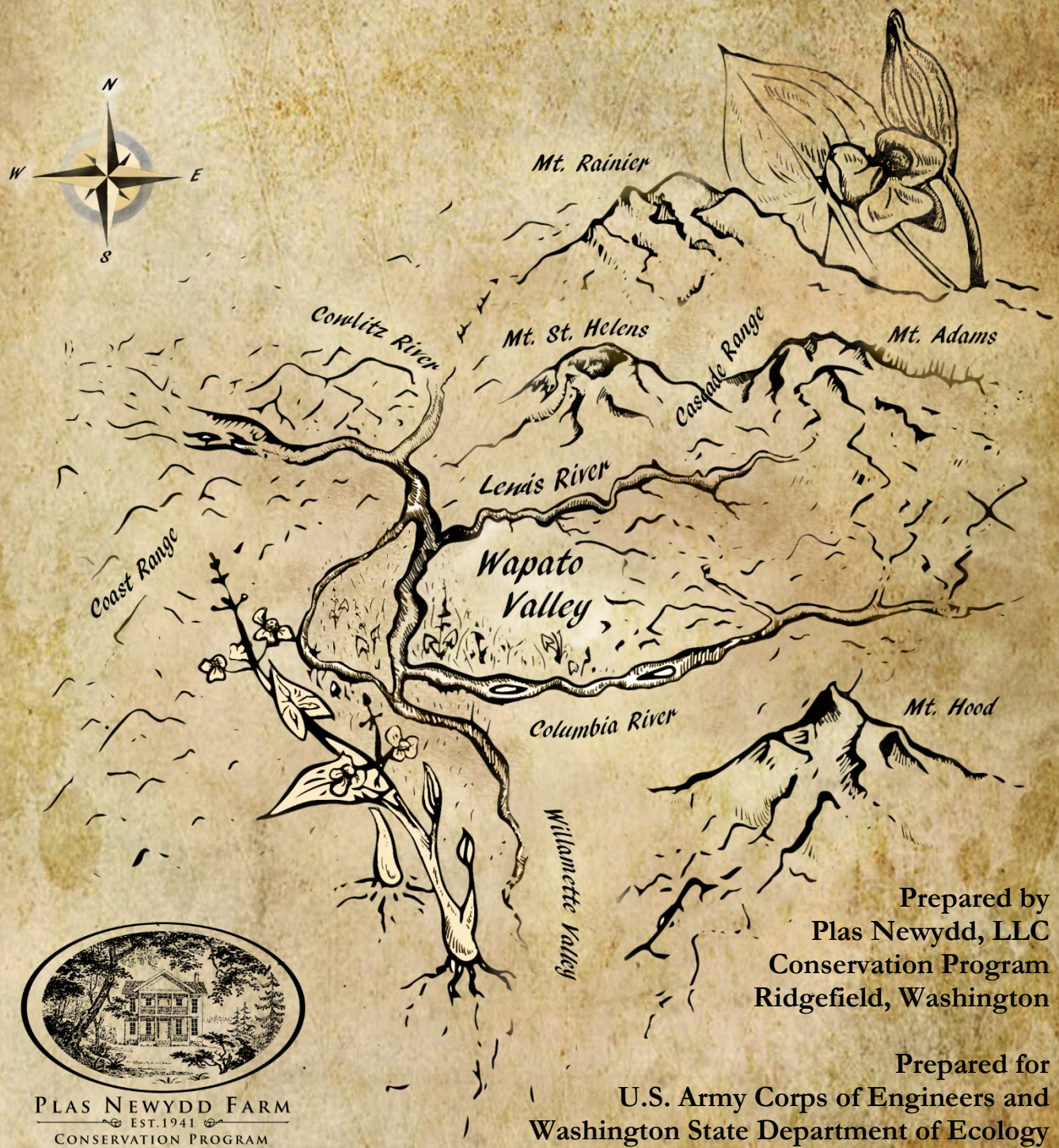
PROSPECTUS FOR THE WAPATO VALLEY MITIGATION AND CONSERVATION BANK

22 OCTOBER 2015



PLAS NEWYDD FARM
EST.1941
CONSERVATION PROGRAM

Prepared by
Plas Newydd, LLC
Conservation Program
Ridgefield, Washington

Prepared for
U.S. Army Corps of Engineers and
Washington State Department of Ecology

Suggested citation:
Plas Newydd, LLC. 2015. Prospectus for the Wapato Valley Mitigation and Conservation Bank. Prepared for U.S. Army Corps of Engineers, Seattle District, and Washington State Department of Ecology by Plas Newydd Conservation Program, Ridgefield, Washington.

CONTENTS

Tables

Figures

Appendices

EXECUTIVE SUMMARY

Project Name: Wapato Valley Mitigation and Conservation Bank (Bank)

Site Description: The proposed 876-acre joint Bank Site (Site) is located on one privately owned property, called Plas Newydd (pronounced PLASS NE-U-WITH, Welsh for 'new place') Farm, in north Clark County, Washington. The Site is situated within the floodplain and at the confluence of the Lewis River (WRIA 27) with the Columbia River at River Mile 87. The Site is located north of the Ridgefield National Wildlife Refuge and the city of Ridgefield, Washington, west of Interstate-5, on the southern shore of the Lewis River, and on the eastern shore of the Columbia River. The Site is situated across the Columbia River from the northern end of Sauvie Island and the confluence of the Multnomah Channel in Columbia County, Oregon. The Site is currently managed for forestry, agriculture, and leased duck hunting. The land is topographically diverse and ranges in elevation from about 5 feet along the Columbia River shoreline to 108 feet on basalt outcrops. The Site is hydrologically complex and influenced by the confluence setting, twice-daily backwater tidal influence from the Columbia River, seasonal flooding, and groundwater and hyporheic interactions. The Site consists of diked and undiked wetlands (including open water lake, stream, and river channel; mudflat; emergent, low, and high marsh; wet pasture; scrub-shrub; and forested wetland), and uplands (including upland pasture, grassland, mixed deciduous/conifer forest, oak woodland, riparian forest, conifer forest, and dike/levee structure). The Site supports biologically diverse habitats and native fish and wildlife species, including rare native plant communities and multiple special-status species (ESA-listed salmonids, Columbian-white tailed deer, Western pond turtle, and others). The proposed Bank provides opportunity for listed-species reintroduction for Oregon spotted frog and streaked horned lark.

Bank Sponsor/Land Owner: Plas Newydd LLC, P.O. Box 428, Ridgefield, Washington, 98642. Phone: 360-887-3531. Email: info@pnfarm.com.

Project Description: The Sponsor proposes to develop 876 acres of their 1,625-acre property in Clark County. The purpose of the Wapato Valley Mitigation and Conservation Bank is to provide mitigation credits for: impacts to aquatic resources authorized under the Clean Water Act, impacts to special-status species including federal ESA-listed or otherwise protected species and habitats and state ESA-listed and protected priority habitat and species, Critical Area Ordinance protected resources, and floodplain impacts. Bank credits would be used to offset future, unavoidable impacts that could result from development projects in the Columbia River floodplain and basin.

The goal of the Bank is restore dynamic habitat forming processes within approximately 876 acres of diverse floodplain habitats, and to make these habitats as self-sustaining as possible by removing landscape constraints. Proposed construction activities include levee/dike removal to restore tidal hydrology, grading to restore channel morphology, excavation of fill to restore channel gradients, regrading floodplain elevations in order to support native plant communities, installation of instream habitat structures, and vegetation enhancements. Bank objectives for wetlands include 29.70 acres of wetland re-establishment, 303.64 acres of wetland rehabilitation, 228.11 acres of wetland enhancement, and 57.36 acres of wetland enhancement and preservation. Bank objectives for ESA-listed salmonids include restoring access to 219.0 acres of inaccessible off-channel rearing habitat and restoration of an additional 128.84 acres of accessible but impaired side-channel and off-channel rearing habitat. Bank objectives for wildlife and other habitat related elements include but is not limited to enhancement of 136.64 acres of Oregon White Oak Woodland priority habitat, and 61.38 acres of enhancements to promote early seral stage floodplain habitat values for streaked horned lark breeding habitat. Additional wildlife habitat targets will be developed in coordination with the Interagency Review Team.

SPONSOR CONTACT INFORMATION

For any inquiries related to the proposed Wapato Valley Mitigation and Conservation Bank, please contact the following individuals:

Conservation Program Manager/ Primary Contact	**Managing Partner/ Landowner**
Kelley Jorgensen P.O. Box 428 Ridgefield, WA 98642 (971) 285-6874 kjorgensen@pnfarm.com	David Morgan P.O. Box 428 Ridgefield, WA 98642 (360) 887-3531 dmorgan@pnfarm.com

1 INTRODUCTION

1.1 PROPOSED BANK OVERVIEW

Plas Newydd Farm LLC (PN Farm) proposes to establish the approximately 876-acre Wapato Valley Mitigation and Conservation Bank (referred to as the proposed Bank) as a combined wetland mitigation and habitat conservation bank. In Washington State, a combined wetland mitigation and habitat conservation bank is commonly referred to as a Joint Agency Bank or Joint Bank.

The proposed Bank is multi-purposed:

- To provide compensatory mitigation for unavoidable impacts to ecosystem services. Mitigated resources include aquatic resources as authorized under the Clean Water Act (CWA) by the U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (EPA) in 33 CFR Parts 325 and 332 and 40 CFR Part 230 (USACE and EPA 2008), and by the Washington State Department of Ecology (Ecology) as authorized under Washington Administrative Code (WAC) 173-700 (State of Washington 2009) and Revised Code of Washington (RCW) 90.48.260 (State of Washington 2012).
- To compensate for unavoidable impacts to aquatic and terrestrial habitats and contribute to the recovery of at-risk species authorized under the federal Endangered Species Act (ESA) by the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). The proposed Bank will specifically provide conservation credits for ESA-listed salmon and steelhead, and could provide conservation credits for a number of ESA-listed wildlife species, including Columbian white-tailed deer, Oregon spotted frog, streaked horned lark, western pond turtle, and other species. A list of scientific and common names for all biota observed within the PN Farm property and mentioned in this report is provided in Appendix A.
- To provide compensatory mitigation for unavoidable impacts to other protected natural environments, including but not limited to: floodplain ecosystem services such as flood storage or Columbia River floodplain habitats; Critical Areas protected by ordinances as regulated by Washington State counties under the Growth Management Act (GMA); Priority Habitats and Species (PHS) identified by the Washington Department of Fish and Wildlife (WDFW); and Waters of the State regulated by WDFW under the Hydraulic Code in WAC 220-660 (State of Washington 2014), and specifically RCW 77.55.241 (State of Washington 2010) which allows off-site mitigation for hydraulic projects.
- To provide mitigation or conservation for other non-listed fish and wildlife species and their habitats as required by federal, state, and local agencies who share responsibility for trust resources.

