SMITH AND BYBEE COMPREHENSIVE NATURAL RESOURCE PLAN APPENDIX

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SMITH AND BYBEE COMPREHENSIVE NATURAL RESOURCE MANAGEMENT PLAN

APPENDIX A: Conservation

ASSESSMENT OF SMITH AND BYBEE LAKES

Prepared in 1990 for the Natural Resources Management Plan

(Note: this assessment is included as background. Since 1990 conditions have changed. References cited refer to the 1990 plan.)

The Smith and Bybee Lakes Study Area is approximately 2100 acres. This study area includes the Smith and Bybee Lakes wetlands bounded by North Portland Road, Columbia Slough, and the Rivergate Industrial District. The study area also includes Columbia Slough, the Ramsey Lake wetland mitigation area, and the St. Johns Landfill.

The configuration of vegetation habitat types in the Smith and Bybee Lakes wetlands is primarily determined by surface water hydrology. Historically, these wetlands were part of an extensive complex of sloughs, marshes and lakes that occupied the south shore of the Columbia River. Most of this original complex has been drained, filled or subject to other development impacts. The Smith and Bybee Lakes complex represents the largest remnant of this habitat in the Portland area.

The Smith and Bybee Lakes wetlands have been manipulated in recent history for purposes of hunting, other recreational activities, and waterfowl management. Various dikes, dams and channels were constructed by property owners to control water levels and flows in the lakes. By 1980, the entire north end of the complex along the Columbia River shore, from Portland Road to the mouth of Columbia Slough, had been filled for industrial development. Any historic connections between the lakes and the Columbia River had long been eliminated. The lakes complex was open to Columbia Slough through North Slough; water levels in the lakes therefore responded to level fluctuations in the Willamette and Columbia Rivers. Descriptions of the lakes from the late 1970's indicate that Bybee Lake experienced daily fluctuations in water level, while Smith Lake did not. The fluctuations in Bybee Lake were either tidal changes conveyed through Columbia Slough, cyclical tidal factors conveyed through the groundwater connection to the Columbia River, or a combination of these.

In 1983, a water level control structure was installed on North Slough for the purpose of maintaining high water levels in the lakes through the summer. This structure was planned by the U.S. Fish and Wildlife Service for the purpose of controlling avian botulism outbreaks experienced in the late 1970's and early 1980's. The Service obtained the necessary permits for the structure and impoundment. The permit was later transferred to the Oregon Department of Fish and Wildlife. Since 1983, the lakes have been maintained at a perched elevation of 10.5 feet mean sea level (MSL) or lower; water depths in the lakes have generally not decreased below 3 feet. Prior to installation of the structure, Smith Lake had often lost most of its water by the end of summer, and summer levels in Bybee Lake had been very low.

The impoundment of water in the lakes since 1983 has dramatically changed the vegetation types in the wetlands. The lakes were classified in 1982 (before impoundment) as "palustrine", generally thought of as marsh or swamp. The 1986-87 environmental studies reclassified the lakes as "lacustrine", or lake habitat (FES 1987, Tech. App. E).

The Smith and Bybee Lakes study area can be characterized as two shallow lakes surrounded by extensive shrub willow swamp and forested areas. The most extensive forested areas are willow; stands of cottonwood, ash, or mixtures of these, are less extensive. The lakes include areas of open water and smartweed swamp; Bybee Lake is more open than Smith Lake. Sedge meadows,

grasslands and small seasonal ponds are interspersed throughout the area. Upland, or non-wetland areas include the landfill and areas bordering the study area. Upland habitat types include grassland, some forested areas, and developed fill areas.

The hydrology of Smith and Bybee Lakes, based on 10 months of data collected during 1986, is dominated by two factors: (1) Columbia/Willamette River levels greater than 10.5 ft MSL (mean sea level), and (2) the net balance of precipitation and evapotranspiration (FES 1987, Tech. App. A). The holding weir on North Slough isolates the lakes from the slough/rivers at approximately 10.5 ft MSL. Thus, river levels below 10.5 ft have no direct effect on lake levels, whereas higher river levels overflow into the lakes. River levels typically exceed 10.5 ft during winter and spring Willamette and Columbia River freshets, and lake levels rise accordingly to levels above 10.5 ft. When river levels are below 10.5 ft, lake levels are mainly influenced by the balance between precipitation, evaporation, and plant transpiration. The water budget calculations for the 1986 study period demonstrated that the small inflows from the creek under Marine Drive were approximately balanced by leakage losses through the control structure. Changes in lake levels matched rainfall amounts and evapotranspiration curves for the Portland area.

A possible "window" between the lakes and a large regional aquifer occurs under Bybee Lake, where a ridge of gravel rises to about sea level (FES 1987, Tech. App. B). The gravel ridge is part of a Pleistocene gravel formation found beneath the alluvial sand and over bank deposits characteristic of the Columbia River floodplain. This Pleistocene gravel aquifer is one of the most productive aquifers in Oregon. The Columbia River acts as a regional outflow boundary to groundwater in the Pleistocene gravels. Groundwater flow in the aquifers of the area converges towards the river during low river stages; groundwater pressures rise in the aquifers during high river stages. Bybee Lake, in its natural condition (not impounded) probably served as an outflow-inflow boundary for groundwater in the Pleistocene gravels. Water levels in the lake could have fluctuated with groundwater hydrology, and some natural exchange of water probably occurred at times between Bybee Lake and the underlying gravel aquifer.

Groundwater mounding has occurred due to leachate buildup in the St. Johns landfill, and natural recharge of sandy deposits making up the Rivergate District fills. Shallow groundwater flow from these areas is generally downward and outward, towards the sloughs, wetlands and underlying aquifers. Existing and potential groundwater contamination sources, such as the landfill, and existing and future industrial sites, could pose long-term environmental threats to water quality in study area wetlands. Leachate contaminated groundwater has been shown to have reached the upper parts of the Pleistocene gravel aquifer along the north margins of the landfill (FES 1987, Tech. App. B; SE/E 1989); this probably does not pose a significant threat to water quality in the lakes due to dilution factors. Existing monitoring wells, however, along the north side of the landfill do not penetrate deeply enough into the Pleistocene gravel aquifer to determine the true nature, severity, and extent of contaminated groundwater. Smith Lake is probably not at risk from deep groundwater contamination because it is underlain by a thick protective layer of low-permeability clay and silt.

Surface water quality of North Slough and Columbia Slough has been sampled approximately four times per year since 1977; Smith and Bybee Lakes water quality sampling was added to this program in 1987. This sampling program is conducted by DEQ and the landfill operator as a requirement of the St. Johns landfill NPDES permit.

Water quality parameters indicative of the presence of leachate (chloride, ammonia, COD, conductivity, hardness, and alkalinity) have shown an upward trend in both North Slough and Smith and Bybee Lakes and to a lesser extent in Columbia Slough during the period of record (1977-89)

(SFJE 1989). Data collected during the period 1987-89 indicates that concentrations of these water quality parameters are higher than the historical means and ranges (Metro/DEQ, unpublished).

The quality of water in Smith and Bybee Lakes is a frequently mentioned environmental concern. Maintenance of good quality water is an essential element of the Management Plan for the lakes. Studies conducted during 1986, and review of water quality data in DEQ files for the past 10 years, showed that the lakes are presently in a eutrophic condition (high levels of plant nutrients), and are out of compliance with several state water quality criteria (for the Willamette River and tributaries). The impoundment of water in the lakes has probably increased plant growth, resulting in more accumulation of nutrient-rich sediments, thus contributing to the eutrophication problem. Although out of compliance with state criteria for phosphorus and nitrate, water quality in terms of nutrients appears to be acceptable for fish and wildlife as well as the intended recreational activities of the lakes.

Since completion of the Smith and Bybee Lakes study in 1986, additional surface water quality data have been collected four times per year from sites in North Slough and Columbia Slough. The Sweet-Edwards IEMCON water quality study (SFJE 1989) indicated that historic average nitrate levels in Columbia Slough below the confluence with North Slough were higher than historic average nitrate levels in Bybee Lake. Construction of the water control structure has probably helped to stem the inflow of certain nutrients into Bybee Lake.

Construction of the water control structure has probably also improved water quality in respect to other parameters, such as fecal coliform bacteria, by isolating the lakes from the poor quality waters of Columbia Slough. Fecal coliform bacteria levels in the lakes between 1982 and 1986 appeared to be in compliance.

Columbia Slough waters are frequently out of compliance for a number of standard parameters. The data indicate that fecal coliform levels probably frequently exceed standards during the period November to May. Information on pesticides and metals is sketchy, but the slough appears to contain levels of certain contaminants similar to other industrial/urban area streams around Portland (Portland BES 1989).

A survey of lake and slough bottom elevations and bottom sediment characteristics was conducted during 1986. Bottom elevation in Smith Lake ranged from 3.7 to 5.7 ft above sea level; Bybee Lake values were 2.8 to 6.1 feet MSL (FES 1987, Tech. App. D). Columbia Slough bottom elevations between the Willamette River and the landfill bridge are generally below sea level (-1 to -5 ft MSL), with the exception of a shoal area off the mouth of North Slough (about 1.5 ft MSL); the slough bottom was slightly above sea level near Portland Road (0.2 ft MSL).

Bottom sediments in the lakes were characteristically silty; the percentage of silt at many stations exceeded 80%. Columbia Slough sediments were generally dominated by sand; samples between the mouth of North Slough and the landfill bridge were 80% or more sand, samples between North Slough and the Willamette 95% or more sand. The silt content of slough sediments was progressively greater with distance from the Willamette; a sample near Portland Road was 66% silt (FES 1987, Tech. App. D).

Zooplankton sampling in the study area found that samples in lake and river water were similar, while those from slough water were characteristically different (PES 1987, Tech. App. F). Cladocerans dominated lake samples during late May; copepods were relatively more abundant during September. Rotifers dominated slough water samples.

Samples of bottom-dwelling animals indicated that aquatic worms (oligochaetes) were the most abundant organism; in fact, most Smith Lake and Columbia Slough samples contained only these worms (FES 1987, Tech. App. F). Bybee Lake and Smith Channel samples had a greater diversity of bottom animals compared to Smith Lake and the slough. A statistical relationship was demonstrated for the abundance of bottom organisms and the volume of organic debris in sediment samples. A 1988 study (Portland BES 1989) described Lower Columbia Slough as an area with low diversity of bottom-dwelling animals.

Samples of fish populations in the study area resulted in the identification of 17 species, including several warm-water game species (FES 1987, Tech. App. G). An interesting result was the great abundance of juvenile Chinook salmon found everywhere in the study area during the spring, and the complete absence of this species during summer and fall. This suggests that the sloughs and lakes provide rearing habitat for young salmon during late winter and spring. High river levels during late winter and early summer provided connections between the river-slough system and the lakes, allowing salmon to enter, and presumably leave the lakes; predation could also account for the absence of juvenile salmon in early summer samples.

The abundance of each fish species varied with season, water body, and habitat. Carp was the most numerous species in most areas and most seasons. Exceptions to carp dominance included the slough during spring (salmon and suckers more abundant), and the lakes and slough during fall (young bluegill more numerous in the lakes, goldfish in the slough).

Growth and food habits information was collected for most species of fish. Results indicated that populations of game and non-game species generally have an age structure indicating successful reproduction in the area. Bass and crappie populations seem strong enough to support recreational fisheries; bluegill populations are more dominated by smaller fish. The food of most species examined is primarily zooplankton, particularly c1adocerans, with very few bottom organisms consumed.

Smith and Bybee Lakes and Columbia Slough appear, from this limited information, to have larger populations of non-game fish species, and fewer numbers of certain species typical of the Columbia River, than other lower Columbia River sloughs and lakes that have been studied. Smith and Bybee Lakes, however, appear to have a more well developed warm-water game fish fauna dominated by bass and crappie, with a good base of small bluegill available as forage.

Wildlife data collected for the study area resulted in the identification of 72 species of birds actually observed, and another 25 species expected to be present FES 1987, Tech. App. H). Waterfowl numbers were very low in all habitats of the study area during late spring, early summer, and fall, 1986. An exception to this finding was the large numbers of waterfowl in the remnant Blind Slough area of the St. Johns landfill; the majority of mallard and cinnamon teal broods observed were in this area. The Blind Slough remnant has since been filled with solid waste. Greater numbers of waterfowl were observed in the lakes during a one-day survey in March, 1987.

Large numbers of scavenging bird species, such as starlings and crows, were observed in various habitats around and on the landfill. These birds feed in the landfill, and roost in nearby cottonwood and willow forests. Many nesting cavities in these areas were occupied by starlings and sparrows rather than the normally occurring species. Large mixed-species flocks of gulls also feed in the landfill and roost on nearby areas of Bybee Lake.

Bald eagles have been observed over the study area, but no roosting or nesting eagles have been seen (1990). *Note that in 2011, nesting eagles are observed in the study area.*

2011 Update

Some native grasses have been noted in former test plots. This may be due to reduced mowing. Seed heads are now visible and grass can be identified. Native grasses and forbs have been seeded in construction area, grazed areas and vegetation islands. Some species have been successful. In order to establish native pants, test plots have been created with upland woody, wetland woody and forb plug species.

ASSESSMENT OF SMITH AND BYBEE LAKES: 2012 UPDATE

Since 1990, Smith and Bybee Wetlands experienced habitat degradation and subsequent improvement as our understanding of the site and its needs improved. The permanently high water levels maintained by the 1983 structure were too much for bottomland willow and ash forest, and hundreds of acres of trees died. In the lakes, the population of non-native carp grew so large that native smartweed beds disappeared and the water became turbid.

The emerging disciplines of conservation biology and ecological restoration provided the basis for the recovery of Smith and Bybee Wetlands. A new water control structure was planned and installed in 2003, one that could allow managers to vary water levels in the wetlands in a pattern more similar to historic conditions. Since the late 1990s, more than a hundred acres have been planted in native trees and shrubs to reclaim areas that had been lost to invasive reed canarygrass. The virtual elimination of combined sewer overflows into the Columbia Slough in the early 2000s increased water quality and erased concerns over reconnecting the wetlands and the slough. Repairs and improvements to the landfill's perimeter bank improved the security of its contents while grassland habitat was established on its surface. The lakes have been removed from DEQ's list of water quality impaired water bodies.

The new water control structure supports restoration of more than half the natural area's acreage. Its original objectives were to control reed canarygrass, increase native plant cover in its place, provide off-channel habitat for young salmon, and provide wintering habitat for waterfowl and mudflats for migrating shorebirds. All of these objectives have been realized. Native willow is regenerating in places where it had died from constant impoundment. Steelhead, Chinook and coho salmon take refuge from high winter flows in the wetlands. Thousands of waterfowl spend the winter on Bybee and Smith lakes, and recent work is documenting the importance of Bybee's late-summer mudflats to shorebirds. In the elevations influenced by water level management, reed canarygrass cover is reduced by nearly half and has been replaced by native plants.

After the hard lessons from the 1983 structure, active monitoring and adaptive management have become routine practices at the wetlands. Metro's work at Smith-Bybee is grounded in the most current science and peer reviewed via academic partnerships, professional conferences and technical working groups. An ongoing partnership with Portland State University allows Metro to quantify the effects of water level management on native and exotic plants and to fine-tune the wetlands' hydrology to benefit natives.

Monitoring of western painted turtles confirmed that the natural area contains one of the largest populations remaining in Oregon. By the late 1990s, turtles were subjected to frequent disturbance by paddlers and their primary nesting grounds were routinely damaged by vehicles. The widening of North Marine Drive provided an opportunity and a challenge, as original plans called for re-locating a rail line on the nesting grounds. The Smith and Bybee Wetlands Advisory Committee advocated for the natural area. As a result, industrial neighbors to the northeast sacrificed some of their land for the road project, an overpass was built to avoid moving the rail line, and an earth berm topped with a concrete sound wall now protects the turtles' habitat.

Much of the work in the 1990s and early 2000s involved changing land use and ownership. During its first years of stewardship, Metro purchased most of the private land within the natural area boundary to consolidate public ownership. A 1992 recreation master plan created by the City of Portland called for a major interpretive center in the southeast portion of Smith Lake. The 1996 flood event demonstrated the site's vulnerability and the plan was shelved. In 1998, spurred by the North Marine Drive project, Metro revisited the access work and procured land north of Smith Lake from the Port of Portland for new facilities. The former parking area was demolished and planted when the new site was finished. The advisory committee was active in the Lombard overpass and Wapato Jail projects, and their completion in the mid-2000s marked the end of the land use advocacy period for the committee.

New work at the St. Johns Landfill site is creating habitat for nesting horned larks and improving conditions for pollinators and grassland birds. Some native grasses have been noted in test plots seeded in the 1990s where it was thought they'd failed. This may be due to reduced mowing; seed heads are now visible and grasses can be identified more easily. Native grasses and forbs have been seeded in construction areas, grazed areas and vegetation islands. Test plots have been created with upland woody, wetland woody and forb (wildflower) species.

In recent years, work at Smith and Bybee Wetlands has focused on documenting its inhabitants and evaluating success of restoration work. A longtime member of Friends of Smith and Bybee Lakes and the advisory committee has provided bird lists from near-weekly walks for more than 10 years; Metro is compiling the data to watch for changes in arrival and departure dates for migrants that may be associated with climate change. In 2011, an extensive botanical collection was completed and it is housed at the PSU herbarium; this plant list provides an important snapshot in time. Quantitative plant and bird surveys monitor changes in habitat structure and function as restoration projects mature. This work sets the stage for the ambitious restoration plans outlined in the CNRP.

ASSESSMENT OF ST. JOHNS LANDFILL VEGETATION

Prepared by Metro, 2011

Conditions at the St. Johns Landfill (SJL) create unique and difficult conditions for establishing native vegetation. Repeated efforts at establishing native vegetation have generally failed. Several reports document the revegetation efforts and the reasons for failure (Fishman 1992, Metro 1997, Wilson et al 1998). Each of these reports identifies site conditions as the primary reason for failure.

As subareas of the landfill were closed in the 1980s, a layer of topsoil was placed as a temporary cover. The soil was a mix of low permeability silt or clay and was spread to a two-foot thickness. Digested sewage sludge was mixed into the surface and then a mix on non-native grasses and forbs was sown over the surface. Perennial rye grass, birdsfoot trefoil, New Zealand white clover and other perennial and annual grasses were included in the mix (Metro 1997).

In the early 1990s, the final closure plan was implemented which involved stripping the top soil and temporary cover, installing a new impermeable membrane, a 12 to 18 inch drainage layer of sand, and topsoil placed at varying depths to accommodate the planned native plant communities. Based on recommendations from the US Soil Conservation Service, the landfill was hydroseeded with a mix of sheep fescue and perennial ryegrass. While the specifications called for placement of weed-free topsoil, project economics and construction schedules prevented its acquisition and use (Metro 1997). Top soil used came from a variety of sources and varied in quality. The stripped temporary cover top soil, with its seed bank of non-native grasses and forbs, was included with the soils placed over approximately 45 percent of the landfill (O'Neil 2004). Soil seed bank tests conducted after topsoil placement revealed huge quantities on non-native grasses and pest plant seed banks (Metro 1997).

Several experiments designed to test methods for establishing native grasses at the SJL failed to establish natives grasses for more than a few years. Reasons given for the failures were related to competition from the heavy cover of perennial ryegrass, a soil seedbank rich with non-native grasses and forbs, seed sources from outside the Willamette Valley, and poor soil conditions. Poor mixing of the various topsoils resulted in profiles with lenses of clay and sand that result in highly variable water infiltration rates ranging from poorly-drained to excessively-drained (Wilson et. al 1999). Additionally, the abrupt interface between the lower sand layer and added topsoils exacerbates soil drainage issues. Because of soil moisture tension relationships relative to soil pore size differences in sands compared to loams, a loamy soil must be saturated at the loam/sand interface before water will drain through to the sand. This situation likely further complicates internal drainage.

Wilson et. al. (1999) concluded their attempt at establishing native vegetation by recommending concentrating replanting efforts around the perimeter of the landfill, determining through experimental plantings whether native woody shrubs or tree could be established in areas with deep topsoil, and managing areas of the SJL where the soil depth is less than 12 inches as waterfowl feeding areas. Continued attempts at establishing native grasses and forbs was not included in the recommendations.

The latest vegetation management plan (Jones & Stokes 2004) acknowledged the difficulties in establishing native vegetation and focuses on improving the wildlife functions the present vegetation can provide. The plan recommends reduced mowing to increase vegetative structural complexity, provide a food source, and increase species diversity. Other habitat improvements recommended included additional low perching structures for grassland birds such as western meadowlark, and the creation of vegetation islands. Vegetation islands are islands of native shrubs, forbs, and grasses constructed atop a countersunk, impermeable liner that would hold water for much longer periods than occurs with the existing cover.

Managers at SJL have adopted these latest measures by rotating annual mowing or grazing among the five subunits and initiating installation of the vegetation islands (Vandenburg, pers. com. 2010).*

Current Planning Effort

Upland prairie, riparian forests, western painted turtle, and streaked horned lark are conservation targets of the SBW Comprehensive Natural Resource Management Plan that occur at SJL. Western meadowlark is a nested target included under the umbrella of the upland prairie conservation target.

Conditions suitable for establishing nesting pairs include upland prairie, which is the dominant planned habitat type for SJL.

Loamy, sandy soils, with sparse vegetation and good exposure to the sun, and within relatively short distance to open water habitat, make ideal nesting habitat for western painted turtle. SJL has the potential to provide a significant amount of nesting habitat. Nesting has been observed in the southeast corner of SJL near the existing stormwater facility.

SJL Management Units

Western Meadowlark nesting area. This unit is comprised of four male meadowlark territories, each approximately 40 acres in size. It encompasses the majority of land at SJL the main upland prairie. This area would be managed to maintain the upland prairies KEAs that are currently in a good or very good condition.

Streaked Horned Lark nesting area. Two 10-acre experimental habitat plots have been created in an attempt to attract nesting streaked horned lark from a nearby property in the Rivergate Industrial Area, where development is threatening the existing nesting colony.

Management activities curtailed during breeding season from mid-April through early August. Gas monitoring, mowing and spraying occurs as needed.

Riparian Forest/Shrub. Limited to the area down-slope of the perimeter road, but extends around the perimeter of SJL. This management unit has been the subject of slope stabilization and revegetation efforts and will continue to be so.

Western painted turtle nesting area. This unit comprises the area 200 feet upslope of the perimeter road along the north and east perimeter of SJL, excluding areas managed for riparian forest/shrub wetland. Because WPT prefer easily negotiable, straight-line corridors

from open water to nesting sites (Kutschera 2010), this management unit includes "turtle trails" through the riparian forest and shrub wetlands down slope of the perimeter road. These trails will link North Slough, Smith Lake and Blind Slough to nesting areas on the SJL. These trails would be maintained to be clear of impenetrable barriers to WPT movement and would lead to under-crossings of the perimeter road and 40-mile loop, day-lighting upslope of any perimeter fence.

Upland shrub areas. These areas are limited to several drainage features around the SJL. Their primary purpose is to provide perches for western meadowlark. As such, they need to be interspersed within the breeding habitat, but must be maintained to provide no more that 5 percent cover.

Goals for revegetation actions typically included development of native plant communities along topographic and hydrologic gradients: mesic prairie communities on the relatively flat ridge tops, xeric prairies along the side slopes, and shrub communities in deeper soils in draws and the toe of slope.

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SMITH AND BYBEE WETLANDS NATURAL AREA MANAGEMENT PLAN

CONSERVATION TARGETS

Prepared by David Evans and Associates

Introduction

Conservation targets are composed of a suite of species, communities, and ecological systems that represent and encompass the full array of native biodiversity of the site; reflect local and regional conservation goals; and are viable or at least feasibly restorable (TNC 2007).

Conservation targets establish the basis for setting goals, carrying out conservation actions, and measuring conservation effectiveness. They are the foundation of conservation planning. Key ecological attributes (KEAs) for each conservation target will be evaluated. KEAs are aspects of a conservation target's biology or ecology that, if missing or altered, would lead to the loss of that target over time (TNC 2007). Viability of the conservation target is inferred by the condition of the KEAs. Analysis of threats affecting Conservation Targets inform the development of action plans to abate serious threats and monitoring plans to gauge success of the action plans. Conservation targets then should consist of species or communities that will provide the focus of management actions and monitoring. Species or communities that for whatever reason are too expensive to manage or monitor are not good candidates for conservation targets.

Methods

Regional conservation plans were referenced to align the conservation goals of the Smith and Bybee Wetlands Natural Area Management Plan with other Willamette Valley ecoregional conservation plans. These plans included the Oregon Department of Fish and Wildlife's Oregon Conservation Strategy (ODFW 2006), the City of Portland's Terrestrial Ecology Enhancement Strategy (COP 2010), the Northwest Power and Conservation Council's Willamette Subbasin Plan (NWPCC 2004), The Nature Conservancy's Ecoregional Assessment of the Willamette Valley – Puget Trough – Georgia Basin (TNC 2004), and Partner's in Flight's Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington (PIF 2000). These plans identify both focal habitats and focal species as conservation targets.

Onsite habitats as mapped by Metro (2006) were used as the foundation for selecting conservation targets, under the assumption that KEAs for the selected habitats would align well with KEAs of the sensitive wildlife species associated with that habitat. However, in the case of the western painted turtle their use of multiple habitats warranted listing them as a conservation target.

Additionally, some sensitive species associated with a particular habitat have KEAs that wouldn't be captured by a general list of habitat-based KEAs. For example, habitat-based KEAs for upland prairie wouldn't necessarily include perches for western

meadowlark or single out important components such as Columbia sedge meadows in emergent wetlands. When these differences became apparent, a sensitive species was designated as a nested target under their umbrella conservation target. The difference being, conservation targets form the basis of this management plan, while nested targets are addressed as a part of action plans developed for their umbrella conservation target.

Results

Using onsite habitat types and regional conservation planning efforts as guides, conservation targets were selected that encompass the site's biodiversity values and regional conservation targets. As discussed in the main document on pages 24-25, they are:

Habitat Conservation Targets

- Upland prairie (including western meadowlark as nested target)
- Emergent wetland and open water (including Columbia sedge meadows, autumnal mudflats, and Chinook salmon as nested targets)
- Shrub wetland
- Bottomland forest wetland
- Riparian forest (including bald eagle as a nested target)

Species Conservation Targets

- Western painted turtle
- Streaked horned lark

The habitat conservation targets represent the major habitat types present at the site. Western painted turtle and streaked horned lark were selected as target species because several of their KEAs would not be captured in a list of habitat-based KEAs.

Discussion

These Conservation Targets reflect local and regional conservation goals. Each of them are represented in one or more of the regional conservation plans listed below in Table 1, which relates the Conservation Targets to focal species and habitats as identified in regional conservation plans.

Table 1. Comparison of Conservation Targets

Smith and Bybee Wetlands Natural Area Conservation Targets	Oregon Conservation Strategy (ODFW 2006)	Terrestrial Ecology Enhancement Strategy (COP 2010)	Willamette Basin Subbasin Plan (NPCC 2004)	Landbird Conservation Strategy (PIF 2000)	Ecoregional Assessment (TNC 2004)
Upland prairie	Grasslands	Upland prairie and native grasslands	Upland prairie and savanna	Grassland - savanna	Upland prairie and savanna

Emergent wetland and open water	Wetlands: marshes	Herbaceous wetlands	Wetland prairie and seasonal marsh; Perennial ponds, sloughs, and their riparian areas	N/A	Freshwater aquatic beds; Autumnal freshwater mudflats
Shrub wetland	Wetlands: deciduous swamps and shrublands	N/A	Perennial ponds, sloughs, and their riparian areas	Riparian	Depressional wetland broadleaf forests
Bottomland forest	Riparian habitats	Bottomland hardwood forests and riparian habitats	Perennial ponds, sloughs, and their riparian areas	Riparian	Depressional wetland broadleaf forests
Riparian forest	Riparian habitats	Bottomland hardwood forests and riparian habitats	Perennial ponds, sloughs, and their riparian areas	Riparian	Riparian forests and shrublands
Western painted turtle	Western painted turtle	Western painted turtle	N/A	N/A	N/A
Streaked horned lark	Streaked horned lark			focal species	

Each of the plant communities and species listed in Table 1 fit the criteria for a good Conservation Target. Western painted turtle are OCS Strategy species (ODFW 2006). The six communities and their representative species characterize the major systems at the site including the St. Johns Landfill.

Sensitive species that have not been included as either Conservation Targets or Nested Targets but have the potential to occur at the site are identified in Table 2. These species will benefit from prescriptions developed for the habitats in which they occur.

Table 2. Non-target Sensitive species with potential to occur at Smith and Bybee Wetlands Natural Area

Species	Federal and State Status	OCS Strategy Species?	Smith and Bybee Wetlands Natural Area Target Habitats					
			Upland prairie	Emergent wetland	Shrub wetland	Bottomland forest	Riparian forest	Open water
Birds								
Common nighthawk	NL/SC	Yes	✓	✓	✓	✓	✓	✓
Dusky Canada goose	NL/NL	Yes	✓	✓				✓
Grasshopper sparrow	NL/SV	Yes	✓					
Little willow flycatcher	NL/SV	Yes			✓	✓	✓	✓
Oregon vesper sparrow	SOC/SC	Yes	✓					
Peregrine falcon	DL/SV	No	✓	✓				✓
Purple martin	SOC/SC	Yes	✓	✓	✓		✓	✓
Streaked horned lark	C/SC	Yes	✓					
Tri-colored blackbird	SOC/NL	No		✓	✓			✓
Western bluebird	NL/SV	Yes	✓					
Western meadowlark	NL/SC	Yes	✓					
White-breasted nuthatch*	NL/SV	Yes				✓	✓	
Yellow-breasted chat	NL/SC	Yes			✓	✓	✓	
Amphibians/Reptiles								
Northern red-legged frog*	SOC/SC	Yes		✓	✓	✓	✓	
Northwestern pond turtle	SOC/SC	Yes	✓	✓		✓	✓	✓
Mammals								
California myotis	NL/SV	Yes				✓	✓	
Hoary bat	NL/SV	No	✓	✓		✓	✓	
Long-legged myotis	SOC/SV	No	✓	✓		✓	✓	✓
Silver-haired bat	SOC/SV	No	✓	✓		✓	✓	
Townsends big-eared bat	SOC/SC	Yes	✓	✓		✓	✓	✓
Yuma myotis	SOC/NL	No	✓	✓		✓	✓	✓

*=Present; C= Candidate; NL=Not Listed; DL=Delisted; SOC=Species of Concern; SC= Sensitive Critical, SV = Sensitive Vulnerabl

KEY ECOLOGICAL ATTRIBUTES

Key Ecological Attributes (KEAs) are aspects of a conservation target's biology or ecology that, if missing or altered, would lead to the loss of that target over time (TNC 2007). KEAs define the conservation target's viability. They are the biological or ecological components that most clearly define or characterize the conservation target, limit its distribution, or determine its variation over space and time. They are the most critical components of biological composition, structure, interactions and processes, and landscape configuration that sustain a target's viability or ecological integrity.

For each KEA, one or more indicators were selected to assess the health of the KEA. Indicators are measurable entities related to the condition of the KEA (TNC 2007). A good indicator should be:

- **Biologically relevant:** The indicator should represent an accurate assessment of target health
- **Sensitive to anthropogenic stress:** The indicator should be reflective of changes in stress
- **Measurable:** The indicator should be capable of being measured using standard procedure
- **Cost-effective:** The indicator should be inexpensive to measure using standard procedures
- **Anticipatory:** The indicator should indicate degradation before serious harm has occurred
- **Socially relevant:** The indicator's value should be easily recognizable by stakeholders.

KEA indicators were categorized by type: size, condition, or landscape context (TNC 2007):

- **Size:** A measure of the area or abundance of the conservation target's occurrence
- **Condition:** A measure of the biological composition, structure and biotic interactions that characterize the occurrence
- **Landscape context:** An assessment of the target's environment including ecological processes and regimes that maintain the target occurrence such as flooding, fire regimes and many other kinds of natural disturbance, and connectivity such as species targets having access to habitats and resources or the ability to respond to environmental change through dispersal or migration.

The status of an indicator will vary over time either within an acceptable range of variation that sustains the conservation target or beyond a critical threshold that threatens the viability of the conservation target. The range is described as very good, good, fair, or poor. The very good and good ratings mean that the indicator is functioning within its acceptable rang of variation. Fair and poor ratings mean an indicator outside its acceptable range of variation. When information was lacking to define all four categories then only a subset of the four categories was defined. Definitions for the four categorizes follow those used by TNC (2007):

- **Very good:** The indicator is functioning within an ecologically desirable status, requiring little human intervention for maintenance within the natural range of variation (i.e., is as close to "natural" as possible and has little chance of being degraded by some random event)
- **Good:** The indicator is functioning within its range of acceptable variation, although it may require some human intervention for maintenance
- **Fair:** The indicator lies outside of its range of acceptable variation and requires human intervention for maintenance. If unchecked, the target will be vulnerable to serious degradation
- **Poor:** Allowing the indicator to remain in this condition for an extended period will make restoration or prevention of extirpation of the target practically impossible (e.g., too complicated, costly, and/or uncertain to reverse the alteration).

Conservation targets at Smith and Bybee Wetlands Natural Area (SBW) are the major habitat types as mapped by Stewart (2009) along with western painted turtle and streaked horned lark. Biological or ecological components that most clearly define or characterize the major habitat types at SBW include:

- gross physiognomy of the plant communities
- their component parts including native and non-native species
- hydrologic and edaphic conditions
- successful reproduction of desired species
- ecological processes which create conditions that maintain the community over time.

For the two species selected as conservation targets, critical biological or ecological components include suitable habitat conditions for key life history traits (e.g. reproduction, foraging), dispersal corridors, and ecological processes that ensure continued favorable habitat conditions.

As stated above, KEAs must be cost-effective to measure. Metro's budget for monitoring is limited, allowing only for KEAs that can be easily measured by such means as visual estimates of percent vegetative cover, point counts, and other metrics that can be quickly and meaningfully measured.

KEAs and their indicators for SBW conservation targets are provided in the following tables.

Key Ecological Attribute
Target: Bottomland Forest

Type	Key Ecological Attribute	Indicator	Indicator Range				Current Status	Current Rating	Desired Rating	Comments
			Poor	Fair	Good	Very Good				
Size	Extent of bottomland forest including Oregon ash forest	Acres of bottomland forest including Oregon ash forest		Reduced due to habitat conversion	Maintained at current size	Increased extent	~90 acres	Fair	Very Good	
Condition	Vegetative structure: tree layer	Percent native tree canopy cover	<20% cover	20-60% cover	60-80% cover	>80% cover	Probably 40 percent in existing stands	Fair	Very Good	Willow flycatcher abundance positively correlated with dense mature deciduous riparian forest (Porasky et. al. 1992 cited in PIF 2000)
Condition	Mature Oregon ash	Number and size (dbh) of mature Oregon ash	Mature Oregon ash lacking	<3 per acre with dbh >24 inches	3-5 per acre with dbh >24 inches	>5 per acre with dbh >24 inches	Large ash limited and scattered in two areas	Fair	Very Good	Recruitment of native trees necessary for long-term health of riparian forest. Saplings are < 2m tall. PIF (2000) biological objective for WV large-canopy trees in riparian deciduous woodland
Condition	Native tree recruitment	Number of Oregon ash saplings in Oregon ash dominated forest per acre	Oregon ash saplings absent from understory	1-5 Oregon ash saplings present per acre	5-10 Oregon ash saplings present per acre	>10 Oregon ash saplings present per acre	Good in revegetated unit; natural recruitment absent.	Very Good	Very Good	Recruitment of native trees necessary for long-term health of riparian forest. Saplings are < 2m tall. PIF (2000) biological objective for WV large-canopy trees in riparian deciduous woodland
Condition	Key habitat feature presence: snags	Number of snags per acre	Snags absent	1-2 per acre	3-5 per acre	>5 per acre with 2 per acre > 10" dbh	Perhaps 1-2 per acre in existing stands	Fair	Very Good	PIF (2000) biological objective for downy woodpecker (snags in riparian deciduous woodland)

- ***Very Good***: The indicator is functioning within an ecologically desirable status, requiring little human intervention for maintenance within the natural range of variation (i.e., is as close to "natural" as possible and has little chance of being degraded by some random event).
- ***Good:*** The indicator is functioning within its range of acceptable variation, although it may require some human intervention for maintenance.
- ***Fair:*** The indicator lies outside of its range of acceptable variation and requires human intervention for maintenance. If unchecked, the target will be vulnerable to serious degradation.
- ***Poor:*** Allowing the indicator to remain in this condition for an extended period will make restoration or prevention of extirpation of the target practically impossible (e.g., too complicated, costly, and/or uncertain to reverse the alteration).

Key Ecological Attribute
Target: Emergent Wetland – Open Water

Type	Key Ecological Attribute	Indicator	Indicator Range				Current Status	Current Rating	Desired Rating	Comments
			Poor	Fair	Good	Very Good				
Size	Exposure of autumnal mud flats	Extent and duration of seasonal low water	Water level above 2m (6.6ft) NVGD29 from June - November	Water level from 1m-2m (3.3 -6.6ft) NVGD29 from June - November	Water level at or below 1m (3.3 ft) NVGD29 from June - November		Annually, water level at or below 1m (3.3 ft) NVGD29 exposing ~700 acres of autumnal mudflats.	Good	Good	Water levels below 1m (3.3 ft) NVGD29 expose ~700 acres of autumnal mudflats.
Size	Size of Columbia sedge meadow	Acres of Columbia sedge meadow	Columbia sedge extirpated	Declining areas with >40% cover of Columbia sedge	Maintained at current size	Acreage expanded	Uncertain; monitoring indicates some holding their own.	Fair to Good	Very Good	
Size	Columbia sedge cover in Columbia sedge meadow	% cover Columbia sedge cover in Columbia sedge meadow	Columbia sedge extirpated	<40% cover	40-80% cover	>80 cover	Cover varies among meadows; biggest competitor is canarygrass.	Fair to Good	Very Good	Reference sites do not exist. The healthiest meadow at SBW is a near-monoculture of sedge. Historic presence and composition of other natives in this habitat is unknown.
Condition	Water quality	Clean Water Act Section 303d listing		Listed on 303d list for one or more parameters	Not listed on 303d list		Not listed on 303d list	Good	Good	
Condition	Native hydrophytic forb and graminoid abundance	Cover of native hydrophytic herbaceous species	<20%	20-30%	30-50%	>50%	Not certain; probably in the fair to good range.	Fair to Good	Very Good	Draft Recovery Plan for the prairie Species of Western Oregon and Southwest Washington (USFWS 2008). Good prairies >50% cover by native species.
Condition	Vegetative structure: tree and shrub layer	Percent tree/shrub canopy cover	>20% cover	20-15% cover	15-5% cover	<5% cover	Little woody plant encroachment occurring	Good	Very Good	Woody vegetation provides <20% cover in emergent wetlands (Cowardin et al. 1979).
Landscape context	Anadromous fish passage	Connectivity to North Slough	Connectivity to North Slough blocked		Open connectivity to North Slough via water control structure		Fish passage maintained.	Good	Good	

- ***Very Good***: The indicator is functioning within an ecologically desirable status, requiring little human intervention for maintenance within the natural range of variation (i.e., is as close to “natural” as possible and has little chance of being degraded by some random event).
- ***Good:*** The indicator is functioning within its range of acceptable variation, although it may require some human intervention for maintenance.
- ***Fair:*** The indicator lies outside of its range of acceptable variation and requires human intervention for maintenance. If unchecked, the target will be vulnerable to serious degradation.
- ***Poor:*** Allowing the indicator to remain in this condition for an extended period will make restoration or prevention of extirpation of the target practically impossible (e.g., too complicated, costly, and/or uncertain to reverse the alteration).

Key Ecological Attribute
Target: Riparian Forest

Type	Key Ecological Attribute	Indicator	Indicator Range				Current Status	Current Rating	Desired Rating	Comments
			Poor	Fair	Good	Very Good				
Size	Extent of riparian forest	Acres of riparian forest	Continued loss	Reduced due to habitat conversion	Maintained at current size	Increased extent.	~300 acres	Good	Very Good	
Condition	Large, interior habitat patches	Forest patches >30 acres with at least 200 ft from center to edge	Large habitat patches lacking or all narrow strands	1-2 patches ≥30 acres and at least 400 ft across	3-5 patches ≥30 acres and at least 400 ft across	3-5 patches ≥30 acres and at least 400 ft across	Perhaps 1 patch	Fair	Good	In the Metro region, 30-acre patches is the size at which certain species that either need a larger territory or avoid edge habitats (e.g. ermine and neotropical migratory songbirds) are present or increase in numbers (Metro 2006)
Condition	Native tree and shrub richness	Number of native tree and shrub species per acre	<2 species per acre	2-5 species per acre	6-9 species per acre	>10 species per acre	Probably 6-10 species per acre	Good	Very Good	
Condition	Vegetative structure: tree layer	Percent native tree canopy cover	<20% cover	20-60% cover	60-80% cover	>80% cover	Varies across the site	Generally Good	Very Good	Riparian forests characterized by high percent canopy cover. Willow flycatcher abundance positively correlated with dense mature deciduous riparian forest (Porasky et. al. 1992 cited in PIF 2000)
Condition	Vegetative structure: shrub layer	Percent native shrub canopy cover	< 10% cover or > 60 percent cover	10-20% cover	20-40% cover	40-60% cover	Varies	Generally Good	Very Good	PIF (2000) biological objective for yellow warbler (sub-canopy, tall shrub foliage in riparian woodland)
Condition	Native tree recruitment	Number of native tree saplings per acre	Native tree saplings absent from understory	1-5 native tree saplings present per acre	5-10 native tree saplings present per acre	>10 native tree saplings present per acre	Probably good, especially in revegetated units.	Very Good	Very Good	Recruitment of native trees necessary for long-term health of riparian forest. Saplings are <2m tall.
Condition	Key habitat feature presence: snags	Number of snag per acre	Snags absent	1-2 per acre	3-5 per acre	>5 per acre with 2 per acre > 10" dbh	Unsure; perhaps good	Good	Very Good	PIF biological objective for downy woodpecker (snags in riparian deciduous woodland) (PIF 2000)
Condition	Key habitat feature presence: bald eagle nest trees	Bald eagle nest trees present		Stand density <45 or >70 trees per acre. Tree heights uniform.	Stand density 45-70 trees per acre. Tree height variable, with trees 75-175 tall present		Several good locations	Good?	Good	Habitat Use by Nesting and Roosting Bald Eagle in the Pacific Northwest (Anthony et. al. 1982)

Type	Key Ecological Attribute	Indicator	Indicator Range				Current Status	Current Rating	Desired Rating	Comments
			Poor	Fair	Good	Very Good				
Landscape context	Wildlife movement corridors	Connectivity to surrounding habitats	Isolated: surrounding habitat lacking beyond SBW or access blocked.	Limited surrounding habitat beyond SBW or access often requires crossing roads, developed areas, etc.	Ample surrounding habitat beyond SBW but access requires crossing roads, developed areas, etc.	Ample surrounding habitat beyond SBW and access constraints minimal.	At least 2 vegetated corridors moving to and from S&B along Columbia Slough.	G?	VG?	Poor connectivity to the Columbia River and Hayden Island to the north.

- ***Very Good***: The indicator is functioning within an ecologically desirable status, requiring little human intervention for maintenance within the natural range of variation (i.e., is as close to "natural" as possible and has little chance of being degraded by some random event).
- ***Good:*** The indicator is functioning within its range of acceptable variation, although it may require some human intervention for maintenance.
- ***Fair:*** The indicator lies outside of its range of acceptable variation and requires human intervention for maintenance. If unchecked, the target will be vulnerable to serious degradation.
- ***Poor:*** Allowing the indicator to remain in this condition for an extended period will make restoration or prevention of extirpation of the target practically impossible (e.g., too complicated, costly, and/or uncertain to reverse the alteration).

Key Ecological Attribute
Target: Upland Prairie

Type	Key Ecological Attribute	Indicator	Indicator Range				Current Status	Current Rating	Desired Rating	Comments
			Poor	Fair	Good	Very Good				
Size	Extent of upland prairie	Number of potential male meadowlark territories (20 acre units)	<40 contiguous acres of contiguous prairie habitat	40 to 60 contiguous acres of contiguous prairie habitat	60 to 80 contiguous acres of contiguous prairie habitat	80 to 120 contiguous acres of contiguous prairie habitat	About 240 ac of upland prairie (grassland)	VG	VG	Patch Sites: KEA's and Indicators for Willamette Valley prairie and oak systems: The Nature Conservancy (TNC 2009)
Condition	Native forb and graminoid abundance	Native forb and graminoid species cover	<20%	20-30%	30-50%	>50%	Unknown; probably less than 10 percent	P	G	Draft Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington (USFWS 2008) Good prairies habitat >50% cover by native species.
Condition	Vegetative Cover: woody species	Area of woody vegetation (trees and shrubs) with cover less than 5%	Total woody cover less than 5% cover over less than 50% of the area being managed for prairie.	Total woody cover <5% over 50% to 90% of the area being managed for prairie.	Total woody cover <5% over at least 90% of the area being managed for prairie, though trees saplings and/or shrub sprouts may be present within these areas.	Total woody cover is <5% over at least 90% of the area being managed for prairie, and trees saplings and/or shrub sprouts are absent.	Very limited cover of trees; probably less than 1 percent	VG	VG	Patch Sites: KEA's and Indicators for Willamette Valley prairie and oak systems: The Nature Conservancy PIF (2000) biological objectives for western meadowlark < 5% cover by woody vegetation.
Condition	Key habitat feature: perches	Perch availability per 20 acre unit	Perches lacking; clarify that they should be shrubs affording cover?	Perches lacking or >100 feet from one or more 20 acre units	Perches dispersed throughout 20 acre units	Small perches, including native shrubs, dispersed throughout.	Ample perches of non-native materials; less than half suitable for predators such as American kestrels?	P: Good for kestrels and savannah sparrows only.	G	Distance to perch site from nest (<100 feet) may be better indicator. Western meadowlark Habitat Suitability Index. Altman (in Jones and Stokes) believes adequate perch sites presently exist at SJL.
Condition	Suitable graminoid height for meadowlark nesting	Graminoid height	Uniformly >30 inches tall	Variable height, but <30 inches tall.	6-20 inches tall	Mosaic of grass heights but dominated by 6-20 inch height	Most grasses are within the height guideline.	VG	VG	Effects of Management Practices on Grassland Birds: Western Meadowlark (Dechant et. al. 2002) PIF (2000) biological objectives for western meadowlark

- ***Very Good***: The indicator is functioning within an ecologically desirable status, requiring little human intervention for maintenance within the natural range of variation (i.e., is as close to "natural" as possible and has little chance of being degraded by some random event).
- ***Good:*** The indicator is functioning within its range of acceptable variation, although it may require some human intervention for maintenance.
- ***Fair:*** The indicator lies outside of its range of acceptable variation and requires human intervention for maintenance. If unchecked, the target will be vulnerable to serious degradation.
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Key Ecological Attribute
Target: Shrub Wetland

Type	Key Ecological Attribute	Indicator	Indicator Range				Current Status	Current Rating	Desired Rating	Comments
			Poor	Fair	Good	Very Good				
Size	Extent of shrub wetland area	Acres of shrub wetland		Reduced due to habitat conversion	Maintained at current size		~550 acres	Good	Good	
Condition	Native shrub richness	Number of native shrub species per acre	<2 species per acre	3-5 species per acre	>6 species per acre		Varies across site, probably on order of 3-5 overall	Fair	Good	
Condition	Vegetative structure: shrub layer	Percent native shrub canopy cover	<30% cover or >80% cover	30-50% cover	50-70% cover	70-80% cover	Varies and depends on maturity of revegetation projects	Fair	Very Good	Shrub wetlands have minimum 30 percent shrub cover (Cowardin 1979). PIF biological objective for willow flycatcher and yellow-breasted chat up to 80% shrub cover with scattered herbaceous openings (PIF 2003)
Condition	Vegetative structure: tree layer	Percent native tree canopy cover	>30% cover	30-20% cover	20-10% cover	<10% cover	Probably very low	Very Good	Very Good	Trees not a dominant vegetative component of shrub wetlands (Cowardin et al. 1979).
Condition	Transition to bottomland and riparian forests	Vegetative type and cover in transitional zone	Monotypic cover by reed canarygrass,	Large gaps with few trees and shrubs present common	Large gaps with few trees and shrubs present rare	Contiguous transition to bottomland and riparian forests	Very little connectivity of these habitats	Poor	Very Good	
Condition	Ovipositing habitat for breeding amphibians	Hydrology timing, depth, and duration	Most breeding area is limited to herbaceous plant material.	Less than 30 percent of shrubland inundated during breeding season	30-60 percent inundated continuously during breeding season	More than 60 percent inundated during breeding season.	Varies annually; typically is probably close to 75% if not more	Very Good	Very Good	Water levels linked to US Army Corps of Engineers manipulated Columbia River water level, but it is believed that sufficient water can be held in all but the lowest water years.

- ***Very Good***: The indicator is functioning within an ecologically desirable status, requiring little human intervention for maintenance within the natural range of variation (i.e., is as close to "natural" as possible and has little chance of being degraded by some random event).
- ***Good:*** The indicator is functioning within its range of acceptable variation, although it may require some human intervention for maintenance.
- ***Fair:*** The indicator lies outside of its range of acceptable variation and requires human intervention for maintenance. If unchecked, the target will be vulnerable to serious degradation.
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Key Ecological Attribute
Species: Streaked Horned Lark

Type	Key Ecological Attribute	Indicator	Indicator Range				Current Status	Current Rating	Desired Rating	Comments
			Poor	Fair	Good	Very Good				
Size	Area of suitable nesting habitat	Acres of sparsely vegetated/ bare ground	Bare ground largely absent	Patches of bare ground occupy <20% of site	Patches of bare ground occupy 20-40% of site	Patches of bare ground occupy >40% of site	Nest area mostly bare ground	Very Good	Very Good	PIF (2000) biological objective for streaked horned lark.
Condition	Suitable graminoid height for streaked horn lark nesting	Graminoid height	>24 inches	24-12 inches	12-6 inches	<6 inches	Vegetation mostly absent, what is there is low growing	Very Good	Very Good	Altman (2003b) found that streaked horned larks were absent in fields having grass layer heights >0.6 m (2 ft). Oregon Wildlife Institute Species Account Streaked horned lark
Condition	Vegetative cover; woody species	Percent woody vegetation cover	Woody vegetation covers >10% of site	Woody vegetation covers 5-10% of site	Woody vegetation covers <5% of site	Woody vegetation absent	Woody vegetation absent	Very Good	Very Good	PIF (2000) biological objective for streaked horned lark.
Condition	Foraging habitat	Presence of herbaceous species with seed size 0.8-1mm								SHL eats a wide variety of weed species and insects (Oregon Wildlife Institute).
Condition	Vegetative type	Rhizomatous grass dominance		Rhizomatous grass dominant graminoid (>20% cover)	Rhizomatous grass present but not dominant (<20% cover)	Rhizomatous grass absent	Rhizomatous grass present but not dominant	Good	Good	ODFW 2005 SHL Conservation Strategy

- ***Very Good***: The indicator is functioning within an ecologically desirable status, requiring little human intervention for maintenance within the natural range of variation (i.e., is as close to "natural" as possible and has little chance of being degraded by some random event).
- ***Good:*** The indicator is functioning within its range of acceptable variation, although it may require some human intervention for maintenance.
- ***Fair:*** The indicator lies outside of its range of acceptable variation and requires human intervention for maintenance. If unchecked, the target will be vulnerable to serious degradation.
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Key Ecological Attribute
Target: Western Painted Turtle

Type	Key Ecological Attribute	Indicator	Indicator Range				Current Status	Current Rating	Desired Rating	Comments
			Poor	Fair	Good	Very Good				
Condition	Western painted turtle population	Presence of (1) at least 200 turtles with (2) at least 50 each at 3 locations, with (3) juveniles and adults seen.	Adult or juvenile age classes absent in annual survey and either fewer than 150 turtles or other conditions not met.	Only 1 or 3 criteria met.	Two of three criteria met.	All three criteria met during survey.	Typically see well over 200 turtles across the site with good numbers in 3 areas and juveniles detected in all locations.	Very Good	Very Good	Metro conducts annual surveys of western painted turtle population, but there is no economically feasible way to accurately estimate population. Population counts range from 100-300 (Gervais et. al. 2009). Criteria based on expert knowledge and 10 years of visual surveys at SBW and many attempts to quantify the population.
Condition	Nest habitat availability	Number of suitable nesting areas within 150 feet of water; at least 0.5 acres in size	Suitable nesting areas lacking	<5 suitable nesting areas within 150 feet of water	6-10 suitable nesting areas within 150 feet of water	> 10 suitable nesting areas within 150 feet of water; at least 5 of them more than 0.5 acres	Probably 4 good nesting areas at least half-acre at present	Fair	Very Good	Suitable nest sites have sandy soil with good exposure to the sun, usually within 50m of water (Gervais et. al. 2009). Current estimate of number of active nesting areas based on data from Metro (2009). St. Johns landfill presents opportunity for increasing the number of suitable nest sites
Condition	Nest habitat distribution	Distribution of suitable nesting areas within 150 feet of water	Suitable nesting areas lacking	Suitable nesting areas limited to 1-2 locations	Suitable nesting areas limited to 3-4 locations	Five or more suitable nesting areas distributed around SBW	Currently 4 large, several smaller areas that are suitable.	Very Good	Very Good	Suitable nest sites have soft, sandy soil with good exposure to the sun. Current location of active nesting areas based on data from Metro (2009). St. Johns landfill presents opportunity for increasing the number of suitable nest sites
Condition	Basking site availability	Number of basking sites	Suitable basking sites lacking	Few basking sites available	Ample basking sites available at each location where more than 20 turtles known to occur		Basking good at 1 site, fair at others.	Fair	Good	Lack of basking sites affects habitat suitability (Gervais et. al. 2009).
Landscape Context	Nest site connectivity to open water	Access to nest sites	Access to suitable nesting sites blocked	Access to most nesting sites requires traversing man-made obstacles culverts	Access to most nesting sites does not require traversing man-made obstacles	Access to suitable nesting sites unobstructed	Probably 2 areas where nesting and water habitats are contiguous; others are separated by roads etc.	Fair	Good	Probably cannot change some of these locations.

Type	Key Ecological Attribute	Indicator	Indicator Range				Current Status	Current Rating	Desired Rating	Comments
			Poor	Fair	Good	Very Good				
Landscape Context	Dispersal corridors (connectivity) to suitable habitat	Availability and access to off-site suitable habitat	Isolated: suitable habitat lacking beyond SBW or access blocked.	Limited suitable habitat beyond SBW or access often requires crossing roads, developed areas, etc.	Ample suitable habitat beyond SBW but access requires crossing roads, developed areas, etc.	Ample suitable habitat beyond SBW and aquatic connectivity present	Connectivity is generally good, although not to Columbia River	Good?	Very Goof?	

- ***Very Good***: The indicator is functioning within an ecologically desirable status, requiring little human intervention for maintenance within the natural range of variation (i.e., is as close to "natural" as possible and has little chance of being degraded by some random event).
- ***Good:*** The indicator is functioning within its range of acceptable variation, although it may require some human intervention for maintenance.
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- ***Poor:*** Allowing the indicator to remain in this condition for an extended period will make restoration or prevention of extirpation of the target practically impossible (e.g., too complicated, costly, and/or uncertain to reverse the alteration).

SMITH AND BYBEE WETLANDS NATURAL AREA MANAGEMENT PLAN

THREAT ANALYSIS

Introduction

A stress is the "impairment or degradation of the size, condition, and landscape context of a conservation target, and results in reduced viability of the target," (TNC 2007) or, in other words, a degraded key ecological attribute (KEA) that is outside its acceptable range of variation. Stresses may also reduce the viability of nested conservation targets such as bald eagle. A source of stress is an extraneous factor, either human (e.g., policies, land use) or biological (e.g., non-native species) that infringes upon a conservation target in a way that results in stress. Put together, stresses and their sources constitute a threat.

Analysis of threats to conservation targets at Smith and Bybee Wetlands Natural Area (SBW) involves three parts:

- identify stresses and apply stress-rating criteria;
- identify sources of stress, rank, and assign threat-to-system rank; and
- assign overall threat rank.

Methods

Identify stresses and apply stress-rating criteria

In identifying stresses, we applied the concept that a stress is any alteration of a KEA that can result or has resulted in a KEA declining below a 'good' rating. For each conservation target, KEA indicators with ratings of 'poor' or 'fair' were analyzed by asking the question "*What types of destruction, degradation, or impairment are responsible for the 'poor' or 'fair' rating?"* We also considered those KEA indicators with 'good' and 'very good' ratings but are likely to degrade to 'poor' or 'fair' if no management actions are taken.

Stresses are ranked according to two criteria: **severity** and **scope** of the anticipated damage.

Severity: The level of damage to the conservation target that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation).

- ***Very High:*** The threat is likely to destroy or eliminate the conservation target over some portion of the target's occurrence at the site.
- ***High:*** The threat is likely to seriously degrade the conservation target over some portion of the target's occurrence at the site.
- ***Medium:*** The threat is likely to moderately degrade the conservation target over some portion of the target's occurrence at the site.
- ***Low:*** The threat is likely to only slightly impair the conservation target over some portion of the target's occurrence at the site.

Scope: The geographic extent of impact on the conservation target at the site that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation).

- ***Very High:*** The threat is likely to be widespread or pervasive in its scope and affect the conservation target throughout the target's occurrences at the site.
- ***High:*** The threat is likely to be widespread in its scope and affect the conservation target at many of its locations at the site.
- ***Medium:*** The threat is likely to be localized in its scope and affect the conservation target at some of the target's locations at the site.
- ***Low:*** The threat is likely to be very localized in its scope and affect the conservation target at a limited portion of the target's location at the site.

Once severity and scope ratings are determined, they are combined to develop a stress ranking using the following stress ranking table (Table 1) (TNC 2007).

Table1. Stress Ranking Table

	Scope			
Severity	**Very High**	**High**	**Medium**	**Low**
Very High	Very High	High	Medium	Low
High	High	High	Medium	Low
Medium	Medium	Medium	Medium	Low
Low	Low	Low	Low	Low

Identify Sources of Stress and Apply Threat to System Rank

Sources of stresses are the proximate cause of the stress. A source of stress may be either human activities or biological (e.g., non-native species). Sources of the stress are rated in terms of **contribution** and **irreversibility** as defined below (TNC 2007):

Contribution: The expected contribution of the source, acting alone, under current circumstances (i.e., given the continuation of the existing management/conservation situation).

- ***Very High:*** The source is a very large contributor of the particular stress.
- ***High:*** The source is a large contributor of the particular stress.
- ***Medium:*** The source is a moderate contributor of the particular stress.
- ***Low:*** The source is a low contributor of the particular stress.

Irreversibility: The degree to which the effects of a source of stress can be restored.

- ***Very High:*** The source produces a stress that is irreversible (e.g., wetlands converted to a shopping center).
- ***High:*** The source produces a stress that is reversible, but not practically affordable (e.g., wetland converted to agriculture).
- ***Medium:*** The source produces a stress that is reversible with a reasonable commitment of resources (e.g., ditching and draining of wetland).
- ***Low:*** The source produces a stress that is easily reversible at relatively low cost (e.g., off-road vehicles trespassing in wetland)

The contribution and irreversibility of each source across all the stresses to each conservation target is ranked using Table 2, resulting in a source of stress rank for each contribution / irreversibility combination (TNC 2007).

Table 2. Source Ranking Table

	Contribution			
Irreversibility	**Very High**	**High**	**Medium**	**Low**
Very High	Very High	High	High	Medium
High	Very High	High	Medium	Medium
Medium	High	Medium	Medium	Low
Low	High	Medium	Low	Low

In a similar fashion stress and source rankings are combined to develop a threat ranking specific to that conservation target (Table 3).

Table 3. Threat Ranking Table

	Source			
Stress	**Very High**	**High**	**Medium**	**Low**
Very High	Very High	Very High	High	Medium
High	High	High	Medium	Low
Medium	Medium	Medium	Low	Low
Low	Low	Low	Low	Low

Threat-to-System Rank

A Threat-to-System rank is a summary ranking for all threats associated with a particular source of stress to a conservation target. Where multiple threats related to the same source of stress occurred, the Threat-to-System rank is adjusted by using the "3-5-7" rule (TNC 2000) as follows:

- Three High rankings equal a Very High.
- Five Medium rankings equal a High.
- Seven Low rankings equal a Medium.

Table 4 illustrates the threat-to-system ranking:

Table 4. Conservation Target A

	Stress 1	**Stress 2**	**Stress 3**	**Threat to System Rank**
Stress Rank	**High**	**Medium**	**Medium**	
Source A Rank	**High**	**Medium**	N/A	***High****
Source B Rank	**Low**	**N/A**	**Medium**	***Medium****

N/A = Not Applicable: stress / source combination doesn't affect conservation target
*, ** - see Table 3

Overall Threat Rank

The last step in the process is to summarize threats across the system and apply an overall threat rank to each threat (source/stress combination). Overall Threat ranks are determined by combining Threat-to-System ranks across all System/Targets affected by that threat. For each threat, DEA will combine the Threat-to-System ranks across all conservation targets into an

Overall Threat rank of Very High, High, Medium, or Low as determined by the "2 Prime" rule which is as follows:

- *Two Very High threat rankings yield an Overall Threat Rank of Very High*
- *One Very High or Two High threat rankings yield an Overall Threat Rank of High*
- *One High or Two Medium threat rankings yield an Overall Threat Rank of Medium*
- *Less than Two Medium threat rankings yield an Overall Threat Rank of Low.*

The Overall Threat rank represents the degree to which a particular source causes stress to the conservation target.

Table 5. Overall Threat Rank

	Target 1	Target 2	Target 3	Overall Threat Rank
Threat A	***High****	Very High	High	**High**
Threat B	***Medium****	Medium	High	**Medium**
Threat C	N/A	Medium	Low	**Low**

*, ** - from Table 5

Threats: Bottomland forest

Stress	Stress Rank	Source	Source Rank	Comments
Native tree natural regeneration lacking: Seedling moisture stress, shading, crowding, cover	Very High	Invasive species: Reed canarygrass competition	Very High	Related to native tree recruitment and vegetative structure KEAs.
Lack of cavity nesting sites, roosting trees	High	Lack of standing, senescent trees	Medium	Related to snags KEA .
Disturbance to sensitive species while nesting	Medium	Recreational trail use	High	Related to goal of providing suitable conditions for sensitive species.
Lack of natural recruitment	Medium	Altered hydrograph: Water control structures	High	Related to native tree recruitment KEA.
Change in wetland hydrology	Medium	Altered hydrograph: Water control structures	High	Related to native tree recruitment and vegetative structure KEAs.
Lack of large standing trees to achieve snags and canopy cover	High	Beaver activity	Medium	Related to snags and vegetative structure KEAs.

