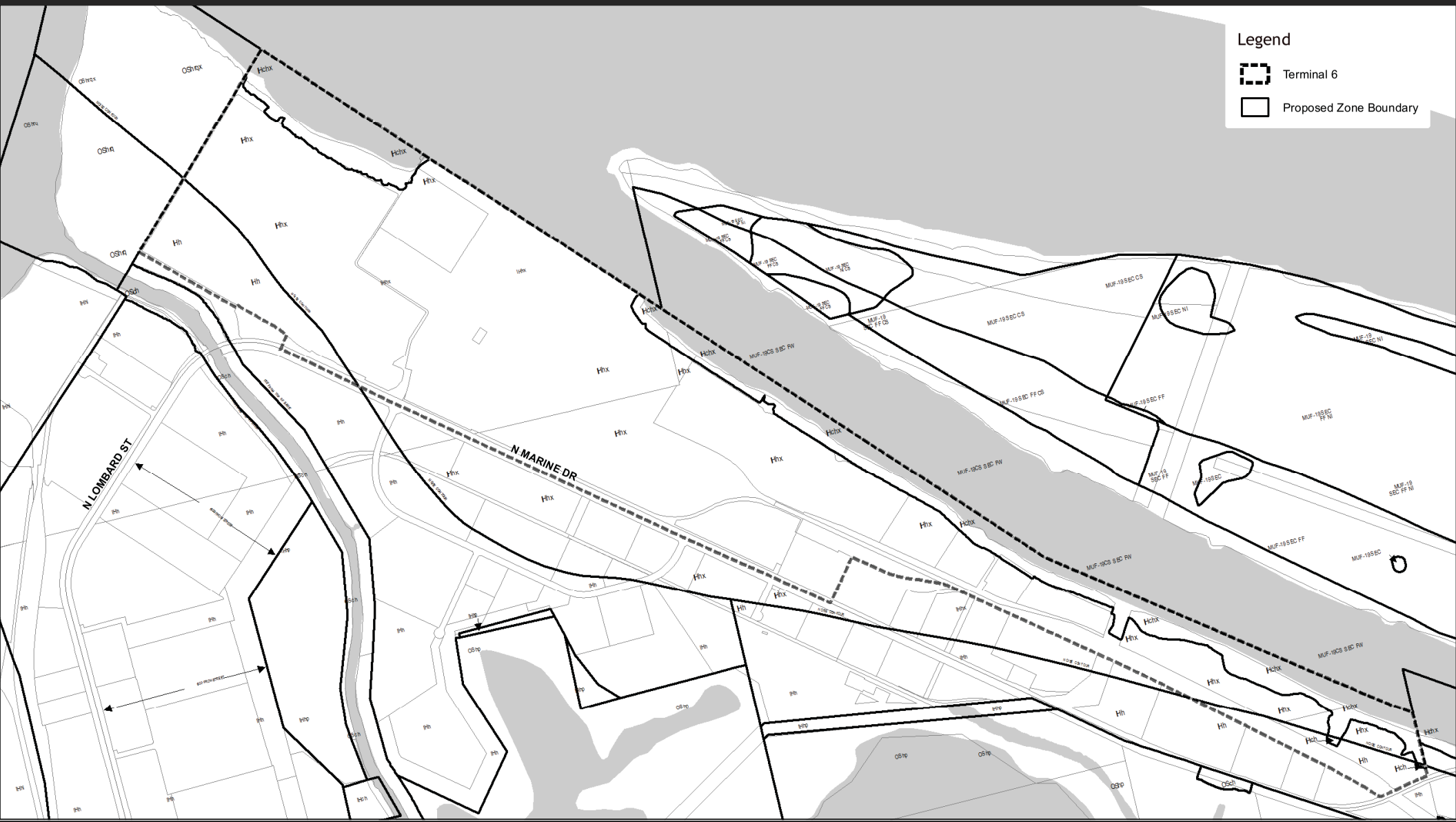
US Army Corps of Engineers. 2004. Portland-Vancouver Harbor Information Package. Second Edition. Reservoir Regulation and Water Quality Section. Portland, OR.

US Department of Energy. Website: http://www.energy.gov/eere/energybasics/articles/propane-fuel-basics

US Fish and Wildlife Service. 2009. State of the Birds Report.

Terminal 6 -Proposed Zoning

Natural Resource Inventory



December 19, 2014

City of Portland, Oregon // Bureau of Planning & Sustainability // Geographic Information System

NORTH

0 500 1,000 1,500 Feet

Bureau of Planning and Sustainability

Innovation. Collaboration. Practical Solutions.

City of Portland, Oregon

Charlie Hales, Mayor • Susan Anderson, Director

\\bpsfile1\support$\gis\Projects\Environmental\Resource_Site_Update\Maps\11x17_T6_proposed_ezones.mxd