

CHAPTER 7

Physical Habitat and Biological Communities Characterization

GOAL

Physical Habitat: Protect, enhance, and restore aquatic and terrestrial habitat conditions to support key ecological functions and improved productivity, diversity, capacity, and distribution of native fish and wildlife populations and biological communities.

Biological Communities: Protect, enhance, and restore native aquatic and terrestrial species and biological communities to improve and maintain biodiversity in Portland's watersheds.

INTRODUCTION

The following characterization chapter is a summary of habitat and biological communities conditions in the Columbia Slough Watershed. The City has not yet developed citywide scientific principles or comprehensive lists of attributes and influences for terrestrial wildlife or plant communities. Therefore, the characterization information presented in this report will be augmented in the future as the citywide strategy is developed.

OVERVIEW

As discussed in Chapter 5: Stream Flow and Hydrology Characterization, the Columbia Slough Watershed's hydrology has been greatly altered – primarily for flood control, agriculture, and urban development – since the building of the levees began in 1919. Pumps, weirs, and levees throughout the drainage district portions of the watershed control water direction and flow. Consequently, the Columbia Slough is now a highly managed system, and this must be taken into account when considering impacts on and restoration of the watershed's habitats and biological communities.

Habitat and Biological Communities

Habitat is an area with the combination of necessary resources (e.g., food, cover, water) and environmental conditions (temperature, precipitation, presence or absence of predators and competitors) that promotes occupancy by individuals of a given species (or population) and allows those individuals to survive and reproduce (Johnson & O'Neil 2001). It comprises the interaction among soils, hydrology, vegetation, and climate. A habitat provides the necessary ecological functions and processes to preserve the biological communities that live within it for all or a portion of their life cycle.

Biological communities are the assemblages of organisms that live within or use a variety of habitats for their range of life functions. They depend on the availability of resources and the ecological processes to maintain their viability. In natural riparian ecosystems, biological diversity (or biodiversity) is higher than in disturbed, simplified systems. Both habitat complexity and high biodiversity are indicators of a balanced, healthy watershed.

Historical Character

The Columbia Slough Watershed was historically a portion of the Columbia River floodplain, extending 20 miles eastward from the Willamette River to the Sandy River. The system was very dynamic, changing yearly with the spring “freshets” (annual floods resulting from snowmelt in the Upper Columbia basin) that deposited silt, carved basins, and created new channels. Wetlands, lakes, and waterways dominated the watershed. The shorelines and low-lying areas were thickly forested, but also contained expanses of wetland prairie and oak savanna (USACE 2000).

The confluence of the Willamette and Columbia Rivers was once very rich in biota. The marshlands were the ideal habitat for wapato, a wetland plant highly prized by Native Americans, and for wintering waterfowl. Pre-development species in the region included 54 mammal species, 24 reptile and amphibian species, 25 to 30 fish species, and over 150 breeding bird species. Most of these species still exist as breeding species in the Willamette Valley today, except for the grizzly bear, gray wolf, California condor, Lewis’ woodpecker, yellow-billed cuckoo and the black-crowned night heron (Hulse & Baker 2002).

The U.S. General Land Office (GLO) completed an extensive survey of the Lower Willamette River and Portland area in 1851 and 1852. Over the 2-year period, surveyors mapped the diversity of habitats found within the region, including the entire Columbia Slough Watershed (Oregon Natural Heritage Information Center 2002). Figure 7-1 is a detailed map of these habitat designations. It identifies historic vegetation communities and habitat types found in 1851. Table 7-1 is a more detailed analysis of the survey findings. It identifies habitat types found in 1851 and acreages of each habitat type. The data were compiled and digitized by the Oregon Natural Heritage Information Center, in partnership with the City of Portland Bureau of Environmental Services and other funders. An extensive database accompanies the mapping data. A general map of the survey efforts can be found in the *Columbia Slough Watershed Atlas*.

For the analysis in this chapter, vegetation and habitat types are classified as open water, riparian, wetland and upland habitat.

Figure 7-1: 1851 Vegetation Classification Map

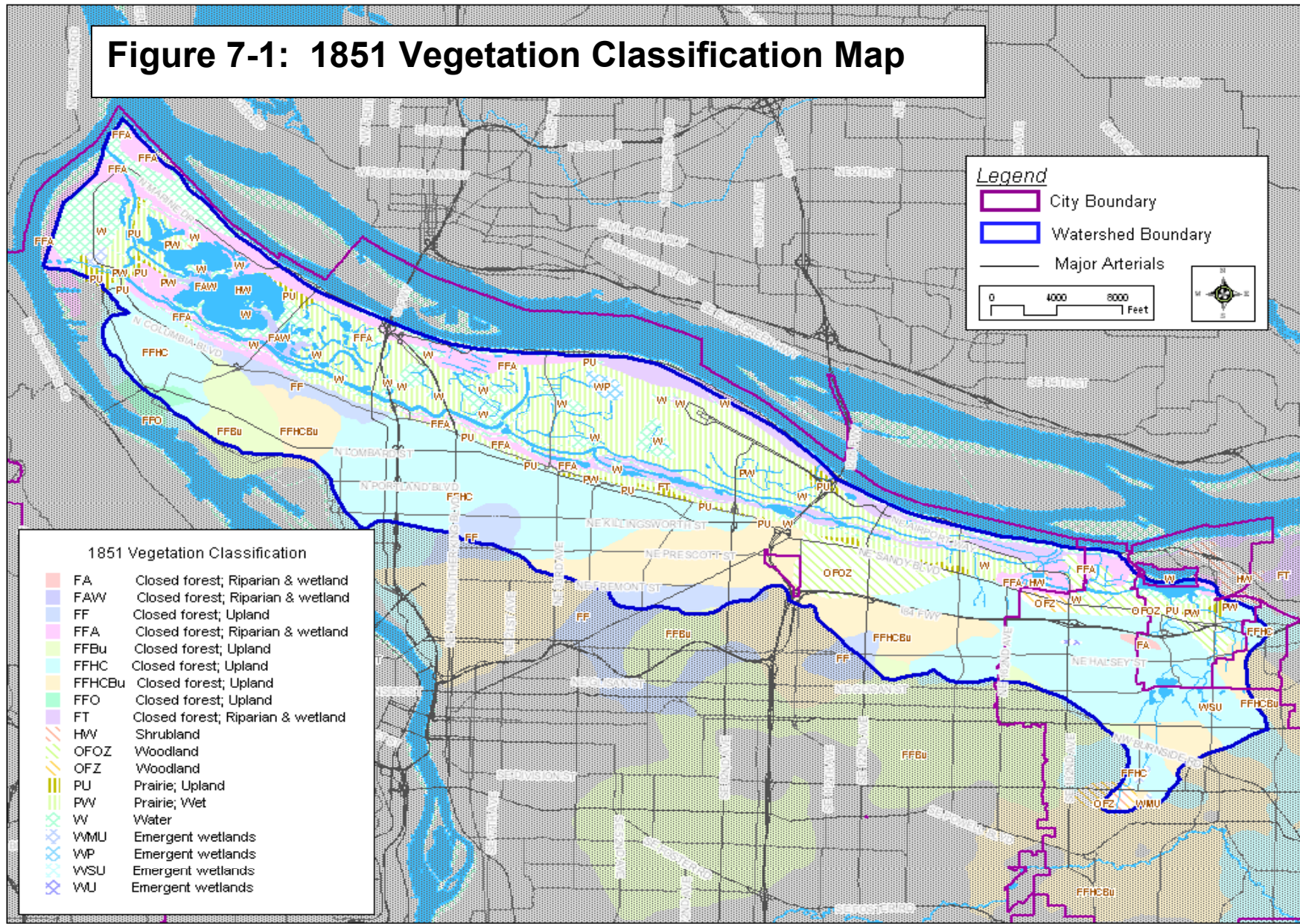


Table 7-1: Habitat Type and Dominant Species (1851)

Habitat Type Abbreviation	Brief Description of Habitat Type and Dominant Species	Acres in 1851	% of Total in 1851
W	Water bodies	3,114	9.5%
WP	Pond lily aquatic bed	104	0.5%
WATER TOTAL		3,218	10%
FFA	Northern mixed deciduous riparian forest	1,994	6%
FT	Black cottonwood riparian forest	910	3%
RIPARIAN TOTAL		2,904	9%
FA	Ash “swamp” and ash “swale”	50	0.15%
FAW	Ash-willow swamp, very thick	284	0.87%
HW	Willow swamp or willow swale	115	0.35%
PW	Seasonally wet prairie with scattering of trees	6,553	20%
WMU	Marsh or wet meadow, composition unknown	86	0.26%
WSU	Swamp, composition unknown	9	0.03%
WU	Wetland, composition unknown	13	0.04%
WETLAND TOTAL		7,110	22%
FF	Douglas fir forest with mixed deciduous. No other conifers or oak present	1,551	5%
FFBu	Same as FF but burned	1,318	4%
FFHC	Mixed conifer forest with Douglas fir, Western hemlock, Western red cedar, grand fir and deciduous trees	10,056	31%
FFHCBu	Same as FFHC but burned	4,297	13%
FFO	Douglas fir and oak dense forest	130	0.4%
OFOZ	Douglas fir and oak scattered woodland	1,560	5%
OFZ	Douglas fir scattered woodland with some deciduous	154	0.4%
PU	Upland and xeric prairie, with some scattered trees	447	1%
UPLAND TOTAL		19,513	59%
TOTAL ACREAGE		32,745	100%

Reference Conditions

The City of Portland Bureau of Environmental Services (BES) Watershed Revegetation Program has identified and studied several reference sites to inform native plant revegetation in the Portland metropolitan region. These reference sites are the best examples of naturally occurring habitats in Portland. Describing current plant communities provides invaluable information when applying land management techniques to natural areas. These reference sites provide a useful guide for restoration, but too often sites have undergone many disturbances (e.g., soil compaction, grazing, logging, farming) and cannot be restored to reference site conditions.

Most reference sites described by the Watershed Revegetation Program have had disturbances that have shaped the plant community. Natural disturbances, such as flooding, fire, and landslides, are primary mechanisms in plant community development. In riparian areas, forests have evolved to withstand and flourish where temporary and seasonal flooding occurs. Sediment during these floods settles to provide nutrients to the plant community, and areas that have been scoured are reseeded with wind- or water-dispersed seeds. Most major rivers have been dammed, diked, and tilled, so that historical flooding regimes no longer occur. This absence of flooding is a major disturbance in the surveyed riparian reference sites. It has caused the disruption of temporal differences in the water table, which changes the soil environment and can completely change what species assemblage will best survive in that area. It has also allowed for the invasion of reed canarygrass and other invasive species.