Bottomland forest

	Source						
Stress	Urban Development	Human Activities	Wildlife	Invasive Species	Global Warming	Water Control Structures in and along the Columbia River	Management Actions
Native tree natural regeneration lacking				Very High (reed canarygrass competition)		Medium	
Disturbance to sensitive species while nesting		Medium (recreational trail use)					
Altered wetland hydrology						Medium	
Lack of large standing trees to achieve snags and canopy cover			Medium (beaver activity)				

Threats: Open water – emergent wetland

Stress	Stress Rank	Source	Source Rank	Comments
Native herbaceous species competition for space, water, light, nutrients	Very High	Invasive species: Reed canarygrass	Very High	Related to native tree recruitment and vegetative structure KEAs.
Decreased fish and amphibian fitness	High	Pollutants in stormwater outfalls	High	Related to water quality KEA. Future action: BES monitor “first flush” pollutants.
Altered hydrograph	High	Global warming	High	Related to native forb and graminoid KEA.
Altered hydrograph	High	Water releases, held by dams	High	Related to native forb and graminoid KEA.
Reduced food supply for ducks, shorebirds	Medium	Invasive species: Carp	High	Related to goal of providing suitable conditions for sensitive species.
Reduced food supply for ducks, shorebirds	High	Invasive species: Reed canarygrass, etc.	High	Related to goal of providing suitable conditions for sensitive species.
Amphibians Increased mortality rate - amphibians	High	Invasive Species: Bullfrog, carp	Very High	Related to goal of providing suitable conditions for sensitive species.
Loss of open water habitat	Medium	Invasive species: yellow-flag iris, *Ludwegia* sp.	Medium	Related to size of open water habitat.
Turbidity	Medium	Invasive species: Carp	Medium	Related to water quality KEA.
Introduction of invasive species	High	Recreational boaters	High	Related native tree recruitment and vegetative structure KEAs and to goal of providing suitable conditions for sensitive species.
Disturbance to over-wintering waterfowl	High	Recreational boaters	Very High	Related to goal of providing suitable conditions for sensitive species.

Open water – emergent wetland

	Source						
Stress	Urban Development	Human Activities	Wildlife	Invasive Species	Global Warming	Water Control Structures in and along the Columbia River	Management Actions
Native herbaceous species competition for space, water, light, nutrients				Very High (reed canarygrass competition)			
Decreased fish and amphibian fitness	High (pollutants in stormwater outfalls)						
Altered wetland hydrology					High	High	
Reduced food supply for ducks, shorebirds				Medium (carp)			
Reduced food supply for ducks, shorebirds				High (reed canarygrass, etc.)			
Increased mortality rate - amphibians				High (bullfrog, carp)			
Loss of open water habitat				Low (yellow-flag iris, *Ludwigia* sp.)			
Turbidity				Low (carp)			
Introduction of invasive species		High (recreational boaters)					
Disturbance to over-wintering waterfowl		High (recreational boaters)					

Threats: Riparian Forest

Stress	Stress Rank	Source	Source Rank	Comments
Disturbance to bald eagle while nesting (February to July)	Medium	Off recreational trail use	Very High	Bald eagles are a nested conservation target. Related to goal of providing suitable conditions for sensitive species. Trails should be located ¼ mile from nest sites with a visual screen and ½ mile without a visual screen.
Edge effect: increased nest parasitism, lack of interior habitat for neotropical migrants	Very High	Urban development, roads (Historic)	Very High	Current stress is lack of native tree regeneration.
Native tree natural regeneration lacking: moisture stress, shading, crowding, cover causing	High	Invasive species: Reed canarygrass competition	High	Related to native tree recruitment and vegetative structure KEAs.
Lack of wildlife dispersal corridors: Columbia Slough provides only corridor	High	Urban development	Very High	Related to wildlife movement KEA.
Lack of large standing tress to achieve snags and canopy cover	High	Beaver activity	Medium	Related to vegetative structure KEA. Potentially affects future bald eagle nest trees.
Destabilized banks	Medium	Nutria burrows	Very High	Related to native tree recruitment and vegetative structure KEAs.
Native tree recruitment	High	Broadleaf invasives (ivy, blackberry)	High	Related to native tree recruitment and vegetative structure KEAs.
Change in wetland hydrology	Low	Altered hydrograph: Water control structures	High	Related to native tree recruitment and vegetative structure KEAs.

Riparian forest

	Source						
Stress	Urban Development	Human Activities	Wildlife	Invasive Species	Global Warming	Water Control Structures in and along the Columbia River	Management Actions
Disturbance to bald eagle while nesting (February to July)		High (off recreational trail use)					
Edge effect: increased nest parasitism, lack of interior habitat for neotropical migrants	Very High (industrial development, roads) [Historic]						
Native tree recruitment lacking				High (competition from reed canarygrass and broadleaf invasives [ivy, blackberry])			
Lack of wildlife dispersal corridors	High (industrial development, roads) [Historic]						
Lack of large standing tress to achieve snags and canopy cover			Medium (beaver activity)				
Destabilized banks				Medium (nutria burrows, beaver activity)			
Altered wetland hydrology						Low	

Threats: Upland Prairie

Stress	Stress Rank	Source	Source Rank	Comments
Moisture stress	High	Soil profile / Liner system	Very High	Related to native forb and graminoid abundance and richness KEAs.
Lack of native forbs / graminoids: competition for moisture, light, space	High	Extensive non-native grasses and broadleaf weeds	Very High	Related to native forb and graminoid abundance and richness KEAs.
Forb and gramonoid herbivory	Low	Grazing waterfowl	Medium	Related to native forb and graminoid abundance and richness KEAs.
Lack of natural (non-infrastructure) perches	High	Lack of shrubs	Medium	Related to key habitat feature: perches KEA.

Upland prairie

	Source						
Stress	Urban Development	Human Activities	Wildlife	Invasive Species	Global Warming	Water Control Structures in and along the Columbia River	Management Actions
Moisture stress							High (soil profile / liner system)
Lack of native forbs / graminoids				High (competition from extensive non-native grasses and broadleaf weeds)			
Forb and gramonoid herbivory			Low (grazing waterfowl)				
Lack of natural (non-infrastructure) perches			Medium (lack of shrubs)				
Inappropriate vegetation height	High (lack of natural disturbance regime) [fire]						

Threats: Shrub wetland

Stress	Stress Rank	Source	Source Rank	Comments
Native tree and shrub natural regeneration lacking: Seedling moisture stress, shading, crowding, cover	Very High	Reed canarygrass competition	Very High	Related to native tree recruitment and vegetative structure KEAs.
Few native shrub species per acre	Medium	Reed canarygrass competition	Very High	Related to vegetative structure KEA.
Shrub canopy coverage low (30-50%)	Medium	Reed canarygrass competition	Very High	Related to vegetative structure KEA.
Change in wetland hydrology	Medium	Altered hydrograph: Water control structures	High	Related to native tree recruitment and vegetative structure KEAs.

Shrub wetland

	Source						
Stress	Urban Development	Human Activities	Wildlife	Invasive Species	Global Warming	Water Control Structures in and along the Columbia River	Management Actions
Native tree and shrub natural regeneration lacking: Seedling moisture stress, shading, crowding, cover				Very High (reed canarygrass competition)			
Few native shrub species per acre				Medium (reed canarygrass competition)			
Shrub canopy coverage low (30-50%)				Medium (reed canarygrass competition)			
Altered wetland hydrology						Medium	

Threats: Streaked horned lark

Stress	Stress Rank	Source	Source Rank	Comments
Nest predation	High	American Kestrel, Killdeer, Northern Harrier are most likely predators at SJL	High	Related to goal of providing suitable conditions for nesting and survival. Strategy ideas: Don't provide hunting perches next to habitat. Provide many nesting habitat areas scattered around the landfill so they are dispersed.
Nest destruction	Low	Vehicle traffic, mowing	Low	Related to goal of providing suitable conditions for nesting and survival.
Flushing while nesting	High	Vehicle traffic, foot traffic, unleashed dogs within 100 feet of nests	Medium	Related to goal of providing suitable conditions for nesting and survival. Strategy ideas: Locate habitat patches away from high-traffic and frequent work areas to the extent possible.
Inappropriate vegetation height	High	Lack of natural disturbance regime (fire)	High	Related to suitable nesting habitat and vegetative structure KEAs.

Streaked horned lark

	Source						
Stress	Urban Development	Human Activities	Wildlife	Invasive Species	Global Warming	Water Control Structures in and along the Columbia River	Management Actions
Nest predation			High (American kestrel, killdeer, northern harrier, crows, western meadowlark)				
Nest destruction							Low (vehicle traffic, mowing)
Flushing while nesting		Medium (vehicle traffic, foot traffic, unleashed dogs within 100 feet of nests)					Low (vehicle traffic, mowing)
Inappropriate vegetation height	High (lack of natural disturbance regime) [fire]						

Threats – Western painted turtle

Stress	Severity / Scope	Stress Rank	Source	Contribution / Irreversibility	Source Rank	Threat Rank	Comments
Limited habitat size	High / High	High	Urban development, current zoning	High / Very High	High	High	Related to nest site availability and distribution and dispersal corridors KEAs. Surrounding areas zoned Heavy Industrial, which allows development to within 10 feet of property line.
Impaired thermoregulation and digestion	High / High	High	Recreational boaters, disturbance while basking	High / Medium	Medium	Medium	Related to goal of providing suitable conditions for sensitive species.
Increased mortality rate	High / Medium	Medium	Bait fishing	High / Medium	Medium	Low	Related to population KEA.
Increased mortality rate	Low / Medium	Low	Urban development: road mortality	Medium / Medium	Medium	Low	Related to nest site availability and connectivity to open water KEAs.
Nest and hatchling predation	High / Very High	High	Wildlife; raccoons, skunks, coyotes	Very High / High	Very High	High	Related to goal of providing suitable conditions for sensitive species.
Competition for food/basking sites	Medium / Medium	Medium	Human introduced red-eared sliders turtles	High / Medium	Medium	Low	Related to goal of providing suitable conditions for sensitive species.
Limited basking sites available due to lack of natural regeneration and young age-class of trees present	High / Medium	Medium	Invasive species: reed canarygrass competition	Very High / High	Very High	Medium	Related to basking sites KEA.
Individuals removed from population	Medium / Medium	Low	Humans collecting turtles	High / High	High	Low	Related to population KEA. There is no staffing available to address poaching
Altered wetland hydrology	Very High / Very High	Very High	Water control structures in and along the Columbia River	Very High / High	High	Very High	Related to goal of providing suitable conditions for sensitive species.
Altered wetland hydrology	High / High	High	Climate change	High / Very High	High	High	Related to goal of providing suitable conditions for sensitive species.
Nest site disturbance	High / High	High	Recreational trail and off-trail use and off-leash dogs	High / High	High	High	Related to population KEA and to goal of providing suitable conditions for sensitive species.
Limited connectivity/dispersal corridors to off-site habitats	High / High	High	Urban development	Very High / Very High	Very High	High	Related to nest site availability and distribution and dispersal corridors KEAs.

Stress

Severity: The level of damage to the conservation target that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation).

- ***Very High:*** The threat is likely to destroy or eliminate the conservation target over some portion of the target's occurrence at the site.
- ***High:*** The threat is likely to seriously degrade the conservation target over some portion of the target's occurrence at the site.
- ***Medium:*** The threat is likely to moderately degrade the conservation target over some portion of the target's occurrence at the site.
- ***Low:*** The threat is likely to only slightly impair the conservation target over some portion of the target's occurrence at the site.

Scope: The geographic scope of impact on the conservation target at the site that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation).

- ***Very High:*** The threat is likely to be widespread or pervasive in its scope and affect the conservation target throughout the target's occurrences at the site.
- ***High:*** The threat is likely to be widespread in its scope and affect the conservation target at many of its locations at the site.
- ***Medium:*** The threat is likely to be localized in its scope and affect the conservation target at some of the target's locations at the site.
- ***Low:*** The threat is likely to be very localized in its scope and affect the conservation target at a limited portion of the target's location at the site.

Source
Contribution: The expected contribution of the source, acting alone, under current circumstances (i.e., given the continuation of the existing management/conservation situation).

- ***Very High:*** The source is a very large contributor of the particular stress.
- ***High:*** The source is a large contributor of the particular stress.
- ***Medium:*** The source is a moderate contributor of the particular stress.
- ***Low:*** The source is a low contributor of the particular stress.

Irreversibility: The degree to which the effects of a source of stress can be restored.

- ***Very High:*** The source produces a stress that is irreversible (e.g., wetlands converted to a shopping center).
- ***High:*** The source produces a stress that is reversible, but not practically affordable (e.g., wetland converted to agriculture).
- ***Medium:*** The source produces a stress that is reversible with a reasonable commitment of resources (e.g., ditching and draining of wetland).
- ***Low:*** The source produces a stress that is easily reversible at relatively low cost (e.g., off-road vehicles trespassing in wetland)

Western painted turtle

Source	Urban Development	Recreational boaters	Bait Fishing	Roads	Raccoons, skunks	Human introduced red-eared sliders	Lack of natural recruitment	Lack of movement corridors	Human collection	Climate Change	Recreational use / off-leash dogs
Stress											
Limited nesting sites at least 0.5 acres within 150 feet of open water	High										
Impaired thermoregulation and digestion		Medium									
Increased mortality rate			Low	Low							
Nest and hatchling predation					High						
Competition for food/basking sites						Low					
Limited basking sites available							Medium				
Reduced fitness / Inbreeding depression? Increased risk of extinction.								High			
Individuals removed from population									Low		
Altered hydrograph										High	
Nest site disturbance											High

Western painted turtle

	Source						
Stress	Urban Development	Human Activities	Wildlife	Invasive Species	Global Warming	Water Control Structures in and along the Columbia River	Management Actions
Limited nesting sites at least 0.5 acres within 150 feet of open water	High (industrial development) [Historic]						
Impaired thermoregulation and digestion		Medium (disturbance while basking)					
Increased mortality rate	Low (crossing roads)	Low (bait fishing					
Nest and hatchling predation			High (raccoons, skunks, etc.)				
Competition for food/basking sites		Low (introduction of red-eared sliders)					
Limited basking sites available due to lack of natural recruitment				Medium (reed canarygrass competition)			
Small, isolated population: reduced fitness / Inbreeding depression? Increased risk of extinction	High (lack of movement corridors)	Low (poaching)					
Altered wetland hydrology					High		
Nest site disturbance		High (recreational use / off-leash dogs)					

Smith and Bybee Wetlands threats summary

	Targets							
Threats	Open Water / Emergent Wetlands	Scrub-shrub Wetlands	Bottomland Forest	Riparian Forest	Upland Prairie	Western Painted Turtle	Streaked Horned Lark	**Overall Threat Rank**
Changes in community competition and succession due to invasive plant species competition	Very High	Very High	Very High	High	High	Medium (lack of basking sites)		Very High
Disturbance to nesting sensitive species and overwintering waterfowl due to recreational use on water and trail use including unleashed or leashed dogs	High (overwintering waterfowl)		Medium	High (bald eagle) Medium or Low		High	Medium Low	High
Edge effect (increased nest parasitism, lack of interior habitat for neotropical migrants due to industrial development		Medium		Very High				High
Altered wetland hydrology due to climate change	High	High	High	High		High		High
Nest and hatchling predation by wildlife					Medium	High (raccoons, skunks, etc.)	High (American kestrel, killdeer, etc.)	High
Inappropriate vegetation height due to lack of natural disturbance regime (fire)					High		High	High

	Targets							
Threats	Open Water / Emergent Wetlands	Scrub-shrub Wetlands	Bottomland Forest	Riparian Forest	Upland Prairie	Western Painted Turtle	Streaked Horned Lark	**Overall Threat Rank**
Altered wetland hydrology due to water control structures in and along the Columbia River	Very High	Medium	Medium	Low				Medium
Limited habitat size due to urban development						High	High	Medium
Limited connectivity/dispersal corridors to off-site habitats due to urban development				High	High	High	High	Medium
Moisture stress due to soil profile and liner system					High			Medium
Decreased fish and amphibian fitness due to pollutants in stormwater outfalls	High Uncertain (strategy would be to investigate)							Medium
Reduced food supply for ducks and shorebirds due to competition from invasive plants (reed canarygrass)	High							Medium
Increased mortality rate in amphibians due to predation from bull frog and carp	High							Medium
Future introduction of invasive species via boats, trailers	High							Medium

	Targets							
Threats	Open Water / Emergent Wetlands	Scrub-shrub Wetlands	Bottomland Forest	Riparian Forest	Upland Prairie	Western Painted Turtle	Streaked Horned Lark	**Overall Threat Rank**
Lack of large standing trees to meet snag and canopy cover KEAs due to beaver activity			High	High				Medium
Few native shrub species per acre and low canopy cover due to invasive plant species competition		Medium (Reed canarygrass)						Low
Lack of natural perches (shrubs)					Medium			Low
Reduced food supply for ducks and bugs due to turbidity from carp	Medium							Low
Reduced food supply for ducks and shorebirds due to competition from carp	Medium							Low
Destabilized slough banks due to nutria burrows and beaver activity			Medium	Medium				Low
Nest destruction or disturbance to nesting sensitive species due to SJL vehicle traffic, mowing					High		High	Low
Increased mortality rate due to urban development						Low (crossing roads)		Low
Forb and graminoid herbivory due to grazing waterfowl					Low			Low

	Targets							
Threats	Open Water / Emergent Wetlands	Scrub-shrub Wetlands	Bottomland Forest	Riparian Forest	Upland Prairie	Western Painted Turtle	Streaked Horned Lark	**Overall Threat Rank**
Loss of open water habitat due to invasive species (yellow flag iris, *Ludwigia peploides*., parrot feather)	Medium							Low
Turbidity due to carp	Low							Low
Threat Status to Targets	Very High	High	High	High	High	High	High	

Additional threat: Introduction of new nonaquatics by visitors that cause eutrification.

Additional threat: Disorientation of species due to artificial lighting

Additional threat: Impact of noise pollution on bird and amphibian communication and reproduction success.

RESTORATION CONTEXT AND TARGETS

Smith and Bybee Wetlands Natural Area is a hidden jewel. Surrounded on all sides by industrial development, the area continues to provide essential habitat for rare plants and a wide suite of wildlife, from sensitive species such as the western painted turtle, bald eagle, and neotropical migrating songbirds, to ubiquitous species such as raccoons, striped skunks, and American robins. Pulses of wildlife enter and exit as the seasons and water levels change over the course of the year. During winter when water levels are high, SBW provides critical off-channel rufugia to ESA listed steelhead, Chinook and coho salmon. During the spring and summer bald eagle and neotropical migrating songbirds nest and fledge their young. As the water levels recede, autumnal mudflats are exposed and a suite of wading and shorebirds enter the site. Egrets, yellow-legs, dowitchers and sandpipers can all be found during this time, either stopping over during their fall migration or preparing for an extended stay and overwinter at SBW. Peregrine falcon have been observed hunting these shorebirds. With the onset of winter rains, the lakes begin to fill, and the cycle begins anew.

Reclamation of the St. Johns Landfill provides an exceptional opportunity to establish many elements of rare Willamette Valley upland prairie habitat. About 99 percent of the historic expanse of this prairie has been lost (USFWS, 2010a). Because of its rarity, many of its associated birds, mammals, reptiles, butterflies, and plants are also rare. The inclusion of SJL in SBW only enhances its ecological value. As an example, ground around the perimeter of SJL may provide additional nesting grounds for western painted turtle and the forested areas adjacent to SJL provide habitat for cavity nesting birds such as American kestrels which forage over the landfill.

But not all is well at SBW. Adjacent development and subsequent disruption of natural systems are placing stress on the resource and its inhabitants and threatening the health of the greater ecosystem. More specifically, the following impacts have been realized.

Invasive plants and animals - Given its position in the landscape adjacent to marine terminals, railroads and truck routes, and subject to colonization by invasive species carried by flood water, invasions of non-native and environmentally damaging plants and animals will always be a concern at SBW, and will be the subject of long-term monitoring and maintenance actions. Non-native, invasive plant species have caused and are causing severe negative changes to native plant community diversity and quality and have fragmented the overall terrestrial plant community structure of SBW. This fragmentation reduces habitat quality for sensitive species that require larger habitat patches for nesting and rearing their young. Many areas at SBW are now completely dominated by reed canarygrass, which greatly reduces overall habitat values.

Aquatic invasive weeds such as yellow-flag iris (*Iris pseudacorus*), parrot feather (*Myriophyllum aquaticum*), and floating primrose (*Ludwigia peploides ssp. montevidensis*) pose a severe threat to the open water habitats of SBW and beyond. Yellow-flag iris and floating primrose displace native plants including sedges and rushes which are a high-energy food source for many species of over-wintering waterfowl. Loss of this food source reduces SBW's ability to sustain waterfowl populations thereby reducing water fowl viewing opportunities. Parrot feather can form dense mats on the surface of water, which reduces native plant diversity and community structure,

impedes recreational use of the lakes, and potentially alters water chemistry due to high levels of decaying vegetation.

Disruption to natural water regimes - Flow regulation, water withdrawals, and the increasing effects of climate change have dramatically altered the historic annual flooding patterns of the Columbia River. These floods help support and maintain the floodplain plant communities and wildlife assemblages that characterized SBW. On the Columbia River, the spring freshet flow has decreased more than 40 percent from pre-development times (1859-1899) (Bottom et. al 2005) and overbank flooding has nearly been eliminated (LCREP 2007).

Disruption in habitat connectivity - Limited connectivity to off-site habitats due to urban development is another threat to a variety of wildlife species. The lack of connectivity is important because over time, isolated patches tend to lose species and without connectivity these species cannot repopulate the habitat (Hennings 2008). The Columbia Slough provides the only dispersal corridor for many aquatic and terrestrial species such as western painted turtles, Chinook, Coho, and chum salmon, steelhead trout, river otters, and black-tailed deer moving through north Portland. Even birds such as the streaked horned lark are affected by the lack of suitable dispersal habitat through the unsuitable matrix of industrial development.

Human interaction - Unintended disturbance to nesting sensitive wildlife species, basking turtles, and overwintering waterfowl by recreational users of SBW is another threat. Bald eagle are sensitive to human presence. Western painted turtles are ectothermic (cold blooded), meaning they control their body temperature through external means. Like most reptiles, western painted turtles regulate their body temperature by basking in the sun. When approached, turtles will seek cover, usually underwater, which disrupts their ability to control their body temperature, negatively impacting their thermoregulation and consequently digestion and other metabolic processes (Gervais, et al 2009). When flushed by approaching visitors, shorebirds that are preparing for long migrations waste their energy by flying rather than storing it for use during migration.

This management plan outlines strategic actions to be carried out at SBW over the next ten years. They are based on the short- and long-term goals for the conservation targets and enhancing the visitor experience. The strategic actions described here are general courses of action to achieve these objectives. They are not highly prescriptive courses of action. Specific prescriptions will be developed by Metro staff to address site specific conditions encountered in the areas targeted for action.

The discussion of restoration actions begins with a discussion of the short- and long-term goals for the conservation targets. Conservation target objectives are specific and measurable statements of short- and long-term goals that represent the assumptions as to what needs to accomplished. As such, they are the measuring stick against which progress is gauged (TNC 2008).

Restoration Targets

The Plan summarized restoration actions and strategies in the Conservation chapter. The following tables identify by sub-area which conservation targets need restoring and the size of the area to be restored.

South Shore Bybee Lake		
Conservation Target	Priority	Acreage
Emergent Wetland (Columbia sedge meadow)	2	1.8
Shrub Wetlands	2	14.4
Bottomland Forest	1	27.5
	Subtotal:	43.7

Ledbetter Peninsula		
Conservation Target	Priority	Acreage
Emergent Wetland (Columbia sedge meadow)	1	6.7
	Subtotal:	6.7

North Shore Bybee Lake		
Conservation Target	Priority	Acreage
Shrub Wetlands	3	7.7
Bottomland Forest	3	15.6
	Subtotal:	23.3

Bybee Lake Peninsula		
Conservation Target	Priority	Acreage
Emergent Wetland (Columbia sedge meadow)	3	6.3
Shrub Wetlands	3	17.1
Bottomland Forest	3	33.1
	Subtotal:	56.5

Interlake Area		
Conservation Target	Priority	Acreage
Emergent Wetland (Columbia sedge meadow)	1	5.1
Shrub Wetlands	2	15.7
Bottomland Forest	1	28.8
Bottomland Forest	3	36.3
Riparian Forest (protect existing trees)	1	29.2
	Subtotal:	115.1

Northeast Shore and Smith Lake Peninsula		
Conservation Target	Priority	Acreage
Shrub Wetlands	3	39.6
Bottomland Forest	3	88.1
Riparian Forest	3	7.9
	Subtotal:	135.6

South and West Shores Smith Lake		
Conservation Target	Priority	Acreage
Emergent Wetland (Columbia sedge meadow)	2	8.5
Shrub Wetlands	1	11.3
Bottomland Forest	1	24.0
Riparian Forest (protect existing trees)	1	49.6
	Subtotal:	43.8

St. Johns Landfill		
Conservation Target	Priority	Acreage
Upland Prairie (Existing habitat and portions of Sub-area 5)	1	20.0
Upland Prairie (Sub-area 1)	2	60.0
Upland Prairie (Remaining Sub-areas)	3	131.9
	Subtotal:	211.9

Because of the scope and severity of the invasive weeds, successful restoration will require all the tools in the restoration practitioner's tool bag. In places, successful restoration will require aggressive site preparation using a variety of techniques including cultural, mechanical, chemical, and potentially prescribed fires. These actions will reduce non-native species cover, prepare a suitable seedbed or planting space, and facilitate successful establishment of planted native trees, shrubs, graminoids and forbs. Use of selective herbicides is an effective weed management and site preparation tool to address the scope and severity of the invasive plant species problem. Any herbicides used in site preparation or maintenance actions will comply fully with the City of Portland's IPM program.

Using plant material from Willamette Valley seed sources will provide seedlings best adapted to site conditions and provide the best chance for increased survival of planted seedlings.

An early action item will be to characterize plant community components (species presence and percent cover) and KEA status in areas to be restored to provide baseline information against which the efficacy of restoration actions will be gauged. This same information should be gathered in similar areas, but not subject to restoration to act as the control.

Target: Emergent Wetland – Open Water

Objectives

Short term: By 2021, increase the extent of Columbia sedge meadow with greater than 40 percent Columbia sedge cover by 22 acres; manage hydrologic conditions that will allow increased distribution of Columbia sedge throughout emergent wetland habitat; and maintain ovipositing habitat for breeding amphibians and fish passage for anadromous salmonids.

Long term: The desired future condition is to have all key ecological attributes (KEAs) functioning at the good to very good levels, thereby maintaining and restoring habitat suitable for sensitive species such as the tri-colored blackbird, dusky Canada goose, migrating and overwintering shorebirds, and providing off-channel refugia for ESA-listed anadromous salmonid smolts.

Key Ecological Attributes Outside Normal Range of Variation

- Native hydrophytic forb and graminoid abundance: percent cover of native hydrophytes is low relative to cover from non-native invasive plant species.

Critical Threats (Very High and High Threat Ratings)

- Changes in plant community composition, structure, and succession caused by invasive plant species competition.
- Altered wetland hydrology due to water control structures in and along the Columbia River and the increasing effects of global warming.
- Disturbance to nesting sensitive species and overwintering waterfowl due to recreational use and dogs.
- Increased mortality rate in amphibians due to predation from bull frog and carp.
- Future introduction of invasive species via boats, trailers.

Strategic Actions

Restoration actions will be concentrated where Columbia sedge meadows currently have an established presence and will undertaken to allow Columbia sedge to spread, either through natural recruitment, direct seeding with site-collected seed, or planting plugs grown from site collected Columbia sedge seed. These activities will be concentrated in five areas of SBW:

Emergent Wetland (Columbia sedge meadow)			
Restoration Area	Priority 1	Priority 2	Priority 3
South Shore Bybee Lake		1.8	
Ledbetter Peninsula	6.7		
Bybee Lake Peninsula	3		6.3
Interlake Area	5.1		
South and West Shores Smith Lake		8.5	
Subtotal:	11.8	10.3	6.3
		Total:	28.4

Target: Shrub Wetlands

Objectives

Short term: By 2021, restore 31 acres of degraded shrub wetland habitat to good condition for native shrub richness and canopy cover KEAs. These actions will link shrub wetland habitats in good condition but fragmented from other habitats in good condition by areas supporting a near reed canarygrass monoculture.

Long term: The long term desired future condition is to have all KEAs functioning at good to very good levels providing suitable habitat for sensitive species such as the little willow flycatcher and ovipositing native amphibians.

Key Ecological Attributes Outside Normal Range of Variation

- Native shrub richness: number of native shrub species per acre is low.
- Shrub layer cover: percent cover provided by native shrubs is low.

Critical Threats (Very High and High Threat Ratings)

- Changes in plant community composition, structure, and succession caused by invasive plant species competition, primarily reed canarygrass.
- Altered wetland hydrology due to global warming.

Strategic Actions

Restoration will be initiated to establish a native shrub plant community in areas currently dominated by reed canarygrass. These actions will link shrub communities or link them to forested communities.

Shrub Wetlands			
Restoration Area	Priority 1	Priority 2	Priority 3
South Shore Bybee Lake		14.4	
North Shore Bybee Lake			7.7
Bybee Lake Peninsula			17.1
Interlake Area		5.1	
Smith Lake Peninsula and Northeast Shore			39.6
South and West Shores Smith Lake	11.3		
Subtotal:	11.3	19.5	64.4
		Total:	95.2

Target: Bottomland Forests

Objectives

Short term: By 2021, restore 93 acres of degraded bottomland forest to fair condition for percent native tree cover and sapling presence KEAs by planting Oregon ash where reed canarygrass monocultures currently fragment bottomland forest habitats.

Long term: The long term desired future condition is to have all KEAs functioning at very good levels creating future interior habitat suitable for sensitive species such as purple martin, yellow-breasted chat, northern red-legged frog, California myotis, and Yuma myotis.

Key Ecological Attributes Outside Normal Range of Variation

- Extent of bottomland forest including Oregon ash dominated forest: suitable bottomland forest habitat lacks native trees.
- Tree layer cover: percent cover provided by native trees is low.
- Mature Oregon ash: the number of mature Oregon ash per acre is low.
- Presence of snags: the number of snags per acre is low.

Critical Threats (Very High and High Threat Ratings)

- Changes in plant community composition, structure, and succession caused by invasive plant species competition, primarily reed canarygrass.
- Altered wetland hydrology due to global warming.
- Lack of large standing trees to meet snag and canopy cover KEAs due to beaver activity.

Strategic Actions

Restoration will be initiated to establish a bottomland forest plant community in areas currently dominated by reed canarygrass. These actions will link fragmented forested communities reducing the edge effect while increasing interior habitat. This will be done through a combination of aggressive site preparation, planting, caging and annual maintenance. The Table below shows the planned prioritization of areas to be restored.

Bottomland Forest			
Restoration Area	Priority 1	Priority 2	Priority 3
South Shore Bybee Lake	27.5		
North Shore Bybee Lake			15.6
Bybee Lake Peninsula			33.1
Interlake Area	28.8		
Interlake Area		36.3	
Smith Lake Peninsula and Northeast Shore			88.1
South and West Shores Smith Lake	24.0		
Subtotal:	80.3	36.3	136.8
		Total:	253.4

Target: Riparian Forests

Objectives

Short term goal: By 2021 protect large trees from beaver predation in 79 acres of riparian forest.

Long term goal: The long term desired future condition is one where forested and shrub habitats are continuous, not fragmented by reed canarygrass monocultures, thereby greatly increasing the extent of interior habitat at SBW. All KEAs will be functioning at good to very good levels. Existing industrial development and accompanying infrastructure will continue to limit our ability to improve the wildlife movement corridor KEA to very good condition.

Key Ecological Attributes Outside Normal Range of Variation

- Large, interior habitat patches: Forest patches that are at least 30 acres in size with at least 200 ft from the center to the edge of the patch.
- Key habitat feature presence: snag abundance
- Wildlife movement corridors: Connectivity to surrounding habitats

Critical Threats (Very High and High Threat Ratings)

- Changes in plant community composition, structure, and succession caused by invasive plant species competition, primarily reed canarygrass.
- Edge effect: increased nest parasitism, lack of interior habitat for neotropical migrants due to urban development
- Limited wildlife dispersal corridors: Columbia Slough provides only corridor due to urban development
- Lack of large standing tress to achieve snag and canopy cover KEAs due to beaver activity
- Destabilized banks due to nutria burrows and beaver activity
- Altered wetland hydrology due to climate change

Strategic Actions

The only areas of riparian forest currently functioning in a poor to fair condition are found in the Interlake Area and in the area that forms the outside edge of SBW along N. Portland Road. Restoration actions will include a combination of aggressive site preparation, planting, caging, and annual maintenance.

Riparian Forest			
Restoration Area	Priority 1	Priority 2	Priority 3
Interlake Area (protect existing trees)	29.2		
Northeast Shore Smith and Lake Peninsula			7.9
South and West Shores Smith Lake (protect existing trees)	49.6		
Subtotal:	78.8	0.0	7.9
		Total:	13.9

Target: Upland Prairie

Objectives

Short term goal: By 2021, restore 80 acres of degraded upland prairie to fair condition for native forb and graminoid cover and availability of natural perches KEAs.

Long term goal: The long term desired future condition is to have up to 210 acres of contiguous upland prairie with all KEAs functioning at good to very good levels creating up to 10 male meadowlark territories and habitat suitable for other sensitive species such as grasshopper sparrow, Oregon vesper sparrow, and western bluebird. Additionally, suitable conditions for nesting western painted turtle will be maintained along the perimeter of the SJL.

Key Ecological Attributes Outside Normal Range of Variation

- Native forb and graminoid abundance and cover
- Key habitat feature: natural perch availability per 20 acre unit

Critical Threats (Very High and High Threat Ratings)

- Moisture stress caused by the shallow soil profile and landfill cover system.
- Lack of native forbs / graminoids caused by extensive cover of non-native graminoids and forbs
- Limited connectivity/dispersal corridors to off-site habitats caused by urban development
- Inappropriate vegetation height resulting from the lack of natural disturbance regime (fire)

Strategic Actions

St. Johns Landfill			
Conservation Target	Priority 1	Priority 2	Priority 3
Upland Prairie	80.0	60.0	70.0
		Total:	210.0

Due to the difficulties experienced at SJL in establishing native grasses and forbs, aggressive site preparation using a variety of techniques will be used in order to reduce non-native, rhizomatous grass cover and to prepare a seedbed suitable for the successful establishment of native grasses and forbs.

Target: Western painted turtle

Objectives

Short term goal: By 2021, increase the number and distribution of suitable nesting area KEAs to very good condition by establishing new suitable nest sites along the perimeter of SJL. Increase the basking site availability KEA from fair to good condition by importing basking logs into areas which currently have insufficient basking sites available.

Long term goal: The long term desired future condition is to maintain conditions that will support a viable population of western painted turtles by having all key ecological attributes functioning at good to very good levels. Existing industrial development and accompanying infrastructure will continue to limit our ability to improve nest site connectivity to open water and dispersal corridor KEAs to very good condition.

Key Ecological Attributes Outside Normal Range of Variation

- Nest habitat availability/Number of suitable nesting areas within 150 feet of water; at least 0.5 acres in size
- Basking site availability/Number of basking sites
- Nest site connectivity to open water/Access to nest sites

Critical Threats (Very High and High Threat Ratings)

- Limited habitat size and limited connectivity/dispersal corridors to off-site habitats due to surrounding urban development
- Nest and hatchling predation caused by wildlife such as raccoons, skunks, and coyotes
- Altered wetland hydrology caused by water control structures in and along the Columbia River and the increasing effects of climate change
- Nest site disturbance caused by recreational trail and off-trail use and dogs

Strategic Actions

- Import and install basking logs along the western shore of Smith Lake. Since log availability cannot be predicted, this action will occur opportunistically throughout the ten-year plan.
- Create nesting habitat along entire lower perimeter of SJL: Maintain grass very low or create bare spots through cultural techniques such as shallow disking or harrowing.
- Create buffers around nest sites and restrict areas from grazing and management activities.
- Maintain clear visual and travel paths for turtles up the slopes from North Slough and Smith Lake to the SJL and monitor effectiveness.

Target: Streaked Horned Lark

Objectives

Short term goal: By 2021, attract nesting pairs and successfully fledge streaked horned lark at the SJL by creating and maintaining 10 acres of sparsely vegetated or bare ground nesting habitat with KEAs for graminoid height, woody vegetation cover, and rhizomatous grass dominance functioning at very good to good levels.

Long term goal: The long term desired future condition is to have successful annual nesting by maintaining key ecological attributes for nesting and foraging functioning at good to very good levels. The challenge presented by rhizomatous grass dominance will continue to compromise these ecological attributes.

Key Ecological Attributes Outside Normal Range of Variation (Fair to Poor

- None

Critical Threats (Very High and High Threat Ratings)

- Nest predation Wildlife: American kestrel, Killdeer, Northern harrier are most likely predators at SJL
- Inappropriate vegetation height due to the lack of natural disturbance regime (fire)
- Limited habitat size and limited connectivity/dispersal corridors to off-site habitats due to surrounding urban development

Strategic Actions

In the absence of natural disturbance regime (fire), cultural activities must be conducted annually to maintain KEAs at good or very good condition. These actions may include importing soil, using chemical and/or mechanical methods to maintain bare ground, and experimental habitat configurations (shape and size).

Prioritized Actions

Target areas: Years 1-5	**Acreage**
South Shore Bybee Lake: bottomland forest	27.5
Bybee Lake Peninsula	3.0
Leadbetter Peninsula: Columbia sedge meadow	6.7
Interlake area: Columbia sedge meadow, riparian forest (cage trees), bottomland	63.1
South and west shores Smith Lake: riparian forest (cage trees), shrub wetland,	84.9
St. Johns Landfill: existing habitat and additional areas TBD	80.0
Total	**265.2**
Target areas: Years 6-10	**Acreage**
South Shore Bybee Lake: Columbia sedge meadow, shrub wetland	16.2
Interlake area: shrub wetland, bottomland forest	41.4
South and west shores Smith Lake: Columbia sedge meadow	8.5
St. Johns Landfill: upland prairie	60.0
Total	**126.1**
Beyond 10 years	**Acreage**
Priority 3 — all areas	285.4

CLIMATE CHANGE

Flow regulation, water withdrawals, and the increasing effects of climate change have dramatically altered the historic annual flooding patterns of the Columbia River. These floods help support and maintain the floodplain plant communities and wildlife assemblages that characterized SBW. On the Columbia River, the spring freshet flow has decreased more than 40 percent from pre-development times (1859-1899) to the present (Bottom et. al 2005) which Bottom, et al, (2005) attribute five percent of the reduction to the effects of climate change. Lower flows and a system of dikes and levees have nearly eliminated overbank flooding in the lower Columbia (LCREP 2007).

Wetlands may experience increased drying during the summer months, impacting local amphibian and turtle populations. Currently, ephemeral wetlands tend to dry out by the mid to late summer, but if climate change causes the wetlands to dry earlier, amphibians may not be able to complete their metamorphoses, and more permanent water bodies may become increasingly important.

Bird ranges are anticipated to change as a result of climate change. The National Wildlife Federation and the American Bird Conservancy have modeled changes to bird distributions due to climate change. Changes may involve loss of summer range habitat, a contracted summer range, an expanded summer range, or new summer range for species not currently present. For sensitive bird species present at SBW the following changes may occur:

- *Future summer range excludes Oregon:* Oregon vesper sparrow
- *Future summer range contracts in Oregon:* willow flycatcher, horned lark, grasshopper sparrow, western meadowlark
- *Future summer range remains relatively unchanged:* white-breasted nuthatch
- *Future summer range expands in Oregon:* purple martin, yellow-breasted chat
- *Future summer range now includes Oregon:* Bell's vireo, phainopepla, blue grosbeak, dickcissel, and Cassin's sparrow.

Loss of target species, or new arrivals at SBW will likely foster changes in management direction and actions. For example, a northward contraction of streaked horned lark summer range will increase the importance of the established nesting habitat at SBW and may spur the need for additional suitable nesting habitat beyond what is currently planned.

Management actions in response to climate change take four basic approaches: resistance, resilience, response, and realignment (USFWS 2010b).

Resistance is to take actions that resist the effects of climate change or forestall undesirable effects. The current water management strategy of holding winter and spring flooding followed by a gradual drawdown is a resistance action that attempts to mimic the historic water regime in light of the effects of dams, water withdrawals, and climate change to water flows in the Columbia River.

Resilience is the ability of a natural system to return to a healthy condition after disturbance. Resilience management actions improve the capacity of an ecosystem such as SBW to return to desired conditions after disturbance. These actions are short-term in nature and may become more difficult in the face of fundamental ecosystem process changes brought about by climate change. It is important to note that resilience actions do not facilitate a transition to new conditions that result from climate change.

Restoring KEAs to their natural range of variation is a form of a resilience management action. It increases the conservation target's ability to return to a desired condition (functioning KEAs) following a disturbance.

Response, the third type of management action, is to manage toward future landscape conditions by predicting the future effects of climate charge and facilitating the transition to the new conditions, by working with the effects of climate change. Response management actions assist ongoing adaptive natural process such as colonization or changes in plant and animal assemblages to encourage the transition of inevitable change. Response management actions are undertaken to avoid rapid threshold or catastrophic conversion that may occur otherwise. Response management actions could include expanding streaked horned lark habitat or planting nectar species not currently present at SBW for a species of butterfly whose range is changing as a result of climate change, and now includes SBW, or is expected to soon.

Realignment occurs when the goal of the management actions are to actively establish the ecosystems that will be able to sustain themselves in expected future conditions rather than historical pre-climate change conditions. Rather than restoring KEAs of the current plant communities, realignment actions would establish the communities and processes expected in the future.

In terms of climate change strategy, Metro will, for the short-term, rely on resistance and resilience measures to maintain historical hydrologic conditions and improve resiliency of the plant communities. In the future, Metro may transition to response and realignment actions as our understanding of the effects of climate change increases and predictive models improve.

Maintaining the current water management plan is the foremost resistance action that can be taken. The water control structure will allow the wetlands to retain lower water levels far later into the spring and early summer than would be possible otherwise, counteracting the effects of changed hydrology on the Columbia River. As other Willamette Valley wetlands experience earlier and increased drying during the spring and summer months, SBW may become a critical resource for amphibians and turtle populations as other sites convert to drier habitats.

MONITORING PLAN

Monitoring framework

As described in the Plan's Conservation chapter, monitoring provides a systematic review of key ecological attributes and allows comparisons of progress against goals. Monitoring at Smith and Bybee Wetlands is an integral part of an adaptive management approach to restoration and maintenance. Based on the monitoring plan developed by Metro, a feedback loop is created between monitoring and management decisions.

The monitoring strategy is based on threats and key ecological attributes associated with conservation targets. Generally, the greatest threats to Smith and Bybee Wetlands are traced to:

- Invasive plants
- Altered wetland hydrology
- Isolation from other natural areas on the larger landscape
- Habitat fragmentation and associated edge effect
- Human disturbance.

The monitoring plan addresses threats directly and indirectly, by tracking changes in certain ecological attributes. It implements techniques that are well-established and continues many monitoring efforts already in place. The Smith and Bybee Wetlands Advisory Committee reviewed the monitoring approach during development of this CNRP. The monitoring plan is likely to change over time, however, this is a worthwhile starting point and a useful tool for focusing staff efforts.

Techniques

Some monitoring techniques are used to monitor more than one conservation target. This discussion is intended to provide a general introduction but not detailed methods.

Aerial inspections/GIS: Several metrics for health of conservation targets relate to their size. Where a desired condition is a minimum acreage, it can be estimated with GIS software using current aerial photography. Similarly, important connections within the natural area and to off-site habitat can be inspected with aerial photographs.

Transects: These are lines or strips of ground, along which measurements are made at regular intervals. Permanent transects will be revisited over the years to track progress toward goals. They are useful in tracking the abundance and composition of native plants and invasive species.

Point counts: Avian (bird) surveys during breeding season follow an established and widely used protocol that allows data sharing with other scientists. By tracking changes in the bird community, Metro can detect changes in habitat function as restoration projects mature. The species present can indicate whether excessive edge effect is occurring as well as whether suitable habitat structure for sensitive species is present.

Conservation targets

Riparian forest: A combination of transects, point counts and GIS work is used for this target. Because forests develop slowly, the detailed plant surveys along transects will occur in 5-year intervals.

Bottomland hardwood wetland: Metro previously conducted several years of avian point counts and established a baseline for the bird community when habitat restoration was initiated. Point counts will be repeated in the future, but immediate monitoring work will focus on habitat patch size and quality.

Shrub wetland: Rather than transects, this target can be tracked with less-formal surveys than the riparian forest while still providing information on the native plant community development. Much of the shrub habitat at Smith-Bybee was planted with a variety of species and visual inspections while walking through the habitat can confirm they remain present and established. Because shrubs serve as important attachment sites for amphibian eggs, Metro will monitor water levels during the breeding season for red-legged frogs and other native amphibians to ensure the shrubs are flooded properly.

Open water: This habitat occupies the most acreage at Smith-Bybee, has the highest overall threat rank and is the most complex to manage; it includes emergent wetlands as well as permanent water. More time and resources are devoted to monitoring and adapting management for open water than for any other target. Focused monitoring on the extent and health of Columbia sedge meadows and frequent attention to the water control structure and hydrologic management are necessary. To track effectiveness of water level management, intensive monitoring will be implemented at regular intervals. This plan calls for two years of detailed vegetation monitoring and data analysis every five years as the native plant community develops and reed canarygrass is controlled.

Upland prairie: Existing point counts and photo points will be embellished with periodic informal surveys to track the presence and general abundance of native plants and invasives on the landfill.

Streaked Horned Lark: Metro works with the Streaked Horned Lark Working Group and key partners to establish habitat for this species on the landfill. Habitat and predator monitoring are necessary each year as this project develops. Standard techniques developed by The Nature Conservancy and Washington Department of Fish and Wildlife are used so data can be compared with other projects and sites.

Western painted turtle: Metro has surveyed painted turtles in the Smith-Bybee complex for more than 10 years and is an active member of the Turtle Working Group. Work is coordinated with other agencies and in partnership with the research community.

Monitoring Framework

Conservation Target	Type	Key Ecological Attribute	Indicator	Method	Frequency	Comments
Bottomland hardwood wetland	Size	Extent of bottomland forest including Oregon ash forest	Acres of bottomland forest including Oregon ash forest	Estimate from aerial photograph in GIS	5-year interval	Will change most quickly as planting projects are completed.
Bottomland hardwood wetland	Condition	Vegetative structure: tree layer	Percent native tree canopy cover	Use commonly accepted tree survey methods.	5-year interval	May adjust to less frequent monitoring.
Bottomland hardwood wetland	Condition	Mature Oregon ash	Number and size (dbh) of mature Oregon ash	Inventory, measure and tag individual trees	10-year interval	Ash grows relatively slowly.
Bottomland hardwood wetland	Condition	Native tree recruitment	Number of Oregon ash saplings in Oregon ash dominated forest per acre	Use commonly accepted tree survey methods.	5-year interval	
Bottomland hardwood wetland	Condition	Key habitat feature presence: snags	Number of snags per acre	Inventory and tag each snag.	10-year interval	
Open water	Size	Exposure of autumnal mud flats	Extent and duration of seasonal low water	Record & track start and end of drawdown.	Annual.	
Open water	Size	Size of Columbia sedge meadow	Acres of Columbia sedge meadow	Existing plots track edges of known meadows	2-year interval	
Open water	Size	Columbia sedge cover in Columbia sedge meadow	% cover Columbia sedge cover in Columbia sedge meadow	Existing plots with transects and point intercept method.	2-year interval	
Open water	Condition	Water quality	Clean Water Act Section 303d listing	Track DEQ actions if and when they occur.	Ongoing.	Presently not on list.

Monitoring Framework

Conservation Target	Type	Key Ecological Attribute	Indicator	Method	Frequency	Comments
Open water	Condition	Native hydrophytic forb and graminoid abundance	Cover of native hydrophytic herbaceous species	Established transects and methods; 2.5 km of transects and point intercept method.	Approx. 5 year intervals	Partnership with PSU.
Open water	Condition	Vegetative structure: tree and shrub layer	Percent tree/shrub canopy cover	Established transects and methods; 2.5 km of transects and point intercept method.	Approx. 5 year intervals	Partnership with PSU.
Open water	Landscape context	Anadromous fish passage	Connectivity to North Slough	Weekly check of structure, including fishway, during November through June.	Annual.	
Riparian forest	Size	Extent of riparian forest	Acres of riparian forest	Estimate from aerial photograph in GIS	5-year interval	Will change most quickly as planting projects are completed.
Riparian forest	Condition	Large, interior habitat patches	Forest patches >30 acres with at least 200 ft from center to edge	Estimate from aerial photograph in GIS	5-year interval	Will change most quickly as planting projects are completed.
Riparian forest	Condition	Native tree and shrub richness	Number of native tree and shrub species per acre	Use commonly accepted tree survey methods.	5-year interval	May adjust to less frequent monitoring.
Riparian forest	Condition	Vegetative structure: tree layer	Percent native tree canopy cover	Use commonly accepted tree survey methods.	5-year interval	May adjust to less frequent monitoring.

Monitoring Framework

Conservation Target	Conservation Target	Conservation Target	Conservation Target	Conservation Target	Conservation Target	Conservation Target
Riparian forest	Condition	Vegetative structure: shrub layer	Percent native shrub canopy cover	Use commonly accepted tree survey methods.	5-year interval	May adjust to less frequent monitoring.
Riparian forest	Condition	Native tree recruitment	Number of native tree saplings per acre	Use commonly accepted tree survey methods.	5-year interval	May adjust to less frequent monitoring.
Riparian forest	Condition	Key habitat feature presence: snags	Number of snag per acre	Inventory and tag each snag.	10-year interval	
Riparian forest	Condition	Key habitat feature presence: bald eagle nest trees	Bald eagle nest trees present	Inventory and tag suitable trees.	10-year interval	
Riparian forest	Landscape context	Wildlife movement corridors	Connectivity to surrounding habitats	Evaluate via aerial photographs and track land use actions on surrounding landscape.	Ongoing.	Columbia Slough Watershed Council, Portland BES and Port of Portland are potential partners.
Scrub-shrub	Size	Extent of scrub-shrub wetland area	Acres of scrub-shrub wetland	Estimate from aerial photograph in GIS	5-year interval	Will change most quickly as planting projects are completed.
Scrub-shrub	Condition	Native shrub richness	Number of native shrub species per acre	Use commonly accepted tree survey methods.	5-year interval	May adjust to less frequent monitoring. Will have species lists for planting units.
Scrub-shrub	Condition	Vegetative structure: shrub layer	Percent native shrub canopy cover	Use commonly accepted tree survey methods.	5-year interval	May adjust to less frequent monitoring.
Scrub-shrub	Condition	Vegetative structure: tree layer	Percent native tree canopy cover	Use commonly accepted tree survey methods.	5-year interval	May adjust to less frequent monitoring.

Monitoring Framework

Conservation Target	Conservation Target	Conservation Target	Conservation Target	Conservation Target	Conservation Target	Conservation Target
Scrub-shrub	Condition	Transition to bottomland and riparian forests	Vegetative type and cover in transitional zone	Use commonly accepted tree survey methods.	5-year interval	May adjust to less frequent monitoring and/or replace with aerial photograph inspection.
Scrub-shrub	Condition	Ovipositing habitat for breeding amphibians	Hydrology timing, depth, and duration	Plot annual hydrograph and inspect elevation range with suitable ovipositing habitat.	Annual.	May adjust to less frequent monitoring if habitat proves reliably available.
STHL	Size	Area of suitable nesting habitat	Acres of sparsely vegetated/ bare ground	Estimate from aerial photograph in GIS	Annual.	Will change most quickly as projects are implemented.
STHL	Condition	Suitable graminoid height for streaked horn lark nesting	Graminoid height	Use established protocol developed by WDFW and TNC.	Annual.	
STHL	Condition	Vegetative cover; woody species	Percent woody vegetation cover	Visual inspection on site visit.	Annual.	
STHL	Condition	Foraging habitat	Presence of herbaceous species with seed size 0.8-1mm	Use established protocol developed by WDFW and TNC; additional sampling if needed	Annual.	
STHL	Condition	Vegetative type	Rhizomatous grass dominance	Use established protocol developed by WDFW and TNC.	Annual.	

Monitoring Framework

Conservation Target	Conservation Target	Conservation Target	Conservation Target	Conservation Target	Conservation Target	Conservation Target
Painted turtle	Condition	Western painted turtle population	Presence of (1) at least 200 turtles with (2) at least 50 each at 3 locations, with (3) juveniles and adults seen.	Use established visual survey protocol for Smith and Bybee Wetlands.	2-year interval	May survey less frequently, depending on results. Use of established protocol allows limited comparisons with prior years.
Painted turtle	Condition	Nest habitat availability	Number of suitable nesting areas within 150 feet of water; at least 0.5 acres in size	Estimate from aerial photograph in GIS and validate with site visits.	2-year interval	Track land use actions on surrounding landscape as they are proposed and occur.
Painted turtle	Condition	Nest habitat distribution	Distribution of suitable nesting areas within 150 feet of water	Estimate from aerial photograph in GIS and validate with site visits.	2-year interval	Track land use actions on surrounding landscape as they are proposed and occur.
Painted turtle	Condition	Basking site availability	Number of basking sites	Visual inspection on site visit.	2-year interval	
Painted turtle	Landscape Context	Nest site connectivity to open water	Access to nest sites	Visual inspection on site visit.	2-year interval	Track land use actions on surrounding landscape as they are proposed and occur.
Painted turtle	Landscape Context	Dispersal corridors (connectivity) to suitable habitat	Availability and access to off-site suitable habitat	Evaluate via aerial photographs and track land use actions on surrounding landscape.	Ongoing.	Columbia Slough Watershed Council, Portland BES, ODFW and Port of Portland are potential partners.

Monitoring Schedule

The following table is a draft monitoring schedule for Smith and Bybee Wetlands and is subject to change. It includes an estimate of staff-days needed to accomplish the work and the frequency with which monitoring may occur.

				Year				
		Days	Freq.	2011	2012	2013	2014	2015
Riparian forest								
	GIS/aerial inspections	0.1	5 yrs					0.1
	Point counts	2	2 yrs		2		2	
	Transects	2	5 yrs					2
BLH wetland								
	GIS/aerial inspections	0.1	5 yrs	0.1				
	Transects	2	5 yrs	2				
	Inventory large trees	2	10 yrs	2				
Shrub								
	GIS/aerial inspections	0.1	5 yrs		0.1			
	Informal walking survey	2	5 yrs		2			
	Hydrograph	0.2	1 yr	0.2	0.2	0.2	0.2	0.2
Open water								
	Hydrology	3	1 yr	3	3	3	3	3
	Columbia sedge meadows	3	5 yrs					2
	Detailed monitoring	10	2/5 yrs			5	5	
Upland prairie								
	Point counts	1	2 yrs	2		2		2
	GIS/aerial inspections	0.1	5 yrs	0.1				
	Informal walking survey/photo points	0.5	5 yrs	0.5				
Streaked Horned Lark								
	Habitat monitoring	1	1 yr	1	1	1	1	1
	Predator monitoring	1	1 yr	1	1	1	1	1
Western painted turtle								
	Visual surveys & habitat monitoring	3	2 yrs		3		3	
	GIS/aerial inspections	0.1	2 yrs		0.1		0.1	
Total	Staff days estimated for work			11.9	12.4	12.2	15.3	11.3

Relative Importance of Monitoring Tasks

Resources may not allow all monitoring tasks to be accomplished in a given year. The following tables are intended to provide assistance if tasks must be prioritized and some must be delayed.

Riparian forest		
KEA or Threat	**Indicator**	**Importance**
Extent of riparian forest	Acres of riparian forest	Medium: could help identify losses that may not be noticed otherwise
Large, interior habitat patches	Forest patches >30 acres with at least 200 ft from center to edge	Very high: tracks key threat of edge effects.
Edge effect	Predominance of edge and generalist species, lack of area-sensitive birds	Very high: tracks habitat function.
Native tree and shrub richness	Number of native tree and shrub species	High
Vegetative structure: tree layer	Percent native tree canopy cover	High: canopy cover is key to maintaining forest
Vegetative structure: shrub layer	Percent native shrub canopy cover	High: canopy cover is key to maintaining forest
Native tree recruitment	Number of native tree saplings per acre	High: if recruitment is not occurring, must plan planting work
Wildlife movement corridors	Connectivity to surrounding habitats	High.

Bottomland hardwood wetland		
KEA or Threat	**Indicator**	**Importance**
Extent of bottomland forest including Oregon ash forest	Acres of bottomland forest including Oregon ash forest	Medium: could help identify losses that may not be noticed otherwise
Vegetative structure: tree layer	Percent native tree canopy cover	High: canopy cover is key to maintaining forest
Native tree recruitment	Number of Oregon ash saplings in Oregon ash dominated forest per acre	High: if recruitment is not occurring, must plan planting work
Invasive plant competition	Increasing cover of invasive plants.	High: will indicate if treatment is needed.
Mature Oregon ash	Number and size (dbh) of mature Oregon ash	Very high: large, old ash are very rare on the landscape
Shrub habitat		
KEA or Threat	**Indicator**	**Importance**
Extent of scrub-shrub wetland area	Acres of scrub-shrub wetland	Medium: could help identify losses that may not be noticed otherwise
Native shrub richness	Number of native shrub species per acre	High
Vegetative structure: shrub layer	Percent native shrub canopy cover	High: tracks key threat of invasive plant competition
Vegetative structure: tree layer	Percent native tree canopy cover	High: track and intercept any conversion to forested habitat
Transition to bottomland and riparian forests	Vegetative type and cover in transitional zone (continuous cover)	Very high: tracks key threat of edge effects.
Ovipositing habitat for breeding amphibians	Hydrology timing, depth, and duration	High

Open water		
KEA or Threat	**Indicator**	**Importance**
Exposure of autumnal mud flats	Extent and duration of seasonal low water	very high
Altered wetland hydrology by management of mainstem dams and/or climate change	Timing and magnitude of high water and seasonal drying on surrounding landscape	very high
Size of Columbia sedge meadow	Acres of Columbia sedge meadow	Very high: ranked S1G1 by ORBIC
Columbia sedge cover in Columbia sedge meadow	% cover Columbia sedge cover in Columbia sedge meadow	Very high: ranked S1G1 by ORBIC
Native hydrophytic forb and graminoid abundance	Cover of native hydrophytic herbaceous species	Very high: basis for adaptive management of wetland with water control structure.
Vegetative structure: tree and shrub layer	Percent tree/shrub canopy cover	Very high: basis for adaptive management of wetland with water control structure.
Invasive plant competition	Increasing cover of invasive plants	Very high: basis for adaptive management of wetland with water control structure.
Anadromous fish passage	Connectivity to North Slough	Very high: site objective and legal requirement

Upland prairie		
KEA or Threat	**Indicator**	**Importance**
Occupancy by grassland- or prairie-dependent species	Presence of breeding birds dependent on open prairie and grassland habitat	Very high: tracks habitat function.
Extent of upland prairie	Number of potential male meadowlark territories (20 acre units)	
Vegetative Cover: woody species	Area of woody vegetation (trees and shrubs) with cover less than 5%	Medium: could help identify woody encroachment that may not be noticed otherwise
Native forb and graminoid abundance	Native forb and graminoid species cover	
Key habitat feature: perches	Perch availability per 20 acre unit	
Suitable graminoid height for meadowlark nesting	Graminoid height	

Streaked Horned Lark		
KEA or Threat	**Indicator**	**Importance**
Area of suitable nesting habitat	Acres of sparsely vegetated/ bare ground	Medium: could help identify losses that may not be noticed otherwise
Suitable graminoid height for Streaked Horn Lark nesting	Graminoid height	High: basis for adaptive management of nesting areas.
Vegetative cover; woody species	Percent woody vegetation cover	High: must not be allowed to establish on nesting sites
Foraging habitat	Presence of herbaceous species with seed size 0.8-1mm	High
Vegetative type	Rhizomatous grass dominance	High

Western painted turtle		
KEA or Threat	**Indicator**	**Importance**
Western painted turtle population	Presence of (1) at least 200 turtles with (2) at least 50 each at 3 locations, with (3) juveniles and adults seen.	Very high: track continued occupancy of site by turtles.
Nest habitat availability	Number of suitable nesting areas within 150 feet of water; at least 0.5 acres in size	Very high: Smith-Bybee is very limited in nesting habitat.
Nest habitat distribution	Distribution of suitable nesting areas within 150 feet of water	Very high: Smith-Bybee is very limited in nesting habitat.
Basking site availability	Number of basking sites	Medium: tends to be available but should be tracked
Nest site connectivity to open water	Access to nest sites	Very high
Altered wetland hydrology by management of mainstem dams and/or climate change	Loss of permanent ponds	Very high
Dispersal corridors (connectivity) to suitable habitat	Availability and access to off-site suitable habitat	High.

RESEARCH PLAN

Streaked Horned Lark

Streaked Horn Lark research will focus on two areas: attracting Streaked Horn Lark to St. Johns Landfill and alternative nest site configurations.

Metro will partner with Center for Natural Lands Management (formerly The Nature Conservancy's South Sound Prairies project) and the US Fish and Wildlife Service on conspecific attraction techniques. Pearson et al. (2005) broadcast Streaked Horn Lark songs at two locations in Washington without success in an attempt to attract SHL to suitable, but unoccupied habitat. While this effort was unsuccessful over a two-year period, this type of conspecific attraction has been used for years for colonial birds and recent research suggests that it may be effective for territorial birds such as the Streaked Horned Lark (Pearson et al 2005). Vocal attract was used at SJC in fall 2009 and 2010. It was being used when Larks appeared on plot in February 2011. Models are also used to attract birds and may be used at St. Johns Landfill as a means of attracting mating pairs.

Capture/relocate studies may also be used should conspecific attraction techniques not attract nesting pairs to St. Johns Landfill. Any research involving capturing birds at Rivergate and relocating them to St. Johns Landfill would only be initiated following consultation with USFWS and ODFW on study parameters and monitoring protocols.

One five-acre patch with suitable nesting characteristics is maintained at St. Johns Landfill and a second patch is under way. Metro will initiate studies on alternative nest habitat designs at St. Johns Landfill such as alternating rows of sparsely vegetated and vegetated habitat and smaller sparsely vegetated patches within the vegetated matrix of upland prairie.

Areas that have been seeded include construction areas, heavily grazed land and vegetated islands. Species that have had some success include:

- Blue wildrye
- Meadow barley
- California broom
- Sitha broom
- Yarrow
- Meadow checkermallow
- Oregon sunshine
- Western buttercup
- Blue gilia

Monitoring of plants in test plots occurs regularly.

Upland Prairie Establishment at St. Johns Landfill

Conditions at the St. Johns Landfill create unique and difficult conditions for establishing native vegetation. Repeated efforts to establish native vegetation in the mid-1990s had mixed results that were initially regarded as failures. Several reports documented the efforts and the reasons for failure (Fishman 1992, Metro 1997, Wilson et al. 1998). Each of these reports identified site conditions as the primary reason for failure, however, since mowing regimes were changed in the mid-2000s, many of the native grasses that were seeded a decade before have become much more apparent and appear to be gaining ground.

Establishing Willamette Valley native upland prairie species will likely require a significant initial effort and ongoing active management. Stanley et al. (2010) conducted a number of experiments and found promising results following intensive site preparation efforts involving a combination of treatments. They found that the success of site preparation treatment varied across different sites. Strategies outlined in Stanley et al. (2010) and other key resources will form the basis for habitat restoration work. Following site preparation and seeding treatments, plant community composition data will be collected and statistically analyzed to determine treatment effectiveness. Results of the experiments will be used to guide future upland prairie restoration efforts at St. Johns Landfill.

Taylor's Checkerspot Introduction at St. Johns Landfill

The Taylor's Checkerspot butterfly (Euphydryas editha taylori) is a candidate for listing under the federal Endangered Species Act. It occurs in upland prairie habitat similar to that which is planned for St. Johns Landfill. Taylor's Checkerspots lay their eggs on species of paintbrush (Castilleja spp.) and introduced species of plantain (Plantago spp.) (Vaughan and Black 2002). Narrow-leaf plantain (Plantago lanceolata) currently occurs throughout St. Johns Landfill. The Oregon Zoo has a captive rearing program for the Taylor's Checkerspot. Following successful establishment of native upland prairie, Metro will consult with the U.S. Forest Service, Oregon Department of Fish and Wildlife, and the Oregon Zoo to explore introducing Taylor's Checkerspots to the St. Johns Landfill. Study parameters and monitoring protocols would be developed at that time.