The Bank is proposed through the Washington State Mitigation Banking Program and is co-chaired by the USACE and Ecology, with Interagency Review Team (IRT) participation by interested agencies anticipated to include NMFS, USFWS, EPA, WDFW, Clark County, the Cowlitz Indian Tribe, and other stakeholders identified, and invited to participate, by the co-chairs. The Joint Bank proposal will also be reviewed and approved by NMFS and USFWS as a Conservation Bank.

1.2 BACKGROUND

On 24 November 2014, a pre-prospectus meeting and Site visit was held with representatives from local, state, and federal agencies and Tribes to initiate Bank development. During that meeting, PN Farm shared information pertaining to land use history and impacts, natural resources and existing conditions data collection, proposed bank types and credit areas, and conceptual mitigation actions.

USACE and Ecology staff presented information on the banking process, including how the IRT is established and what the various roles are within the IRT. Subsequent to these presentations, attendees had the opportunity to take a tour of the proposed Bank Site, to ask questions, and to provide input both in person and using an anonymous online follow-up survey.

The online follow-up survey consisted of three parts: one section where pre-prospectus meeting participants were asked to rank the proposed credit types in order of perceived need and importance (as modified by input received during the meeting on the initial list, when more potential credit types were added); a series of 7 specific questions to help refine existing conditions data collection, IRT collaboration, conceptual design refinement, and anticipated monitoring needs; and a field for providing any additional thoughts or comments participants wished to convey. When asked to rank the proposed credit types, fish was #1, wetlands was #2, and Section 10/Waters of the U.S. was #3. Of the specific questions and open-ended comment field, the most notable responses that were integrated into this prospectus include:

- support for developing additional credit types including credits for oak woodland, Oregon spotted frog, streaked horned lark, and Western yellow-billed cuckoo in addition to our original list of proposed credit types;
- the potential for an out-of-basin Service Area for fish credits as well as a cross-state Service Area for various credit types;
- support for the idea and belief in the feasibility of stacking credits in a way that can be accounted for and would not be considered "double-dipping";
- that aside from wetland credits, proposed buffers for alternate credit types will vary based on the specific habitat function or species, and will need to be developed with the IRT as there is in general currently little to no guidance for this determination.

The feedback received from the participating agencies and co-chairs was invaluable. This prospectus is prepared using input and feedback received during the pre-prospectus meeting and follow-up communications with participants, as well as our market analysis and existing conditions data collected to date. This document provides a conceptual overview of the proposed Bank and serves as a scoping document and basis for initial review and comment by the IRT and public. The IRT Co-chairs then use the prospectus and comments received during the public notice period to make an initial determination of completeness, and to identify any critical issues that might potentially affect the certification of the Bank. The template for this prospectus is based on the requirements of Ecology's revised November 2014 *Prospectus Submittal Procedures for Federal and State Wetland Mitigation Banks in Washington State* (Ecology 2014) as well as co-chair feedback on a preliminary draft prospectus and a revised proposed joint wetland and conservation bank prospectus outline. The Bank Sponsor also consulted wetland mitigation and conservation bank prospectus guidance documents from other states, most notably checklists developed by multiple agencies for initiating the development of mitigation banking proposals in California (Multi-Agency Product Delivery Team 2010). These checklists outline biological resource information needed from preliminary site surveys that is necessary to help address conservation bank proposals, since there is not yet any official guidance for joint wetland and conservation bank proposals in Washington State.

1.3 PROPOSED BANK SITE LOCATION

The Site is in northwest Clark County, in southwest Washington State (Figure 1). It is located in the Columbia River watershed, in the freshwater tidally influenced portion of the lower floodplain at the confluence of the Lewis River at River Mile (RM) 87. The Site is approximately two-thirds the distance between the mouth of the Columbia River as it enters the Pacific Ocean (RM 0) and Bonneville Dam (RM 146), which is the most downstream of 14 mainstem dams on the Columbia River. The Site is located in Water Resource Inventory Area (WRIA) 27, Lewis River watershed.

The Site is situated west of U.S. Interstate 5 (I-5), east of the Columbia River, north of the town of Ridgefield and south of the town of Woodland (Figure 2), in portions of Sections 1, 2, 11, and Donation Land Claim (DLC) 37[1], and Section 12 in Township 4 North, Range 1 West (Clark County 2015, AINW 2013) (Figure 3). The Site is bordered by the BNSF Railway (Railway) to the east, the Lewis River to the north, the Columbia River to the west, and Gee Creek and the Ridgefield National Wildlife Refuge (RNWR) to the south.

1.4 EXISTING CONDITIONS

A summary of existing conditions on the proposed Bank Site is described in this section in terms of existing land use (including current farm and forestry management actions, Figure 4), site topography and bathymetry (Figure 5), hydrologic elevations and typical vegetation communities (Figure 6), Clark County and neighboring Cowlitz County zoning (Figure 7), and soils (Figure 8). More detailed descriptions of existing conditions for wetlands including hydrology, vegetation, and soils can be found in Section 4.1.1. Regional biogeography that provides larger-scale context for existing conditions on site is described in Section 5.2. Existing conditions for fish and wildlife habitats can be found in Sections 5.6.3 and 5.7.3, respectively.

Current land use practices on the Site include sustainable timber harvest, seasonal leased cattle grazing, duck hunting leases, NRCS-funded farm activities, and maintenance of forestry and agricultural infrastructure including outbuildings, dikes, levees, water control structures, ditches, access roads, rock pits, gates, fencing, and off-channel watering systems (Figure 4). Adjacent land use includes the Columbia River federal navigation channel, the Ridgefield National Wildlife Refuge which is managed for passive recreation and waterfowl hunting, the Lewis River mainstem that is used for boating, fishing, and other water-based recreation, and the BNSF Railway that carries freight and passenger rail. Additional details on current and historical land use management are described in Section 7.

The site topography and bathymetry are depicted in Figure 5, and illustrate the landform and hydrologic complexity of this floodplain site at the confluence of the Columbia and Lewis rivers, and Gee Creek. The outcrop of Grande Ronde Basalt in the center of the Bank area (referred to as the Middle Lands) has a high point of 108 feet, while the shoreline along the Lewis River has an elevation range in the single digits. The Lewis River levee was already a relatively high naturally formed berm prior to 1920s era levee enhancements as a result of overbank flooding from both tidal action and major flood events that deposited sand and fine sediment along the river channel and out on the floodplain. As a result, the Site drains in a clockwise direction, starting at 12 o'clock, out through a one-way tidegate through the Lancaster Lake levee flowing out through Gee Creek towards 9 o'clock, and fills counterclockwise from Columbia River tidal backwater action (Figure 5). The nature of the Portland Basin (one of several topographic and structural depressions that collectively constitute the Puget-Willamette Trough) is to accumulate massive fine sediment deposits, in which the Site is located at the north end (Evarts et al 2009). The Missoula glacier-outburst floods stripped unconsolidated deposits and soil from the Grande Ronde formation in the Middle Lands and scoured a complex, scabland-style topography into the basalt (Evarts 2004) (Figures 5 and 8). Also visible on the Site in Figure 5 are relic scroll bar formations that create negative and positive topographic relief that provide storage and passage of surface waters and the creation of a range of riparian, wetland, lacustrine, and lotic water habitats (Lewin and Ashworth 2013). This landform creates complex hydrological and sedimentological river floodplain ecology, supporting an extensive biodiversity of flora and fauna.

[1] Sometimes shown as DLC 57, which varies by data source due to Donation Land Claim origin.

Daily tidal flux and extreme seasonal river fluctuations create a dynamic floodplain environment. A typical cross-section of the Site through the floodplain starting at the Lewis River shoreline and proceeding toward the Middle Lands is illustrated in Figure 6. This illustration highlights the relationship between relevant hydrologic elevations including Mean Low Water and Mean Lower Low Water (MLW and MLLW), Mean High Water and Mean Higher High Water (MHW and MHHW), Ordinary High Water (OHW) based on field indicators, the USACE jurisdictional limit OHW (a regulatory overlay), and the USACE 100-year flood elevation for the Site location at RM 87. This figure also provides elevation ranges for typical vegetation communities and a selection of representative species to give a sense of vertical distribution of plant communities relative to hydrologic elevations.

A larger-scale ecological and hydrological context is provided throughout this report to emphasize the significance of the Site to the larger landscape that surrounds it. The proposed Bank has potential positive effects on a larger scale than is typically considered for wetland mitigation banks. This expanded view should also aid in understanding the watershed approach, the process-based design considerations, and off-site constraints that affect the site-scale, habitat-forming floodplain processes.

2 BANK STRATEGY

2.1 GOALS AND OBJECTIVES

The goals described below are compatible with local land use goals, regional estuary management plans, regional recovery plans for salmon and other fish and wildlife species including the subbasin and watershed management plans, and adjoining lands' comprehensive conservation plans. The proposed Bank Site is ideal in both location and scale to address notable local and regional goals for ecosystem restoration and conservation. The stated goals are compatible with Clark County, Washington local land use planning goals, which are examined in Section 6.2, and Columbia River Estuary Management Plan goals identified in Section 5.6.6.2. A review of the RNWR Comprehensive Conservation Plan is referenced in Section 5.1. Specific recovery goals to address limiting factors for native fish and wildlife are reviewed and addressed in more detail in Section 5, *Conservation Bank Resources*. A review of compatibility with the Salmon-Washougal and Lewis WRIA 27/28 Watershed Management Plan is addressed in Section 5.6.6.3.

2.1.1 Goals

The overarching goal of the proposed Bank design is to restore site-scale watershed processes with a focus on dynamic floodplain habitat-forming and maintaining processes that support a broad range of ecological functions. Specific goals include:

- restoring natural landform and hydrology by removing site-scale stressors and land use constraints;
- using restoration methods that have a proven track-record for achieving objectives, provide a high certainty of success, and require minimal maintenance;
- restoring an evolving landscape comprised of a continuum of diverse aquatic and terrestrial habitats that form a mosaic of different seral stages that supports biodiversity of native fauna and flora; and
- increasing wetland functions and area by re-establishing freshwater tidal and wetland hydrology on Site that will also benefit imperiled ESA-listed species.

2.1.2 Objectives

The objectives provided below help to define the strategies and actions necessary to achieve the stated goals. These objectives will be refined and quantified during the design process so that they are measurable and can be linked to the monitoring plan and success criteria that will be developed for the proposed Bank. Each mitigated resource may have different metrics used to measure area or function restored, and will be developed in concert with the IRT. General objectives are described below, and specific objectives for wetland mitigation actions are provided in Section 4.1.2.

Hydrology

- Restore tidal hydrology and reconnect surface water flood storage to impounded areas north of and including Lancaster Lake by removing levee fill and water control structures.
- Improve surface water connections, increase tidal exchange, and reduce areas of fish stranding in Lewis River side-channel habitats by excavating fill from and regrading in relic side-channel habitat.
- Increase the range of hydrologic connectivity with Gee Creek over a wider range of flows and tidal cycles by removing levee fill and water control structures from three locations in the southwest portion of the Site.
- Rehabilitate degraded off-channel wetland habitat impacted by the same three levees mentioned above (in the southwest portion of the Site) through excavation and levee fill removal, and regrading a distributary channel network for positive drainage.

