FINAL SHORELINE INVENTORY, ANALYSIS, AND CHARACTERIZATION REPORT

RICHLAND SHORELINE MASTER PROGRAM UPDATE

Prepared for

City of Richland

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LIST OF ACRONYMS AND ABBREVIATIONS

%	percent
°C	degrees Celsius
ALEP	Arid Lands Ecology Preserve
BLM	U.S. Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
City	City of Richland
CRB	Columbia River Basalt
DAHP	Washington State Department of Archaeology and Historic Preservation
DART	Data Access in Real Time
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
HPA	Hydraulic Project Approval
HRNM	Hanford Reach National Monument
Integrated Plan	Integrated Water Resource Management Plan
MTCA	Model Toxics Control Act
NEPA	National Environmental Policy Act
NWI	National Wetlands Inventory
OHWM	ordinary high water mark
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
SMA	Shoreline Management Act
SMP	Shoreline Master Program
SR	State Route
TMDL	total maximum daily load
UGA	urban growth area
USBR	U.S. Bureau of Reclamation
USDA	U.S. Department of Agriculture

USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish and Wildlife
WSU	Washington State University

1 INTRODUCTION

1.1 Background and Purpose

The City of Richland (City) received grant funding from the Washington State Department of Ecology (Ecology) to develop an updated Shoreline Master Program (SMP). A primary purpose of this effort is to update the SMP to comply with Chapter 90.58 Revised Code of Washington (RCW), the Shoreline Management Act (SMA), and Ecology's 2003 Shoreline Master Program Guidelines (Chapter 173-26 Washington Administrative Code [WAC]).

The Inventory, Analysis, and Characterization Report is a foundational step for the SMP. This report includes a discussion of the setting and ecosystem-wide processes that influence ecological functions within Richland shorelines. The report also addresses alterations based on existing land use patterns and future potential development within the shoreline jurisdiction areas. Inventory, analysis and characterization tables summarizing conditions by reach for the Yakima and Columbia Rivers are provided in Appendix A. A map folio is provided in Appendix B.

The guidelines require the City to demonstrate that the SMP will result in "no net loss" to shoreline ecological functions during implementation. This report will serve to describe the existing baseline conditions of shoreline ecological function. An associated Shoreline Restoration and Protection Plan and Cumulative Impacts Analysis will follow development of the Final program and code elements. The cumulative impacts analysis will demonstrate how future development under the proposed SMP will result in no net loss of shoreline ecological function. The restoration measures described in the Shoreline Restoration and Protection Plan could be implemented to improve shoreline ecological functions beyond existing conditions.

1.2 Report Organization

The report is organized in the following sections:

- Regulatory Overview describes the SMA; local, state, and federal regulations, and cultural resource considerations.
- Shoreline Jurisdiction reviews the data and analysis used to determine the shoreline jurisdiction waterbodies and extents of the SMA shoreline jurisdiction.

- Richland Overview provides a description of the project area, including ownership and land cover characteristics, land use and SMP environment designations, geology, climate, surface water resources, water quality, floodplains and floodways, channel migration zones, and geologic hazard characteristics.
- Shoreline Inventory, Analysis, and Characterization describe the ecosystem processes and the level to which they are currently impaired or altered. The processes most critical to ecological functions are described for the Columbia and Yakima rivers. Also included are a review of the reach characterization methods and overview of inventory, analysis, and characterization tables.
- Public Access identifies existing public access goals and policies.
- Land Capacity Analysis identifies developable lands and associated residential unit and commercial area available for specific geographic areas within the City.
- Information sources and limitations are also described.

2 REGULATORY OVERVIEW

2.1 Shoreline Management Act

Counties, cities, and towns develop or update local SMPs to be in compliance with Washington State's SMA (RCW 90.58), and consistent with Ecology's guidelines. The State of Washington's SMA addresses concerns about the effects of unregulated development on shorelines. The SMP update process indicates the joint state/local nature of the SMA program as local governments develop SMPs in close coordination with Ecology, informed by local opportunities and constraints, and consistent with state law and guidelines.

2.2 Local, State, and Federal Plans and Regulations

SMPs provide provisions to protect archaeological resources, historic resources, and environmentally critical areas within the shoreline, as well as to maintain flood hazard protection (WAC 173-26-221). Environmentally sensitive areas (critical areas) within Richland include wetlands, frequently flooded areas, critical aquifer recharge areas, geologically hazardous areas, and fish and wildlife habitat conservation areas.

In addition, federal, state, and City regulations also apply to these features. Federal regulations include the Clean Water Act, Sections 404 and 401, Endangered Species Act (ESA), Federal Water Pollution Control Act, National Environmental Policy Act (NEPA), and the National Floodplain Insurance Program. Federal regulations relevant to the Hanford Nuclear reservation in the northern part of the City and Urban Growth Area (UGA) include the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). Additionally, the US Army Corps of Engineers owns the Columbia River and lower Yakima River shorelines in Richland. The Corps leases these lands to the City for public park purposes. Maintenance and operation of existing public facilities and development of new facilities within Corps ownership is subject to the provisions of the lease agreement between the Corps and the City of Richland.

State regulations are administered through the RCW and include the State Environmental Policy Act (SEPA), the Hydraulic Project Approval (HPA), the Bald Eagle Protection Rules, the Surface Mining Act, the State Water Code and Water Pollution Control Act, and the SMA. State law and regulation relevant to the Hanford Nuclear reservation in the northern part of the City and UGA include the Model Toxics Control Act (MTCA) Statute (RCW Chapter 70.105D and Chapter 64.70) and MTCA Cleanup Regulation WAC Chapter 173-340.

The City has an existing SMP and critical areas regulations for wetlands, frequently flooded areas, geologically hazardous areas, aquifer recharge areas, and fish and wildlife habitat conservation areas. These areas are identified, as applicable to the City, in the map folio. Table 1 includes a summary of these regulations.

Critical areas for each shoreline jurisdiction reach are also described within the flooding and geological hazards and habitat characteristics sections of the Reach Characterization Tables provided in Appendix A.

Table 1

Critical Areas Regulation Summary (as of 2013)

Jurisdiction	Date of Last Update	Wetland Rating System	Fish and Wildlife Areas	Protection Standards				
Richland	2013	Wa. State Wetland Rating System for E.Wa. (Ecology Publication #91-58, or as revised proved by Ecology) Category I, II, III, and IV.	(As described in 22.10.170 - Definitions) 1. The areas listed under WAC 332-30-151; 2.The Lake Wallula wildlife habitat areas managed by the U.S. Army Corps of Engineers, including the Yakima River Wildlife Management Area and the Hanford Islands in the Columbia River managed by the U.S. Fish and Wildlife Service; 3. Category I wetland; 4. State nature area preserves or natural resource conservation areas.	**Wetlands**				
Title No.				**Buffer (feet)**	Category I	Category II	Category III	Category IV
Richland Municipal Code 22.10.010 - 22.10.380 General; Wetlands; Fish and Wildlife Habitat Areas; Geologically Haz. Areas.				High Intensity Land Use	150	100	50	50
				Low Intensity Land Use	75	50	25	25
				Mitigation Ratio	I	II	III	IV
				Replacement Ratio	6:1	3:1	2:1	1.5:1
				Enhancement Ratio	12:1	6:1	4:1	3:1
				Fish and Wildlife Habitat Conservation Areas				
				Buffer (feet)	Wildlife Habitat Type: Critical	Wildlife Habitat Type: Secondary		
				High Impact Land Use	150	100		
				Low Impact Land Use	75	50		
				Geologically Hazardous Areas				
				Identification (as described in 22.10.240)	Geologic hazard areas identification and designation shall be consistent with the minimum guideline classifications established in WAC 365-190-080(4) which includes any future amendments to the code. Areas that are susceptible to one or more of the following types of hazards shall be classified as a geologic hazard area: 1. Erosion hazard; 2. Landslide hazard; 3. Seismic hazard; 4. Mine hazard.			
				Regulation (as described in 22.10.290)	The city of Richland may approve, conditionally approve or deny an activity, as appropriate, based on the degree to which significant risks are posed to public and private property and to the health and safety of the community. Conditional approval of the activity may include mitigation measures based on the geologic reports and studies. Where potential impacts of the activity cannot be effectively mitigated, or where the risk to public health, safety and welfare of the community is significant notwithstanding mitigation, the activity shall be denied. [Ord. 48-93; Ord. 45-00; Ord. 23-01].			

Notes:
WAC = Washington Administrative Code

2.3 Cultural Resources and Shoreline Development

State and local cultural resources laws apply to shoreline development. State laws include RCW 27.53 (Archaeological Sites and Records), which prohibits the unpermitted removal of archaeological materials and establishes a permitting process, and RCW 27.44 (Indian Graves and Records) which describes how human remains must be treated. Additionally, the City of Richland has a Memorandum of Understanding with the Umatilla Nation that calls for the City to coordinate with the Umatillas on shoreline projects that may have an impact on cultural resources.

Given the importance of shoreline locations throughout the human history of the area, the potential for cultural resources should be considered high for any shoreline development permit unless demonstrated otherwise. To comply with state and local law, applicants should be prepared to follow the provisions of RCW 27.53 and 27.44 if cultural resources are identified or encountered during the planning or construction process.

3 SHORELINE JURISDICTION ANALYSIS

The Washington state SMA defines the Shoreline of the State as "all 'shorelines' and 'shorelines of statewide significance' within the state" (RCW 90.58.030).

Shorelines are defined as:

> "[A]ll of the water areas of the state, including reservoirs, and their associated shorelands, together with the lands underlying them; except
>
> (i) shorelines of statewide significance;
>
> (ii) shorelines on segments of streams upstream of a point where the mean annual flow is twenty cubic feet per second or less and the wetlands associated with such upstream segments; and
>
> (iii) shorelines on lakes less than twenty acres in size and wetlands associated with such small lakes." (RCW 90.58.030)

Shorelines of statewide significance for east of the crest of the Cascade Mountains (RCW 90.58.030) are defined in the statute as:

(i) "Those lakes, whether natural, artificial, or a combination thereof, with a surface acreage of one thousand acres or more measured at the ordinary high water mark; and

(ii) Streams or rivers (or segments of natural streams) "that have either: a mean annual flow of 200 cubic feet per second or more, or;

(iii) The portion downstream from the first 300 square miles of drainage area."