Western Painted Turtle

The effectiveness of visual monitoring techniques to determine turtle populations is a critical monitoring question (Rosenberg 2009). Metro will continue to track the issue and work with partners to determine which, if any, protocol is sufficient to track population trends at Smith and Bybee Wetlands.

INVASIVE SPECIES AT SMITH BYBEE WETLANDS

More than 100 species of exotic plants have been found at Smith and Bybee Wetlands, however, not all are invasive. Table 1 summarizes a preliminary list of invasive exotic plants that require control in all or parts of SBW, including areas of greatest interest and seasonality of control measures. Some plants, such as lesser burdock, are known to be pests elsewhere but their threat to this area requires further evaluation. Other plants, such as Canada thistle and teasel, are problematic in Columbia sedge meadows but do not pose a long-term threat to areas planted with trees and shrubs that will eventually shade out the thistles. Species such as purple loosestrife and parrot feather are widespread in parts of the natural area, but control methods are focused near the canoe launch to prevent their spread to other sites when people take out their boats after paddling. Finally, poison hemlock and bittersweet nightshade are important targets for control in public areas because of their toxicity.

Table 1. Working list of priority non-native species for control at Smith and Bybee Wetlands.

Genus	**species**	**common name**	**Focus area**	**Control timing**
Arctium	*minus*	Lesser burdock	TBD	TBD
Centaurea	*diffusa*	Diffuse knapweed	Anywhere	EDRR
Chenopodium	*album*	Lambsquarters	TBD	TBD
Chondrilla	*juncea*	Rush skeletonweed	Sandy areas	Late spring
Cirsium	*arvense*	Canada thistle	Sedge meadows	Spring
Clematis	*vitalba*	Old man's beard	Anywhere	EDRR
Conium	*maculatum*	Poison hemlock	Public areas	Spring
Crataegus	*monogyna*	Common hawthorn	Anywhere	Fall
Cytisus	*scoparius*	Scotch broom	Anywhere	EDRR
Dipsacus	*fullonum*	Teasel	Sedge meadows	Spring
Epipactis	*helleborine*	Non-native orchid	Cottonwood forest	Late spring
Hypericum	*perforatum*	St John's wort	Sedge meadows	Spring
Ilex	*aquifolium*	Holly	Anywhere	EDRR
Iris	*pseudacorus*	Yellow iris	TBD	TBD
Ludwigia	*peploides*	Water primrose	Channel	Fall
Lythrum	*salicaria*	Purple loosestrife	Canoe launch	Summer
Mentha	*pulegium*	Pennyroyal	Anywhere	EDRR
Myriophyllum	*aquaticum*	Parrotfeather	Smith Lake	Fall
Phalaris	*arundinacea*	Reed canarygrass	Sedge meadows, planted areas	Fall; when prepping for planting
Polygonum	*cuspidatum*	Japanese knotweed	Anywhere	EDRR
Robinia	*pseudoacacia*	Black locust	Anywhere	Fall
Rubus	*armenianus*	Himalayan blackberry	Sedge meadows, planted areas	Fall; when prepping for planting
Solanum	*dulcamara*	Bittersweet nightshade	Public areas	Spring

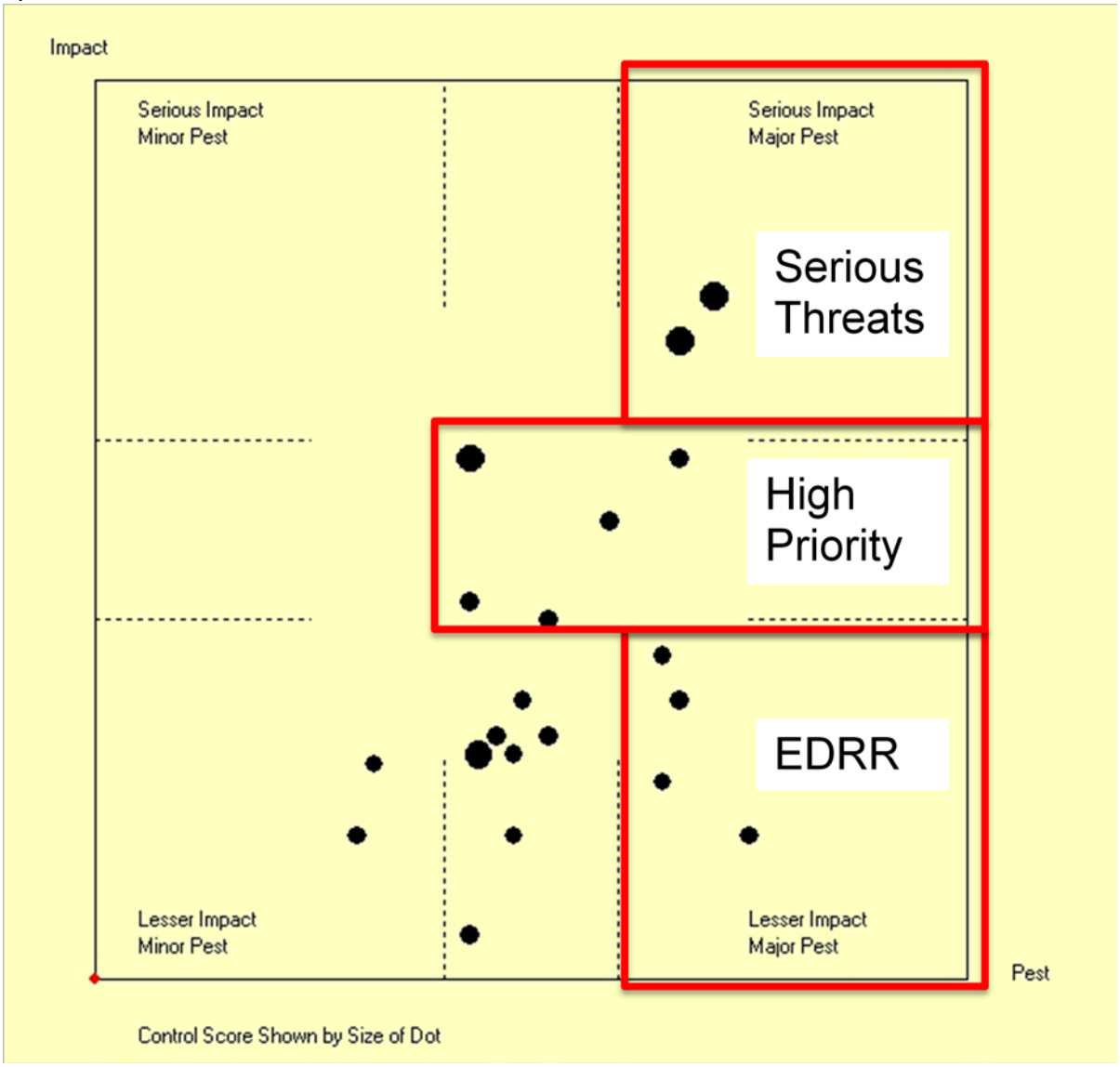
As discussed in the Plan, Metro evaluated a number of plants with the Alien Plants Ranking System. Metro selected 20 species (Table 2), including many from the previous list. These species were expected to produce a range of results.

Table 2. List of species evaluated with Alien Plants Ranking System.

Genus	**species**	**common name**
Arctium	*minus*	Common burdock
Centaurea	*diffusa*	Diffuse knapweed
Chenopodium	*album*	Lambsquarters
Chondrilla	*juncea*	Rush skeletonweed
Cirsium	*arvense*	Canada thistle
Clematis	*vitalba*	Old man's beard
Conium	*maculatum*	Poison hemlock
Dipsacus	*fullonum*	Teasel
Epipactis	*helleborine*	Non-native orchid
Iris	*pseudacorus*	Yellow iris
Ludwigia	*peploides*	Water primrose
Lythrum	*salicaria*	Purple loosestrife
Mentha	*pulegium*	Pennyroyal
Myriophyllum	*aquaticum*	Parrotfeather
Phalaris	*arundinacea*	Reed canarygrass
Robinia	*pseudoacacia*	Black locust
Rubus	*armenianus*	Himalayan blackberry
Sisymbrium	*irio*	London rocket
Solanum	*dulcamara*	Bittersweet nightshade
Trifolium	*arvense*	Hare’s-foot clover

The plot in Figure 1 shows results for all 20 species. Increasing impact to Smith and Bybee Wetlands is on the vertical axis, and increasing potential to be a pest is on the horizontal axis. The size of the dot indicates relative difficulty of control for that species. Invasive species that pose the greatest threat are represented by dots in the upper right corner of the plot – they are major pests with a big impact. The red box in the bottom right corner indicates plants that are major pests but have not made as much impact at Smith and Bybee Wetlands yet. Because their distribution is limited, there is an opportunity to control them before they become major problems. In the middle area, a red box outlines plants (dots) that are emerging threats, at least in some areas.

Figure 1. Scatter plot showing general results for 20 species evaluated with Alien Plants Ranking System.



In Figure 2, selected species are labeled to show their placement by APRS. Labeling all species would render the graph unreadable; the species shown were selected to demonstrate the range of results for well-known weeds that differ in their abundance and distribution at SBW. Reed canarygrass is known to be a serious problem at the wetlands, displacing Columbia sedge meadows, shrub habitats and riparian forests. Yellow flag iris is an emerging threat, and Canada thistle can have big impacts on open meadows. Diffuse knapweed, a major problem throughout the West, is in the early stages of invasion at Smith and Bybee Wetlands. Rush skeletonweed, although somewhat invasive, is not posing much of a problem there.

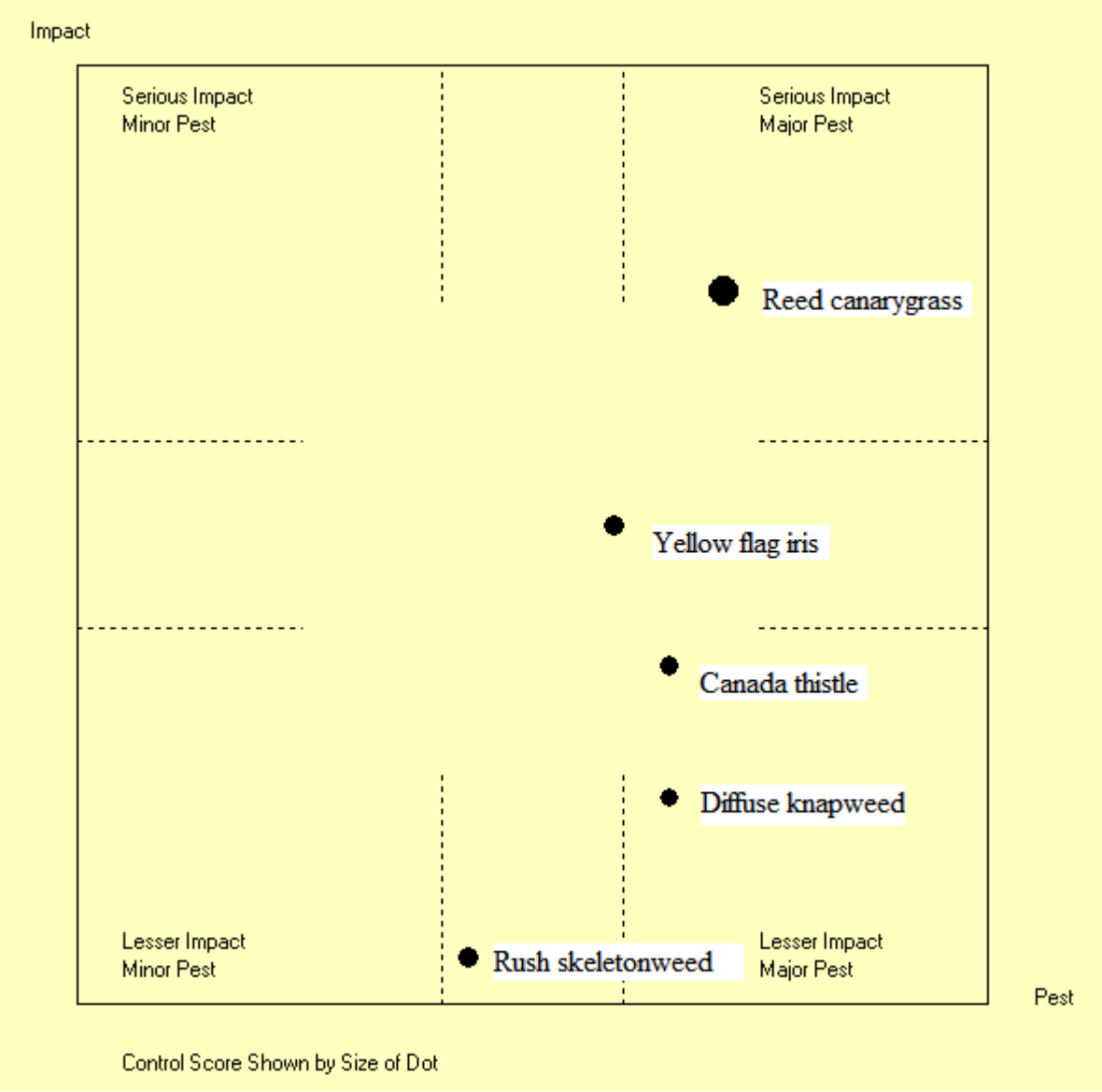


Figure 2. Selected species evaluated with APRS, showing their relative placements.

Integrated Pest Management Approach

Metro follows IPM principles in managing weeds at SBW. In brief, IPM includes these steps:

- Know the pest
- Understand its environment
- Consider the tools that are available and the setting
  - Cultural control
  - Biocontrol
  - Mechanical control
  - Chemical control
- Select the least harmful, effective control
- Monitor results of treatment and adjust as needed

The water control structure is the largest initiative to control weeds at SBW. By flooding reed canarygrass early in the growing season and drawing down to expose soils for late, warm-season native plants, Metro influences the plant community over at least 650 acres. Other weeds at the water's edge, such as Himalayan blackberry and St. Johns wort, are also controlled with flooding. Biological controls have been released at SBW for purple loosestrife. Reed canarygrass at higher elevations has been covered with shadecloth, although this technique is labor-intensive, expensive, and best applied over relatively small areas (e.g., less than 0.25 acre). Herbicides are useful tools in some instances. Metro has generally limited herbicide use to glyphosate and triclopyr, although other chemicals are used on an experimental basis when triclopyr and glyphosate do not provide the most effective control.

Aquatic weeds such as parrot feather and floating water primrose pose a challenge. In a court case involving the application of a labeled herbicide into irrigation canals that discharge to navigable waters (Headwaters Inc. v. Talent Irrigation District), the Ninth Circuit Court held that the application constituted a point source discharge of a pollutant not covered by a National Pollution Discharge Elimination System (NPDES) permit, in violation of the Clean Water Act. The court also held that an approved label does not eliminate the need for a NPDES permit when the herbicide is applied. Metro has not conducted aquatic applications at SBW but has had good control of parrot feather on mudflats around Bybee Lake after drawdown with glyphosate, but with beaver damming the outlet of Smith Lake opportunities for controlling these species in Smith Lake have been greatly reduced. In 2011, the Oregon Department of Environmental Quality developed a NPDES permit for aquatic herbicide application. Metro may seek a permit and make such applications.

Invasive Animals

A number of invasive animals inhabit SBW or are likely to occur there in the near future. Management options for invasive animals are more limited than those for plants. Metro employs a variety of methods to tackle the problem. The most direct action is habitat management. Many invasive terrestrial vertebrates (e.g., European starling) prefer edges of fragmented habitats. As Metro and other landowners conduct habitat restoration and knit habitat fragments back together, conditions improve for many native animals and are less hospitable to edge-loving invaders.

Indirectly, Metro works with partners to prevent new invasions and act on already-present invaders. Examples include working with USDA and ODA to place traps around SBW's perimeter to detect early infestations of Emerald ash borer and other invertebrates. By providing support to partners such as Oregon Invasive Species Council, Oregon Department of Fish and Wildlife and City of Portland, Metro contributes to local and statewide efforts to find ways to deal with invasive animals.

Early Detection and Rapid Response Program

Treatment of infestations early on is the most successful, cost effective, and least environmentally damaging means of control. As described in the Plan's section on the invasion process, there is typically a short period of opportunity for eradication and containment after initial introduction of a new invasive species. Once permanently established, what was once a new invader can quickly become a long-term management problem.

In addition to the priority species listed in Table 1 of this section, there are many other species that are likely to invade SBW. These species, listed in Table 3, are "watch list" species. They include West Multnomah County Soil and Water Conservation District's EDRR species, aquatic plants, land plants and aquatic invertebrates on the Oregon Invasive Species Council's (OISC) "100 most dangerous" invaders to keep out, species identified by the City of Portland as being likely to invade within the next 5-10 years (by 2020), and all species which appear on the "A" list on the Oregon State noxious weed list. The State noxious weed list is maintained by the Oregon State Weed Board (OSWB) and Noxious Weed Control Program. "A" designated weeds are weeds of known economic importance which occur in the state in small enough infestations to make eradication or containment possible; or they are not known to occur but their presence in neighboring states make future occurrence in Oregon seem imminent. Infestations are subject to eradication or intensive control when and where found. Many of these weeds currently on the list are not known to occur in Oregon as of 2010 and several, such as the cordgrasses (*Spartina* sp.) are coastal weeds that don't occur in freshwater systems.

Because Metro will continue to partner with APHIS and the State of Oregon in monitoring for invertebrate species such as the Asian gypsy moth and the Emerald ash borer, terrestrial invertebrates are not included on the watch list. The SBW watch lists will be updated at least annually to incorporate changes to the various agencies' lists.

Purple loosestrife (*Lythrum salicaria*), a West Multnomah County Soil and Water Conservation District's EDRR species is already present at SBW, and therefore excluded from the list.

Table 3. SBW Watch List plants.

Common Name	**Scientific Name**	**Source**
Terrestrial Plants		
African rue	*Peganum harmala*	2, 4
camelthorn	*Alhagi pseudalhagi*	2, 4
coltsfoot	*Tussilago farfara*	2, 4
false brome	*Brachypodium sylvaticum*	1
giant hogweed	*Heracleum mantegazzianum*	1, 2
gorse	*Ulex europaeus*	1
garlic mustard	*Alliaria petiolata*	1
orange hawkweed	*Hieracium aurantiacum*	1
pokeweed	*Phytolacca americana*	1
spurge laurel	*Daphne laureola*	1
non-native knotweed species	*Polygonum spp.*	1
flowering rush	*Butomus umbellatus*	4
giant hogweed	*Heracleum mantegazzianum*	4
barbed goatgrass	*Aegilops triuncialis*	2, 4
ovate goatgrass	*Aegilops ovata*	2, 4
goatsrue	*Galega officinalis*	2, 4
king-devil hawkweed	*Hieracium piloselloides*	2, 4
meadow hawkweed	*Hieracium pratense*	2, 4
mouse-ear hawkweed	*Hieracium pilosella*	2, 4

orange hawkweed	*Hieracium aurantiacum*	2, 4
yellow hawkweed	*Hieracium floribundum*	2, 4
Japanese dodder	*Cuscuta japonica*	2, 4
kudzu	*Pueraria lobata*	2, 4
matgrass	*Nardus stricta*	2, 4
oblong spurge	*Euphorbia oblongata*	2, 4
Paterson's curse	*Echium plantagineum*	2, 4
purple nutsedge	*Cyperus rotundus*	4
silverleaf nightshade	*Solanum elaeagnifolium*	2, 4
Spanish heath	*Erica lusitanica*	4
skeletonleaf bursage	*Ambrosia tomentosa*	2, 4
squarrose knapweed	*Centaurea virgata*	2, 4
Iberian starthistle	*Centaurea iberica*	2, 4
purple starthistle	*Centaurea calcitrapa*	2, 4
Syrian bean-caper	*Zygophyllum fabago*	2, 4
Texas blueweed	*Helianthus ciliaris*	2, 4
plumeless thistle	*Carduus acanthoides*	2, 4
smooth distaff thistle	*Carthamus baeticus*	2, 4
Taurian thistle	*Onopordum tauricum*	2, 4
woolly distaff thistle	*Carthamus lanatus*	2, 4
white bryonia	*Bryonia alba*	2, 4
travelers joy/old man’s beard	*Clematis vitalba*	1
Aquatic Plants		
African waterweed	*Lagarosiphon major*	2
dead man's fingers	*Codium fragile tomentosoides*	2
European water chestnut	*Trapa natans*	2
flowering rush	*Butomus umbellatus*	2
giant salvinia	*Salvinia molesta*	2
hydrilla	*Hydrilla verticillata*	2, 4
common reed	*Phragmites australis ssp. australis*	4
common cordgrass	*Spartina anglica*	4
dense-flowered cordgrass	*Spartina densiflora*	4
European water chestnut	*Trapa natans*	4
saltmeadow cordgrass	*Spartina patens*	4
smooth cordgrass	*Spartina alterniflora*	4
rock snot	*Didymosphenia geminate*	2
yellow floating heart	*Nymphoides peltata*	2
Aquatic Invertebrates		
Asian clam	*Potamocorbula amurensis*	2
spiny waterflea	*Bythotrephes cederstroemi*	2
fishhook waterflea	*Cercopagis pengoi*	2
zebra mussel	*Dreissena polymorpha*	2, 3
western quagga mussel	*Dreissena rostriformis bugensis*	2, 3
mitten crab	*Eriocheir sinensis*	2
rusty crayfish	*Orconectes rusticus*	2, 3

virile crayfish	*Orconectes virilis*	3
ringed crayfish	*Orconectes neglectus*	3
Swamp crayfish	*Procambarus clarkia*	2
Chinese mystery snail	*Bellamya chinensis*	3
Apple snail	*Pomecea* sp.	3
New Zealand mudsnails	*Potamopyrgus antipodarum*	3
red swamp crayfish	*Procambarus clarkia*	2
Reptiles		
eastern snapping turtle	*Chelydra serpentine serpentine*	2

1= West Multnomah County Soil and Water Conservation District's EDRR species
2= Oregon Invasive Species Council's (OISC) 100 most dangerous invaders to keep out
3= City of Portland as being likely to invade within the next 5-10 years
4= State of Oregon noxious weed "A" species

EDRR Monitoring

Metro will complete annual surveys for species on the EDRR Watch List. Priority areas include the perimeter of SBW, particularly where it is adjacent to railroads and arterial roads. Staff will watch for aquatic plants around the perimeter of the wetland during drawdown and via boat at strategic times.

Staff and any volunteer monitors will be trained in the identification of all species on the EDRR Watch List. Each detection will be mapped and appropriate treatment will be initiated. Metro will continue its coordination with other SBW landowners, the 4-County Weed Management Area partners and Oregon Department of Agriculture to ensure they are aware of noxious and other high-priority weeds.

TOOLS USED TO EVALUATE INVASIVE PLANTS

Metro used the Alien Plants Ranking system to evaluate the level of threat posed by various weeds. The following pages provide background information on this assessment tool. In order to answer questions in the APRS, some additional information on the plants' biology is needed. That information was obtained from NatureServe Explorer, and an example from that site follows the APRS description.

Alien Plants Ranking System

http://sbsc.wr.usgs.gov/cprs/swepic/

Introduction to Alien Plant Ranking System (APRS)

PURPOSE
The Alien Plant Ranking System (APRS) is a computer-implemented system to help land managers make difficult decisions concerning invasive nonnative plants. The management of invasive plants is difficult, expensive, and requires a long-term commitment. Therefore, land managers must focus their limited resources, targeting the species that cause major impacts or threats to resources within their management, or the species that impede attainment of management goals. APRS provides an analytical tool to separate the innocuous species from the invasive ones (typically around 10% of the nonnative species). APRS not only helps identify those species that currently impact a site, but also those that have a high potential do so in the future. Finally, the system addresses the feasibility of control of each species, enabling the manager to weigh the costs of control against the level of impact.

SYSTEM DESCRIPTION
The system relies on a set of 23 questions (DataSheet) to be answered for each nonnative plant known to occur in (or near) the site of concern. The questions are organized into 3 sections. Section I, which addresses the current level of impacts to the site, must be based upon site surveys. Section II asks specific questions that give indications of the potential of the species to be invasive. For many alien plants, answers to these questions are available within the system (species FactSheets). If this information is unknown, and not available within the system, it should be obtained through library research. Section III poses questions that affect the feasibility (and costs) of control.

SYSTEM OUTPUT
Upon completion of the DataSheets for all nonnative species found on a site, the manager can print the following:
1. Completed DataSheet for each species
2. List of all entered species sorted by level of impact, or potential to be invasive, or feasibility of control
3. Lists, such as species found to be innocuous, or species causing serious impact, or species not currently causing impacts but having high potential to invade and cause impacts, or some other grouping determined by the user
4. Graphic depiction of data showing impact, potential to be invasive, and feasibility of control for the suite of species in the data file

USING THE SYSTEM

Individuals who use APRS must be able to interpret specific biological information on each species both in the field and in the literature. It is essential to identify species correctly in the field.

FIVE STEPS TO APRS

1. DETERMINE THE NONNATIVE SPECIES that do occur or are likely to occur within the site of interest. Possible sources of lists include research reports for the site or region, catalogs of specimens for regional herbaria, species lists by county from state or county weed boards, or lists from biological surveys or natural feature organizations. Once a list of species is completed, local floras and the Kortez species should be consulted to see which species are nonnative.

2. SURVEY THE SITE. The best survey method is to conduct quantitative sampling stratified by vegetation type, using a geographical information system (GIS). This not only provides the information to complete Section I of the ranking system but allows for analysis of correlations of distribution and abundance of nonnative species with vegetation type, roads, trails, etc. Sufficient information can, however, be obtained by a less intensive, systematic qualitative survey of the area. The location and extent of nonnative species stands should be mapped.

3. CONSULT THE SPECIES FACTSHEETS to see whether information to complete Section II (Potential to be a Pest) of the DataSheet is included. Also, consult the FactSheets to obtain information to complete portions of Section III (Feasibility of Control). If a FactSheet for the species is not available, a literature search should be made to gather the needed information for completing Section II and Section III. Keyword searches using the common and scientific names of the species are suggested.

4. CREATE DATASHEETS for all of the nonnative species found within or adjacent to the site. After completing this step, save as a data file for your site. All of the products listed above can then be generated for the site. If you leave the "unknown" response to one of the questions, you can test the importance of answering the question by using the maximum-minimum function in the Graphs mode.

5. STUDY THE INFORMATION AND GRAPHS GENERATED and apply them towards the development of a management plan for the site and surrounding area.

APRS IMPLEMENTATION TEAM:
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NatureServe Explorer

http://www.natureserve.org/explorer/index.htm

NatureServe Explorer provides conservation status, taxonomy, distribution, and life history information for more than 70,000 plants, animals, and ecological communities and systems in the United States and Canada.

The data available through *NatureServe Explorer* represent a "snapshot" of the U.S. and Canadian data managed in the NatureServe Central Databases. These databases are dynamic, being continually enhanced and refined through the input of hundreds of natural heritage program scientists and other collaborators. NatureServe Explorer is periodically updated from these central databases to reflect information from new field surveys, the latest taxonomic treatments and other scientific publications, and new conservation status assessments.

Example: reed canarygrass (Phalaris arundinacea) results, U.S. Invasive Species Rank (I-Rank), downloaded May 2011.

I-Rank: High
Rounded I-Rank: High
I-Rank Reasons Summary: This species can form dense, persistent, monotypic stands of creeping rhizomes in a thick sod layer in wetlands, moist meadows and riparian areas. In a study on the St. Lawrence River, this species (as well as a few other aquatic wetland invasive plant species) was found to expand aggressively to a point of almost monospecific dominance during periods of low water levels. Populations can dominate wetlands outcompeting and eliminating native species, often in undisturbed areas on nature preserves. Although distributed in nearly every U.S. state it is particularly invasive in the northeast where it has spread over the last 200 years and more recently, in the west. Almost any moist, fertile habitat is suitable including wetlands and riparian areas. A combination of management strategies works best although management is somewhat difficult but can be rapid if invasions are caught in time. Unfortunately, control often has deleterious impacts on native species.
Subrank I - Ecological Impact: High
Subrank II - Current Distribution/Abundance: High
Subrank III - Trend in Distribution/Abundance: Medium
Subrank IV - Management Difficulty: High/Medium
I-Rank Review Date: 26Jun2006
Evaluator: J. Cordeiro
Native *anywhere* in the U.S? Yes; native and non-native in the U.S.
Native Range: Reed canarygrass is the only member of the genus *Phalaris* that is circumboreal, and it may be the precursor to all New World taxa of the genus (Anderson, 1961 cited in Lyons, 1998). Clearly native to Europe, some authors view it as native to Asia and North America as well but the present day range extends throughout the Old and New Worlds, where it is found primarily in northern latitudes (Lyons, 1998).

Screening Questions

S-1. Established outside cultivation as a non-native? YES
Comments: There is some debate as to whether *Phalaris arundinacea* is native to North America (Merigliano and Lesica, 1998) as collections from the inland Pacific Northwest predate settlement of the area by Europeans. Modern *Phalaris* populations in this region may be a mixture of cultivars and "native" material. It is widely regarded as non-native in more southern latitutes. The invasive character of some populations may be the result of agronomic breeding for vigorous growth and drought tolerance. It is generally thought that invasive populations of reed canarygrass, however, are descendents of non-native cultivars or ecotypes (Apfelbaum and Sams, 1987; Hutchinson, 1992) or the vigorous result of crosses between cultivated varieties and native strains (Barnes, 1999; Barrett, 1983; Gilford et al., 2002; Merigliano and Lesica, 1998) with native and non-native strains coexisting in the U.S. since the 1800s. Several subspecies and cultivars have been planted throughout the United States since the 1800s for forage and erosion control (Czarapata, 2005).

S-2. Present in conservation areas or other native species habitat? Yes
Comments: There is some debate as to whether *Phalaris arundinacea* is native to North America (Merigliano and Lesica, 1998) as collections from the inland Pacific Northwest predate settlement of the area by Europeans. Modern *Phalaris* populations in this region may be a mixture of cultivars and "native" material. It is widely regarded as non-native in more southern latitutes. It is considered an aggressive, rhixomatous, colony-forming perennial common in wet areas of the U.S. (Uva et al., 1997).

Subrank I - Ecological Impact: High

1. Impact on Ecosystem Processes and System-wide Parameters: Moderate significance
Comments: Reed canarygrass promotes silt deposition and consequent constriction of waterways (Hodgson, 1968).

2. Impact on Ecological Community Structure: High significance
Comments: Reed canarygrass can form dense, persistent, monotypic stands of creeping rhizomes in a thick sod layer (over 0.5 meters thick) in wetlands, moist meadows and riparian areas (Czarapata, 2005; Lyons, 1998; Tu et al., 2004; Randall and Marinelli, 1996). In a study on the St. Lawrence River, this species (as well as a few other aquatic wetland invasive plant species) was found to expand aggressively to a point of almost monospecific dominance during periods of low water levels (be they natural or artificial) as the plants monopolize light and space better than less aggressive species (Hudon, 2004).

3. Impact on Ecological Community Composition: High significance
Comments: Reed canarygrass can form dense, persistent, monotypic stands in wetlands, moist meadows and riparian areas that exclude and displace desirable native plants and animals (Lyons, 1998; Tu et al., 2004; Randall and Marinelli, 1996). It usually forms monotypic stands and is highly competitive with timothy (*Phleum pratense*), Kentucky bluegrass (*Poa pratensis*), and redtop (*Agrostis alba*), often invading these grasslands to become the dominant cover type (Apfelbaum and Sams, 1987). Barnes (1999) documented formerly abundant herbs and grasses in western Wisconsin displaced following reed canarygrass invasion. A few native plants may be survive within a thick infestation (*Eleocharis palustris*, *Typha latifolia*, *Veronica scutellata*, *Carex aperta*), but wetlands without *Phalaris arundinacea* tend to have a much higher diversity of native species (Tu et al., 2004). Similarly, Green and Galatowitsch (2002) found that if *P. arundinacea* is present during restoration of sedge meadow communities, the restored community will not achieve levels of abundance that are possible when it is not present.

4. Impact on Individual Native Plant or Animal Species: High significance
Comments: Stewards of the Nature Conservancy indicated reed canarygrass may threaten populations of many species including *Zygadenus glaucus* (northeast, central Ohio Herrick Fen, beck Fen, Brownslake Bog), *Carex lyngbuei*, *Scirpus acutus*, *Equisetum fluviatile* (Blind Slough Preserve, Oregon) (Lyons, 1998). A few native plants may be survive within a thick infestation (*Eleocharis palustris*, *Typha latifolia*, *Veronica scutellata*, *Carex aperta*), but wetlands without *Phalaris arundinacea* tend to have a much higher diversity of native species (Tu et al., 2004). Miller and Zedler (2003) determined that reed canarygrass comes to dominate wetlands at the expense of native *Spartina* due to its high ratio of total shoot length: biomass and its adaptable morphology.

5. Conservation Significance of the Communities and Native Species Threatened: High significance
Comments: On TNC's Swan River Oxbow Preserve in Montana, reed canarygrass poses a threat to the federally endangered annual aquatic plant *Howellia aquatilis* causing an extensive decrease in patch size (Lesica, 1997). Akerson and Gounaris (2000) list this species as a serious threat as an invasive and one of the most difficult plants to control in Colonial National Park, Yorktown, Virginia.

Subrank II. Current Distribution and Abundance: High

6. Current Range Size in Nation: High significance
Comments: *Phalaris arundinacea* is distributed in every U.S. state except Texas, Hawaii, and the extreme southeastern states (Louisiana, Mississippi, Georgia, Florida, South Carolina) (USDA, 2006). Crow and Hellquist (2000b) list distribution in North America as Newfoundland wet to Manitoba, southwest to Northwest Territories and Alaska, south to Virginia, west to North Carolina, Kentucky, Illinois, Missouri, Oklahoma, New Mexico, Arizona, and northeast California.

7. Proportion of Current Range Where the Species is Negatively Impacting Biodiversity:
High/Moderate significance
Comments: *Phalaris arundinacea* is particularly abundant in the west and northeast (Lyons, 1998). It is listed as an invasive (though not banned) species in Connecticut and a Class C noxious weed in Washington (USDA, 2006). Of late, it has become particularly invasive in western states although has been well established in the northeast as an invasive for almost 200 years (Czarapata, 2005). It grows successfully in northern latitudes and can be invasive in wet habitats (Lyons, 1998). There is some debate as to whether *Phalaris arundinacea* is native to North America (Merigliano and Lesica, 1998) as collections from the inland Pacific Northwest predate settlement of the area by Europeans. Modern *Phalaris* populations in this region may be a mixture of cultivars and "native" material. It is widely regarded as non-native in more southern latitutes. The invasive character of some populations may be the result of agronomic breeding for vigorous growth and drought tolerance.

8. Proportion of Nation's Biogeographic Units Invaded: High significance
Comments: *Phalaris arundinacea* is distributed in every U.S. state except Texas, Hawaii, and the extreme southeastern states (Louisiana, Mississippi, Georgia, Florida, South Carolina) (USDA, 1999). It is conservatively estimated that well over half of the U.S. ecoregions have been invaded by the either invasive strains of this species or native x invasive crosses (Cordeiro, pers. obs. March 2006

based on TNC, 2001).

9. Diversity of Habitats or Ecological Systems Invaded in Nation: High significance
Comments: Almost any moist, fertile habitat is suitable for this species as it invades and dominates wetland and riparian areas but is valued as a forage grass and for revegetating denuded ditchbanks (Lyons, 1998; Crow and Hellquist, 2000b). This includes wet meadows, wetlands, marshes, fens, old fields, floodplains, wet prairies, roadsides, ditchbanks, streambanks, lake shores, and shore swales (Ohio Department of Natural Areas and Parks, 2001; Snyder, 1992). The species has a high tolerance for varying nutrient and oxygen levels and can live in fluctuating and submerged water successfully (Brix and Sorrell, 1996; Figiel et al., 1995; Green and Galatowitsch, 2002; Kao et al., 2003).

Subrank III. Trend in Distribution and Abundance: Medium

10. Current Trend in Total Range within Nation: Moderate significance
Comments: Of late, *Phalaris arundinacea* has become particularly invasive in western states although has been well established in the northeast as an invasive for almost 200 years (Czarapata, 2005). It has been spreading considerably throughout the United States (and the world) for the last 200 years and has occupied many habitats (Lyons, 1998).

11. Proportion of Potential Range Currently Occupied: Low significance/Insignificant
Comments: Reed canarygrass has a long agronomic history in the U.S. with forage cultivation occurring as early as the 1830s in New England and continuing actively today (Lyons, 1998). Most of its potential range is likely occupied.

12. Long-distance Dispersal Potential within Nation: High/Moderate significance
Comments: Seeds inherently have no adaptation for long-distance dispersal. Both rhizome fragments and seeds may are dispersed via flowing water, resulting in rapid colonization of unvegetated sediment deposits. Because reed canarygrass has been planted widely for forage and erosion control, potential to spread by human activity is high.

13. Local Range Expansion or Change in Abundance: Medium/Low significance
Comments: A study by Barnes (1999) on a small river island in western Wisconsin showed rapid expansion over a 15 year period from a single small population in 1981 to becoming the dominant plant at elevations of <1 m above the normal high water level in 1996. Reed canarygrass is considered an undesirable invader in oak savannahs of south-central Wisconsin (Henderson, 1990). Akerson and Gounaris (2000) list this species as a serious threat as an invasive and one of the most difficult plants to control in Colonial National Park, Yorktown, Virginia.

14. Inherent Ability to Invade Conservation Areas and Other Native Species Habitats: Moderate significance
Comments: This species is listed as an "invasive plant of major concern" in Czarapata (2005). Reed canarygrass invasion is promoted by disturbances such as ditching of wetlands, stream channelization, deforestation of swamp forests, sedimentation, overgrazing, and intentional planting (Lyons, 1998; Barnes, 1999), but natural disturbances such as scouring floods and low water conditions also promote invasion. Miller and Zedler (2003) suggested *P. arundinacea* will grow in balance with native wetland vegetation without becoming dominant until there is a nutrient input from anthropogenic sources that shifts that balance and allows it to dominate the natives. They further noted it has a high ratio of total shoot length: biomass and an adaptable morphology. Raven (1986) reported *P. arundinacea* proliferated along the unidisturbed portion of riverbank (below the excavated portion) on the River Roding, Essex, United Kingdom, following excavation of flood berms to create a two-stage channel in 1980-82. The excavation apparently caused favorable habitat for this species. Reinhardt and Galatowitsch (2004) found *P. arundinacea* grew rapidly compared to other wetland species, producing 132 g/ plant of aboveground biomass and 333 g/ plant of below ground biomass in just two growing seasons. Also, root to shoot ratios revealed that *P. arundinacea* produced proportionally more aboveground biomass during the first 2 months of establishment and proportionally more belowground biomass for the rest of their study. This morphologic plasticity may explain why *P. arundinacea* is so successful at first preempting establishment of other species and then spreading rapidly.

15. Similar Habitats Invaded Elsewhere: Low significance
Comments: It appears this species has maximized all potential habitats in the United States such that is similarly considered a widespread invader circumboreal in distribution, and it may be the precursor to all New World taxa of the genus (Anderson, 1961 cited in Lyons, 1998). No occupied habitats outside the U.S. are not yet colonized within the U.S.

16. Reproductive Characteristics: High significance
Comments: Reed canarygrass spreads within sites by creeping rhizomes and forms dense and impenetrable mats of vegetation and new sites are colonized by seeds (Lyons, 1998; Snyder, 1992). There are two periods of growth, one prior to seed maturation and one after (Lyons, 1998). Seeds germinate immediately after ripening with no known dormancy requirements (Apfelbaum and Sams, 1987). Growth occurs vegetatively by rhizomes (most often) and sexually by seeds (less common) with a transition from the former to the latter occurring in the shoot tips in early to mid-April with inflorescence development continuing into May. Most plants and recurring populations are likely from rhizomes (Czarapata, 2005; Tu et al., 2004; Uva et al., 1997). Estimated total net productivity was found to

be 2028 g/sq. m/year, higher than other species such as *Typha* and *Scirpus* (Klopatek and Stearns, 1978). Reinhardt and Galatowitsch (2004) found *P. arundinacea* grew rapidly compared to other wetland species, producing 132 g/ plant of aboveground biomass and 333 g/ plant of below ground biomass in just two growing seasons. Also, root to shoot ratios revealed that *P. arundinacea* produced proportionally more aboveground biomass during the first 2 months of establishment and proportionally more belowground biomass for the rest of their study. Nodes can spread at rhizomes. Seed banking can occur in soil for years (Leck, 1996) with an extensive seedbank (Czarapata, 2005) but survival in water is limited to 1-2 years only.

Subrank IV. General Management Difficulty: High/Medium

17. General Management Difficulty: High/Moderate significance

Comments: A combination of management strategies over several years will yueidl the best results (Lyons, 1998). Control is generally difficult due to the rhizomatous nature of the species and may require herbicide treatment for several years (Lyons, 1998; chemical treatment information provided) and because selective control is extremely difficult (Czarapata, 2005), but depending on available time and resources, even highly infested arreas can be restored to more desirable vegetation (Tu et al., 2004; summarizes treatment options). Removal by hand-pulling is practical only for small stands and requires a large time commitment (e.g. > 5 years) (Hutchinson, 1992). Grazing and cutting may be effective controls (again, long-term) but only in fields and croplands. Non-selective herbicides like glyphosate are most effective (Lyons, 1998; Randall and Marinelli, 1996) for small infestations, although commercial glyphosate-based herbicides are often enhanced by surfactants to help the chemical cling to plant leaves which are themselves potentially more harful thean the glyphosate itself (Apfelbaum and Sams, 1987). Lowering of water levels followed by restoration of water levles may control this species because the seeds are generally short-lived (1 or 2 years max.) when inundated (Lyons, 1998). Fire is effective in highly productive wetlands but should only be used for sites with a healthy seed bank of fire-adapted native spedcies that will readily colonize the area after a burn (Hutchinson, 1992). Generally, however, fire is only effective root-burn occurs, and this is unlikely because water or mud often covers the rhizomes (Marks et al., 1994; Snyder, 1992). Currently, there are no biological control methods (Ohio Department of Natural Areas and Parks, 2001). Because most control methods have negative impacts on native wetlands, Johnson (2005) investigated alternative control methods for small, incidental invasions (used AFTER mowing)` and found solarization with black plastic (cost $40/ 2000 sq. ft.; equals $2150/ha) was most effective (100% reduction of stems) and woodchip mulch somewhat effective (85% stem reduction but later regrowth through the mulch leading to reclamation), both with minimal impact on native wetlands and minimum time and cost.

Recent control efforts were summarized in Reinhardt and Galatowitsch (2004): Herbicide applications significantly reduced *P. arundinacea* biomass, and the effectiveness of the herbicide hinged on the timing of the herbicide application. When measured in the growing season after treatment, the mid-May herbicide application reduced *P. arundinacea* to 25% of control levels, but both late August and late September herbicide applications were significantly more effective, and reduced *P. arundinacea* to 10% of control levels. Further, spring burn does not reduce *P. arundinacea* biomass in the long term, nor does it enhance the effectiveness of subsequent herbicide applications.

18. Minimum Time Commitment: Medium/Low significance

Comments: A combination of management strategies over several years will yueidl the best results (Lyons, 1998). Control is difficult due to the rhizomatous nature of the species and may require herbicide treatment for several years (Lyons, 1998) and because selective control is very difficult (Czarapata, 2005). It can be controlled with glyphosate, followed by covering treated areas with black plastic. This method is successful if done for 3 years, and then the treated area seeded with desirable species. Selective hand-pulling is also successful but must be carried out two to three times a year for 5 years (Henderson, 1990). Other chemicals, such as Dalapon and Amitrol, are effective in fall or early winter (Apfelbaum and Sams, 1987). Hodgson (1968) found consecutive, yearly chemical treatments were required to control reed canarygrass. A mixed strategy (e.g. disking mowing, early and late treatments with glyphosate herbicide, late glyphosate treatment alone, and ealry glyphosate treatment plus disking) seems most effective providing effective control in 1-2 years in some cases (Paveglio and Kilbride, 1996). Removal by hand-pulling is practical only for small stands and requires a large time commitment (e.g. > 5 years) (Hutchinson, 1992). Fire is effective in highly productive wetlands but should only be used for sites with a healthy seed bank of fire-adapted native spedcies that will readily colonize the area after a burn and requires a 2-3 year burn rotation cycle for up to 6 years (Hutchinson, 1992). Because most control methods have negative impacts on native wetlands, Johnson (2005) investigated alternative control methods for small, incidental invasions (used AFTER mowing)` and found solarization with black plastic (cost $40/ 2000 sq. ft.; equals 2150/ha) was most effective (100% reduction of stems) and woodchip mulch somewhat effective (85% stem reduction but later regrowth through the mulch leading to reclamation), both with minimal impact on native wetlands and minimum time and cost.

19. Impacts of Management on Native Species: High significance

Comments: Few herbicides may be used in wetlands or near running water, where reed canarygrass is usually most troublesome; plus selective control in these areas is nearly impossible (Czarapata, 2005). In such cases, non-selective herbicides like glyphosate are most effective (Lyons, 1998; Czarapata, 2005), although commercial glyphosate-based herbicides are often enhanced by surfactants to help the chemical cling to plant leaves which are themselves potentially more harful than the glyphosate itself (Apfelbaum and Sams, 1987) so wick application (more selective) works best. However, many sources believe that the impact of common control techniques are so severe that removal of the species from wetlands with those techniques would result in overall net loss to the wetland (Johnson, 2005). Fire is effective in highly productive wetlands but should only be used for sites with a healthy seed bank of fire-adapted native spedcies that will readily colonize the area after a burn (Hutchinson, 1992). Because most control methods have negative impacts on native wetlands, Johnson (2005) investigated alternative control methods for small, incidental invasions (used AFTER mowing) and

found solarization with black plastic was most effective (100% reduction of stems) and woodchip mulch somewhat effective (85% stem reduction but later regrowth through the mulch leading to reclamation), both with minimal impact on native wetlands. Currently, there are no biological control methods (Ohio Department of Natural Areas and Parks, 2001). When reed canarygrass is eliminated, there may be a danger of soil erosion if other species fail to cover the area quickly.

Most recently from control efforts outlined in Reinhardt and Galatowitsch (2004): In the context of a newly restored wetland, results indicated that a high density of native seeds suppressed *P. arundinacea* growth, and the effect was more pronounced at high seed densities of *P. arundinacea* (>100 seeds/ sq. m). However, higher densities of native seeding did not suppress recruitment from seed, even when *P. arundinacea* was present at 10 seeds/ sq. m and native species were present at 15,000 seeds/ sq. m. Although native species in high propagule density can suppress early growth of *P. arundinacea*, they do not suppress recruitment of *P. arundinacea* individuals from seed.

20. Accessibility of Invaded Areas: Low significance/Insignificant
Comments: It appears most to all areas are easily accessible, as for most aquatic plants outside unusual habitats such as caves or high elevation streams or ponds. Because reed canarygrass has been planted widely for forage and erosion control, a few areas may not be accessible, particularly on private lands.

Other Considerations: It is generally thought that invasive populations of reed canarygrass, however, are descendents of non-native cultivars or ecotypes (Apfelbaum and Sams, 1987; Czarapata, 2005; Hutchinson, 1992) or the vigorous result of crosses between cultivated varieties and native strains (Barnes, 1999; Barrett, 1983; Gilford et al., 2002; Merigliano and Lesica, 1998) with native and non-native strains coexisting in the U.S. since the 1800s. Therefore, for the purposes of this invasiveness ranking assessment only, all U.S. populations of reed canarygrass will be treated as invasive.

Note: All species and ecological community data presented in NatureServe Explorer at http://www.natureserve.org/explorer were updated to be current with NatureServe's central databases as of **August 2010**.
Note: This report was printed on **May 17, 2011**

Smith and Bybee Wetlands Wildlife list

Taxon	Genus	species	common name	native/introduced
FISH				
	Lampetra	sp.	Lamprey	N
	Carassius	*auratus*	Goldfish	I
	Cyprinus	*carpio*	Common Carp	I
	Mylocheilus	*caurinus*	Peamouth	N
	Ptychocheilus	*oregonensis*	Northern pikeminnow	N
	Richardsonius	*balteatus*	Redside Shiner	N
	Notemigonus	*crysoleucas*	Golden shiner	I
	Misgurnus	*anguillicaudatus*	Dojo loach, weather loach	I
	Ameiurus	*nebulosus*	Brown Bullhead	I
	Oncorhynchus	*kisutch*	Coho Salmon	N
	O.	*mykiss*	Steelhead or Rainbow Trout	N
	O.	*tshawytscha*	Chinook Salmon	N
	Catostomus	*macrocheilus*	Largescale sucker	N
	Gambusia	*affinis*	Mosquitofish	I
	Fundulus	*diaphanous*	Banded killifish	I
	Gasterosteus	*aculeatus*	Three-spined Stickleback	N
	Cottus	*asper*	Prickly Sculpin	N
	Lepomis	*gibbosus*	Pumpkinseed Sunfish	I
	L.	*gulosus*	Warmouth	I
	L.	*macrochirus*	Bluegill	I
	Micropterus	*salmoides*	Largemouth Bass	I
	Pomoxis	*annularis*	White Crappie	I
	P.	*nigromaculatus*	Black Crappie	I
	Perca	*flavescens*	Yellow Perch	I
	Platichthys	*stellatus*	Starry Flounder	N
AMPHIBIANS				
	Ambystoma	*macrodactylum*	Long-toed salamander	N
	Pseudacris	*regilla*	Pacific tree (chorus) frog	N
	Rana	*aurora*	Northern Red-legged Frog	N
	Lithobates	*catesbeianus*	American bullfrog	I
REPTILES				
	Chrysemys	*picta*	Western painted turtle	N
	Actinemys	*marmorata*	Pacific (Western) pond turtle	N
	Trachemys	*scripta*	Red-eared slider	I
	Thamnophis	*ordinoides*	Northwestern garter snake	N
	Thamnophis	*sirtalis*	Common garter snake	N
BIRDS	*Branta*	*hutchinsii*	Cackling Canada Goose	N
	Branta	*canadensis*	Canada Goose	N
	Cygnus	*columbianus*	Tundra Swan	N
	Aix	*sponsa*	Wood Duck	N
	Anas	*strepera*	Gadwall	N

Smith and Bybee Wetlands Wildlife list

Taxon	Genus	species	common name	native/introduced
	A.	*americana*	American Wigeon	N
	A.	*platyrhynchos*	Mallard	N
	A.	*discors*	Blue-winged Teal	N
	A.	*cyanoptera*	Cinnamon Teal	N
	A.	*clypeata*	Northern Shoveler	N
	A.	*acuta*	Northern Pintail	N
	A.	*crecca*	Green-winged Teal	N
	Aythya	*valisineria*	Canvasback	N
	A.	*americana*	Redhead	N
	A.	*collaris*	Ring-necked Duck	N
	A.	*marila*	Greater Scaup	N
	A.	*affinis*	Lesser Scaup	N
	Bucephala	*albeola*	Bufflehead	N
	B.	*clangula*	Common Goldeneye	N
	Lophodytes	*cucullatus*	Hooded Merganser	N
	Mergus	*merganser*	Common Merganser	N
	Oxyura	*jamaicensis*	Ruddy Duck	N
	Podilymbus	*podiceps*	Pied-billed Grebe	N
	Pelecanus	*erythrorhynchos*	American White Pelican	N
	Phalacrocorax	*auritus*	Doubled-crested Cormorant	N
	Botaurus	*lentiginosus*	American Bittern	N
	Ardea	*herodias*	Great Blue Heron	N
	A.	*alba*	Great Egret	N
	Butorides	*virescens*	Green Heron	N
	Nycticorax	*nycticorax*	Black-crowned Night Heron	N
	Cathartes	*aura*	Turkey Vulture	N
	Pandion	*haliaetus*	Osprey	N
	Haliaeetus	*leucocephalus*	Bald Eagle	N
	Circus	*cyaneus*	Northern Harrier	N
	Accipiter	*striatus*	Sharp-shinned Hawk	N
	A.	*cooperii*	Cooper's Hawk	N
	Buteo	*lineatus*	Red-shouldered Hawk	N
	B.	*jamaicensis*	Red-tailed Hawk	N
	B.	*lagopus*	Rough-legged Hawk	N
	Falco	*sparverius*	American Kestrel	N
	F.	*columbarius*	Merlin	N
	F.	*peregrinus*	American Peregrine Falcon	N
	Rallus	*limicola*	Virginia Rail	N
	Porzana	*carolina*	Sora	N
	Fulica	*americana*	American Coot	N
	Grus	*canadensis*	Lesser Sandhill Crane	N
	Charadrius	*vociferus*	Killdeer	N
	Tringa	*melanoleuca*	Greater Yellowlegs	N
	T.	*flavipes*	Lesser Yellowlegs	N
	Actitis	*macularia*	Spotted Sandpiper	N

Smith and Bybee Wetlands Wildlife list

Taxon	Genus	species	common name	native/introduced
	Calidris	*pusilla*	Semipalmated Sandpiper	N
	C.	*mauri*	Western Sandpiper	N
	C.	*minutilla*	Least Sandpiper	N
	C.	*bairdii*	Baird's Sandpiper	N
	C.	*alpina*	Dunlin	I
	Limnodromus	*griseus*	Short-billed Dowitcher	N
	L.	*scolopaceus*	Long-billed Dowitcher	N
	Gallinago	*delicata*	Wilson's Snipe	N
	Chroicocephalus	*philadelphia*	Bonaparte's Gull	N
	Larus	*canus*	Mew Gull	N
	L.	*delawarensis*	Ring-billed Gull	N
	L.	*occidentalis*	Western Gull	N
	L.	*agentatus*	Herring Gull	N
	L.	*thayeri*	Thayer's Gull	N
	L.	*glaucescens*	Glaucous-winged Gull	N
	L.	*hyperboreus*	Glaucous Gull	N
	Hydroprogne	*caspia*	Caspian Tern	N
	Columba	*livia*	Rock Pigeon	N
	Patagioenas	*fasciata*	Band-tailed Pigeon	N
	Streptopelia	*decaocto*	Eurasian Collared-Dove	N
	Zenaida	*macroura*	Mourning Dove	N
	Tyto	*alba*	Barn Owl	N
	Megascops	*kennicottii*	Western Screech-Owl	N
	Bubo	*virginianus*	Great Horned Owl	N
	Chaetura	*vauxi*	Vaux's Swift	N
	Calypte	*anna*	Anna's Hummingbird	N
	Selasphorus	*rufus*	Rufous Hummingbird	N
	Megaceryle	*alcyon*	Belted Kingfisher	N
	Picoides	*pubescens*	Downy Woodpecker	N
	Colaptes	*auratus*	Northern Flicker	N
	Dryocopus	*pileatus*	Pileated Woodpecker	N
	Contopus	*cooperi*	Olive-sided Flycatcher	N
	C.	*sordidulus*	Western Wood-Pewee	N
	Empidonax	*traillii*	Willow Flycatcher	N
	E.	*dificilus*	Pacific-slope Flycatcher	N
	Tyrannus	*verticalis*	Western Kingbird	N
	Lanius	*excubitor*	Northern Shrike	N
	Vireo	*cassinii*	Cassin's Vireo	N
	V.	*huttoni*	Hutton's Vireo	N
	V.	*gilvus*	Warbling Vireo	N
	Cyanocitta	*stelleri*	Steller's Jay	N
	Aphelocoma	*californica*	Western Scrub-Jay	N
	Corvus	*brachyrhynchos*	American Crow	N
	Corvus	*corax*	Common Raven	N
	Progne	*subis*	Purple Martin	N

Smith and Bybee Wetlands Wildlife list

Taxon	Genus	species	common name	native/introduced
	Tachycineta	*bicolor*	Tree Swallow	N
	T.	*thalassina*	Violet-green Swallow	N
	Stelgidopteryx	*serripennis*	Northern Rough-winged Swallow	N
	Petrochelidon	*pyrrhonota*	Cliff Swallow	N
	Hirundo	*rustica*	Barn Swallow	N
	Poecile	*atricapilla*	Black-capped Chickadee	N
	Psaltriparus	*minimus*	Bushtit	N
	Sitta	*carolinensis*	White-breasted Nuthatch	N
	Certhia	*americana*	Brown Creeper	N
	Thryomanes	*bewickii*	Bewick's Wren	N
	Troglodytes	*aedon*	House Wren	N
	T.	*pacificus*	Pacific Wren	N
	Cistothorus	*palustris*	Marsh Wren	N
	Regulus	*satrapa*	Golden-crowned Kinglet	N
	R.	*calendula*	Ruby-crowned Kinglet	N
	Catharus	*ustulatus*	Swainson's Thrush	N
	C.	*guttatus*	Hermit Thrush	N
	Turdus	*migratorius*	American Robin	N
	Ixoreus	*naevius*	Varied Thrush	N
	Sturnus	*vulgaris*	European Starling	I
	Anthus	*rubescens*	American Pipit	N
	Bombycilla	*cedrorum*	Cedar Waxwing	N
	Oreothlypis	*celata*	Orange-crowned Warbler	N
	Geothlypis	*trichas*	Common Yellowthroat	N
	Setophaga	*petechia*	Yellow Warbler	N
	S.	*coronata*	Yellow-rumped Warbler	N
	Cardellina	*pusilla*	Wilson's Warbler	N
	Pipilo	*maculatus*	Spotted Towhee	N
	Passerculus	*sandwichensis*	Savannah Sparrow	N
	Passerella	*iliaca*	Fox Sparrow	N
	Melospiza	*melodia*	Song Sparrow	N
	M.	*lincolnii*	Lincoln's Sparrow	N
	M.	*georgiana*	Swamp Sparrow	N
	Zonotrichia	*leucophrys*	White-crowned Sparrow	N
	Z.	*atricapilla*	Golden-crowned Sparrow	N
	Junco	*hyemalis*	Dark-eyed Junco	N
	Piranga	*ludoviciana*	Western Tanager	N
	Pheucticus	*melanocephalus*	Black-headed Grosbeak	N
	Passerina	*amoena*	Lazuli Bunting	N
	Agelaius	*phoeniceus*	Red-winged Blackbird	N
	Sturnella	*neglecta*	Western Meadowlark	N
	Xanthocephalus	*xanthocephalus*	Yellow-headed Blackbird	N
	Euphagus	*cyanocephalus*	Brewer's Blackbird	N
	Molothrus	*ater*	Brown-headed Cowbird	N
	Icterus	*bullockii*	Bullock's Oriole	N

Smith and Bybee Wetlands Wildlife list

Taxon	Genus	species	common name	native/introduced
	Carpodacus	*mexicanus*	House Finch	N
	Spinus	*psaltria*	Lesser Goldfinch	N
	S.	*tristis*	American Goldfinch	N
	Passer	*domesticus*	House Sparrow	I
MAMMALS				
	Sorex	*trowbridgii*	Trowbridge's Shrew	N
	Scapanus	*townsendii*	Townsend's Mole	N
	Myotis	*yumanensis*	Yuma Myotis	N
	M.	*californicus*	California Myotis	N
	M.	*lucifugus*	Little Brown Myotis	N
	M.	*volans*	Long-legged Myotis	N
	Lasionycteris	*noctivagans*	Silver-haired Bat	N
	Eptesicus	*fuscus*	Big Brown Bat	N
	Lasiuris	*cinereus*	Hoary Bat	N
	Sylvilagus	*floridanus*	Eastern Cottontail	I
	Castor	*canadensis*	American Beaver	N
	Microtus	*townsendii*	Townsend's Vole	N
	Ondatra	*zibethicus*	Common Muskrat	N
	Myocastor	*coypus*	Nutria	I
	Canis	*latrans*	Coyote	N
	Procyon	*lotor*	Common Raccoon	N
	Mustela	*erminea*	Short-tailed Weasel (Ermine)	N
	M.	*frenata*	Long-tailed Weasel	N
	M.	*vison*	Mink	N
	Lontra	*canadensis*	Northern River Otter	N
	Odocoileus	*hemionus*	Black-tailed deer	N

PLANTS OF SMITH AND BYBEE WETLANDS

The following list contains all documented species at SBW, however, many additional species collected in 2010 have not been identified and catalogued. The list may grow by as many as 125 species when all specimens have been keyed (anticipated completion by December 2011). Most species will be mounted as museum specimens and housed at the Portland State University herbarium.