Floodplain connectivity

- Improve live floodplain storage (direct surface water connection) capacity by removing 4 levees that are barriers to inundation.
- Increase the opportunity for overbank flooding and floodplain habitat inundation through barrier removal as noted above.

Water quality

- Improve water quality through increased area and frequency of tidal exchange by removing barriers to normative tidal hydrology (as detailed above).
- Reduce thermal gain in currently impounded areas by restoring tidal exchange.
- Increase connectivity of areas with cool water inputs in off-channel and side-channel habitats to provide thermal refuge habitat for native fish and wildlife.
- Reduce suspended sediment impacts from presence of non-native warm water fish species by reducing habitat conditions that support carp and other invasive species.
- Increase capacity of the Site for nutrient uptake, and nutrient cycling.

Vegetation

- Increase native cover across all plant communities on the entire Bank Site.
- Encourage native emergent wetland marsh communities through excavation to preferred elevations and restored hydrology in lowest-lying elevations.
- Reduce non-native cover through design of preferential elevations for native species, using mechanical and chemical control as appropriate.
- Enhance upland WDFW Oak Woodland Priority Habitat by removing competing tree and understory species.

Sediment

- Restore normative sediment transport processes and floodplain sediment storage across the Site by removing barriers to tidal hydrology, floodplain flooding, and connectivity.
- Reduce channel constriction, off-channel habitat isolation, and fish stranding through excavation of accumulated sediments and placed fill.

- Reduce suspended sediment load and export into Gee Creek by eliminating preferred habitat of non-native species that chronically perturb the substrate.

Aquatic habitat values (species dependent, to be determined)

- Increase habitat quantity and diversity—improve opportunity to access juvenile rearing habitats.
- Improve habitat quality and complexity—improve the capacity of the habitat to support more native species and more individuals.

Terrestrial habitat values (species dependent, to be determined)

- Increase habitat quantity and diversity—improve opportunity to access habitats, enhance habitat linkages, and increase native vegetation cover.
- Improve habitat quality and complexity—improve the capacity of the habitat to support more native species and more individuals.

Biological response (species dependent, to be determined)

- Decrease habitat conditions preferred by non-native species.
- Increase fitness and survival rates for native species.
- Improve food web dynamics.

As noted above, during the Bank development process in collaboration with the IRT, these broad-scale objectives will be utilized to develop more resource- and implementation-phase specific objectives that will evolve into the Performance Standards for incorporation into the Monitoring Plan and Mitigation Banking Instrument.

2.2 GENERAL NEED FOR THE PROPOSED BANK

The Bank Site is located proximal to the North-South I-5 corridor that connects Canada, the United States, and Mexico, and the East-West Interstate-84 corridor starting in Portland, Oregon and ending in Utah (Figure 2). It is adjacent to the BNSF Railway which carries freight and passengers similar to the I-5 route, and connects to transcontinental rail service heading east from Portland, Oregon. The Bank is in proximity to major water-dependent infrastructures and facilities including several Columbia River and Willamette River port facilities, the Portland, Oregon, and Vancouver, Washington, metropolitan areas, and is well positioned to address water-dependent impacts in the Columbia River and its associated tributaries along the full range of Columbia River basin salmonid distribution. The proposed Bank Service Area includes many critical aquatic resources and other important habitat types that have the potential to be impacted as development pressure increases with a growing human population. The watershed restoration need for and ecological suitability of the proposed Bank is discussed in throughout the document, and described in detail in Sections 4.1.3, 5.6.5, and 5.6.6.

2.3 REGULATORY FRAMEWORK

The proposed Bank will serve to offset those unavoidable impacts requiring compensatory mitigation that are incurred from development, construction, and operation of projects within the bounds of the Service Area (as described in Sections 2.5, 4.1.3, 5.6.5, and 5.7.4). Potential credit users of the proposed Bank include ports, proponents of commercial and industrial water-dependent projects, cities, counties, surface transportation agencies, other public infrastructure projects and public or private utility districts, real estate developers, and other permittees requiring compensatory mitigation. In addition to the aforementioned potential credit users, the potential regulated resources, permitting or reviewing agencies, and regulatory authorities that may utilize credits from the proposed Joint Bank are summarized in Table 1; however, it should be noted that this is not an

exhaustive list of all potential credit users. A detailed description of the watershed-based need for the proposed Bank based on a review of compatibility with local land use plans, watershed management plans, regional recovery plans, and estuary management plans is provided in Section 5.6.6.

Table 1. Potential regulated resources, permitting or reviewing agency, and regulatory authority that may utilize credits from a Joint Bank.

Resource	Agency	Authority
FEDERAL		
Aquatic Resources[1]	USACE, EPA	CWA, Rivers and Harbors Act
Listed Species, Designated Critical Habitat, Suitable Habitat	NMFS, USFWS	ESA
Essential Fish Habitat (EFH)	NMFS	Magnuson-Stevens Fishery Conservation and Management Act (MSA)
Fish and Wildlife Resources	USFWS, NMFS, States	Fish and Wildlife Coordination Act (FWCA)
Natural Environment and Biosphere, Ecological Systems and Natural Resources	Council on Environmental Quality (CEQ) Guidance for Any Federal Agency	National Environmental Policy Act (NEPA)
Resources of the Nation's Environment	Natural Resource Trustees	Oil Pollution Act and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)
Migratory Birds	USFWS	Migratory Bird Treaty Act (MBTA)
WASHINGTON STATE and LOCAL[2]		
Critical Areas	Local jurisdiction Planning Departments	Growth Management Act (GMA)
Shorelines of the State	Local jurisdiction Shoreline Master Programs	Shoreline Management Act (SMA)
Environmental Resources	State and Local Agencies	State Environmental Policy Act (SEPA)
Finfish, Shellfish, and their Aquatic Environment	WDFW	Hydraulic Code
Wetlands and Aquatic Resources	Ecology	CWA and Washington Wetland Policies

[1] Aquatic resources mean those areas where the presence and movement of water is a dominant process affecting their development, structure, and functioning. Aquatic resources may include, but are not limited to, vegetated and non-vegetated wetland or aquatic sites (e.g., mudflats, deep-water habitats, lakes, and streams) (WAC 173-700-104d).

[2] Washington State has an Alternative Mitigation Policy that applies to aquatic permitting requirements from Ecology and WDFW under the SMA, Section 401 CWA, and Hydraulic Code. This policy requires using a watershed approach when considering mitigation proposals.

2.4 CREDITING APPROACH

Given the geographic setting of Plas Newydd Farm as well as the landscape restoration focus of the proposed Bank, the Bank is functionally a *biodiversity* bank; it will restore, protect, and preserve a unique community of lower Columbia River floodplain habitats and the diversity of native flora and fauna that depend on them. As such, the proposed Bank has the potential to provide a suite or combination of credit types. An appropriate crediting system that accommodates the many potential credit types on the proposed Bank Site (Site) will be evaluated and developed in coordination with the IRT. Conceivably, credits may be in the form of bundled credits, credit zones or spatially distinct credits, and stacked credits (see Appendix B for definitions of terminology used in this document). Credit stacking is frequently misinterpreted as double-dipping and as such can be controversial.

However, stacked and bundled credits are widely supported in the literature as beneficial for many reasons including: (1) encouraging greater amounts of ecological improvements per site, (2) decreasing single-resource fragmented management by promoting the integration of multiple ecological values, (3) encouraging more landowner participation in restoration and conservation by increasing economic incentives, and (4) increasing agency coordination outside typical agency jurisdictions (LaRocco and Deal 2011, Cooley and Olander 2011, Willamette Partnership 2013, and Robertson 2014, 2015).

Ecosystem functions can be additive, and as such, it is reasonable that credits to address these functions may also be additive. For example, not all wetland mitigation banks provide equal opportunities for live flood storage. Some sites, such as the proposed Bank Site, provide a broader degree of surface water hydrological connectivity and live flood storage at a wider range of river stages than most other sites. Hydrologically disconnected sites (i.e., sites that are not connected to the Columbia River or other waterbody through direct surface water connections) would not provide flood storage at any but the highest and least frequent river stages. This is especially true on a hydropower-influenced system where peak flood flows are muted and spring freshets are no longer an annual event, and yet both wetlands could be used for wetland credits, but not provide equal flood storage functions. Similarly, not all wetland mitigation sites or banks provide habitat for ESA-listed or special-status species. Due to the perceived complexity of credit stacking and bundling, we expect to work closely with the IRT on the development of a multi-resource compatible crediting system for the proposed Bank.

2.5 SERVICE AREAS

For aquatic resources, a Service Area that follows the watershed-based approach as set forth in federal and state mitigation rules is described, and supporting rationale has been included in Section 4.1.3. The preliminary proposed Service Area includes a credit area for ESA-listed salmonids (assumed to be DSAYs), and a supporting biological rationale is provided in Section 5.6.5. For all other fish, wildlife, and other ecosystem services, PN Farm anticipates multiple service areas for the various mitigated resources and will develop these service areas in partnership with the IRT.

3 CONCEPTUAL DESIGN

The conceptual restoration design is anchored in a watershed approach based on historical ecology and process-based restoration whereby historical and modern reference conditions are utilized to re-create an approximation of pre-development[2] ecosystem processes to the extent possible. Given current landscape-scale land use patterns and river management programs, this is only possible to a certain degree. Restoration to pre-development conditions are not feasible in light of past and present actions (both off- and on-site) that are anticipated to continue impacting the Site to some extent. The focus of the conceptual restoration design is to remove on-site constraints to ecosystem and habitat-forming processes to allow for a self-sustaining landscape to the extent practicable. The conceptual design highlights the human-made infrastructure that was established over the course of over 150 years of surrounding development, river training and management, and land use conversion to a managed agricultural setting.

The design takes into account off-site land use and aquatic resource management activities which are outside the scope of the proposed Bank. A couple of examples are current Columbia River

[2] Meaning that time before large-scale European-American anthropogenic impacts accumulated. We acknowledge that the Columbia River basin was widely populated with Native American Tribes pre-contact that were estimated at one time to be in the tens of thousands of inhabitants, who actively utilized and worked the landscape, albeit in a less intensive and exploitive manner.

management practices including USACE maintenance of the federal navigation channel, and USACE/Bonneville Power Administration (BPA) (Columbia River system) and PacifiCorp (Lewis River system) hydropower operations and seasonal fluctuations of surface water elevations and flow for flood control, hydropower generation, and fish habitat. In the Columbia River, the USACE uses both flow augmentation in spring and summer and spill releases over dam spillways, which are intended to improve juvenile migration through the Columbia River system. Working at the confluence of two hydropower-modified river systems adds both complexity and predictability to the design process. It allows restoration designers to work within the established flow release schedules for these systems, to use the continuous river stage data collected from nearby gages to help set design criteria, and to utilize flood and flow predictions to anticipate wetted conditions and to validate the site-specific hydrology model in real time during the design process.