Shorelands (also known as shoreland areas) are defined by the statute as:

> "[T]hose lands extending landward for two hundred feet in all directions as measured on a horizontal plane from the ordinary high water mark; floodways and contiguous flood plain areas landward two hundred feet from such floodways; and all wetlands and river deltas associated with the streams, lakes, and tidal waters which are subject to the provisions of this chapter; the same to be designated as to location by the department of ecology. Any county or city may determine that portion of a one hundred-year flood plain to be included in its master program as long as such portion

includes, as a minimum, the floodway and the adjacent land extending landward two hundred feet therefrom."

WAC Title 173, Chapter 18, Section 070 contains a listing of streams of statewide significance in Benton County, including the Columbia and Yakima rivers. Richland's shoreline jurisdiction waterbodies are the Columbia and Yakima rivers. No lakes or other streams have been determined to meet the shoreline jurisdiction definitions provided above.

3.1 Shoreline Master Program Jurisdiction Determination Methodology

Anchor QEA received Geographic Information System (GIS)-formatted datasets for the Yakima and Columbia rivers from the Benton County GIS department, the City, the U.S. Geological Survey (USGS), the U.S. Department of Agriculture (USDA), and the U.S. Fish and Wildlife Service (USFWS). These datasets contained information from a variety of sources on the Yakima River and potential shorelands within the City. To create a dataset representing the mapped extent of the shoreline jurisdiction within the City, Anchor QEA utilized the following information:

- The [waterbodies] dataset was buffered by 200 feet (horizontally) on all sides utilizing the estimated ordinary high water mark (OHWM).
- The National Wetlands Inventory (NWI) layer was dissolved to create a new layer that included all wetland areas without boundaries between wetlands differing in classifications.
- All wetlands that intersected the [waterbodies] dataset were selected and exported into a temporary dataset of potential associated wetlands.
- The potential associated wetlands were reviewed and areas determined to be separated by a clearly distinct upland area, such as a road or levee, from shoreline waters were removed from dataset of potential associated wetlands.
- The NWI dataset was then reviewed and wetlands that did not intersect the [waterbodies] layer in the GIS but clearly appeared to be associated wetlands in the imagery were included in the dataset of potential associated wetlands.

3.2 Study Area

Based on the shoreline jurisdiction analyses, the Yakima River and the Columbia River, with associated wetlands and floodway, were identified for inclusion in SMP jurisdiction. Both rivers are shorelines of statewide significance. The extent of the shoreline jurisdiction is shown in Map 2 of the map folio.

3.3 Reach Breaks

The analysis and characterization information in this report is organized using a system of analysis reaches and subreaches to represent variations in land use and geomorphic characteristics along the shoreline. Physical changes often translate into differences in the function of the shoreline with regards to ecological and physical processes, which in turn may influence the shoreline designation.

The reach delineation was performed by evaluating aerial photography, topographic data, geologic maps, and land cover data, which were compiled in a GIS database. Specific factors that influenced the delineation of stream reaches include channel and floodplain geomorphology, geologic controls, channel confinement and modification, hydrology, and irrigation practices. Subreaches were used in the analysis and characterization primarily to distinguish different patterns in land use, ownership, zoning, and level of development. Subreaches were delineated primarily where changes in land use, parcel density, or zoning affected the current or potential future ecosystem function.

A list of the reaches and subreaches for the Yakima and Columbia River shoreline jurisdiction areas within the City are provided in Table 2.

Table 2
Yakima and Columbia River Reaches

Waterbody	City/ UGA	Reach Label	Reach Description
Yakima	City	1	The shoreline within this reach extends about 4,000 feet along the left bank of the Yakima River and is agricultural land owned by the City of Richland; it is currently in agricultural use.
Yakima	City	2	The shoreline within this reach extends about 3,000 feet along the left bank of the Yakima River on an outer oxbow with a very narrow band of riparian vegetation on a steep slope up from the river. At the top of the slope is the Bluffs subdivision, which is part of the Horn Rapids Golf Course development. SMA jurisdiction of 200 feet from the OHWM extends to just below the top edge of the slope.
Yakima	City	3	The shoreline within this reach extends about 4 miles along the left bank of the Yakima River from north of Glen Road to the I-182 bridge. Land use is largely agriculture or large lot rural lands in lots of 2 to 10 acres to the border of the W.E. Johnson Park at about the alignment of Swift Boulevard. The park and lands to the south are in public ownership. This area is largely floodplain that ranges up to 3/4 of a mile wide to Glen Briar Lane. Between this point and the bridge, there is a narrow riparian corridor bounded by a steep slope.
Yakima	City	4	The shoreline within this reach extends about 3 miles along the river south of the I-182 bridge over the Yakima River extending to the I-182 bridge over the Columbia River and is floodplain under U.S. Army Corps of Engineers jurisdiction and adjacent uplands managed by the City of Richland.
Yakima	City	5	The shoreline within this reach extends about 8,300 feet along the right bank of the Yakima River from the City Limits at Northlake Drive to the I-182 Yakima River bridge.
Yakima	City	6	The shoreline within this reach extends along the right bank of the Yakima River from the I-182 Yakima River bridge through the SR 240 bridge and to the eastern city limits, including Bateman and other smaller islands
Columbia	UGA	7	The shoreline within this reach extends about 8,000 feet along the right bank of the Columbia River from the north Urban Growth Area boundary to the City limits at Horn Rapids Road. The reach includes largely U.S. Department of

Waterbody	City/ UGA	Reach Label	Reach Description
			Energy land and includes portions of Wooded Island, Susan Island, and Barb Island in the Columbia River.
Columbia	City	8	The shoreline within this reach extends about 8,000 feet along the right bank of the Columbia River from the current City limits at Horn Rapids Road to Spring Road. The reach includes shoreline areas managed as part of the McNary Dam project and private and public uplands.
Columbia	City	9	The shoreline within this reach extends along the right bank of the Columbia River from Spring Road to Howard Amon Park.
Columbia	City	10	The shoreline within this reach extends about 2 miles along the right bank of the Columbia River from the north end of Howard Amon Park to the I-182 bridge. The reach includes shoreline areas managed by the City as park and open space, as well as residential and commercial uses, including a marina.

Figures depicting these reaches and subreaches, where applicable, are provided in the map folio; characterization tables are provided in Appendix A.

4 RICHLAND OVERVIEW

4.1 Ownership and Land Cover

Ownership throughout the City is dominated by private lands; however shoreline areas are predominantly under public ownership. Public lands are dominated by City-owned parcels. Public space within the shoreline jurisdiction of the Yakima River includes W.E. Johnson Park, the Chamna Natural Preserve, the Riverview Preserve managed by the U.S. Army Corps of Engineers and Bateman Island at the river delta. On the Columbia River, public space includes Leslie Groves Park, Howard Amon Park, Columbia Point Marina Park, South Columbia Point Park, and Columbia Park West at the confluence of the Columbia and Yakima rivers. Table 3 documents the percentage of ownership types within the City limits and UGA.

Table 3
Ownership Types within City Limits and UGA

Ownership Type	Percentages
City	19.12%
County	0.61%
Private	78.25%
State	1.90%
Federal*	0.12%

*Federal land under lease to the City is classified as City land

Land cover in Richland is dominated by developed areas and shrub/scrub habitat. Table 4 documents the percentage of land cover types within the City limits and UGA.

Table 4
Land Cover Types within City Limits and UGA

Land Cover Type	Percentages
Agriculture	17.62%
Developed	42.23%
Forested	0.06%
Grassland	0.23%
Open Water	7.80%
Shrub/Scrub	30.80%
Wetlands	1.26%

4.2 Land Use

4.2.1 Citywide Existing Land Use

Land use is characterized by reach in the tables and text below.

4.2.2 Current Citywide Land Use

The City is part of the Tri-Cities Metropolitan Area in southeast Washington state and includes 25,197 acres in the current incorporated limits and additional 5,433 acres in the UGA. The 5.8 square miles in the City and the associated UGA comprise about 5 percent of the 111 square miles designated UGA in the Benton County Comprehensive Plan.

Residential use comprises about 23 percent of the land area, industrial and business park about 20 percent, commercial/retail about 5 percent, natural open space about 8 percent, and developed open space about 7.4 percent.

Much of the Columbia River shoreline and portions of the Yakima River shoreline are managed by the U.S. Army Corps of Engineers as part of the McNary Dam project with large portions of the federal ownership leased to the City as park and open space.

The major area of private commercial development on the Columbia River shoreline is located in the Columbia Point Area between Howard Amon Park and the Interstate 182 bridge, and includes two hotels and a commercial/restaurant complex as well as a marina. The majority of this area is multi-family development.

The natural open space system includes most of the Yakima River and Columbia River shorelines, islands, greenways, and designated areas within residential developments.

Major elements on the Yakima River include the Tapteal Greenway which runs approximately 30 river miles, from Benton City to Columbia Point; City owned W.E. Johnson Park includes about 236.0 acres located south of Van Giesen Street including mostly natural open space with about 1/2 mile of Yakima River frontage; the Corps owned Chamna Natural Preserve is a 276+ acre park located on the left bank of the river between the Interstate 182 bridge and State

Route (SR) 240; the Riverview Preserve is a 268.0-acres area owned and managed by the Corps on the right bank of the Yakima River; Bateman Island is 160 acres in the Yakima River Delta under Corps ownership and leased to the City.