Genus	Species	Subspecies	Synonym
Native species			
Acer	macrophyllum		
Acmispon	parviflorus		Lotus micranthus
Actaea	rubra		
Agrostis	exarata		
Alisma	triviale		
Alnus	rubra		
Amaranthus	powellii		
Amelanchier	alnifolia		
Amsinckia	menziesii		
Anaphalis	margaritacea		
Apocynum	androsaemifolium		
Arctostaphylos	uva-ursi		
Artemisia	douglasiana		
Azolla	mexicana		
Bidens	cernua		
Bidens	frondosa		
Bromus	carinatus		
Bromus	sitchensis		
Cardamine	occidentalis		
Carex	aperta		
Carex	deweyana		
Carex	feta		
Carex	lenticularis		
Carex	obnupta		
Ceratophyllum	demersum		
Chamerion	angustifolium		Epilobium
Conyza	canadensis		
Cornus	sericea		
Corylus	cornuta		
Crataegus	douglasii		
Cuscuta	occidentalis		
Cyperus	erythrorhizos		
Cyperus	strigosus		
Deschampsia	cespitosa	beringensis	

Genus	Species	Subspecies	Synonym
Eleocharis	acicularis		
Eleocharis	palustris		
Eleocharis	obtusa		
Eleocharis	ovata		
Elodea	canadensis		
Elodea	nuttallii		
Elymus	glaucus		
Epilobium	*brachycarpum*		
Epilobium	ciliatum		
Equisetum	spp.		
Eragrostis	hypnoides		
Euthamia	occidentalis		Solidago
Fraxinus	latifolia		
Galium	aparine		
Gilia	capitata		
Glyceria	elata		
Gratiola	neglecta		
Helenium	autumnale		
Holodiscus	discolor		
Hydrocotyle	ranunculoides		
Hydrophyllum	tenuipes		
Juncus	bufonius		
Juncus	patens		
Juncus	acuminatus		
Juncus	articulatus		
Juncus	bolanderi		
Juncus	ensifolius		
Koeleria	macrantha		
Leersia	oryzoides		
Lemna	minor		
Lotus	purshianus		
Ludwigia	palustris		
Lupinus	rivularis		
Lycopus	asper		
Lycopus	americanus		
Lycopus	uniflorus		
Mahonia	nervosa		
Malus	fusca		
Mentha	canadensis		arvensis
Mimulus	guttatus		
Navarretia	squarrosa		
Nuphar	polysepala		
Oemleria	cerasiformis		

Genus	Species	Subspecies	Synonym
Oenothera	villosa	strigosa	
Panicum	capillare	capillare	
Paspalum	distichum		
Persicaria	hydropiperoides		Polygonum
Persicaria	lapathifolia		Polygonum lapathifolium
Persicaria	punctata		Polygonum punctatum
Phacelia	nemoralis		
Physocarpus	capitatus		
Pinus	ponderosa		
Plagiobothrys	scouleri		
Polypodium	glycyrrhiza		
Polystichum	munitum		
Populus	trichocarpa		balsamifera
Potamogeton	foliosus		
Potamogeton	nodosus		
Potamogeton	pectinatus		
Potentilla	anserina		
Psilocarphus	elatior		
Ranunculus	sceleratus		
Rhamnus	purshiana		
Ribes	divaricatum		
Ribes	lacustre		
Ribes	sanguineum		
Ricciocarpus	natans		
Rorippa	curvisiliqua		
Rosa	pisocarpa		
Rosa	nutkana		
Rubus	parviflorus		
Rubus	spectabilis		
Rubus	ursinus		
Sagittaria	latifolia		
Salix	columbiana		S. fluviatilis
Salix	hookeriana		S. piperi
Salix	lasiandra		
Salix	sessilifolia		
Salix	sitchensis		
Sambucus	mexicana		S. cerulea
Sambucus	racemosa		
Schoenplectus	tabernaemontani		Scirpus validus
Scutellaria	lateriflora		
Solidago	canadensis		
Sparganium	eurycarpum		
Spiraea	douglasii		

Genus	Species	Subspecies	Synonym
Spirodela	polyrhiza		
Stachys	cooleyae		
Symphoricarpos	albus		
Symphyotrichum	chilense		Aster
Thuja	plicata		
Typha	latifolia		
Urtica	dioica		
Veronica	americana		
Vulpia	bromoides		
Wolffia	spp.		
Introduced species			
Acer	saccharinum		
Agrostis	capillaris		
Agrostis	stolonifera		
Aira	caryophyllea		
Alopecurus	pratensis		
Ambrosia	artemisiifolia		
Anthemis	arvensis		
Anthemis	cotula		
Arctium	minus		
Artemisia	biennis		
Bassia	hyssopifolia		
Bidens	vulgata		
Brassica	rapa		
Bromus	commutatus		
Bromus	hordeaceus	hordeaceus	B. mollis
Bromus	sterilis		
Cardamine	hirsuta		
Centaurea	diffusa		
Centaurea	pratensis		
Cerastium	fontanum	vulgare	
Chamaesyce	serpens		Euphorbia
Chenopodium	album		
Chenopodium	murale		
Chondrilla	juncea		
Cichorium	intybus		
Cirsium	arvense		
Cirsium	vulgare		
Clematis	vitalba		
Conium	maculatum		
Crataegus	monogyna		
Crepis	setosa		

Genus	Species	Subspecies	Synonym
Crypsis	alopecuroides		Heleochloa
Cynosurus	echinatus		
Cytisus	scoparius		
Dactylis	glomerata		
Daucus	carota		
Digitalis	purpurea		
Digitaria	sanguinalis		
Dipsacus	fullonum		
Dysphania	ambrosioides		Chenopodium
Dysphania	botrys		
Echinochloa	crus-galli		
Egeria	densa		
Elymus	repens		
Epipactis	helleborine		
Fallopia	japonica		Polygonum cuspidatum
Festuca	filiformis		
Festuca	trachyphylla		
Gnaphalium	uliginosum		
Hedera	helix		
Hieracium	vulgatum		
Holcus	lanatus		
Holcus	mollis		
Hypericum	perforatum		
Ilex	aquifolium		
Impatiens	capensis		
Iris	pseudacorus		
Lactuca	ludoviciana		
Lactuca	saligna		
Lactuca	serriola		
Lathyrus	sphaericus		
Leontodon	saxatilis		L. nudicaulis, ssp. taraxacoides
Leucanthemum	vulgare		Chrysanthemum leucanthemum
Lolium	perenne		
Lotus	corniculatus		
Ludwigia	peploides	montevidensis	
Lysimachia	nummularia		
Lythrum	portula		
Lythrum	salicaria		
Mentha	pulegium		
Mollugo	verticillata		
Myosotis	stricta		M. discolor
Myriophyllum	aquaticum		
Myriophyllum	spicatum		

Genus	Species	Subspecies	Synonym
Nymphaea	odorata		
Oenothera	glazioviana		O. erythrosepala
Origanum	vulgare		
Parentucellia	viscosa		
Persicaria	amphibia		Polygonum
Persicaria	aviculare		
Persicaria	hydropiper		Polygonum
Persicaria	maculosa		Polygonum persicaria
Phalaris	arundinacea		
Plantago	lanceolata		
Plantago	psyllium		
Plantago	major		
Polypogon	monspeliensis		
Potamogeton	crispus		
Quercus	rubra		
Ranunculus	repens		
Raphanus	sativus		
Robinia	pseudoacacia		
Rosa	eglanteria		
Rotala	rotundifolia		
Rubus	bifrons		R. discolor, R. armeniacus
Rubus	laciniatus		
Rumex	crispus		
Senecio	jacobaea		
Sisymbrium	irio		
Solanum	americanum		
Solanum	dulcamara		
Solanum	nigrum		
Sonchus	oleraceus		
Tanacetum	vulgare		
Thinopyrum	intermedium		Elymus hispidus
Trifolium	arvense		
Trifolium	pratense		
Verbascum	blattaria		
Verbascum	thapsus		
Veronica	anagallis-aquatica		
Veronica	arvensis		
Vicia	cracca		
Vicia	sativa		
Vicia	tetrasperma		
Uncertain status			
Juncus	effusus		

Genus	Species	Subspecies	Synonym
Marchantia	spp		
Poa	spp		
Prunella	vulgaris		
Xanthium	strumarium		

SMITH AND BYBEE COMPREHENSIVE NATURAL RESOURCE MANAGEMENT PLAN

APPENDIX B: Recreation and access

Excerpts from:
Smith and Bybee Wetlands Natural Area Trail Feasibility Study

December 2005

METRO

PORTLAND
PARKS & RECREATION
Healthy Parks, Healthy Portland

Smith and Bybee Wetlands Natural Area
Trail Feasibility Study
Portland, Oregon

Prepared for:

Metro Regional Parks and Greenspaces Department
Metro Solid Waste and Recycling Department
Portland Parks and Recreation Department

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VI. ALTERNATIVE ALIGNMENTS

Table 2. Alternative Trail Alignments

Alignment	Segment							
	Ash Groves	North Landfill	East Landfill	South Lake Shore	South Slough	Landfill Connector	Pier Park	
							with NR	without NR
Ash Groves	X		X			X	X	
Landfill		X	X			X		X
South Lake Shore		X	X	X		X		X
South Slough		X	X		X	X		X

NR= Neighborhood Routes

Four draft trail alternative alignments were developed by the consulting team and were presented to the Technical Working Group for review and comment. These draft trail alignments represent a range of options of experience and impacts to habitat. These four draft alignments were discussed, some changes were made, and the Technical Working Group recommended the final four alternative alignments that would be forwarded for further analysis and presentation to the public. Table 2 shows the segments that are included in each of the four alternative alignments.

The following section includes a detailed description of each of the four trail alternatives studied. Appendix C contains detailed cost estimates for all of the trail segments studied. A map and photos accompany each alternative alignment.

Elements Common to All Trail Alternative Alignments

There are many issues and costs that are found in all of the alignments. These commonalties are summarized below.

Safety

- A safety concern to all routes is the at-grade crossing of Columbia Boulevard. The crossing will be designed to meet all traffic standards but the fact remains that this is a very busy truck route.

Environmental

- The East Landfill segment is common to all alignments. Fencing along the landfill side of the East Landfill perimeter road will keep trail users off of the landfill but there is some risk that trail users may wander off the perimeter road and into the wetland area east of the road.

Capital Costs

- East Landfill segment $493,737
- Landfill Connector segment $2,333,555
- Pier Park segment (excludes neighborhood routes) $1,413,836
- Total Common costs shared by all routes $4,241,128

The cost of the East Landfill segment includes grading, surfacing of trails, and fencing. The cost of Landfill Connector segment includes minor improvements to the existing landfill bridge, grading and surfacing of the trail, a proposed pedestrian/bicycle railroad underpass, and a proposed at-grade crossing of Columbia Boulevard into Chimney Park. The cost of the Pier Park segment includes a proposed pedestrian/bicycle bridge over the Union Pacific railroad tracks that currently separate Pier Park from Chimney Park.

Multi-Use Potential

- All routes have the potential to provide access to multiple trail uses, including hikers, cyclists, and those with disabilities, although trail surface (hard versus soft) has not been determined for some portions of some routes.
- Trail design will consider many variables in determining the appropriate trail width for a particular route, but it is expected that the trail widths may range between 8´ to 12´ given the specific location and setting. Settings range from landfill roads to sensitive wildlife habitat to local park trails to neighborhood bike lanes and sidewalks.

User Experience

- Two proposed viewpoints are recommended near the northeast corner of the landfill. One would be located on the slope of the landfill that would offer 360-degree spectacular views of Forest Park to the south and west and Bybee and Smith Lakes and the Cascade Mountains to the north and east. The landfill viewpoint would be part of a later phase of development, when landfill closure activities no longer occur in that area. The other viewpoint would be on the east side of the landfill road, providing a view of Smith Lake.
- There can be seasonal flooding of parts of the Port of Portland trail and the four alternative routes, all of which will require periodic closures. During flooding episodes, access to the alignments would only be available from the landfill side, since the Port of Portland trail is at a lower elevation and floods first.
- There are existing trail heads and public parking provided in the vicinity of the Natural Area at the following locations:
  - Kelley Point Park
  - Smith and Bybee Wetlands Natural Area on the north side of Smith Lake off of Marine Drive
  - Chimney Park
  - Pier Park
  - Columbia Slough Waste Water Treatment Plant
  - There is also the potential for a small trailhead at the existing canoe launch on the south side of the Slough near the landfill offices. This potential trailhead needs to be further explored in future phases of this project.

Permitting

- Right-of-way easements will be required from the Union Pacific for the proposed railroad underpass and overpass needed to link the landfill to the neighborhood.

Management

- Management issues are alignment specific and described in detail beneath each alignment subheading later in this chapter.

Trail Connectivity

- All routes connect to the southern end of the Port of Portland Trail near the northwest corner of the landfill.
- All routes connect to Peninsula Crossing trail.
- All routes provide a connection between the landfill and the St. Johns Neighborhood via the Landfill Connector segment.

Alternative 1: Ash Groves Alignment

The Ash Groves alignment begins at the end of the Port of Portland trail in the west, and extends east between Bybee Lake and the North Slough. The trail then crosses the water control structure, and heads south along the east side of the St. Johns landfill on an existing landfill access road. It crosses the existing landfill bridge, goes through a proposed pedestrian underpass under the Union Pacific railroad tracks, and crosses Columbia Boulevard with an at-grade crossing before entering Chimney Park. A proposed pedestrian overpass would take trail users across the railroad tracks between Chimney and Pier Parks. This is the only alignment that includes improvements to existing bike lanes, intersections and sidewalks between Pier Park and the Peninsula Crossing trail along either North Fessenden Street or North Smith Street.

Safety

The route through the Ash Groves and landfill is safe from vehicular traffic although trail users may occasionally encounter a landfill maintenance vehicle on the landfill road. The Ash Groves portion of this alignment is isolated with little visibility and patrols will be important to monitor unauthorized uses. Proposed on-street improvements through the neighborhood will improve safety for trail users. The risk to the landfill infrastructure is the least of any alternatives, as this alignment minimizes the distance traveled on or around the landfill.

Environmental

This trail poses high potential impacts to habitat and wildlife. The Ash Groves contains the only remnant stands of Oregon ash in the Natural Area, many of which are 200 years old. There are very few of these stands left in the region, and their gnarled bark provides rare habitat for wildlife such as songbirds and bats. Existing groundcovers are, for the most part, non-native grasses and forbs with limited habitat value. There are direct habitat connections between Bybee Lake, the associated wetlands, and the North Slough through this area. Several turtle basking sites are found in the vicinity. There are wetlands throughout the area and while the trail may encroach upon wetlands in a few areas, a route that avoids crossing wetlands directly is feasible. Constructing the trail would likely not require removal of any of the mature ash trees, though there may be a few willows that would need removal. Trail design, mitigation and management can play a role in keeping trail users from leaving the trail in this sensitive area.

Capital Costs

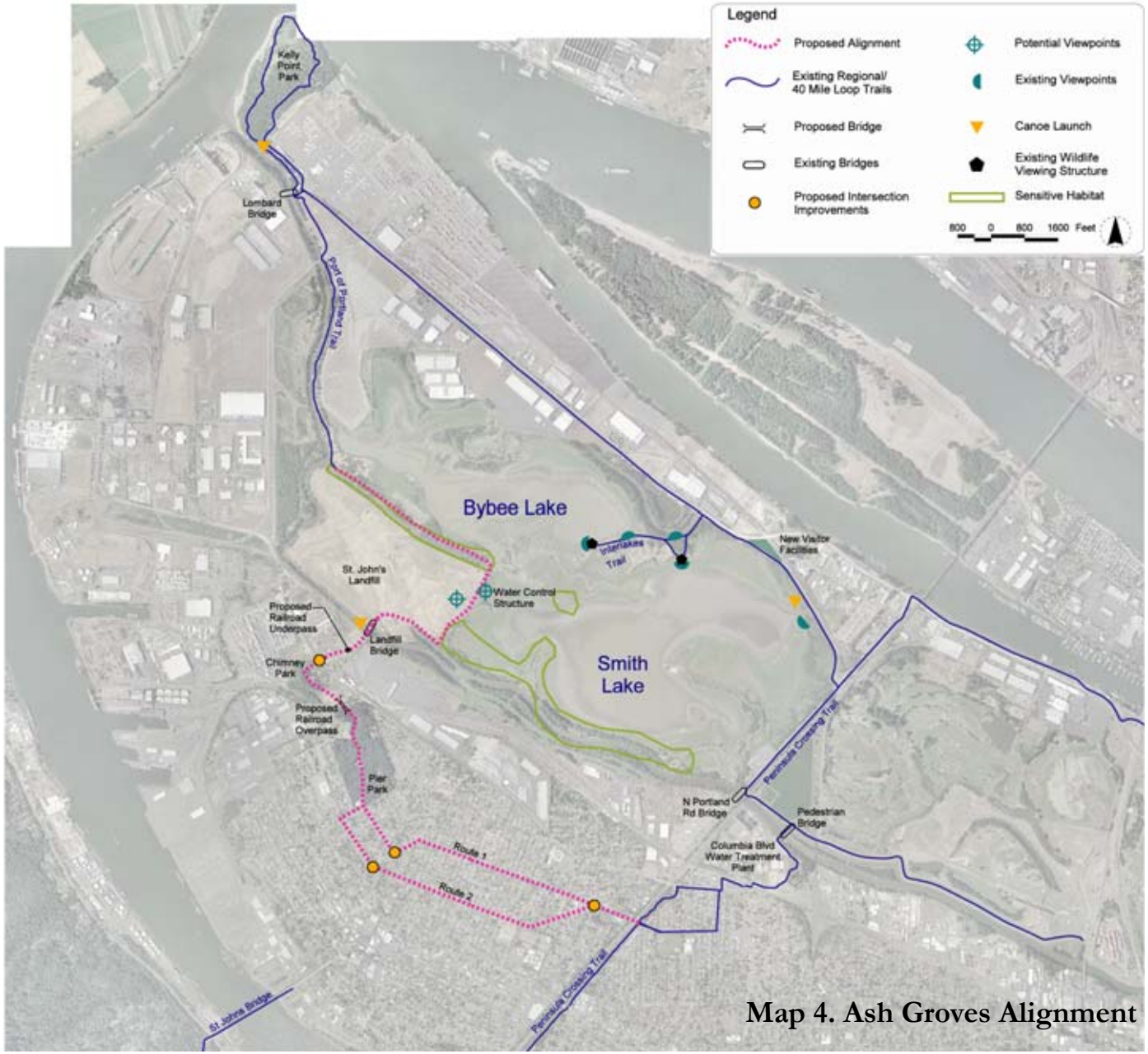
This alignment is the lowest cost of the four alternatives. By going through the Ash Groves and using the existing water control structure, the expense of a new pedestrian bridge over the North Slough is avoided. Grading or rerouting will be required to connect the trail to the landfill perimeter road from the water control structure to meet accessibility standards.

Multi-Use Potential

This route has good multi-use potential between the southern end of the Port of Portland trail and south side of Pier Park. From this point to the Peninsula Crossing Trail, trail users would use multi-modal on-street bike lanes and sidewalks along either North Fessenden Street or North Smith Street. Further study will be necessary to determine which of these streets should be improved for trail users.

User Experience

This alignment ties with the South Lake Shore alignment for highest-ranked user experience. The route in the Ash Grove travels through an attractive woodland. There are several opportunities for capturing views of the North Slough and Bybee Lake. Over time some of these views will be obscured by plant growth from revegetation projects. The Ash Grove area is far from highway and industrial noise. A trail here opens an area up to use that is presently remote and seldom visited. Interpretive and environmental education opportunities are good – especially surrounding the ash forest.



Map 4. Ash Groves Alignment

Permitting

Multiple permits would be required for this and all route alternatives. The permits specific to this route could be related to wetland encroachment, and concerns from NOAA Fisheries due to the trail's proximity to salmonid habitat in the North Slough. There is enough higher ground through the Ash Groves segment to meet the DSL regulation on fill below 11 feet elevation.

Management

As this alignment has the shortest distance of travel on the landfill, it thus would impact daily operations at the landfill the least. Vehicular access for the Ash Groves segment is available from the Port of Portland trail or landfill side. Patrolling and maintaining the isolated Ash Groves segment will require more time than the other segments in this alignment.

Trail Connectivity

The route through the Ash Groves links the Port of Portland trail to the water control structure. From there the route crosses the east end of the landfill and connects to the St. Johns neighborhood, but does not offer a direct connection to the Peninsula Crossing or Columbia Slough Trails near the North Portland Road bridge. Users would traverse improved neighborhood sidewalks and bike lanes to complete the connection.

Advantages:

- The route through the Ash Groves and along the east side of the landfill is very scenic, quiet, and opens new environmental interpretation opportunities.
- Crossing the North Slough at the existing water control structure avoids environmental impacts and the expense associated with building a new pedestrian bridge.
- There are no expected expenses associated with new land acquisition.
- This is the least costly alternative.
- By going through the neighborhood, potential impacts to Bald Eagle nests, the heron rookery, and other sensitive wildlife areas along the south shore of Smith Lake are avoided.
- Improved on-street bike lanes, intersections, and sidewalks between Pier Park and Peninsula Crossing Trail will result in a safer and more enjoyable experience for trail users.

Disadvantages:

- Building a new trail through the undeveloped Ash Groves may disturb wildlife in this area, including western painted turtles and nesting songbirds (e.g. willow flycatcher) and river otter, and may negatively impact the roots of ash trees.
- There could be encroachment and impacts to wetlands in the Ash Groves.
- There is the potential for vandalism at the water control structure.
- This alternative fails to provide a direct link to the Peninsula Crossing Trail or Columbia Slough Trail near the North Portland Road bridge. It relies instead on existing sidewalk and street improvements through the neighborhood.

Cost Estimate*

Ash Groves segment	$357,500
East Landfill segment	493,737
Landfill Connector segment	2,333,555
Pier Park segment	1,475,539**
Total Cost Estimate:	$4.6 million

*Cost estimate for 8´ wide asphalt trail with 2´ gravel shoulders.

**Includes Neighborhood Route 2 providing improvements to existing on-street bike lanes, sidewalks and intersections from Pier Park to Peninsula Crossing Trail.

1. Southern end of Port of Portland Trail where Ash Groves trail would begin.

2. Looking east into Ash Groves route from southern end of Port of Portland trail.

3. View across north slough to landfill.

4. View of Smith Lake from viewpoint along east perimeter road on landfill.

5. Heading west toward landfill entrance on southern perimeter landfill road.

6. Looking south towards Forest Park from north side of landfill bridge.

7. Looking south towards Chimney Park near landfill office.

8. Columbia Blvd. crossing location at Chimney Park driveway.

9. Columbia Blvd.

10. In Chimney Park looking across railroad tracks to Pier Park.


11. Pier Park entry at N. Seneca Street.


12. Existing bike lanes on N. Smith Street.


13. Existing bike lanes on N. Fessenden Street.


14. Connection to Peninsula Crossing trail at N. Fessenden Street

Alternative 2: Landfill Alignment

The Landfill trail alignment begins at the end of the Port of Portland Trail, and immediately crosses over the North Slough to the St. Johns landfill on a proposed pedestrian bridge. It then follows an existing maintenance road along the south bank of the North Slough, heading east. It loops around the east end of the landfill, in the same alignment as described in the text for Alternative 1 - Ash Groves. It crosses the existing landfill bridge and makes its way to through Chimney and Pier Parks. The trail continues through the St. Johns neighborhood along existing (unimproved) bike lanes and sidewalks on either North Fessenden or North Smith Streets to Peninsula Crossing Trail.

Two significant differences between the Landfill and Ash Groves trail alignments are the construction of a new pedestrian bridge across the North Slough (to avoid impacts to habitat and wildlife in the Ash Groves area) and no improvements to neighborhood streets between Pier Park and the Peninsula Crossing Trail.

Safety

The route using landfill roads is felt to be quite safe from vehicles. Occasional use of these roads by Metro staff may interfere with trail users, but does not pose much risk. Additional time spent on the landfill could expose trail users to more hazards associated with landfill operations.

Environmental

This trail poses the least risks of impact to habitat and wildlife. However, placement of the bridge over the North Slough will need to take an existing turtle basking site into consideration and may have impacts to fish in the crossing area. There will be soil disturbance and loss of riparian vegetation at the points where the bridge footings are built. In addition, constructing footings in this location could alter groundwater flow and movement of potential contaminants in the groundwater in this vicinity.

Capital Costs

This alignment is the second lowest cost of the four alternatives. The estimated cost of this alternative is greater than the Ash Groves alignment largely due to the proposed North Slough bridge. Other expenses are in paving the surface of the existing gravel landfill perimeter roads, and fencing to protect landfill infrastructure from vandalism.

Multi-Use Potential

Good multi-use potential from the end of Port of Portland trail through Pier Park. Existing bike lanes and sidewalks provide for multiple uses between Pier Park and Peninsula Crossing trail.

User Experience

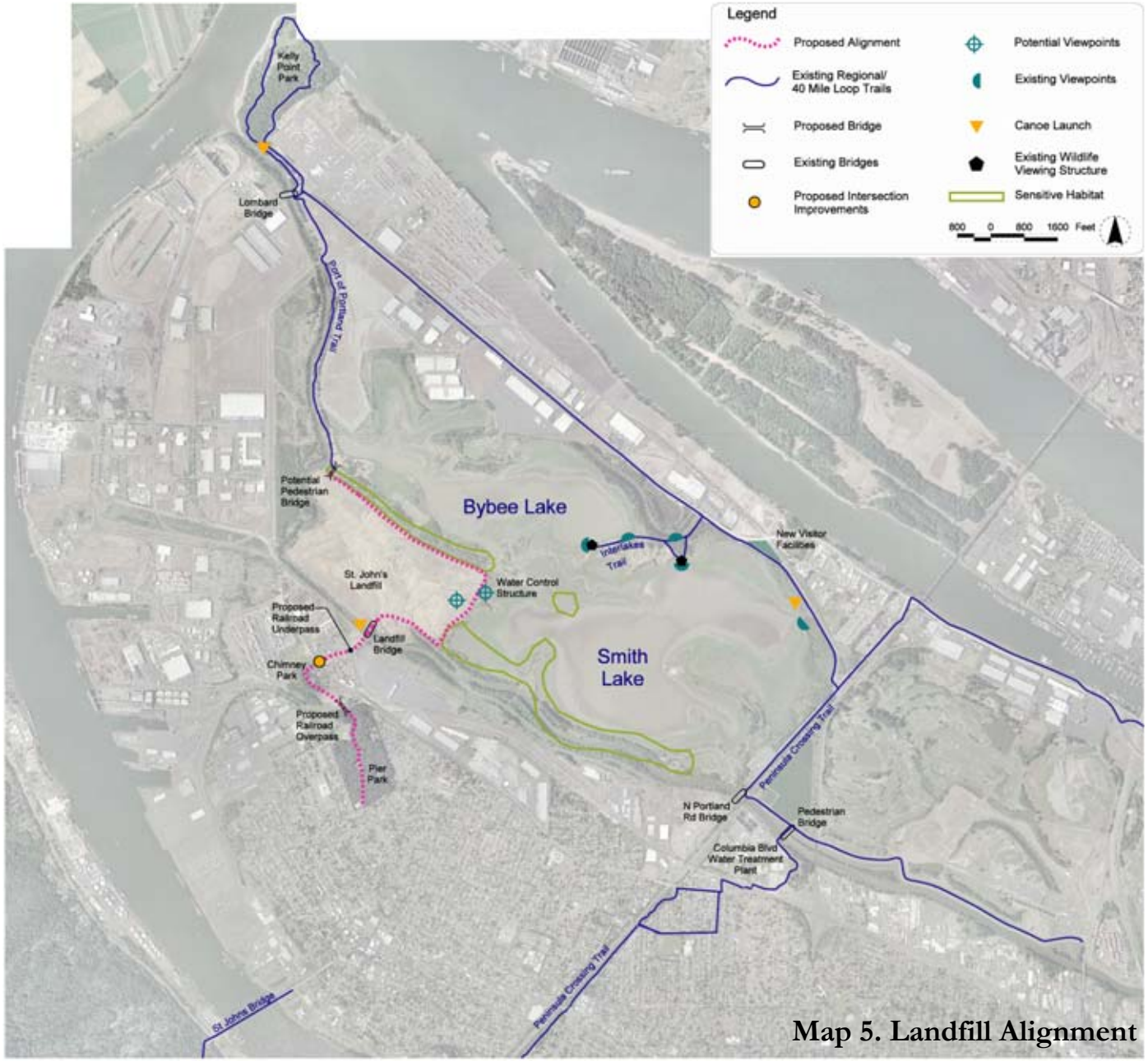
The North Slough bridge will offer exceptional views and interpretive opportunities. The route across the landfill is fairly attractive, with views of water and the Natural Area to the north and east. On the negative side, the trail user would have a fence and landfill infrastructure on one side, with natural landscapes on the other. Overall, this alternative ranks lowest of the four with regard to user experience.

Permitting

Multiple permits would be required for this and the other two routes that include the North Landfill segment. The main issues for permitting agencies will be related to the North Slough bridge design and construction. National Marine Fisheries Service consultation is likely due to the presence of federally listed juvenile salmonids in the North Slough.

Management

The main management concerns are the greater length of trail on the landfill, as compared with the Ash Groves alternative. This raises the risk of vandalism to landfill infrastructure, a risk common to Alternatives 3 and 4 as well. This trail could be easily maintained, as there is easy vehicular access to all segments.



Map 5. Landfill Alignment

Trail Connectivity

This route links the Port of Portland trail to the landfill and on to Pier Park. This alignment does not offer a direct link to the Peninsula Crossing and Columbia Slough trails as Alternatives 3 and 4 do. Users would traverse existing (unimproved) neighborhood sidewalks and bike lanes from Pier Park to complete the connection to the Peninsula Crossing Trail.

Advantages:

- Crossing the North Slough and use of the existing landfill perimeter roads avoids impacts to wildlife and habitat that would occur with development in the Ash Groves and South Lake Shore routes.
- The new bridge could be an attractive feature, and opens new views over the water at the confluence of the North and Columbia Sloughs.
- The north end of the landfill has good views of water and the Natural Area.
- This alternative has the lowest overall impacts to wildlife of the four being considered.

Disadvantages:

- Trail users will be on the landfill perimeter road versus a more pleasing forested setting provided in other alignments.
- The new bridge over the North Slough adds considerable expense to this alignment. There may be impacts to fish and wildlife in the crossing area, particularly to federally listed juvenile salmonids. Further engineering/hydrological analysis will be required to address the potential for the bridge footings to exacerbate the movement of contaminants in groundwater in the vicinity.
- Periodic trail closures may occur if the landfill bank requires major repair work.
- Additional length of trail on the landfill raises the risk of vandalism and other management problems associated with protecting landfill infrastructure.
- This alignment does not provide a direct link to the Peninsula Crossing or Columbia Slough Trails near the North Portland Road bridge.

Cost Estimate*

North Landfill segment	$1,941,123**
East Landfill segment	493,737
Landfill Connector segment	2,333,555
Pier Park segment	1,413,836***
Total Cost Estimate:	$6.2 million

*Cost estimate for 8´ wide asphalt trail with 2´ gravel shoulders.
**Includes new North Slough bridge.
***Includes crossing Union Pacific rail lines between Chimney and Pier Park, does **not** include neighborhood on-street bike lanes and sidewalks.

1. Looking north from landfill towards southern end of Port of Portland trail.

2. Looking east on north landfill perimeter road.

3. View of north slough from landfill perimeter road.

4. View of Smith Lake from viewpoint along east perimeter road on landfill.

5. Heading west toward landfill entrance on southern perimeter landfill road.

6. Looking south towards Forest Park from north side of landfill bridge.

7. Looking south towards Chimney Park near landfill office.

8. Columbia Blvd. crossing location at Chimney Park driveway.

9. Columbia Blvd.

10. In Chimney Park looking across railroad tracks to Pier Park.


11. Pier Park entry at N. Seneca Street.

Summary of Alignments

Table 3. summarizes and compares the development considerations unique to each alternative trail alignment. A similar table comparing the same development considerations for each individual segment is found in Appendix B.

Table 3: Alternative Alignment Comparison Table

Alignment	Segments* Included	Major Improvements	Length (miles)	Acquisition/ Easement/ Right-of-Way	Agency Approvals Needed	Capital Cost[1]	
						Hard Surface	Soft Surface
Ash Groves	AG, EL, LC, PP, NR2	Fencing, Modify Landfill Bridge, RR underpass & overpass, Col. Blvd. crossing On-street improvements	4.5	RR Easements PDOT	NOAA DSL/ACOE (if wetland fill) USFWS DEQ City of Portland – PDOT, Planning, Parks	$4.3 million $ .96 million per mile	$3.6 million $.8 million per mile
Landfill	NL, EL, LC, PP	Slough Bridge, Fencing, modify Landfill Bridge, RR underpass & over-pass, Col. Blvd. Crossing	2.8	RR Easements PDOT	DEQ City of Portland – PDOT, Planning	$6.2 million $2.2 million per mile	$5.1 million $1.8 million per mile
South Lake Shore	NL, EL, SL, LC, PP	Slough Bridge, Fencing, Modify Landfill Bridge, RR underpass & over-pass, Col. Blvd. crossing	4.4	RR Easements PDOT SL segment crosses 2 private parcels	NOAA, DSL/ACOE (if wetland fill) USFWS DEQ ODOT City of Portland – PDOT, Planning	$7.1 million $1.6 million per mile	$5.7 million $1.3 million per mile
South Slough	NL, EL, SS, LC, PP	Slough Bridge, Fencing, Modify N. Portland Road Bridge, RR under-pass & overpass, Col. Blvd. crossing	4.8	RR Easements PDOT SS Segment crosses 2 private & 1 public par-cels	NOAA DSL/ACOE (if wetland fill) USFWS DEQ ODOT City of Portland – PDOT, Planning	$7.6 million $1.6 million per mile	$6.1 million $1.3 million per mile

* Segment Abbreviations:

AG = Ash Groves
NL = North Landfill
EL = East Landfill
SL = South Lake Shore
SS = South Slough
LC = Landfill Connector
PP = Pier Park
NR1 = Neighborhood Route 1
NR2 = Neighborhood Route 2

1. Excludes Property Acquisition, Includes Design/Engineering/Permits

North Slough Bridge Feasibility Study

September 2010

Prepared by

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For

Metro Sustainability Center

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Executive Summary

Project Purpose

The Metro Sustainability Center initiated the North Slough Bridge Feasibility Study to determine the feasibility of a bicycle / pedestrian bridge over the North Slough, which would connect the existing Port of Portland trail to the future trail system on the St. Johns Landfill. This connection will also provide a missing link in the 40-Mile Loop Trail network between the Smith and Bybee Wetlands Natural Area and existing trails, parks and neighborhoods. These connections, including a North Slough bridge, are described in the Smith and Bybee Wetlands Natural Area Trail Feasibility Study (MacLoed Reckord, 2005).

Background & Previous Studies

Extensive public involvement was conducted during the Smith and Bybee Wetlands Natural Area Trail Feasibility Study mentioned above. A trails working group including representatives from partner agencies, community organizations and trail advocates, played a key role in developing the Trail Feasibility Study. The trail feasibility work occurred over an 18 month period, and included site visits and regular meetings with the trails working group, public open houses and presentations to interested groups. Based on the findings of the 2005 study, the Metro Council recommended a preferred trail alignment (South Slough alignment), of which the North Slough bike/pedestrian bridge is s a key element.

Alternatives Analysis

Eight alternatives – each representing a unique combination of basic bridge design (cable stay or steel truss), orientation (perpendicular or skewed), and two locations (Site A and B) - were evaluated against 19 criteria relevant to regulatory compliance, permitting, technical design, and design guidelines. For a given criterion, each alternative was assigned one of three ratings: “Pass”, “Pass with Modification”, or “Fail”. Figure 1 is a map showing the project vicinity. Figure 2 is an aerial photograph overlain with the study area, locations studied for the bridge crossing, and certain environmental constraints.

Of the eight alternatives, two received “Pass” ratings for all evaluation criteria. The most critical determinants of feasibility were Americans with Disabilities Act (ADA) requirement for bridge approach grades, American Association of State Highway and Transportation Officials (AASHTO) design guidelines for curve radii, and Oregon State Marine Board (OSMB) guidelines for recreational navigation.

Both of the feasible alternatives place the bicycle / pedestrian bridge at Site A and on a skewed orientation. The alternatives that failed these criteria would have either failed to provide for clearance of recreational navigation and/or accessibility required under the ADA, or would have resulted in either excessively long and high approach ramps that would impede maintenance vehicle access to areas of the St. Johns Landfill perimeter road and/or would have required deep excavations into the landfill itself.

Recommended (Preferred) Alternative

Based on the application of all feasibility criteria established for this project, the recommended preferred alternative is the steel truss bridge placed on a skewed orientation located at Site A, nearest the confluence with Columbia Slough. The steel truss structure is preferred over the cable-stay structure for its aesthetic quality and comparatively low cost. This is the only configuration that meets all environmental, technical and design criteria without the need for exceptions or deviations from standard design practices. The cost to design, permit and construct this alternative is estimated to be approximately $2.77 million.

Next Steps for Preferred Alternative

Metro provides periodic updates to the Smith and Bybee Wetlands Management Committee and members of the trails working group throughout the bridge feasibility work. Metro will distribute the final feasibility study to the members of the trails working group and other interested stakeholders and meet with them to discuss the study findings. Following the stakeholder meetings, Metro staff will present the report findings to the Metro Council in a work session, which the public is welcome to attend. Since the study determines that a bridge is feasible, the work session is primarily an opportunity for staff to inform the Council of the feasibility findings and next steps to implement the project.

The scope of this feasibility study was conceptual in nature. Assuming the North Slough bridge project moves into the design phase, additional studies and detailed analysis would be necessary to develop a constructible bridge alternative that meets all applicable regulatory, technical and design criteria. For example, detailed geotechnical, hydraulic and environmental studies would be necessary to quantify design parameters, constraints and environmental impacts.

Project Description

Project Purpose

The goal of the North Slough Bridge Feasibility Study is to determine the feasibility of a bicycle / pedestrian bridge over the North Slough, which would connect the existing Port of Portland trail to the future landfill perimeter road / trail system. A bridge over the North Slough would provide a key link in the 40-Mile Loop trail network connecting the Smith and Bybee Wetlands Natural Area with nearby existing trails, parks and neighborhoods. Alternative trail alignments were evaluated in the Smith and Bybee Wetlands Natural Area Trail Feasibility Study (MacLeod Reckord, 2005) and the Metro Council preferred alternative (the South Slough alignment) recommends a new bridge over the North Slough.

Background and Previous Studies

The 2005 Smith and Bybee Wetlands Natural Area Trail Feasibility Study was developed in close coordination with a trails working group who met regularly to review project materials and weigh in on decisions. The trails working group included representatives from partner agencies, community organizations and trail advocates who all had a stake in the project's success. The purpose of the study was to present the facts and an objective analysis of alternative trail alignments, and to leave the decision for a preferred alignment to the Metro Council. The working group reached consensus that the content of the study was accurate and fairly represented the analysis. Based on the results of the study and input from the public, Metro Council adopted a preferred trail alignment (South Slough alignment) in 2005. When the Metro Council adopted the South Slough alignment, they directed staff to conduct further studies for portions of the alignment, including a feasibility study for the North Slough bridge.

Project Area & Site Context

The 16-acre study area is located within the 1,928-acre Smith and Bybee Wetlands Natural Area, situated in the common historical floodplain at the confluence of the Willamette and Columbia Rivers. The rectangular-shaped study area is located on a southeast to northwest axis, and is defined by the mouth of the North Slough to the northwest; the BPA powerline right-of-way to the southeast; and forested wetlands along the north and the landfill along the south boundary. The study area is located in Section 25 of Township 2 North, Range 1 West in Multnomah County, Oregon. Figure 1 shows the project location and vicinity. Photos of the study area are provided under separate cover as Appendix A.

Baseline Information

Topographic Survey

A detailed topographic survey of natural and manmade features showing 1-foot contour intervals including elevation points within the study area was conducted in early 2007. Pre-field research included a review of existing mapping and surveys of record and land deeds for the project area and immediate vicinity. The topographic survey recorded all regulatory elevations in addition to the edge of water and the vegetation line at water boundaries. Property corners and existing infrastructure within the study area (e.g., monitoring wells, culverts, transmission towers, existing roads) were also identified and mapped. The Survey Narrative prepared by Thurston & Associates, Inc. (2008) is provided as Appendix B.

Natural Resources

The primary natural feature in the study area is the North Slough which is an arm of the Columbia Slough and is connected hydrologically to the Bybee Wetland via a water control structure at the eastern extent of the North Slough. The confluence of the North Slough with the Columbia Slough is located at the western end of the study area. Elevations within the study area range from approximately 10 to 26 feet (National Geodetic Vertical Datum [NGVD] of 1929). The banks of the North Slough are steeply incised (between 4 and 6 feet vertical) and provide the greatest topographic change within the study area. The St. Johns Landfill (located immediately south of the study area) is approximately 64 feet in elevation at its highest and slopes down to the North and Columbia Sloughs.

During a February 2007 field reconnaissance conducted by consulting biologists, three distinct habitat types were observed within the study area. These habitats include 1) a large forested wetland at the northeastern edge of the study area; 2) an open upland area (dominated by reed canarygrass between the forested wetland and the North Slough's north bank; and 3) the North Slough and its associated riparian area. Photographs documenting the condition of these habitats during the field reconnaissance are presented in the Natural Resources Technical Memo prepared by Mason, Bruce & Girard [MB&G] (2007) (see Appendix C). The Technical Memo includes mapping indicating the approximate limits of wetlands and other habitats. Figure 2 shows the major environmental features and constraints identified during the field reconnaissance.

Review of data provided by the Oregon Natural Heritage Information Center (ORNHIC) resulted in the identification of 25 records for sensitive, threatened or endangered species within a 1.5-mile radius centered on the study area (ORNHIC 2007 in MB&G 2007). Of these records, 12 are fish species or populations, seven are wildlife species or populations, and six are botanical species.

NORTH

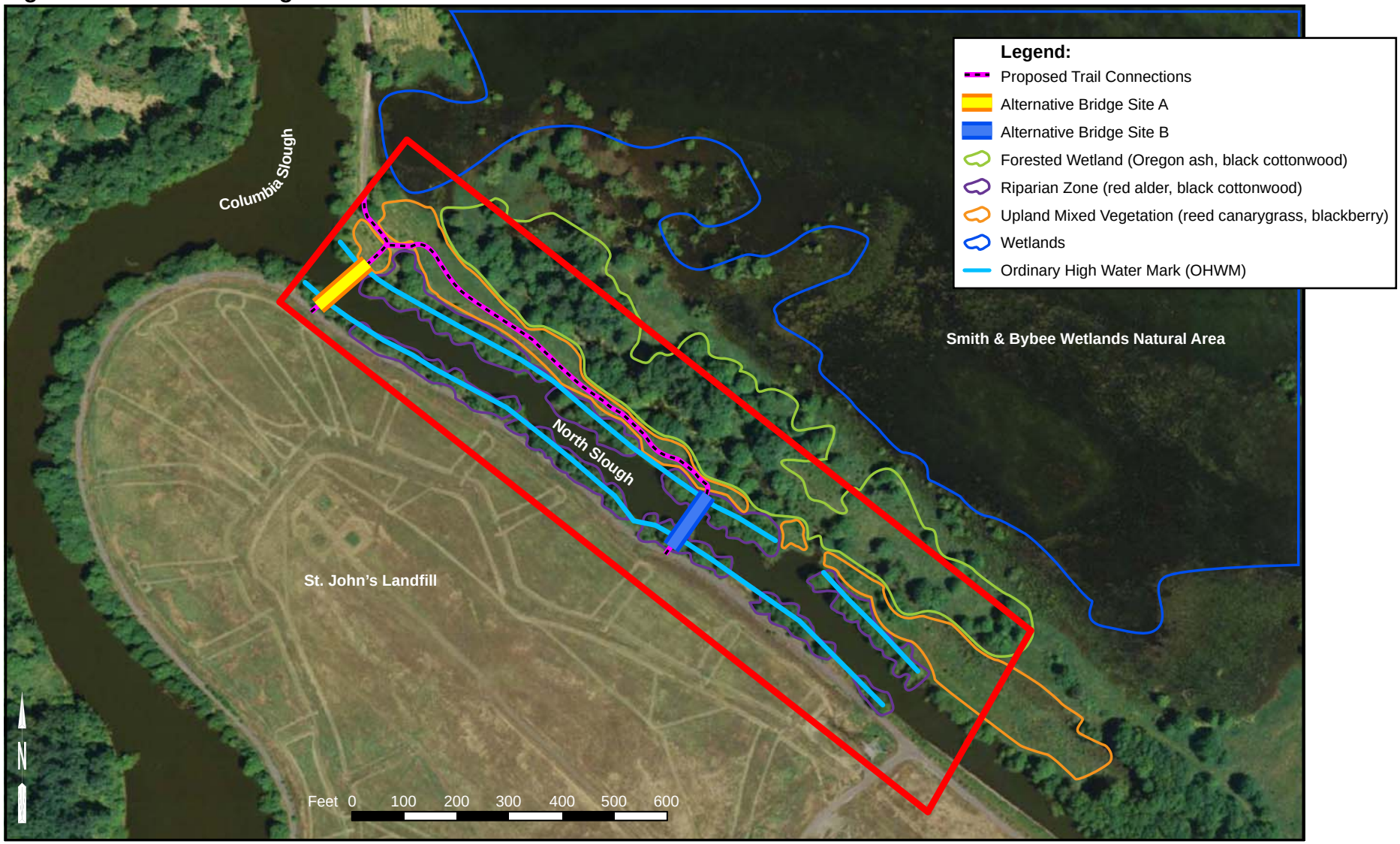
Figure 1

Project Vicinity
North Slough Bridge Feasibility Study
Multnomah County, Oregon

exeltech

Data Source: Bing Maps

Figure 2. Alternative Bridge Sites and Environmental Constraints



Given the study area's location within the floodplain of the Columbia and Willamette Rivers it is subject to high water conditions in the winter and spring months. Table 1 was prepared to show the average number of days annually when the Port of Portland trail (situated at an elevation of 13.0 feet NGVD) would be submerged during high water conditions (approximately 14 days a year). This data is important since a new section of trail that would be needed to connect the Port of Portland trail to the North Slough Bridge would also be underwater unless elevated to prevent flooding (MB&G 2007).

Geotechnical

The North Slough Bridge study area is located on the south floodplain of the Columbia River in the western portion of the Portland Basin, approximately two miles up the Columbia Slough from its confluence with the Willamette River. The Portland basin is a structural basin, elongated in a northwest-southeast direction and bounded by the Tualatin Mountains (locally called the "Portland Hills" or the "West Hills") on the west and the foothills of the Cascade Range on the east. The floor of the basin is relatively flat and contains the confluence of the Willamette and Columbia Rivers. The structural floor of the Portland Basin is underlain by a thick sequence of middle Miocene-age Columbia River Basalt lava. Even as the basalts were emplaced, horizontal stresses in the earth's crust began to fold and fault the basalt strata, and a ridge-and-basin topography slowly developed. Much of the basalt surface was exposed to the atmosphere for millennia, and where unaffected by erosion, the rock weathered deeply to red clay soils.

Results of the geotechnical assessment conducted for this study by Shannon & Wilson in 2007 (see Appendix D) indicated that the project area may be underlain by soft to stiff silt and loose sand. The dense to very dense sandy gravel layer is about 40 to 50 feet below the south bank of the North Slough. Based upon site reconnaissance and review of existing available information, our opinion is that the existing North Slough bank slopes appear to be marginally stable. This potential instability of the bank slopes may affect bridge foundations located landward of and near the existing slopes.

The expected seismic hazards at the study area mainly include liquefaction potential, lateral spreading, and slope stability. Feasible bridge foundation alternatives include driven steel pipe piles and drilled shaft foundations. However, these foundation types may have major constraints, such as groundwater contamination on the south side of the slough and wetland fill limitations on the north side, and potential construction-related impacts to riparian resources and the aquatic environment. Concrete panels may be used at the bridge ends as a means to connect the bridge ends to land, assuming that no loading is placed on them due to questionable bank stability. The foundation types and design parameters should be evaluated based upon borings and laboratory testing data during the final design phase of the project.

Table 1. Water Levels of the Columbia Slough at Portland (October 1993 to February 2001): Average Number of Days the Daily Water Surface Reached or Exceeded the Indicated Elevation of the Port of Portland Trail (reprinted from MB&G 2007).													
ELEV. (ft) [1]	**OCT (days) [2]**	**NOV (days) [2]**	**DEC (days) [2]**	**JAN (days) [2]**	**FEB (days) [2]**	**MAR (days) [2]**	**APR (days) [2]**	**MAY (days) [2]**	**JUN (days) [2]**	**JUL (days) [2]**	**AUG (days) [2]**	**SEP (days) [2]**	**Total Days**
7.0 ft	*5.3*	*14.7*	*19.5*	*21.7*	*23.8*	*25.7*	*19.8*	*29.8*	*28.5*	*20.5*	*7.8*	*0.9*	**217.9**
8.0 ft	*2.5*	*8.7*	*14.3*	*18.3*	*22.4*	*19.5*	*14.1*	*26.7*	*23.7*	*9.9*	*2.5*	*0.0*	**162.5**
9.0 ft	*0.9*	*4.5*	*9.6*	*13.0*	*18.5*	*11.8*	*9.6*	*23.3*	*18.6*	*3.7*	*0.3*	*0.0*	**113.8**
10.0 ft	*0.0*	*2.1*	*5.6*	*10.2*	*12.3*	*7.4*	*7.2*	*17.7*	*11.1*	*1.2*	*0.0*	*0.0*	**74.9**
11.0 ft	*0.0*	*1.5*	*2.8*	*7.4*	*7.0*	*3.4*	*4.2*	*10.9*	*9.0*	*0.0*	*0.0*	*0.0*	**46.2**
12.0 ft	*0.0*	*0.9*	*1.9*	*4.0*	*4.5*	*2.8*	*1.2*	*5.6*	*7.2*	*0.0*	*0.0*	*0.0*	**28.0**
13.0 ft	*0.0*	*0.9*	*1.2*	*1.9*	*3.1*	*1.2*	*0.3*	*2.8*	*3.0*	*0.0*	*0.0*	*0.0*	**14.4**
14.0 ft	*0.0*	*0.6*	*0.6*	*1.2*	*2.0*	*1.2*	*0.0*	*1.6*	*1.2*	*0.0*	*0.0*	*0.0*	**8.4**
15.0 ft	*0.0*	*0.3*	*0.3*	*0.3*	*0.8*	*0.9*	*0.0*	*0.9*	*0.9*	*0.0*	*0.0*	*0.0*	**4.5**
16.0 ft	*0.0*	*0.3*	*0.3*	*0.3*	*0.6*	*0.3*	*0.0*	*0.6*	*0.3*	*0.0*	*0.0*	*0.0*	**2.7**

Source: David Evans and Associates, 2001

Note: North Slough connects to the Columbia Slough approximately near the western end of the study area.

Note: Double line between the 12 and 13 foot elevation depicts a change in flood duration that should be considered in trail and bridge design.

[1] Elevations are NGVD.

[2] Average number of days when at some time during the day, water levels reach or exceed the noted elevation.

Alternatives Analysis

Evaluation Criteria

Prior to identifying the bridge alternatives, a set of 19 evaluation criteria were identified to use when comparing the bridge alternatives against each other. These criteria fall under three categories; regulatory criteria, technical criteria and design guidelines. The criteria are summarized below and are described in more detail in Appendix E, Evaluation Criteria and Measures. The evaluation methodology used to compare the bridge alternatives against one another is described later in this chapter.

To be feasible, a bridge alternative (location, design, trail connections) must be one that can be permitted by local, state, and federal agencies, in addition to meeting technical and design criteria.

Regulatory feasibility includes required protection of endangered, threatened and sensitive fish and wildlife species, rare plant communities, and other sensitive habitats and the ability to provide mitigation for any potential impacts to regulated or sensitive resources. A feasible alternative must be able to secure all applicable permits and satisfy natural resource concerns identified in this study and outlined in the Smith and Bybee Wetlands Trail Feasibility Study.

Regulatory Feasibility Criteria

A feasible alternative must be able to comply with the following rules, regulations, and guidelines:

1. Natural Resources Management Plan (NRMP) for Smith and Bybee Lakes (City of Portland)

   The goal of the NRMP (City of Portland 1990) is to protect and manage the Smith and Bybee Lakes area as an environmental and recreational resource for the Portland region. Only those recreational uses that are compatible with environmental objectives of the NRMP are encouraged.

2. City Code Title 33: Planning and Zoning / Environmental Zones (City of Portland)

   Compliance with Title 33 is dependent on standards regulations & approval criteria identified in the NRMP (Pages 61-69). Applicable zoning designations include Environmental Protection, Open Space, Heavy Industrial, and Aircraft Landing Zone.

   Construction, operation and maintenance of a pedestrian bridge should have no long-term negative impacts. Short term impacts will be managed through implementation of a Construction Management Plan.

3. City Code Title 24: Building Regulations / Flood Hazard Areas (City of Portland)

   This code requires that non-residential construction within Willamette River Flood Zone AE Special Flood Hazard Area shall have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. An engineer must certify that the design and methods of construction are in accordance with accepted standards of practice.

4. Oregon State Marine Board Guidelines for Recreation Navigation Clearance

   The Guidelines require “adequate vertical, horizontal and bottom clearance to allow safe passage of all forms of boats that can reasonably expected to be used in ordinary water conditions, including motorized boats and non-motorized boats.”

5. Americans with Disabilities Act (ADA) Standards for Accessible Design (US Department of Justice)

   Bridge and trail connections must meet ADA standards of 5% (2-3% preferred) maximum slope.

6. Clean Water Act Section 404 Permit (US Army Corps of Engineers)

   Section 404 of the Clean Water Act regulates discharge of dredged or fill material into Waters of the U.S. The Nationwide Permit program limits impacts to wetlands and Waters of the State to one-half acre. An individual permit would be required for impacts exceeding one-half acre.

7. Oregon Removal-Fill Law (Oregon Department of State Lands)

   The Department of State Lands (DSL) grants General Authorization (GA) for Certain Transportation Related Structures. The GA limits fill impacts to 5,000 cubic yards and 0.5 acre in wetlands and Waters of the State.

   ORS 196.820 is a special regulation originally written to prevent encroachment of the landfill into the Smith and Bybee wetlands. The law prohibits fill permits for areas below 11' mean sea level (MSL) in Smith and Bybee wetlands, with the exception of fill for the purpose of fish and wildlife habitat enhancement. The DSL has indicated that the north bank of the North Slough is not part of Bybee Lake and is therefore not subject to this particular regulation (Mike McCabe, DSL, pers. comm. June 27, 2008).

8. Endangered Species Act (ESA) of 1973 (USFWS and NOAA Fisheries)

   The Project would require formal consultation under Section 7 of the Federal ESA provided a federal nexus is achieved via funding or permitting through a Federal Agency (e.g., CWA Section 404 Permit from the US Army Corps of Engineers).

9. Oregon Fish Passage Law (Oregon Department of Fish and Wildlife)

   Oregon law requires that all artificial structures maintain fish passage for all native migratory fish species. The project will require an approved Fish Passage Plan from ODFW.

10. Solid Waste Disposal Site Closure Permit (DEQ)

    Metro is required to maintain compliance with any permits relevant to landfill closure operations.

11. Order on Consent No. LQSW-NWR-02-14 (DEQ)

    Metro is required to maintain compliance with consent order relevant to preventing or responding to and mitigating "releases" of hazardous substances from the St. Johns Landfill.

12. Stormwater Management Guidelines (DEQ)

    The Guidelines comprise the anti-degradation policy for surface water in Oregon. A Stormwater Management Plan following DEQ Guidelines will be submitted with the Removal-Fill Permit application.

13. National Environmental Policy Act (Lead Federal Agency)

    The National Environmental Policy Act (NEPA) requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions.

Technical Feasibility Criteria

To be feasible, an alternative (bridge location, design, trail connections) must meet the following technical criteria:

1. Bridge foundations and structures and construction methods must have no significant adverse impacts on the following:
    - Structural integrity of the south bank (landfill side) of North Slough
    - Existing landfill infrastructure (e.g., monitoring wells, culverts, transmission towers, roads)
2. Bridge foundations and structures must withstand the forces of a 100-year flood.
3. Bridge and trails connecting to the bridge are not flooded with greater frequency than the terminus of the existing Port of Portland trail at Site A .
    - The bridge shall be designed in accordance with the requirements of the AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges, December 2009
4. The bridge shall be designed in accordance with the Final Geotechnical Assessment prepared for this study.

Design Guidelines

To be feasible, an alternative (bridge location, design, trail connections) must meet the following Design Guidelines:

1. The trail shall be designed in accordance with the Draft Trail Design Guidelines for South Slough Trail Alignment Revised July 2007 including:
    - The trail shall consist of a multi-use hard surface; width shall be 10 to 16 feet with 1 to 4 foot wide soft shoulders
    - Bridge and trail slope shall be 2-3%, 5% maximum (ADA accessible)
2. The bridge alternatives shall be:
    - Constructible, using conventional construction techniques
    - Require little or no maintenance
    - Design and scale is in balance (not dominant) with the landscape

Range of Possible Alternatives

Eight different alternatives were evaluated. Each alternative represents a unique combination of bridge design (cable stay or steel truss), orientation (perpendicular or skewed), and location (Site A or Site B). The alternatives are defined in Table 2 and described in more detail in this section.

Table 2. North Slough Bicycle / Pedestrian Bridge Alternatives				
Alternative	Site	Bridge Type	Foundation Type(s)	Bridge Orientation to N. Slough
1 A	A	Two Span Cable-Stay	Drilled shaft mid slough with concrete panels at each bank	Perpendicular
1 B	A	Two Span Cable-Stay	Drilled shaft mid slough with concrete panels at each bank	Skewed
1 C	B	Two Span Cable-Stay	Drilled shaft mid slough with concrete panels at each bank	Perpendicular
1 D	B	Two Span Cable-Stay	Drilled shaft mid slough with concrete panels at each bank	Skewed
2 A	A	Two Span Steel Truss	Drilled shaft in slough Drilled shaft or driven steel piles in north bank of slough Concrete panel on south bank of slough	Perpendicular
2 B	A	Two Span Steel Truss	Drilled shaft in slough Drilled shaft or driven steel piles in north bank of slough Concrete panel on south bank of slough	Skewed
2 C	B	Two Span Steel Truss	Drilled shaft in slough Drilled shaft or driven steel piles in north bank of slough Concrete panel on south bank of slough	Perpendicular
2 D	B	Two Span Steel Truss	Drilled shaft in slough Drilled shaft or driven steel piles in north bank of slough Concrete panel on south bank of slough	Skewed

Bridge Type Options

The two-span bridge options would place a load-bearing foundation structure at some midpoint along the bridge, within the North Slough, in contrast to a single-span structure that would be supported on foundations located only at the bridge ends.

Two-span Cable Stayed Bridge

This bridge option (see Figure 3, page 15) is beneficial because it allows all of the bridge load to be centered on the mid-channel drilled shaft. This cantilevered design eliminates the need for foundation support at the bridge ends where bank stability is considered marginal, as determined in the Geotechnical Assessment prepared by Shannon & Wilson (Appendix D). In addition, the aesthetic quality of a cable-stayed structure may be appealing to trail users. However, the cable-stayed bridge would present a relatively high vertical profile, somewhat in contrast with the surrounding low-lying landscape. The primary drawback to a cable-stayed structure is its relatively high cost compared to the steel truss bridge. The cost of the cable-stayed structure is estimated to be $140 per square foot, not including assembly and concrete deck.

Two-span Steel Truss Bridge

This bridge option (see Figure 4, page 16) has a lower cost compared to the cable-stayed structure, at around $100 per square foot, not including assembly and concrete deck. The steel truss could also be primarily supported on a drilled shaft foundation located within the slough in addition to concrete panels on the north and south banks. The bridge would be cantilevered over the mid-channel pier, being supported primarily by the mid-channel pier. Placing none of the bridge load on the north and south abutments minimizes bank slope stress and potential environmental effects associated with disturbance of the adjacent St. John's Landfill. The mid-channel pier could be a smaller diameter than the drilled shaft needed for the cable-stay structure. The steel truss also presents a low profile, more in keeping with the context of the surrounding landscape. Acceptable foundation types must be confirmed with detailed geotechnical analysis during project design.

Single-span Bridge

While a single-span would be preferred over a multi-span structure for environmental and regulatory concerns, this option was ruled out because a single-span structure would require substantial foundations on the banks of the North Slough. The Geotechnical Assessment associated with this study determined that the banks are marginally stable, and deep foundations on the south bank would pose a significant risk of facilitating groundwater contamination from St. Johns Landfill leachate.

Bridge Site Options

Site A

Site A (see Figures 5 and 6, pages 17 and 18, respectively) is located nearest the North Slough's confluence with the Columbia Slough and lies within about 50 feet of the terminus of the existing Port of Portland Trail, giving this site the advantage of proximity to the existing trail system. Another advantage of Site A is the height of the south bank, which is approximately 12 feet above the Ordinary High Water (OHW) elevation of 9.5 feet, allowing sufficient clearance for navigation by recreational boats under Oregon State Marine Board Guidelines. It should be noted that under a 100-year flood condition, the POP trail and possibly the bridge alternatives considered in this study

would be inundated, rendering them impassable to bicycle and pedestrian traffic. Nevertheless, all of the bridge alternatives could be constructed to withstand a flood event of this magnitude.

The North Slough at Site A is wider than at Site B, requiring an approximately 16-foot longer structure under a perpendicular orientation and an approximately 39-foot longer structure under a skewed orientation.

Site B

Site B (see Figure 7, page 19) is located approximately 750 feet east of Site A, which would necessitate construction of an approximately 750-foot trail connection, possibly an elevated boardwalk, along the north bank to connect with the existing Port of Portland trail. Key disadvantages of this scenario are the additional cost to construct the trail connection and the added impacts to sensitive wetland and wildlife habitats resulting from trail construction and regular use.

Site B is considered infeasible due to the ADA standards requiring a maximum 2-3% slope of the bridge and trail approaches. Compliance with this standard would require that the south end of the bridge be raised approximately 5 feet above the elevation of the landfill perimeter road, rendering it impassable to maintenance vehicles. In addition, the access ramp to the bridge would need to extend 150 feet horizontally into the landfill (see Figure 2). This type of intrusion in to the landfill has potential to disturb the flow of leachate beneath the landfill and likely presents an unacceptable risk when there are other options.

Bridge Orientation Options

Perpendicular Crossing

A perpendicular bridge orientation (see Figures 5 and 7, pages 17 and 19, respectively) refers to the alignment of the bridge relative to the North Slough. Its main advantages are the minimal bridge length required, therefore minimal cost of construction and the likelihood that it would be the more acceptable option from the perspective of regulatory agencies concerned with minimizing habitat disturbance. A perpendicular crossing with a shorter bridge and therefore smaller substructures, would minimize aquatic habitat impacts.

The disadvantage of the perpendicular crossing is the resulting need for encroachment into the St. John's Landfill footprint in order to construct bridge approaches meeting AASHTO design standards for bike paths. A 36-foot radius for a 12 mile per hour curve would require excavation approximately 8 feet deep into the existing landfill cover. The average thickness of the landfill cover is approximately 3.5 feet. There is a high likelihood that an 8-foot deep excavation would encounter buried waste. Meeting the AASHTO and ADA standards for 2-3% slope may also inhibit maintenance vehicle access to the landfill perimeter road at this location due to the need for an elevated structure across the road.

Skewed Crossing

A skewed crossing (see Figures 6 and 7, pages 18 and 19, respectively) can be designed to meet AASHTO curve requirements for bike paths without the need for excavation into the landfill cover.

Drawbacks to the skewed orientation will be additional cost associated with a longer structure and potential for greater impacts to aquatic and riparian habitat. However, these should not be interpreted as "fatal flaws", but simply a more costly yet potentially more feasible alternative in view of all criteria.