Within the constraints of off-site hydrological influences, the proposed conceptual design will utilize proven restoration techniques focused on restoring self-sustaining processes, thus reducing the need for intense maintenance. The conceptual design is focused on restoring dynamic habitat-forming processes, which will include the installation of certain habitat features that will provide structure and function in the short-term while longer term, more process-based habitat functions evolve. The design initiates succession on the landscape and will result in a mix or mosaic of terrestrial and aquatic habitats in a range of successional stages including seral, early, mid-, late and climax successional stages. A process-based approach will be more successful than forcing static conditions on a site that is already dynamic and complex, and will become increasingly effective when land use management and infrastructure constraints are removed.

All elevations provided in this document and figures are based on the NAVD88 datum unless otherwise noted.

3.1 PROPOSED CONSTRUCTION ACTIONS AND SEQUENCING

This section provides a brief description of the proposed mitigation actions and construction elements as shown in Figure 9 (Construction Actions and Phasing). This figure shows the additional mitigation actions or techniques that will be contemplated in collaboration with the IRT. Construction actions will be designed for a cut-fill balance, and no native soil material is anticipated to be hauled off the PN Farm property. All excavated material will be utilized on site for actions such as filling ditches, creating appropriate elevations for targeted native plant communities, to enhancing the Lewis River levee in order to allow for future overtopping events as Columbia River backwater will once again inundate more of the Site, allowing the major access road to be relocated out of the floodplain and onto the levee. Some man-made structures will be dismantled (concrete and steel water control structures for example) and recycled whenever possible, or disposed of in a permitted, appropriate facility.

Due to the large size of the proposed Bank Site and the logistics of large-scale in-water and floodplain/wetland construction, construction will require implementation of an estimated 5 phases over 5 or more construction seasons. Much of the earthwork will be limited to regulatory in-water work periods and summer and fall dry periods when soils will be dry enough for access and excavation. Vegetation enhancements are also seasonal in sequencing, and planting in areas of high groundwater connectivity and tidal exchange can be challenging. Construction efficiency is heavily influenced by hydrology and river stage in the Columbia River in any given year. In good flow years when snowpack provides a sufficient spring freshet-like late spring/early summer flood event, ground water and hyporheic flows can be so charged up that soils do not dry out until late fall, and can be challenging to complete before the protective in-water work window closes. Even in parts of the Site that are not currently accessible to fish, the water table must subside below the soil surface before access and excavation or other heavy equipment activity is possible. The construction

sequencing will be refined during the design process and activities may shift to accommodate seasonal water levels in any given year. The specific design elements proposed for each of the five construction phases are described in more detail below.

3.1.1 Remove Dikes, Levees, and Water Control Structures

Four individual levees with water control structures (three plank checkboard dams and a one-way tide gate) that impound ponds and agricultural jurisdictional wetlands will be removed. The entire fill footprint of the levees will be removed and native rock from which these dams were constructed will be stockpiled and reused for other PN Farm purposes, such as maintaining access roads. The levee footprint area will be restored to blend with adjacent landscape contours to support native wetland vegetation communities. Dike and water control structure removal will allow for restored hydrologic conditions in relation to daily tidal flux and seasonal flood flows. Levee removal and restored hydrology will allow for normative sediment transport processes, reconnected floodplain processes, and unimpeded off-channel rearing fish habitat access, as well as improved habitat connectivity for other native fauna.

3.1.2 Fill Ditches and Excavate Distributary Channel Morphology

Nearly three miles of agricultural ditches will be filled or regraded to re-create a distributary channel network that will connect a series of ponded wetlands with Lancaster Lake, Gee Creek, and Columbia River freshwater tidal daily hydrologic influence. Restoring channel morphology will re-establish historic flow patterns and grading will establish topographic elevations that will encourage native plant communities and discourage invasive and non-native species. There is no drainage tiling on site that landowners are aware of.

3.1.3 Install Instream Habitat Structures and Regrade Channel Morphology

The conceptual design proposes several instream restoration techniques including the installation of small wood beaver dam analog structures or beaver dam starter structures, installation of large and small wood habitat complexity structures, channel excavation (restoration of relic channel morphology), and removal of fill. These actions will serve to improve short-term habitat functions during the timeframe it takes for long-term ecosystem functions that are dependent on habitat forming processes to develop. The specific location of these instream features will be determined during the design process, using in part lessons learned from placement of PacifiCorp Aquatic Coordination Committee grant-funded large wood structures along the Lewis River shoreline in 2010, and observations of naturally recruited large woody debris. Instream enhancements could be placed in Gee Creek, the Lewis River, side-channels, off-channel areas, distributary channels, ponded areas, and lakes.

3.1.4 Plant Native Communities and Control Invasive/Non-native Plant Species

Many areas will require post-construction planting to initiate habitat functions and the evolution of ecosystem processes. Based on existing conditions monitoring to date, many species have been observed to self-seed from adjacent seed sources or to recruit from stored seed banks (for instance, wapato commonly does this after appropriate hydrology is restored). The drought of 2015 provided opportunities to see many emergent wetland species grow, flower, and produce seed in areas that were underwater too long into the growing season for the last 5 years. Planting will be focused on those areas that are disturbed during construction, that will be hard to access after construction is completed, or where competition with non-native species is a concern. Invasive and non-native plant control will be most intensive during the plant establishment phase when disturbed soils and open

canopy are abundant. In WDFW Oak Woodland Priority Habitat areas, enhancements will be focused on removal of competing Douglas-fir and understory species to mimic the historical fire disturbance regime, which allow for an oak-dominated overstory and a more open understory to approximate historic habitat conditions. The current lack of a regular wildfire disturbance regime necessitates periodic removal of Douglas-fir, Himalayan blackberry, scotch broom, and other species to maintain a healthy oak woodland community.

3.1.5 Remove Fill and Regrade Channel Gradients

Fill that was placed as part of dredge spoil disposal from Columbia River and Lewis River channel maintenance activities, and accumulated sediment related to diking will be removed to re-establish wetlands, ponds, and side-channel habitats. Removal of fill is necessary to restore channel gradients to reduce stranding of juvenile salmonids and other native aquatic fauna during fluctuations in river water surface levels, to encourage desired plant communities (such as wapato emergent wetland), and to discourage invasive and non-native flora (such as reed canarygrass and purple loose-strife) and fauna (such as bullfrogs and common carp).

3.2 PHASED CONSTRUCTION

The proposed order of construction sequencing, or phasing, beginning with Phase 1, and ending with Phase 5, is illustrated in Figure 9. It is possible the phases could be built over 5 consecutive years if each earthwork phase takes a single construction and in-water work season; however, Columbia River hydrology will drive the constructability in any given year as described above. The estimated size of each construction phase is between 75 and 250 acres, and as such could require 1–2 years of construction to complete any given phase. The particular sequence of construction is important because of the hydrodynamics of the Site and the need to complete all earthwork behind an impounding structure prior to levee and water control structure removal. All work downstream of and influenced by the Narrows levee at Lancaster Lake needs to be completed prior to reopening the nearly 300 acres of additional tidal prism that will greatly influence downstream surface water elevations, flow velocities and volumes, scour and sediment transport.

The following construction elements are proposed for each phase of construction:

Phase 1 (approximately 335.20 acres)

- Excavate fill and restore channel morphology in Lewis River side-channel and off-channel habitats.
- Utilize excavated materials to reconstruct Lewis River levee to function as an overtopping levee and streaked horned lark nesting habitat at the mouth of the Lewis River and near Lewis River RM 1–1.5.
- Install instream habitat structures.
- Remove competing species to enhance oak woodland habitats.
- Vegetation enhancements and non-native species control.

Phase 2 (approximately 159.55 acres)

- Excavate fill and restore distributary channel morphology in impounded duck hunting wetland areas.
- Install instream habitat structures.
- Remove water control structures and levee fill, and regrade to design elevations.
- Vegetation enhancements and non-native species control.

Phase 3 (approximately 246.29 acres)

- Excavate distributary channel network.

- Fill agricultural ditches.
- Install instream habitat structures.
- Relocate access road to on top of renovated levee.
- Vegetation enhancements and non-native species control.

Phase 4 (approximately 87.82 acres)

- Restore channel morphology in Gee Creek and off-channel areas.
- Install instream habitat structures.
- Vegetation enhancements and non-native species control.

Phase 5 (approximately 47.44 acres)

- Regrade any settled or non-conforming areas to meet design criteria for positive drainage and appropriate elevations.
- Install instream habitat structures.
- Vegetation enhancements and non-native species control.
- Remove water control structures and levee fill, and regrade bed to match Lancaster Lake outlet design elevations.
- Excavate primary channel through prior fill area.

3.3 SITE PROTECTION AND STEWARDSHIP

The underlying land title will stay in the ownership and management of the Morgan family and Plas Newydd LLC. The proposed Bank Site will be protected via perpetual conservation easement, and the terms of the conservation easement(s) will be approved by the IRT. At the time that performance standards are met and upon completion of required monitoring, a qualified land steward as defined by RCW 47.12.370 will be engaged and provided with a sufficient endowment to protect and maintain the Site in perpetuity. Plas Newydd LLC will post necessary financial assurances so that the first construction phase of the project can be completed prior to any sale from pre-construction release of credit for the Site.

3.4 FEDERAL, STATE, AND LOCAL REGULATORY COMPLIANCE

The sponsor will work closely with the IRT during Bank development and certification in order to comply with USACE and EPA's banking rules including 33 CFR Part 325 and 332 *Compensatory Mitigation for Losses of Aquatic Resources* (USACE and EPA 2008) and subsequent guidance letters and documents, Washington State's *Wetland Mitigation Banks* regulations (WAC 173-700) (State of Washington 2009), and Clark County's guidance for mitigation for Critical Area Ordinance compliance. During Bank design and MBI development, we will apply for all necessary federal, state, and local permits as required for Bank approval and multiple phases of restoration construction. The establishment, use, operation, and maintenance of the proposed Bank will comply with all pertinent legal authorities.

4 MITIGATION BANK RESOURCES

4.1 WETLANDS

4.1.1 Existing Conditions

4.1.1.1 Types

Wetland delineation of the Site was conducted and completed in 2014 and 2015. Water levels during the 2014 delineation period were characteristic of normal high-flow (i.e., spring freshet) conditions, and as such, many emergent marsh areas were flooded from Columbia River backwater. A list of

scientific and common and names for all biota observed within the PN Farm property are provided in Appendix A.

The Site has been divided into two Study Areas for the purpose of wetland delineation based on ecological conditions: The Lewis River and Gee Creek Study Area and the Farm Fields and Lancaster Lake Study Area. The Lewis River and Gee Creek Study Area is subjected to surface water flooding by the Lewis and Columbia rivers and Gee Creek; the Farm Fields and Lancaster Lake Study Area is protected from flooding by levees along the Lewis River and Gee Creek. The preliminary wetland delineation draft report (CEG 2015) identifies approximately 589.12 acres of existing wetland within the Site (both study areas) (Table 2).

Table 2. Wetland classifications and areas within the study areas.