The reference sites described in each habitat section have been chosen for their low level of human-caused disturbance, yet they are not pristine. They have few invasive species, but that does not mean the plant community has not changed from what occurred historically. Without processes like fire and flooding, tree and shrub density are often much different than historical levels. The absence of fire usually spurs an increase in shrub and tree density. The absence of flooding can decrease tree density. Without opening holes in the canopy and knocking down trees, tree recruitment is hampered.

Current Conditions

Today, the watershed is characterized by industrial, commercial, and residential development. Only a small percentage of the original wetlands, sloughs, lakes, riparian, and forested habitats still remain.

Table 7-2 compares acreages of habitat types found in 1851 by GLO surveyors with general acreages of each habitat type found in 2003.

Table 7-2: Habitat Acreages and Types

Habitat Type	Acres in 1851	% of Watershed in 1851	Acres in 2003	% of Watershed in 2003	Acre Change	% Change
TOTAL	32,745					
WATER total	3,218	10%	1,584	5%	-1,634	-50%
WETLAND total	7,110	22%	382	1%	-6,728	-95%
RIPARIAN AND UPLAND* total	22,417	68%	8,835	27%	-13,582	-61%
ALL HABITAT total	32,745	100%	10,801	33%	-21,944	-67%
DEVELOPED	0	0%	11,143	34%	+11,143	+34%

*Upland habitats in 2003 include vacant land (regardless of zoning) as well as developed farms, parks, and golf courses.

The remnant habitat is highly disturbed, dominated by non-native species such as reed canarygrass and Himalayan blackberry. The riparian corridor, where it exists, is a narrow strip of native black cottonwood and Oregon ash adjacent to the Slough channel. Some riparian areas are devoid of trees. Maintenance of primary levees requires the removal of all trees and shrubs. This fragmentation of the riparian corridor, combined with numerous dangerous road crossings, prevents safe travel for wildlife along the Columbia Slough. Much of the floodplain area contains buildings and other paved surfaces.

The biological communities that currently exist have been severely impacted by the development of the watershed over the last 150 years, yet they support a rich diversity of wildlife found nowhere else within the City of Portland. Many, if not most, of the species that are native to the Slough still occur there. However, many of them are much less abundant, and several introduced species have become so abundant that they dominate plant and animal communities throughout the watershed. Although impacts have occurred, there remain valuable habitat areas and wildlife populations in the city, such as large wetland expanses, that warrant continued preservation and restoration. Some habitat pockets and large natural areas, such as Smith and Bybee Lakes Wildlife Area (the best representation of historic Slough habitat), still exist.

The following conditions exist today:

- Native vegetation such as willow, black cottonwood, Oregon ash, Douglas hawthorn, Oregon white oak, sedges, and rushes are scattered throughout the watershed. Populations of wapato and Columbia sedge are less common, found only in a few places (Lev et al. 1994).
- More than 150 species of birds roost, feed, nest and/or migrate through the watershed in an average year (Fitchen & Tomlinson 2003). At least one active great blue heron rookery is

present in a black cottonwood grove along the Slough. Recently, a nesting pair of bald eagles has taken up residence in the watershed.

- The watershed serves as a travel corridor along the Lower Columbia River, Pacific Flyway, and other migratory bird pathways. The Slough provides a vital corridor for wildlife movement between the Columbia River Gorge, Sandy River Delta, and Blue Lake in the east, to Smith and Bybee Lakes Wildlife Area, Forest Park, Sauvie Island, Vancouver Lake, and Ridgefield National Wildlife Refuge to the west. More than a dozen species of ducks, geese, swans, and raptors winter in the region, and neotropical migrant shorebirds and songbirds stop over in spring and fall. Many neotropical migrant songbirds and migrant waterfowl remain throughout the summer to nest in the watershed. The watershed hosts a number of state and federally listed species during the breeding season.
- The mainstem and secondary channels and lakes are home to American beaver, muskrat, northern river otter, several amphibian species, painted and western pond turtles, and 12 native fish species, including seasonal use of the Lower Slough by anadromous salmonid species. The once-extensive salmon runs spawning in the Columbia and Willamette Rivers and their tributaries are now threatened with extinction.
- Mammals such as coyote, black-tailed deer, and non-native red fox live in the upland and riparian habitats.
- As urbanization increases, non-native species proliferate, adapting to the urban environment and out-competing native species. Some of the noxious wildlife species in the watershed include the house sparrow, European starling, rock pigeon, nutria, common carp, bluegill, and bullfrog. Some noxious weed species in the watershed include Himalayan blackberry, English ivy, reed canarygrass, purple loosestrife, and Japanese knotweed.

HABITAT AND BIOLOGICAL COMMUNITIES CHARACTERIZATION

Four primary habitat types exist in the Columbia Slough Watershed: in-channel, riparian, wetlands, and uplands.

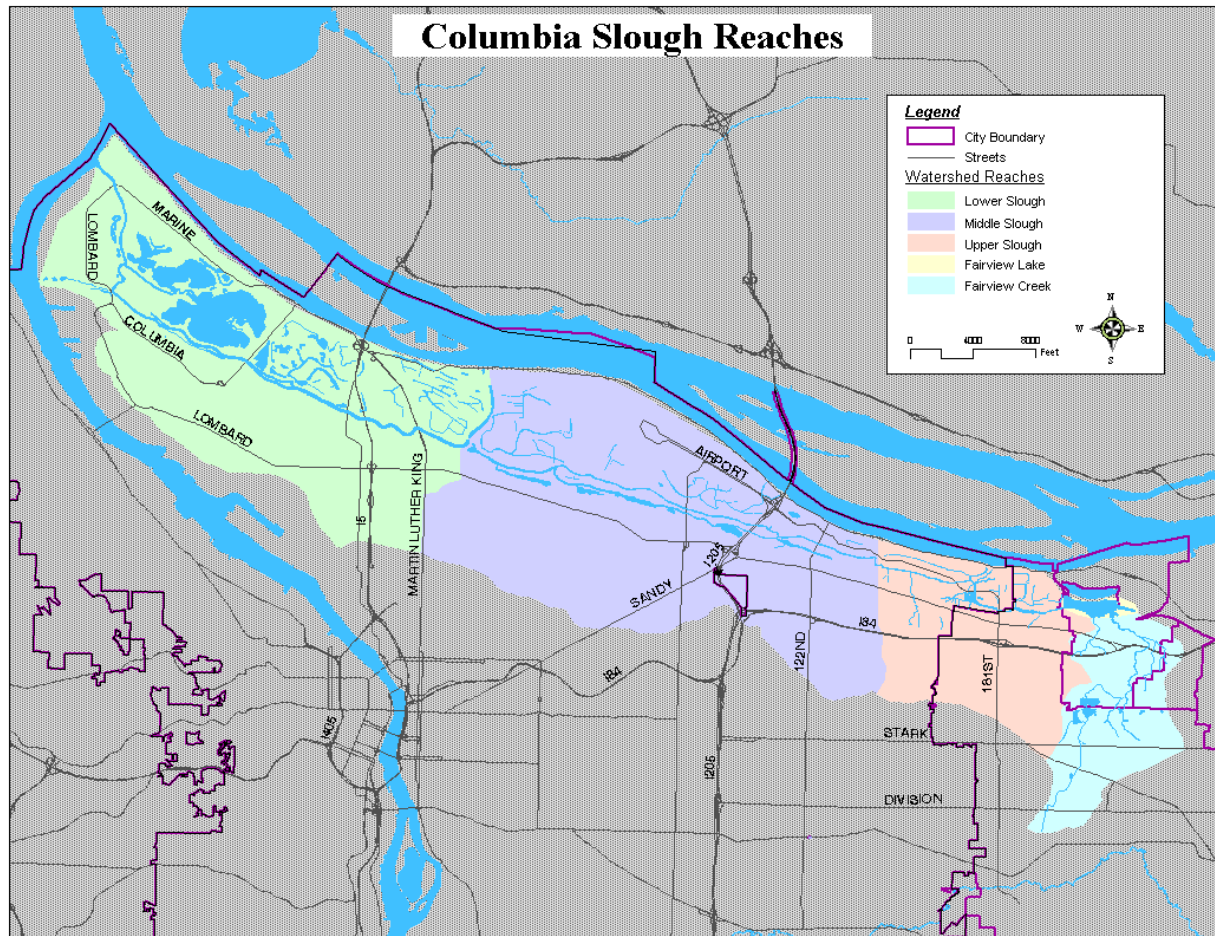
In-Channel Habitat

The following discussion about in-channel habitat focuses on the aquatic communities found in the mainstem Lower, Middle, and Upper reaches of the Columbia Slough, and also includes the Buffalo Slough, North Slough, Whitaker Slough, and the many miles of secondary waterways that are hydrologically disconnected from the Columbia Slough. For the purposes of this report, the in-channel habitat is divided into two distinct categories: water column and benthos (stream bottom and its organisms).

Overview and Reach Descriptions

The Columbia Slough has distinct hydrologic reaches (Figure 7-2). The following descriptions summarize relevant features of each reach of the Slough.

Figure 7-2: Columbia Slough Watershed Reaches



General

- Levees and dikes, built for flood control beginning in 1919, exist throughout the watershed and have eliminated the ability of the Columbia Slough to meander throughout its floodplain.
- The entire length of the Columbia Slough is extremely low gradient (less than 6-inch drop per mile) and consists almost solely of monotypic glide habitat.
- Flow within the Middle and Upper Columbia Slough is managed by Multnomah County Drainage District #1 (MCDD), primarily for flood control, but also for water rights holders, water quality, and recreation purposes. (See Chapter 5: Stream Flow and Hydrology Characterization, for more detailed information of the waterbody.)

Lower Columbia Slough

- Subject to tidal influences and maintains a hydrologic connection to the Willamette River. Also affected by pumped flows from the Middle Slough.