REVISIONS				
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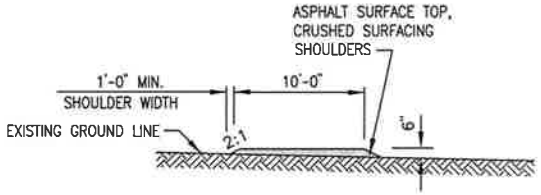
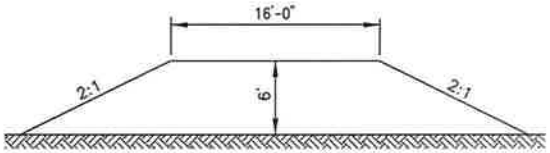
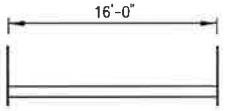


TRAIL SECTION (SOUTH END)
SCALE: 1"= 10'



OPTIONAL RAMP SECTION
@ BRIDGE (NORTH END)
SHOWN NEAR BRIDGE PIERS



BRIDGE SECTION
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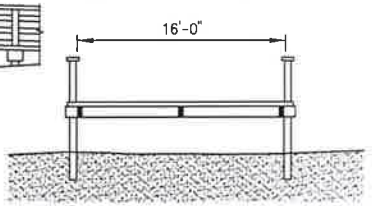
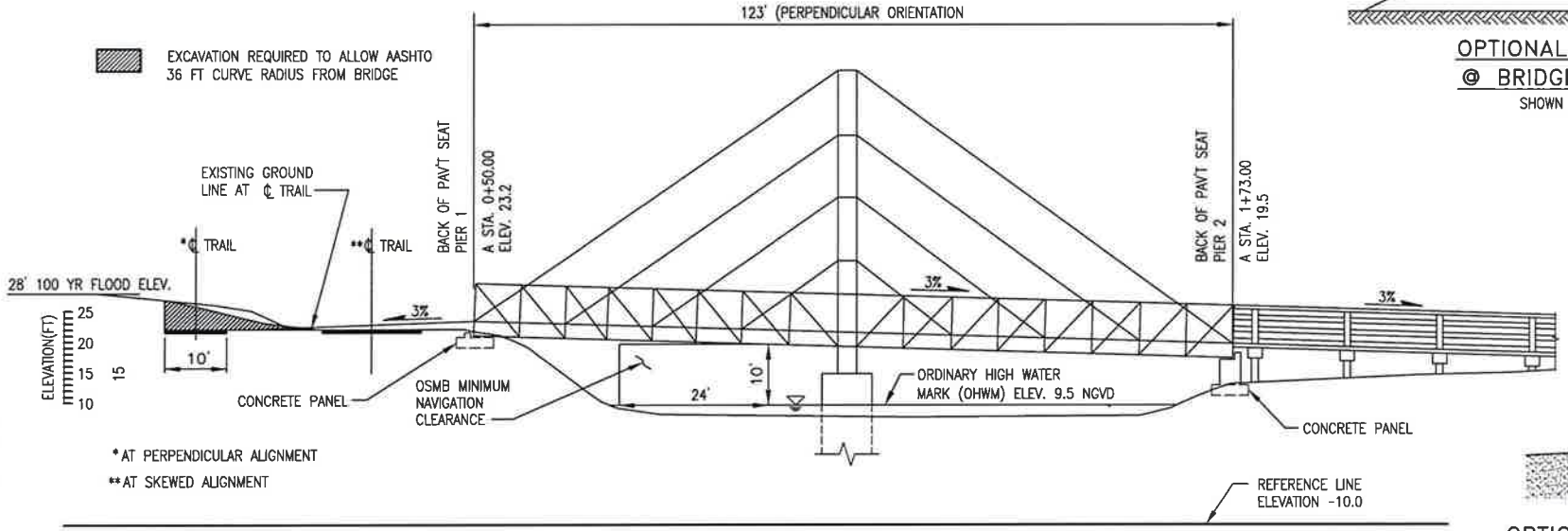
SHOWN NEAR MID SPAN



OPTIONAL RAMP/BOARDWALK
SECTION (NORTH END)
SCALE: 1"= 10'



ELEVATION
SCALE: 1"=20'

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NORTH SLOUGH BRIDGE FEASIBILITY STUDY

SITE A – ELEVATION – CABLE STAYED BRIDGE
FIGURE 3

SIZE	FSCM NO.	DWG NO.	REV

DATE: APRIL 2010

SCALE | SHEET

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REVISIONS				
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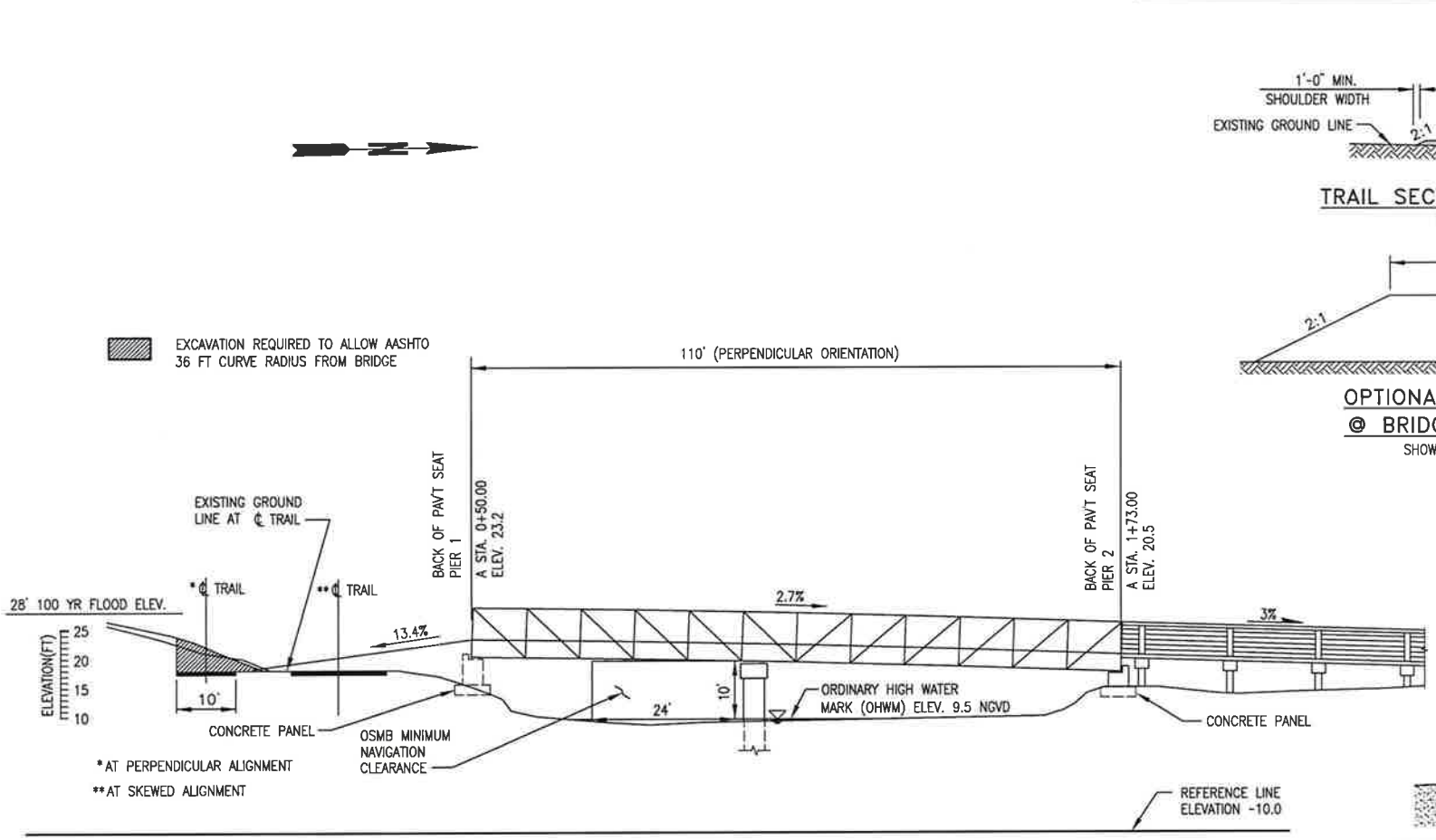
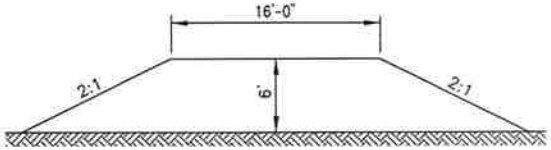


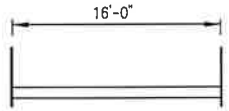
NOTE: COMPLIANCE W/ ADA STANDARD 3% SLOPE WOULD EXTEND EXCAVATION APROXIMATELY 150 FEET HORIZONTALLY INTO LANDFILL.

ELEVATION
SCALE: 1"=20'

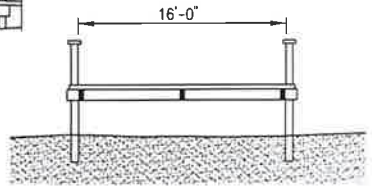
TRAIL SECTION (SOUTH END)
SCALE: 1"= 10'



OPTIONAL RAMP SECTION @ BRIDGE (NORTH END)
SHOWN NEAR BRIDGE PIERS

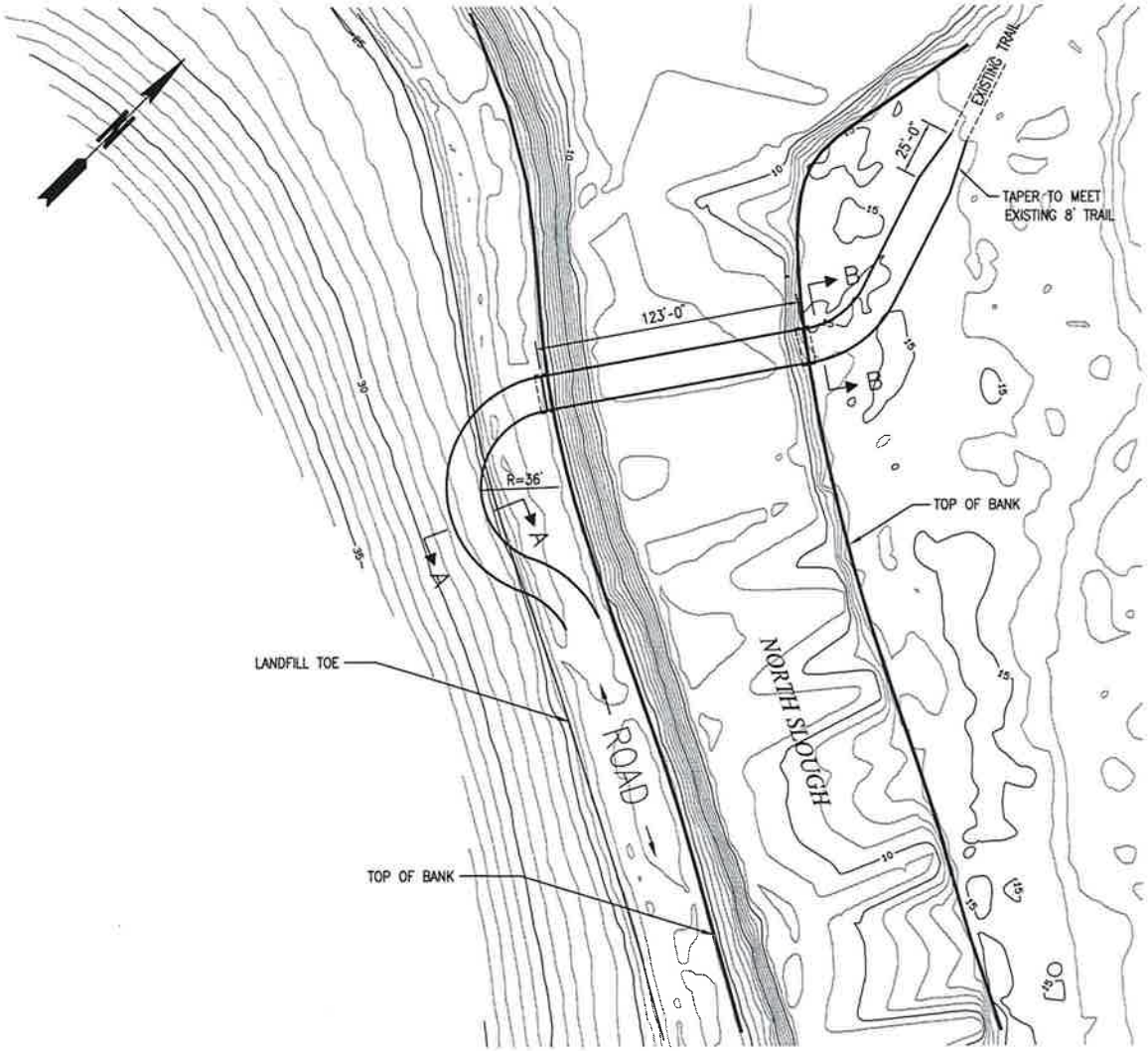


BRIDGE SECTION
SCALE: 1"= 10'
SHOWN NEAR MID SPAN

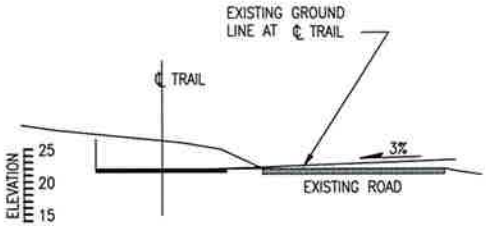


OPTIONAL RAMP/BOARDWALK SECTION (NORTH END)
SCALE: 1"= 10'

exeltech Lacey, WA Seattle, WA Portland, OR	NORTH SLOUGH BRIDGE FEASIBILITY STUDY		
	SITE B – ELEVATION – CURVED STEEL TRUSS FIGURE 4		
	SIZE	FSCM NO.	DWG NO. REV
DATE: APRIL 2010	SCALE		SHEET



PLAN
SCALE: 1"= 60'



SECTION A–A
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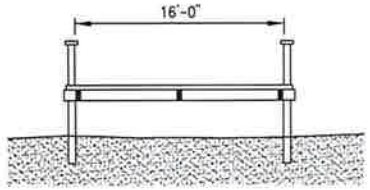

SECTION B–B
SCALE: 1"= 10'

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

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NORTH SLOUGH BRIDGE FEASIBILITY STUDY

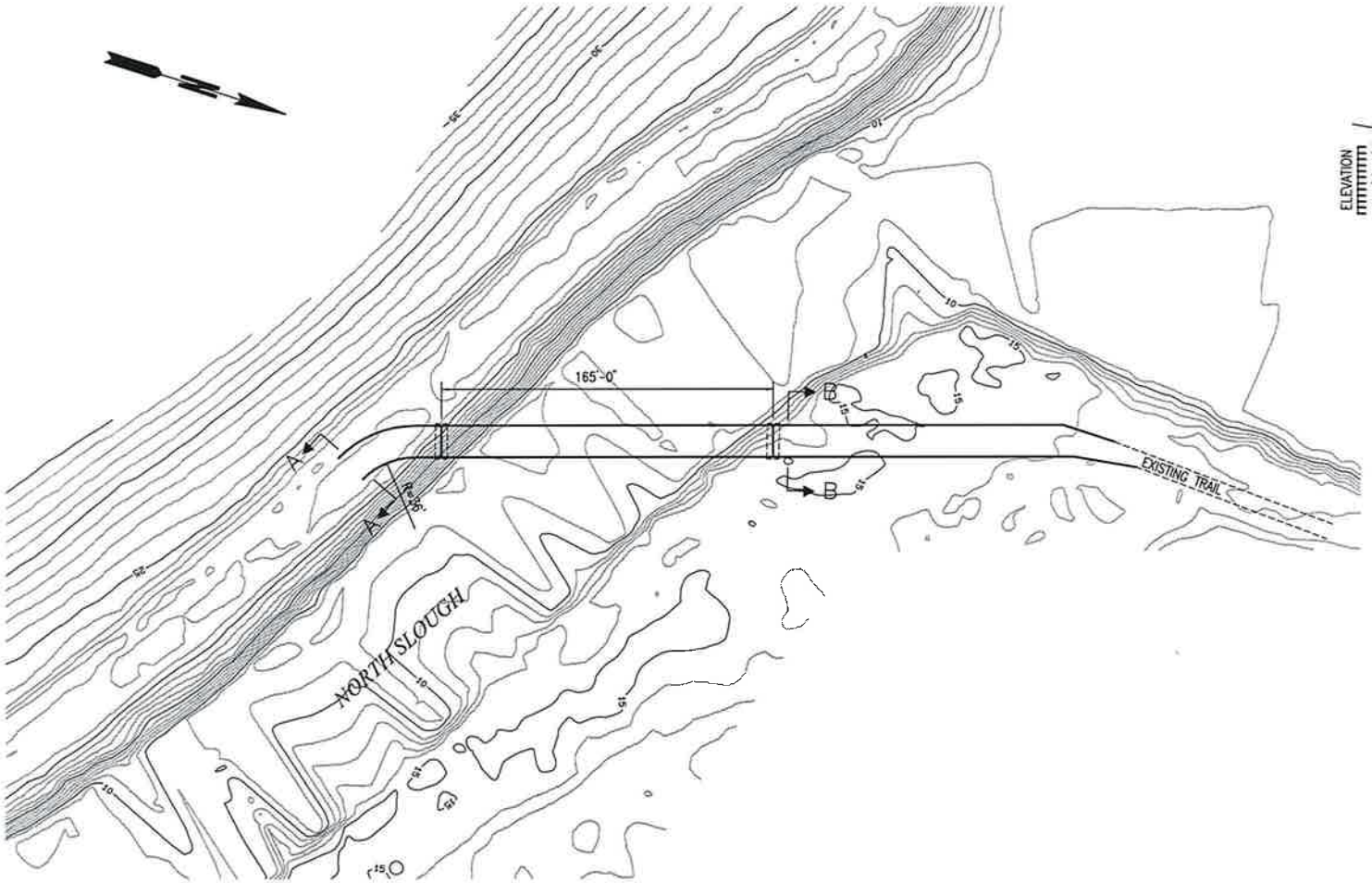
SITE A – PLAN VIEW–PERPENDICULAR ORIENTATION
FIGURE 5

SIZE	FSCM NO.	DWG NO.	REV

DATE: APRIL 2010

SCALE		SHEET

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



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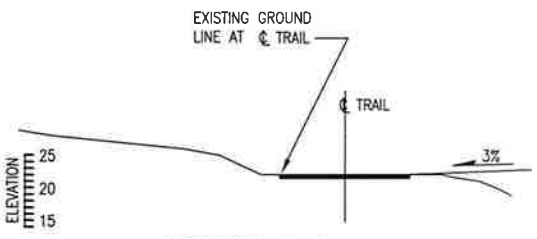

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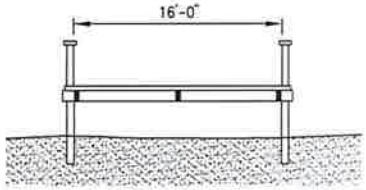

SECTION B–B
SCALE: 1"= 10'

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Lacey, WA Seattle, WA Portland, OR

NORTH SLOUGH BRIDGE FEASIBILITY STUDY

SITE A – PLAN VIEW – SKEWED ORIENTATION
FIGURE 6

SIZE	FSCM NO.	DWG NO.	REV

DATE: APRIL 2010

SCALE		SHEET

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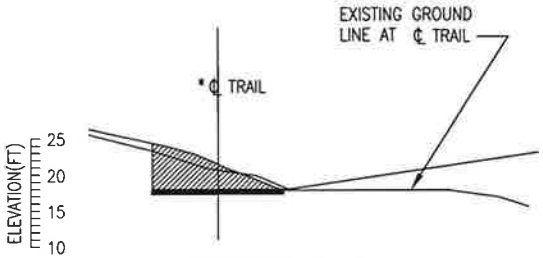

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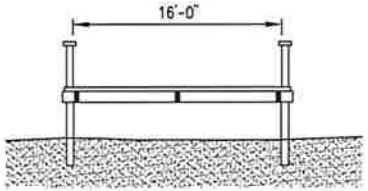

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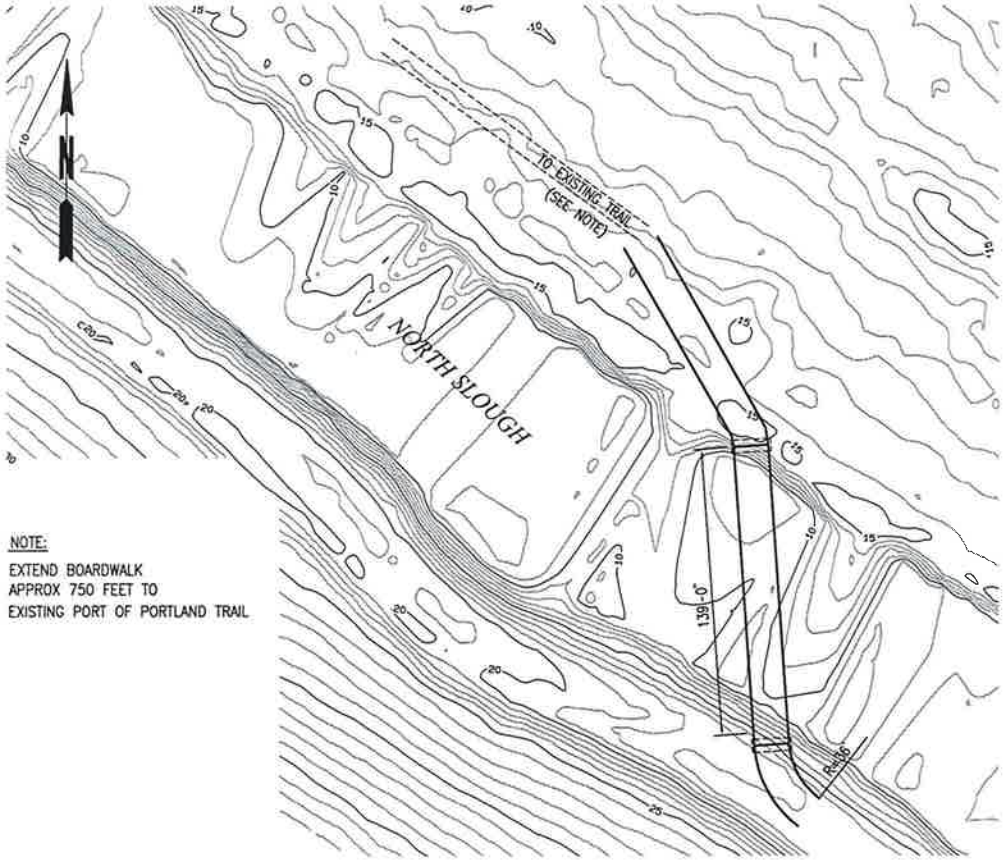
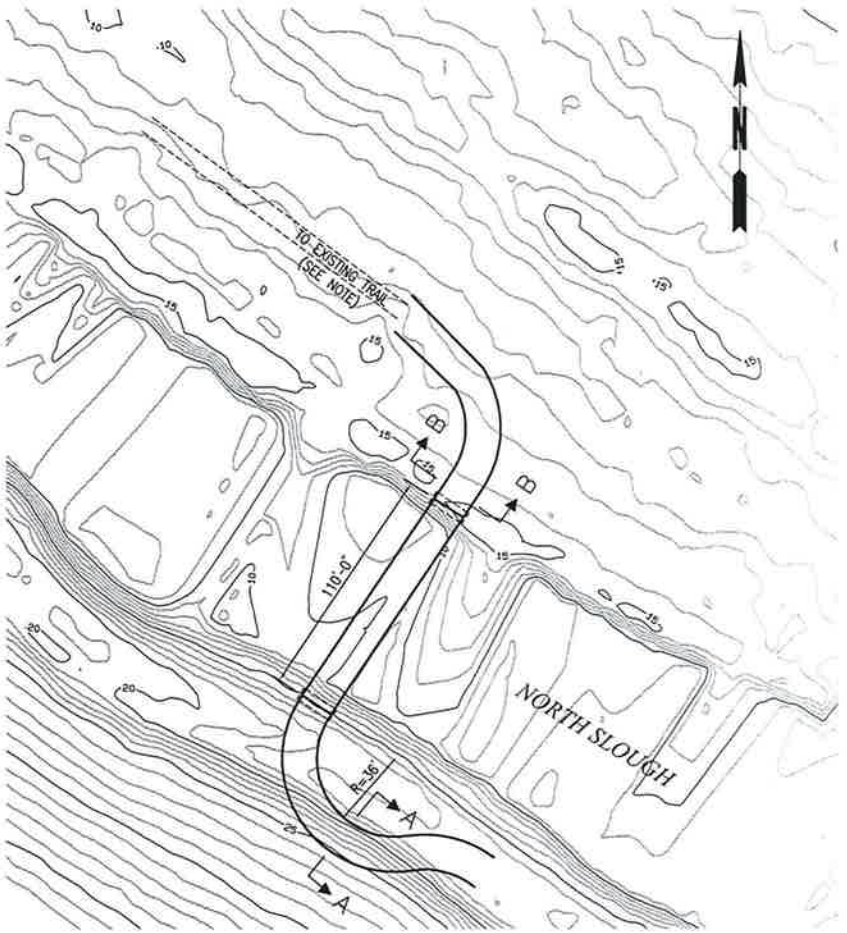


NOTE:
EXTEND BOARDWALK
APPROX 750 FEET TO
EXISTING PORT OF PORTLAND TRAIL

PLAN
SCALE: 1"= 60'

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



PLAN
SCALE: 1"= 60'

exeltech
Lacey, WA Seattle, WA Portland, OR

NORTH SLOUGH BRIDGE FEASIBILITY STUDY

SITE B – PLAN VIEW – BOTH ORIENTATIONS
FIGURE 7

SIZE	FSCM NO.	DWG NO.	REV

DATE: APRIL 2010

SCALE: SHEET:

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Alternatives Screening Process & Outcome

The eight bridge alternatives were evaluated against each criterion with the range of outcomes rated as either "Pass", "Pass with Modification", or "Fail". The completed Alternatives Comparison Table can be found in Appendix F. The outcome ratings are defined below, followed by a summary of the alternative screening process.

Pass – Construction of the alternative bridge type and orientation at the specified location would meet the minimum standards of the respective criterion.

Pass w/ Modification – The alternative could be designed and/or constructed to meet the minimum criterion standards if the design or construction methods are modified in some manner, such as through design exception or variance.

Fail – The alternative bridge type and orientation at the specified location would not meet the repective criterion. Modification of bridge design and/or construction methods would not be feasible or would not meet accepted design or construction practices.

Table 3. Bridge Alternatives Evaluation Summary

Alternative	Bridge Type	Orientation	Site	Screening Outcome
1A	Two-Span Cable Stay	Perpendicular	A	Pass w/ Modification[1]
1B	Two-Span Cable Stay	Skewed	A	Pass
1C	Two-Span Cable Stay	Perpendicular	B	Fail[2]
1D	Two-Span Cable Stay	Skewed	B	Fail[2]
2A	Two-Span Steel Truss	Perpendicular	A	Pass w/ Modification[1]
2B	Two-Span Steel Truss	Skewed	A	Pass
2C	Two-Span Steel Truss	Perpendicular	B	Fail[2]
2D	Two-Span Steel Truss	Skewed	B	Fail[2]

[1] Perpendicular crossing will likely require excavation/grading of the soil above landfill cover to meet AASHTO guidelines for bike trails. Appropriate measures will be required to ensure integrity of landfill cover. No conflict with other infrastructure expected.

[2] Landfill perimeter road would likely be rendered impassable at bridge site B due to the elevation of bridge and trail connections necessary to meet ADA, AASHTO trail guidelines and OSMB recreational navigation requirements.

Feasible Alternatives

Only alternatives 1B and 2B received "Pass" ratings for all evaluation criteria. Alternative 1B is the two-span cable-stay structure, while Alternative 2B is the steel truss. The primary determinants of feasibility were ADA requirements for bridge slope and trail approach grades, AASHTO design guidelines for curve radii, and OSMB guidelines for recreational navigation. Both of the feasible alternatives place the bicycle / pedestrian structure at Site A and on a skewed orientation due the height of the south bank. The alternatives that failed these criteria would have resulted in either

excessively long and high approach ramps that would impede maintenance access along the St. Johns Landfill perimeter road and/or would have required deep excavations into the landfill itself.

From a value engineering perspective, there are two perpendicular crossing alternatives, 1A and 2A, that would be feasible if a design exception or deviation could be obtained to the AASHTO design guidelines for curve radii. In this case, a 36-foot radius curve would be replaced with a shorter radius curve or even a "T" intersection where the south bridge approach meets the landfill perimeter road. This would eliminate the need for deep excavation into the landfill and the risk of encountering waste material. Subsurface exploration would determine the depth of the landfill cover and the allowable depth of excavation. The perpendicular crossing would also require sharper curves where the north bridge approach meets POP trail connections. If Metro were to consider this value engineering approach, it would save the added cost of the longer bridge associated with a skewed orientation and minimize impacts to the North Slough and associated riparian habitat. Since this design alternative is not in the best interest of the safety and experience of the bicyclists who will be using the trail, it is not being recommended.

Permitting Issues/Required Permits

The feasible alternatives for the North Slough bicycle / pedestrian bridge will affect two land ownerships: Metro and the Port of Portland. Multiple regulatory jurisdictions will require that project design, construction and operation are in conformance with existing permits and approvals (e.g. St. John's Landfill Closure Permit); and will require a number of additional permits and approvals addressing local, state and federal laws and regulations. Project permitting may take up to one year to complete and therefore should be initiated at the outset of project design. The following environmental permits and approvals are anticipated for construction of the North Slough bicycle / pedestrian bridge.

- Type II Land Use Review (City of Portland)
- Clean Water Act Section 404 Permit (UACE)
- Wetland Removal-Fill Permit (ODSL)
- Approved Fish Passage Plan (ODFW)
- Federal Endangered Species Act - Section 7 Consultation (NMFS/USFWS)
- National Environmental Policy Act - Documented Categorical Exclusion (Lead Federal Agency)

Recommended Conceptual Mitigation

Construction of a new bicycle / pedestrian bridge over North Slough will require some compensatory activity for unavoidable impacts to Waters of the State and U.S., habitat for aquatic species such as fish and amphibians, riparian habitat, flooding conditions, and potentially wetlands. Temporary impacts to aquatic and riparian habitat, including wetlands normally requires simple restoration to pre-existing grades, contours and vegetation conditions. Permanent impacts resulting from placement of bridge support structures, trail connections and other fill may require formal mitigation in the form of wetland creation, restoration or enhancement. There are likely to be opportunities within and around the Columbia Slough and Smith and Bybee wetland complex for such compensatory actions. Any placement of fill in the Willamette River Flood Zone will require removal of at least an equal amount of soil removal per City of Portland Building Code.

NEPA Classification

The Project will likely receive a determination of No Significant Impact under NEPA and a Documented Categorical Exclusion. Documentation of NEPA concerns will require coordination with the lead federal agency for the project. It is expected that federal funding will be received to build this project and the agency that provides those funds will take on the lead role. It is recommended that permitting agencies such as US Army Corps of Engineers, National Marine Fisheries Service and US Fish and Wildlife Service be invited to be co-operating agencies during the NEPA process.

Opinion of Probable Cost

The preliminary estimate of cost to design, permit and construct the preferred bridge alternative (Alternative 2B) is approximately $2.7 million. This estimate has been developed based on conceptual drawings and findings of this feasibility study. Details of the cost estimate are provided in a cost estimating model provided by Metro for this analysis (see Appendix G).

Schedule for Design, Permitting and Construction

Design and permitting for the North Slough bicycle / pedestrian bridge could be expected to take up to one year to complete, with construction (contractor mobilization to the site through final clean up) requiring at least 65 days. The actual time frame for construction would depend on the alternative selected. Construction of a cable-stayed structure would likely require more time than a steel truss due to the more complex nature of the structure.

Maintenance and Monitoring Requirement

Should project construction result in permanent impacts to wetlands, a compensatory wetland mitigation plan would likely be a requirement of USACE/ODSL permits. Approvals for compensatory wetland mitigation plans often require post-construction monitoring of the mitigation wetlands for a period of no less than 5 years.

A riparian restoration plan would be required in the event of vegetation removal without any other resource impacts. Although the requirements of the plan are normally determined in consultation with NMFS, USFWS, USACE, ODSL and ODFW, these agencies typically require 2:1 replacement of tree and shrub vegetation removed by the project.

Development of mitigation or restoration plans would be initiated upon determination of impacts to wetlands and riparian areas and pre-application coordination with the USACE and ODSL.

Recommended (Preferred) Alternative & Rationale

The North Slough Bridge Feasibility Study was initiated to identify alternative bridge configurations (if any) that would meet an established set of regulatory, technical and design criteria. Based on the application of all feasibility criteria established for this project, the preferred alternative is 2B, the steel truss bridge located at Site A on a skewed orientation (Figure 8 shows a simulation of a bridge in this location). This is the only configuration that meets all environmental, technical and design criteria. An estimated schedule for design through construction of Alternative 2B, the steel truss at Site A is provided in Appendix H.

Figure 8. Conceptual view of North Slough Bicycle / Pedestrian Bridge recommended alternative (looking west toward confluence with Columbia Slough).

Recommended Next Steps for Preferred Alternative

Further Analysis or Studies Needed

The scope of this feasibility study was conceptual in nature. Additional studies and detailed analysis will be necessary to develop a constructible bridge alternative that meets all applicable regulatory, technical and design criteria.

Geotechnical

The Geotechnical Assessment recommended feasible foundation types based on probable site conditions determined through a review of existing data and literature. The foundation types and design parameters should be evaluated based upon borings and laboratory testing data during the preliminary design phase of the project. Further geotechnical analysis should also include an evaluation of slope stability to determine the potential impact of bridge construction on the stability of the slough banks.

Hydraulic

No hydraulic analysis was completed for this feasibility study. A detailed hydraulic analysis must be completed by a qualified hydraulics engineer during the preliminary design phase of the project to determine flooding and scour potential. Hydraulic analysis may also address frequent flooding of the POP trail where it approaches the study area from the north.

Trail

The intersection of the trail approach with the south end of the bridge will require careful geometric analysis due to the need to keep the trail within the existing landfill road footprint to the extent possible. Compliance with AASHTO standards for bike path curves and ADA standards must be considered in the design.

Threatened and Endangered Species

The Natural Resources Technical Memorandum identified fish, wildlife and plant species potentially present within the study area and described general habitat conditions. A detailed Biological Assessment (BA) must be completed to determine the potential effects to fish, wildlife and plant species that are or may be present within or in proximity to the study area that are listed as threatened or endangered under the Federal Endangered Species Act of 1973. The BA should be completed during preliminary design of the project. Formal consultation with the NMFS and/or USFWS may take a year or more to complete.

Wetlands

The Natural Resources Technical Memorandum identified approximate location and size of wetland and water resources within and immediately adjacent to the study area. A formal wetland delineation will be necessary to accurately document wetland and waters impacts in order to determine the need for, and obtain, wetland removal-fill permits from Oregon Department of State Lands (ODSL) and the USACE.

Survey

A detailed topographic survey was completed for this study and may be sufficient for design purposes. Additional survey may be needed if the project boundaries are expanded beyond the limits of this study area.

Bridge

Although it may appear to be stating the obvious, the bridge type, size and location should be finalized prior to final design plans, specifications, and estimates.

Public and Stakeholder Involvement Recommendations

Metro staff made periodic presentations to interested stakeholders during the bridge feasibility work. Members of a former trails working group and other interested stakeholders will receive a copy of the final study and Metro staff will meet with them to present the study findings. Following the stakeholder meeting, Metro staff will present the study findings to the Metro Council in a work session which the public are welcome to attend. Since the study determined that the bridge is feasible, the work session is primarily an opportunity for staff to inform the Council of the study findings and next steps to implement the project.

Recommended Future Phases Discussion

This study has established the feasibility of a bicycle / pedestrian bridge across the North Slough. Realization of a North Slough bridge requires appropriation of the necessary funding. With those requirements in place, project design and permitting could commence, including the NEPA process, followed by advertisement for construction bids and selection of a construction contractor.

References

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Smith and Bybee Wetlands Natural Area

South Slough Trail Alignment Feasibility Study

January 2011

Prepared for:
Metro Sustainability Center

Prepared by:
Alta Planning + Design
711 SE Grand Avenue
Portland, Oregon 97214

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Executive Summary

Project Purpose

Metro's Sustainability Center initiated the South Slough Trail Alignment Feasibility Study to determine the feasibility of developing portions of the trail on non-Metro owned land in the vicinity of the Smith and Bybee Wetlands Natural Area. The study identifies an 'on the ground' location for the trail and provides cost estimates and construction phasing information for development of the 5-mile trail alignment.

Project Background

In 2004 Metro Council directed staff to conduct a feasibility study to determine trail alignment options to fill a gap in the 40-Mile Loop trail system to connect St. Johns neighborhoods with the Smith and Bybee Wetlands Natural Area and other nearby parks and trails. Years of previous efforts had failed to produce consensus amongst stakeholders on a trail alignment.

The study was a collaborative effort between Metro and key stakeholders to conduct a fact based, objective analysis, weighing the pros and cons of each feasible alignment option. The stakeholders participated on a trails working group to advise Metro and Metro's consultants throughout development of the feasibility study. The working group's charge was to reach consensus on the accuracy of the study, but to stop short of recommending a preferred alignment.

In December 2005, Metro Council approved the *Smith and Bybee Wetlands Natural Area Trail Feasibility Study* (MacLoed Reckord, 2005) and recommended the South Slough alignment as the preferred trail alignment (Fig. ES-1).

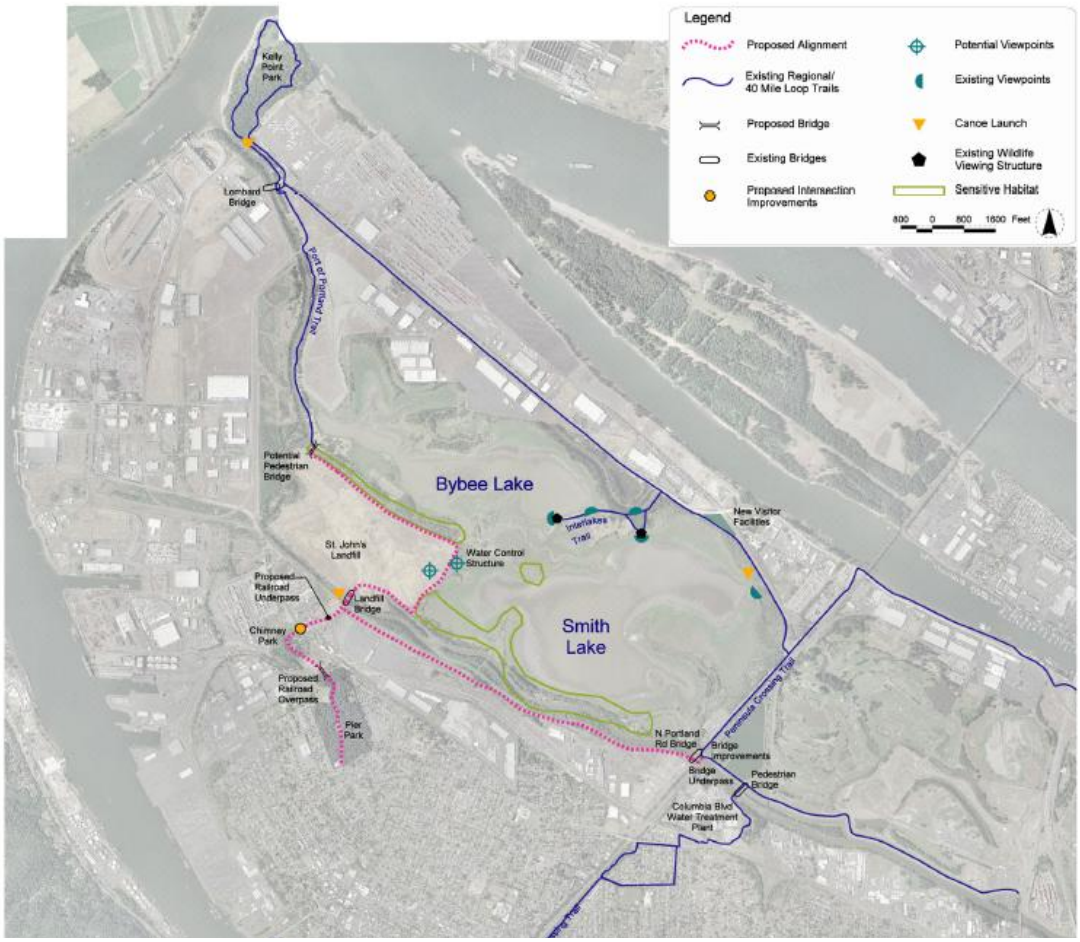


Figure ES-1. South Slough Trail Alignment

At that time, Metro Council also directed staff to perform additional feasibility analysis related to the preferred alignment.

This report addresses Metro Council's direction to study the feasibility of locating portions of the trail on other publicly and privately owned lands within the South Slough alignment.

A companion study, the North Slough Bridge Feasibility Study (Exeltech, January 2011) responds to Metro Council's direction to study the feasibility of constructing a bicycle/pedestrian bridge over the north arm of the Columbia Slough near the St Johns landfill.

During preparation of the above mentioned reports Metro staff worked closely with staff from the city of Portland Parks and Recreation Department and Bureau of Environmental Services. Metro staff also provided periodic updates to members of the former trails working group to keep them informed of study milestones.

The two reports will be presented to Metro Council in a work session for their consideration, discussion and recommended next steps for implementation.

Project Significance

Over the last five years Metro, partner agencies and trail advocates collaborated closely and made great strides towards providing a seamless trail connection through North Portland between the Willamette and Columbia Rivers; the South Slough trail is a key component of this larger vision. This network of trails will serve the 25,000 (and growing) residents of the five adjacent North Portland neighborhoods, provide additional access and opportunities to recreate and enjoy nature, and connect people to shopping and jobs. It will also increase the recreational opportunities for millions of regional trail users.

Significant achievements towards realizing this greater vision for a trail network in North Portland include;

- Passage of Metro's 2006 Open Spaces Bond Measure which identified the Columbia Slough and Willamette River Greenway trails as target areas to receive regional and local share funds for acquisition; the South Slough trail is part of both target areas.
- The City of Portland adopted the North Willamette River Greenway trail into their comprehensive plan, which designates segments of the South Slough alignment as part of that trail.

- Portland Parks and Recreation Department was awarded funds to prepare the North Portland Greenway master plan, between the Willamette and Columbia Rivers, including sections of the South Slough alignment.
- ODOT funds were awarded and work is underway for design and construction of a bike/pedestrian bridge between Pier and Chimney Park; this bridge will serve as an important node providing connections between several local and regional trails.
- The Smith and Bybee Natural Resources Management Plan (1990) is being updated and will be completed in the spring of 2011. The update sets the stage for including the South Slough trail improvements (within the natural area boundary) in a conditional use master plan that the city of Portland will adopt.

Trail Segment Analysis

The South Slough trail alignment was divided into four segments for purposes of this study. Figure ES-2 shows the study segments. The segment analysis focused on those areas of the alignment where the exact location of the trail was not known.

The segment analysis methodology included the following steps:

- Develop evaluation criteria and measures
- Conduct site visit and meetings with landowners
- Identify opportunities and constraints for trail development within each study segment
- Identify trail alignment options within each segment
- Evalulate trail alignment options
- Identify the preferred trail alignment within each study segment.

The site visits and opportunities and constraints exercise helped to identify the feasible alignment options within each segment.

A total of 21 alignment options were evaluated against 10 criteria including, but not limited to, likelihood of adjacent landowner support, connectivity to other trails and community destinations, user safety, user experience, cost, natural resource protection, topography and regulatory requirements.

Preferred Trail Alignment

The preferred alignment (Fig. ES-3) is the result of combining the alignment options within each segment that best met the evaluation criteria.

Project Implementation

The planning-level cost estimate for the preferred alignment is approximately $21 million, based on an accepted Metro cost model approved by multiple agencies in the area with slight modifications based on a nationally accepted Alta cost model. This estimate reflects a 40% construction contingency and the assumption that federal funding will be used to develop the trail; “federalized” projects typically cost 30% more to complete than projects that are not federalized.

Phase 1: Trail Segments 1-3

Completing trail segments 1-3 is recommended as the first phase of implementation. This approach is consistent with Metro Council resolution No. 05-3592B which directed staff to pursue the connection between the Smith and Bybee Wetlands Natural Area and the St. Johns neighborhood as a first priority.

Segments 1-3 are located on lands owned by other public agencies who are supportive project partners. Once complete, people will have a non-motorized alternative for traveling from Pier Park to Chimney Park, through the

Smith and Bybee Wetlands Natural area, and on to Kelley Point Park and the existing Marine Drive Trail.

Funding requests for this phase will have a strong leveraging advantage given the ongoing trail acquisition efforts and trail planning in the St. Johns vicinity. These efforts support the same vision of providing North Portland neighborhoods with a non-motorized connection to other trails and parks, schools, jobs, nature and the Willamette and Columbia Rivers.

Phase 2: Trail Segment 4

Implementing trail segment 4 requires negotiating with private property owners along the south side of the Columbia Slough between the St. Johns landfill entrance bridge and North Portland Road. Metro's policy to work only with willing sellers makes it hard to predict when the land may be ready for trail development. The Columbia Slough is a target area of Metro's voter approved 2006 Natural Areas Bond Measure. One of the central objectives of this target area is to acquire property to close trail gaps in the Columbia Slough Trail. To date, Metro has acquired several trail easements and/or fee parcels for the trail within this target area.

When completed, this phase will allow for recreational loop rides around Smith & Bybee Wetlands Natural Area, with direct connections to the Peninsula Crossing trail.

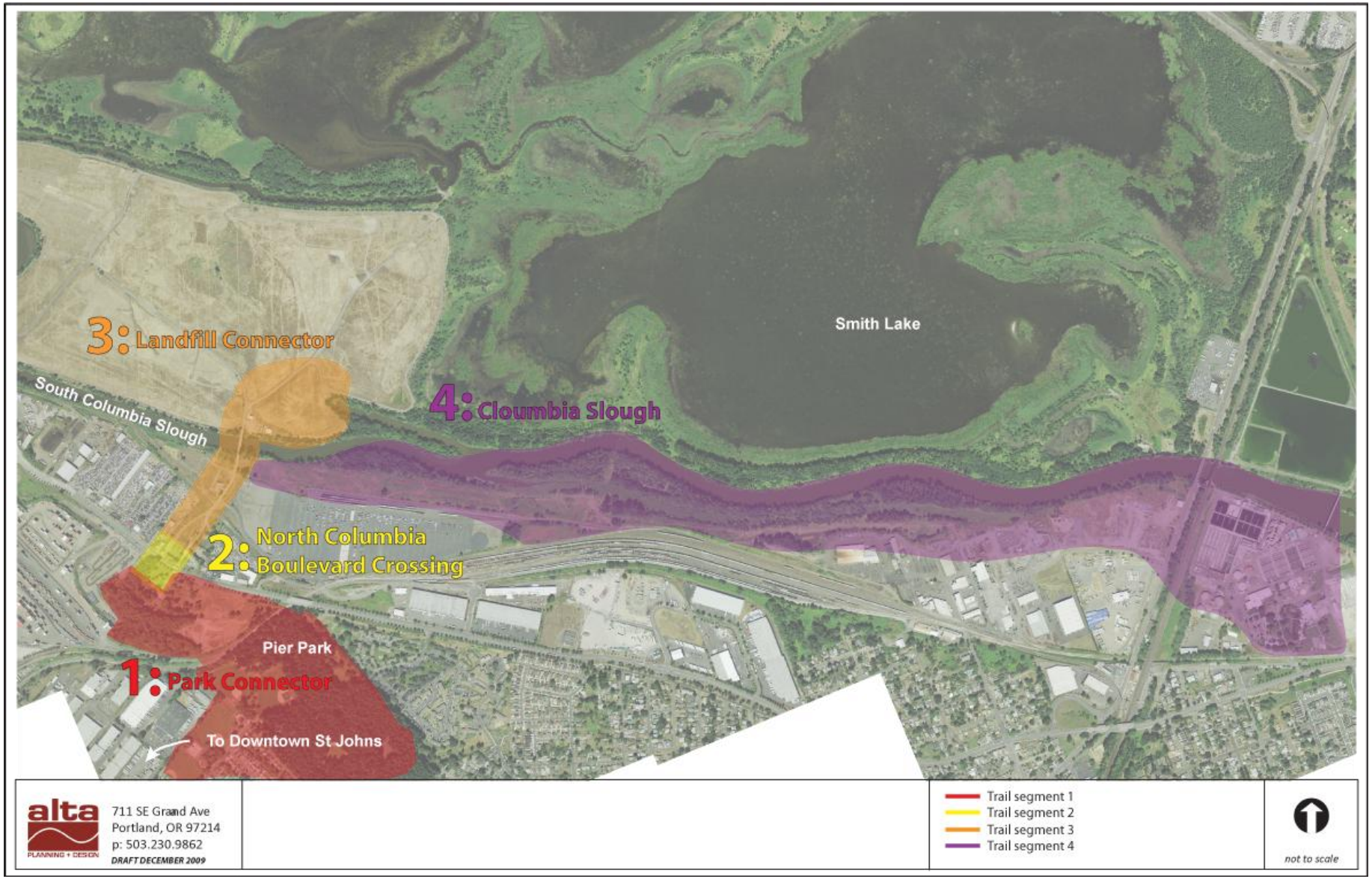


Figure ES-2. South Slough Trail Alignment Study Segments

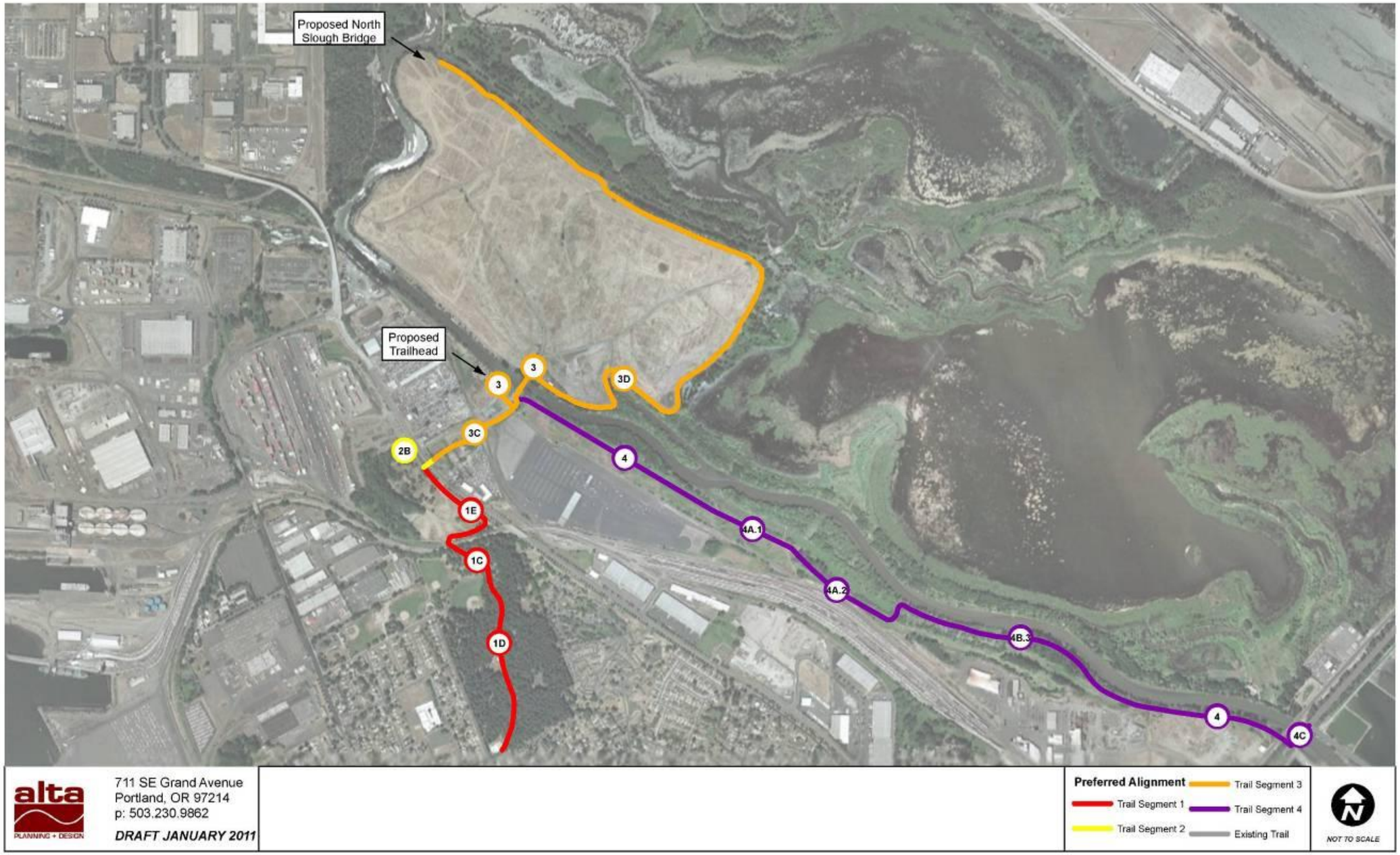


Figure ES-3. Preferred South Slough Trail Alignment

I. Trail Segment Analysis

The South Slough trail alignment was divided into four segments for purposes of this study. Figure 1 shows the study segments. The goal of the segment analysis was to determine the best location of the trail on lands that cross either non-Metro owned public land or privately owned land. Three of the four segments cross non Metro-owned property. The segment analysis also included reviewing a small adjustment to the preferred alignment on the Metro owned St. Johns landfill.

The general extent of the study segments are described below:

- Park Connector Segment: Connects Pier Park to Chimney Park
- North Columbia Boulevard Crossing Segment: Connects Chimney Park to the St. Johns landfill road.
- Landfill Connector Segment: Connects the existing St. Johns landfill road to the existing landfill bridge over the South Slough, to the southeast corner of the landfill perimeter road.
- South Slough Segment: Extends in easterly direction along south side of the Columbia Slough between the existing landfill bridge and the N. Portland Road Bridge. Then the trail continues to the existing bike/pedestrian bridge on the eastern boundary of the Columbia Boulevard Wastewater Treatment Plant.

Evaluation Criteria

Evaluation criteria and measures were developed to compare and screen the trail alignment options within each study segment to determine the best placement for the trail. Given the specific nature of each segment, some evaluation criteria are unique to only one segment, while other criteria may apply to more than one segment. The evaluation criteria are summarized below and are described in more detail by segment in Appendix A, South Slough Alignment Evaluation Criteria and Measures.

Connectivity

Evaluates connectivity to other recreational uses and to utilitarian destinations. Considers access to trailheads, the Peninsula Crossing trail, and other trails, bikeways and parks. Also evaluates connectivity and access to residential, commercial or employment areas as well as schools.

Safety & Security

Addresses the safety and security concerns of the following:

- Property owners concerns related to trespassing and crime if trail crosses or is in vicinity of their properties
- Trail users traveling along the corridor
- Trail users at roadway and railroad crossings

User Experience

Measures the quality of the experience of the trail user. Considers potential views, aesthetics, ability to provide user amenities, as well as characteristics such as noise and air quality.

Cost

Rates alignment option based on the cost of design, engineering, and/or construction, especially where

crossing improvements, fencing, or other expensive infrastructure improvements would be necessary.

Consistency with Funding Eligibility Requirements

Evaluates whether costs associated with an alignment will qualify for potential funding sources.

Topographical Constraints

Considers topographical constraints and the ease of providing for ADA accessibility.

Habitat Protection

Considers the need to protect sensitive habitats for herons, eagles, turtles, and other plants and wildlife within the Columbia Slough.

Compatibility with Land Use and Permitting Requirements

Considers the compatibility of the alignment option with existing land use and permitting requirements.

Maintenance and Operations

Evaluates the expected relative effort required to maintain the alignment. Typical maintenance includes signage and trail marking replacement, vegetation pruning, and pavement sealing.

Stakeholder Buy-in

Considers the level of support or opposition that an alignment option may receive from landowner.

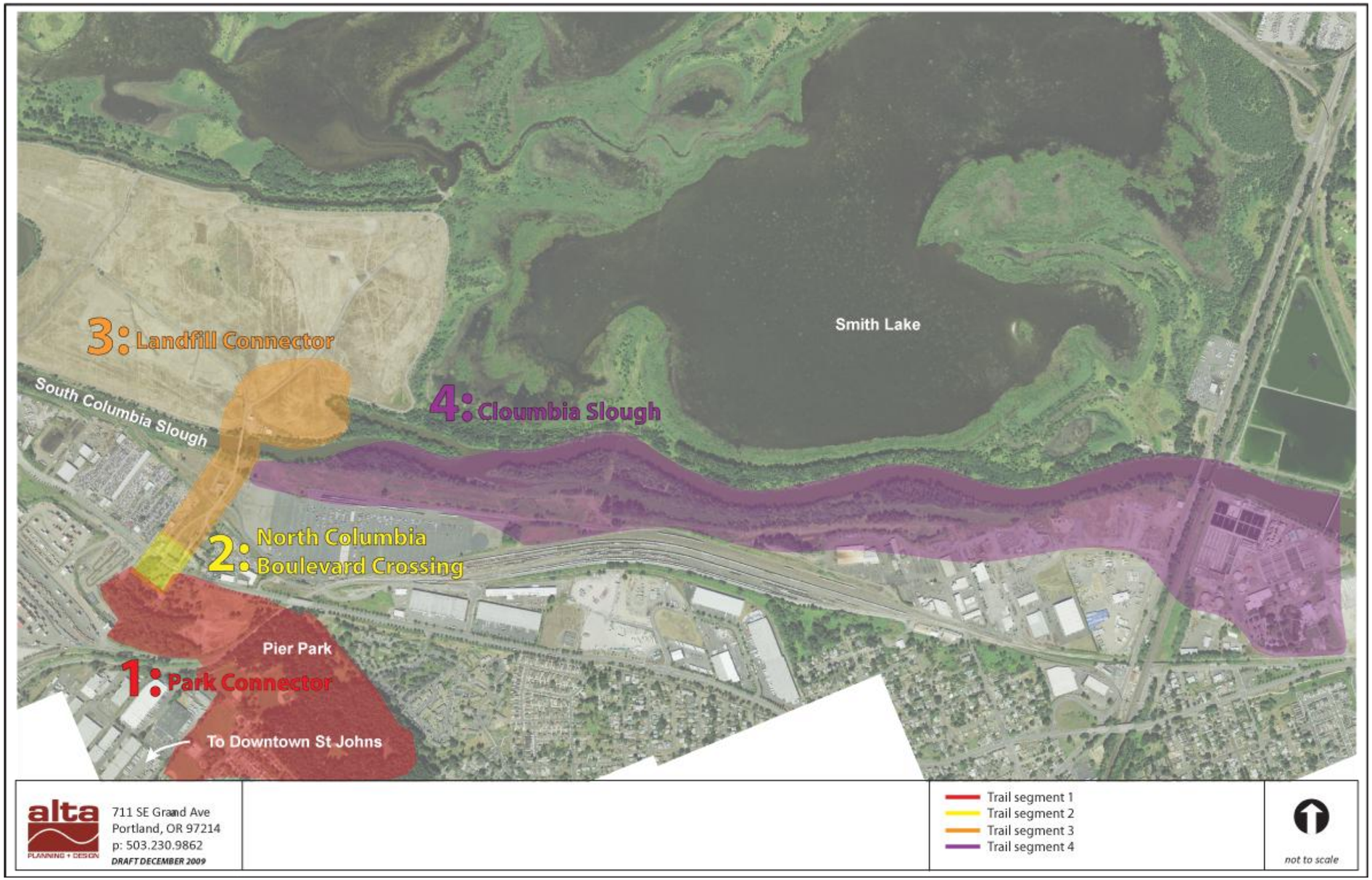


Figure 1. South Slough Trail Alignment Analysis - Study Segments

Opportunities & Constraints

The consultant team conducted a walking tour of the four study segments to identify opportunities and constraints to trail development, including private landowner concerns. The results of the field work analysis, are documented in Appendix B, South Slough Alignment Opportunities and Constraints Analysis. Table B1 and maps B1 and B2 (in Appendix B) identify the site specific opportunities and constraints related to developing a trail within each study segment.

Elements Common to All Study Segments

Property Ownership

All study segments are entirely or partially located on property that Metro does not own. In order to determine the feasibility of the trail alignment on non-Metro owned property, discussions with private and public property owners were initiated. Communications with private landowners remain confidential to protect their rights and their privacy. Land ownership type is shown on Map B3 in Appendix B.

Safety & Security

All of the trail segments include publicly and privately owned industrial lands with ongoing operations. Special attention was paid to operational, safety, and security issues related to these properties to identify opportunities for providing physical separation (horizontal distance and/or fencing) between trail users and active industrial uses. Site visits and communications with various public and private landowners provided valuable insight and were strongly considered when evaluating the trail alignment options.

Land Use and Environmental Resource Zones

The extent of the floodplain and environmental overlay zones in relation to the study segments are shown on map B4 in Appendix B. The map shows both conservation and protection overlay zones. Map B5 in Appendix B shows underlying zoning designations, including areas zoned heavy industrial. Trail development in these zones will require a conditional use approval from the City of Portland.

Trail Crossings

The trail will need to cross at least one major transportation facility or natural feature in each of the study segments as described below:

- Park Connector Segment – Railroad overpass
- N Columbia Blvd Crossing Segment – Roadway
- Landfill Connector Segment – Landfill access road; at-grade railroad crossing.
- South Slough Segment– Waterway (Wapato wetlands).

Site visits and communication with the relevant agencies confirmed allowable locations and design considerations for crossings within each segment.

Description of Trail Alignment Options

Taking into consideration the opportunities and constraints described above and the more site specific opportunities and constraints identified in Appendix B, a total of 21 trail alignment options were identified within the four study segments.

The trail alignment options are shown in Figures 2 & 3 and their characteristics are described briefly below.

Segment 1: Park Connector

1A: Existing gravel path (about 8’ wide), steep sections.

1B: Existing gravel and paved path (about 8'wide), steep sections.
1C: New proposed ADA connection between Pier and Chimney Parks includes bicycle/pedestrian bridge (funded) over railroad tracks.
1D: Existing paved path (about 8'wide) which connects to on-street bike lanes that connect to Peninsula Crossing trail to the east.
1E: This is the preferred alignment of Portland Parks & Recreation who own and operate Chimney Park.

Segment 2: N. Columbia Boulevard Crossing

2A: Columbia Blvd. crossing at intersection of Chimney Park driveway and St. Johns landfill entrance road.
2B: Columbia Blvd. crossing at former landfill entrance road (currently not used).

Segment 3: Landfill Connector

3: This portion of the alignment was approved in 2005 study, and no further analysis needed; it is shown for purposes of trail continuity.
3A: This option would be located on the NW side of landfill access road between the road and junk car yard. The trail would utilize an underpass to cross the existing railroad tracks and travel behind the existing landfill offices to the trailhead. This option was recommended in the 2005 study.
3B: This option would be located on the SE side of the landfill access road directly adjacent to the road. The trail would cross the existing at-grade railroad crossing along the SE edge of the landfill road and continue along the SE side of the road up to the existing landfill bridge.
3C: This option would follow the former landfill access road up to the at-grade railroad crossing. The at-grade crossing would be modified to accommodate the trail along the SE edge of road. After the railroad crossing, the trail travels along the southeast side of the access road to the existing landfill bridge.

3D: Newly identified option re-routed around the southeast perimeter of landfill (alternate to 3E), for better user experience.
3E: Alignment approved in 2005 study; travels through interior landfill perimeter road; requires fencing on both sides.

Segment 4: South Slough

4: This option follows under the existing power lines and was approved in 2005 study; no further analysis needed, but shown for purposes of trail continuity.
4A.1/4A.2/4A.3: These options allow the trail to continue under the power lines.
4B.1/4B.2/4B.3: These options are located on higher ground closer to the south slough. Three crossing options are shown to get from the power line options to the options closer to the slough. Each 4B option begins at its western intersection with a 4A option and ends at the northern extent of the next crossing option.
4C: This option was recommended in the 2005 study and calls for a separated bicycle/pedestrian bridge that would be built adjacent to the east side of the existing North Portland Road bridge near the top of the bank. This option connects to the existing off-street Peninsula Crossing Trail on the east side of N. Portland Road
4D: This option would be a cantilevered structure over the bank of the Columbia Slough outside the existing Wastewater Treatment Plant fence.
4E: This option would follow the toe of the slope of the railroad ballast, and require a new crossing structure over the railroad tracks just north of N. Columbia Court. The railroad tracks are in a cut at this location, requiring little to no rise in the new bridge structure. The bridge could also serve as emergency/secondary access to the Wastewater Treatment Plant when their main entrance is blocked by railroad cars.