On the Columbia River, major components of the City managed open space system include: Leslie Groves Park located between Snyder Street and Van Giesen Street which is 149.2 acres in size; Howard Amon Park which extends from about Gowen Drive to the Hampton Inn on Bradley Blvd.; Columbia Point Marina Park which is 14.1 acres in size and located in the southerly portion of Columbia Point Drive; Columbia Point South Park, which is a largely undeveloped area of 230 acres located at the confluence of the Yakima River and the Columbia River. Columbia Park West is 65 acres and located south of the Yakima River delta.

Existing land use information provides a baseline understanding of land use intensity, character, land cover, and the location of structures and other uses found within the shoreline jurisdiction. Tables 5 and 6 provide a summary of land use characteristics and the geographic character of existing development per reach. Table 6 includes descriptions of the size and dimensions of parcels that abut the shoreline, the extent to which existing structures are located in proximity to the water, and the extent (width) and quality of existing riparian, wetland, and shrub steppe vegetation. The wider vegetation depths indicated in Table 6 primarily exist in the Yakima River delta and Yakima River floodplains.

This data covers a range of parcels and often covers a range of conditions within a given reach. For the most part, land uses on the Yakima River are in recreation or open space use with large parcels, few structures, and generally high quality riparian vegetation. The Columbia River reaches are characterized primarily by open space and parks and with c urban development in Reach 10, the Columbia Point area.
A.

Table 5

Shoreline and Land Uses Summary Characteristics by Reach

			Land Use									
					Commercial		Industrial		Recreation			
Waterbody	City/ UGA	Reach Label	Single Family	Multi-Family	Water-Oriented	Non-Water-Oriented	Water-Oriented	Non-Water-Oriented	Water-Oriented	Non-Water Oriented	Transportation	Vacant or Other
Yakima	UGA	1	0	0	0	0	0	0	0	0	0	48 ac
Yakima	UGA	2	0	0	0	0	0	0	0	0	0	14 ac
Yakima	UGA	3	5 ac	0	0	0	0	0	0	0	0	850 ac
Yakima	City	4	0	0	0	0	0	<1 ac	0	<1 ac	0	1,736 ac
Yakima	City	5	0	0	0	0	0	0	0	0	<1ac	192 ac
Yakima	City	6	0	0	0	4 ac	0	2 ac	6 ac	30 ac	30 ac	321 ac
Columbia	UGA	7	0	0	0	0	0	0	0	0	<1 ac	79 ac
Columbia	City	8	4 ac	0	0	0	0	0	1 ac	<1 ac	0	70 ac
Columbia	City	9	5 ac	0	0	0	0	0	2 ac	40 ac	2 ac	41 ac
Columbia	City	10	0	8 ac	0	5 ac	0	0	14 ac	29 ac	<1 ac	2 ac

Notes:

ac = acres

Table 6

Parcels Summary Characteristics by Reach

			Average Conditions by Parcel					Total by Reach	
Waterbody	City/ UGA	Reach Label	Parcel Size (acre)	Parcel Width (feet)	Parcel Depth (feet)	Existing Structures Setback (feet)	Vegetation Depth (feet)	Overwater Structures	Impervious %
Yakima	City								
Yakima	UGA	1		4,000	500	100	100	0	>10%
Yakima	UGA	2		3,000	200	100	100	0	>10%
Yakima	UGA	3		300-5,000	600-3,000	100-1,000	10-1,000	0	>10%
Yakima	City	4		450-25,300	1,600	30-4,300	0-4,300	3	>10%
Yakima	City	5		8,300	50-650	50-650	50-650	1	>10%
Yakima	City	6		100-21,000	350-2,300	20-4,500	20-4,500	12	10%
Columbia	UGA	7		8,000	2,600-4,100	60-800	30-100	0	>10%
Columbia	City	8		100-11,000	60-600	0-600	0-130	12	>10%
Columbia	City	9		100-14,520	300-700	0-500	0-500	1	>10%
Columbia	City	10		100-7,500	350-600	0-100	0-100	7	50%

4.2.3 Water-dependent Uses

Water-dependent uses in the City include largely recreation marinas (Columbia Park West and Columbia Point) and boat launches on both the Columbia and Yakima rivers. Two port facilities are located in North Richland near Horn Rapids Road and consist of barge offloading piers and ramps.

4.2.4 Water-related Uses

Water-related uses, including water enjoyment uses, include much of the park and open space areas along the shorelines that provide for recreational use, including water-related beach and swimming access as well as aesthetic enjoyment of the shoreline on trail systems and passive recreation areas. Some mixed use development on Columbia Point provides opportunities for public access and the public access component is generally on public land adjacent to the trail corridor.

4.2.5 Non-water-related uses

Non-water-related uses directly adjacent to the water are largely limited to a small area of large lot single family/rural use along the Yakima River in the vicinity of Van Giesen Street; a single family residential area along the Columbia River between Ferry Road and Sprout Street and the Washington State University (WSU) Tri-Cities campus north of Sprout Road.

4.2.6 Future Land Use

4.2.6.1 Vacant Lands

The largest area of shoreline vacant lands in Richland is the Port of Benton Technology and Business Campus located in North Richland adjacent to the Columbia River with more than 6,000 feet of river frontage.

4.2.6.2 Water-oriented Uses

The potential for water-dependent use is largely limited to recreation and moorage. The expansion of port uses related to barge traffic on the Columbia River is limited by regional demand and the apparent surplus of potential port sites in Benton and Franklin Counties

(POK 2010). In addition, the City is at the end of the navigable portion of the Columbia River and does not have railroad access adjacent to the river.

There may be some potential for water-related and water enjoyment use in the Columbia Point area, however vacant or re-developable private land is limited in that area.

4.2.6.3 Non-water-Oriented Uses

The potential for non-water oriented use is greatest in the North Richland Technology & Business Campus. There are relatively few private undeveloped or re-developable parcels in the Columbia Point area. The most likely potential site in this area is the existing Shilo Rivershore Hotel. Additional single family and multi-family development is designated for portions of North Richland north of Battelle Blvd.

4.3 Current SMP Environment Designation

The City applies its shoreline environment designations within its shoreline jurisdiction under its current SMP. The 1979 Shoreline Master Program indicates four Environment Designations: Natural, Conservancy, Rural, and Residential. The SMP also includes policies for each Environment Designation. The existing Environment Designations are shown in the Reach Characterization Tables in Appendix A.

4.3.1 Natural

Natural shorelines contain unique and valuable natural or cultural features, including several islands. These areas should be preserved and protected from intolerant forms of development and use. All shorelines are presently in use, primarily for city parks/natural open space and residences, as well as some industrial and commercial uses. Some Natural Environment occurs in all of the shoreline areas.

4.3.2 Conservancy

The Conservancy Environment is used for those areas that contain a unique character (natural, cultural, aesthetic, historic, recreation) that should be maintained, but limited

development or use can be tolerated. These areas are important for present and future recreation uses that can maintain the natural character of the shoreline as practicable.

4.3.3 Rural

The Rural Environment is intended for those areas characterized by intensive agricultural and outdoor recreational uses and those areas having a high capability to support active agricultural practices and intensive outdoor recreational development. Designation of Rural Environment areas protects prime farming lands and rural areas from urban expansion and also provides opportunities for recreation and other compatible uses.

4.3.4 Urban

The Urban Environment is an area with few limitations for high intensity land use including residential, commercial, recreational, and industrial development. It is particularly suitable to those areas presently subjected to extremely intensive use pressure, as well as areas planned to accommodate urban expansion. The purpose of the Urban Environment designation is to ensure that optimum utilization of shorelines is occurring within urbanized areas for a multiplicity of urban uses.

4.4 Geology

The geology, soils, and topography of the Richland area are primarily dictated by glacial outburst flooding that occurred near the end of the last major glacial period, approximately 18,000 to 20,000 years before present. This event is referred to as the Missoula Floods. The geologic makeup is the result of erosion of pre-Floods geologic units, deposition of sediments carried by the floodwaters, and the formation of the unique topographic features that influence present-day hydrology. Prior to the Floods, the geology of the County consisted primarily of Miocene-aged Columbia River Basalt (CRB) flows that were in some places (e.g., plateaus) capped with varying thicknesses of wind-blown fine sands and silt known as loess (Grolier and Bingham 1978). The segments of the Yakima and Columbia rivers around Richland are located in a wide valley that is comprised primarily of alluvial soils with relatively high infiltration rates. Within upland areas, particularly areas farther from the confluence of the river, outburst flood deposits of gravel occur as well.

4.5 Climate

The City falls within the Central Basin region of Washington, which has the lowest precipitation rates within Washington state. Annual precipitation in the Richland area averages around 7.15 inches and precipitation is commonly associated with summer thunderstorms and winter rains and snowfall. Snowfall depths rarely exceed 2 to 3 inches and occur from November to March. High temperatures in January can range from 35 to 45 degrees Fahrenheit (1.6 to 7.2 degrees Celsius [°C]) with low temperatures between 20 to 30 degrees (-6.7 to -1.1 °C). Summer high temperatures are usually in the high 80s to low 90s with low temperatures in the high 50s (WRCC 2012).

4.6 Water Resources

4.6.1 Surface Water Resources

This section presents surface water resources as they relate to shoreline master planning for the planning area. The planning area is located in the lower Yakima River basin (Water Resource Inventory Area 37). Major surface water resources are the Yakima River and Columbia River.

4.6.1.1 Yakima River

The Yakima River is a major surface water resource for the planning area. The nearest current instantaneous USGS gage on the Yakima River is gage #12510500 (Yakima River at Kiona, Washington). The Yakima River at this gage has an average annual flow of 3,497 cubic feet per second (cfs) for its 78-year period of record (1934 to present; USGS 2012. The Yakima River drains a basin area of 5,615 square miles at this gage. This gage is also a U.S. Bureau of Reclamation (USBR) gage (gage KIOW).

Yakima River hydrology in the planning area is affected by the Yakima Project. The Yakima Project includes a reservoir system that stores natural flow in the upper Yakima River and Naches River basins for release during high demand periods. The storage and release cycle causes the Yakima River in the planning area to be regulated with flows higher than natural in the late summer and fall and lower than natural in the spring and early summer.