- Separated from the Middle Slough and the Peninsula Canal by levees located near NE 18th Avenue, but connected hydraulically to Middle Slough by gravity gates or pumping at MCDD Pump Station No. 1.
- Connected to Smith and Bybee Lakes via North Slough through a water control structure that allows fish passage.
- The levee near NE 18th Avenue functions as a fish passage barrier, restricting available anadromous fish habitat to the Lower Slough (Fishman 1989).
- Rearing juvenile Chinook and coho salmon use the Lower Slough and have access to over 1,000 acres of refugia habitat in Smith and Bybee Lakes (City of Portland ESA Program 2002). Salmon spawning has not been observed or documented and is unlikely because of a lack of suitable spawning habitat.
- Adjacent land use is predominantly open space in the lower 4 miles; commercial/industrial occupies the upper 5 miles.

Middle Columbia Slough

- Extends east from the levee near NE 18th Avenue to the cross-dike levee at NE 142nd Avenue.
- Hydraulically connected to the Upper Slough when gravity gates at cross-dike levee are open.
- Adjacent land use is predominantly commercial/industrial, with interspersed residential areas and open space, including golf courses.
- No detailed habitat assessment has been completed in the Middle Slough.

Upper Columbia Slough

- Extends from the cross-dike levee at NE 142nd Avenue to the weir at Fairview Lake.
- Adjacent land use is predominantly commercial/industrial; extensive open space and agriculture upstream of NE Airport Way is rapidly being converted to commercial/industrial.
- No detailed habitat assessment has been completed in the Upper Slough.

Fairview Creek, Osborn Creek, and No Name Creek

- Fairview Creek extends south from Fairview Lake approximately 5 miles to its origin, a small wetland complex near SE 181st Avenue and SE Powell Boulevard, where it forms the “headwaters” of the Columbia Slough.
- Osborn Creek extends south from Fairview Lake approximately 3 miles to its headwaters.
- No Name Creek extends south from Fairview Creek approximately 1 mile to its headwaters.
- Fairview Creek and Osborn Creek contain the last known remaining populations of resident cutthroat trout in the watershed (Fairview Creek Watershed Council 2002 and 2003).

North Slough

- Approximately 1 mile long; lies south of Bybee Lake and north of St. Johns Landfill.
- In-channel habitat is marginal to poor, largely because of lack of habitat diversity, marginal in-channel cover, and substrate dominated by 100 percent silt.
- Bank protection provided by vegetation is also sub-optimal (score of 78-117). An optimal in-channel habitat score of 150 would be given to a reach with good in-stream cover,

sufficient bank vegetation and stability, and a channel form that provides opportunities for fish spawning and rearing (HARZA 2000).

- North bank is composed primarily of mature Oregon ash.

Peninsula Canal

- A 1.5-mile-long channel that used to connect the Lower Slough with the Columbia River, but is now disconnected from both.
- Snags are present in riparian areas, and large wood is present in the water.
- Painted turtles have been sighted in the area.
- Livestock grazing was present in areas adjacent to the canal until recently, resulting in some areas of soil compaction, degraded vegetation, and erosion.
- Canal banks provide limited vegetative cover, with scrub/shrub, grass, and some forested areas found from water level to levee bank.

Buffalo Slough

- A 1.0-mile-long channel extending east from its confluence with Middle Slough at NE Argyle Street to just west of NE 43rd Avenue.
- Several culverts and extensive macrophytes restrict flow through the Broadmoor Golf Course.
- In-channel habitat quality is poor (score of 0-37) (HARZA 2000).

Whitaker Slough

- Extends from confluence with Middle Slough near NE 42nd Avenue to NE 128th Avenue.
- Adjacent land use is predominantly commercial/industrial, with interspersed residential areas and open space.
- In-channel habitat ranges from sub-optimal (score of 78-117) to poor (score of 0-37) (HARZA 2000).

Big Four Corners North Slough

- Short branch that historically connected to the Columbia River, but now terminates at MCDD Pump Station No. 4.
- Probably once served as a major source of inflow to the Slough (City of Portland Bureau of Planning 2001).
- A large area of structurally diverse riparian forest and connectivity to grassland and scrub/shrub areas provide a high-quality wildlife corridor.

Secondary Waterways

- Approximately 20.0 miles of small, secondary waterways, located within the three drainage districts, can be found in the watershed.
- These secondary waterways were once connected to the mainstem Columbia Slough, but have been disconnected as a result of levee building and flood control measures.

- Hydrology is managed, and water from these channels is pumped to mainstem Columbia Slough.

Water Column Habitat

Water column habitat is defined as all free-standing or flowing water bodies contained by the channel substrate (stream bottom) and channel banks (stream banks). Fish species dominate this habitat, although other species are also present (e.g., macrophytes, algae). In addition, some wildlife species such as northern river otter, American beaver, nutria (non-native), muskrat, and several species of waterfowl, may use the water column for various life stages or habitat uses; these species are discussed elsewhere in association with their dominant habitats.

Macrophytes, or vascular aquatic vegetation, blur the lines between the water column environment and benthos environment because some species can occur in the water column, rooted in the benthos, while others can populate the near-shore fringe and exposed mudflats. In 1995, MCDD increased flow velocities by lowering water levels in the Upper Slough to reduce algae growth, which can compromise in-stream habitat quality and restrict in-stream flow (Figure 7-3). However, the reduced algal growth enabled sunlight to penetrate deeper into the water column, allowing macrophytes to quickly establish themselves in the Middle and Upper Slough. The rooted macrophytes have significantly restricted flow in the Middle Slough, increasing concerns about water level management and biochemical oxygen demand (BOD) in the fall, when vegetation dies off and decomposes in the water column (USACE 2001). (See Chapter 5: Stream Flow and Hydrology Characterization, and Chapter 6: Water and Sediment Quality Characterization, for additional information about macrophyte growth and effects.)

Figure 7-3: Algae Blooms



It is likely that the Columbia Slough historically contained off-channel and rearing habitat for coho salmon, coastal cutthroat trout, Chinook salmon, and possibly steelhead during some portion of their life cycle (Fishman 1989). Extensive lakes, wetlands, and slough channels found

throughout the watershed offered a mosaic of habitat types for juvenile salmonids during their migration from their natal streams in the Willamette and Columbia basins to the ocean.

A 1988 survey of the mainstem portions of the Lower, Middle, and Upper Sloughs recorded 17 game and non-game fish species (Fishman 1989). Game fish are both native and introduced species that are targeted by sport and recreational fisherman; examples include bass, crappie, bluegill, and salmon. Non-game fish are both native and introduced and include all others, such as stickleback, sculpin, and sucker. The survey concluded that food resources and habitat for reproduction and cover appear to be the major factors affecting fish populations in the Columbia Slough.

Since 2001, the City of Portland Endangered Species Act program, Ducks Unlimited, and the Oregon Department of Fish and Wildlife have been collaboratively sampling the Lower Slough for fish use. The sampling efforts have resulted in 19 species of fish, freshwater shrimp, and crawfish. Juvenile salmonids have been observed in the Lower Slough and North Slough in the fall (November), winter (February), and spring (March and May) (City of Portland ESA Program 2002).

Salmonid use of the watershed is limited to the Lower Slough below the cross-levee and MCDD No. 1 pump station near NE 18th Avenue. In December 2003, a new water control structure was completed to hydrologically reconnect the North Slough with Smith and Bybee Lakes. This structure allows safe passage for juvenile salmonids to use the wetlands, providing over 1,000 acres of off-channel rearing and refuge habitat. The Lower Slough and Smith and Bybee Lakes provides some of the only remaining off-channel and refugia habitat for juvenile salmonids in the Lower Willamette River area. In May 2004, 180 juvenile Chinook salmon were documented using the Smith and Bybee Lakes complex.

As of 2004, studies of Columbia Slough fish have identified a cumulative number of 26 species that utilize the watershed during some period of their life cycle. Of these, 12 species are native to the watershed, and the remaining 14 have been introduced. As stated above, several of these native species are listed under the Endangered Species Act.

Table 7-3 identifies wildlife species found in the water column and listed by state and federal agencies (e.g., as endangered, threatened, or sensitive).

Some areas of the Upper Slough seem to provide better habitat than other areas. The Big Four Corners area (between NE 158th Avenue and NE 185th Avenue) is a relatively narrow channel with cover, shade, and in-water structure and vegetation, providing good habitat for game fish species. Populations of both game and non-game fish appear to be healthy (i.e., contain a variety of size classes for many species, including abundant young).

Table 7-3: Water Column Habitat Wildlife – Listed Species

Fish Species	USFWS Status	ODFW Status
Pacific lamprey <i>Lampetra tridentata</i>	SoC (Species of Concern)	SV (Vulnerable)
Chinook salmon <i>(Oncorhynchus tshawytscha)</i> Lower Columbia River ESU Upper Willamette River ESU	LT (Listed Threatened)	SC (Critical)
coho salmon <i>(Oncorhynchus kisutch)</i> Lower Columbia River/SW Washington ESU	C (Candidate)	LE (Listed Endangered)
Steelhead <i>(Oncorhynchus mykiss)</i> Lower Columbia River ESU Upper Willamette River ESU	LT (Listed Threatened)	SC (Critical)

ESU = Evolutionarily Significant Unit

USFWS = U.S. Fish and Wildlife Service

ODFW = Oregon Department of Fish and Wildlife

Benthos Habitat

The benthos is defined as the habitat created by the stream substrate on the channel bottom and sides, and its organisms. Benthic organisms, consisting primarily of macroinvertebrates, establish communities in all levels of the substrate, from debris to deeper aerobic and anaerobic environments. Benthic macroinvertebrates serve as the basis for the food chain in most aquatic ecosystems and are a major food source of both salmonids and warm-water fish species.

Additionally, they are commonly used as indicators of water quality and stream health or impairment, integrating both habitat and chemical disturbances.

A 1989 survey of the Lower, Middle, and Upper Slough by Fishman Environmental Services found that diversity of benthic macroinvertebrates is correlated with sediment size (Fishman 1989). Most Slough sediments are dominated by sand and silt, with silt dominant in the Upper Slough and sand dominant in the Lower Slough. Macroinvertebrate diversity was typically less in sand-dominated substrates; the diversity progressively increased moving up the Slough. A total of 36 taxa (named groups of organisms) were identified, falling into several broad taxonomic categories (e.g., Oligochaete worms, Chironimidae midge larvae). Species abundance also generally increased moving from the Lower to the Upper Slough. The 1989 survey also found abundant crayfish throughout the Slough. Freshwater mussels were found only in the Upper Slough, near NE 185th Avenue, although shells were observed throughout both the Upper and Lower Slough.