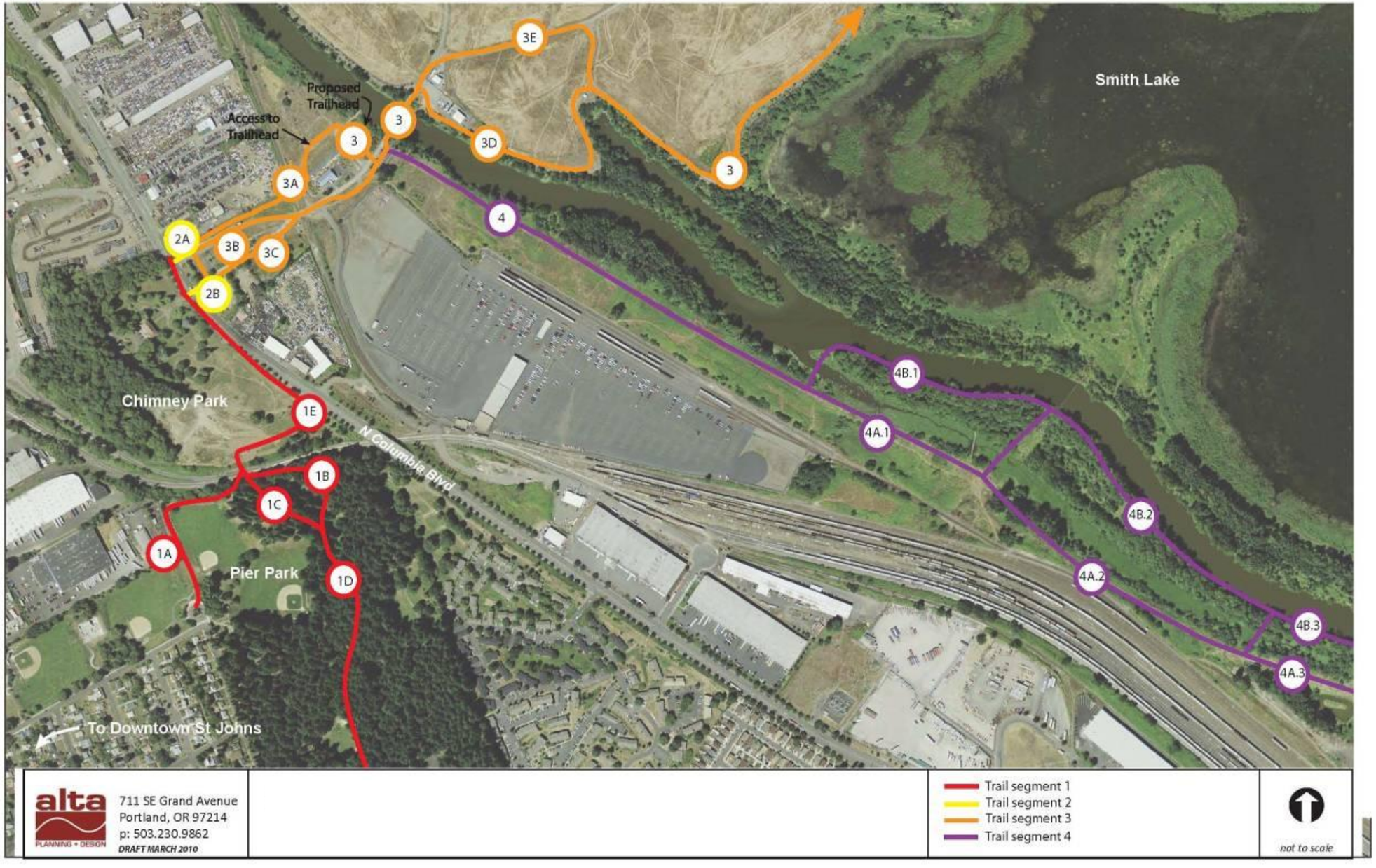


Figure 2. South Slough Trail Alignment Options - West

Figure 3. South Slough Trail Alignment Options - East

Alignment Options Evaluation

The 21 alignment options described in the previous section were evaluated against 10 criteria and related criteria measures. For a given criterion, each alignment option was assigned one of three ratings: "+"(meets criteria well), "0" (meets criteria somewhat) or "-" (does not meet criteria). When a criterion did not apply to an alignment option, a "N/A" (not applicable) was assigned. The criteria and measures are qualitative by nature and the ratings were used as a means to compare the options with each other in a given segment.

Table 1 provides a summary of how each alignment option was rated for each evaluation criteria. A more detailed evaluation matrix that shows ratings for each criteria measure can be found in Appendix C, Alignment Options Analysis and Evaluation (see Table C1 – Alignment Options Comparison Table).

The rationale for determining and selecting the preferred alignment option(s) within a given segment is described in more detail below.

Segment 1: Park Connector

The preferred alignment is 1D /1C / 1E.

The choice of option 1C was determined by the need for an ADA-compliant regional trail. Options 1A and 1B are existing gravel trail segments that have challenging topographical constraints that would require significant grading and incur considerable costs to meet ADA requirements. Option 1C connects Pier Park to Chimney Park over the railroad tracks. Option 1C also connects to Option 1D, which is an existing ADA trail within the park that connects to North Portland neighborhoods.

Option 1E is the preferred alignment of Portland Parks & Recreation who own and operate Chimney Park.

The alignment preserves the majority of the park to accommodate future uses (to be identified in a future Park Master Plan)

Segment 2: N. Columbia Boulevard Crossing

The preferred alignment is 2B.

The choice of option 2B was determined by the need to maximize the sightlines available to both trail users and motor vehicle drivers along Columbia Boulevard. Option 2B provides slightly better sightlines than 2A. Improved sightlines at 2B enhance the safety and security of trail users when using the proposed at-grade crossing improvements- median island, pedestrian-activated signal. 2B also provides a more direct connection to option 3C.

Segment 3: Landfill Connector

The preferred alignment is 3C / 3D / 3.

The choice of option 3C was determined by safety and security concerns, connectivity, and overall user experience. Locating the trail as far as possible from the private property to the northwest provides greater safety and security for landowners while providing a more desirable user experience for trail users. Option 3C also connects more directly to the preferred crossing location (2B) at N. Columbia Boulevard and the at-grade railroad crossing on the landfill access road. Option 3D on the landfill was preferred over 3E as it provides a more desirable user experience (less trapped-in feeling) while reducing conflict between trail users and landfill maintenance activities. Option 3 includes the location of trail head and the trail on the landfill perimeter roads; both are 'givens' since they were approved in the 2005 trail study. No further analysis is needed but these components are shown for purposes of continuity.

Segment 4: South Slough

The preferred alignment is 4 / 4A.1 / 4A.2 / 4B.3 / 4.

Option 4 follows under the existing power lines and was approved in the 2005 study; no further analysis is needed, but it is shown for purposes of trail continuity.

Options 4A.1 and 4A.2 continue to follow the existing power lines and were chosen after a careful consideration and balancing of safety and security, cost, and environmental constraints. Additional security measures would be provided with new fencing and the vertical separation between the preferred trail location and the private property located on the rise to the south.

The choice of option 4B.3 was determined by the strong desire to provide a high-level of security for adjacent private property owners, as well as providing the very best trail experience to trail users. Crossing the Wapato Wetlands on a boardwalk at this location is cost effective while providing significant horizontal distance separation from the industrial uses on private property to the south. Combined with fencing, this option provides a high degree of safety and security for trail users and adjacent property owners alike.

Option 4C was identified after considering the safety and security of trail users and adjacent property owners, as well the structural characteristics of the N. Portland Road bridge, and cost. Option 4C provides the most direct connection to the existing Peninsula Crossing Trail, and avoids need for a costly railroad crossing north of N. Columbia Court (4E). Option 4C will maintain operational integrity of the adjacent land uses.

Table 1. Summary of Alignment Options

Evaluation Criteria	*Segment 1*					*Segment 2*		*Segment 3*					*Segment 4*								
	1A	1B	1C	1D	1E	2A	2B	3A	3B	3C	3D	3E	4A.1	4A.2	4A.3	4B.1	4B.2	4B.3	4C	4D	4E
Connectivity – Recreational Trips	-	O	+	+	O	N/A	N/A	O	O	+	+	-	O	O	-	+	+	+	O	O	-
Connectivity - Utilitarian Trips	O	-	+	+	+	N/A	N/A	O	O	+	N/A	N/A	+	+	+	-	-	-	O	O	O
Safety - Roadway Crossing	N/A	N/A	N/A	N/A	N/A	-	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Safety - Railroad Crossing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	O	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Safety & Security - Trail Users	+	-	+	+	+	N/A	N/A	-	+	+	+	+	+	+	+	-	O	O	+	O	O
Safety & Security - Adjacent Property Owners	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O	+	+	O	-	O	O	O	+	+	+	+	-	-
User Experience	O	O	+	+	O	N/A	N/A	-	O	+	+	-	O	-	-	+	+	+	O	+	O
Cost	-	-	O	+	-	N/A	N/A	-	O	O	O	O	+	+	-	-	-	O	+	-	O
Consistency with Funding Eligibility Requirements	-	-	+	+	+	N/A	N/A	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Topographical Constraints	-	-	+	+	-	N/A	N/A	-	+	+	+	O	+	+	+	-	-	O	+	-	+
Habitat Protection	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	O	O	O	O	O	O	+	O	+
Compatibility with Land Use and Permitting Requirements	O	O	O	+	+	+	+	-	O	O	O	+	O	O	O	-	-	-	+	-	O
Maintenance & Operations	-	-	O	+	-	O	O	-	+	+	O	+	+	O	-	-	-	O	+	-	-
Stakeholder Buy In[1]	O	O	+	+	+	-	-	O	+	+	O	O	O	O	-	O	+	O	+	-	-
Legend **+ = alignment option meets the criteria very well** **O = alignment option meets the criteria somewhat** **- = aligmnet option does not meet the criteria** **N/A = criteria does not apply to the alignment option**																					

[1] Ratings for options crossing privately owned land in segment 4 are based on best professional judgment.

Preferred Alignment

The preferred South Slough trail alignment is shown on Figures 4 & 5 on pages 31 and 32. It should be noted that while this is the preferred alignment, there are other feasible options within each segment if one of the preferred options becomes infeasible for any reason.

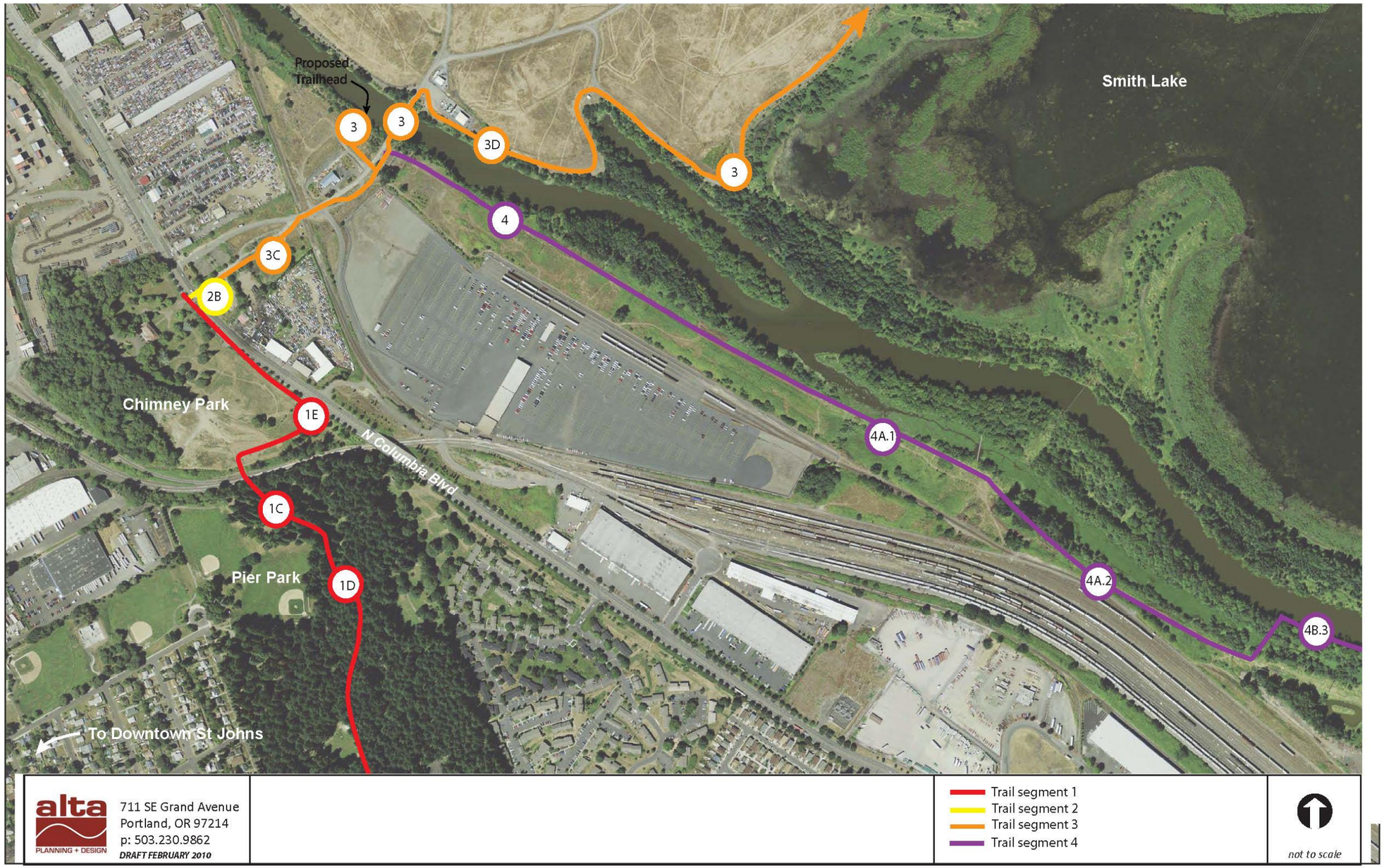


Figure 4. South Slough Trail Preferred Alignment - West

Figure 5. South Slough Trail Preferred Alignment - East

II. Trail Design

The 2005 Smith and Bybee Wetlands Trail Feasibility Study included a chapter on trail design. The trail design has changed little since that time, but more detail about certain design elements is provided in this chapter.

One of these elements relates to design recommendations to address concerns private and public industrial landowners may have if the trail were to cross their property. Members of the project team met with landowners to discuss the trail project, and the design recommendations discussed in this chapter reflect those conversations. Communications with landowners are confidential to protect landowner rights and their privacy.

This chapter also includes conceptual drawings of the proposed trailhead on the south side of the existing St. Johns landfill bridge.

Table 2 provides the design guidelines for the trail surface and figures 6-10 below show cross-sections of the trail in the different settings it will travel through.

Table 2: South Slough Trail Design Recommendations	
Width	12’ (optimum), 10’ on landfill roads
Surface	Asphalt (permeable if appropriate)
Soft Shoulder	0-2’ crusher fines or gravel
Vertical Clearance	10’
Horizontal Clearance	2’ (or less in habitat areas)
Grade	2-3%, 5% maximum

Cross-Sections

Figures 6-10 illustrate the trail in different settings throughout the preferred alignment.

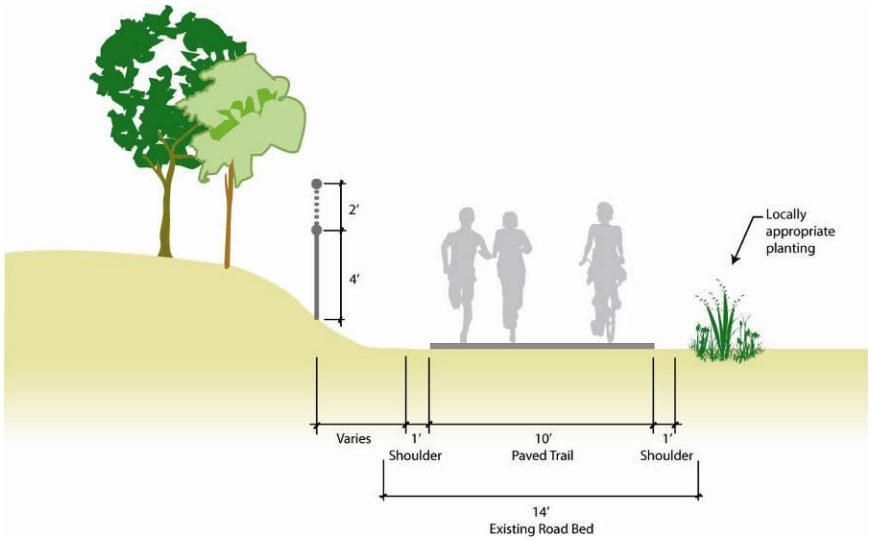


Figure 6. Paved Multi-Use Trail in Landfill

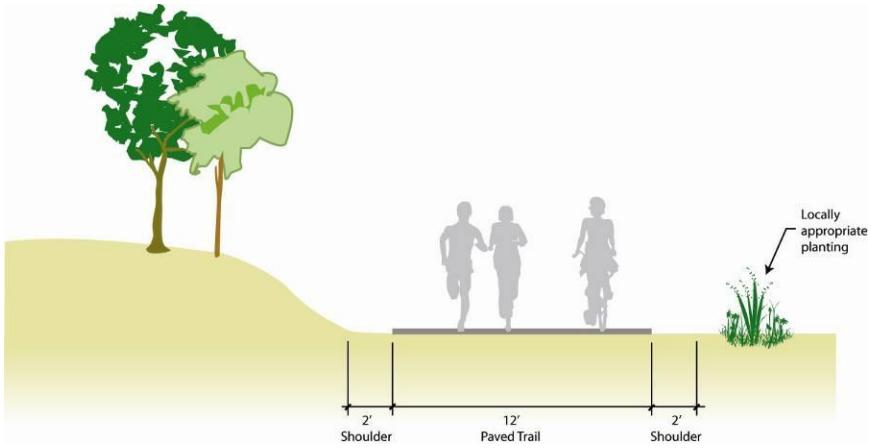


Figure 7. Paved Multi-Use Trail along Sough Slough

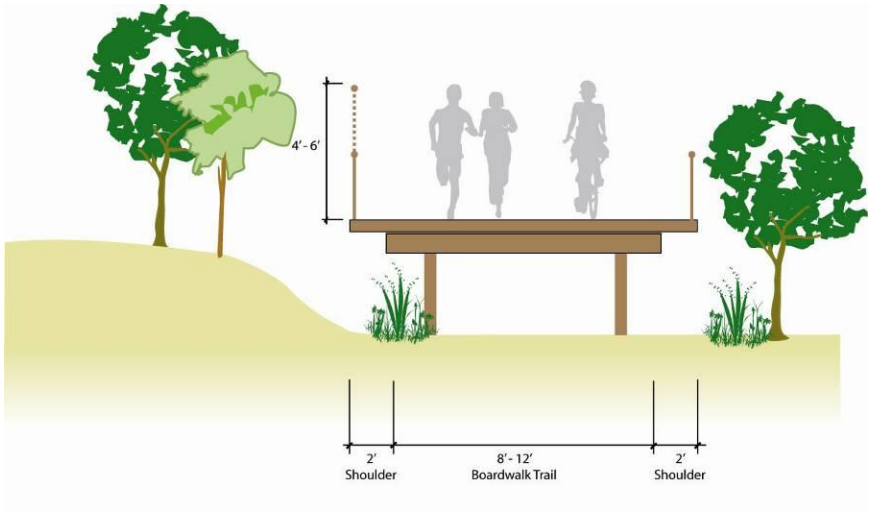


Figure 8. Boardwalk over Wapato Wetlands

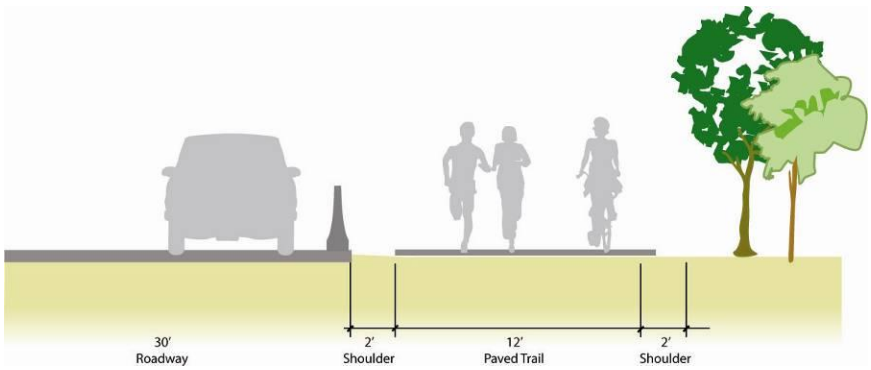


Figure 9. Trail adjacent to Landfill Access Road

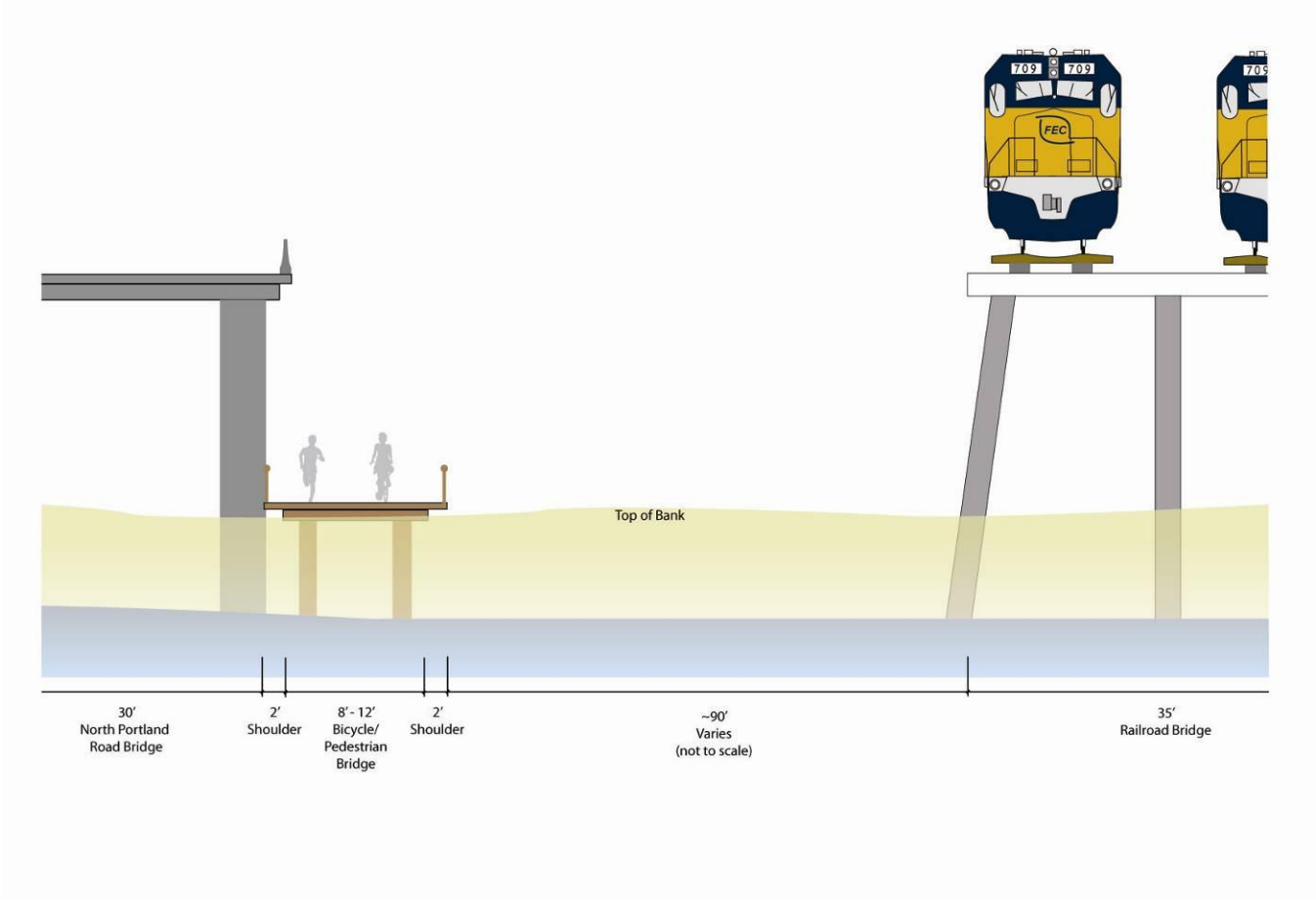


Figure 10. Bicycle/Pedestrian Bridge adjacent to North Portland Road

Figure 11 below shows the proposed trailhead adjacent to the south side of the St. Johns landfill bridge. Trailhead improvements will include paved parking for approximately 8 vehicles, bioswale to filter stormwater from the parking area, connection to the South Slough trail, ramp to the canoe/boat launch and a portable restroom.

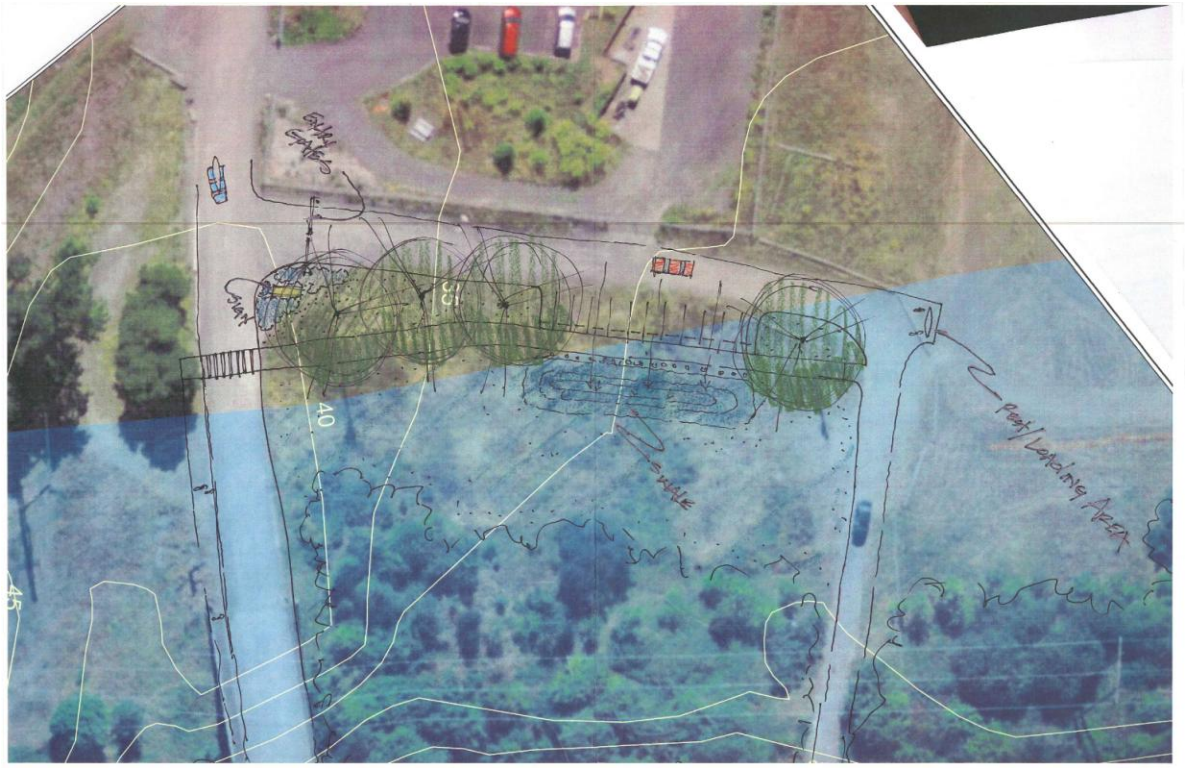


Figure 11. Sketch of proposed trailhead adjacent to existing St. Johns landfill bridge

Design for Safety and Security

Given the proximity of the trail to private and publicly owned industrial lands, trail separation is an important design consideration, especially along the South Slough. Vegetative buffers and fencing, or both as needed, are proven ways to address safety and security needs of industrial land owners and trail users. Below is a more detailed discussion of these design solutions.

Vegetative Buffers

When possible, landscaping is the first choice for creating separation between the trail and adjacent properties. Vegetative buffers have the dual purpose of creating a natural privacy screen, providing habitat and stabilizing soils. Landscaping can also be an effective barrier to unwanted access where needed.

Fencing

Where a vegetative buffer will not suffice, fencing is another means of assuring safety by prevention of unwanted access, reducing the ease of trespassing and potential crime issues on private property.

There are numerous fencing types that can be considered. Solid fencing that does not allow any visual access to the trail should be discouraged. Fencing that allows a balance between the need for privacy and security while simultaneously allowing informal surveillance of the trail should be encouraged.

As appropriate, a combination of both vegetative buffer and fencing may be the best design approach.

The recommended fence to separate the trail from the industrial properties along the South Slough is a vinyl-coated chain link fence, 5-6’ feet high, with appropriate measures taken to allow for the passage of wildlife while

preventing trail users from accessing the adjacent properties.

A boardwalk treatment is recommended where the trail crosses the Wapato Wetlands (between alignment sections 4A.2 and 4B.3). The trail will travel closer to the slough in this location to provide a visual separation from the industrial operations to the south. Fencing along the south side of the Wapato Wetlands will also create additional deterrence from trespassing on to the nearby private property. The fencing would continue to the N. Portland Road bridge.

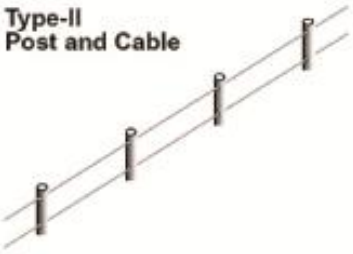
For the trail on the landfill perimeter road, a chain link fence that allows for wildlife passage below is recommended.

Fencing options are shown in Figure 12 below. Additional safety and security considerations and recommendations are shown in Table 3 below.

Type-I
Picket Fence

Where trespassing is not as much of a problem, a low wood rail fence can still serve as an effective reminder to trail users to stay on the trail.

Type-II
Post and Cable



This inexpensive fence is primarily used where trespassing has not been an historical problem, there is adequate setback, and the fence serves primarily to demarcate the railroad property boundaries. The fence does not provide any screening or anti-trespassing features.

Type-III
Chain Link

Chain link fences are popular due to their effectiveness in keeping trail users on the trail, relative low cost, and ease of maintenance. Chain link fence may not be appropriate for areas with a high history of trespassing, since it is very easy to cut and vandalize. Most chain link fences are visually unappealing - and tend to project an image of an urban industrial environment. For this reason, trail designers should explore using other, more appealing types of fences whenever possible.

Type-IV
Vinyl-Coated
Chain Link

Similar to Type III, but with either a plastic woven fabric or wood battens in the chain link material providing a stronger deterence to potential trespassers and a solid-type barrier to help catch debris and provide wind and visual buffering.

Figure 12. Fencing Types

Table 3. Safety and Security

Safety Issue	Recommended Improvements
Litter and Dumping	1. Post trail rules encouraging pack it in pack it out etiquette.
	2. Place garbage receptacles at trailheads.
	3. Provide good visual access to the trail.
	4. Manage vegetation within the right-of-way to allow good visual surveillance of the trail from adjacent properties and from roadway/trail intersections.
Trespassing	1. Clearly distinguish public trail right-of-way from private property through the use of vegetative buffers and the use of good neighbor type fencing.
	2. Post trail rules that encourage respect for private property.
	3. Place good neighbor fencing between trail and private property to the south in Segment 4.
Crime	1. Manage vegetation so that corridor can be visually surveyed from adjacent streets and properties.
	2. Select shrubs that grow below 3' in height and trees that branch out greater than 6' in height.
	3. Place lights strategically and as necessary.
	4. Place benches and other trail amenities at locations with good visual surveillance and high activity.
	5. Provide mileage markers at quarter-mile increments and clear directional signage for orientation.
	6. Create a "Trail Watch Program" involving local residents and employers.
	7. Proactive law enforcement.
Intersection Safety	1. Require all trail users to stop at public roadway intersections through posting of stop signs.
	2. Provide cross walk striping and trail crossing warning signs for vehicle drivers.
	3. Install median island and pedestrian-activated signal at N. Columbia Boulevard crossing.
	4. Manage vegetation at intersections to allow visual access at crossings.
Trailhead Safety	1. Clearly identify trailhead access areas.
Vandalism	1. Select benches, bollards, signage and other site amenities that are durable, low maintenance and vandal resistant.
	2. Respond through removal or replacement in rapid manner.
	3. Keep a photo record of all vandalism and turn over to local law enforcement.
	4. Encourage local residents and employers to report vandalism.
	5. Create a trail watch program; maintain good surveillance of the corridor.
	6. Involve neighbors in trail projects to build a sense of ownership.
	7. Place amenities (benches, etc.) in well used and highly visible areas.

III. Implementation & Phasing

Trail Development Considerations

The 2005 Feasibility Study contains a list of land use and regulatory approvals needed for trail development. That list was reviewed and found to be complete for purposes of this report. A table summarizing trail development considerations for the preferred alignment can be found in Appendix D (see Table D-1). These references, along with the cost estimates (below) provide the level of information needed to move from the planning to the design phase of this project. See Figure ES-3 for the alignments described below in Table 4.

Cost

The planning-level cost estimate for the preferred alignment is approximately $21 million (Table 4). This estimate reflects a 40% construction contingency and the assumption that federal funding will be used to develop the trail; “federalized” projects typically cost 30% more to complete than projects that are not federalized. See Appendix E, Table E-1 for a detailed cost estimate. The cost estimate was developed using a model developed using Metro’s cost estimating worksheet (accepted by several regional governments), supplemented by additional cost estimating information from a nationally-accepted model developed by Alta.

Table 4. Planning-level Cost Estimate

	Length (ft)	Federalized Cost Estimate
Segment 1: Park Connector		
1C	803	$81,000
1D	2,700	$347,000
1E	1,506	$194,000
Segment 1 sub-total	**5,009**	**$622,000**
Segment 2: Columbia Blvd Crossing		
2B	**153**	**$446,000**
Segment 3: Landfill Connector		
3C	1,112	$143,000
3 (spur)	212	$27,000
3 (trailhead)	n/a	$253,000
3 (bridge)	692	$89,000
3D	8,935	$6,858,000
Segment 3 sub-total	**10,951**	**$7,370,000**
Segment 4: South Slough		
4	2,625	$872,000
4A.1	988	$363,000
4A.2	1,583	$2,069,000
4B.3	3,119	$3,795,000
4	1,884	$2,152,000
4C	310	$3,322,000
Segment 4 sub-total	**10,510**	**$12,573,000**
Total	**26,622**	**$21,011,000**

Funding Source

It is assumed that the majority of funding for implementation will be acquired through the non-motorized programs and funding opportunities provided by the Federal Highway Administration, including federal funding that is passed through to Oregon Department of Transportation.

Phasing

The primary purpose for a trail phasing plan is to ensure a logical sequence of implementation that provides a high degree of success as each phase is built, thereby building momentum for each future phase of the project.

Success is directly correlated with a substantial level of use, strong public and political support, and proven effective management of the trail as each phase is

implemented. Success of the first built phase is critical to securing future funding. The first phase must be well received by the public and become a model for all other future phases.

Phase 1: Trail Segments 1-3

Completing trail segments 1-3 is recommended as the first phase of implementation. This approach is consistent with Metro Council resolution No. 05-3592B directing staff to pursue the connection between the Smith and Bybee Wetlands Natural Area and the St. Johns neighborhood as a first priority. Segments 1-3 are located on lands owned by other City of Portland agencies who have been long-time project partners and trail advocates.

Metro, in close partnership with Portland Parks and Recreation Dept. received grant funding to design and build a bike/pedestrian bridge that provides the first critical link towards a neighborhood connection.

Funding requests for phase I have a strong leveraging advantage with the bike/pedestrian bridge project mentioned above underway, as well as ongoing trail acquisition and planning efforts to complete the North Portland Greenway between the Willamette River and Pier Park. Between these two trail projects, a continuous, non-motorized loop will be in place to travel from the Willamette River, through St. Johns to Pier and Chimney Parks, through the Smith and Bybee Wetlands Natural area, on to Kelley Point Park and the existing Marine Drive trail, and finishing the loop by connecting to Peninsula Crossing trail.

Phase 2: Trail Segment 4

Implementing trail segment 4 requires negotiating with private and public property owners along the south side of the Columbia Slough between the St. Johns landfill entrance bridge and the North Portland Road. Metro's policy to work only with willing sellers makes it hard to predict when the land may be ready for trail development. The Columbia Slough is a target area of Metro's voter-approved 2006 Natural Areas Bond Measure. One of the central objectives of this target area is to acquire property to close trail gaps in the Columbia Slough Trail. To date, Metro has acquired several trail easements and/or fee parcels for the trail within this target area.

When completed, this phase will allow for recreational loop rides around Smith & Bybee Wetlands Natural Area, with direct connections to the Peninsula Crossing trail.

Appendix A: South Slough Alignment Evaluation Criteria and Measures

South Slough Alignment Evaluation Criteria and Measures

Table A1

Segment 1: Park Connector - Vicinity of Pier and Chimney Parks

Criteria Definition	Criteria Measures
Connectivity – Recreational Trips This criterion evaluates connectivity and access to the Peninsula Crossing trail, other trails, bikeways and parks. This criterion also evaluates the quality of the travel experience.	• Provides opportunities to access existing recreational amenities within Pier and Chimney Parks • Trails in Pier and Chimney Parks enhance pleasurable travel experience by considering views within and between the parks • Maximizes connection to Peninsula Crossing Trail, North Portland Greenway trail and North Reach of Willamette River Greenway Trail.
Connectivity - Utilitarian Trips This criterion evaluates connectivity and access to residential, commercial or employment areas as well as schools. More direct pathways will receive a higher score.	• Provides the most direct access to destinations such as major employers, downtown St. Johns • Minimizes out of direction travel
Safety and Security – Trail Users This criterion addresses the safety concerns of trail users traveling along the trail. The better the sightlines, the higher the score.	• Surrounding area is open and visible from all angles • Trail users have good lines of sight along the trail and to immediate adjacent surrounding area • No buildings or large structures obscure views of the trail
User Experience This criterion measures the quality of the users' experience of the trail. It considers potential views, environmental aesthetics, comfort and characteristics such as noise, and air quality.	• Limits views of industrial/commercial activity • Minimizes Level of noise from surrounding land uses such as roadways and railroads • Potential and ease of providing amenities (e.g. directional signage)
Cost This criterion will score options based on the cost of acquisitions, design, engineering, and/or construction, especially where crossing improvements, fencing, or other expensive infrastructure improvements would be necessary. Lower cost options will receive higher scores.	• Minimizes cost of easement / acquisition • Minimizes cost of design/engineering/construction • Minimizes cost of maintenance

Consistency with Funding Eligibility Requirements This criterion evaluates whether costs associated with an alternative will qualify for potential funding sources. Alternatives with a higher percentage of eligible costs will receive a higher score.	• High percentage of project cost eligible for funding
Topographical Constraints This criterion considers topographical constraints and the ease of providing for ADA accessibility. Higher scores if earth moving, retaining walls and long ramps are not needed or minimized.	• Minimizes number of slopes associated with option • If present, slopes are minimized • Ample room to grade trail to meet ADA accessibility • Minimizes length of ramps needed
Compatibility with Land Use and Permitting Requirements This criterion considers the compatibility of the alignment option with existing land use and permitting requirements. Alignment options with least cost to permit and most ease to receive approvals will receive higher scores.	• Proposed segment does not conflict with existing land use planning documents, land use approvals or permit requirements (City of Portland – Parks, Planning, PBOT) • Meets Union Pacific guidelines • Segment is compatible with existing uses in Pier Park and future potential uses in Chimney Park.
Maintenance & Operations This criterion evaluates the expected relative effort required to maintain the alignment. Typical maintenance includes trash disposal, signage and marking, replacement, vegetation pruning, and pavement sealing. Options requiring less maintenance and lower costs will score higher.	• Less intensive maintenance required • Minimizes cost of required maintenance activities
Stakeholder Buy In This criterion considers the level of support or opposition an alignment option receives from landowners and project partners. Alignments with less opposition will receive a higher score.	• Landowner (City of Portland) and project partners helped to develop alignments and weighed in on preferences.

Segment 2: North Columbia Boulevard Crossing

Criteria Definition	Criteria Measures
Safety and Security of Trail User at Roadway Crossing of North Columbia Boulevard This criterion evaluates the safety of the trail user while crossing the road based on 1) the driver's ability to see the trail user, 2) the trail user's ability to see approaching vehicles. Trail crossings where sightlines are best receive the higher score.	• Trail-roadway crossing is designed to maximize trail user safety and sightlines • Crossing location maximizes visibility of trail users and vehicle drivers of each other • Provides open, and easily viewable crossing approaches for trail user • Limits sight obstructions for trail users and drivers caused by buildings or other large obstacles •
Compatibility with Land Use and Permitting Requirements This criterion considers the compatibility of the alignment option with existing land use and permitting requirements. Alignment options with least cost to permit and most ease to receive approvals will receive higher scores.	• Proposed segment does not conflict with existing land use planning documents, land use approvals or permit requirements (PBOT) • Minimizes cost of permits
Maintenance & Operations This criterion evaluates the expected relative effort required to maintain the alignment. Typical maintenance includes roadway striping, replacing worn or missing signage, and re-striping when necessary. Options requiring less maintenance and lower costs will score higher.	• Less intensive maintenance required • Minimizes cost of required maintenance activities
Stakeholder Buy In This criterion considers the level of support or opposition an alignment option receives from landowners, project partners and public. Alignments with less opposition will receive a higher score.	• Landowner (City of Portland) and project partners have expressed minimal or no objections to crossing location

Segment 3: Landfill Connector - North side of Columbia Blvd. to SE corner of Landfill

Criteria Definition	Criteria Measures
Connectivity – Recreational Trips This criterion evaluates connectivity and access to the trailhead, landfill bridge, trails in the vicinity of the landfill entrance and South Slough Segment. This criterion also evaluates the quality of the user experience.	• Provides opportunities to enhance pleasurable travel experience between Columbia Boulevard and the trailhead, landfill bridge, trails in vicinity of landfill entrance and south slough segment • Provides views of Chimney Park, Pier Park and the Columbia Slough • Avoids views of the junk yard west of existing landfill access road
Connectivity - Utilitarian Trips This criterion evaluates the most direct connectivityto trailhead, landfill bridge, landfill trails and South Slough segment. More direct pathways will receive a higher score.	• Provides the most direct access • Minimizes out of direction travel
Safety – Rail Crossing This criterion evaluates how well the location and design for each alignment protects trail users from active Union Pacific railroad tracks.	• Provides the best sight line for railroad operator to see trail users approaching railroad crossings. • Minimizes exposure to conditions that limit trail user's ability to hear and see approaching trains or warning mechanisms • Minimizes wait time for trail user to cross tracks.
Safety and Security – Trail Users This criterion addresses the sense of safety and security trail users feel in areas other than railroad crossings.	• Trail users have good lines of sight along the trail and to immediate adjacent surrounding area, surrounding area is open and visible for all angles • No buildings or large structures obscure views of the trail • Trail is easy to light (were appropriate) • Minimizes user exposure to driveways and other types of motor vehicle traffic
Safety and Security - Adjacent Property Owners This criterion addresses the safety and security of adjacent property owners. For example, these criteria will give points to alignments that deter trespassers onto adjacent industrial properties.	• Deters trespassing ont neighboring properties (i.e. accommodates lighting, fencing) • Minimizes proximity to existing commercial or industrial equipment and structures

User Experience This criterion measures the quality of the experience of the trail user. It considers potential views, environmental aesthetics, comfort and characteristics such as noise, and air quality.	• Fewer views of industrial/commercial activity • Level of noise from surrounding land uses such as roadways and industrial activities is minimized • Potential and ease of providing amenities where appropriate (e.g., benches, trash cans and directional signage)
Cost This criterion will score options based on the cost of acquisitions, design, engineering, and/or construction, especially where crossing improvements, fencing, or other expensive infrastructure improvements would be necessary. Lower cost options will receive higher scores.	• Minimizes cost of easement / acquisition • Minimizes cost of design/engineering/construction • Minimizes cost of maintenance
Consistency with Funding Eligibility Requirements This criterion evaluates whether costs associated with an alignment will qualify for potential funding sources. Alignments with a higher percentage of eligible costs will receive a higher score.	• High percentage of project cost eligible for funding
Topographical Constraints This criterion considers topographical constraints and the ease of providing for ADA accessibility. Higher scores if earth moving, retaining walls and long ramps are not needed or minimized.	• Minimizes number of slopes associated with option • If present, slopes are minimized • Ample room to grade trail to meet ADA accessibility • Minimizes length of ramps needed
Stakeholder Buy-In This criterion considers the level of support or opposition an alignment option receives from landowners. Alignments with less opposition will receive a higher score.	• Landowner (City of Portland) is willing to sell or grant an easement • Surrounding landowners have expressed minimal or no objections • Alignment option does not conflict with UP railroad guidelines
Compatibility with Land Use and Permitting Requirements This criterion considers the compatibility of the alignment option with existing land use and permitting requirements. Alignment options with least cost to permit and most ease to receive approvals will receive higher scores.	• Proposed segment does not conflict with existing land use planning documents, land use approvals or permit requirements (DEQ, NOAA, City of Portland – Planning, PBOT) • Minimizes cost of permits

Maintenance & Operations This criterion evaluates the expected relative effort required to maintain the alignment. Typical maintenance includes signage and marking replacement, vegetation pruning, and pavement sealing. This criterion also measures level of disruption to landfill closure activities and proximity to landfill equipment.	• Less intensive maintenance required • Minimizes cost of required maintenance activities • Alignment placement minimizes disruption to landfill activities • Proposed alignment avoids proximity to landfill equipment

Segment 4 Columbia Slough - Between landfill bridge and Col. Blvd. WWTP

Criteria Definition	Criteria Measures
Connectivity – Recreational Trips This criterion evaluates connectivity and access to the proposed trail head and existing landfill bridge, Peninsula Crossing Trail, Columbia slough trail, and other bikeways or parks. This criterion also evaluates the quality of the travel experience.	• Provides opportunities to access existing trailhead and existing landfill bridge • Alignment provides opportunities to enhance pleasurable travel experience by offering views of the Columbia Slough, Wapato wetlands, and Smith Lake
Connectivity - Utilitarian Trips This criterion evaluates connectivity and access to residential, commercial or employment areas as well as schools. More direct pathways will receive a higher score.	• Provides the most direct access to destinations such as major employers • Minimizes out of direction travel
Safety and Security – Trail Users This criterion addresses the safety concerns of trail users, looking at how compatible adjacent land uses are with various alignments.	• Surrounding area is open and visible from all angles • Trail is clearly visible for its entire length • No buildings or large structures obscure views of the trail • Trail is easy to light (where appropriate)
Safety and Security - Adjacent Property Owners This criterion addresses the safety and security of adjacent property owners. Alignment options that address specific concerns of property owners along this segment will score higher.	• Addresses landowner's concerns regarding trail and trail users being in close proximity to their property • Trail design deters trespassing from trail to neighboring properties • Meets Union Pacific railroad guidelines • Meets Pacific Corps guidelines for trails beneath utility corridor. • Minimizes proximity to industrial structures

User Experience This criterion measures the quality of the experience of the trail user. It considers potential views, environmental aesthetics, interpretive opportunities, comfort and characteristics such as noise, and air quality.	• Fewer views of industrial/commercial activity • Level of noise from surrounding land uses such as roadways and steel manufacturing is minimized • Potential and ease of providing amenities (e.g. directional signage) • Potential to interpret natural and cultural history unique to the Columbia Slough corridor • Promotes connection to nature
Cost This criterion will score options based on the cost of acquisitions, design, engineering, and/or construction, especially where crossing improvements, fencing, or other expensive infrastructure improvements would be necessary. Lower cost options will receive higher scores.	• Minimizes cost of easement / acquisition • Minimizes cost of design/engineering/construction • Minimizes cost of maintenance
Consistency with Funding Eligibility Requirements This criterion evaluates whether costs associated with an alignment will qualify for potential funding sources. Alignments with a higher percentage of eligible costs will receive a higher score.	• High percentage of project cost eligible for funding
Topographical Constraints This criterion considers topographical constraints and the ease of providing for ADA accessibility. Higher scores if earth moving, retaining walls and long ramps are not needed or minimized.	• Minimizes number of slopes associated with option • If present, slopes are minimized • Ample room to grade trail to meet ADA accessibility • Minimizes length of ramps needed
Stakeholder Buy-In This criterion considers the level of landowner support that each alignment will likely receive. Alignments less likely to receive opposition will receive a higher score.	• Ratings are assigned based on communications with landowners and Metro acquisition staff's best professional judgement at this time. • Communications with landowners are confidential to protect their interests and respect their privacy.
Habitat protection This criterion considers the need to protect sensitive habitats for herons, eagles, turtles, and other animals within the Columbia Slough.	• Avoids existing wetlands • Avoids existing sensitive habitat areas such as eagle or osprey nests • Provides opportunities to enhance /restore habitat • Discourages disturbance to sensitive habitat. • Avoids construction within the flood plain to the maximum possible extent

Compatibility with Land Use and Permitting Requirements This criterion considers the compatibility of the alignment option with existing land use and permitting requirements. Alignment options with least cost to permit and most ease to receive approvals will receive higher scores.	• Proposed segment does not conflict with existing land use planning documents, land use approvals or permit requirements (NOAA, DSL/ACOE, USFWS, City of Portland – Planning, ODOT) • Minimizes cost of permits
Maintenance & Operations This criterion evaluates the expected relative effort required to maintain the alignment. Typical maintenance includes trash disposal, signage and marking replacement, vegetation pruning, and pavement sealing.	• Intensity of required activities (options requiring less maintenance will score higher) • Ongoing cost of required activities (lower cost options will score higher) • Alignment minimizes conflicts with WWTP operations • Alignment minimizes conflicts with St. Johns landfill closure operations.

Appendix B: South Slough Alignment Opportunities & Constraints Analysis

South Slough Trail Alignment – Opportunities and Constraints Analysis

Table B1 is divided into three sections: opportunities, neutral factors and constraints. Each opportunity, neutral factor and constraint is assigned a number that correlates to a location shown on Map B1 (Opportunities and Constraints – West) and Map B2 (Opportunities & Constraints – East). The 'neutral' category fits circumstances that fall between an opportunity and a constraint. Each number is color coded to indicate if it is an opportunity (green), neutral factor (white) or constraint (red). In a few cases a number is coded with two colors, because it fits into more than one category.

Map B3 illustrates opportunities and constraints pertaining to land ownership and Map B4 illustrates opportunities and constraints pertaining to existijng land uses and zoning.

Table B1

Opportunities

No.	Location	Description
2	Railroad tracks separating Pier Park and Chimney Park	Received state grant to design/build bike/pedestrian bridge over railroad tracks between Pier and Chimney Parks. Project expected to be complete in 2011.
5	A closed access road that starts at Columbia Boulevard and ends at the existing landfill access road just south of the at-grade railroad crossing.	The closed access road presents the opportunity for the trail to be separated from traffic until the road meets up with the existing access road at the railroad crossing. It would also avoid views along the existing access road of a junkyard. The entrance to this road at Columbia Blvd. lines up directly with a walkway on the opposite side of Columbia Blvd. that leads to the entrance to the building at Chimney Park.
7	At-grade railroad crossing on landfill access road.	An at-grade railroad crossing exists on the landfill access road. The railroad must be crossed to continue the proposed trail and the existing at-grade crossing is the most straightforward option. UP railroad is likely to approve an at-grade trail crossing at this location with minor improvements (pers. comm. Brock Nelson UP Railroad 4/09). Installing speed bumps on either side of the railroad crossing would slow down fast-moving semi-trucks that deliver cars to an adjacent car lot to the east.
9	Landfill access road north of the at-grade railroad crossing	North of the at-grade railroad crossing, the landfill access road is suitable for a trail directly adjacent to the roadway and provides direct access to the proposed trailhead (Opportunity 10) and the proposed trail on landfill (see Opportunity 13).
10	South shore of Columbia Slough, just west of entrance to the landfill bridge .	A trailhead with canoe launch is proposed on a plot of land on the south side of the Columbia Slough, just west of the entrance to the landfill bridge. Trailhead provides canoe access to slough, and access to trail onto landfill

No.	Location	Description
		(Opportunity 13) and along south side of Columbia Slough (Opportunity 15).
11	Existing bridge at landfill access road.	An existing bridge with sufficient width to accommodate trail users and landfill vehicles crosses the Columbia Slough, connecting North Columbia Boulevard to the landfill site on the north side of the slough, providing a connection to the planned trail on the landfill .
13	Southeast section of landfill perimeter from Landfill Bridge, east to landfill perimeter road near 'blind' slough.	There is space available to have the proposed trail travel east along the slough after it crosses over the landfill bridge until it joins up again with the planned trail on the landfill road near the head of the 'blind slough'. This route avoids having trail users travel past industrial equipment along a fenced (on both sides) corridor through the interior of the landfill as currently recommended in the 2005 feasibility study.
14	South shore of Columbia Slough from proposed trail head east to North Portland Road	A power line corridor traverses the south side of the Columbia Slough. The corridor, which is already clear of trees and has an existing easement from Union Pacific, is a potential trail alignment.
18	South shore of Columbia Slough approximately ¾ mile south-east of existing landfill bridge	The existing peninsula just north of the powerline corridor along the southern edge of the Columbia Slough is higher than the surrounding land, providing opportunities to locate the trail outside of nearby Wapato wetlands and provide access to additional viewpoint and interpretive opportunities of the slough.
22	Property just west of North Portland Road on south sideof the Columbia Slough	This property is owned by the City of Portland's Bureau of Environmental Services, and as a condition of development, BES has allocated land along the northern edge of the property for the location of a trail.
23	North Portland Road bridge and railroad bridge just east of North Portland Road near the Columbia Slough	There is sufficient area below North Portland Road and the railroad structure on the southern edge of the Columbia Slough for a trail undercrossing of both bridge structures.
24	Existing North Portland Road bridge crossing the Columbia Slough	The opportunity exists to build a bicycle/pedestrian bridge adjacent to the existing North Portland Road bridge near the top of the bank. The bike/ped bridge would be supported on its own piers and be at a sufficient height above bank of slough to avoid seasonal flooding.

No.	Location	Description
27	The north / south corridor between the railroad tracks and the WWTP on east side of North Portland Rd.	There is a potential north/south trail corridor along the western edge of the WWTP to connect the trail to Peninsula Crossing Trail at North Columbia Court.
28	East of North Portland Road and railroad tracks between North Columbia Boulevard and the Columbia Slough	BES desires secondary access to the WWTP east of North Portland Boulevard near the Columbia Slough to allow access to their property when trains block the entrance at N. Woolsey.
29	Union Pacific railroad tracks south of WWTP	A new railroad overpass would provide better access for Columbia Street and WWTP employees.
30	Peninsula Crossing Trail between North Columbia Boulevard and Marine Drive. At the Columbia Blvd. WWTP,	The Peninsula Crossing Trail is in close proximity to the proposed trail in the vicinity of the WWTP, presenting an opportunity to provide connections between the two trail systems.
31	North Columbia Court	North Columbia Court is a low volume roadway near the proposed trail that could be designed to serve as a bicycle boulevard that would provide a connection to the existing Peninsula Crossing Trail and the South Slough trail .
32	Columbia Slough ¼ mile east of North Portland Road	The Peninsula Crossing trail crosses the Columbia Slough via a bicycle/pedestrian bridge just east of the Columbia Blvd. WWTP. If there is a way to connect the proposed trail to this bridge, it would avoid the cost of needing to improve the N. Portland Road Bridge to accommodate the trail.

Neutral Factors

No.	Location	Description
1	Pier Park	A proposed bike/ped bridge (Opportunity 2) will connect existing trails in Pier Park with Chimney Park. A large disc golf course 'hole' is in close proximity to the proposed bridge landing. Close coordination with stakeholders will be important on all siting issues.
3	Chimney Park	Portland Parks and Recreation requested that 1) the trail in Chimney Park be located to maintain as much flexibility for future development of the undeveloped parts of the park, and 2) . That the trail and bridge be located in a manner that will not conflict with exiting uses including a fenced dog park, large trees and a stormwater manhole. Close coordination with Portland Parks will be important on siting issues.
13	Southeast section of landfill perimeter from Landfill Bridge, east to landfill perimeter road near 'blind' slough.	There may need to be a ramp constructed from the north end of the bridge down towards the slough, while still meeting ADA. The slough route would require land use review, by virtue of being in the e-zone but should be permittable.
15	Spit of land east of landfill access bridge between blind slough and south slough.	There is a blue heron nesting area on this spit of land but it is approx. 400 feet north of where a trail would be located, and this is within the neutral impact area determined by the 2005 trail study.
16	east of the landfill access road, between North Columbia Boulevard and the Columbia Slough	The railroad has plans to expand the number of tracks in this location.
19	¾ mile east of landfill bridge, north side of the Columbia Slough, south shore of Smith Wetland	There is an active bald eagle nest in this location. It is approximately 400 feet north of the south bank of the Columbia Slough. The 2005 feasibility study determined this distance as neutral with respect to impacts to bald eagle habitat. This is due to the physical distance and because the Columbia Slough and riparian areas on both sides of the slough separate the nest visually from the potential trail location on south side of slough.
21	West of North Portland Road between North Columbia Boulevard and the Columbia Slough	There is a temporary access road to Columbia Steel Castings off of North Portland Road. Columbia Steel Castings would be interested in formalizing this entrance to allow access to their facility when trains are blocking access through North Macrum Ave.

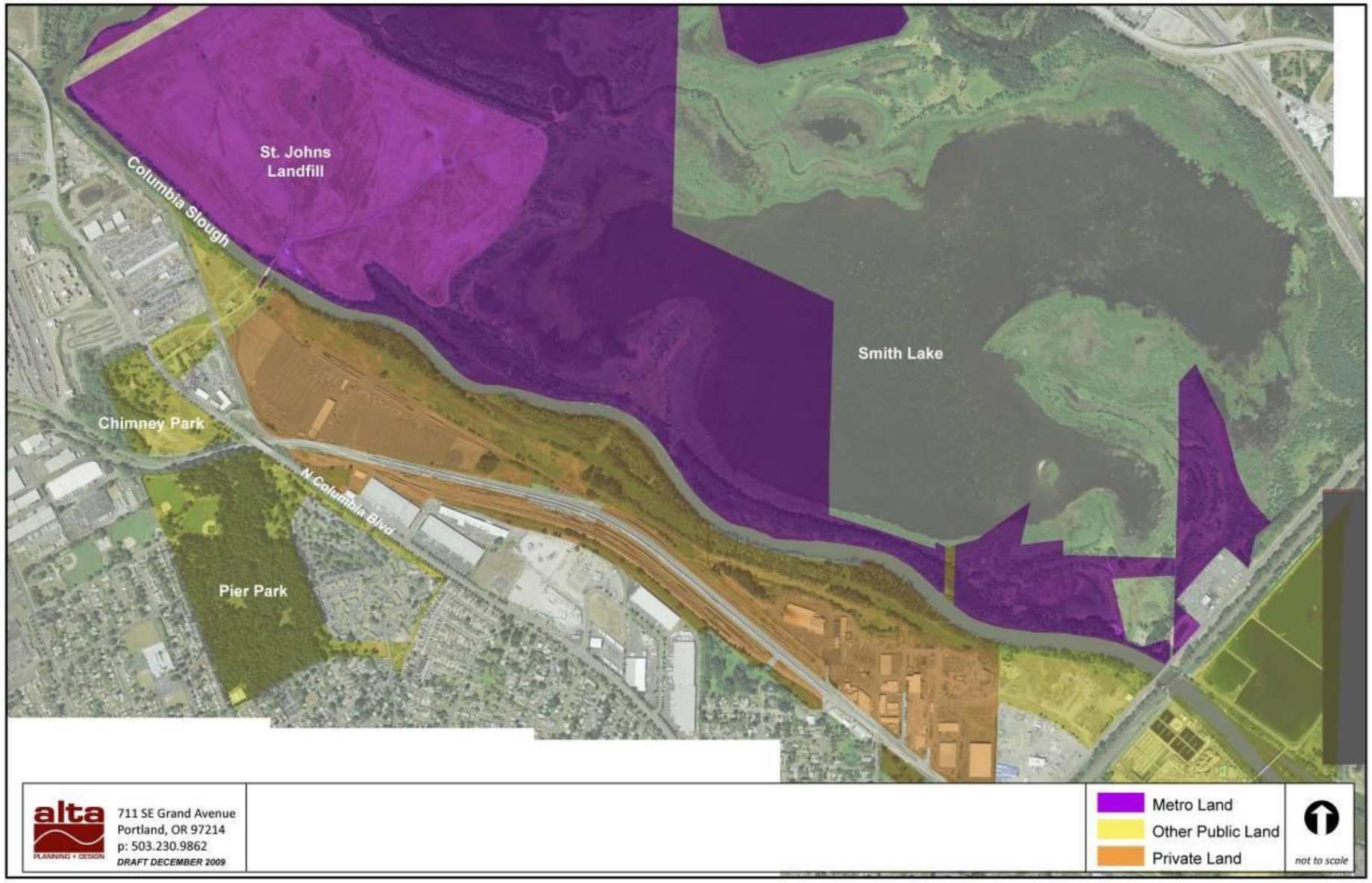
Constraints

No.	Location	Description of Issue
4	North Columbia Blvd / Chimney Park entrance intersection	2005 Feasibility Study recommends an at-grade signaled crossing, but the crossing would still have an element of risk for trail users due to heavy traffic volumes and speeds on Columbia Boulevard. This crossing design meets code requirements, but the City may not want to have another signal at this location.
5	The closed access road that starts at Columbia Blvd.	The entrance to this closed access road from Columbia Blvd. is about 200 feet closer than the current access road to the 'blind' curve in westbound lanes of Columbia Blvd. and this could significantly offset the opportunities it offers.
6	Parcel adjacent to northwest westside of landfill access road	The junk yard that borders the west side of the landfill access road (where the preferred trail alignment is proposed) presents aesthetic and safety issues. Junk from the yard tends to 'drift' onto the existing access road and can include abandoned vehicles and trailers. Effective mitigation (removal of debris and landscape plantings) would be costly.
7	At –grade railroad crossing on landfill access road.	Long waits for trains can be experienced at this crossing, up to 20 minutes at a time. This would be a disadvantage to trail users, especially commuters. Fast-moving semi-truck traffic cross the at-grade crossing and turn right into an adjacent car lot, presenting a safety hazard to bicyclists and pedestrians.
8	Landfill access road, in vicinity of existing railroad crossing	The 2005 feasibility study recommended a railroad undercrossing to the west of where the existing landfill road crosses the railroad tracks at-grade. Upon further analysis, this design is not feasible due to lack of space to accommodate the trail approaches to an underpass or overpass on either side of the railroad crossing. Locating the trail anywhere but on the road for the railroad crossing causes difficulties in design and construction.
12	North side of the exiting landfill bridge at landfill entrance area	As recommended in the 2005 trail feasibility study, the trail would pass close to noisy industrial equipment at the landfill entrance and continue along an existing interior landfill road before joining up with the landfill perimeter road to the east.
14	East of the landfill access road, south of the Columbia Slough	Union Pacific (UP) has a large rail yard in this location and owns land between the Columbia Slough and North Columbia Blvd. An easement from UP would be required to locate a trail in this area.
17	~¾ of a mile east of landfill access road, south of the Columbia Slough	There is a seasonal wetland that may limit the location of the trail alignment in this vicinity.