Additionally, Yakima River flow in the planning area is affected by return flow from water use in the upper Yakima River and Naches River basins.

The Yakima Project reservoir system also captures floods in the upper Yakima River basin. This operation reduces the frequency, duration, and magnitude of floodplain inundation and decreases the regulatory floodplain and floodway size compared to natural conditions (USBR 2002). The City planning area has portions along the Yakima River with good floodplain connection causing the floodplain area to be significantly greater than the floodway area.

Water resources in the Yakima River and Yakima River basin are the subject of the Integrated Water Resource Management Plan (Integrated Plan). The Integrated Plan is a proposed approach to improve water management in the Yakima River basin. According to the Integrated Plan, the goals are "to protect, mitigate, and enhance fish and wildlife habitat; provide increased operational flexibility to manage instream flows to meet ecological objectives; and improve the reliability of the water supply for irrigation, municipal supply, and domestic uses" (USBR and Ecology 2011). The proposed Integrated Plan is expected to provide pulse flows in the spring to the Yakima River during dry months within the planning area.

4.6.1.2 Columbia River (Lake Wallula)

The Columbia River is the second major surface water resource for the planning area. The portion of the Columbia River within the planning area is part of the upstream portion of Lake Wallula. Lake Wallula is created from the impoundment of the Columbia River by McNary Dam. The active continuous USGS gage nearest to the planning area is gage #12514500 (Columbia River on Clover Island at Kennewick, Washington). The Columbia River at this gage drains 104,000 square miles. This gage is a water surface elevation gage and has records from Water Year 1988 to present. The water surface elevation at this gage ranges from 335 feet to 344 feet (NGVD 1929).

Because the planning area is within the Lake Wallula portion of the Columbia River, water levels are generally stable. Columbia River floodplain levels are also confined due to river regulation.

4.6.2 Surface Water Quality

This section presents surface water quality as it relates to shoreline master planning for the planning area.

4.6.2.1 Yakima River

The Yakima River is listed on the current 303(d)[1] list of impaired waters for several parameters including pH, dichlorodiphenyldichloroethylene (DDE), and dichlorodiphenyltrichloroethane (DDT) within the planning area.

Ecology has a long-term water quality monitoring gage located near the planning area (gage #37A090, Yakima River at Kiona, Washington). Its period of record is 1947 to 1948, 1953 to 1962, and 1967 to present. At this gage, water quality standards criteria that are typically exceeded are pH during the irrigation season and temperature during the late summer (July and August).

One of the water quality parameters (temperature) was studied in detail within the planning area during summer months of 2008 and 2009. It was noted in this study that temperatures were above the lower Yakima River water quality standard of 21 °C. There were however localized areas of cooler temperatures caused by non-point source seeps likely caused by groundwater discharge. The localized areas did not appear to be located within the planning area (Benton Conservation District 2011).

In the planning area, Yakima River water quality is affected by irrigation return flows. Irrigation return flows and operational spills from drains and tributaries contribute up to 80 percent of the flow in the lower Yakima River. These return flows can affect many water quality parameters, including increases in suspended sediment, turbidity, fecal coliform, pesticides, temperature, and nutrients. The return flows can also cause a reduction in

[1] The term "303(d) list" is short for the list of impaired and threatened waters (stream/river segments, lakes) that the Clean Water Act requires all states to submit for EPA approval every two years on even-numbered years. Accessed April 29, 2013 from: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/overview.cfm

dissolved oxygen and an increase in pH (USBR 2002). Some return flows may cause localized areas of lower temperatures (Benton Conservation District 2011).

4.6.2.2 Columbia River (Lake Wallula)

The Columbia River is on the 303(d) list of impaired waters for temperature within the planning area. Additionally, the Columbia River has a total maximum daily load (TMDL) for total dissolved gas and is a 305(b) water of concern for pH.

Total dissolved gas is measured in the Columbia River at several gages as part of the Columbia River Data Access in Real Time (DART) program. The DART gage nearest to the planning area is gage PAQW (Columbia River at Pasco, Washington). This gage has been in operation since 2000.

4.6.3 Groundwater Resources

Groundwater in the planning area is within the Columbia Plateau aquifer system, which consists of the Columbia River Basalt Group overlain by quaternary flood deposits. Groundwater in the planning area is hydraulically connected to surface water, so the amount of groundwater pumping affects surface water stream flow, and groundwater resources are recharged by surface water interaction. The estimated mean annual groundwater recharge in the planning area is up 2 inches (USGS 2011).

Groundwater interaction with surface water also causes seepage losses or gains within rivers. The Yakima River within the planning area has an estimated loss. This can have an effect on surface water quantity and quality.

4.6.4 Floodplain and Floodway

Damage from flooding along the Columbia River occurred in 1948 prior to the construction of the dam system. Flooding from the Yakima River has affected the City more recently. Flood stage for the Yakima River is at 13.0 feet and is measured at the Kiona gage near the SR 223 bridge in Benton City. Benton County has determined that moderate flooding occurs when flows at this gage measure above 14.5 feet and major flooding occurs above 16.0 feet (Benton County Emergency Services 2012). Flood stage for the Columbia River is 32.0 feet and is measured at the gauge below the Priest Rapids dam. During maintenance of the

Priest Rapids Dam spillway in July of 2012, high outflows from the dam raised the river near flood stage in the Tri-Cities (KNDU 2012). The floodway boundary is shown in the map folio on Map 7.

4.6.5 Channel Migration Zone

In the vicinity of the City, the Yakima River is a meandering single- thread channel that widens and becomes braided as it approaches the Columbia River. Historical photos indicate some lateral movement and potential bank flooding. Much of this area is mapped in the Federal Emergency Management Agency (FEMA) High Risk Flood Area supports wetlands, especially at the confluence of the Columbia River. The channel migration zone is depicted on applicable figures in map folio, and also discussed in the Yakima River tables in Appendix A.

The Columbia River is a stable, confined, single-thread channel with low sinuosity and depositional (un-vegetated) mid channel islands and bars. The flooding risk is low in the Columbia River due to the levy and dam system maintained by the Corps of Engineers.

4.7 Geologic Hazards

Geologically hazardous areas are defined as those lands susceptible to erosion, landslides, seismic or mine hazard events. Identified hazardous areas are shown on Map 7 in the map folio. The boundary of this area is based on a 200-foot buffer from either the OHWM of the Yakima River or from the floodway boundary as determined by FEMA flood insurance maps.

4.8 Cultural Resources

4.8.1 Historical Background

The City is located at the confluence of the Yakima and Columbia rivers. It is in the Southern Plateau, part of the larger Columbia Plateau culture area. The Southern Plateau stretches from southern Okanogan County in the north to the northern border of the Great Basin to the south. The prehistory and history of the Southern Plateau is briefly summarized here. Known archaeological and historic sites are discussed, as well as potential for archaeological and historic sites.

At the end of the Pleistocene era, hunters of large mammals fanned out across North America. This period is known in the Columbia Plateau as Paleoindian (Ames and Maschner 1999:64-66), and in the southern Plateau as Period Ia (Ames et al. 1998). In the Columbia Plateau as a whole, Chatters and Pokotylo (1998) included these early mobile foragers in the Early Period from about 11,000 to 8,000 years ago. The earliest Paleoindian sites recorded in the Columbia Plateau are attributed to the Clovis culture, including the Ritchey-Roberts Clovis cache in East Wenatchee, which dates to 12,250 BP (Mehringer and Foit 1990).

After the brief but widespread Clovis occupation, a "broad-spectrum" hunter-gatherer culture developed in the Columbia Plateau region and persisted until the middle Holocene, around 5,300 years ago. This culture spans the latter part of the Early Period and the Early Middle Period in the Columbia Plateau sequence (Chatters and Pokotylo 1998), and Period Ib in the Southern Plateau sequence (Ames et al. 1998).

A shift towards more permanent settlement began around 6,000 years ago. Known as the Late Middle Period in the Columbia Plateau, and Period II in the Southern Plateau, this period lasted until the beginning of the early Holocene around 3,000 years ago (Chatters and Pokotylo 1998; Ames et al. 1998). In general, Period II tool assemblages are characterized by the addition of groundstone and bone/antler tools to the existing flaked stone technology.

Late Holocene cultures in the Columbia Plateau region exhibit "a "shift in adaptations…to storage-dependent collector strategies" (Chatters and Pokotylo 1998:76), which are characterized by intensive salmon fishing and associated storage features, social inequality, large permanent winter villages, and diverse tool assemblages. Labeled the Late Period, this shift begins around 4,000 years ago and persists until historic contact (Chatters and Pokotylo 1998). In the southern Columbia Plateau, the contemporaneous Period III also includes evidence of intensive camas processing and fiber and wood artifacts preserved in the relatively dry climate (Ames et al. 1998). The late Holocene archaeological cultures correlate with historic ethnographic descriptions.

The Yakima-Columbia confluence has a rich archaeological record, with sites in the area attributed to all of the Southern Plateau cultural phases. The area has been "occupied more or less continuously for the last 10,000 years" (Western Heritage 1983:4). There are 32

recorded archaeological sites within a mile of the confluence. National Register-listed properties include the Columbia Point site, the Bateman Island Site, and the Tri-Cities Archaeological District.

The City is in the traditional territory of the Yakama Nation, a Sahaptin-speaking Plateau people (Walker 1998). Wanapum and Walla Walla people also used the area (Kershner 2008). Traditional Plateau cultures were based on a seasonal round that took advantage of fish runs, game, and root resources, as well as trade, kinship ties, and intermarriage among groups (Walker 1998). Prior to historic resettlement, permanent winter villages anchored the seasonal round (Boyd and Hajda 1987). Villages consisted of large mat lodges, each housing an extended family, and occasionally also smaller conical structures (Stern 1998; Schuster 1998). Villages were the basic political unit (Schuster 1998).