A 1992-93 survey of aquatic macroinvertebrates in the Smith and Bybee Lakes Wildlife Area found Oligochaete worms and Chironomidae midges to be the most species-rich groups (Hulse

& Baker 2002). Both groups have many species that are adapted to low dissolved oxygen levels and lentic (still water) conditions. In general, the taxonomic groups present were tolerant of nutrient-rich waters and low dissolved oxygen levels. This survey concludes that increased summer drawdown of water levels would increase the abundance of vegetation and allow for greater aquatic invertebrate populations and diversity.

During a summer 1996 survey of aquatic macroinvertebrates in Buffalo Slough and Columbia Slough by Parametrix, Inc., the most dominant species found were Chironomid midges, ostracods, and oligochaete worms (Wiseman 2001). Amphipoda (scuds-crustacea), Copepoda (microcrustaceans), Cladocera (microcrustaceans), and Corixidae (water boatmen) were also found. The preliminary conclusion from this analysis was that limited diversity of the benthic community is most likely due to extremely low levels of dissolved oxygen. Additional sampling occurred in November in Whitaker Slough as part of an assessment of potential impacts from sewer pipeline construction through a portion of the Slough. Five samples were taken along the vegetative edge, and four samples were taken from open water benthic sediments. Diversity was higher in the vegetative edge and included Gastropoda (snails), Pelecypoda (clams), Ephemeroptera (mayfly), Sialis (alderfly), Trichoptera (caddisfly), Gyronidae (whirligig beetle), as well as the species mentioned above for Buffalo Slough.

Based on a 2001 independent appraisal of the benthic community of the Columbia Slough from surveys performed since 1989, Parametrix and Aquatic Biology Associates found that the highest diversity of macroinvertebrate taxa is found in association with aquatic vegetation (Wiseman 2001). The benthic environment (bottom sediment) tends to be very light and unconsolidated, contains some toxic pollutants from historic discharges, and can have very low DO levels. As a result, fewer macroinvertebrates are found in the Slough benthos. Rather, macroinvertebrates are found clinging to aquatic vegetation, such as elodea and coontail, that inhabits the Slough.

To examine whether the benthic fauna in the Columbia Slough are impoverished in either density or taxa richness, results from studies in nearby slow-moving and riverine waters with soft bottom substrates were used, including Smith and Bybee Lakes and the Portland Harbor in the Willamette River. Total invertebrate densities of the Columbia Slough have been reported to be typically in the 2,000 to 7,000 per m² range. This is comparable to and often above densities found in Smith and Bybee Lakes. It is also approximately an order of magnitude greater than densities seen for many fine sediment habitats examined in the lower Willamette and Columbia Rivers. In terms of overall density or standing crop, the benthic invertebrate community found in soft sediments of the Columbia Slough does not appear to be impoverished. However, the extent and taxonomic resolution of benthic invertebrate studies conducted in the Columbia Slough thus far cannot really address whether benthic community taxa richness is particularly degraded (Wiseman 2001).

Freshwater Mussels

The Columbia Slough and Smith and Bybee Lakes provides habitat for three species of native freshwater mussels. These species include Oregon floater (*Anadonta oregonensis*), California floater (*A. californiensis*), and winged floater (*A. nuttalliana*). These species belong to a large family, Unionidae, which includes 300 species of freshwater mussels in North America. A large number of the unionids (members of the Unionidae family) are federally listed as threatened or endangered. This is due to threats to mussel habitat (siltation, channelization, and dams), indirect mortality (loss of glochidial hosts), and direct mortality (predation, toxic chemicals, siltation, shell industry, and competition from non-native species). Of the three species found in the Columbia Slough, only the California floater (*A. californiensis*) is federally listed as a species of concern (SOC). In addition to the three species found in the Columbia Slough and Smith and Bybee Lakes, three other native species of freshwater mussels can be found in Oregon. These species include western floater (*Anadonta kennerlyi*), western ridgemussel (*Gonidea angulata*), and western pearlshell (*Margaritifera falcata*).

Freshwater mussels are bivalves that prefer the soft bottom substrate (silt and sand) found in the Columbia Slough and Smith and Bybee Lakes. They move very little throughout their life and remain fairly inconspicuous with their plain brown shells, which are partially buried in the sediments. Freshwater mussels are long lived – they are commonly believed to live 20-60 years, although some species can live up to 200 years. All three species of mussels are obligate parasites on the gills of fish at the larval stage (glochidia) of their life history. The primary purpose of this adaptation is for dispersal, since adult mussels move very little in their lifetime. Little is known about fish hosts in the Pacific northwest, although salmonids are believed to be an important host for the glochidia. Freshwater mussels provide important functions for water quality; they continuously pump water through their bodies and use their gills to filter oxygen, plankton, and other organic matter suspended in the water. This filtering process helps clean the stream and improve water quality. Additionally, their sensitivity to pollutants makes them an indicator of stream health that can help track sources of pollution.

The Columbia Slough and Smith and Bybee Lakes hosts a variety of large, intermediate, and smaller mussels, indicating reproduction of mussels in the Columbia Slough system. Limited sampling of freshwater mussels in the Columbia Slough and Smith and Bybee Lakes has shown a healthy population of the three *Anadonta* species, as well as a large number of non-native Asian clams (*Corbicula fluminea*), which were introduced in the 1930s in ballast water. Although formal sampling or surveys have not occurred, observations by paddlers indicate that freshwater mussels are widespread throughout the Columbia Slough.

In 2001, the Smith and Bybee Lakes system completely dried out, and this drought resulted in the elimination of the entire population of freshwater mussels. It is believed that the mussels died from lack of water and high temperatures and were then scavenged by birds. Of the 39 shells found in 2001, only five were found in Smith Lake and their size (up to 8.5 inches) indicated a very old, non-reproducing population of three species of mussels. The distribution of species types was 45 percent California floaters, 50 percent Oregon floaters, and 5 percent

winged floaters. Recent sampling (September 2004) confirmed that the lakes have been recolonized and that two species of young mussels (Oregon floater and California floater) are thriving in the lakes. In 2001, all carp (the dominant fish species in both lakes) died. The dense carp population had likely suppressed successful mussel reproduction for a number of years by disturbing the bottom substrate and/or eating the tiny juvenile mussels that settled after release from the gills of fish. The building of a dam in the early 1980s, disconnecting Smith and Bybee Lakes from the North Slough, likely limited new glochidia from entering the system on host fish. In December 2003, access to Smith and Bybee Lakes was restored for juvenile salmonids and other fish species, which likely carried new glochidia into the lakes. During surveys in September 2004, the carp were far less numerous and the water turbidity was much lower. These new mussel populations should remain if the lakes retain some water year-round and the carp population stays at a reduced level.

Riparian Habitat

Riparian habitats are water-dependent ecosystems characterized by rich and diverse groups of plant and animal species. They are the transitional ecosystem between terrestrial and aquatic ecosystems. Riparian ecosystems provide a variety of watershed functions, including reducing flood peaks and regulating stream flow, stabilizing banks, and replenishing groundwater (City of Portland Bureau of Planning 2001). Riparian vegetation helps improve water quality by moderating in-stream temperatures through shading and filtering sediment, nutrients, and pollutants. Riparian areas provide large wood to the stream, while also providing a variety of food sources (fine organic litter) for aquatic species. Riparian areas also function as travel corridors for various wildlife species, provide feeding and nesting habitat for resident and neotropical migratory bird species, and provide important habitat functions for water-dependent species (Johnson & O'Neil 2001). Riparian widths will vary with topography, geology, and soils, and with the degree of development under current conditions.

The majority of the riparian corridor in the Columbia Slough Watershed contains buildings and paved spaces, including large expanses of residential and commercial/industrial property with minimal riparian vegetation. The remaining riparian forest habitat is generally a narrow band dominated by black cottonwood, Oregon ash, willow species, and red osier dogwood, with an understory of Himalayan blackberry (non-native), common snowberry, and reed canarygrass (non-native). A few stands of Oregon white oak are also found. In general, riparian areas along the Columbia Slough (Figure 7-4) are not of a sufficient width to adequately provide the important functions of riparian areas, including a contiguous wildlife travel corridor, microclimate and shade, bank stabilization and sediment control, pollution control, streamflow moderation, organic matter input, and large woody debris.

Figure 7-4: Riparian Corridor along Columbia Slough



In 2002, Metro completed an inventory of regionally significant riparian and wildlife habitat resources for the development of its Goal 5 Program, which classifies riparian areas into Classes I to III, with Class I including the highest-quality habitats. In the Columbia Slough Watershed, the following acreages exist for each Goal 5 Riparian Class:

- Riparian Class I: 3,964 acres
- Riparian Class II: 897 acres
- Riparian Class III: 476 acres

The City of Portland Bureau of Planning is currently working on an update to the City's natural resource inventory.

Of the approximately 96 miles of stream bank in the watershed (48 miles of main and secondary channels), approximately 6 miles along the Columbia Slough are maintained as primary levees (earthen dams) to protect land and property from flooding. These primary levees, located along Peninsula Drainage Districts No. 1 and 2 in the Lower Columbia Slough, are maintained with only grassy vegetation (Figure 7-5). To protect the integrity of the primary levees, no trees or woody vegetation are allowed to grow; therefore, the levees provide minimal riparian habitat functions. An additional 20 miles of levees are located under North and Northeast Marine Drive along the Columbia River. (Chapter 5: Stream Flow and Hydrology Characterization, provides additional information about the levee system and the management of the Columbia Slough for flood control.)

Figure 7-5: Levee Maintenance



Prior to the mid-1990s, trees were cleared and riparian vegetation was removed to maintain and repair the extensive bank areas (non-leveed areas). Since then, MCDD has used in-channel equipment to reach channel and bank areas for needed repairs and maintenance. The changed maintenance practices have allowed for riparian regrowth and native revegetation plantings along the banks of the Middle and Upper Slough.

The City of Portland's Watershed Revegetation Program partners with willing public and private property owners to plant native vegetation and remove invasive weed species throughout the watershed. To achieve water quality goals, the program focuses on properties along waterbodies. To date, the program has revegetated more than 500 acres along nearly 40 miles (210,000 linear feet) of riparian corridor throughout the watershed and has consistently exceeded the goal of 400 trees per acre. The plantings have greatly increased native vegetation diversity and total canopy coverage in the watershed, and have displaced non-native vegetation.