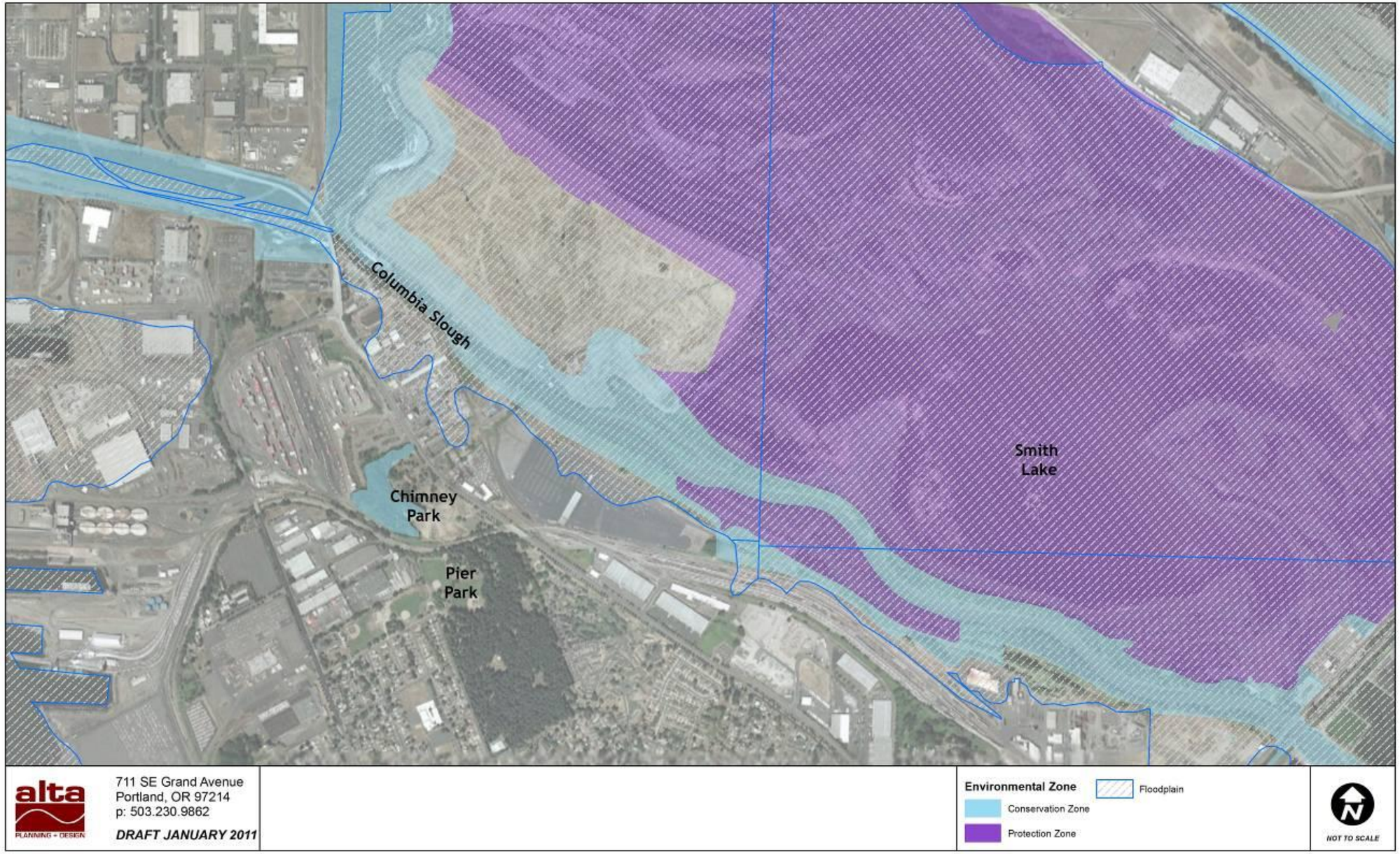
No.	Location	Description of Issue
20	1¼ mile east of the landfill access road, south of the Columbia Slough	Privately owned industrial land east of the Union Pacific rail yard between the Columbia Slough and the railroad tracks. Manufacturing plant owner is highly concerned with security issues including trespassing and theft from their property and safety of their employees.
25	Interior roads along northern boundary of the Wastewater Treatment Plant	Operational demands of the road and equipment located along the northern boundary of the wastewater treatment plant eliminate possibility of locating the trail adjacent to interior roads.
26	South bank of Columbia Slough between east side of North Portland Road bridge and the existing bike/pedestrian bridge near the WWTP.	There is an overgrown restored riparian edge along the Columbia Slough just outside the WWTP fencing that might accommodate a trail on a cantilevered platform. It would require extensive engineering and environmental review for implementation.
29	Union Pacific railroad tracks south of WWTP	The railroad tracks are located in a narrow cut, requiring a new bike/ped bridge to crossover them, allowing trail to continue south and east to existing Peninsula Crossing trail.

Map B1. Opportunities & Constraints - West

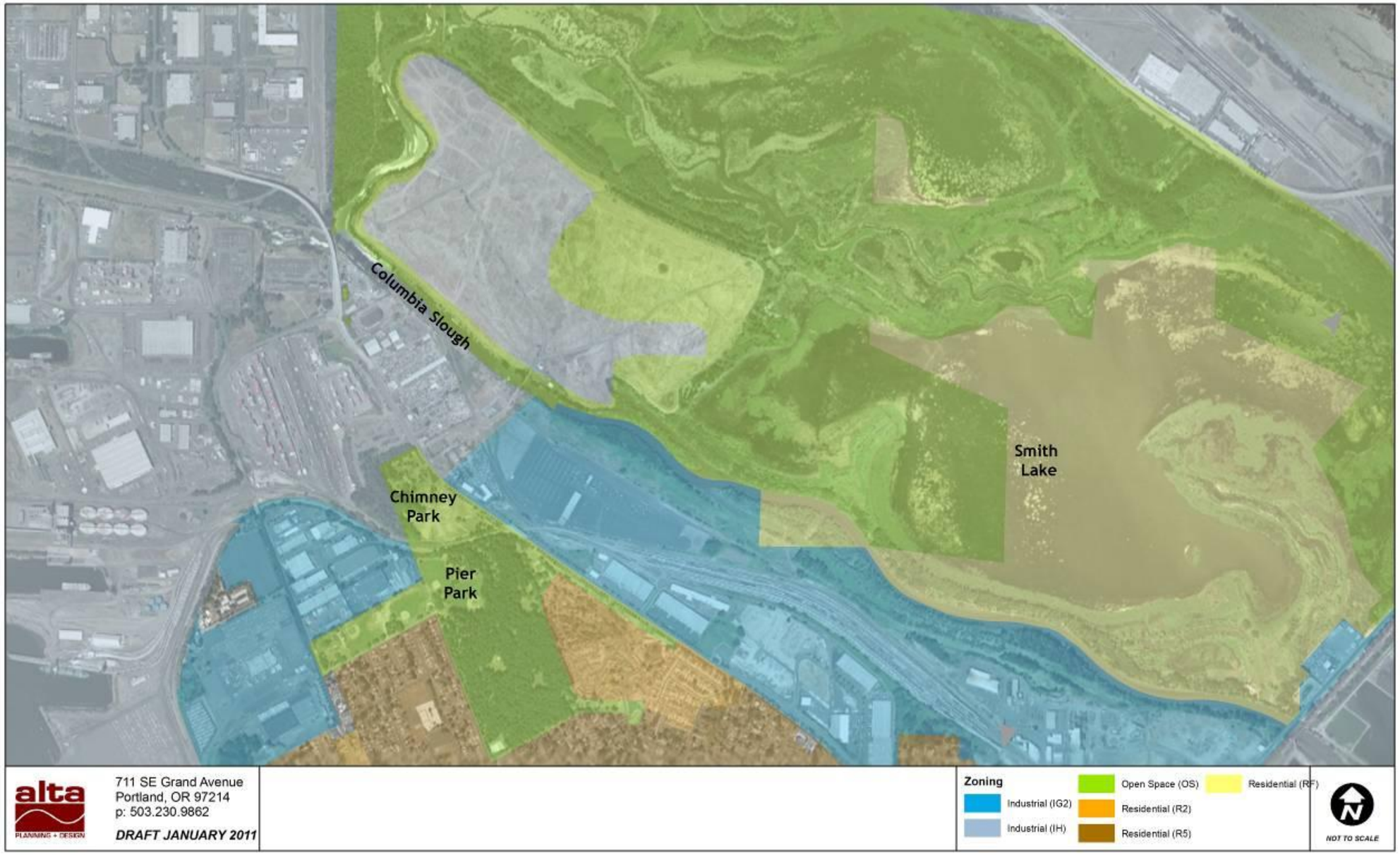
Map B2. Opportunities & Constraints - East



Map B3. Opportunities & Constraints – Property Ownership Type



Map B4. Opportunities & Constraints - Environmental



Map B5. Opportunities & Constraints - Zoning

Appendix C: Alignment Options Analysis and Evaluation

Table C1. Alignment Options Comparison

Evaluation Criteria and Measures	Alignment Options																				
	Segment 1					*Segment 2*		*Segment 3*					*Segment 4*								
	1A	1B	1C	1D	1E	2A	2B	3A	3B	3C	3D	3E	4A.1	4A.2	4A.3	4B.1	4B.2	4B.3	4C	4D	4E
Connectivity – Recreational Trips	**-**	**O**	**+**	**+**	**O**	**N/A**	**N/A**	**O**	**O**	**+**	**+**	**-**	**O**	**O**	**-**	**+**	**+**	**+**	**O**	**O**	**-**
Provides access to adjacent recreation opportunities	O	O	+	+	+	N/A	N/A	+	O	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	O	-
Provides opportunities to enhance travel experience	-	-	+	+	O	N/A	N/A	O	O	+	+	-	O	O	-	+	+	+	O	+	-
Provides opportunities for desirable views	-	O	+	+	-	N/A	N/A	-	O	+	+	-	O	-	-	+	+	+	O	+	-
Provides regional trail connections	-	-	+	+	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	O	O
Connectivity - Utilitarian Trips	**O**	**-**	**+**	**+**	**+**	**N/A**	**N/A**	**O**	**O**	**O**	**N/A**	**N/A**	**+**	**+**	**+**	**-**	**-**	**-**	**O**	**O**	**O**
Most direct access to destinations	-	-	+	+	+	N/A	N/A	O	O	O	N/A	N/A	+	+	+	-	-	-	O	O	O
Minimizes out-of-direction travel	O	-	+	+	+	N/A	N/A	O	O	O	N/A	N/A	+	+	+	-	-	-	O	O	O
Safety - Roadway Crossing	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**-**	**O**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Maximize trail user safety and sightlines	N/A	N/A	N/A	N/A	N/A	-	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Maximizes visibility of trail users and vehicle drivers of each other	N/A	N/A	N/A	N/A	N/A	-	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Provides open, and easily viewable crossing approaches for trail user	N/A	N/A	N/A	N/A	N/A	-	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limits sight obstructions for trail users and drivers caused by buildings or other large obstacles	N/A	N/A	N/A	N/A	N/A	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Crossing is furthest distance from blind curves	N/A	N/A	N/A	N/A	N/A	-	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Safety - Railroad Crossing	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**+**	**O**	**O**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Provides the best sight line for railroad operator to see trail users	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	O	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Minimizes exposure to conditions that limit trail user's ability to hear and see approaching trains or warning mechanisms	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	O	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Minimizes wait time for trail user to cross tracks.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	O	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Safety & Security - Trail Users	**+**	**-**	**+**	**+**	**+**	**N/A**	**N/A**	**-**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**-**	**O**	**O**	**+**	**O**	**O**
Surrounding area is open and visible	+	-	+	+	+	N/A	N/A	-	+	+	O	O	+	+	+	-	-	-	+	O	+
Good lines of sight	+	-	+	+	+	N/A	N/A	-	+	+	O	+	+	+	+	-	O	O	+	O	O
No buildings or structures obscure view of trails	+	+	+	+	+	N/A	N/A	-	+	+	+	+	+	+	+	+	+	+	O	O	O
Safety & Security - Adjacent Property Owners	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**O**	**+**	**+**	**O**	**-**	**O**	**O**	**O**	**+**	**+**	**+**	**+**	**-**	**-**
Provides deterence to trespassing of neighboring properties	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	+	O	O	+	+	-	+	+	+	+	-	O
Minimizes proximity to existing commercial or industrial uses	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	+	+	O	-	-	-	+	+	+	+	+	-	-
User Experience	**O**	**O**	**+**	**+**	**O**	**N/A**	**N/A**	**-**	**O**	**+**	**+**	**-**	**O**	**-**	**-**	**+**	**+**	**+**	**O**	**+**	**O**
Limits views of industrial/commercial activity	O	+	+	+	-	N/A	N/A	-	O	+	+	-	O	-	-	+	+	+	+	+	-
Minimizes level of noise from surrounding land uses	O	O	+	+	-	N/A	N/A	-	-	+	O	O	O	-	-	+	+	+	-	+	O
Potential and ease of providing amenities	-	-	+	+	+	N/A	N/A	-	O	+	+	-	O	O	-	O	+	+	O	-	O
Promotes connection to nature	-	+	+	+	O	N/A	N/A	N/A	N/A	N/A	+	-	-	-	-	+	+	+	O	+	-
Legend																					
+ indicates that the alignment option meets the criteria very well																					
0 indicates that the alignment option meets the criteria somewhat																					
- indicates that the alignment option does not meet the criteria																					
N/A indicates that the criterion does not apply to the alignment option																					

Table C1. Alignment Options Comparison (con't)

Evaluation Criteria and Measures	Alignment Options																				
	Segment 1					*Segment 2*		*Segment 3*					*Segment 4*								
	1A	1B	1C	1D	1E	2A	2B	3A	3B	3C	3D	3E	4A.1	4A.2	4A.3	4B.1	4B.2	4B.3	4C	4D	4E
Cost	**-**	**-**	**O**	**+**	**-**	**N/A**	**N/A**	**-**	**O**	**O**	**O**	**O**	**+**	**+**	**-**	**-**	**-**	**O**	**+**	**-**	**O**
Minimizes cost of easements/acquistions	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O	O	O	N/A	N/A	-	-	-	O	O	O	+	-	O
Minimizes cost of design/engineering/construction	-	-	+	+	-	N/A	N/A	-	-	O	-	O	+	+	-	-	-	O	O	-	O
Minimizes cost of maintenance	-	-	-	+	-	N/A	N/A	-	O	O	O	O	+	+	-	-	-	O	+	O	-
Consistency with Funding Eligibility Requirements	**-**	**-**	**+**	**+**	**+**	**N/A**	**N/A**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**
High percentage of cost eligible for funding	-	-	+	+	+	N/A	N/A	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Topographical Constraints	**-**	**-**	**+**	**+**	**-**	**N/A**	**N/A**	**-**	**+**	**+**	**+**	**O**	**+**	**+**	**+**	**-**	**-**	**O**	**+**	**-**	**+**
Minimizes number of slopes associated with option	-	-	+	+	-	N/A	N/A	-	+	+	+	O	+	+	+	-	-	O	+	-	+
If present, minimizes total slope	-	-	+	+	-	N/A	N/A	-	+	+	+	O	+	+	+	O	O	O	+	-	+
Ease of providing ADA accessible	-	-	+	O	-	N/A	N/A	-	+	+	O	O	+	+	+	-	-	-	+	-	+
Minimizes length of ramps needed	-	-	+	+	-	N/A	N/A	-	+	+	+	+	+	+	+	-	-	-	O	-	+
Habitat Protection	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**+**	**+**	**O**	**O**	**O**	**O**	**O**	**O**	**+**	**O**	**+**
Avoids existing wetlands	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	+	-	-	-	+	+	N/A	N/A	N/A
Avoids existing sensitive habitat areas such as eagle or osprey nests	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	+	+	O	+	O	O	+	+	+
Provides opportunities to enhance /restore habitat	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	-	O	O	O	+	+	+	N/A	N/A	N/A
Discourages disturbance to sensitive habitat	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O	+	O	O	O	-	-	-	N/A	N/A	N/A
Avoids construction within the flood plain to the maximum possible extent	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	O	O	O	O	O	O	O	-	+
Compatibility with Land Use and Permitting Requirements	**O**	**O**	**O**	**+**	**+**	**+**	**+**	**-**	**O**	**O**	**O**	**+**	**O**	**O**	**O**	**-**	**-**	**-**	**+**	**-**	**O**
US Corps of Engineers	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O	+	O	O	O	-	-	-	+	-	O
NOAA Fisheries / USFWS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O	+	O	O	O	-	-	-	+	-	O
Union Pacific Railroad	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	O	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	O	-
DEQ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	+	+	O	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DSL & ODFW	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O	+	O	O	O	-	-	-	+	-	O
ODOT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	O	O
Environmental Zone Review	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	O	O	O	O	O	O	O	O	+	-	O
City of Portland	O	O	O	+	+	+	+	O	O	O	+	+	O	O	O	O	O	O	+	-	-
Maintenance & Operations	**-**	**-**	**O**	**+**	**-**	**O**	**O**	**-**	**+**	**+**	**O**	**-**	**+**	**O**	**-**	**-**	**-**	**O**	**+**	**-**	**-**
Less intensive maintenance required	-	-	O	+	-	O	O	-	+	+	O	-	+	O	-	-	-	O	+	-	-
Minimizes cost of maintenance activities	-	-	O	+	-	O	O	-	+	+	O	-	+	O	-	-	-	O	+	-	-
Minimizes disruption to surrounding uses/operations	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	-	O	-	-	+	+	+	+	-	-
Stakeholder Buy In*	**O**	**O**	**+**	**+**	**+**	**-**	**-**	**O**	**+**	**+**	**O**	**O**	**O**	**O**	**-**	**O**	**+**	**O**	**+**	**-**	**-**
Minimal or no objections to trail location	O	O	+	+	+	-	-	O	+	+	O	O	O	O	-	+	+	O	+	-	-
Landowner is willing to sell or grant easement	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	+	+	N/A	N/A	O	O	-	O	+	O	+	-	-
Alignment option does not conflict with UP railroad guidelines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	O	O	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+	+	+
Legend																					
+ indicates that the alignment option meets the criteria very well																					
0 indicates that the alignment option meets the criteria somewhat																					
- indicates that the alignment option does not meet the criteria																					
N/A indicates that the criterion does not apply to the alignment option																					
* Ratings for options crossing privately owned land in segment 4 are based on best professional judgment at this time.																					

Appendix D: Trail Development Considerations

Table D1. Trail Development Considerations

Preferred Alignment				Implementation					
Options	**Location**	**Length (miles)**	**length (feet)**	**Improvements Needed**	**Land Ownership**	**Property/ Easement/ ROW Acquisition Needed**	**Zoning**	**Environmental Opportunities and Constraints**	**Safety and Security Measures**
Segment 1: Pier Park / Chimney Park									
1D/1C	South end of Pier Park to RR overcrossing	0.51	2693	New bike/ped bridge over RR tracks, new paved path	City of Portland	No	Parks - Open Space	None	Lighting, signage
1E	RR overcrossing to Columbia Blvd crossing	0.25	1320	New paved path	City of Portland	No	Parks - Open Space	None	Lighting, signage
Segment 2: Columbia Boulevard Crossing									
2B	Entrance to former landfill access road	0.05	264	New crossing / bike-ped signal	City of Portland	No	ROW	None	N/A
Segment 3: Landfill Connector									
3C	Former landfill access road to south side of existing landfill bridge	0.20	1056	Improve roadway, improve at-grade RR crossing,new trailhead	City of Portland	No	Heavy Industrial	Crosses flood zone	Lighting, signage
3D	North side of existing landfill bridge to North Slough Trail bridge	0.45	2376	Upgrade existing landfill bridge, improve landfill perimeter road, new N. Slough bike/ped bridge	City of Portland/ St. Johns Landfill	No	Heavy Industrial/ Parks - Open Space	Flood zone/ Environmental conservation zone	Lighting, signage
Segment 4: South Slough									
4	Southwest corner of existing landfill bridge to Segment 4A.1	0.51	2693	New paved path	Private \ Industrial	Yes	Light Industrial	Flood zone/ Environmental conservation & protection zone	Lighting, signage, fencing
4A.1	Eastern end of 4 to west end of 4A.2	0.19	1003	New paved path	Private \ Industrial	Yes	Light Industrial/ Rural Residential	Flood zone/ Environmental protection zone	Lighting, signage, fencing
4A.2	Southern alignment (under powerlines)	0.88	4646	New paved path, boardwalk over wetlands	Private \ Industrial	Yes	Light Industrial/ Rural Residential	Flood zone/ Environmental conservation & protection zone	Lighting, signage, fencing
4B.3	Northern alignment (closer to slough)	0.84	4435	New paved path	Private \ Industrial	Yes	Light Industrial	Flood zone/ Environmental conservation &	Lighting, signage, fencing
4	4B.3 to North Portland Road	0.30	1584	New paved path	Private \ Industrial	Yes	Light Industrial	Flood zone/ Environmental conservation zone	Lighting, signage, fencing
4C	South side of slough to north side of slough at N. Portland Rd. Bridge	0.06	317	New bike-ped bridge, improve roadway	ROW	Yes	Light Industrial	Flood zone/ Environmental conservation zone	N/A

Appendix E: Cost Estimates

Table E1. Cost Estimates

Preferred South Slough Trail Alignment			Segment 1: Park Connector				Columbia Blvd Crossing	Segment 3: Landfill Connector					Segment 4: South Slough								
			1C 803 ft		1D 2,700 ft		1E 1,506 ft	2B 153 ft	3C 1,112 ft		3 (spur) 212 ft	3 (trailhead) 0 ft	3 (bridge) 692 ft	3D 8,935 ft	4 2,625 ft		4A.1 988 ft	4A.2 1,583 ft	4B.3 3,119 ft	4 1,884 ft	4C 310 ft	26,622 Feet 5.04 Miles
12' Trail Common condition	39.75	LF	803 $ 31,909		2,700 $ 107,338		1,506 $ 59,871	153 $ 6,069	1,112 $ 44,221		212 $ 8,426	- $ -	692 $ 27,500	8,935 $ 355,228	2,625 $ 146,125		988 $ 55,004	1,583 $ 88,107	3,119 $ 173,582	1,884 $ 104,855	310 $ 17,251	$ 1,225,485
Add for Difficult soils	23.00	LF	$ -		$ -		$ -	$ -	$ -		$ -	$ -	$ -	$ -	1,369 $ 31,487		988 $ 22,724	$ -	3,119 $ 71,737	$ -	$ -	$ 125,948
Add for 4' Fill	20.71	LF	$ -		$ -		$ -	$ -	$ -		$ -	$ -	$ -	1,100 $ 22,784	$ -		$ -	$ -	$ -	$ -	$ -	$ 22,784
Add for 4' Cut	37.68	LF	$ -		$ -		$ -	$ -	$ -		$ -	$ -	$ -	1,100 $ 41,451	$ -		$ -	$ -	$ -	$ -	$ -	$ 41,451
Add for Parallel to stream	99.90	LF	$ -		$ -		$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
Add for Remove railroad/roadway	10.65	LF	$ -		$ -		$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
Add for Wetland mitigation	262.50	LF	$ -		$ -		$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -		$ -	$ -	3119 $ 818,738	1,884 $ 494,550	$ -	$ 1,313,288
12' wide Boardwalk	600.00	LF	$ -		$ -		$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -		$ -	827 $ 496,200	$ -	$ -	$ -	$ 496,200
bridge		LF			$ -		$ -	$ -	$ -		$ -	$ -	$ -	McLeod $ 2,765,047	$ -		$ -	$ -	$ -	$ -	$ 998,798	$ 3,763,845
															$ -		$ -	$ -	$ -	$ -	$ -	$ -
Add for:																						$ -
Intersection	8,760.00	EA	$ -		$ -		$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
Signalized intersection	131,760.00	EA	$ -		$ -		$ -	1 $ 131,760	$ -		$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ 131,760
Trailhead (20 cars)	78,267.60	EA	$ -		$ -		$ -	$ -	$ -		$ -	1 $ 78,268	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
Fencing	35	LF												8935 $ 312,725	2,625 $ 91,875		988 $ 34,580	1583 $ 55,405	3,119 $ 109,165	1,884 $ 65,940	310 $ 10,849	$ 680,539
Direct Construction Costs incl O&P			**$ 31,909**		**$ 107,338**		**$ 59,871**	**$ 137,829**	**$ 44,221**		**$ 8,426**	**$ 78,268**	**$ 27,500**	**$3,497,235**	**$ 269,487**		**$ 112,308**	**$ 639,712**	**$ 1,173,221**	**$ 665,345**	**$ 1,026,898**	**$7,879,567**
Contingency																						
Concept Alignment	40%		40%		40% $ 42,935		40% $ 23,948	40% $ 55,131	40% $ 17,688		40% $ 3,370	40% $ 31,307	40% $ 11,000	40% $ 292,875	40% $ 107,795		40% $ 44,923	40% $ 255,885	40% $ 469,289	40% $ 266,138	40% $ 410,759	$ 2,001,737
Master Planned	35%		35%		35%		35%	35%	35%		35%	35%	35%	35%	35%		35%	35%	35%	35%	35%	$ -
Preliminary Design	30%		30%		30%		30%	30%	30%		30%	30%	30%	30%	30%		30%	30%	30%	30%	30%	$ -
Final Design	25%		25%		25%		25%	25%	25%		25%	25%	25%	25%	25%		25%	25%	25%	25%	25%	$ -
Under Contract	10%		10% $ 3,191		10%		10%	10%	10%		10%	10%	10%	10%	10%		10%	10%	10%	10%	10%	
			$ 3,191		$ 42,935		$ 23,948	$ 55,131	$ 17,688		$ 3,370	$ 31,307	$ 11,000	$ 292,875	$ 107,795		$ 44,923	$ 255,885	$ 469,289	$ 266,138	$ 410,759	**$2,036,235**
Burdened Construction Value (w/o inflation)			**$ 35,100**		**$ 150,273**		**$ 83,819**	**$ 192,960**	**$ 61,909**		**$ 11,796**	**$ 109,575**	**$ 38,499**	**$3,790,110**	**$ 377,281**		**$ 157,231**	**$ 895,597**	**$ 1,642,510**	**$ 931,484**	**$ 1,437,657**	**$9,915,802**
Inflation																						
Annual Inflation	4.0%		4.0%		Trail Type		4.0%	4.0%	4.0%		4.0%	4.0%	4.0%	4.0%	4.0%		4.0%	4.0%	4.0%	4.0%	4.0%	
Enter Year of Construction	2008		2010		2010		2010	2010	2010		2010	2010	2010	Enter year> 2010	Enter year> 2010		Enter year> 2010	Enter year> 2010	Enter year> 2010	Enter year> 2010	Enter year> 2010	
Year of Construction Cost			**$ 39,483**		**$ 169,037**		**$ 94,285**	**$ 217,054**	**$ 69,639**		**$ 13,269**	**$ 123,257**	**$ 43,307**	**$4,263,359**	**$ 424,390**		**$ 176,863**	**$1,007,425**	**$ 1,847,600**	**$ 1,047,792**	**$ 1,617,169**	**$11,153,929**
Multipliers																						
Design & Engineering	20%		20% $ 7,897		20% $ 33,807		20% $ 18,857	20% $ 43,411	20% $ 13,928		20% $ 2,654	20% $ 24,651	20% $ 8,661	20% $ 83,893	20% $ 84,878		20% $ 35,373	20% $ 201,485	20% $ 369,520	20% $ 209,558	20% $ 323,434	$ 1,437,355
Mobilization	15%		15% $ 5,922		15% $ 25,355		15% $ 14,143	15% $ 32,558	15% $ 10,446		15% $ 1,990	15% $ 18,488	15% $ 6,496	15% $ 62,919	15% $ 63,659		15% $ 26,530	15% $ 151,114	15% $ 277,140	15% $ 157,169	15% $ 242,575	$ 1,078,016
Burdened and Inflated Construction Cost			$ 53,302		$ 228,199		$ 127,285	$ 293,023	$ 94,013		$ 17,914	$ 166,396	$ 58,464	$4,410,171	$ 572,927		$ 238,766	$1,360,024	$ 2,494,260	$ 1,414,520	$ 2,183,178	$ 13,546,044
Construction Management	20%		20% $ 9,081		20% $ 38,878		20% $ 21,686	20% $ 49,922	20% $ 16,017		20% $ 3,052	20% $ 28,349	20% $ 9,961	20% $ 865,256	20% $ 97,610		20% $ 40,679	20% $ 231,708	20% $ 424,948	20% $ 240,992	20% $ 371,949	$ 2,421,738
Cost Opinion for Construction			**$ 62,383**		**$ 267,078**		**$ 148,971**	**$ 342,945**	**$ 110,030**		**$ 20,966**	**$ 194,745**	**$ 68,424**	**$5,275,426**	**$ 670,537**		**$ 279,444**	**$1,591,731**	**$ 2,919,208**	**$ 1,655,512**	**$ 2,555,127**	**$ 16,162,527**
Federal Administrative Costs	30%		30% $ 18,715		$ 80,123		$ 44,691	$ 102,883	$ 33,009		$ 6,290	$ 58,424	$ 20,527	$1,582,628	$ 201,161	$ -	$ 83,833	$ 477,519	$ 875,763	$ 496,654	$ 766,538	
Cost Opinion for Federalized Built Project			**$ 81,098**		**$ 347,201**		**$ 193,662**	**$ 445,828**	**$ 143,039**		**$ 27,255**	**$ 253,169**	**$ 88,952**	**$6,858,054**	**$ 871,698**		**$ 363,277**	**$2,069,251**	**$ 3,794,971**	**$ 2,152,165**	**$ 3,321,665**	**$ 21,011,285**

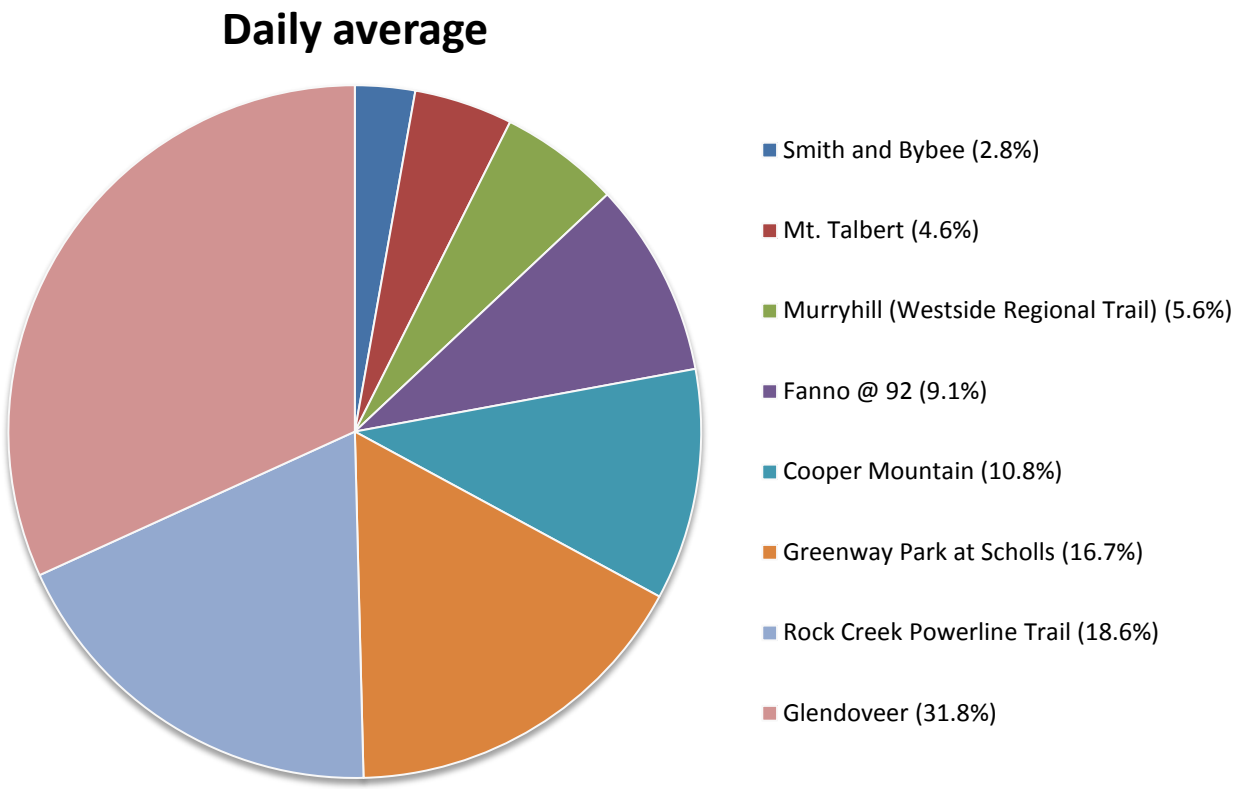
Notes:
Segment 1C: A bike/ped bridge over the RR tracks between Pier and Chimney Parks is part of the preferred trail alignment but not included in this cost estimate since it is already funded.
Segment 3 (bridge): Includes cost to upgrade the existing landfill bridge to accommodate the trail.
Segment 3D: This segment includes costs for accomodating the trail on the landfill and for the bike/ped bridge over the North Slough in the northwest corner of the landfill.
Segment 4: Includes both sections identified as #4 on map (from southwest corner of existing landfill bridge up to segment 4A.1; and across BES property at western extent)

Trail Counts Related to Smith Bybee Wetlands

Interlakes Trail

The trail counter on the Interlakes Trail records people walking to and from the wetlands. From February 2010 to February 2011, a daily average of 55 people was counted. Saturdays and Sundays were the busiest days with over 75 people counted per day with more people counted mid-day than morning or evening.

Compared with other sites counted during this time period, Smith Bybee Wetlands has a small number of visitors.



Peninsula Crossing Trail

Peninsula Crossing Trail is adjacent to Smith Bybee Wetlands and potentially links people walking and bicycling to the site. During September volunteers count trail users all over the region, including on the Peninsula Crossing Trail. In September 2008, 25 people/hour were counted on the trail. In September 2010, again 25 people/hour were counted.

DESCRIPTION OF ACCESS TO SMITH AND BYBEE LAKES AND ST. JOHNS LANDFILL

Prepared by David Evans and Associates

Through analysis of existing aerial photography and mapping, site visits, photo documentation and conducting interviews with Metro staff a comprehensive documentation and analysis of the access and use at Smith Bybee Lakes and the St John's Landfill has been produced. The access analysis includes existing auto, bicycle, pedestrian, and non-motorized watercraft facilities, including roadways, parking lots, restrooms, hiking trails (hard surface and soft surface), wildlife viewing structures, biking trails and non-motorized watercraft launch facilities and common paddling routes. Where possible the analysis attempts to identify informal and undesired access. Note: A separate analysis of the existing signage system will be conducted and documented.

Auto access

Primary automobile access to Smith Bybee Lakes occurs approximately 1400 ft west of the railroad bridge at approximately 5334 North Marine Drive. The entry is well marked and there is a left hand turn lane on Marine Drive. Internal circulation within the site is via a two lane access road that runs parallel to the edge of a dense riparian forest that is on the northeast shores of Smith Lake. The road includes a bike lane on the inbound side as well as a curb separated paved pedestrian path that returns visitors to the intersection at Marine Drive and the primary trailhead into Smith Bybee Lakes.

Once on site drivers are directed east parallel to Marine Drive approximately 1100 feet to a welcome area and parking lot. The parking lot consists of a 39 parking spaces including 17 parallel parking spaces, 20 angled parking stalls and 2 handicapped stalls. There is a restroom building, picnic shelter, trailhead and interpretive/way finding plaza located adjacent to the parking lot. The access road continues south and east around Smith Lake toward Portland Road the road is gated approximately 2000 feet beyond the parking lot. There is a cul-de-sac at the gate allowing drivers to turn around and return to the main entry. Approximately 100 feet before the gate there is a two car turnout at the top of the non-motorized boat launch trailhead. Across the road and north of the trailhead there are 8 parallel parking spaces including one handicapped space. Currently these spaces are intended for boat unloading only.

The access road continues south beyond the gate approximately 1400 feet to the intersection at N. Portland Road. This portion of the access road is typically closed to through auto traffic but is opened to bicycles.

There is secondary access to the site via City Dump Road south of the former St Johns Landfill and across North Columbia Blvd. from Chimney Park; the intersection is located at approximately 9387 N. Columbia Blvd. The road formerly provided truck access to the landfill and currently serves as access to the landfill maintenance office building and small informal parking area and boat launch facility that allows users to launch watercraft into the Columbia Slough. From Columbia Blvd. the road proceeds north approximately 1200 feet past the maintenance office building and parking area,

that are on the west side of the road, to a bridge that crosses the Columbia Slough onto the site. This access is gated and is currently for exclusive use by Metro Staff.

Bicycle access
Bicyclists share much of the same site circulation as automobiles with the few noted exceptions described above and described here. Bike lanes along North Marine Drive that represent part of the 40-Mile Loop Trail System and bike lanes along North Portland road provide primary access to bicyclists. The entry on North Portland Road provides a through route for bicyclists to connect to the 40-Mile Loop on Marine Drive. Bicyclists can also access the site via the Rivergate Trail adjacent to the entrance to Kelley Point Park. The Rivergate Trail is a hard surface trail that currently terminates at the confluence of the North Slough and the Columbia Slough at the southwest edge of Bybee Lake. There has been undesirable use of an informal trail that extends from the end of the Rivergate Trail east along the north shore of the North Slough. This informal trail runs through a sensitive Bottomland Forest habitat and terminates at the water control structure at the southeastern edge of Bybee Lake forcing users to either return to the Rivergate Trail or try to exit the site through the landfill which is gated and posted.

Pedestrian access
Pedestrians have access to the site via a system of trails that extend from the non-motorized boat launch at the eastern edge of Smith Lake north and west through a riparian forest to the eastern shores of Bybee Lake. The primary trailhead is at the intersection of North Marine Blvd. and the access road described above. From the parking lot to the trailhead the trail parallels the access road and is separated by a post and cable system and striping on the roadway. The trail system offers a mix soft and hard surfaces.

Trails emanating from the trailhead are generally paved and turn to soft surface (mostly wood fiber) as they get further into the site. The trailhead on the eastern shore of Smith Lake that services the canoe launch is constructed of gravel. The trail system offers several spurs that allow pedestrians closer access to the shores of the lakes at viewpoints and two viewing blinds. Access to the viewing blind on the north shore of Smith Lake is via a hard surface trail that turns to a raised grated walk as it goes over terrain that becomes inundated with water in peak seasons. The trail that goes west toward Bybee Lake is paved to the viewing blind at which point it turns to wood fiber. This trail extends west and then south to the channel that separates Smith and Bybee lakes where it terminates. This portion of the trail is subject to inundation during peak water seasons.

Non-motorized watercraft access
Non-motorized watercrafts have access to most of the water bodies that surround or comprise the Smith Bybee Lake complex. Access to the Smith and Bybee lakes is limited to the launch on the eastern shore of Smith Lake adjacent to the access road described above. During low water this launch can be challenging requiring users to cross significant mud flats from the end of wooden launch. A channel between the two lakes is passable for most of the year.

Access to the system of sloughs that surround the lakes can be gained at the launch adjacent to the St Johns Landfill entry on the south shore of the Columbia Slough. Columbia Slough can be accessed from points east of Smith Bybee Lakes and via the Willamette River at Kelly Point Park.

There are two small sloughs that fork off of the Columbia Slough that provide limited access within the site but do not connect requiring the boater to return to the Columbia Slough. These are Blind Slough which is southeast of the St Johns Landfill and North Slough which runs between the landfill and Bybee Lake. Boaters have been known to port the control gate at the end of North Slough into Smith Lake.

Utility Maintenance access

There is a high voltage power line corridor that runs north to south across Smith Bybee Lakes roughly between Smith Lake and Bybee Lake. There are approximately 9 towers located within the Smith Bybee Lakes that require periodic inspection and maintenance. Replacement of specific pole may require significant and disruptive access to specific areas within the Smith Bybee Lakes. There is also a power line corridor that runs along the west end of SJL and across Bybee Lake.

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Portland, OR 97232-2736
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Metro | *Memo*

Date: March 4, 2011
To: Smith Bybee Wetlands Management Committee
From: Paul Ehinger, Program Director
Paul Vandenberg, Principal Solid Waste Planner
Bill Jemison, Risk Management
Janet Bebb, Principal Regional Planner
Subject: Security considerations and the landfill trail

A regional trail for biking and walking is proposed around the base of St. Johns Landfill. The purpose of this memo is to document the key security issues and resolution regarding the proposed trail. Careful consideration was given to this topic by the authors along with assistance by Therese Mitchell and landfill staff.

Potential Risks
The landfill has a gas collection system above ground. Methane production is declining as the landfill ages. Still, there are potential security concerns in combining trail users with the landfill operations. Potential risks include:

- Injury to a visitor. Most claims arising from a visitor will be covered by the recreational immunity statute, which in this case would hold Metro harmless. However several situations are worth avoiding through design:
    a. Exposure to H2S (hydrogen sulfide) at some wellheads.
    b. Metro vehicle versus park visitor accident. This trail/road will be used on a weekly basis by SJLF staff.
    c. Drowning (probably not avoidable by design but may require signage).

- Property damage to the road from flooding
- Property damage from vandalism to well heads, condensate collection stations, piping support
- Unwanted uses such as mountain biking and camping

Considering these potential risks the team discussed whether or not a perimeter fence was needed parallel to the trail. A six foot high fence was considered. For wildlife, the fence would need about 8" of crawl space at the bottom to allow wildlife to move freely between the wetlands and the landfill. Even a six foot fence with a gap at the bottom could be climbed by a determined individual; barbed wire at the top seems excessive. A consistent fence would be costly and

detract from the rural scenery. Because of recreational immunity statute and because much of the landfill is neither inviting nor hazardous from the trail, the team recommends "hardening" or protecting gas infrastructure and selectively fencing the landfill from the trail. Careful signage and planting will also promote the security of the landfill.

The following are top priorities for hardening and fencing:

- Flare facility
  The flare facility and compressor need a high level of security from people. Complete fencing that is at least 6' high is needed, potentially with addition barbs at the top.

- Internal roads
  The internal roads are used for operating and maintaining the landfill. Except for the designated trail, these roads are not appropriate for trail users. Each road needs to be gated where it intersects with the trail, including a parallel fence to each side for a distance to be determined.

- Locking cabinets on wells
  Hardening could include locked structures or enclosures around wellheads and condensate stations. The greatest risk of exposure to H2S is at wellheads, of which there are approximately 85 at the landfill. Also, as illustrated in the top photo, wellheads include flexible hose which could be subject to vandalism. As the trail project proceeds, an inventory of the equipment and its associated security solution will be needed. That inventory will include consideration of:
  - Motor blower flare;
  - 5 vacuum stations;
  - Protection of the groundwater monitoring wells; and
  - Gas well heads in view of or near the trail.

Design considerations to minimize property damage:
Design road to either minimize flood damage or make it easily repairable. The road section illustrated frequently has water near the road and every few years it floods. Design of the trail will need to find solutions for this problem, potentially increasing the elevation and adding drainage structures.

A final word about the fence design. The team discussed the potential of a split rail fence as a psychological barrier where the landfill slope is steep or for other reasons is not attractive to trail users to explore. This is, obviously, a judgement call. During the first five years of trail operation, adaptive management may be needed, including fencing or hardening of facilities that have proved vulnerable to vandalism.

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cc: Therese Mitchell and SJLF staff
Kathleen Wadden, Portland Parks and Recreation
Gill Williams, David Evans and Associates
Mary Anne Cassin

Smith and Bybee Wetlands Natural Area Signage Development Matrix – April, 2011

In 2005 the visitor area to Smith and Bybee Wetlands was constructed. This area includes a parking lot, restroom and shelter. The visitor area is about ¼ mile from the Interlakes Trail in one direction and the canoe launch is close by in the other direction. Signage was installed in 2005 but experience has shown that visitors are often confused and revisions are needed. Ini particular bicyclists confuse the Interlakes trail with the continuation of the trail toward Kelly Point Park.

The following changes to signage were developed by Metro staff who guide visitors regularly and David Evans and Associates. The signage standard column refers to Metro sign standards, developed in 2010, that will improve both the information and the graphic quality of the signage.

Sign #	Location	Existing Situation	Signage Standards Manual proposed sign type	Message	Priority	Notes
1	Entrance sign					
2	On right side of entry road way just past Interlakes Trailhead	Wayfinding inadequate and confusing	Directional sign w/ arrows, 6.1.1	Parking and Canoe Launch, Gates close at sunset	1	
3a	Restripe					
4	Regulatory sign at Interlakes Trailhead	Clutter, redundent signage	Trailhead sign and Trail post, 7.1 one of each	Mix of text and icons communicating rules and regulations	1	
5	Welcome sign on Interlakes Trail	Old sign needs upgrade	Interpetive sign, 8.1	To be determined	3	
	Interpretive sign at Turtle Turnout	None exist	Interpretive sign, 8.3 - 8"x8"	To be determined	1	
7						
8 &9	On the right side of parking lot driveway	Too small, not clear	Directional sign w/ arrows, 6.1	Parking and Picnic Area,Gates close at sunset	1	Relocate sign to right side of driveway
10	At trail head Intersection of trail and road crossing	Confusing insuffecient information	Trailhead sign w/ arrows, 7.1	Kelley Point Park, Interlakes Trail, Penn X Trail w/ milage, canoe launch	1	
13	Canoe Launch	Inadequate signage	Trailhead sign, 7.1	Canoe launch w/ regulations	1	
14	End of Road	metal pole w/ Vehicle Turnaraound sign	Switch to Metro standard 3 1/2" sq cedar post	NA	3	

Smith and Bybee Wetlands

Signage Development

Proposed Signs

1 Directional sign with arrows
2 Trailhead sign and trail post
3 Interpretive sign
4 Interpretive sign
5 Directional sign with arrows
6 Trailhead sign with arrows
7 Trailhead sign
8 Switch to Metro standard 3 1/2" sq. cedar post

METRO

DAVID EVANS AND ASSOCIATES INC.

SMITH AND BYBEE COMPREHENSIVE NATURAL RESOURCE MANAGEMENT PLAN

APPENDIX C: Coordination

Smith and Bybee Wetlands comprehensive natural resource plan public involvement process

Introduction

The Smith and Bybee Wetlands natural area is one of the largest protected wetlands within an American city and an important natural resource surrounded by port terminals, warehouses and other commercial developments. Managed by Metro for the past 20 years, the 2000 acre natural area is home to a diversity of birds and wildlife and extensive wetlands, sloughs and forested areas. The natural area currently offers a paved trail that leads to two wildlife viewing stations and a new canoe launch. The natural area also includes the now-closed St. Johns Landfill, a former wetland that was filled and served as the region's primary garbage disposal site from 1940 to 1991. The landfill is not currently open to the public. It is open meadows surrounded by sloughs and has spectacular views. It has significant potential for improving wildlife habitat. Metro has been working to safely restore and reintegrate the 238-acre landfill site into the overall natural area.

Public Involvement

The Smith and Bybee Wetlands comprehensive natural resource plan was developed in partnership with the Smith and Bybee Wetlands Management Committee and public input. Public involvement in the process involved multiple opportunities to inform stakeholders about the project and process and gather feedback on the values and experiences most important to the natural area's visitors.
A structured process was established at the outset of the project to incorporate stakeholder input at key project milestones Resources used to inform and solicit feedback from the public included:

- A project web page with key information and public involvement opportunities.
- E-mail updates to the project's stakeholder mailing list (104 members)
- A public meeting notice mailed to 1,100 businesses, residents and interested parties near the natural area.
- The distribution of more than 100 posters to local schools, churches, community centers and local business about the project and open house.
- The distribution of more than 50 posters translated into Spanish to multicultural organizations and community centers.
- An article about the project written by Metro Councilor Rex Burkholder and published in the Neighborhood Notes.
- An online survey about stakeholder use at the natural area, priorities and values (30 responses).
- A project open house and tour of the St. Johns Landfill (34 participants).

What we heard

Regular users and first time visitors agreed that the Smith and Bybee Wetlands is a beautiful natural area in an urban landscape. Comments from the open house and survey indicated that the property provides important wildlife habitat and that should remain a priority for Metro. Stakeholders are very excited about the restoration of the decommissioned St. Johns Landfill and expressed a desire to one day be able to hike around the prairie. Some concerns about the property included a desire for better access, particularly for bird watching, the installment of interpretive signage and increased educational opportunities.

1. Please provide contact information in case Metro staff have questions about your comments.

	Response Percent	Response Count
Name:	**96.7%**	**29**
Address:	90.0%	27
Address 2:	0.0%	0
City/Town:	73.3%	22
State:	83.3%	25
ZIP:	80.0%	24
Email Address:	80.0%	24
Phone Number:	66.7%	20
answered question		**30**
skipped question		**0**

2. In the past five years, how many times have you visited Smith and Bybee Wetlands:

	Response Percent	Response Count
Never	10.0%	3
Once	6.7%	2
2-10 times	30.0%	9
more than 10 times	**53.3%**	**16**
answered question		**30**
skipped question		**0**

3. How did you get there and what did you do? (please check all that apply)

	Response Percent	Response Count
Bike	33.3%	9
Car	**92.6%**	**25**
Walked	22.2%	6
School bus or group event	0.0%	0
Walked on Interlakes Trail	48.1%	13
Canoe/kayaked the lakes	48.1%	13
Fished from banks or lakes	7.4%	2
Other (please specify)		11
answered question		**27**
skipped question		**3**

4. Which statement best reflects your sense of balance between the preservation of natural resources and people experiencing nature at Smith and Bybee Wetlands?

	Response Percent	Response Count
The region continues to become more and more developed. Wildlife and habitat preservation is a top priority for Smith and Bybee Wetlands; access by people needs to be subtle and not at the expense of wildlife.	**55.2%**	**16**
Wildlife and habitat preservation is important. Equally important is access by people so they can enjoy, appreciate and support the Wetlands.	31.0%	9
The wetlands are in an urban area and people need contact with nature. Access to and education about wildlife and natural systems is the most important function at Smith and Bybee Wetlands.	13.8%	4
	answered question	**29**
	skipped question	**1**

5. Smith and Bybee Wetlands is an outstanding resource for a number of reasons. Which are most important to you? (please check all that apply)

	Response Percent	Response Count
Wildlife habitat	**86.2%**	**25**
Flood storage	34.5%	10
Place to canoe/kayak	58.6%	17
Bird watching	69.0%	20
Fishing	6.9%	2
Ecological values (water quality, etc.)	58.6%	17
Walking, running or biking on the trail	37.9%	11
Other (please specify)		7
answered question		**29**
skipped question		**1**

6. What would you like to see more of at Smith and Bybee Wetlands Natural Area? (please check all that apply)

	Response Percent	Response Count
Education programs	37.0%	10
Trails	40.7%	11
Habitat restoration and protection	**74.1%**	**20**
Canoe launches/water access	14.8%	4
Wildlife viewing stations	40.7%	11
Other (please specify)		7
answered question		**27**
skipped question		**3**

7. Thousands of school children visit Smith and Bybee Wetlands each year to learn about natural systems, animals and habitats. Adults also participate in volunteer work parties, kayaking and birding events. Have you participated in any educational activities at Smith and Bybee Wetlands?

	Response Percent	Response Count
Yes	41.4%	12
No	**58.6%**	**17**
answered question		**29**
skipped question		**1**

8. If you have participated in an educational or volunteer experience at Smith and Bybee Wetlands what did you like about the program? What suggestions do you have to make the experience better?

	Response Count
	10
answered question	**10**
skipped question	**20**

9. Please share any other comments about Smith and Bybee Wetlands that you'd like Metro to consider.

	Response Count
	20
answered question	**20**
skipped question	**10**

Smith and Bybee Wetlands Advisory Committee

June 2011

Prior to 1990, coordination of issues at Smith Bybee Wetlands was handled by the respective property owners and regulatory agencies. One of the main strengths of the 1990 Plan was the formation of the Smith and Bybee Lakes Management Committee. The Committee was formally sanctioned through an Intergovernmental Agreement between Metro, City of Portland and the Port of Portland in 1990.

The Committee was composed of representatives from the City, Metro, the Port, state and federal resource agencies, citizens groups, and property owners. The initial charge of the Committee included:

- developing specific plans for environmental projects and recreation facilities that were cited in the 1990 Plan;
- budget development to submit to Portland City Council or the Metro Council for approval of annual funds for the Trust Fund;
- oversight of Plan implementation and ongoing policy guidance.

The 1990 Plan establishes committee members or their representatives as follows:

- Superintendent of Portland Parks and Recreation
- Administrator of the Bureau of Environmental Services
- Director of the Port of Portland
- Director of the Oregon Department of Fish and Wildlife
- Executive Officer of Metro
- Metro Councilor
- Present of Portland General Electric
- President of the Friends of Smith and Bybee Lakes
- President of the 40 Mile Loop Land Trust
- President of the Board of the Portland Audubon Society
- A representative of other private landowners within the Management Plan boundary; and
- President of the Peninsula Neighbors

Over the past twenty years the Management Committee has participated in many decisions about Smith and Bybee Wetlands. They have been dedicated to the vision in the 1990 Plan and helped steer many specific projects as they became realized.

As property was consolidated some of the players have changed but the spirit of representation is still the same. The organizations and individuals who have guided the development of the 2011 Plan include:

Dave Helzer, Chair, Portland Bureau of Environmental Services
Troy Clark*, Vice Chair, Audubon Society of Portland
Larry Devroy, Port of Portland (former chair)
Patt Opdyke, North Portland Neighborhoods
Pam Arden*, 40-Mile Loop Land Trust
Dale Svart*, Friends of Smith & Bybee Lakes
Dan Kromer and Dan Moeller, Metro

Susan Barnes, Oregon Department of Fish and Wildlife
Lynn Barlow, Portland Parks and Recreation

*Member has been with the Committee since 1990.

The Committee meets quarterly or as needed. During Plan development they met every month for a year. During this process the Committee discussed the way their role has changed. When the Committee was formed, Metro had never had responsibility for the management of a natural area. As a result the Committee was initially involved in many management decisions. Over time Metro became a seasoned land manager and Fund manager. The Committee took on more of an advisory role and renamed themselves Smith and Bybee Wetlands Advisory Committee.

Both the Committee and Metro staff felt the need to coordinate more carefully. As a result attached Communications Plan was developed. This is viewed as a starting point to refresh the communication channels. It may be changed over the next ten years and key projects and relationships change.

NRMP and CNRP

One of the key decisions the Committee entertained was the form of the Plan. The 1990 Plan was a Natural Resources Management Plan which is a plan that becomes part of City of Portland Zoning Code. As such, it takes a legislative – or representative – process to amend. That process is cumbersome and so the document never changed and became out-dated in several areas. As we approach the 2011 Plan we asked City of Portland Planning and Sustainability Bureau if there was an alternative. They developed a new document type that resembles a conditional use master plan but for natural areas. The main idea is to allow property owners with large natural areas to anticipate land use actions in advance for ten year. The resultant Plan then facilitates the land use actions and can be modified by property owners in a quasi-judicial, or direct, process.

The Committee agreed that the new document type would be more flexible.

Smith and Bybee Wetlands Advisory Committee Meeting and Communications Plan

The Smith and Bybee Wetlands Advisory Committee will hold at least four meetings each year. The Committee may decide that additional meetings are necessary.

Meeting#1 (January) – The results of the yearly Special Work Session will be discussed. The Committee's project priorities and funding strategies for the coming year will be finalized and presented to the Committee and Metro staff for discussion. (Note that grants each have their own schedule and will need to be coordinated with the Smith and Bybee Wetlands Fund for match. The Committee will be involved based on the timing of the grants which may not fit with the January funding meeting.)

The Metro Natural Areas land manager will present a Metro staffing update, organizational chart and Metro contact list to the Committee. The land manager will provide an update on proposed projects, permit requests or other changes that may affect the wetlands for discussion and comment from the Committee. The City of Portland and Port of Portland will provide general updates.

Meeting #2: (March) – The Metro scientist responsible for Smith and Bybee Wetlands will present a work plan for the coming field season and the Metro naturalist assigned to Smith and Bybee Wetlands will present a programming plan for the coming year. The committee will discuss the plans and provide feedback to Metro.

The Metro Natural Areas land manager will provide an update on proposed projects, permits or other changes that may affect the wetlands for comment from the Committee. The City of Portland and Port of Portland will provide general updates.

Meeting #3: (September) – The Metro scientist for Smith and Bybee Wetlands will present a summary of the work that was completed during the spring and summer field season and a "State of the Wetlands" report. The scientist will also present a draft work plan for next year's restoration actions including what grant funding will be pursued. The Committee will discuss the plan and provide feedback to Metro.

The Metro land manager will update the committee on proposed projects, permits or other changes that may affect the wetlands for comment from the Committee.

Meeting#4: (November) – The Committee will conduct a Special Work Session to plan the Committee's project and funding priorities for the coming year. The Committee will discuss any initiatives they'd like to pursue, assign roles and responsibilities and address other outstanding issues.

What decisions need to be vetted through the committee and what decisions can be made without committee comments?

The Smith and Bybee Wetlands Advisory Committee is a valuable asset to Metro's management of the Wetlands. Metro will utilize the committee as a sounding board for management actions that are outside the annual work plan and have an impact on either conservation goals or the visitor experience. The Metro land manager will work with the chair of the Committee to determine if permit requests or other projects outside of the annual work plan have impacts to conservation goals and visitor experience and require review by the Committee. Whenever possible such proposals will be presented at a Committee meeting for discussion and comment. If management actions that are outside of annual work plan or have impacts to conservation goals or visitor experience need to be resolved before the next Committee meeting, the Metro land manager will collaborate with the advisory committee chair to determine a course of action and present that to the committee at the next meeting.

Examples of actions that would require Committee review:

- Changes to trail routes or future trail planning
- Changes to the bird blinds or view points
- Special-use permit requests that would substantively alter vegetation or the landscape
- Special-use permit requests that might draw visitor attention – setting up highly visible research plots, exhibits, etc.
- Special-use permit requests for large events – paddle tours of the lakes, running races, a fishing derby, kite festivals etc.
- Land use actions
- Design changes to existing infrastructure.

Examples of actions that would not need Committee review:

- General maintenance or restoration actions identified in the CNRP
- Special-use permits for educational, research or tours that would not have substantial impact to the resource or would not be unusually visible
- Replacement of infrastructure that is an emergency safety concern
- Addition of barriers to protect the resource – stop vehicles from illegally accessing the property
- Maintaining the water control structure
- Adding rule signage or posting information at entry points
- Volunteer work parties
- Landfill maintenance and routine repairs.

Project Code Review Status

Projects identified in the Plan and other future projects are subject to City of Portland Zoning Code anticipated below.

Project Type and Description	Document location	Review Status
Water Management	Appendix A-6	Allowed as written
Early Detection and Rapid Response	Appendix A-6	Allowed as written
Habitat Restoration Actions Emergent Wetlands Scrub-shrub Wetlands Bottomland Forests Riparian Forests Upland Prairie Western Painted Turtle Streaked Horned Lark	Appendix A-6	Allowed as written
Landfill regional trail and bridge Construct the trail on St. Johns landfill, including a bridge over the North Slough, an overlook on the landfill, two overlooks adjacent to the trail, and interpretive signage	Page 55, Appendix B 2	Type II Review
Willow Management Periodic clearing of willows that obstruct views to the wetlands from the bird blinds	Page 56	Allowed as written
North Slough/Bybee Lake Portage Improve the portage between the North Slough and Bybee Lake	Page 55	Type II
Improve access to Interlakes Trails Facilitate access by adding bus parking and parking for people with disabilities at the trailhead. Improve the walk from the parking lot to the trailhead by separating the trail from the road.	Page 54	Type II
View Platform renovation Add a second level to Bybee and Smith Lakes bird blinds.	Page 55	Allowed as written
Interlakes Trail Extension Validate the seasonal extension with signage and increase the path width to 2 feet with bark much, board walk or metal grating	Page 54	Allowed as written
Signage Upgrade	Page 56	Allowed as written

Seating	Page 57	Allowed as written
St. Johns Landfill bank repair The environmental review included here is for a typical bank repair. As repair is needed, the specific location will be identified.	Appendix D	Type I
St. Johns Landfill flare facility modifications		Type II
St. Johns Landfill water monitoring well The environmental review included here is for a typical well construction. As wells are needed, the specific location will be identified.		Type I
Lombard Pump Station, BES Install a standby diesel engine generator set and upgrade the electrical distribution system.		Type I
Lower Slough Refugia Project, BES Place large wood structures within Columbia Slough channels and re-vegetate riparian banks with native vegetation.		Type I


Smith and Bybee Wetlands Ownership Map
Port Of Portland
Port of Portland
Metro - 1/2
Port of Portland - 1/2
Port of Portland
Oil Re-Refining Company
City of Portland
City of Portland
Metro
Metro
BNSF Railway Company & Union Pacific Railroad Company
Port of Portland
Heron Leasing Company
Metro - 3/4
Private - 1/4
Private Property
N

Smith and Bybee Wetlands Summary of Regulatory Environment

April 2011

Regulation	Agency	Description
Environmental Code Including trail development	City of Portland	Provides details on uses that are allowed, not allowed or conditional uses. Refer to this chapter for information on trails 30" and soft surface, tree cutting, development standards for trails over 30", actions pertaining to native plants. http://www.portlandonline.com/bps/index.cfm?c=34562&a=53343
Open Space Code	City of Portland	Includes uses that are allowed, not allowed or require a conditional use permit. http://www.portlandonline.com/bps/index.cfm?c=34560&a=53294
Off-site Impacts	City of Portland	This chapter address open space zone objectionable off-site impacts with reference to noise, odor, glare and http://www.portlandonline.com/bps/index.cfm?c=34561&a=53319
Industrial Zone	City of Portland	Sections include information on required screening, setback and landscaping requirements, fences. http://www.portlandonline.com/bps/index.cfm?c=34560&a=53298
Storm water Management, discharge from adjacent properties	City of Portland, Bureau of Environmental Services	Management requirements and facility design http://www.portlandonline.com/bes/index.cfm?c=47954 The specific chapter on source control is: http://www.portlandonline.com/bes/index.cfm?c=47954&a=202885
Archaeological resources	Oregon Historic Preservation Office	Current state cultural resources laws and regulations http://www.oregon.gov/OPRD/HCD/ARCH/index.shtml
Boating regulations	Oregon Marine Board	Boating at Smith Bybee is regulated including use of motors. OMB policies 250-019-0010; 0040 and 0060 http://arcweb.sos.state.or.us/rules/OARS_200/OAR_250/250_019.html
Oregon Conservation Plan	ODFW	Willlamette Valley summary of list strategy species, Willamette River floodplain information http://www.dfw.state.or.us/conservationstrategy/
Metro Functional Plan, Title 13, Nature in Neighborhoods	Metro	Riparian protection including class I and II habitat, exempt uses and conditioned activities http://library.oregonmetro.gov/files//chap307_cleanup_02.eff_011311.pdf

Regulation (St. Johns Landfill Site)	Agency	Description
Solid Waste Site Closure Permit 116	Oregon DEQ	Regulates site operations - environmental monitoring – remedial actions
Order on Consent LQSW-NWR-02-14	Oregon DEQ	Requires remedial investigation and feasibility study leading to record of decision
NPDES Stormwater Discharge General Permit 1200-COLS	Oregon DEQ	Regulates quality of stormwater discharged to Columbia Slough and wetlands
Wastewater Best Management Practices Certification	City of Portland	Specifies BMPs required to control pollutants in wastewater discharged to sanitary sewer
Oregon Title V Operating Permit 26-3310	USEPA / OR DEQ	Regulates air emissions from site
Hazardous Waste Generation Report Rules	Oregon DEQ	Requires annual report of hazardous waste generation unless conditionally exempt
Hazardous Substances Report Rules	Oregon Office of State Fire Marshal	Requires annual report of hazardous substance quantities stored on site
Greenhouse Gas Emissions Report Rules	USEPA / DEQ	Requires annual report of greenhouse gas generation and emissions from site
Land Use Review	City of Portland	Regulates projects conducted within environmental overlay zone
Removal-Fill Permit	Corps of Engineers / Oregon DSL	Regulates projects conducted below the line of ordinary high water
State-Owned Submerged and Submersible Land Easement	Oregon DSL	Requires authorization for certain land uses along site perimeter fronting Columbia Slough below line of ordinary high water
Access and Use Agreement	City of Portland	Allows access to and use of monitoring wells on City property within SBWNA
Electric Power Transmission Line Easement	Bonneville Power Administration	Limits land use within a defined power line corridor crossing the site
Electric Power Transmission Line Easement	Portland General Electric	Limits land use within a defined power line corridor crossing the site

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Former NRMP Policies

The following topics formerly were policies in the 1990 Plan. With the current Plan, these regulations are covered by Portland Zoning Code.

Policy 22 Future land development bordering the Smith and Bybee Wetlands regulations Management Area will be subject to the following standards:

A. New storm water outfalls that flow into the wetlands or the Columbia Slough system will be designed to minimize their potential impact on water quality within the guidelines of the NPDES permit process. Drainage systems will include such features as settling ponds, sumps, or filters to assure adequate treatment of runoff before it can have a significant negative impact on the wetlands ecosystem. Natural features, such as cattail marshes, should be designed into the pollution control system. See Figure 5 for the location of outfalls known at the time of the Plan's adoption.

B. The following will apply to development adjacent to the resource area:

   1. Where planting is practicable (i.e., the slope is 1:3 or less, soil conditions are appropriate), fill slopes will be seeded and/or planted with appropriate species present in the adjacent wetlands area. Where plantings are not practicable, other methods will be employed to prevent erosion.