Fishing activities revolved around an early salmon run in March, and a second, larger run in June (Schuster 1998). Fishing technology included the portable (toggling harpoons, leisters, hook-and-line, and nets) and the non-portable (traps, weirs, and platforms at permanent fishing stations; Schuster 1998). Gathering activities took place throughout the year. Fish, roots, and berries were processed, dried, and stored. Although salmon were a key staple, plant foods also made up a significant portion of the diet (Hunn 1981). Religious life involved adherence to both the Guardian-Spirit complex, which included the sweatlodge and curative "sings"; and the Washat religion, which was based on ceremonies held in the longhouse and included first food feasts in the spring celebrating the return of the salmon and newly sprouting plants (Schuster 1998).

By the time of the first sustained contact between the tribes of the Richland area and Euro-American settlers in the mid1800s, tribal life had already been significantly impacted. Introduced diseases decimated the population (Vibert 1997:50) while the introduction of the horse altered social and economic activities.

The earliest recorded Euro-American exploration of the Columbia River was in 1792 (Hayes 1999), but settlement of the region was slow until the 1840s when Americans were attempting to wrest control from the British (Mackie 1997). The Oregon Treaty of 1846 awarded the Oregon Territory to the United States (Wells 2000). In 1853, Washington

became a territory separate from Oregon, and by the next year, governors of both territories began pursuing treaties that relegated tribes to reservations (Wilma 2003). Fourteen tribes and bands signed the Treaty of 1855 that established the Yakama Indian Reservation (YNM 2011).

The Lewis and Clark expedition recorded the first description of the confluence of the Columbia and Yakima Rivers in 1805, and David Thompson passed through in 1811 (Nisbet 2005:109). The area was rarely visited, and several early attempts at settlement (e.g., a mission, a group of cattle ranchers) failed (Kershner 2008). However, by the 1890s, settlers had established an agricultural economy and built irrigation systems (Kershner 2008).

Richland remained a small, primarily agricultural community until 1943, when the plutonium production site was established just to the north at Hanford (Sanger 1995:4). The shift in the community was profound, and "the old Richland became, virtually, extinct [while]…the new Richland was being built at an astonishing pace" (Kershner 2008:1). Everything in the city was owned by the U.S. government until 1960. The Hanford plant was deactivated piecemeal in the 1990s, though many Richland residents are still employed in maintenance and cleanup at the site (Gerber 1992:223). The modern economy is focused on technology, medicine, and education (Kershner 2008).

4.8.2 Recorded Cultural and Historical Resources

The Department of Archaeology and Historic Preservation (DAHP) maintains an electronic database of archaeological sites, historic structures, and cemeteries. Resources, except for cemeteries, are listed by reach in Table 7.

Table 7
Recorded Cultural and Historical Resources within 1,000 Feet of the Shoreline in the Richland Area, by Reach

Reach	Archaeological Site or Isolate	National Register-Listed Property	Structures Older than 50 Years, Significance Not Evaluated
1	None recorded (just downstream of the Horn Rapids Traditional Cultural Property)	None recorded	None recorded
2	None recorded	None recorded	1 structure
3a	2 precontact sites	None recorded	10 structures
3b	None recorded	None recorded	1 structure
3c	2 precontact sites	None recorded	2 structures
4a	1 precontact site 1 multi-component site	None recorded	None recorded
4b	1 precontact site	Precontact site is Register-listed	None recorded
4c	1 precontact sites 1 historic era site	Precontact site is Register-listed Tri-Cities Archaeological District	None recorded
5	1 historic era site	None recorded	1 structure
6a	1 precontact site	None recorded	7 structures
6b	1 historic era site	None recorded	1 structure
6c	11 precontact sites 5 historic era sites 1 multi-component site	1 precontact site is NRHP-listed Tri-Cities Archaeological District	> 30 structures
7a	6 precontact sites 2 historic era sites 1 multi-component site	Hanford South Archaeological District	1 structure
7b	4 precontact sites 2 historic era sites	Hanford South Archaeological District	3 structures
7c	7 precontact sites 4 historic era sites	Hanford South Archaeological District	None recorded
7d	2 precontact sites	Hanford South Archaeological District	None recorded
7e	None recorded	Hanford South Archaeological District	None recorded
7f	1 precontact sites	Hanford South Archaeological District	None recorded
8a	2 historic era sites	Hanford South Archaeological District	None recorded
8b	1 precontact site	Hanford South Archaeological District	None recorded
8c	1 precontact site 1 historic era site	Hanford South Archaeological District	None recorded
8d	1 precontact sites	Hanford South Archaeological District	None recorded

Reach	Archaeological Site or Isolate	National Register-Listed Property	Structures Older than 50 Years, Significance Not Evaluated
8e	1 precontact sites	Hanford South Archaeological District	> 30 structures
8f	5 precontact sites	Hanford South Archaeological District	None recorded
9a	1 precontact site	Hanford South Archaeological District	> 30 structures
9b	None recorded	Hanford South Archaeological District	> 30 structures
9c	1 precontact site	Hanford South Archaeological District Tri-Cities Archaeological District Gold Coast Historic District	> 30 structures
9d	1 precontact site	Tri-Cities Archaeological District	> 30 structures
9e	2 precontact sites	Hanford South Archaeological District	None recorded
9f	1 precontact site	Hanford South Archaeological District	None recorded
10b	1 precontact site	Tri-Cities Archaeological District	None recorded
10c	2 precontact sites	1 precontact site is Register-listed Tri-Cities Archaeological District	None recorded

4.8.3 Potential for Archaeological and Historic Resources

The Richland area has a dense concentration of archaeological and historic resources, many with exceptional significance and cultural value. A number of archaeological and historical site types could be expected, including:

- Lithic scatters, quarries, and caches
- Precontact habitation sites (camps, villages, cave sites)
- Burial sites and cemeteries
- Resource procurement sites (fish traps, camas ovens)
- Pictographs and petroglyphs
- Historic habitation sites (homesteads, farms, cabins)
- Historic agricultural infrastructure
- Historic and precontact transportation corridors (trails, routes, railroad grades, road grades)
- Historic public works infrastructure (dams, transmission corridors)

Some sites may be on or near the surface, and others may be deeply buried, depending on the localized geomorphology.

4.8.4 Cultural Resources and Shoreline Development

State and local cultural resources laws apply to shoreline development. State laws include RCW 27.53 (Archaeological Sites and Records), which prohibits the unpermitted removal of archaeological materials and establishes a permitting process, and RCW 27.44 (Indian Graves and Records) which describes how human remains must be treated.

Given the importance of shoreline locations throughout the human history of the area, the potential for cultural resources should be considered high for any shoreline development permit unless demonstrated otherwise. Shoreline areas near the confluence should be considered especially sensitive. To comply with state and local law, applicants should be prepared to follow the provisions of RCW 27.53 and 27.44 if cultural resources are identified or encountered during the planning or construction process.

5 SHORELINE INVENTORY, ANALYSIS, AND CHARACTERIZATION

5.1 Ecosystem-wide Processes and Conditions in Richland

An ecosystem is a natural system consisting of biological (plants, animals, and microorganisms), physical, and chemical factors that together make up the environment. Ecosystem-wide processes are the naturally occurring physical and chemical cycles that shape the landscape and determine habitat types and associated ecological functions (WAC 173-26-020 (14)). Processes occur at multiple scales and are influenced by hydrology, geology, topography, soils, land cover, and land use characteristics. These processes determine the types and quality of shoreline functions or services that contribute to the maintenance of aquatic and terrestrial environments that make up an ecosystem (WAC 173-26-020 (13)).

The following sections discuss ecosystem processes and habitat structures that these processes form and maintain. This section also describes conditions, including alterations to the ecosystem process, for the Yakima and Columbia Rivers and shoreline along the City and the UGA. Alterations to ecosystem processes can affect habitat structure and the availability of habitat services, especially over long periods of time. Ecosystem processes and conditions in Richland are presented through the categories of hydrology, sediment, water quality, and habitat.

5.1.1 Hydrology

5.1.1.1 Ecosystem Process

The process of water delivery, movement, and storage within an ecosystem is largely affected by landform, geology, soil characteristics, and climate including precipitation. Rain and snowmelt provide the hydrologic inputs into a watershed. This cycle affects other physical, chemical, and biological functions of the river system. The speed with which water flows through the watershed also affects whether nutrients, sediments, or other materials are deposited or retained in the water and transported through the watershed.

Water is delivered to streams primarily from surface water runoff from above and, in some cases, from groundwater. The horizontal structure of river and stream channels includes the wetted channel zone where water is present during low-flow events, an active channel that

is seasonally inundated, and the riparian zone located above seasonal high water elevations. The vertical structure of these systems includes a benthic zone along the surface of the bottom substrate and the hyporheic zone, which provides a transition between the surface and the groundwater, or phreatic zone. Hyporheic and benthic zones cycle out excessive nutrients and contaminants, store and transport both water and sediment, maintain base flows, and can support vegetation and microorganism communities. The interaction of hydrologic and geomorphic processes contributes to habitat structures useful to aquatic species including shallow water and off-channel refugia, gravel bars, pools, riffles, and the transport of organic material, including large woody debris.

5.1.1.2 Conditions in Richland

The City has two major surface water resources: the Yakima and Columbia Rivers. See Table 1 in Section 3.3 for a description of the reaches identified for these water bodies. There are a number of small inlets along the Yakima River, including a shallow groundwater return within Reach 2, and the City's wastewater treatment plant discharge within Reach 4. Along the Columbia River there is a surface water outlet within Reach 9 and the Yakima River inlet at Reach 10. The hydrologic process occurring within the City on the Yakima River and associated drainage area is affected by Yakima Project operations. Along the Columbia River, McNary Dam operations affect the hydrologic processes. Major alterations from this system include the artificial storage and release cycle that produces higher than natural flows in the late summer and fall and lower than natural flows in the spring and early summer. Riparian vegetation and aquatic species adapt to seasonal inundation fluxes and these changes in the natural flows may adversely affect these systems and species. Flood storage occurring in the upper Yakima River and Columbia Basins outside of the City reduces the frequency, duration, and magnitude of floodplain inundation, while decreasing the floodplain size. This change in the hydraulic regime also affects the cycling of sediment, nutrients, and organic materials within the river, as discussed below.