Wildlife species diversity in the watershed is richest in the riparian fringe because both water-dependent and upland species use this habitat for feeding, resting, breeding, and cover. Upland species also use the riparian areas for travel, feeding, and other life functions. Stands of mature black cottonwood adjacent to waterways provide a particularly important habitat for great blue heron rookeries. One such rookery with over 70 nests exists adjacent to the Lower Slough.

The watershed includes the following important riparian areas. (Figure 7-8 at the end of the chapter shows the location of each site.)

- Middle Slough—NE 47th Avenue to NE 82nd Avenue (*Site 18*)
- Upper Columbia Slough—Big Four Corners area (*Site 1*)
- Whitaker Slough—NE 92nd Avenue and Interstate 205 (*Site 34*)
- Wapato Wetland (*Site 30*)

- North Slough (*Site 20*)
- Lower Slough – Smith and Bybee Lakes Wildlife Area (*Site 16*)

Table 7-4 identifies wildlife species found in riparian habitat in the Columbia Slough Watershed and listed by state and federal agencies (e.g., as endangered, threatened, or sensitive).

Table 7-4: Riparian Habitat Wildlife – Listed Species

Bird Species	USFWS Status	ODFW Status
Bald Eagle <i>Haliaeetus leucocephalus</i>	LT (Listed Threatened)	LT (Listed Threatened)
Willow Flycatcher <i>Empidonax traillii brewsteri</i>	None	SV (Vulnerable)
Yellow-breasted Chat <i>Icteria virens</i>	SoC (Species of Concern)	SC (Critical)

USFWS = U.S. Fish and Wildlife Service
ODFW = Oregon Department of Fish and Wildlife

Wetlands Habitat

Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (USACE 1987). The majority of the wetlands found in the Columbia Slough Watershed are relics of the once extensive complex of lakes, channels, marshes, and forested wetlands found in the historic Willamette/Columbia River floodplains. Additionally, some of the wetlands include newly constructed mitigation wetlands or water quality treatment wetlands that have been installed in locations where wetlands may or may not have existed previously. These have been classified with their dominant vegetation type in the subsequent sections.

Wetlands provide a multitude of functions and values for a watershed, such as the hydrologic, geochemical, and biological processes, and water storage. The hydrogeomorphic (HGM)-based assessment method, developed by Oregon Division of State Lands in 2001, highlights 13 functions for wetlands and provides a method for rapidly assessing these functions (Adamus & Field 2001). The functions include:

- Water storage and delay
- Sediment stabilization and phosphorus retention
- Nitrogen removal
- Thermoregulation
- Primary production
- Resident fish habitat support
- Anadromous fish habitat support

- Invertebrate habitat support
- Amphibian and turtle habitat
- Breeding waterbird support
- Wintering and migrating waterbird support
- Songbird habitat support
- Support of characteristic support

HGM assessments have been conducted on a small number of wetland sites in the Columbia Slough Watershed.

Much of the watershed's wetland complex has been filled, dredged, channelized, and/or degraded by urban impacts. Still, the remnant wetlands provide important habitat, water quality and water quantity functions, and recreation values in the watershed. Some of these wetlands have been and are being revegetated by the Watershed Revegetation Program. In addition, several restored mitigation wetlands, such as Vanport Wetlands, provide high-quality habitat for over 100 bird species and a diversity of amphibian, reptile, and mammal species.

Many of the remaining wetlands found in the watershed are isolated habitat islands. An important habitat need for many wetland wildlife species is adjacent forested upland habitat. This is especially important for many wetland-breeding amphibian species that utilize upland habitats for certain seasons or portions of their life cycle. An additional need is connectivity of wetland habitats through safe corridors to riparian areas, upland areas, and other wetland areas.

Wetlands areas are categorized into five types in this characterization:

- Forested wetlands
- Scrub/shrub wetlands
- Emergent wetlands
- Exposed mudflats
- Off-channel open water

Forested Wetlands

Forested wetlands and riparian areas often overlap in the watershed; they are not mutually exclusive by definition. The dominant vegetation of forested wetlands is similar to riparian areas in the watershed: mixed-age black cottonwood, a variety of willow species, and Oregon ash, with an understory of reed canarygrass (non-native), red osier dogwood, and common snowberry. Forested wetlands provide habitat for cavity nesters and roosting, perching, and nesting habitat for raptors, woodpeckers, and songbirds. The species found are similar to those using riparian habitats.

Stands of forested wetlands are scattered throughout the watershed. High-quality sites include the following (City of Portland Bureau of Planning 2001). (See Figure 7-8 for site locations.)

- Broadmoor Golf Course Wetlands (*Site 5*)
- Heron Rookery Wetlands (*Site 13*)
- Smith and Bybee Lakes Management Area (*Site 26*)
- Big Four Corners Wetlands (*Site 1*)

Scrub/Shrub Wetlands

Scrub/shrub wetlands historically dominated the Columbia River floodplain, occurring on gravel bars and in stream channels and tolerating variable water flow (Fitchen & Tomlinson 2003). This habitat type diminished with agriculture, flood control, and urbanization, and is now almost nonexistent in the watershed. The few communities remaining are dominated by willows, Douglas spirea, rose (*Rosa sp.*), common snowberry, and red osier dogwood, and are often associated with emergent wetland habitats.

High-quality scrub/shrub wetlands in the watershed include the following. (See Figure 7-8 for site locations.)

- Heron Rookery Wetlands (*Site 13*)
- Broadmoor Golf Course Wetlands (*Site 5*)
- Big Four Corners Wetlands (*Site 1*)
- Smith and Bybee Lakes Wildlife Area (*Site 26*)

Emergent Wetlands

Emergent wetland habitats have water at the surface during the growing season and emergent vegetation. The water level typically recedes in the summer, exposing mud flats and creating habitat for seasonal species such as shorebirds. Channel dredging, flood control, and draining for agriculture in the watershed have caused a sharp decline in emergent wetland habitat. The hydrologic changes to the watershed have also created a favorable environment for non-native species such as reed canarygrass and purple loosestrife.

Emergent wetland is the most prevalent wetland habitat in the Columbia Slough Watershed. The vegetation includes soft rush, smartweed, beggar's tick, and reed canarygrass (non-native), and sometimes includes native rice cut-grass and ovate spike-rush. Habitat value is highest where the emergent wetland is adjacent to or mixed in with other wetland or habitat types. In many areas, reed canarygrass forms a monoculture stand that reduces the habitat value of the wetland.

The City of Portland, MCDD, and the USACE initiated a 3-year project (USACE Section 1135 Project) in 2002 to improve water flow and quality and create additional habitat. The project is creating emergent wetland benches along approximately 7 miles of the Slough from NE 18th Avenue to NE 158th Avenue by dredging a meandering channel through the Slough and casting the dredged material along the channel edges (Figure 7-6). MCDD has used this technique to complete a project within Bridgeton Slough. The ecological goal of the wetland benches is to increase channel complexity and provide hydrologic conditions that more closely resemble off-channel sloughs with direct connection to the Columbia River. It is anticipated that the project will create 15 acres of in-channel emergent wetlands. It is important to note that the meandering

channel will continue to be contained within the current banks and will not meander throughout the larger floodplain.

Figure 7-6: Emergent Wetland Benches



Emergent wetland areas in the watershed that contain a majority of native species include the following. (See figure 7-8 for site locations.)

- Smith and Bybee Lakes Wildlife Area (*Site 26*)
- Wapato Wetlands (*Site 30*)
- Vanport Wetlands (previously Radio Towers Wetlands) (*Site 29*)
- Big Four Corners Wetlands (*Site 1*)
- Middle and Upper Slough wetland benches (U.S. Army Corps of Engineers Section 1135 Ecosystem Restoration Program; see Chapter 5: Stream Flow and Hydrology Characterization, for more information.)

Exposed Mudflats

Exposed mudflats are created where the water column abuts the stream bank, and provide a variety of habitat for numerous species. Vegetation frequently consists of aquatic macrophytes, emergent wetland species, mixed grasses, and occasionally shrub species. Shrub and groundcover include red osier dogwood, willow species, sedges, rushes, beggars tick and reed canarygrass (non-native). In many cases, riparian emergent and scrub/shrub wetlands occur adjacent to exposed mudflats and provide cover and nesting habitat for numerous songbirds. The presence of ample water and terrestrial vegetation also provides suitable nest and den habitat for a number of mammal species. In the spring and fall, these mudflats provide feeding habitat for migrating shorebirds.

Exposed mudflats in the watershed include the following. (See Figure 7-8 for site locations.)

- Lower Slough tidal and seasonal mudflats (*Many sites along Lower Slough*)
- Smith and Bybee Lakes Wildlife Area (*Site 26*)
- Wapato Wetlands (*Site 30*)
- Whitaker Ponds (*Site 33*)

Off-Channel Open Water

The ponds, lakes, and off-channel open water areas are remnants of the large, shallow, open water lakes and sloughs historically found in the Columbia River floodplain. They are scattered throughout the watershed and are most often ringed by riparian and emergent marsh vegetation. The channels often have steep banks resulting from maintenance dredging, or are rip-rapped. Water is present throughout the entire year. Water levels vary, based on pumping regimes in the leveed areas of the watershed, but generally correlate to the water levels in the Columbia and Willamette Rivers. The water levels in summer are maintained to provide irrigation to water rights users.

Off-channel open water areas in the watershed include the following. (See Figure 7-8 for site locations.)

- Force Lake (*Site 10*)
- Whitaker Ponds (*Site 33*)
- Johnson Lake (*Site 14*)
- Mays Lake (*Site 17*)
- Fairview Lake (*Site 9*)
- Bridgeton Slough (*Site 3*)

Table 7-5 identifies wildlife species found in wetlands habitat in the Columbia Slough Watershed and listed by state and federal agencies (e.g., as endangered, threatened, or sensitive).

Upland Habitat

The upland portion of the Columbia Slough Watershed is primarily located south of Columbia Boulevard. It is predominantly commercial and residential development that provides little habitat value. The small portions of upland habitat with native vegetation are isolated remnants or recently planted revegetation sites. One of the pressing habitat issues in upland areas is the connectivity of high-quality upland areas with other habitat types, including riparian areas and wetlands. Interspersion of different habitat types in the watershed with connected corridors will help provide the highest-quality habitat possible for native terrestrial and aquatic wildlife species.