   2. A vegetative screen (for examples see Figure 6) of native trees and/or plants, or other species present in the wetlands area, will be provided where necessary so that visually displeasing or disruptive industrial development (e.g., outdoor storage yard, 24-hour truck loading area) will not be visible from the wetlands or the trail system. The screen will be at least 6 feet high and 75 percent opaque within 3 years of planting. Because of the extensive size and nature of the resource area, and the built-in buffers provided by the fill slope and slough buffer areas, a visual screen will only need to be planted in those instances where the natural vegetation does not provide an adequate screen. The screen may be located inside the boundary of the Management Area if no significant existing vegetation will be disturbed, as in cross-section B.

   3. Where no reasonable opportunity exists to otherwise buffer industrial activity from the resource (i.e., development could be placed immediately adjacent to the resource as in cross-section C), a minimum 10 foot wide vegetative screen will be planted and maintained at an L3 level adjacent to the resource area.

   4. Lights adjacent to the natural area will be cut-off type fixtures that do not cast direct light beyond the development/fill boundary.

Policy 27 Archaeological resources shall be included as a major feature of the Management Area. Interpretation of archaeological resources and the prehistoric ways of life of the native peoples of the Portland area shall be integrated into educational programs developed for the Smith and Bybee Wetlands Natural Area.

Policy 28 When any development within the Management Area is planned, the following steps will be taken in the area affected by the proposed development to insure protection of archaeological resources:

- Obtain information on recorded sites within the area affected from the State Historic Preservation Office;
- Evaluate the current status of the known sites;
- Conduct reconnaissance surveys in areas affected by proposed projects which include dredging, excavation, fill, or possible changes in the hydrological regime of the wetlands and Columbia Slough;
- Evaluate potential impacts of the proposed project on the archaeological resource; and
- In cases where significant archaeological resources are identified, take appropriate measures to avoid impact or to develop appropriate mitigation measures through consultation with the Oregon Historic Preservation Office.

Scenario 1: 1:1 Grant Leverage

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Beginning Fund Balance	3,817,257	3,677,611	3,531,455	3,396,124	3,270,013	3,151,633	3,104,579	3,064,454	3,030,660	3,002,659
Grants	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Landfill Closure Contribution	32,500	32,500	32,500	32,500	32,500	97,500	97,500	97,500	97,500	97,500
Interest	19,086	18,388	35,315	50,942	65,400	78,791	93,137	107,256	121,226	135,120
Total Resources	3,943,843	3,803,499	3,674,270	3,554,566	3,442,913	3,402,923	3,370,216	3,344,210	3,324,386	3,310,278
NRMP Implementation	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Metro Direct Costs	116,232	122,044	128,146	134,553	141,281	148,345	155,762	163,550	171,728	180,314
Total Expenditures	266,232	272,044	278,146	284,553	291,281	298,345	305,762	313,550	321,728	330,314
Ending Fund Balance	3,677,611	3,531,455	3,396,124	3,270,013	3,151,633	3,104,579	3,064,454	3,030,660	3,002,659	2,979,964

Scenario 2: Most Likely

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Beginning Fund Balance	3,817,257	3,640,111	3,456,268	3,282,685	3,117,372	2,958,439	2,869,055	2,784,365	2,703,267	2,624,670
Grants	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500
Landfill Closure Contribution	32,500	32,500	32,500	32,500	32,500	97,500	97,500	97,500	97,500	97,500
Interest	19,086	18,201	34,563	49,240	62,347	73,961	86,072	97,453	108,131	118,110
Total Resources	3,906,343	3,728,312	3,560,831	3,401,925	3,249,719	3,167,400	3,090,127	3,016,817	2,946,398	2,877,781
NRMP Implementation	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Metro Direct Costs	116,232	122,044	128,146	134,553	141,281	148,345	155,762	163,550	171,728	180,314
Total Expenditures	266,232	272,044	278,146	284,553	291,281	298,345	305,762	313,550	321,728	330,314
Ending Fund Balance	3,640,111	3,456,268	3,282,685	3,117,372	2,958,439	2,869,055	2,784,365	2,703,267	2,624,670	2,547,467

Scenario 3: No Grant Revenue

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Beginning Fund Balance	3,817,257	3,652,611	3,481,330	3,320,498	3,168,252	3,022,837	2,947,563	2,877,728	2,812,398	2,750,666
Grants	-	-	-	-	-	-	-	-	-	-
Landfill Closure Contribution	32,500	32,500	32,500	32,500	32,500	97,500	97,500	97,500	97,500	97,500
Interest	19,086	18,263	34,813	49,807	63,365	75,571	88,427	100,720	112,496	123,780
Total Resources	3,868,843	3,703,374	3,548,644	3,402,805	3,264,117	3,195,908	3,133,490	3,075,948	3,022,394	2,971,946
NRMP Implementation	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Metro Direct Costs	116,232	122,044	128,146	134,553	141,281	148,345	155,762	163,550	171,728	180,314
Total Expenditures	216,232	222,044	228,146	234,553	241,281	248,345	255,762	263,550	271,728	280,314
Ending Fund Balance	3,652,611	3,481,330	3,320,498	3,168,252	3,022,837	2,947,563	2,877,728	2,812,398	2,750,666	2,691,632

Proforma to illustrate sample 10-year fund strategies

The numbers on this spreadsheet are examples and do not represent any proposed budgets.

Each year an annual budget will be developed that includes staff, restoration and capital expenditures.

The purpose of this spreadsheet is to illustrate the potential of the Wetlands Fund to leverage grants and to illustrate Fund balance at the end of 10 years.

prepared by Brian Kennedy
March 22, 2011

Definition of Terms

Beginning Fund Balance	This is the principal balance of the Smith Bybee Fund estimated to be available at the beginning of the fiscal year.
Grants	These are estimates for payments from other government agencies or non-profits. They are typically designated for specific projects.
Landfill Closure Contribution	It is anticipated that the Landfill Closure Account for the St. Johns Landfill will be able to be used to pay for some of the restoration activites at Smith Bybee. This is an estimate of those amounts.
Interest	Interest earnings are applied to the fund based on the principal balance of the fund. Funds are invested according to Metro's Investment Policy and overseen by the Metro Investment Advisory Board.
Ending Fund Balance	This is the principal balance of the Smith Bybee Fund estimated to be available at the end of the fiscal year.
NRMP Implementation	This is a placeholder for expenses relating to the implementation of the Natural Resource Management Plan.
Metro Directo Costs	These are costs for Metro staff that support Smith Bybee. It includes portions of salary and benefits for a staff scientist, park ranger, and operations staff.

Cost Estimate for Habitat Restoration at Smith Bybee Wetlands

21-Dec-10

These costs are general estimates for the purpose of understanding the magnitude of costs.

	Conservation Target	Years	Acreage														Years 1-5	Years 6-10
43.7	**South Shore Bybee Lake**			Acreage	Condition	**Cost/Acre**	Acreage	Condition	**Cost/Acre**	Acreage	Condition	**Cost/Acre**	Acreage	Condition	Cost/Acre			
1.8	Emergent Wetland (Columbia sedge meadow)	6-10	1.8	0.7	P/F	$8,120	1.1	P/F	$8,120									$14,616
14.4	Scrub-shrub Wetlands	6-10	14.4	14.4	P/F	$4,750												$68,400
27.5	Bottomland Forest	1-5	27.5	25.6	P/F	$5,550	1.9	P/F	$5,550								$152,625	
6.7	**Leadbetter Peninsula**																	
	Emergent Wetland (Columbia sedge meadow)	1-5	6.7	6.7	P/F	$8,210												
78.8	**Interlake Area**																	
5.1	Emergent Wetland (Columbia sedge meadow)	1-5	5.1	2.2	P/F	$2,704	1.6	P/F	$8,210	1.3	P/F	$8,210					$27,296	
15.7	Scrub-shrub Wetlands	6-10	15.7	3.9	P/F	$4,750	11.8	P/F	$4,750									$74,575
28.8	Bottomland Forest	1-5	28.8	28.8	P/F	$2,340											$67,392	
29.2	Riparian Forest (protect existing trees)	1-5	29.2	2	G/VG	$1,000	6.1	G/VG	$1,000	0.8	P/F	$1,000	20.3	G/VG	$1,000		$29,401	
93.4	**South and West Shores Smith Lake**																	
8.5	Emergent Wetland (Columbia sedge meadow)	6-10	8.5	8.5	P/F	$8,210												$69,785
11.3	Scrub-shrub Wetlands	1-5	11.3	11.3	P/F	$4,750											$53,675	
24	Bottomland Forest	1-5	24	24	P/F	$3,340											$80,160	
49.6	Riparian Forest (protect existing trees)	1-5	49.6	29.9	G/VG	$3,340	19.7	G/VG	$3,340								$165,664	
80	**Saint Johns Landfill**																	
20	Upland Prairie (Existing habitat and portions of Sub-area 5)	1-5	20	20	P/F	$8,120											$162,400	
60	Upland Prairie (Sub-area 1)	6-10	60	60	P/F	$8,120												$487,200
																	$738,613	**$714,576**

Smith and Bybee Lakes Wildlife Area

Educational Programs

School Field Trips

- School classes coming to S & B for a field trip
- Students, teachers, and parent helpers
- Available year-round but mainly done in Sept, Oct, April, May, and June.
- Charge of $2 per student
- Staffed by James and volunteer naturalists
- About 30 programs per school year
- Topics are wildlife watching and tracking and wetland ecology

Youth Group Field Trips

- Scouts, campfire, day care, day camp, etc.
- Kids and their parent leader(s)
- Available year-round; most are fall and spring
- Charge of $2 per child
- Staffed by James with occasional help from volunteer naturalists
- Variable, 5-10 programs a year
- Topics are wildlife watching and tracking, wetland ecology, and various other topics requested by leader such as outdoor careers.

Other Group Field Trips

- Wide range of groups - - church group, treatment programs, college classes, The Nature Conservancy, etc.
- Mainly adults and older teens with leaders and/or staff
- Charge of $2 per person
- Staffed by James with occasional help from volunteer naturalists
- Number caries but is under 10 a year
- Topics vary but are still focused on the plants and wildlife of the wildlife area and on nature observation skills. Some of these programs, especially for the college classes, are specifically about m ore advanced topics such as management practices at the lakes, teaching techniques for environmental education, and water quality testing.

Bird Watching Walks

- Weekends; 2-hour long bird watching walks for the general public
- Adults and a few older kids
- Year-round except for August and December
- Free
- Staffed by James
- Averages 14-18 a year
- Emphasis is on teaching beginners the basic skills of identifying birds

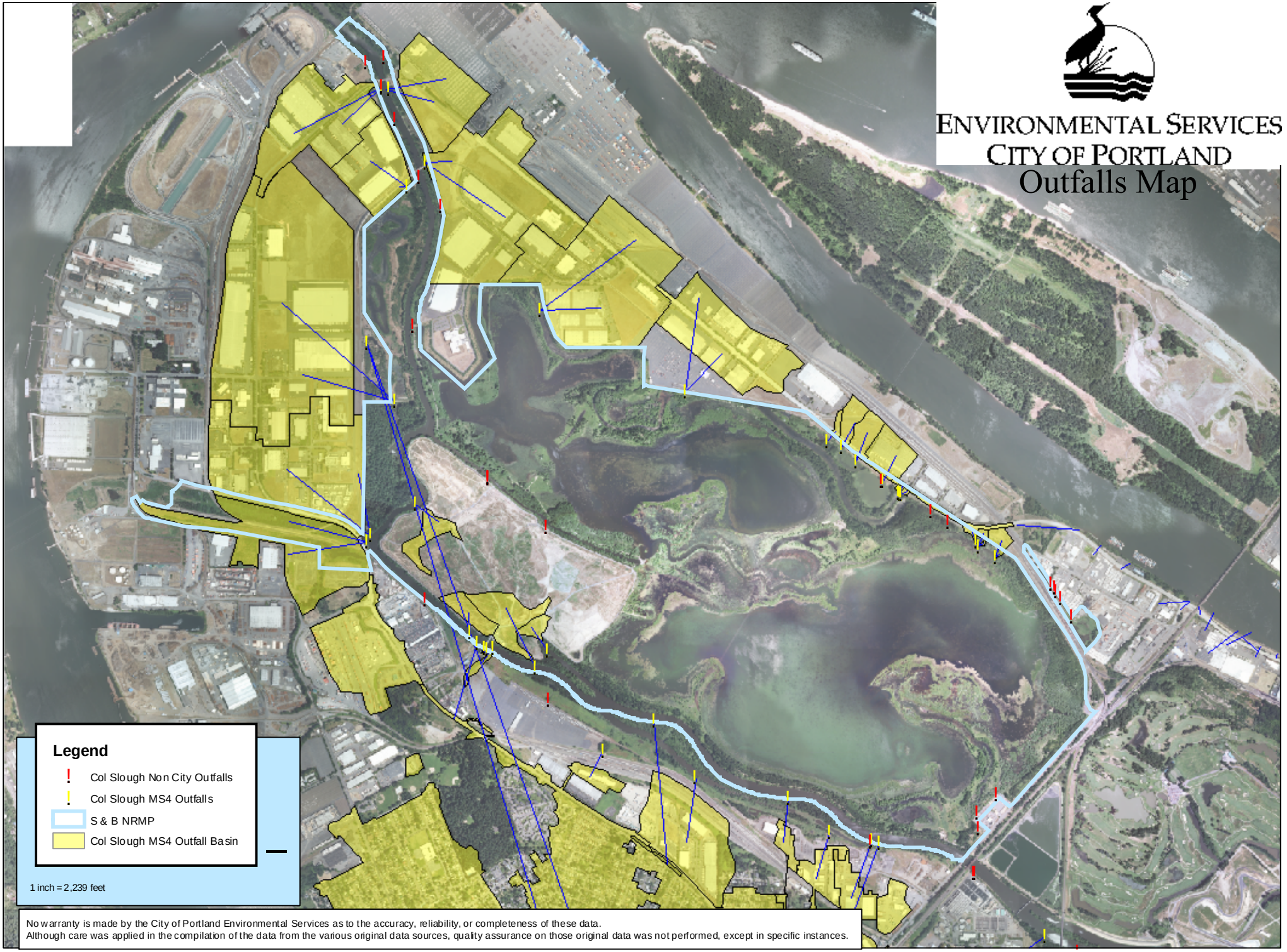
Turtle Walks

- Weekends; 1 to 2 hour walks for the general public focused on the western painted turtle
- Families, lots of kids 4 to 10 years old
- April through July
- Staffed by James or by volunteer naturalists
- Free
- Twice a month during turtle season
- In addition to thoroughly discussing turtle natural history and the plight of the western pond turtle we observe and discuss other aquatic life we see or that comes up in questions.

Twilight Tuesdays

- Wednesday nights - - ha, ha, just checking to see if you're awake!
- Tuesday evenings starting about two hours before sunset; very quiet walks for the general public
- Adult and families
- Summer
- Staffed by James
- Free
- Six a summer
- These are so awesome! This is where people learn that they can actually see mammals like beaver, deer, raccoon, nutria, otter, and mice by using the proper stalking and observing techniques. On almost every trip at least one aquatic mammal was seen, often beaver when the water level was higher. Baby heaver, nutria, and muskrat have been seen on some trips. This experience has a very dramatic impact on some people.

James Davis, Naturalist


ENVIRONMENTAL SERVICES
CITY OF PORTLAND
Outfalls Map
Legend
Col Slough Non City Outfalls
Col Slough MS4 Outfalls
S & B NRMP
Col Slough MS4 Outfall Basin
1 inch = 2,239 feet
No warranty is made by the City of Portland Environmental Services as to the accuracy, reliability, or completeness of these data.
Although care was applied in the compilation of the data from the various original data sources, quality assurance on those original data was not performed, except in specific instances.

SMITH AND BYBEE COMPREHENSIVE NATURAL RESOURCE MANAGEMENT PLAN

APPENDIX D: St. Johns Landfill typical slope repair environmental review

Overview

The following description will outline efforts required to mitigate slope and stream bank failures within the Smith Bybee Wetlands and Natural Area primarily adjacent to the St Johns landfill. It is important to understand the existing conditions and random occurrence and causes for slope and stream bank failures at the St Johns landfill to appreciate the content of this application.

I. Introduction

The 2,000-acre Smith and Bybee Wetlands Natural Area (Natural Area) is managed by Metro's Department of Regional Parks and Greenspaces. It is located on the north Portland peninsula within the Columbia Slough watershed near the confluence of the Willamette and Columbia rivers, and is the largest remnant of a former extensive network of sloughs, marshes, and lakes that historically occupied the south shore of the Columbia River. Existing habitat includes open water, emergent shrub/scrub wetlands, forested wetlands, upland forest, and upland meadow (the closed St. Johns Landfill). Wildlife using the area includes more than 100 bird species and a variety of mammals, reptiles and amphibians.

In 1990, the City of Portland adopted the Natural Resources Management Plan for Smith and Bybee Lakes (NRMP). The NRMP was prepared cooperatively by Portland Parks and Recreation, the Portland Planning Bureau, the Port of Portland, and interested neighbors and stakeholders. It established the Natural Area as a major regional, environmental, and recreational resource for the Portland metropolitan area. Its overall goal is to protect and enhance natural resources, and to provide compatible recreational uses.

The document that includes this application represents the update to the NRMP and is meant to serve as a guide for the management and development of this natural resource for the next ten years.

The NRMP describes City of Portland review procedures for development projects within the Natural Area. The site of potential projects covered in this application (St. Johns Landfill) is within the Natural Area. Under the NRMP, the proposed project meets the description of a Minor Exception to the plan (p.68, h), and is therefore subject to a Type II environmental review, using approval criteria specified in the NRMP. As such, Metro is requesting a Type II Environmental Review for future slope stabilization projects as needed – these projects will entail streambank restoration of eroding and unstable sections of the St. Johns Landfill perimeter levee.

II. Site and Project Description

Site Description

The St Johns landfill sits on the southwestern edge of the Smith Bybee Wetland and Natural Area and is surrounded on all sides by water. The potential project site is the entire slough bank around the

perimeter of the landfill, which is owned and operated by Metro. The site is located within taxlots R 971360 300 (2N1W36-00100) and R 371360 360 (2N1W36-00200).

An earthen dike, constructed and naturally occurring around its perimeter, in essence encapsulates the waste within. Along the entire perimeter of the landfill the dike functions as stream bank to one of four primary natural water resources; Site boundaries include the North Slough (north), Columbia Slough (south and west) Blind Slough (southeast) and Smith Lake (south) and the landfill perimeter road and adjacent sections of the landfill perimeter levee. The slough banks are typically covered in a mix of native riparian vegetation and provides critical habitat for both aquatic and terrestrial wildlife. Simply, the dike functions to keep water out of the landfill and the landfill debris out of the adjacent water. There is a gravel maintenance road that runs the entire perimeter of the landfill on top of the dike. The landfill is capped with an impermeable membrane, a 12 to 18 inch drainage layer of sand, and topsoil placed at varying depths to accommodate the planned native plant communities. This construct has made the establishment of significant larger vegetation both undesirable due to root invasion into the membrane cap and somewhat unlikely due to the shallow soils. Runoff is typically horizontal into a series of settling ponds at the perimeter of the landfill inside the maintenance road.

The project site is zoned open space (OShp) and heavy industrial (IHhp), with environmental protection overlay. Based on the FEMA Flood Insurance Rate Map, the site is within flood hazard area/zone A12, and within the floodway boundary.

Existing facilities within the site include two wells (K-3 and G-7) used by Metro for groundwater quality monitoring, and one piezometer (P-3, co-located with K-3) used for groundwater level monitoring. After the 1996 flood, the aboveground casings of the two wells and piezometer were extended, and wood platforms were constructed around K-3/P-3 and G-7 in order to access the top of the extended casings. Other facilities within the site include two outfall pipes that discharge stormwater to the North Slough; a BPA utility right-of-way (overhead electricity transmission line) crosses the landfill at its center running north and south.

There are no buildings on or adjacent to the site, and because it is part of the closed St. Johns Landfill to which limited public access is proposed via a multi-use pathway that will run along the perimeter road from the north end of North Slough south and east to the access bridge that crosses Columbia Slough on the western edge of the landfill. There are no transit facilities on or within 100 feet of the site, and no adjacent curbs or sidewalks.

The levee is a natural embankment of alluvium consisting of soft, fine sandy, slightly clayey silt, to loose, sandy silt. During the course of landfilling operations, the natural levee was raised around much of the landfill by placing fill consisting of medium stiff, fine sandy, slightly clayey silt to loose silty sand. The condition of existing vegetation at the site is typical of disturbed riparian areas. Dominant species include ash, willow, dogwood, blackberry, thistle, and reed canary grass.

The embankment has undergone significant erosion. Natural cyclical changes in water level and flow (seasonal and tidal) have a tendency to undercut the bank “toe”, and slumping has generally occurred further up the bank from the toe. In areas where the toe has been undermined, tree roots can be

exposed on steep cut banks. The approximate annual range of daily tidal flux in the sloughs is 1 to 3 feet. During late summer at low tide, some areas of the have little or no standing water.

In 2003 Metro replaced an earthen dam at the east end of the North Slough with a water control structure that includes a fish way for passage in and out of the Smith-Bybee complex. Metro operates the water control structure to simulate historical hydrology within the wetlands, in order to achieve restoration objectives. The yearly operational cycle implemented by Metro includes three stages. During the first stage (late-November to mid-June) the structure is fully closed to retain water in the wetlands. If during this stage, water level in the wetlands rises above the highest boards of the structure, water drains from the wetlands back into the North Slough. This retention of water simulates the spring freshet and prolonged recession of floodwater out of the wetlands. The second stage (mid-June to late-July) involves a gradual drawdown of water from the wetlands to North Slough. This long drawdown imitates historical conditions by slowly exposing shallow areas as mudflats in early summer, during the warming period that favors emergent native plant communities. During the third stage (late-July to late-November) the structure is fully opened to simulate historical tidal flow between the wetlands and North Slough.

The overall working area for potential projects, as shown on the Construction Site Management Plan, includes the extent of streambank adjacent to the landfill where construction would occur, landfill access roads, and separate on-site areas for staging construction materials and equipment, and storing excavated soil would be established.

Typical Project Description

Metro proposes to restore any eroding and unstable sections of streambank dominated by vegetation characteristic of disturbed riparian zones, to a structurally stable bank with a diverse community of native vegetation characteristic of the historical riparian and wetland systems of the lower Columbia River floodplain. By reinforcing the barrier between buried waste (and leachate) and adjacent surface waters, this restoration would provide distinct long-term benefits to public health and safety, and to water quality. Functional values of existing wildlife and fish habitat will be enhanced through implementation of a mitigation-planting plan.

The proposed design would combine traditional methods with biotechnical methods to stabilize the bank and establish native vegetation. Project design would call for rockfill in the lower portion of the slope, and compacted silty soil reinforced with geogrids and stacked geocells in the upper portion. The stabilized slope will then be revegetated.

Total excavation for any project would vary based on the extent of the slope failure. At the bank toe, a backhoe or crane would create an 8 to 10-foot bench to support rock materials. A crushed rock filter layer would be placed beneath both the lower and upper portions of the slope to prevent/relieve pore water pressure buildup. Graded rockfill material would consist of hard, clean, angular, durable, 12-inch minus blasted or crushed rock. Filter material would consist of hard, clean, angular, durable, ¾-inch minus crushed rock. The filter and graded rockfill materials would be placed in 1-foot lifts and compacted by either tamping with a backhoe bucket or by several passes from the treads of the

spreading equipment. Rockfill below the HTW would strengthen and buttress the slope and provide scour protection in the vital toe area. To offset habitat loss resulting from the use of rockfill, large woody material with root wad would be integrated into the rock structure as it is constructed.

A transition from rockfill to reinforced soil would occur at elevation 12 feet. From elevation 12 to 15 feet, the outer face of the slope would include stacked geocells that are in-filled with lightly compacted silty soil. The geocells will provide additional scour protection on the portion of the slope where vegetation can grow but is still frequently inundated and subject to scour during winter floods and spring freshets. Above elevation 15 feet, the slope would be comprised of compacted lifts of silty soil reinforced by wraps of geogrid. The soil would consist of sandy silt to slightly clayey silt that is compacted at moisture content from 1% below to 3% over the optimum moisture content, and to at least 95% of the maximum dry density as determined by a Standard Proctor compaction test. The soil would be placed in 6 to 12-inch lifts and compacted using a pad-foot roller.

All existing vegetation within a project site would be removed; The numbers of replacement trees/shrubs required per Chapter 33.430 (Table 430-3), and the numbers that would actually be planted, would be indicated on a Mitigation Site Plan. The number that would be planted would be substantially larger than the number required. This over-planting would be designed to ensure 100% and 80% survival of the required number of trees and shrubs, respectively, and the planting density that it represents would be consistent with similar projects implemented previously at St. Johns Landfill, and with vegetation management goals for the Natural Area generally. All species selected for planting would be included in the City of Portland Plant List and the Metro Native Plant List. Selection would be based on observations and project experience with native plant communities in the Columbia Slough area, vegetation development in previously stabilized and restored sections of the perimeter levee, and site conditions.

For planting purposes, the slope would be divided into zones between 12 to 15 feet and 15 to 18+ feet elevation, respectively. The lower planting zone would represent the wetter habitat where inundation may occur at varying intervals from winter storms and spring freshets. This zone will also experience the dry conditions of late summer and early fall. The upper planting zone would be saturated only briefly during heavy rainfall coupled with high river levels. Typical conditions in the upper zone include moist soils during much of the winter/spring, and drier conditions during the rest of the year. As such, species selected for the upper zone will be tolerant of a relatively wide range of moisture conditions. A terrace constructed mid-slope would receive a separate planting mix (alder/cedar) to create a unique visual response and to enhance wildlife habitat.

Project construction periods would be scheduled for late summer (approximately late July through August). Based on anticipated site conditions, appropriate measures would be taken to minimize erosion in the project area, and these would be consistent with the City of Portland Erosion Control Manual, and would incorporate Oregon DEQ Construction Best Management Practices. Control measures would be upgraded as necessary in response to unexpected weather.

Project s would include a 5-year monitoring and maintenance plan for mitigation and enhancement plantings, with qualitative and quantitative performance measures designed to ensure a self-sustaining, viable habitat. Adaptive management measures would be taken if performance measures are not met.

III. Streambank Stabilization Alternatives Evaluation

Due to the random nature and location of the slope failures and the need to mitigate immediately render the need to seek alternatives locations is unrealistic. There are however several alternatives for slope and bank stabilization. Due to the nature of the failures often these solutions require quick response using known methods. Damage caused by debris disbursement from the landfill into the adjacent natural areas mandate a quick response which is often guided by existing data and knowledge.

The primary objectives of the project design are to provide long-term stability and erosion protection to the embankment, to avoid or minimize impacts to water quality, and to provide enhanced ecological values within the Smith and Bybee Wetlands Natural Area.

No Action Alternative

If no action were taken to stabilize eroding sections of levee, tree and soil loss from the embankment would continue, thereby posing an increasing risk to public health and safety, and to the environment. The risk of a catastrophic bank failure, with potential spilling of buried waste into the surrounding waterways, would increase. There would be continued loss and degradation of riparian habitat along the adjacent sloughs as the bank is undermined and collapses; and continued deterioration of water quality resulting from sedimentation and lack of shade provided by relatively dense stands of mature trees in the riparian zone.

An overview of the conceptual repair alternatives is presented below.

Traditional Alternatives

In general, traditional dike repairs have involved techniques such as rock/riprap fills, various types of retaining walls, or commercially available erosion control products. Many of these alternatives involve the use of larger rock pieces and/or man-made materials (e.g., metal or concrete). Specific traditional alternatives considered for project design include: a rockfill buttress with riprap armoring, a sheetpile bulkhead wall, a tied-back wall, a stacked gabion wall, stacked geotubes (i.e., large-diameter, soil-filled geotextile tubes), a micropile wall (dike reinforcement using thin-diameter pipe piles), sand benches, and erosion/scour control products such as A-Jacks, Reno Mats and Petraflex blocks.

Aside from potential problems with wildlife habitat, there are technical concerns that ruled out many of the traditional alternatives. The sheetpile wall, tied-back wall, and micropile wall alternatives would all have to penetrate very deep (35 to 40 feet beneath the dike) to embed into underlying dense sand and gravel layers to provide support for the dike slope, and each method would be susceptible to corrosion. In addition, the micropile option would not address the scour problem occurring at the toe of the dike. The concerns about the stacked gabions and geotubes are that they could overload the soft foundation soils at the toe of the dike, and they would be susceptible to corrosion/degradation. The sand bench

option carries potential permitting problems, and would also require significant study to assess the effects on slough channel hydraulics. The drawback of using only erosion control products is that they would not replace (and enhance) support at the bank toe that has deteriorated over time due to scour and erosion.

Alternatives that feature primarily traditional methods can be very useful for stabilizing a dike and preventing erosion. However, at St. Johns Landfill they could produce an adverse impact on the existing fish and wildlife resources, and would not be visually appealing. On that basis, traditional stabilization measures alone would not meet the goals of the Natural Resources Management Plan for Smith and Bybee Wetlands.

Biotechnical Alternatives

Biotechnical alternatives rely largely on a combination of natural biological materials and products made from biological materials. A typical approach would involve planting willows, grasses, and other vegetation on a slope face that has been reinforced with logs, coconut fiber mats or some other biodegradable product. The vegetation serves several purposes: (i) the root systems help reinforce the slope and reduce erosion, (ii) it improves the appearance of the slope, and (iii) it provides wildlife habitat and shade that would enhance water quality. The fact that some tree species effectively uptake and process environmental contaminants, including some found in landfill leachate, could further enhance surface water quality.

Potential problems with biotechnical alternatives include: the length of time before plants become well established and their complex root systems have developed (possibly several growing seasons), inability to successfully establish plants on the lower elevations of the dike due to frequent inundation, predators destroying the plants, and the loss of internal support as the logs or fiber reinforcement mats deteriorate.

Specific biotechnical options considered include: a live crib wall, a gabion wall with vegetation, and a mechanically stabilized earth wall (MSE) that utilize geotextiles and native plants. A live crib wall consists of a vegetated rock and soil slope supported by a log structure. The major disadvantage of a live crib wall is that it is typically limited to about 4 feet in height because it cannot withstand heavy soil and rock loading. The gabion wall with vegetation method would consist of stacked rows of gabion baskets in-filled with a mixture of soil and rock that could support plant growth. The primary drawbacks to this method are that the finer/silty soil could erode out of the baskets and destabilize the wall, the baskets could corrode, and the wall could overload the soft foundation soil.

Remaining biotechnical options considered was a vegetated MSE slope. This method involves reconstructing the outer slope of the dike with silty soil reinforced internally with geotextiles. The slope face is heavily planted with vegetation to help provide slope stability and resistance to scour. The benefits of this method are that it provides all the biotechnical advantages listed above. However, for this method to work properly it must have vegetation that grows well. Without a healthy stand of vegetation, the slough current and tidal action could wash out the soil and contribute to slope

instability. A key design issue is that at St. Johns Landfill, vegetation does not grow well below the average high tide waterline, which is near elevation 12 feet (City of Portland datum).

Combined Alternatives

A combination of traditional and biotechnical alternatives was used in the final design of the levee repair project completed in 2000 at St. Johns Landfill. Traditional rockfill material was placed below the average high tide line to strengthen and buttress the slope, and to provide scour protection in the vital toe area. Large woody material with root wad will be integrated into the rockfill structure as it is constructed. The upper portion of the slope was comprised of silty soil reinforced with geotextiles (i.e., geogrids and geocells), coconut fiber mats, and native vegetation, which provided aesthetic and ecological value to the dike. The design of the proposed project includes a substantially similar approach.

IV. Resources and Functional Values Description

The applicable study for identifying existing resources and functional values is the NRMP.

The Natural Area represents the largest remnant of a former extensive network of sloughs, marshes, and lakes that historically occupied the south shore of the Columbia River. It is a large wetland complex surrounded by extensive shrub willow swamp and forested areas. Stands of cottonwood, ash, or mixtures of these dominate the uplands. The 240-acre St. Johns Landfill, which has been covered, contoured and revegetated, is the most disturbed and developed habitat within the Natural Area.

Habitat types within the Natural Area include grassland, emergent wetland and mudflat (late summer conditions; seasonally variable), scrub/shrub (includes regenerating willow), bottomland hardwood forest (includes ash and established willow forest), riparian forest, and open water. The revegetated landfill mound represents an upland meadow environment within the Natural Area. Mammals present include beaver, nutria, river otter, mice, and blacktail deer. Reptiles found in the wetlands include turtles and garter snakes. Amphibians include salamanders and frogs. Fish species include juvenile salmonids, largemouth bass, bluegill, crappie, yellow perch, and carp. Over 100 species of waterfowl, songbirds, shorebirds, and raptors have been sighted in the area.

A list of threatened and endangered species that may occur in the general vicinity of the project site was obtained from the US Fish and Wildlife Service in May 2005 (USFWS Reference # 1-7-05-SP-0350); The list was verified in November 2006. Bald eagle (Haliaeetus leucocephalus), Chinook salmon (Lower Columbia River) (Oncorhynchus tshawytscha), Coho salmon (Lower Columbia River) (O. kisutch), and Steelhead (Lower Columbia River) (O. mykiss ssp.) are the listed species that may occur in the area.

Critical habitat has been designated for Chinook and Steelhead. The Pacific Fisheries Management Council has designated Essential Fish Habitat (EFH) for three species of Pacific salmon including Chinook (O. tshawytscha), Coho (O. kisutch), and Puget Sound Pink salmon (O. gorbuscha) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water

bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable barriers.

Recent monitoring studies conducted in 2003 through 2005 indicated that juvenile Chinook, Coho and Steelhead are present in the North Slough and the Smith-Bybee complex during winter and early spring. Fin clipped markings indicate that these juvenile fish are likely all of Lower Columbia River ESUs origins. These juvenile salmonids use the Natural Area for winter rearing and refugia from high winter flows. The juvenile fish migrate out of the area before summer water temperatures rise in the Columbia Slough. No adult fish of these species have been reported in the results of the monitoring studies (Baker and Miranda). There is no indication that waters in the vicinity of the site are used for spawning or summer rearing. It is likely that the area is used only by juveniles for winter rearing.

A bald eagle nest is located in Smith Wetland more than one mile east of the project site. Winter use by bald eagles typically would occur from November to March. There is no critical habitat designated for bald eagle.

Any potential project site would include eroding, unstable streambank on the perimeter of the landfill. In the context of the resources and habitat functions characteristic of the Natural Area, and the goals and objectives of the NRMP, the site provides relatively low quality resource or functional value. The native habitat functions once provided by the site were lost decades ago. Vegetation at the site includes an assortment of trees, shrubs and grasses typical of disturbed riparian areas. Dominant species include ash, willow, blackberry, thistle, and reed canary grass. Reed canary grass dominates in some areas. In areas where the toe has been undermined, tree roots are exposed on steep cut banks.

Recreational uses of the sloughs around the St Johns Landfill are limited by NRMP conditions and by access. There is a 10’ wide multi-use pathway proposed along the maintenance road on top of the levee extending from the north end of North Slough south and east to the access bridge on the west side of the landfill. The water control structure area, which is located at the eastern end of North Slough, is occasionally used by the public for fishing, or as a temporary take-out spot for paddlers, who mainly paddle in the wetlands complex during high water conditions, and to a lesser extent in the sloughs.

V. Potential Impacts Evaluation

Minor, temporary impacts to water quality due to construction activities would be minimized through the implementation of a Construction Management Site Plan, which includes erosion and sediment control measures, and methods for handling, staging and storing excavation and construction materials.

No long-term negative impacts to biological or physical resources would be expected. Construction would typically take place during late summer when water levels and flow are typically the lowest of the year, and most bird nesting and rearing, and warm water fish spawning will be complete. Juvenile Chinook, Coho and Steelhead that use the sloughs will not be present during the time of construction. Most resident wildlife will disperse to nearby areas. Any impacts to water quality are expected to be minor and temporary. Existing vegetation would be removed to allow for restructuring and stabilizing

the levee, and would be replaced with extensive plantings of native species including grasses, forbs, shrubs and trees.

The Columbia Slough is designated as critical habitat for both Lower Columbia River Chinook and Steelhead. Freshwater rearing (winter rearing) is the Primary Constituent Element (PCE) associated with critical habitat at this site for both Chinook and Steelhead. There will be short-term, temporary impacts to the freshwater rearing PCE during the excavation and fill activities. However, the risk of a catastrophic dike failure and potentially significant impacts to aquatic habitat will be substantially reduced. Native plantings will protect and enhance water quality in the North Slough and provide stable riparian habitat for the site. Projects are not likely to adversely affect Chinook, Coho or Steelhead or designated critical habitat for Chinook and Steelhead.

Essential Fish Habitat is present for both Chinook and Coho. An EFH assessment was completed and submitted to the NMFS for consultation under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). There will be short-term, temporary impacts to EFH during the excavation and fill activities. However, there would be long-term benefits to EFH from the intensive planting and maintenance of native vegetation on restored slopes.

The Columbia Slough is a water quality limited, 303(d) listed water body. A complete list of the parameters, season, criteria, and status for the Columbia Slough can be found in the Oregon's 2004/2006 Integrated Report (Oregon Department of Environmental Quality, 2006). Restructuring, stabilizing and re-planting of degraded sections of the levee would significantly reduce loading of suspended solids caused by poor vegetative cover and erosion. It would also significantly reduce the potential for waste materials and leachate to come into contact with adjacent surface water, thereby reducing potential risks public welfare and the environment. As the planted trees and shrubs mature, an increasing amount of shade will be provided for the sloughs, thereby reducing average water temperatures and improving water quality and habitat, particularly for salmonids and amphibians.

A cultural resource survey for the Columbia Slough/St. Johns Landfill project was completed in 1998 and the results were provided to the Oregon State Historic Preservation Office. The entire perimeter levee was surveyed. Three cultural sites were located during the survey, although none of these are located within the potential project sites.

VI. Typical Mitigation, Monitoring and Maintenance Plan

Metro views the proposed projects as restoration of landscape and habitat consistent with the goals of the NRMP. Eroding and unstable sections of streambank would be reconstructed and stabilized in order to protect public welfare and the environment from the effects of buried waste and leachate, and to restore a diverse community of native vegetation characteristic of historical lower Columbia River floodplain riparian habitat. Degraded streambanks offer low quality resource value in itself, and poses an ongoing environmental risk to the functional values of surrounding resources.

The loss of existing vegetation and habitat would be mitigated through a planting plan designed to increase vegetation density, diversity and complexity, thereby providing high quality native riparian habitat that was lost by past filling and erosion over time. As a result, value and function would be added to the overall resources of the Natural Area. To compensate for loss of habitat value associated with rockfill placement in the lower slope, large woody material with root wad will be integrated into the rockfill structure as it is constructed, and soil on the upper slope will be reinforced to accommodate dense native vegetation.

Existing vegetation at the site primarily includes ash, willow, dogwood, blackberry, thistle, and reed canary grass. Reed canary grass dominates in some areas. In areas where the toe has been undermined, tree roots are exposed on steep cut banks. Overall, the sparse density and condition of the woody vegetation is typical of disturbed riparian area. Potential projects would involve removing all existing vegetation, many of which would be growing in unstable bank conditions. Loss of these trees will be compensated by planting a substantially greater number of native trees/shrubs throughout the mitigation area than is required by City. This over-planting is designed to ensure 100% and 80% survival of the required number of trees and shrubs, respectively; and the planting density that it represents is consistent with Metro's vegetation management goals for St. Johns Landfill and the Natural Area generally.

Species to be planted would be selected based on observations of existing plant communities along the lower Columbia Slough, an assessment of conditions in previously-stabilized and restored sections of the perimeter levee, past project experience working with native plant communities in the Columbia Slough area, and matching species to anticipated site conditions. All selected species are included in the Metro Native Plant List (1998) and the City of Portland Plant List (updated March 2004).

An essential goal of any project would be to establish a native-dominated vegetative community above elevation 12 feet. For planting purposes, the dike slope would be divided into two zones, including elevation 12 to 15 and elevation 15 to 18^{+} (City of Portland datum). The lower zone (elevation 12 to 15) represents wetter habitat where inundation occurs at varying intervals during heavy winter storms and the Columbia River's spring freshets. This zone also experiences dry conditions typical of late summer and early fall. The upper zone (elevation 15 to 18^{+}) is above typical inundation levels and would experience saturated soils only briefly during heavy rainfall combined with high river levels. More typical conditions on the upper slope would be moist soils present during much of winter/spring with more xeric conditions during the remainder of the growing season. Plant species selection reflects this anticipated drier riparian habitat, using species that are adaptable to a relatively wide hydrologic range. The constructed terrace would receive a separate planting mix (alder/cedar) to create a unique visual response and to enhance wildlife habitat.

Immediately upon completing bank reconstruction, the entire slope above 12 feet elevation will be direct-seeded with native grasses and forbs. The seeded area would then be covered with a biodegradable, nonwoven coir (coconut fiber) blanket, to prevent surface erosion and hold moisture. After surface soils are thoroughly moistened by autumn/winter rains, native trees and shrubs (primarily live pole stock) would be planted throughout the seeded area.

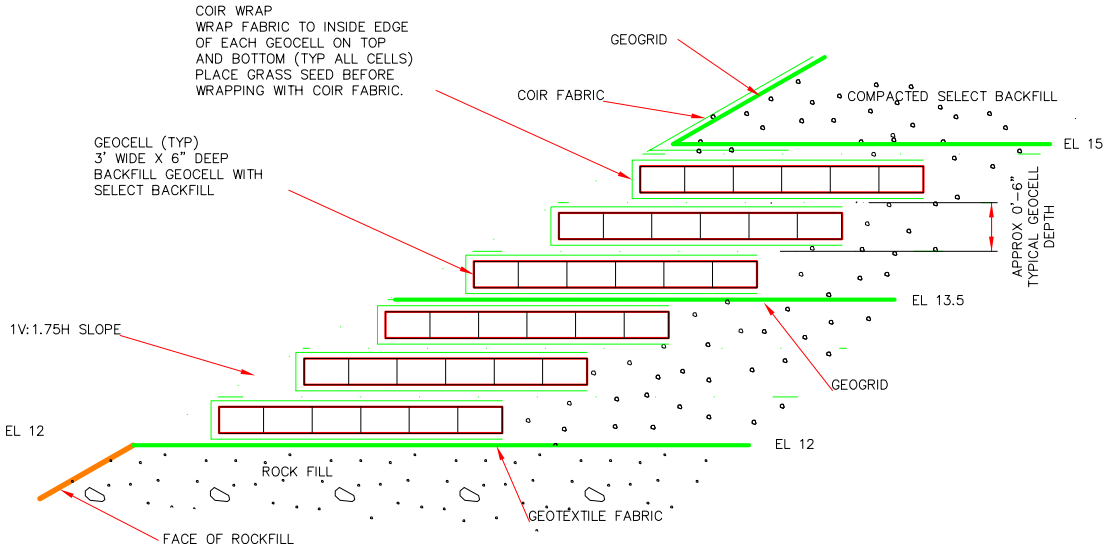
Survival of woody plants would be monitored for a period of 5 years. The number of trees/shrubs to be planted would represent a substantial over-planting relative to the number required, the purpose of which is to ensure 100% and 80% survival of the required number of trees and shrubs, respectively. In the unexpected situation where the count of surviving woody plants for any growing season falls below either of these goals, additional plantings would be installed during the following dormant season to bring the plant numbers back up to that level. Annual reports will include quantitative estimates of plant survival, a record of monitoring and maintenance activities, and photographs taken per OWEB photo-monitoring protocol.

To increase survival rates, trees would be protected from beaver and small mammal damage using vexar tubing, and would be mulched during the first two growing seasons. The Bureau of Environmental Services would perform adaptive monitoring and maintenance using Watershed Revegetation Program (WRP) monitoring and documentation protocol. Adaptive management strategies include annual monitoring to assess treatment needed in the next growing season to accomplish site goals.

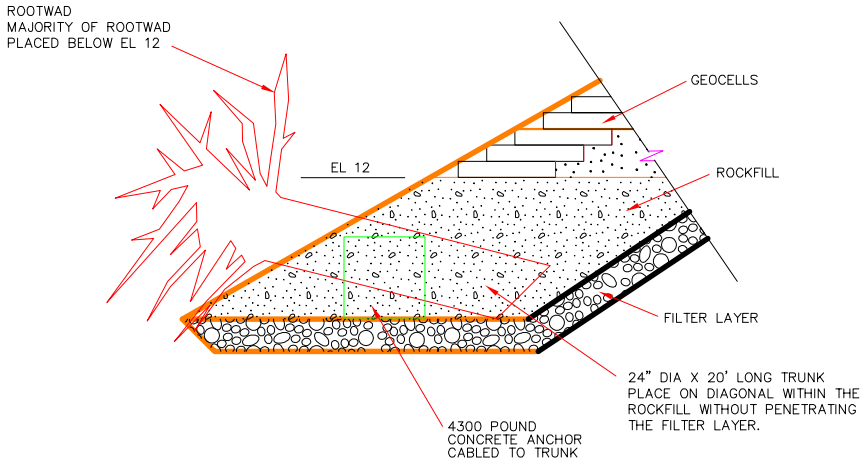
Monitoring events would be recorded in the WRP Database and will be translated into a schedule of annual treatments that would include manual weed pulling, scalping, mowing, cutting, herbicide application, and continued mulching if needed. Herbicide applications would be timed to optimize effectiveness and minimize drift. Applicators are supervised by and ODA licensed applicator and all applications conform to City of Portland Parks and Recreation Integrated Pest Management guidelines for waterway areas (Chapter 9).

Proposed Development Plan – As needed

Construction Management Plan – As needed



TYPICAL GEOCELL DETAIL
NTS



TYPICAL ROOTWAD DETAIL
NTS

AS-BUILT

DAVID EVANS AND ASSOCIATES INC.
2100 Southwest River Parkway
Portland Oregon 97201
Phone: 503.223.6663

PROJECT	ST. JOHNS LANDFILL		SHEET
TITLE	SLOPE STABILIZATION		2
DWG. REF.	PROJECT	SCALE	AMENDMENT NO.
	MTOX00000042	NA	0.0
DRAWN BY	DESIGN BY	APPROVED BY	DATE
			4-28-11

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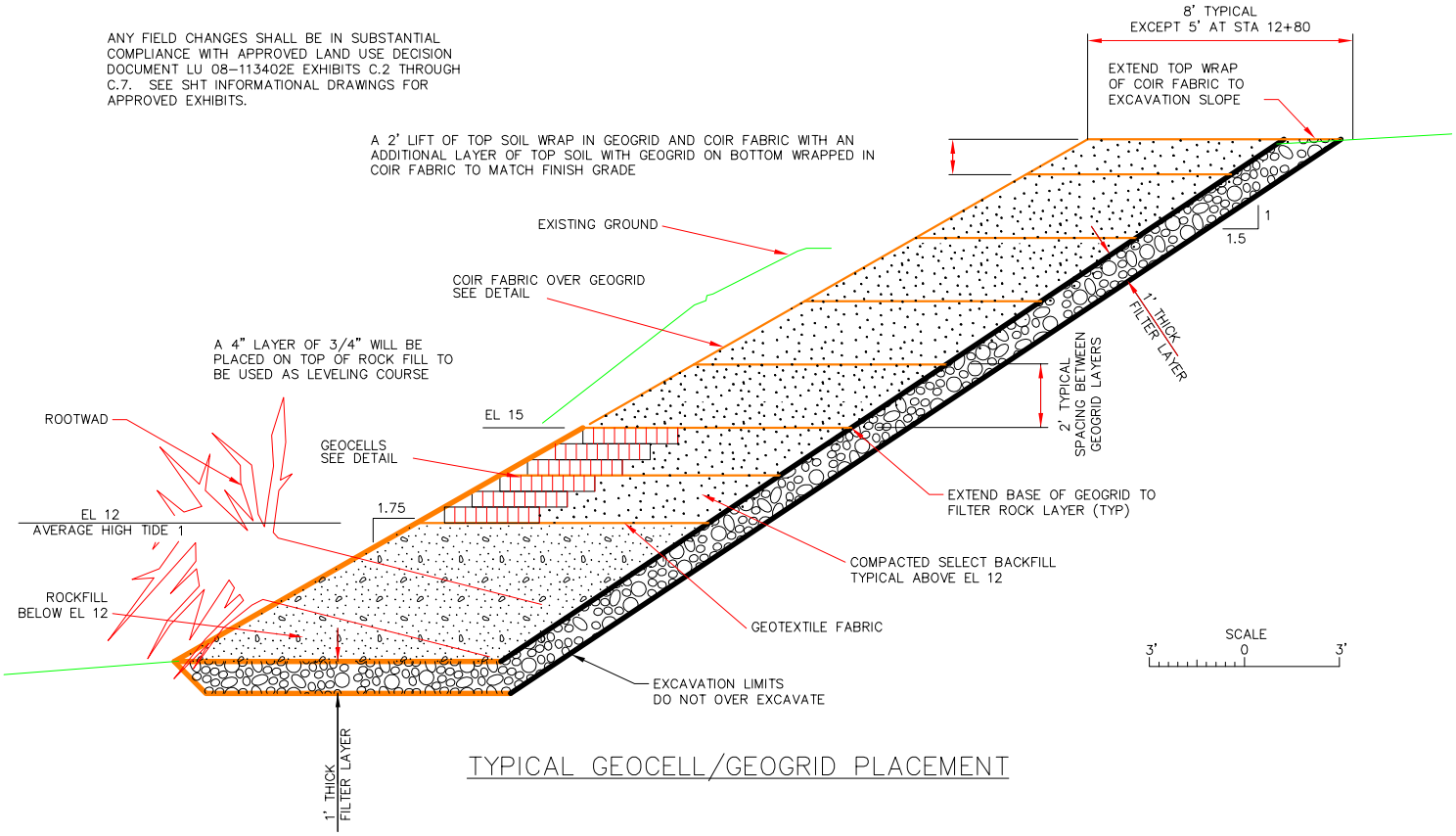
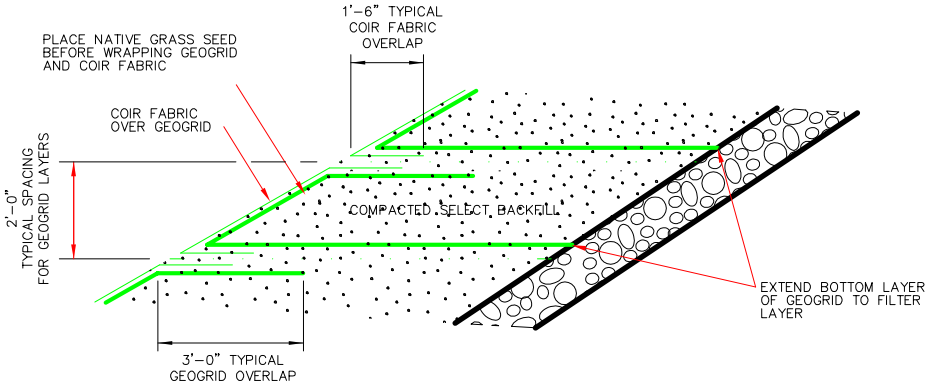
ANY FIELD CHANGES SHALL BE IN SUBSTANTIAL COMPLIANCE WITH APPROVED LAND USE DECISION DOCUMENT LU 08–113402E EXHIBITS C.2 THROUGH C.7. SEE SHT INFORMATIONAL DRAWINGS FOR APPROVED EXHIBITS.



TYPICAL GEOCELL/GEOGRID PLACEMENT



TYPICAL GEOGRID DETAIL
NTS

AS-BUILT

DAVID EVANS AND ASSOCIATES INC.
2100 Southwest River Parkway
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Phone: 503.223.6663

PROJECT	ST. JOHNS LANDFILL		SHEET
TITLE	SLOPE STABILIZATION		1
DWG. REF.	PROJECT	SCALE	AMENDMENT NO.
	MTOX00000042	NA	0.0
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Projects Potentially Subject to City of Portland Land Use Review
St. Johns Landfill Program

Overview

In addition to streambank restoration, which is covered in detail separately in this Appendix, three other types of projects associated with the St. Johns Landfill program, and potentially subject to land use review by the City of Portland, may be implemented during the 10-year term of the CNRP; including the following:

- Groundwater Monitoring Well Installation
- Remediation of Environmental Contamination
- Modification of Landfill Gas Management Facilities

General descriptions of these projects are provided below. Detail provided is a function of the degree to which project objectives, procedures, and design can be reasonably predicted, based on available information.

Groundwater Monitoring Well Installation

Rationale

Consistent with Oregon Solid Waste Disposal Site Closure Permit No. 116 (pursuant to ORS 459) and Order on Consent DEQ No. LQSW-NWR-02-14 (pursuant to ORS 465), Metro is required to conduct environmental monitoring of St. Johns Landfill and the surrounding environment, including extensive monitoring of groundwater. The permit regulates post-closure care operations, including features and systems designed to protect the surrounding environment from the effects of buried waste and its byproducts. The consent order requires a remedial investigation and feasibility study (RI-FS) to identify any remaining risks not controlled by the existing environmental protection features/systems; and where such risks are identified, to evaluate feasible alternatives for remediation. Identifying and addressing risks in this manner will provide an essential benefit to public health and safety, and will enhance the value of natural resources in the Smith-Bybee Wetlands Natural Area. As the RI-FS progresses, additional information may be required to achieve the objective. Among other methods, this could include installing monitoring wells to collect additional groundwater quality data.

Existing Conditions

St. Johns Landfill is a 240-acre closed municipal solid waste landfill located within the Natural Area. Under applicable state regulations groundwater quality is monitored using a network of 41 wells, 29 of which are located on the landfill site proper and twelve 12 of which are located off-site. Of the 41 total wells, all but 3 are located within the Natural Area, and in riparian or

wetland environmental zones. The project site is generally defined as the Natural Area – at, or in the vicinity of the landfill site.

Access routes to existing wells include: Improved gravel roads on the landfill site, used daily by Metro staff and contractors for landfill post-closure operations and site restoration projects; an unimproved dirt road used by the City of Portland Bureau of Environmental Services to access its Ramsey Lake site; a paved trail that originates near the entrance to Kelly Point Park and extends southeast through Port of Portland property along Columbia Slough to a terminus between North Slough and Bybee Wetland (across from the northwest corner of SJLF); an unimproved dirt trail that extends from the water control structure at the terminus of the North Slough northwest to the terminus of the paved trail; and a unimproved dirt path along railroad tracks (to access the 3 wells located outside of the Natural Area). River conditions occasionally require accessing some wells by water.

Project Description

Based on current understanding of local hydrogeological conditions, and on the existing and anticipated regulatory status of St. Johns Landfill, it is probable that the location of any monitoring well installed during the 10-year term of the CNRP would be within the Natural Area, in an environmental overlay zone, and on property owned by one of three agencies: Metro, the City of Portland, or the Port of Portland.

The project would involve construction of monitoring wells for the purpose of collecting groundwater samples for field testing and laboratory analysis. An anticipated scenario would involve the installation of one to 3 wells, from which samples would be collected twice per year for a minimum of 5 years. Wells would be installed, operated, and abandoned (when appropriate) in compliance with all applicable rules of the Oregon Water Resources Department (WRD), pursuant to OAR 690-240.

Access would be required to install wells and collect groundwater samples. Installation would involve the transport of drilling equipment along specified access routes to the construction site. To collect groundwater samples, a standard size pickup truck carrying sampling equipment (e.g., small electronic units and sample containers) would travel along the same access routes; and as needed based on river conditions, sampling equipment would be transported to the wells by non-motorized boat.

To minimize environmental disturbance, wells would be drilled using a relatively small, highly maneuverable drill, such as a Rotosonic™ rig, which generates the least amount of drilling waste of any viable method, and is mounted on rubber tracks to minimize rutting and damage to vegetation. This rig is sufficiently maneuverable to avoid contact with large woody vegetation.

Any constructed well would be screened at a depth to be determined, in one of two hydrogeological formations: Overbank Silt (OBS) or Columbia River Sand/Pleistocene Gravel (CRS/PG). Typical drilling and well installation activities would include the following steps:

- A 6-inch diameter boring drilled to the design depth;
- Soil cuttings from drilling activities drummed and disposed offsite in an appropriate manner, as required based on soil chemistry;
- Monitoring wells installed in 6-inch diameter boring, including:
  - Casing: 2-inch diameter Schedule 40 PVC
  - Filter pack: Pre-washed silica sand
  - Down-well screen: 0.010-inch machine slot screen
  - Well bottom: 1-foot sump with flush-threaded joints and end cap
  - Well top: 2-inch diameter Schedule 40 PVC with flush-threaded joints

Potential Impacts / Mitigation Measures

No tree removal would be required to transport drilling equipment or to install wells, and the clearing of any groundcover and shrubs for these purposes would be mitigated through revegetation with appropriate native species, consistent with CNRP conservation targets and in accordance with applicable permits.

Overall impacts of the project would be minor and temporary. Transport of drilling equipment would utilize approved existing access routes, thereby minimizing environmental disturbance. The footprint of the well construction area would be small. Well installation would involve a 6-inch diameter boring from which soil cuttings would be extruded directly into 55-gallon drum containment. Because of the small scale of the affected area, and a large degree of control over construction activity, erosion is not expected to be a significant issue.

Any negative impacts on wildlife and organisms would be negligible due to the small scale of the affected area. The project would not significantly affect any existing resource or habitat function of the Natural Area. Installed wells would be maintained by Metro following protocols required by DEQ and WRD, ensuring that they provide meaningful data while having minimal environmental impact.

Remediation of Environmental Contamination

Rationale

Consistent with Order on Consent DEQ No. LQSW-NWR-02-14 (pursuant to ORS 465), Metro is required to carry out a remedial investigation and feasibility study (RI-FS) at St. Johns Landfill. The objective of the RI-FS is to identify any remaining risks not controlled by existing environmental protection features and systems, and where such risks are identified, to evaluate

feasible alternatives for remediation. Identifying and addressing risks in this manner provides an essential benefit to public health and safety, and enhances the value of natural resources in the Natural Area.

The RI is conducted with oversight by DEQ. The final RI report will include a characterization of the nature and extent of contamination in the vicinity of the landfill. Based on work completed to date, there is a reasonable possibility that some remedial action will be conducted as part of overall actions to reduce the impacts of chemical contamination near the landfill site. This remedial action would be conducted under a consent agreement with DEQ.

Existing Conditions

Areas most likely to be subject to future remedial action are located at the head of Blind Slough and at the "West Mud Flat", which is located about 1,500 feet upstream from the confluence of North Slough with Columbia Slough. Both of these locations are depositional areas with shallow sediments that are periodically exposed during low water conditions. Chemical contamination is present in sediment in these areas, with the highest concentrations present in a layer approximately 2 to 4 feet below the sediment surface.

In some years, a dense colony of the native Wapato plant, or broadleaf arrowhead (*Sagittaria latifolia*), emerges in sediments at the head of Blind Slough.

Project Description

It is anticipated that an FS will be required to identify and evaluate possible remedial actions for these areas, which could include localized dredging or capping. No action other than monitoring is also a possible outcome of the study. Affected areas, though not yet finalized, are expected to be one acre or less at the West Mud Flat and approximately one half acre at the head of Blind Slough. Any action would be approved through a DEQ process and would entail a public comment period. Remediation involving in-water work, if conducted, would likely be performed by excavators operating from land and/or from a barge, under applicable approvals, easements and permits from state and federal agencies.

Potential Impacts / Mitigation Measures

If remediation involving in-water work were implemented, as described above, the required approvals, easements and permits would include conditions for minimizing disturbance and re-suspension of sediments, and any associated erosion on the adjacent streambank. A primary control measure would be the use of silt curtains to isolate work areas.

Little removal of vegetation would be involved in remediation at the West Mud Flat. At Blind Slough, disturbance of the Wapato plant is a possible impact. Revegetation of the affected area would be implemented consistent with CNRP conservation targets, and in accordance with applicable approvals, easements and permits.

Modification of Landfill Gas Management Facilities

Rationale

As part of the landfill cover project implemented in 1992-1996, a motor blower/flare facility (MBFF) was constructed for the purpose of withdrawing and efficiently burning gas generated by decomposing wastes. The in-field components of this system include gas wells, trenches and pipeline. Five remote pump stations collect liquid condensate that forms in the pipeline and pump it into lines that carry it to an evaporator at the MBFF.

In 1998, the MBFF was reconfigured and a compressor station constructed, for the purpose of directing gas into a 2-mile pipeline to the Ash Grove Cement Company (AGC), where it is used as a fuel source for the manufacture of lime. AGC is able to draw gas into the pipeline as needed; and gas not drawn by AGC is flared on-site.

As expected, gas generated by the landfill has steadily decreased over time. Eventually, modifications of the gas management facilities (e.g., equipment removal, replacement, retrofit), at the MBFF or in the field, will be required to adapt to this change.

At such time when the AGC project ends, the compressor station would likely be dismantled and removed, and projects designed for other beneficial uses of the remaining gas (e.g., electric generation) may be implemented, if determined to be economically feasible.

Existing Conditions

The MBFF is located in the southeast portion of the landfill site and consists of the following components:

- Motor blowers (2)
- Flare stacks (3)
- Condensate extraction and discharge system
- Process Air Compressor
- Electrical system and programmable logic controller
- Oxygen monitor
- Autodialer

There are four industrial equipment pads at the MBFF, which hold the following equipment:

- Motor blowers, condensate knock-out tanks, and condensate oil/water separator
- Flares, condensate process tanks and evaporator
- Process Air Compressor
- Process equipment related to sending gas down pipeline to AGC

The MBFF is surrounded by security fencing. The blowers, condensate knock-out tanks, condensate manhole, condensate evaporator, propane tanks, and control room are located under constructed cover; flares and the flare control panel are not covered. The control room is contained within an enclosed and insulated structure that includes the oxygen monitor, program logic controller, controls for all motors, and autodialer.

The AGC compressor station is also on a constructed pad, surrounded by security fencing, and is partly under cover.

Project Description

It is anticipated that modification of gas management facilities will be required during the 10-year term of the CNRP. Modification projects will likely be implemented on existing equipment pads, for purposes of removing, replacing or retrofitting existing components or systems. Under these circumstances, no construction excavation/fill is expected. Where a project involves the dismantling and removal of equipment as well as pads (e.g., compressor station, condensate pump stations), small quantities of fill may be required to regrade the affected areas in order to maintain or otherwise restore efficient stormwater control.

Project types that might be implemented included:

- Replace motor blowers with more efficient models.
- Replace or rebuild flares to efficiently combust a smaller volume of landfill gas.
- Install process equipment to convert landfill gas to use as an alternative fuel; including to generate electricity. This could include scrubbers, compressors, turbines and/or internal combustion engines.
- Replace the condensate evaporator with a more efficient evaporation system, or with a system that manages condensate through the flaring operation.
- Plumb condensate to the municipal sanitary sewer if allowed by the City of Portland based on a demonstration that pollutants in untreated condensate have dropped to levels sufficiently below local discharge limits.
- Dismantle and remove system for transporting gas to AGC, primarily the compressor station, and restore the affected area.
- Dismantle and remove condensate pump station, and restore the affected area.

Potential Impacts / Mitigation Measures

Standard measures would be implemented to control any dust and erosion that may result from construction or demolition activities. Erosion control would be carried out in accordance with the site NPDES stormwater discharge permit, including the site stormwater pollution control plan. Additional control and mitigation measures required by any project-specific permit would be implemented. Where appropriate soil testing would be conducted, and the

detection of contaminants at levels of concern would be further investigated and, if needed, the impacted area would be remediated following DEQ protocols.

Where pads are removed, for example, in the dismantling and removal of the compressor station, a relatively small amount of fill may be used to regrade the affected area in order to maintain or otherwise restore efficient stormwater control. Unless the cleared area is determined to be needed for some form of continued use in managing gas, or any other landfill closure operation, it would be revegetated consistent with CNRP conservation targets and in accordance with any project-specific permit.

SMITH AND BYBEE COMPREHENSIVE NATURAL RESOURCE MANAGEMENT PLAN

APPENDIX E: References

Appendix E – References

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