5.1.2 Sediment

5.1.2.1 Ecosystem Process

Sediment delivery through a watershed is based on interactions between, gravity, wind, and water across the various geologic features, soils, and land covers. Soil erosion, landslides, and

mass wasting provide the majority of sediment inputs within the Yakima River. Landslides and mass wasting are a function of slope, soil, and water interacting to create instability. Soil erosion is a function of slope, soil cohesiveness, and cover interacting with water or wind forces. Sediments transported by water or wind are deposited wherever and whenever the water or wind transporting them slows. This is often within topographic depressions where sediment is deposited into lakes and stream pools, wetlands, and floodplains. The sediment erosion, transport, and deposition cycle is a major aspect of river and stream channel formation and channel migration.

The maintenance of shallow water habitat along the Yakima and Columbia Rivers is driven by the recruitment and transport of appropriately-sized sediments. Shallow water areas with small, clean natural substrates (e.g., sand and pebbles) are important for benthic production and as refuge for juvenile fish. Coarser substrates tend to provide habitat for predatory fish. Fine sediment (silt and clay) can decrease water quality by creating turbidity that adversely affects some aquatic species.

Shoreline armoring typically exists in developed areas or in areas where significant infrastructure exists, such as overwater bridge crossings or boat ramps. These armoring structures tend to disconnect natural sediment sources from erosion by forming a physical barrier between the shore and the water itself. The wave energy reflected off of these types of armoring leads to the washing away of smaller substrate sizes that support small benthic animals and also prevents riparian vegetation establishment with associated habitat functions.

5.1.2.2 Conditions in Richland

Channelization of streams can include hardening of banks with levees or revetments, straightening of channels, deepening of channels, removal of roughness that impedes flow, and other efforts to minimize the migration of the channel while maximizing flow capacity. Confinement, channelization, and channel incision of the Yakima River has occurred in certain reaches upstream of Richland. Downstream effects of these alterations include greater deposition of transported sediments, increased flood stage, and loss of channel capacity. Localized impacts of hardened banks in Richland include higher water velocities,

increased sediment transport, potential head cutting, and bank instability potentials near the areas of hardening.

Natural channel migration and sediment deposition occurs in reaches of the river that are not confined through shoreline development or that contain hardened banks. Shoreline hardening along the Yakima River includes bridge abutments within reaches 3 and 4 and armoring to protect park and trail infrastructure in Reach 6. Along the Columbia River, hardening includes a bulkhead and riprap armoring around the water intake facility and barge slip within Reach 8 as well as docks within this reach, a water intake structure, docks and boat ramps within Reach 9, and marina docks, boat ramps, a riprap breakwater structure and significant riprap armoring within Reach 10. Near these abutments and hardened shorelines, channel migration and beneficial sediment inputs are limited, though areas adjacent to this hardening may have increased erosion because of localized higher water velocities and wave reflectance.

Fine sediment inputs to the Yakima and Columbia rivers are accelerated through agricultural tillage and livestock impacts to soil structure within the uplands. Reaches 1, 2, and 3 contain upland agricultural development, though Reach 2 fields occur on the West Richland side of the Yakima River. All of these reaches have a fairly limited riparian buffer near the fields, which limits the sediment and contaminant capturing function that can protect against runoff and turbidity in the river.

Sediment transport is affected by diking of stream segments within the basin. Dikes reduce spring flooding and associated sediment deposition within the surrounding floodplain. Dike grading occurs within reaches 8 through 10 along the Columbia River to protect residential and commercial properties as well as infrastructure. The dikes are topped with multi-use trails throughout much of the shoreline, allowing for public recreation and enjoyment of the waterfront.

5.1.3 Water Quality

5.1.3.1 Ecosystem Process

The combined processes that deliver, transport, and store water and sediment in the ecosystem have a substantial impact on water quality. Impacts to water quality occur through land cover changes and development, chemical use in agriculture and recreation, pathogens from waste, temperature, and natural processes such as plant respiration.

Human-induced changes to water quality (e.g., industrial effluents, sewer overflows, and runoff from upland areas) can alter river and lake water temperatures, turbidity, and oxygen content, as well as nutrient, toxin, and pathogen concentrations (Karr 1995; Welch and Lindell 2000). In general, these changes can affect the presence, abundance, and vitality of all aquatic organisms. Water delivery and water quality is affected by soil loss, soil compaction, and road and building construction typically associated with development and urbanization. These activities increase the amount of impervious surface (e.g., parking lots and roads), reduce the percolation of precipitation into the ground, and concentrate pollutants into stormwater discharge areas. Reduced water infiltration increases the amount and rate of surface water runoff, causing high stream discharge or high direct delivery of water to the stream and lake shorelines (Dunne and Leopold 1978; Arnold and Gibbons 1996; Poff et al. 1997).

Fertilizers, pesticides, and automobile- and boat-generated pollutants are linked to runoff-borne pollution that enters streams and lakes. These toxins can settle in river pools, contaminating the sediments of the benthic zone. This leads to toxins either directly affecting benthic species through illness and mortality, or indirectly affecting aquatic and terrestrial species through bioaccumulation from animals lower on the food chain.

Many pathogenic protozoa, bacteria, and viruses can be found in the environment. These come from fecal material of wildlife and domesticated animals deposited within upland areas that drain into aquatic ecosystems or deposited directly into them (Sherer et al. 1992; Stanley et al. 2005). Development near the Yakima and Columbia rivers increases the potential for pathogens to be added to the system because of increased impervious surface runoff, as described above.

Solar energy input can be another important factor that impacts water quality, especially in the summer when high temperatures coincide with high nutrient loads from agricultural runoff and lower river flows. This can result in high water temperatures and very low levels of dissolved oxygen, both of which can alter the ecology of rivers and streams. Water temperature, a physical characteristic, affects the chemical process of breaking down organic material into nutrients, as well as the biological processes of phytoplankton and zooplankton reproduction and the metabolism of fish species.

Water temperatures, plant respiration, and biological decomposition are also inversely related to dissolved oxygen levels, which play a critical role in supporting aquatic organisms such as salmonids. Similarly, alkalinity/pH and nutrient concentrations influence biological processes, particularly phytoplankton production.

5.1.3.2 Conditions in Richland

Water quality listings for the Yakima River include those for pH, DDE, and DDT. Causes of these listings are most likely due to surrounding agricultural uses and return flows from irrigation canals upstream from Richland. The Columbia River is on the 303(d) list of impaired waters for temperature within the planning area. Additionally, the Columbia River has a TMDL for total dissolved gas and is a 305(b) water of concern for pH. Features within the City that may contribute to water quality concerns include impervious development over and near the river, recreational boating and herbicide and pesticide use in residential landscaping.

5.1.4 Habitat

5.1.4.1 Habitat Structures

Habitat is the natural environment in which particular species or populations have adapted to live. Habitat provides the physical conditions and biological functions needed to support the species as part of a larger ecosystem. The lifecycles of aquatic, avian, and terrestrial species are often interdependent, meaning that the habitat requirements of a single species include other species on which they depend. The habitat requirements vary for different species and can vary for different life stages of a species.

Habitat is often described in terms of the functions of reproduction, forage, and shelter (Morrison 1992).

- The reproduction needs of species vary greatly. All species have specific needs for areas to find a mate, reproduce, and successfully rear offspring (often referred to as breeding sites, birthing areas, and nest sites). Some species have very specific needs; for example, amphibians (frogs, toads, and salamanders) require water or moist areas for laying eggs and for larval development.
- Forage includes water and food sources. Water is a universal need of all species, while forage needs vary greatly by species. An important consideration is whether a species is prey or a predator. Predators obviously require that the habitat needs for prey species are met.
- Shelter includes areas for safe resting, refuge or cover from predators, and shelter from environmental hazards (e.g., daytime or nighttime temperatures, extreme weather events, seasonal climate fluctuations, and unpredictable disturbances such as drought, fire, or flooding).

5.1.4.1.1 Aquatic Habitat

Some of the ecosystem features that are generally applicable to Yakima and Columbia River fish habitat include water temperature; water depth; instream cover, including larger rocks and wood; substrate size; instream and riparian vegetation; floodplain health; water quality; and migration access.

Freshwater fish in the Yakima River include cold water fish (including trout and salmon) that have an upper lethal limit of approximately 25 °C, introduced species such as brown trout that can tolerate slightly warmer waters (upper limit of approximately 28 °C) , and warm water fish (largemouth bass) that can tolerate temperatures as high as 36 °C (Morrow and Fischenich 2000). Freshwater fish in the Columbia also include warm and cold water species.

Water depth requirements vary by species and life stage; in general, shallow water depths are needed for migration and spawning for salmonid species. Substrate requirements can vary by species, but many fish cannot reproduce in substrate smaller than gravel.

Instream cover increases the structural complexity of a system through wood and larger rocks that improve the habitat quality for most fish. Instream vegetation, similar to instream cover, can improve habitat as long as the amount of aquatic vegetation does not create a low dissolved oxygen issue; in general, native aquatic vegetation provides quality vegetated aquatic habitat while introduced species such as Eurasian watermilfoil (Myriophyllum spicatum) does not.

Riparian vegetation stabilizes banks, reduces summer temperatures, and provides nutrients through leaf debris and insect fall, and provides instream cover through tree fall where trees exist along Yakima and Columbia River shorelines. Floodplain habitat is required for many fish species during multiple life stages. Extensive and unaltered floodplains that are accessible to fish species are ideal.

Water quality constraints to fish survival include low dissolved oxygen conditions (less than 3 parts per million [ppm] in warm water streams, or less than 5 ppm in cold water streams), very low alkalinity, or high turbidity conditions (Morrow and Fischenich 2000).