Wetland name	HGM class	Cowardin classes	Area (acres)
Wetland 1	Riverine	PFO, PSS, PEM, R1EM, R1UB, PUB	275.89[a]
Wetland 2	Slope/Lacustrine[b]	PFO, PSS, PEM, PAB, LUB	255.87
Wetland 3	Riverine	PEM, PFO, R1EM	7.30
Wetland 4	Riverine	PFO, PSS, PEM, R1EM	50.06
TOTAL			**589.12**

[a] Includes estimated wetland area from wetland/upland mosaic polygon.
[b] Formerly Riverine HGM Class.

Four wetlands were identified within the Bank Site: The Lewis River and Gee Creek Study Area includes Wetlands 1, 3, and 4, and Wetland 2 occurs within the Farm Fields and Lancaster Lake Study Area. Wetlands identified during the field work are identified in Figure 10.

Wetland 1 is 275.89 acres and occupies the majority of the Lewis River and Gee Creek Study Area, occurring below elevation 15.5 feet, and wetland/upland mosaic occurs within the mapped elevation range of 15.5 to 17.0 feet where vegetation communities were observed primarily as a mix of facultative (FAC) and facultative upland (FACU) species typical of riparian areas (Reed 1988), underlain by soils that meet hydric soil criteria (CEG 2015). Vegetation communities varied within minor changes in elevation and included common species with broad hydrological tolerance; native species tended to dominate in forested areas, whereas non-native species dominate pasture areas above 11 feet. Wetland/upland mosaic was determined to be 42.32 acres in this Study Area, with approximately 60% of the mosaic as wetland (25.39 acres of wetland within the mosaic). Wetland 1 is a riverine hydrogeomorphic (HGM) class and features several Cowardin classifications (Cowardin et al. 1979) including palustrine emergent, temporarily flooded (PEMA); palustrine emergent, seasonally flooded (PEMC); palustrine emergent, artificially flooded, diked/impounded (PEMKh); palustrine scrub-shrub, broad-leaved deciduous, seasonally flooded (PSS1C); palustrine forested, broad-leafed deciduous, temporarily flooded (PFO1A); palustrine forested, broad-leaved deciduous, seasonally flooded (PFO1C); riverine non-persistent emergent, seasonally flooded-tidal (R1EMR); palustrine unconsolidated bottom, artificially flooded, diked/impounded (PUBKh); and riverine, unconsolidated bottom, permanently flooded-tidal (R1UBV) classes. A large tract of the wetland (Long Meadow) is grazed by cattle at moderate stocking densities using a short-rotation approach; these areas have been historically tilled, fertilized, and seeded with forage grasses (CEG 2015).

Wetland 1 extends along the floodplain area between the Lewis and Columbia rivers and Gee Creek bounded on the north by the Lewis River, on the west by the Columbia River, on the south by Gee Creek, and the east by the steep basalt slopes of the Middle Lands and gravel roads. A ridge of wetland/upland mosaic separates Wetland 1 into two drainage areas that route surface flows during

lower water levels towards the Columbia and Lewis rivers, or towards Gee Creek. Wetland 1 is divided into three units: Units 1a, 1b, and 1c.

Unit 1a includes the riverine shoreline of the Lewis and Columbia rivers and a series of ridges and channels parallel to the shoreline. Fluvial processes of deposition have formed these linear ridges (scroll bars) of sandy loam soil interspersed throughout the wetland which also support wetland/upland mosaic and upland vegetation. A large side channel or slough associated with the Lewis River bisects the wetland in the northeastern portion, flowing between the Lewis and Columbia rivers. Flow in the slough reaches the Columbia River only intermittently during high-water periods, whereas the mouth of the slough is connected to the Lewis River most of the year. Portions of the channels within Unit 1a have filled in with sediment due to existing geomorphic conditions or due to past dredge spoil deposition. Sediment accumulations have reduced the amount of seasonal open water and hydraulic interaction with adjacent rivers, and affected the plant community composition. Neither the sediment accretion nor spoils deposition have affected the extent of wetland area, as affected elevations are all well below the 15.5 foot wetland elevation applied to the Study Area.

Wetland Unit 1b occurs south and east of Unit 1a, separated by a natural ridge that routes surface drainage in Unit 1b towards Gee Creek, rather than towards the Lewis and Columbia Rivers. The banks of Gee Creek and the basalt upland (Middle Lands) form a broad basin that confines surface flow towards the south and east along a steady gradient. Surface flows in Unit 1b are impounded by a series of rock dams with adjustable outlets to allow water levels to be managed for waterfowl hunting in the area referred to as the Hathaway Area. Surface water is managed generally to maintain higher surface water elevations (and larger ponded area) during hunting season, and then allowed to fully drain during summer months to allow for cattle grazing.

Wetland Unit 1c occurs along Gee Creek, downstream of the last impoundment. Unit 1c is separated from Unit 1b by a natural levee formation along Gee Creek that causes a hydrologic break between the units (the rock dams that were constructed in Unit 1b tie into this natural levee). Unit 1c is a vegetated bench with a mix of native and nonnative vegetation and has only minor topographic changes. Unit 1c is regularly inundated by Gee Creek, likely several times each winter and spring.

Wetland 2 extends along the floodplain area between the Lewis River and Gee Creek; encompassing 255.87 acres. The wetland is bounded on the north by levee-protected upland pasture, on the east by upland forest and a railroad embankment, on the west by the steep basalt slopes of the Middle Lands, and on the south by a levee associated with Gee Creek at The Narrows. The wetland is fenced in and cross-fenced off into five main fields that are short-rotation grazed by cattle at moderate stocking densities; these areas have been historically tilled, fertilized, and seeded with forage grasses. A gravel access road bisects the wetland in the northern section.

Wetland 2 slopes gradually from north to south, with drainage improved by a network of ditches, totaling 2.94 miles. The northern end of the wetland is drier and supports marginal wetland characteristics. This wetland retains progressively more surface water throughout the growing season as it proceeds south to the shoreline of the 35-acre Lancaster Lake (as measured at a river stage of 7.5–8.0 feet). At the southern end, the wetland supports a predominantly facultative wetland (FACW) plant community that includes several native wetland species, with areas of forested and shrub-scrub wetland. Lancaster Lake is formed by the impoundment of surface inputs by the levee and groundwater/hyporheic inputs. A flapper valve tide gate at the levee regulates the water level in the lake. Seasonal flooding of the southern section of the Study Area occurs when the lake backwaters into ditches and as sheet flow across the wetland surface. A small drainage adjacent to the basalt hillslope along the southwestern boundary also flows into the wetland seasonally.

Historically, Wetland 2 functioned as a riverine wetland with surface water flooding occurring primarily from the south through The Narrows via Gee Creek, and backwater and tidal influence from the Columbia River. The levees now prohibit routine flooding, changing the hydrogeomorphic class of the wetland area. The constructed levee along the Lewis River occurs in a location where a natural floodplain levee had existed, but the natural levee was also likely overtopped during 50- to 100-year flood events. Upstream damming and onsite levee construction have prevented surface water flooding by the Lewis River except during major (100-year) flood events such as those that occurred in 1948, 1956, 1964 and 1996. The delineated wetland boundary for Wetland 2 corresponds with the elevation of the wetland boundary for Wetland 1, likely due to hyporheic groundwater maintaining a level water table across both study areas. This wetland is categorized as slope and lacustrine HGM classes due to the effects of levee-protection, and features several Cowardin classifications (Cowardin et al. 1979) including palustrine aquatic bed, semi-permanently flooded (PABF); palustrine emergent, persistently vegetated, semi-permanently flooded (PEM1F); palustrine emergent, temporarily flooded (PEMA); palustrine emergent, seasonally flooded (PEMC); palustrine forested, broad-leaved deciduous, temporarily flooded (PFO1A); palustrine scrub-shrub, broad-leaved deciduous, seasonally flooded (PSS1C); and lacustrine unconsolidated bottom, artificially flooded, diked/impounded (LUBKh) (CEG 2015). Wetland 2 is divided into three rating units (2a, 2b, and 2c) based on hydrologic divisions caused by ditching.

Wetland 3 is a floodplain bench along the north bank of Gee Creek. This bench formed at the base of steep basalt outcrops, and supports a mix of native and nonnative vegetation. Similar to Wetland Unit 1c, this wetland is regularly inundated by Gee Creek flows. Wetland 3 occupies 7.30 acres and is categorized as a riverine HGM class. It consists of palustrine emergent, seasonally flooded (PEMC); palustrine forested, broad-leaved deciduous, seasonally flooded (PFO1C); and riverine, non-persistent emergent, semipermanent-tidal (R1EM2T) Cowardin classes.

Wetland 4 is 50.06 acres and extends from the channel connecting The Narrows to Gee Creek into the Ridgefield National Wildlife Refuge to the south. This wetland is bounded by, and includes, numerous basalt outcrops that form steep upland boundaries. Wetland 4 includes broad floodplain areas ranging in elevation from 8 to 13 feet, supporting long-duration inundation. Substantial fields of wapato are supported at lower elevations, wapato occurring as a co-dominant with beggar's tick and mannagrass occur at slightly higher elevations and transitions into reed canarygrass and Pacific willow communities. This wetland is regularly inundated for long periods by Gee Creek flows and backwater effects from the Columbia River. The basalt outcrops that are interspersed with wetland areas are steep and vegetated with Oregon white oak, snowberry, ovate-leaf viburnum, serviceberry, and beaked hazelnut. Wetland 4 is categorized as a riverine HGM class and consists of palustrine emergent, seasonally flooded (PEMC); palustrine forested, broad-leaved deciduous, seasonally flooded (PFO1C); palustrine scrub-shrub, broad-leaved deciduous, seasonally flooded (PSS1C); and riverine, non-persistent emergent, semipermanent-tidal (R1EM2T) Cowardin classes.

4.1.1.2 Hydrology

Surface Water

The Bank Site boundaries include areas above the Mean High Water Line (MHWL) of the Lewis and Columbia rivers and the Gee Creek channel to its centerline, as well as surface water features within the boundary such as Lancaster Lake, a Lewis River side channel, and impounded areas within wetlands. The Lewis and Columbia rivers, Gee Creek, and Lancaster Lake remain inundated all year; water surface elevations decline as Columbia River levels drop and typically experience the lowest water surface elevations in August and September. Impounded areas within Wetlands 1 and 2 (see Figure 10) experience a drastic decline in surface water; however, soil saturation is generally retained throughout drier seasons and ponding can be exhibited in especially low-lying areas.

Surface water hydrology on the Site is highly dynamic. Winter precipitation and spring and early summer snowmelt characteristically generate significantly runoff from higher elevations in the Cascade and Rocky Mountain ranges to the east. During these high-flow seasons, inundation across the property increases drastically, and areas that often remain dry during summer and fall become completely submerged for weeks to months. Highly dynamic spring freshet-snow melt, hyporheic exchange, and tidal influence from the Columbia and Lewis rivers result in an average of 2–4 feet of water surface elevation fluctuation on a daily basis and 10–12 feet of annual surface water elevation variation.