Table 7-5: Wetlands Habitat Wildlife – Listed Species

Mammal Species	USFWS Status	ODFW Status
Silver-haired Bat <i>Lasionycteris noctivagans</i>	SoC (Species of Concern)	SU (Undetermined Status)
Yuma myotis (bat) <i>Myotis yumanensis</i>	SoC (Species of Concern)	None
Bird Species	USFWS Status	ODFW Status
Bufflehead <i>Bucephala albeola</i>	None	SU (Undetermined Status)
Peregrine Falcon <i>Falco peregrinus anatum</i>	None	LE (Listed Endangered)
Tricolored Blackbird <i>Agelaius tricolor</i>	SoC (Species of Concern)	SP (Peripheral / Naturally Rare)
Purple Martin <i>Progne subis</i>	SoC (Species of Concern)	SC (Critical)
Amphibian Species	USFWS Status	ODFW Status
Northern red-legged frog <i>Rana aurora aurora</i>	SoC (Species of Concern)	SV (Vulnerable) / SU (Undetermined Status)
Reptile Species	USFWS Status	ODFW Status
Northwestern pond turtle <i>Clemmys marmorata marmorata</i>	SoC (Species of Concern)	SC (Critical)
Western painted turtle <i>Chrysemys picta bellii</i>	None	SC (Critical)

USFWS = U.S. Fish and Wildlife Service
 ODFW = Oregon Department of Fish and Wildlife

In addition to the habitat features provided by upland areas, forested upland areas also provide important functions for hydrology, water quality and air quality. Mature tree canopy intercepts up to 30 percent of the rain that falls on it and provides onsite infiltration. This helps decrease the amount of rainwater that enters the stormwater sewer system and provides some level of groundwater recharge. In addition, interception helps reduce pollutants that may reach the Slough (sediments and suspended solids). Other benefits include shade that can reduce the urban heat island effect and cool stormwater runoff, noise abatement, reduction of air temperature, carbon sequestration, and reduction of greenhouse gases.

In 2002, Metro completed an inventory of regionally significant riparian and wildlife habitat resources for the development of its Goal 5 Program, which classifies upland areas into Upland Wildlife Habitat Classes A to C, with Upland Habitat Class A including the highest-quality habitats. In the Columbia Slough Watershed, the following acreages exist for each Goal 5 Upland Wildlife Habitat Class:

- Class A Upland Wildlife Class: 407 acres
- Class B Upland Wildlife Class: 247 acres
- Class C Upland Wildlife Class: 575 acres

The City of Portland Bureau of Planning is currently working on an update to the City's natural resource inventory.

Upland areas in the watershed are categorized into four vegetation types:

- Mixed-canopy forested area
- Non-forested open area
- Landscaped area
- Urban area

Mixed-Canopy Forested Area

Mixed-canopy forests in the Portland area generally occur in areas of low-density urbanization. The forested uplands in the Columbia Slough Watershed are primarily mixed deciduous stands dominated by big leaf maple, black cottonwood, red alder, Oregon ash and willow species, with occasional Oregon white oak. These forests contain a diversity of native and non-native understory vegetation.

Most conifers found in the watershed are within City parks, and on the escarpment in the eastern portion of the watershed, south of Airport Way between NE 154th Avenue and NE 181st Avenue (the Wilkes Creek and Big Four Corners area). In addition, several revegetated areas along the Slough include western red cedar, Douglas fir, and grand fir saplings.

The snags and bare-topped trees found in forested areas provide nesting and roosting habitat for various raptors. Mature stands of trees can provide important nesting habitat for cavity dwellers such as woodpeckers and tree swallows (City of Portland Bureau of Planning 1989). Diverse foliage heights (limbs and stalks of varying height) correlate to increased bird species diversity. These areas of denser vegetation result in a greater abundance of small mammals, especially rodents (mice, voles), that are essential for healthy biological communities and important in bird food chains (Ferguson, Robinette, & Stenberg 2001).

Important mixed-forested upland areas in the watershed include the following. (See Figure 7-8 for site locations.)

- 200+ year-old Oregon white oaks (NE 122nd & Sandy Boulevard) (*Site 28*)
- Kelley Point Park (*Site 15*)
- Big Four Corners upland area (between NE Mason St. and Sandy Blvd.) (*Site 1*)
- Johnson Lake (*Site 14*)
- Mays Lake (*Site 17*)
- Force Lake (*Site 10*)
- Rocky Butte and the Grotto (*Site 25*)

Non-Forested Open Area

Numerous areas in the watershed have been severely affected by human activities. These include the St. Johns Landfill (a grassland), dredge material disposal sites, levees, empty lots, and Portland International Airport. These non-forested open areas often contain sparse scrub brush and grass vegetation, and the soil is usually fill and/or compacted. They have taken over the function of natural meadow habitat, which is non-existent in the area. Levees are included in this category because they are maintained with grassy vegetation (to ensure that trees and woody vegetation do not compromise their stability for flood control).

Although these areas are often dominated by non-native grasses and invasive vegetation, such as Himalayan blackberry and reed canarygrass, they provide limited habitat for generalist species such as moles, voles, and other small mammals. Predators such as coyotes and raptors use them extensively for hunting grounds. These areas also serve as the last remaining habitats for bird species requiring meadow habitat, such as streaked horned lark and western meadowlark, whose populations have rapidly declined in the watershed in recent years. These species may occasionally be found in the last remaining agricultural fields in the upper watershed, at the St. Johns Landfill, and in the undeveloped portions of the Rivergate Industrial Area in the lower watershed.

The Portland International Airport (PDX) airfield is approximately 1,735 acres and contains a large expanse of non-forested open area, in addition to two primary parallel runways, taxiways, and associated roads and buildings, yet it is not suitable habitat for terrestrial wildlife. Due to Federal Aviation Administration (FAA) requirements, the Port of Portland was required to develop a Wildlife Hazard Management Plan, an integrated and adaptive program to effectively manage risk at PDX by reducing the probability of wildlife/aircraft collisions.

The species of concern at PDX include predatory birds (primarily raptors), flocking birds (especially European starlings) and species with a relatively large body mass (Canada goose and great blue heron). Predatory birds such as hawks, owls and herons pose complex challenges regarding prey base (e.g., moles and voles) management. The program utilizes a non-lethal approach to discouraging wildlife from using the airfield area and focuses on immediate operational strategies, ongoing applied research, long-term management strategies, and an information and education component (Port of Portland 2003). Additionally, an aircraft landing overlay zone, to provide safer operating conditions for aircraft, limits the heights of structures and vegetation in the area. Both the program and zoning overlay are important to consider when prioritizing future habitat restoration projects in the vicinity of the airport.

Important open “meadow” habitat areas in the watershed include the following. (See Figure 7-8 for site locations.)

- St. Johns Landfill (a grassland) (*Site 27*)
- West Delta Park and Portland International Raceway (*Site 31*)
- East Delta Park Sloughs (*Site 8*)

- Portland International Airport (open meadow areas) (*Site 22*)
- 26 miles of grass-covered levees throughout the watershed (See Chapter 5: Stream Flow and Hydrology Characterization, Section 3: Hydrology and Hydraulics for additional information about levees and locations of the levee system.)

Landscaped Area

This habitat type comprises open space that is maintained for specific purposes, including golf courses, agricultural lands, athletic fields, cemeteries, and maintained parks. The majority of the understory vegetative cover is non-native grass species. However, edges and roughs in golf courses and the use of native plants and Naturescaping (creating natural landscapes with native vegetation) can provide islands of wildlife habitat.

Habitat function is limited in landscaped habitat. Numerous insect-eating bird species, mice, moles, voles, and rabbits use these areas for foraging, and raptors use them for hunting grounds. Less-maintained areas provide shelter and forage for a limited number of species. Despite being isolated from other habitat areas, larger city parks can be oases for bird species.

Important landscaped areas in the watershed include the following. (See Figure 7-8 for site locations.)

- Former agricultural land near the Big Four Corners (*Site 1*)
- Six golf courses:
 1. Broadmoor Golf Course (*Site 4*)
 2. Columbia Edgewater Country Club (*Site 6*)
 3. Colwood National Golf Course (*Site 7*)
 4. Glendoveer Golf Course (*Site 11*)
 5. Heron Lakes Golf Course (*Site 12*)
 6. Riverside Golf and Country Club (*Site 24*)

Urban (Built Environment) Area

The vast majority of land in the Columbia Slough Watershed has industrial, commercial, and residential uses. These urban areas are characterized by built structures and paved surfaces, providing minimal habitat value. Naturescaping and street trees provide shelter and forage for some tolerant species, as well as more sensitive migratory species. Street trees, in addition to providing some habitat value, help restore the natural hydrologic cycle and reduce the volume and negative effect of stormwater runoff (Figure 7-7). Residential neighborhoods often have bird feeders, bird baths, and bird houses that support some backyard wildlife during some parts of the year.

Figure 7-7: Street Trees



Urban areas in the watershed typically have less species diversity and a greater percentage of exotic flora and fauna than the other habitat types. Mammals are primarily limited to tolerant, small rodents such as the non-native house mouse. Both possum and raccoon have adapted to urbanization and can often be sighted in neighborhoods, scavenging around houses for garbage and pet food. Omnivorous birds, such as the European starling (non-native) and house sparrow (non-native), and various species of gulls and corvids (crows and jays), dominate. One sensitive species, the peregrine falcon, has adapted to using Portland bridges for nesting.

Table 7-6 identifies wildlife species found in upland habitat in the Columbia Slough Watershed and listed by state and federal agencies (e.g., as endangered, threatened, or sensitive).

Unique Habitats

In addition to the individual habitat types described above, three areas in the watershed have exceptional habitat value: Smith and Bybee Lakes Wildlife Area, Wapato Wetlands and Big Four Corners.

Smith and Bybee Lakes Wildlife Area

Smith and Bybee Lakes Wildlife Area (Figure 7-8, Site 26) is the largest and most diverse habitat in the Columbia Slough Watershed and serves as a regionally significant natural area. The 2,000-acre wildlife area is a complex system of shallow lakes, wetlands, riparian area, and upland grasslands (St. Johns Landfill). Most dominant habitat types found in the Columbia Slough Watershed are represented in the wildlife area.