5.1.4.1.2 Terrestrial Habitat

Shrub-steppe upland habitat is the largest native land cover type in Benton County and is also prevalent within the City. In some areas, shrub-steppe communities abut or nearly abut the shoreline. The largest shrub-steppe plant association type in the Yakima Basin is the big sagebrush-bunch wheatgrass association. The habitat structure of this association includes an overstory of 6 foot tall big sagebrush, an understory of bluebunch wheatgrass and Sandberg's blue grass, and groundcover dominated by algae, lichens, and moss providing a microbiotic crust (Link et al. 2006).

Riparian areas are prevalent within the City, and this habitat has greater structural diversity and productivity in terms of organic material than adjacent upland areas. Habitat characteristics of healthy riparian areas include a connected corridor for fish and wildlife travel, vegetation types adapted to wetter soils, occasional flooding, and natural disturbance regimes. Riparian areas also offer important functions for species that inhabit the shrub-steppe, as well as species more limited in range to the riparian zone. For shrub-steppe

species, they provide a critical water source and often provide a more productive environment for forage, escape, thermal cover, and nesting sites. For many species, they provide critical winter habitat. Riparian areas typically support larger flocks and a greater density of upland birds than shrub-steppe habitat because of the greater production of biomass and the more complex mosaic of vegetation (Stinson and Schroeder 2012).

Movement corridors are crucial to wildlife and may be seasonal, depending on the species. The primary function of a corridor is to connect disjunctive areas of habitat by allowing migration and dispersal between the areas. Movement corridors provide the following functions essential to healthy wildlife populations:

- Provides connectivity and, thereby, genetic variation and biodiversity between differing populations and habitats, connects isolated habitats, and may allow recolonization of extirpated species
- Provides varying habitats for migration patterns (e.g., foraging, mating and nesting, rearing, shelter, and wintering) and allows populations to move in response to habitat changes such as fires
- Can provide habitat for "corridor dwellers"—species that live within corridors for extended periods (Beier and Loe 1992)

Irrigated agriculture provides for greater productivity in areas converted from shrub-steppe vegetation. Irrigated pasture, for example, produces much higher biomass than native shrub-steppe in arid areas and, therefore, greater potential forage. Such agricultural areas may support a greater number of wildlife, while at the same time displacing native species because their specific lifecycle needs are not met. Agriculture also may change the predator and prey community that affects native species. Agricultural landscapes typically support much higher rodent populations. This larger population in turn supports higher populations of predators, such as raptors, that also support native species. This artificially higher population of predators may substantially change the balance between native species and introduced species more adapted to human alternation (Dunn 1978; Moulton 2006).

The removal of native riparian vegetation, the introduction and proliferation of invasive plant species, like Russian Olive, and the filling or degradation of wetlands along shorelines impacts the organic inputs that fuel production of the lower levels of the food chain and,

therefore, can have impacts throughout the entire food web. Organic matter produced by these habitats supports terrestrial and aquatic insects and other organisms that are then eaten themselves by birds, juvenile salmonids, and other fish species. An example of invasive plants is the aquatic plant Eurasian water milfoil, which can cover lake bottoms and out-compete the native aquatic species (altering the plant community), deplete dissolved oxygen, and lead to fish mortality (Frodge et al. 1995).

Habitat fragmentation, through the building of roads, utility corridors, agricultural and urban development, and irrigation channels can affect, in varying degrees, aquatic ecosystems and habitat types. Dam development upstream of the City has altered waterbodies and wood recruitment and transport within the Yakima River basin. Urban and agricultural development has resulted in loss of shrub-steppe habitat, habitat degradation, and fragmentation.

Plants and animals are adapted to natural light intensities and timing of lighted periods. Human-induced alterations to light transmission can interfere with plant production and aquatic animal behavior. Light energy affects water temperature, animal behavior (such as the relationship between predators and prey), and plant photosynthesis and growth (Tilzer et al. 1975). Natural light is altered when riparian vegetation is removed or when structures such as docks are built that create shade and prevent natural light from reaching the water. Reductions in this natural light preclude plant colonization and growth beneath these structures and can cause changes in animal behavior. For example, shade cast by overwater structures may disrupt juvenile salmon migration in the Yakima River by creating visual barriers to their movement (Carrasquero 2001). Natural light can also be reduced by the presence of algal blooms caused by excess nutrient additions that can collect in slack water areas.

Artificial light refers to the light that humans create at night, such as lights used for roads, parking lots, industrial complexes (including dams), houses, docks, piers, and sports fields. This light can interfere with aquatic and terrestrial animals' routines and change predator-prey relationships.

5.1.4.2 Conditions in Richland

5.1.4.2.1 Aquatic Habitat

The aquatic areas of the Yakima River throughout Richland support concentrations of wintering migratory waterfowl, primarily as a resting and feeding area for dabbling ducks, primarily mallard, Canada goose, canvasback, ring-necked duck, and wood duck. Some nesting likely occurs in areas with wider riparian buffers. The Columbia River also provides a breeding area for long billed curlew and a variety of gulls, as well as a resting area with limited nesting for great blue heron and egret.

Several fish species populate the Yakima and Columbia rivers within Richland. Salmonid fish include steelhead (Oncorhynchus mykiss) and spring and fall Chinook salmon (Oncorhynchus tshawytscha). Coho salmon (Oncorhynchus kisutch) were historically present here, and a coho reintroduction program is currently underway in the Yakima River Basin. Bull trout (Salvenlinus confluentus) were historically present and abundant in upper tributaries of the Yakima River basin and may now occur in this portion of the river in low numbers. Pacific lamprey (Lampetra tridentate) are present but have experienced population decline in recent years.

Resident fish include small (Micropterus dolomieu) and largemouth bass (Micropterus salmoides), northern pikeminnow (Ptychocheilus oregonensis), sculpin (Cottoidea sp.), mountain whitefish (Prosopium williamsoni), white sturgeon (Acipenser transmontanus), catfish (Ictalurus punctatus), sucker (Catostaomidae sp.), walleye (Sander vitreus), chiselmouth (Acrocheilus alutaceus), dace (Leuciscus leuciscus), common carp (Cyprinus carpio), redside shiner (Richardsonius balteatus), peamouth (Mylocheilus caurinus), and various minnow species. Shellfish include the Columbia River limpet, spire snail and California floater. Invasive species found in the Yakima and Columbia rivers include bluegill, bass, crappie, shad, carp, channel catfish, perch, and walleye.

Limitations to aquatic habitat in Richland are the elevated water temperatures and low flow common to the lower Yakima River. Fish passage is impeded regionally by the presence of several dams, though no dams are present in the City.

The following aquatic restoration opportunities are common to the lower Yakima River in this area:

- Improve migration conditions in the lower Yakima River by changing hydrograph through artificial storage
- Reconnect floodplain/side channels and oxbows near this reach, and investigate leasing/purchasing floodplain areas
- Reduce influence of predatory fishes such as smallmouth bass and northern pikeminnow
- Increase spawning habitat for salmon by reducing water stargrass, an invasive plant that leads to fine sedimentation
- Retain and recruit large woody debris or engineered logjams into the lower Yakima River to restore and enhance fish habitat, taking into consideration the risk of possible predation issues on juvenile salmonids
- Restore riparian buffers where possible
- Update irrigation intakes, as applicable, for protection of salmon from uptake and impingement

5.1.4.2.2 Terrestrial Habitat

Richland is dominated by developed land cover (42 percent of total area) and shrub-steppe vegetation (31 percent of total area). Agriculture areas make up approximately 18 percent of the total land cover and croplands are largely located in former shrub-steppe, riparian, and floodplain habitat. The shrub-steppe habitat provides many ecosystem services including soil stabilization, wildfire moderation, and overall biodiversity. The displacement of shrub-steppe plant species by the invasive cheat-grass (Bromus tectorum), Russian thistle (Salsola tragus), and other invasive species, in particular, increase fire intensity and frequency, which in addition to the hazards this creates for humans and wildlife also impacts the dominant shrub-steppe plant species big sagebrush (Artemisia tridentata), an important species for rare birds such as the sage grouse (Link et al. 2006).

While undisturbed shrub-steppe habitat is very rare, moderately disturbed shrub-steppe communities are fairly common. Such areas have been affected to various degrees by grazing, exotic plant infestations, and other disturbances. About 26 percent of the relatively undisturbed shrub-steppe habitat is dominated by native grasses and sagebrush, with an

intact cryptogam crust (a thin layer of moss and lichen that indicates an undisturbed community), and contains mostly native shrubs (e.g., big sagebrush and bitterbrush) with a predominantly native grass understory. This habitat type, while damaged by grazing, off-road vehicle use, and other disturbances, still provides cover, food, and nesting habitat for many species of wildlife. These moderately disturbed shrub-steppe areas are particularly important during winter months when nearby and adjacent cultivated fields provide no vegetative cover for wildlife (YSFWPB 2004). Recommendations for preserving shrub-steppe habitat includes limiting development footprints including agricultural land cover changes, limiting road and utility corridors to avoid fragmenting habitat, restricting vegetation clearing, keeping domestic pets and livestock out of sensitive species habitat, limiting fencing to avoid barriers to native wildlife, and limiting irrigation canals through shrub-steppe habitat (Azerrad et al. 2011).