Wetland 1 receives hydrologic inputs primarily from surface water flooding by the Columbia and Lewis rivers and Gee Creek and from hyporheic groundwater effects—groundwater either directly causes shallow soil saturation or affects drainage of precipitation. Wetland 2 historically experienced regular flooding as well, but is now protected by routine flood events by levees. The Lewis River side channel (within Wetland 1) varies greatly from season to season. In drier summer and fall months, the channel can be completely dewatered except for ponding in especially low topographic depressions. In wetter months as water surface levels begin to rise, the side channel is inundated and drained daily (due to tidal influence). During spring snowmelt years where a spring freshet-like flood occurs, the channel remains wetted.

Both of the large ponded areas within Wetlands 1 and 2 are enlarged by impounding surface flows from water control structures. Water surface elevation in Lancaster Lake is dictated by a rock-fill dam installed in the 1920s, subsequently breached by flooding and repaired in the 1940s. The smaller ponded area in Wetland 1 experiences water impoundment from two checkboard dams installed by the Natural Resource Conservation Service (NRCS) in the 1980s to hold more water for waterfowl habitat. The dam system maintains a constant water surface elevation in the impounded pond throughout the managed season (waterfowl hunting season) and then a drawn-down during summer months. Neither impoundment structure appears to affect the overall wetland area, but both affect the wetland function by altering habitat and occupying live storage flood capacity.

Groundwater

Groundwater on the Site is dictated by hydraulic fluctuation of the Lewis and Columbia rivers. The rivers in this reach are both tidally influenced and dam regulated, resulting in both seasonal and diurnal river fluctuations and substantially higher water surface levels during the early growing season when excessive water generated from spring snowmelt is released from Bonneville Dam which is located upstream from the Site on the Columbia River and results in dynamic and unique hydrologic conditions.

Groundwater observations for determining wetlands were considered in context of adjacent river stage because of the anticipated (and later, observed) correlation. A study performed to assess restoration feasibility within the nearby Lake Rosannah area (upstream on the Lewis River) concluded that groundwater levels on that property were hyporheic in nature based on comparisons of groundwater monitoring wells and river stage correlation (Interfluve Inc. 2013). The location of the study areas (surrounded by large rivers), coarse texture of the soils observed throughout the study areas, and lack of other significant hydrologic inputs suggested that both delineation study areas would have similar, hyporheic-driven groundwater conditions. Observations of soil saturation during wetland delineation fieldwork also correlated; direct groundwater observations were made in soil pits when sampled near river stage elevations. Wetland vegetation, wetland hydrology, and hydric soil indicators were present at similar elevations throughout both study areas and correlated to typical river stage recorded during the growing season, indicating that the timing for shallow soil saturation during the growing season is strongly linked to river flows throughout most of the delineated study

areas. The porous sandy soils underlying the study areas appear to respond rapidly to fluctuating river levels, particularly on the wetland perimeter, nearest to the river channels.

4.1.1.3 Vegetation

Vegetation at the proposed Bank Site strongly correlates to elevation and land management. Portions of the proposed Bank are managed for cattle production or waterfowl hunting, other areas are dominated by unmanaged vegetation communities.

Wetland 1 (Lewis River and Gee Creek Study Area)

Wetland 1 consists of forested and scrub-shrub wetland classes interspersed with herbaceous pasture and low-lying, seasonally flooded areas of emergent vegetation. Cowardin classes featured in Wetland 1 are included in Table 3.

Forested areas are generally located along the banks of the waterways and feature an overstory dominated by black cottonwood (FAC) and Oregon ash (FACW) with an understory composed largely of Pacific willow (FACW), red osier dogwood (FACW), Pacific crabapple (FACW), and reed canarygrass (FACW). Scrub-shrub areas generally occur within the interior of the Study Area and are characterized by a Pacific willow overstory with a reed canarygrass understory. Herbaceous pasture areas include a mix of creeping bentgrass (FAC), colonial bentgrass (FAC), meadow foxtail (FAC), perennial ryegrass (FAC), and velvet grass (FAC) along with weedy forbs. The wettest areas within Wetland 1 occur in the southern section where water control structures impound water year-round. These areas feature reed canarygrass, slough sedge (obligate [OBL]), creeping spike grass (OBL), water purslane (OBL), and smartweeds (OBL to FACW) occasionally interspersed with wapato (OBL) beds.

Table 3. Cowardin classes identified within Wetland 1.

Cowardin Class	Area (acres)
Palustrine emergent, artificially flooded, diked/impounded (PEMKh)	24.62
Palustrine emergent, seasonally flooded (PEMC)	36.00
Palustrine emergent, temporarily flooded (PEMA)	6.35
Palustrine forested, broad-leaved deciduous, seasonally flooded (PFO1C)	89.32
Palustrine forested, broad-leaved deciduous, temporarily flooded (PFO1A)	19.04
Palustrine scrub-shrub, broad-leaved deciduous, seasonally flooded (PSS1C)	80.88
Palustrine unconsolidated bottom, artificially flooded, diked/impounded (PUBKh)	1.22
Riverine non-persistent emergent, seasonally flooded-tidal (R1EMR)	15.83
Riverine, unconsolidated bottom, permanently flooded-tidal (R1UBV)	2.63
TOTAL	**275.89**

Wetland 2 (Farm Fields and Lancaster Lake Study Area)

Vegetation within Wetland 2 consists primarily of herbaceous pasture grass communities with areas of scrub-shrub, low-lying emergent, and forested wetland classes. Wetland hydrology follows a north-south gradient, with the north end of the Study Area featuring the driest conditions, and Cowardin classes progress along this spectrum. Cowardin classes featured in Wetland 2 are listed in Table 4. Pasture grass communities are dominated by colonial bentgrass, velvet grass, perennial ryegrass, and tall fescue (FAC), with common rush (FACW) occurring as a dominant in more seasonally wet areas. Scrub-shrub areas are generally located in the southern section along the north side of Lancaster Lake and are dominated by Pacific willow with an understory of reed canarygrass. Along the lakeshore, the community is dominated by reed canarygrass interspersed with smartweed and occasional wapato beds. Wetland forest occurs only as a narrow fringe along the margins of the

wetland; it is characterized by a mixed black cottonwood and Oregon ash overstory with a reed canarygrass understory.

Table 4. Cowardin classes identified within Wetland 2.

Cowardin Class	Area (acres)
Lacustrine unconsolidated bottom, artificially flooded, diked/impounded (LUBKh)	35.15
Palustrine aquatic bed, semi-permanently flooded (PABF)	1.19
Palustrine emergent, persistent, semi-permanently flooded (PEM1F)	24.40
Palustrine emergent, seasonally flooded (PEMC)	66.74
Palustrine emergent, temporarily flooded (PEMA)	80.44
Palustrine forested, broad-leaved deciduous, temporarily flooded (PFO1A)	8.27
Palustrine scrub-shrub, broad-leaved deciduous, seasonally flooded (PSS1C)	39.67
TOTAL	**255.87**

Wetland 3 (Lewis River and Gee Creek Study Area)

Vegetation within Wetland 3 consists of a band of Oregon ash-reed canarygrass forest along the margins of wetland/upland boundary interspersed with reed canarygrass dominated emergent areas. A narrow fringe of wapato-creeping spikerush emergent community colonizes the bank of Gee Creek during times of low water. Cowardin classes featured in Wetland 3 are listed in Table 5.

Table 5. Cowardin classes identified within Wetland 3.

Cowardin Class	Area (acres)
Palustrine emergent, seasonally flooded (PEMC)	1.02
Palustrine forested, broad-leaved deciduous, seasonally flooded (PFO1C)	5.33
Riverine, non-persistent emergent, semipermanent-tidal (R1EM2T)	0.95
TOTAL	**7.30**

Wetland 4 (Lewis River and Gee Creek Study Area)

Vegetation in Wetland 4 is predominantly herbaceous emergent: dense wapato-ovate spikerush beds colonize the wettest areas during summer drawdown and reed canarygrass interspersed with smartweed dominates the southern section of the wetland, which receives somewhat less flooding. A few shrub-scrub "islands" occur within the wapato beds; these areas consist of a Pacific willow overstory and a reed canarygrass understory. A narrow fringe of Oregon ash-reed canarygrass forest occurs along the margins of the wetland/upland boundary. Cowardin classes featured in Wetland 4 are included in Table 6.

Table 6. Cowardin classes identified within Wetland 4.

Cowardin Class	Area (acres)
Palustrine emergent, seasonally flooded (PEMC)	13.28
Palustrine forested, broad-leaved deciduous, seasonally flooded (PFO1C)	2.69
Palustrine scrub-shrub, broad-leaved deciduous, seasonally flooded (PSS1C)	8.32
Riverine, non-persistent emergent, semipermanent-tidal (R1EM2T)	25.77
TOTAL	**50.06**

4.1.1.4 Soils

The *Custom Soil Resource Report for Clark County, Washington* (NRCS 2015) indicates that indicate seven significant soil types present within the Site (Figure 8), including:

- Sauvie silty clay loam, 0–8% slopes (non-hydric)
- Olympic very stony clay loam, shallow variant 5–15% slopes (non-hydric)
- Sauvie silt loam, sandy substratum, 0–3% slopes (hydric)
- Sauvie silt loam, 0–3% slopes (non-hydric)
- Washougal stony loam, 30–60% slopes (non-hydric)
- Pilchuck fine sand, 0–8% slopes. (non-hydric)
- Sara silt loam, 8–20% slopes (non-hydric)

Three soil variants within the Sauvie series occur over the majority of the Site. The Sauvie series formed mainly in alluvium. Sauvie silt loam generally occurs in pasture and is indicated to occur through the central section of the Site and is rated as completely non-hydric. Sauvie silt loam with a sandy substratum generally occurs over the forested areas along the Lewis River and is rated as completely hydric. Sauvie silty clay loam occurs over low-lying areas in the southern section of the Site and is rated as completely non-hydric.

Pilchuck fine sand occurs along the Lewis River shoreline, and this series consists of deep, somewhat excessively drained soils that formed in gravelly and sandy alluvium on floodplains at elevations of 10–800 feet and slopes of 0–8%. Pilchuck fine sand is prone to occasional flooding and is rated as non-hydric.

A shallow variant of Olympic very stony clay loam occurs over small upland areas along the southern and eastern boundaries of the Site. This is a well-drained soil which is formed in residuum and colluvium weathered from basic igneous rock occurring on summits of foothills and mountains with elevations of 200–2,000 feet and slopes of 5–15%. Olympic very stony clay loam is not prone to flooding or ponding and is rated non-hydric.

Washougal stony loam occurs along the eastern boundary of the Site at slopes of 30–60%. This soil series consists of very deep, somewhat excessively drained soils that formed in alluvium from volcanic ash, basalt, and andesite, and occurs on river terraces and terrace escarpments at slopes of 0–60% and elevations of 50–800 feet. Washougal stony loam is rated non-hydric and is not prone to flooding or ponding.

Sara silt loam occurs along the eastern Site boundary at slopes of 8–20%. The Sara series consists of very deep, moderately well-drained soils formed in old alluvium on river terraces and terrace escarpments at slopes of 0– 40% and elevations of 250–450 feet. It is rated as non-hydric and is not prone to flooding or ponding.