Table 7-6: Upland Habitat Wildlife – Listed Species

Mammal Species	USFWS Status	ODFW Status
Silver-haired Bat <i>Lasionycteris noctivagans</i>	SoC (Species of Concern)	SU (Undetermined Status)
Yuma myotis (bat) <i>Myotis yumanensis</i>	SoC (Species of Concern)	None
Bird Species	USFWS Status	ODFW Status
Peregrine Falcon <i>Falco peregrinus anatum</i>	None	LE (Listed Endangered)
Northern Pygmy-Owl <i>Glaucidium gnoma</i>	None	SC (Critical)
Olive-sided Flycatcher <i>Contopus cooperi</i>	SoC (Species of Concern)	SV (Vulnerable)
Streaked Horned Lark <i>Eremophila alpestris strigata</i>	SoC (Species of Concern)	SC (Critical)
Western Meadowlark <i>Sturnella neglecta</i>	None	SC (Critical)
Pileated Woodpecker <i>Dryocopus pileatus</i>	None	SV (Vulnerable)

USFWS = U.S. Fish and Wildlife Service

ODFW = Oregon Department of Fish and Wildlife

Before 1980, the Smith and Bybee Lakes area experienced inundation during the freshets of the Columbia and Willamette Rivers. The water levels receded during summer, exposing large mudflats. Human activity, including placement of a water control structure in early 1980, has dramatically altered the hydrologic regime. The lakes were maintained to at least a minimum water level during normal rainfall years. The new water level drowned over 350 acres of riparian willow forest and changed the ecological functions of the lakes.

Construction was completed in December 2003 to replace the existing dam with an adjustable water control structure that allows the hydrology of the lakes to be managed for multiple objectives. The primary objective is to restore, to the maximum extent possible, the natural hydrology to these large wetlands, with the understanding that during some periods of the year, water will need to be physically retained within the wetlands for vegetation management. The new water control structure allows safe passage for juvenile salmonids to use the wetlands, providing over 1,000 acres of off-channel rearing and refuge habitat.

Even with the changed hydrology of the last 25 years, the area has a rich diversity of plants and animals not found in other parts of the watershed (Lev et al. 1994). Native vegetation species include Columbia sedge, water ladysthumb, and lesser duckweed. A large stand of Oregon ash is on the south side of Bybee Lake, with some trees over 100 years old. This ash forest hosts a large population of bats, two of which are listed as species of concern under the Endangered

Species Act. Populations of painted turtles live in the wildlife area and also breed there. Osprey and bald eagle also breed in the wildlife area; several nests are perched on top of the power poles crossing Smith Lake. Non-native species also invade the wildlife area. As in the rest of the watershed, reed canarygrass is the dominant vegetation in the open meadow and emergent marsh wetland areas. Teasel, deadly nightshade, Himalayan blackberry and Canada and bull thistles are also abundant. Purple loosestrife is also present. Two species of leaf beetles, two species of seed weevils, and a species of root weevil have been introduced to control the loosestrife.

Wapato Wetlands

Wapato Wetlands, an off-channel wetland area in the Lower Slough (Figure 7-8, Site 30), is located south of Smith and Bybee Lakes Wildlife Area. From its mouth with the Lower Slough, the wetland site extends approximately 1 mile in an easterly direction. The site contains one of the largest remaining stands of wapato, *Sagittaria latifolia*, in the region. Lush seasonal growth of the wapato plant occurs from bank to bank from July through October when the water levels are low. During the rest of the year, the wetland lacks wapato vegetation, but the tubers persist. Tubers, which are the most valuable part of the plant, are accessible to ducks because of the soft mud and partial inundation characteristic of the wapato stand. Wapato is an important wildlife food: the tubers and fruits are eaten by waterfowl; muskrats and porcupines consume the tubers; and the vegetation is eaten by insects, waterfowl and other animals (deer, semi-aquatic mammals, wood ducks) (HARZA 2000).

In addition to its large stand of wapato, the site contains high quality riparian forest on both banks. The riparian areas contain a significant amount of dead and downed material within the riparian corridor and extending into the water. Dead and down material provides good access to the water and cover for birds, small mammals, amphibians and turtles. It also provides habitat for macroinvertebrates. All of the reaches contained many snags (HARZA 2000).

A power transmission line right-of-way (ROW) is adjacent to the south bank. With its limited access and width of 100-150 feet, the ROW buffers the south bank riparian corridor. However, maintenance activities along the ROW could disturb wildlife in the area. The Union Pacific Railroad yard and another ROW are further upland from the transmission ROW. There is some noise disturbance from the frequent trains. Contaminants may enter the wetlands from the Union-Pacific railroad yard (HARZA 2000).

Two large pipes crossing the wetlands in a north-south direction may act as artificial barriers. The pipes cross the wetlands and are partially buried in sediment and partially above ground. The 4-foot-diameter pipe has enough debris and sediment collected about it as to have established vegetation (HARZA).

Big Four Corners

The Big Four Corners habitat area (Figure 7-8, Site 1) lies between NE 158th Avenue and NE 185th Avenue in the upper watershed. Big Four Corners refers to the confluence of four arms of the Columbia Slough (upstream and downstream arms of the mainstem Columbia Slough and arms of the Big Four Corners North Slough). The approximately 300-acre habitat area

comprises vacant industrial land, agricultural land, natural and mitigation wetlands, and natural vegetation along riparian and upland areas. Much of the acreage in the Big Four Corners habitat area has an environmental protection zone overlay. It contains significant natural resource values. The majority of the acreage is in private ownership, with over 150 acres in public ownership. At least half of the parcels in public ownership are mitigation wetlands or stormwater treatment facilities. Wetland restoration by the Watershed Revegetation Program is also occurring along the Slough in this area.

The Big Four Corners area contains examples of once-common Columbia Slough vegetation, including forested wetlands dominated by black cottonwood, Oregon ash, willow, and Douglas hawthorn and a historic grove of Oregon white oak trees. This structurally diverse forest provides habitat for raptors, woodpeckers, and neotropical migratory songbirds. Yellow-breasted Chats, an uncommon bird along the Columbia Slough, have been observed at this site in the past (City of Portland Bureau of Planning 1989).

Supplemental Planning Area

Hayden Island and Oregon Slough are located within the Columbia River and provide high-quality habitat for native fish and wildlife species. Although both are located outside the topographic boundary of the Columbia Slough Watershed, they are included in the Columbia Slough Watershed Characterization.

Hayden Island

Hayden Island, which includes the connected Tomahawk Island on the east side (Figure 7-8, Site 32), is located in the Columbia River, approximately 1 mile upstream from the confluence with the Willamette River. The eastern side of the island (east of the Burlington Northern railroad tracks) consists almost entirely of urban commercial and residential areas. It contains sparse wildlife habitat and supports mostly exotic wildlife, including rock pigeons, European starlings, and house sparrows, as well as generalist native species, including gulls and crows. The western side of the island (owned by the Port of Portland and comprising approximately 825 acres) includes a number of habitat types that all function to support a high-quality riparian ecosystem. It contains wetlands, upland meadow, forested upland, and a large sandy area resulting from ongoing dredge material disposal. The 488-acre forested area is a large remnant stand of black cottonwood/Oregon ash floodplain forest, which was historically abundant within the Lower Columbia River (Johnson & O'Neil 2001). Ground-dwelling birds, small and large mammals, and neo-tropical migratory bird species use the area. An extensive marine development is planned for West Hayden Island, but has been postponed until demand for expanded facilities has been achieved.

Oregon Slough

The Oregon Slough (Figure 7-8, Site 21), located between Hayden/Tomahawk Island and north Portland, is hydraulically connected to the Columbia River at both its east and west ends, and comprises very different aquatic habitat from the Columbia Slough. The active channel is considerably wider than other Slough reaches, and currents in the Columbia River provide constant mixing and cycling of nutrients. Water levels are directly tied to tidal activity and

Columbia River water level. Water clarity is limited less by sediment turbidity than by microscopic algae and zooplankton in the water column. The Oregon Slough is a known migratory route for Upper Columbia River Basin and Snake River Basin salmonids, a number of which are listed as threatened or endangered and protected under the federal Endangered Species Act. Juvenile salmonids use the Oregon Slough for rearing and migration. Lampreys and sturgeon can also occur in the habitat present in the Oregon Slough. Land use in the Oregon Slough includes extensive houseboat moorages in the eastern portion; a more natural bank exists along West Hayden Island.

IMPACTS OF URBANIZATION ON HABITAT

The impacts of urbanization on wildlife habitat are various and complex, depending on the degree and location of urban development, type of degradation, and affected species. Overall, the loss of habitat in the Columbia Slough Watershed is detrimental to a large number of bird, mammal, fish, reptile, and amphibian species that use the watershed at various points in their life cycle. While generalist species may benefit from particular impacts, the populations of more specialized species have been greatly reduced. For example, the simplification of habitat (e.g., creation of large lawns) decreases plant diversity, but provides ideal habitat for generalist species (such as the American robin) that flourish at the expense of other bird and mammal species (such as the yellow warbler).

The major characteristics of urbanization that affect biological communities in the Columbia Slough Watershed are (Ferguson, Robinette, & Stenberg 2001):

- Concentrated human population, which has significantly altered native habitats by:
 - Landscaping with non-native vegetation and maintaining landscaping with herbicides, pesticides and fertilizers
 - Extending the photoperiod with artificial lighting
 - Adding garbage as a food source
 - Increasing the number and sizes of structures, which increase dangers for birds and bats
 - Introducing pets that increase predation, particularly to ground nesters and feeders
 - Increasing noise throughout the watershed
 - Increasing runoff and potential water quality impacts
- Fragmented landscape (non-native vegetation, buildings located in riparian areas). Isolated habitat patches are more vulnerable to species disturbance and extinction.
- Increased impervious surfaces. The Columbia Slough Watershed comprises about 54 percent impervious surface area. This results in increased stormwater runoff and associated pollutants, affecting water quality and habitat functions.
- Mobility barriers (including roadways, culverts, elevated levees, and artificial lighting). The watershed's extensive infrastructure creates barriers to animal movement and puts animals at greater risk of being killed by cars, trains, or airplanes. Replacing culverts with bridges is a

high priority in the watershed because increased conveyance benefits water quality in the Columbia Slough and provides increased mobility for wildlife species.