An abundant and diverse community of wildlife inhabits and utilizes shrub-steppe communities in the area. These include a variety of reptiles such as western rattlesnake (Crotalus viridis), Great Basin spadefoot toad, and northern sagebrush lizard; raptors such as golden eagle(Aquila chrysaetos), ferruginous hawk (Buteo regalis), and short-eared owl (Asio flammeus); a variety of other birds such as long-billed curlew (Numenius americanus), loggerhead shrike (Lanius ludovicianus), sage sparrow (Artemisiospiza belli), Brewer's sparrow (Spizella breweri), sage thrasher (Oreoscoptes montanus), greater sage-grouse (Centrocercus urophasianus), western kingbird (Tyrannus verticalis), western meadowlark (Sturnella neglecta), mourning dove (Zenaida macroura) downy woodpecker (Picoides pubescens); small mammals such as Townsend ground squirrel (Urocitellus townsendii), black-tailed jackrabbit (Lepus californicus), white- tailed jackrabbit (Lepus townsendii), and Merriam's shrew (Sorex merriami); and large mammals such as coyote (Canis latrans), badger (Taxidea taxus), mule deer (Odocoileus hemionus), and elk (Cervus canadensis). Historically, gray wolves (Canis lupus) were a top-level predator in the area, preying primarily on deer and elk. The breeding population of wolves was decimated by the 1930s as a result of the expansion of ranching and farming in the state. In the absence of natural predators, large mammals such as deer and elk have increased substantially, often in excess of the land's carrying capacity (WDFW 2011).

Riparian and floodplain areas as well as wetlands are primarily associated with the mainstem and tributaries of the Yakima and Columbia rivers although they are also present in seep

areas in shrub-steppe areas. Black cottonwood is the dominant plant species in lowland riparian areas and plays a key role in the integrity of riparian systems (USBR 2008). Other species include a variety of willow species, red-osier dogwood, aspen, water birch, serviceberry, chokecherry, rose, hawthorn, and snowberry, as well as invasive species such as Russian olive.

Reptile and amphibian species found in these habitats include western painted turtle (Chrysemys picta), spotted frog (Rana pretiosa), gopher snakes (Pituophis melanoleuces), garter snake (Thamnophis sirtalis), and others. Small mammals include beaver (Castor canadensis), river otter (Lutra canadensis), muskrat (Ondatra zibethicus), mink (Mustela vison), porcupines (Erethizon dorsatum), raccoons (Procyon lotor), skunks (Mephitis mephitis), silver-haired bats, and pallid bats (Antrozous pallidus). River otters are occasionally observed in the Hanford Reach. Common avian species include Wilson's phalarope (Phalaropus tricolor), belted kingfisher (Megaceryle alcyon), peregrine falcon (Falco peregrinus), and downy woodpecker (Picoides pubescens). Species of waterfowl that utilize the wetland and riparian habitats within the affected area include mallard (Anas platyrhynchos), American wigeon (A. Americana), and others (USFWS 2008, 2012).

Both the Lower Yakima Basin and the Pasco Basin are located in the Pacific Flyway and serve as a resting area for neotropical migrant birds, migratory waterfowl, and shorebirds. During the fall and winter months, ducks (mallard (Anas platyrhynchos), common merganser (Mergus merganser), gadwall (Anas strepera), blue-winged teal (Anas discors), cinnamon teal (Anas cyanoptera), redhead (Aythya americana), American wigeon (Anas americana) northern shoveler (Anas clypeata); and Canada geese (Branta canadensis) utilize shorelines. The Columbia River Islands in Richland and along the Hanford Reach support large migratory populations. Other species observed in the area include great blue heron (Ardea herodias), American white pelicans (Pelecanus erythrorhynchos), egrets (Bubulcus ibis), double-crested cormorants (Phalacrocorax auritus), coots (Fulica americana), and common loons (Gavia immer) (USFWS 2008, 2012).

In the Lower Yakima River Basin/Pasco Basin wildlife resources are positively affected by several large public land holdings, including the Hanford Site, the Hanford Reach National Monument (HRNM) and the Fitzner-Eberhart Arid Lands Ecology Preserve (FEALE), all of which provide a large contiguous range for native species.

For City shorelines, several factors affect the suitability of wildlife habitat.

- Local shoreline habitat is connected to the biological reservoir of native species in large public land holdings to the north in the HRNM and Department of Energy Hanford Site. Currently there are few barriers to wildlife movement down the Columbia River to North Richland. Connections from the ALEP are provided over federal, state, and City-owned lands in the Horn Rapids area.
- Wildlife connections also are provided along much of the Yakima River floodplain where agricultural activities and low-intensity residential use provide relatively few barriers to wildlife movement.
- The quality and size of habitat areas in floodplains in the Yakima River Delta and the extent of human disturbance in those areas determines the range of native and introduced populations. These areas among the most productive habitat areas in the Lower Yakima Basin. They are large enough to provide a range of breeding, forage, and shelter for small species, including reptiles, amphibians, small mammals, and birds. These areas, however, are not large enough to provide all of the resources that would support year-round use by large mammals, although animals may pass through the area and use these areas as corridors to connect with other habitat areas. Mule deer do use the Yakima Delta for breeding.
- Connections along Columbia River may be provided by public open space. It is likely, however, that this side of the river is not used as extensively as a migration corridor compared to that the opposite bank in Franklin County, which features lower-intensity agricultural and large-lot rural residential uses.
- Urban development near the open space areas along the Columbia River largely limits the use of those areas to species tolerant of human disturbance.
- The Columbia River shoreline south of Leslie Groves Park provides narrow and managed areas of riparian vegetation with low present and potential habitat value and little potential for movement corridors.
- Islands in the Columbia River that are part of the McNary National Wildlife Refuge provide resting areas for a range of migratory wildlife. The river provides a substantial buffer from human disturbance.

- Ongoing efforts to enhance existing habitat in areas where past disturbance has occurred, together with limiting access to critical nesting areas provides the potential to substantially enhance habitat values in existing floodplain areas.

5.2 Reach Characterizations

Characterization of shoreline reaches and subreaches are provided in Appendix A. These reach and subreach characterization tables summarize existing physical conditions; characterizations and analyses for water quantity and sediment, water quality, and habitat and species; ecological functions analysis, including identifying functional conditions, stressors, and restoration and protection opportunities; preliminary shoreline environment designation considerations; existing public access and potential additional public access opportunities; and cumulative impact considerations.

Each reach was categorized overall in terms of ecosystem function. The categories include functioning, partially functioning, or impaired. The framework, definitions, and categories for this analysis were adapted from a system originally developed for Riparian Area Management guidelines proposed by the U.S. Bureau of Land Management (BLM; Prichard 1998). This assessment is a relative assessment with some degree of calibration to reflect the overall conditions found in the City.

The potential ecological function is defined as the highest ecological status a shoreline reach can attain given no development or management constraints, but does take into account the extent to which management (particularly water management) supports ecological function. This is a distinction that is fairly important in the Yakima River, where the management, storage, diversion, use, and reclamation of water for agriculture, hydropower, and other uses has a substantial effect on the amount of shoreline as well as the overall function of those shorelines.

Ecological function is defined here as the degree of similarity between existing physical and biological conditions, and the potential ecological function of a site; the higher the ecological function, the closer the site is to potential. Potential, for this assessment, encompasses all the resources defined by the interaction of hydrology, vegetation, water quality, and erosion/deposition (soils), and aquatic and riparian habitat. For example, the potential of the

hydrologic component includes the concept of a stream channel's physical characteristics (dimension, pattern, and profile) being within a "normal or usual" range (e.g., entrenchment, sinuosity, width, depth, and slope of the bankfull channel) as defined by landform and geomorphic stream type given current flows.

- Functioning is a state of resiliency that will allow a shoreline to hold together during high-flow events with a high degree of reliability. This resiliency allows an area to then produce desired values, such as fish habitat, bird habitat, or forage, over time. Riparian-wetland areas that are not functioning properly cannot sustain these values over time and are susceptible to stochastic disturbances such as fire.
- Partially functioning is a state in which the ecological function of the shoreline is somewhat compromised by development or management trends, or is particularly susceptible to future degradation due to development, management or ecological conditions. A partially functioning shoreline has some ability to recover through changes in management or the removal of identified stressors on ecological function.
- Impaired is a state in which the ecological functions of the shoreline are heavily compromised by development or management of the reach. An impaired reach has a low probability of recovery, through restoration, due to the degree of structural change to the shoreline, waterbody, and surrounding shorelands. Impaired shorelines can be functionally improved, but are unlikely to be self-sustainable.

6 PUBLIC ACCESS

The Reach Characterization Tables in Appendix A describe public access for each reach in the City and its unincorporated UGA.

The Yakima River shoreline has agricultural lands and open spaces along it, with some publicly owned park and recreation facilities along the lower river and at the confluence with the Columbia River. A regional plan for 30 miles of connected parks and open space has been developed and is called the Tapteal Greenway Plan. Much progress has been made to implement this plan, and continued implementation will result in added and improved shoreline public access.

In general, the City has excellent waterfront shoreline access along most portions of the Columbia River with boating facilities, trails, and active and passive recreation opportunities. Park master plans such as for Columbia Park West will allow for additional and improved facilities. An area where future shoreline access and open space is minimally found is in the North Richland UGA. This area is part of the existing Hanford 300 Area. As development occurs in this area, incorporating shoreline access may be appropriate to meet future demand for access created by the development.

7 INFORMATION SOURCES, ASSUMPTIONS, AND LIMITATIONS

This document is based on the best information available to the City at the time this document was produced. This information was obtained from a variety of sources and was collected and prepared for a variety of different purposes. The information was collected over a long time period; however, a substantial effort was made to use the most accurate and current information available.

Existing data, reports, and information used for the shoreline inventory are shown in the reference section. Generally, the documents used include City-comprehensive plans and municipal codes, USFWS and Washington State Department of Fish and Wildlife (WDFW) subbasin and habitat conservation plans, historical references, and scientific literature on ecological functions. GIS data illustrated in the map folio includes information on hydrology, soils, topography, vegetation, land cover, priority habitat and species concentrations, and other features.

This report relied largely on GIS data and remotely sensed imagery. Integrating various GIS layers together into map folio projects often resulted in polygon boundary discrepancies. Rectification of these discrepancies was only conducted for layers and geographic locations most relevant to the SMP update. For example boundaries for zoning or land use designations do not always match identified OHWM. The identified shoreline jurisdiction areas are only an approximation for purposes of updating the SMP for the City. Precise OHWM delineation and associated shoreline jurisdiction boundaries will be determined on a project-by-project basis, based on site-specific analysis during the proposal development application and review process.

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