Soil observed in wetland delineation plots met USACE wetland hydric soil indicator criteria (CEG 2015)for depleted below dark surface (A11), sandy redox (S5), and depleted matrix (F3) classifications, indicating that iron in the soil has been removed or transformed by processes of reduction and translocation, in some cases below a dark soil surface layer. Dark soil surface layer colors are very dark grayish brown (10 YR 3/2) while depleted matrix layer colors are dark gray (10 YR 4/1) to dark grayish brown (10 YR 4/2) to grayish brown (10 YR 5/2) silt with common to many prominent yellow-red redoximorphic features occurring as soft masses and pore linings and common depletions. Soils textures range from sand and sandy loam in sample plots along the riverbanks to silt loam in plots located in landward areas.

Despite much of the Site soils not being mapped as hydric by NRCS (NRCS 2015), all soils observed in wetlands, mosaic areas, and in some upland areas, clearly met hydric soil indicators, and USFWS National Wetland Inventory (NWI) maps did identify the entire Study Area as wetland (USFWS 2015a). Based on extensive soil samples conducted during wetland delineation field work, the NRCS

soil mapping appears to be inaccurate for the Bank Site, perhaps due to the soils being of alluvial origins. Regardless of soil mapping, the overwhelming presence of wetlands shown on NWI maps indicates that mapping errors from the original soil mapping efforts have been identified and corrected by resource agencies.

4.1.1.5 Functions

Wetlands within the Bank Site were assessed for wetland functions using the *Washington State wetland rating system for western Washington – 2014 update* (Hruby 2014) in the current condition, as a preliminary assessment, consistent with standard wetland delineation protocols (Table 7). Additional assessment of wetland functions will be performed during the mitigation banking process to specifically consider the benefits of mitigation actions on wetland function.

Table 7. Results of the wetland functions assessment for all wetlands.

Wetland unit	HGM class	Water quality	Hydrology	Habitat	Total function score	Final rating	Acreage
1a	Riverine	9	6	9	24	I	139.10
1b	Riverine	9	8	8	25	I	132.90
1c	Riverine	7	7	8	22	I	3.89
2a	Slope[1]	5	5	7	17	III	13.67
2b	Slope[1]	5	5	7	17	III	35.72
2c	Lake-fringe[1]	8	4	8	20	II	206.47
3	Riverine	7	7	8	22	II	7.30
4	Riverine	8	8	8	24	I	50.06

[1] Formerly Riverine; converted due to levee.

In Wetland 1, all three units were determined to be riverine HGM classes. Rating units 1a and 1b scored "high" on water quality functions based on characteristics including surface depressions that cover one-half to three-quarters of the wetland area and the presence of trees and shrubs covering more than two-thirds of the area. The presence of grazing within the units and their location within a basin where human activities have affected water quality afford landscape potential and site value. Rating Unit 1c scored somewhat lower than Units 1a and 1b on water quality functions due to its location at the margin of the wetland along Gee Creek, where few depressions are present and grazing does not occur. Dense cover of herbaceous plants, however, affords the unit some site potential. All three units scored "medium" to "medium-high" on hydrologic function. Though they each have site potential and value afforded by high forest and shrub cover, which slow down water velocities during floods, and are located upstream of flood-prone areas, they have a limited capacity for overbank floodwater storage based on the ratio of wetland to stream width (averaging the Columbia River, Lewis River, and Gee Creek together in the case of Units 1a and 1b; considering Gee Creek alone in assessing Unit 1c). With regard to habitat function, the units score "high" to "medium-high". Units 1a and 1b feature diverse vegetation structure, multiple hydroperiods, and high dispersion of habitats. All three units include special habitat features including large, downed woody debris, standing snags (Unit 1a), undercut banks and steep banks in adjacent waterways (for wildlife cover and denning), and thin-stemmed persistent vegetation in areas of seasonal inundation (structures for egg-laying amphibians), all of which provide habitat potential. They also feature large, relatively undisturbed buffers and intact corridors affording opportunity for habitat. Unit 1a rates slightly better in regards to habitat because it contains more habitat features than the other units. All units feature the "special characteristic" of Wetlands of High Conservation Value (WHCV) and Units 1a and 1b feature the "special characteristic" of mature forest (WDNR 2015). The WHCV characteristic is based on the location of the units within a section/township/range that contains a WHCV wetland and the mapped presence of rare and threatened plant species and communities.

WNHP data indicate the presence of water howellia, a state- and federally-listed threatened plant species, small-flowered trillium, a state-listed Sensitive species, and Pacific willow woodland, a rare plant community. The mature forest characteristic is based on the presence of at least 1 acre of forest where the trees are over 80 years old.

Within Wetland 2, Units 2a and 2b were both determined to be slope HGM classes and scored identically. With regard to water quality functions, the units scored "low" on site potential due to a lack of dense, uncut herbaceous vegetation (wetlands are grazed and mown); however, the presence of grazing within the units and their location within a basin where human activities have impacted water quality afford landscape potential and site value. In regard to hydrologic functions, site and landscape potential was "low" due to vegetation conditions and the lack of excess surface water runoff draining into the wetlands, though site value is present due to flood-prone areas downstream. Habitat functions rated moderately well; site potential is limited by a lack of diversity in vegetation structure, hydroperiods, species richness, and special habitat features, but connectivity to undisturbed habitat and their inclusion in a Shoreline Master Plan afford landscape potential and site value.

Unit 2c of Wetland 2 was determined to be a lake-fringe HGM class. It scored well in regard to water quality functions based on the average width of vegetation along the shore of Lancaster Lake (more than 33 feet wide) and the presence of grazing within the wetland. Hydrologic functions scored low due to the lack of power boat use and low fetch distance of the lake, and absence of human structures or resources within 25 feet of the ordinary high water mark (OHWM), though the wetland has the potential to reduce shoreline erosion with the presence scrub-shrub lakeshore vegetation. Finally, habitat functions scored moderately well due to some diversity in vegetation structure and plant species and special habitat features including the presence of large woody debris, standing snags, and thin-stemmed persistent vegetation; all of which provide habitat potential. Reasonably intact buffers and good connectivity to relatively undisturbed areas lends high landscape potential. It should be noted that this wetland's HGM class type limits the maximum possible score for wetland functions.

The rating units within Wetland 2 are all located within a section/township/range which contains a WHCV, according to the DNR WHNP website. However, they do not feature any mapped presence of state-listed threatened or endangered plant species, so they do not qualify as WHCV. The WHNP does map rare Pacific willow woodland within Unit 1c.

Wetland 3 was determined to be a riverine HGM class and scored "medium-high" for all three sets of functions. Water quality functions scored well due to the wetland's considerable cover of trees and location within a watershed with impaired water quality, though a lack of surface depressions, absence of pollutant generating land uses within the immediate vicinity, and the generally rural character of the contributing basin limits site and landscape potential. The score for hydrologic functions is attributed to the wetland's tree cover, its functional connectivity with Gee Creek (which is not downcut within the vicinity of the wetland), and its location upstream of a sub-basin with flooding problems. Site and landscape potential are slightly limited by the low ratio of wetland width to stream width and dam regulation of the Columbia River. Habitat functions rating is based on moderate interspersion of habitats along with the presence of multiple special features, including large woody debris, snags, stable steep banks, and thin-stemmed persistent plants, which afford moderate site potential, along with large, intact buffers providing accessible and valuable habitat. Wetland 3 is also located within a section/township/range that contains a WHCV and includes WHNP mapped Pacific willow woodland, though it does not feature state-listed threatened or endangered plant species.

Wetland 4 is also a riverine HGM class and rated "medium-high" on all functions. Water quality functions rating was based on the presence of depressions and trees and shrubs over more than two-

thirds of the area, as well as its location within a basin with impaired water quality. Landscape potential was limited somewhat by the absence of pollutant generating land uses within or near the wetland and the rural character of the contributing basin. Hydrologic functions scored well due to a high wetland to stream width ratio and its location upstream from a sub-basin with flooding problems. Landscape potential was limited with regard to hydrologic function as well due to dam regulation of the Columbia River. With regard to habitat function, the wetland scored well due to the presence of diverse vegetation structure, multiple hydroperiods, high dispersion of habitats, and abundant special features. It also features large, relatively undisturbed buffers and intact corridors that afford opportunity for habitat, and supports habitat valued by society. Wetland 4 is located within a section/township/range featuring a WHCV and features WHNP mapped small-flowered trillium and Pacific willow woodland.

4.1.2 Proposed Conditions

4.1.2.1 Wetland Mitigation Types

Consistent with the overall Bank goals, wetland mitigation actions will focus on restoring geomorphic processes to establish self-sustaining conditions that will support Site protection and succession. Additional, specific improvements to habitats will be made that target individual species and life stages, and guilds of species, to provide immediate benefits for native aquatic and terrestrial wildlife and native fish species. Specific objectives for wetland mitigation actions are identified below, and are included for fish and wildlife habitats in their respective sections.

Work will include improvements to both aquatic and terrestrial habitats through grading and vegetation enhancements using design data collected regionally and specific to the Bank Site. Wetland habitats will be improved through a range of proposed mitigation types, as described below and in Figure 11 and Table 8:

- Wetland re-establishment or restoration will occur in areas where fill is removed, including the footprints of water control structures that will be dismantled, and grading to restore wetland conditions to upland pasture;
    - Objective: remove fill to re-establish 29.70 acres of riverine wetland.
- Wetland rehabilitation will be performed in areas where historic processes are restored to existing wetlands, such as the reintroduction of riverine flooding to the Farm Fields and Lancaster Lake Study Area and impounded waterfowl hunting area;
    - Objective: reintroduce riverine and daily freshwater tidal flooding to rehabilitate 303.64 acres of riverine wetland.
- Wetland enhancement will occur through grading and vegetation enhancements to restore target habitat types;
    - Objective: enhance existing wetland functions across 228.11 acres by regrading certain locations to provide increased opportunities for normative hydrology, sediment transport, overbank flooding, and by improving elevations to support native wetland plant communities.
- Wetland enhancement and preservation will apply to 57.36 acres where existing high quality wetlands are protected in perpetuity; and
- Upland and riparian enhancement will be performed in buffer and riparian areas where vegetation communities and structure will be improved.

Table 8. Proposed wetland mitigation actions, types, and approximate quantities.