- Simplification of habitat (non-native vegetation, landscaping, tree pruning, lawns). Intensively managed areas (parks, golf courses, remnant agricultural areas, lawns and conventional landscaping) offer minimal habitat diversity. Simplified habitat eliminates foraging and nest sites for ground- and shrub-dependent wildlife.
- Overall loss of habitat (buildings, roadways, parking lots, other impervious surfaces). As native habitats are eliminated, the remaining habitat increasingly supports non-native invasive species and native generalist species.
- These conditions affect the physiological, behavioral, and life history of birds and other wildlife in urban areas. The impacts often include the following, most of which have negative impacts on native birds and wildlife (Ferguson, Robinette, & Stenberg 2001):
 - Reduced migrations; winter residency in areas formerly used only for stopovers.
 - Loss of stopover habitats.
 - Changes in feeding and foraging behavior.
 - Changes in food/diet; feeding on garbage.
 - Prolonged breeding season; multiple clutches during the breeding season.
 - Change in nesting habits.
 - Reduced reproductive success.
 - Smaller population sizes.
 - Tolerance of humans.
 - Change in species composition and diversity.

These impacts are hard to measure without comprehensive baseline information about wildlife habitat and about species use before urbanization and channel modification occurred. Studies of selected species behavior compared to wild populations would indicate wildlife adaptations in the watershed.

In-Channel Impacts

Alteration of the hydrologic cycle is the single-largest adverse impact on the Columbia Slough's in-channel habitat. Biota and habitat characteristics are greatly changed from historical conditions. The changes are compounded by significant contributions of stormwater and its associated pollutants, chemical contaminants, and industrial pollutants. While many point source contaminants have been reduced or eliminated, their legacy continues to affect the environment through degraded water quality, contaminated sediments, and bioaccumulated toxins in invertebrate and vertebrate species. As the Columbia Slough Watershed continues to develop, impervious surface and pollutants in stormwater runoff will have greater effects on the Slough system, if stormwater is discharged without pretreatment. (See Chapter 6: Water and Sediment Quality Characterization, for additional information about water and sediment quality.)

Riparian Impacts (including Hayden Island)

Urbanization, fragmentation, non-native species, and reduced width of riparian areas have reduced the habitat value of the riparian ecosystem. The Watershed Revegetation Program has increased the amount of native riparian vegetation along the Slough. As the forest and shrub communities mature, their habitat values should increase.

Wetlands Impacts (including Smith and Bybee Lakes Wildlife Area)

Hydrological manipulation has had significant adverse impacts on wetlands habitat within the Slough ecosystem. The change in water regime has resulted in isolated systems dependent on precipitation and affected by stormwater runoff, creating habitats dominated by non-native vegetation. Purple loosestrife is present in several areas of the watershed. (Control beetles have been released to control the loosestrife in the Smith and Bybee Lakes Wildlife Area.) Invasive species lead to a decline in plant and animal diversity. The lack of adjacent upland habitat also reduces species use because the majority of wetland species use upland habitat for their complete life cycle.

Upland Impacts

Upland habitats (forest, prairie, and scrub/shrub ecosystems) are significantly lacking in the watershed. The upland open spaces that do exist are developed parks, golf courses, agricultural land, and the St. Johns Landfill (grassland habitat). These areas have a low diversity of plant species, contain mostly exotic species, often do not include multiple plant heights, and lack woody plants. This reduces the nesting and foraging opportunities for specialized native bird species (Fairview Creek Watershed Council 2002 & 2003). The non-native vegetation, human uses, and fragmentation of the upland areas limit use by wildlife species, except foraging raptors and common neighborhood birds such as American robins, European starlings, house sparrows, American crows and house finches.

CONCLUSIONS

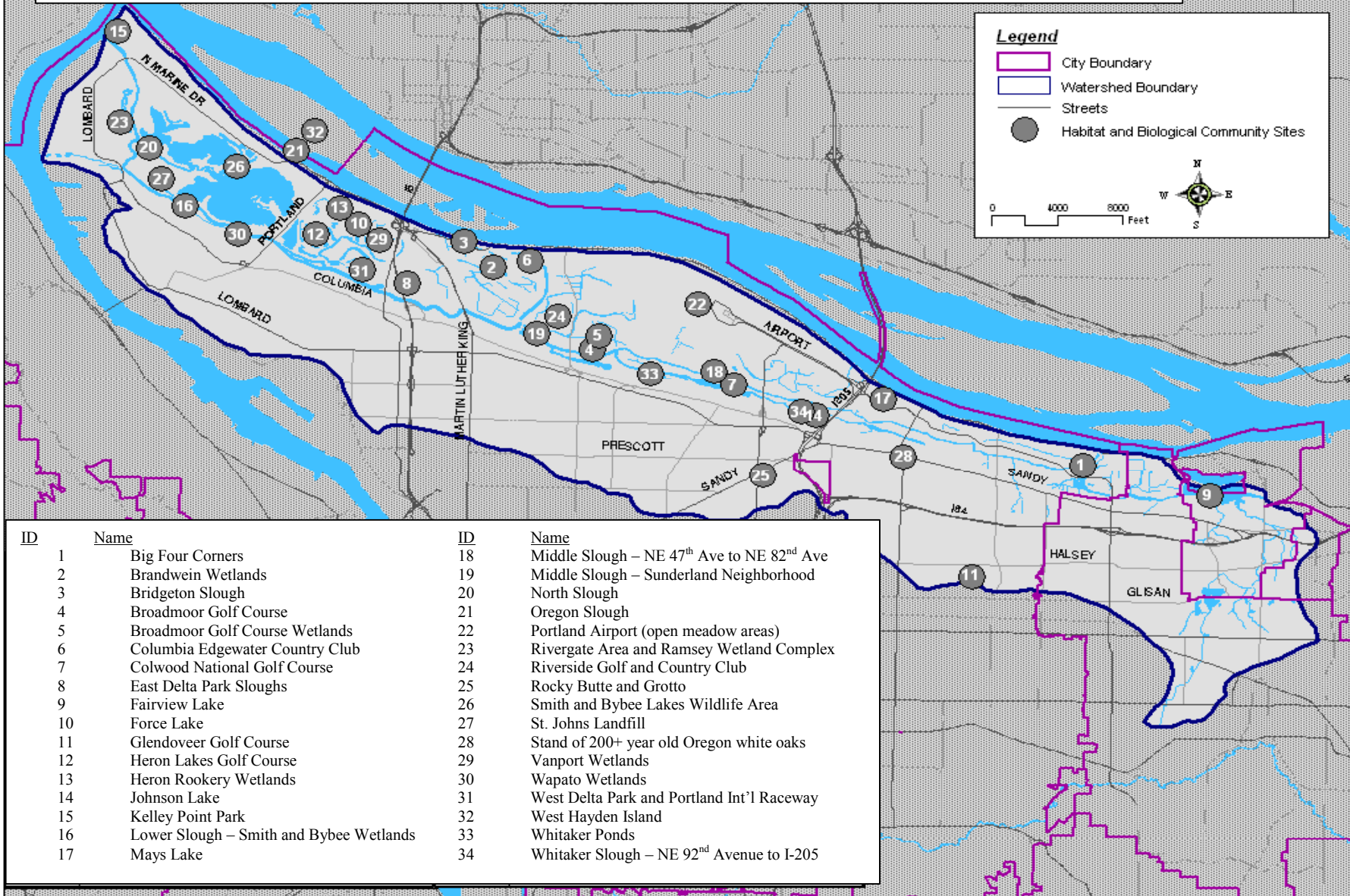
Although habitats in the Columbia Slough Watershed are much reduced from historic levels, they still provide a diverse range of functions and values at a variety of levels.

- Even with the adverse habitat impacts, some several sensitive species have survived, including bald eagle, western painted turtle, osprey, and northern river otter. Over 150 species of birds feed, live, nest, over-winter, or migrate through the watershed each year. Although native wildlife numbers have decreased, the biodiversity found in the watershed is unique and valuable in the Portland region and warrants continued preservation and restoration.
- Opportunities for restoration and enhancement exist throughout the watershed. A partial list of strategies includes:
 - Removing non-native vegetation and planting native species
 - Widening the existing riparian corridor
 - Connecting habitats with a continuous riparian corridor and removing wildlife corridor

passage problems

- Increasing and enhancing upland habitat associated with wetlands and riparian areas
 - Improving connections between the Slough and upland and riparian habitats
 - Obtaining water rights for ecological benefits
 - Floodplain restoration and reconnection, where feasible
 - Restoring hydrological connections to the Slough
 - Enhancing in-channel habitat complexity in the Lower Slough for rearing juvenile salmonids
- Specific locations for protection, restoration and enhancement exist throughout the watershed, as follows. (See Figure 7-8 for site locations.)
 - Kelley Point Park (*Site 15*)
 - Smith and Bybee Lakes Wildlife Area (*Site 26*)
 - Rivergate mitigation sites and Ramsey Wetlands Complex (*Site 23*)
 - Delta Park and Heron Lakes Golf Course complex (*Sites 8, 12, 13, & 31*)
 - Vanport Wetlands (*Site 29*)
 - Brandwein Wetlands (*Site 2*)
 - Bridgeton Slough (*Site 3*)
 - Broadmoor Golf Course Wetlands (*Site 5*)
 - Middle Slough through the Sunderland neighborhood (*Site 19*)
 - Whitaker Ponds (*Site 33*)
 - Big Four Corners complex (*Site 1*)
 - Columbia Slough and secondary waterways (*unnamed sites*)
 - In-channel habitat is poor throughout the entire system because of past impacts and ongoing inputs of sediment and pollutants in stormwater. The tidally influenced Lower Slough provides much-needed refugia habitat for juvenile salmon, especially during high flows in the Willamette and Columbia Rivers. Development has restricted the ability of the channel to meander within the floodplain. Opportunities exist to re-contour the channel bank throughout many areas of the watershed.
 - Decreased native vegetation and increased non-native, invasive vegetation have perhaps the largest impact on species composition. Reed canarygrass, English ivy, purple loosestrife, and Himalayan blackberry limit available food sources, nesting opportunities, and other general habitat requirements of native wildlife. Invasive non-native plant species also often preclude natural regeneration of native plant species. It will be impossible to control invasive species completely, but continual management and replacement with native species will increase habitat diversity and species numbers in the watershed. At the same time, widening riparian corridors helps reduce the edge effect that allows non-native species to proliferate.

Figure 7-8: Physical Habitat and Biological Communities Sites



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