Existing wetland unit		Existing wetland acreage	Proposed wetland acreage	Construction phase and activity	Proposed wetland mitigation action	Ecological outcome
WETLAND 1	1a	139.10	19.48	Phase 1: Excavate fill, grade side-channel morphology, construct in-stream habitat complexity structures, and restore native vegetation communities.	Rehabilitation	Restore appropriate tidal hydrologic regimes and habitat conditions to provide fish rearing and refugia habitat types and eliminate fish stranding. Grading will be focused on areas of reed canarygrass to alter elevations and establish planting benches that will support native vegetation and low-water channels that will support rearing and outmigrating juvenile salmonids (and other native fishes and aquatic fauna) during low water periods. Invasive species will be removed and vegetation will be managed. Channels will have positive drainage to avoid stranding.
			119.62	Phase 1: Grading, planting, and other vegetation enhancements, treat non-native species.	Enhancement	Increase native species cover to improve habitat, and increase surface roughness to decrease flood velocities. Grading will remove non-native species and establish diverse hydrologic regimes to support interspersed vegetative communities. Grading will enhance floodplain habitats across a range of seral stages.
	1a SUBTOTAL	**139.10**	**139.10**			

Existing wetland unit		Existing wetland acreage	Proposed wetland acreage	Construction phase and activity	Proposed wetland mitigation action	Ecological outcome
WETLAND 1	1b	0.00	0.69	Phase 2: Remove dike fill and structures, regrade, plant native vegetation.	Re-establishment	Restore wetland functions and area to footprint of upland levee area, restore historic hydrologic regimes.
		132.90	28.30	Phase 2: Remove impoundment (see previous row), excavate fill, regrade distributary channel network, install channel habitat complexity structures, and restore native vegetation.	Rehabilitation	Restore historic hydrologic conditions. Restore live storage capacity for surface flooding and increase surface roughness through installation of native woody species. Improve habitat by enlarging area of long-duration inundation that support desirable emergent species, removing invasive species, and increasing habitat interspersion. Improve water quality by expanding area of long-duration inundation and emergent vegetation cover for nutrient uptake.
			104.60	Phase 2: Grading, construct instream habitat complexity structures, planting and other vegetation enhancements, treat non-native species.	Enhancement	Increase riparian cover, shade, large woody debris inputs; grading will restore elevations to support increased areas and improved complexity of target habitat types. Increase tidal channel and emergent marsh surface area.
	1b SUBTOTAL	**132.90**	**133.59**			
	1c	3.89	3.89	Phase 2: Grading, planting and other vegetation enhancements, treat non-native species.	Enhancement	Increase riparian cover, shade, large woody debris inputs; grading will restore elevations to support increased areas and improved complexity of target habitat types.
	WETLAND 1 TOTAL	**275.89**	**276.58**			

Existing wetland unit		Existing wetland acreage	Proposed wetland acreage	Construction phase and activity	Proposed wetland mitigation action	Ecological outcome
WETLAND 2	Upland pastures (adjacent to 2a, 2b and 2c)	0.00	28.16	Phase 3: Relocate part of access road on top of levee. Remove agricultural fill, grading, and planting native species.	Re-establishment	Grading to restore wetland conditions to upland pasture with relic hydric soils, indicating historic wetland conditions. Restore wetland conditions, remove pasture species, and restore native wetland communities.
	2a and 2b	49.39	49.39	Phase 3: Excavate fill. Grading to fill ditches and restore distributary channel network. Vegetation enhancements.	Rehabilitation	Restore tidal riverine hydrologic conditions through levee breach. Restore appropriate floodplain topography through grading to improve hydrologic and water quality functions; fill existing ditches and excavate sinuous drainage channel to retain surface flood flows. Restore positive drainage to maintain live storage capacity and prevent fish stranding. Restore native vegetation communities to improve habitat.
	Upland Levee Structure (adjacent to 2c)	0.00	0.85	Phase 5: Remove dike fill and structures.	Re-establishment	Restore wetland area and functions to footprint of levee.
	2c	206.47	206.47	Phase 3: Excavate fill. Grading to fill ditches and restore distributary channel network. Grading to prepare elevations for planting and other vegetation enhancements, treat non-native species.	Rehabilitation	Restore tidal riverine hydrologic conditions through levee breach. Restore appropriate floodplain topography through grading to improve hydrologic and water quality functions; fill existing ditches and excavate sinuous drainage channel to retain surface flood flows. Restore positive drainage to maintain live storage capacity and prevent fish stranding. Restore native vegetation communities to improve habitat.
	WETLAND 2 SUBTOTAL	**255.86**	**284.87**			

Existing wetland unit		Existing wetland acreage	Proposed wetland acreage	Construction phase and activity	Proposed wetland mitigation action	Ecological outcome
WETLANDS 3 and 4	3	7.30	7.30	Phase 4: Install woody habitat structures at margin of Gee Creek channel. Treat non-native species and vegetation enhancements.	Enhancement and Preservation	Restore habitat complexity and cover for native fish, maintain quality wetland habitat values.
	4	50.06	50.06	Phase 4: If monitoring demonstrates need, regrade and treat higher areas dominated by reed canarygrass to address fish stranding. Vegetation enhancements, treat non-native species.	Enhancement and Preservation	Enhanced off-channel habitat areas to provide more suitable ingress/egress for juvenile salmonids, maintain high quality wetland habitat values.
	WETLANDS 3 and 4 SUBTOTAL	**57.36**	**57.36**			
ALL WETLANDS TOTAL		**589.12**	**618.81**			

4.1.2.2 Hydrology

Site hydrologic conditions are currently degraded by impoundment structures and historic fill placement. Removing impoundment structures will restore typical hydrologic conditions to large wetland areas currently managed for agricultural or hunting practices. Removing fill will restore wetland area and restore desired hydrologic conditions to areas. Restored vegetation will provide surface roughness to the floodplain and further contribute to hydrologic benefits provided by the Bank.

Two areas within the proposed Bank are affected by impoundments: Wetland 2 (Farm Fields and Lancaster Lake Study Area), and Wetland 1, rating unit 1b (Lewis River and Gee Creek Study Area). Wetland 2 formed as a riverine wetland, receiving regular overbank flooding from Gee Creek and backwater conditions from the Columbia River. The existing elevation of Wetland 2 is below the estimated elevation of the 2-year flood Columbia River flood stage, suggesting that riverine wetland conditions would be restored by removing the levee at The Narrows. Additional grading work performed in Wetland 2 to fill ditches and restore typical floodplain topography will further restore typical riverine hydrologic conditions.

Impoundments in Wetland Rating Unit 1b maintain open surface water for waterfowl hunting, and flashboards are removed to drain the ponds during the summer months. During winter and spring, the impoundments eliminate the live storage capacity of the wetland by maintaining surface water over the natural basin. The impoundments will be fully removed to restore typical hydrologic conditions to the affected areas, which are low-lying areas at suitable elevations that can support long-duration inundation plant communities such as wapato and spike rush dominated emergent communities.

High flow channels in Wetland Rating Unit 1a have been filled with dredge spoils in some areas, as well as aggrading through natural deposition. These channels provide important habitat components to focus species, such as juvenile salmonids. The sediment fill occupies these habitat areas and can also strand fish as water levels fluctuate seasonally. Sediment from these channels will be removed to establish specific hydrologic regimes to support salmonids and other aquatic species in the current river conditions. Channels will be excavated to maintain surface waters during key life stage times, and to drain towards rivers as river stage decreases to avoid fish stranding.

The Site will be graded in other targeted areas to establish hydrologic conditions to support targeted habitat types, such as lengthening inundation duration in areas, or mounding soil to create drier conditions. Adjustments to hydrologic regime will be based on collected hydrologic data and grading plans will be developed in collaboration with the IRT to clearly establish appropriate habitat objectives.

4.1.2.3 Vegetation

Existing vegetation communities within the Bank Site include a mix of native and nonnative communities. Native species occur primarily as upland or wetland floodplain forests, and as low-lying wetland areas that experience long-duration inundation. Nonnative species occur in areas managed for agriculture, where pasture grasses are maintained as forage for cattle, and as common weedy floodplain understory components. Existing forests include mature trees that are mostly deciduous, with conifer species occurring at and above about 17 feet.

Proposed vegetation will be managed to improve native cover through adjusting hydrologic conditions and grading to design elevations to better support native communities, and through direct vegetation management.

4.1.2.4 Functions

Restoration actions will improve hydrologic, water quality, and habitat functions by restoring typical floodplain conditions and restoring desired habitat types. Removing artificial structures, site grading, and vegetation management will be used to restore wetland functions. Restoration design will consider both historic site conditions and current flood regime conditions, as affected by both the Columbia River and Lewis River hydropower systems that have modified watershed flooding regimes.

Hydrologic functions will be improved by restoring tidal hydrology, Columbia River backwater influence, and surface water flooding conditions to areas that are currently managed using water control structures. Live storage provided by removing the structures will improve peak flow and seasonal storage function by enlarging storage capacity and increasing the average tidal prism by greater than 400 acres. Daily flood and draw-down conditions will be restored by allowing normal tidal action and seasonal spring freshet flood and draw-down to occur, as will habitat availability both in the form of in-channel habitats during nearly year-round flow conditions and floodplain habitats during spring freshet and winter flood events. Baseflow support functions will also be improved by the same actions, as spring freshet flood events will have the opportunity to inundate wetland soils that are currently protected or managed.

Water quality functions will be improved by restoring historic hydrologic regimes, providing opportunities for surface water interaction with wetland components. Changes to hydrologic regimes will provide typical conditions for nutrient and toxic absorption. Tidally influenced Columbia River backwater conditions restored to the Site will allow for organic matter accumulations, providing greater opportunities for dissolved nutrient uptake over time. Vegetation removal by widespread grazing of cattle will also cease, allowing for increased biomass to provide increased sediment retention and a decrease of toxic inputs. Vegetation established will provide cover and habitat complexity, and shade to reduce localized water temperatures.

Habitat functions will be improved through restoring historic hydrologic conditions and specific habitat types within the Bank Site. Floodplain interactions will be restored by removing impoundment structures, allowing freshwater tidal riverine wetland interactions, and the reintroduction of daily tidal flux and seasonal inundation patterns. Biologic production will increase by improving vegetation communities, increasing biomass production and improving water quality inputs by eliminating widespread grazing and reducing the impoundment of non-native warm water fish species (such as carp and bullhead catfish) that constantly churn the bottom substrate. Appropriate hydrologic regimes will be restored through removal of dredge spoils and grading to establish desired off-channel and side-channel habitat elevations. Hydrologic regimes will support targeted plant communities and habitat types. Native vegetation will be restored to further improve habitat functions. Restoration of normative seasonal and daily tidal flux hydrology has the effect of creating habitat conditions that are more beneficial and preferential for native wildlife species (that evolved with the summer low-flow conditions) than non-native species (who benefit from impounded warm-water habitats).

4.1.3 Proposed Service Area and Rationale

The proposed Service Area for wetlands, Columbia River mainstem, and other waters mitigation is shown in Figure 12 and includes WRIAs 27 and 28, the Portland Basin as defined by geology, and all 8 hydrogeomorphic reaches of the Columbia River Estuary. The Site is appropriate to compensate for impacts to the Lewis River (WRIA 27) watershed, and the Salmon-Washougal (WRIA 28) watershed, where similar geologic, stochastic flood, and volcanic events influenced watershed conditions (as noted in the WRIA 27/28 Watershed Management Plan [LCFRB 2006]). The location

satisfies mitigation guidance from USACE and EPA (2008), joint agency guidance (USACE et al. 2012), and the *Summary of Watershed Characterization and Analysis Project for Clark County* (Ecology 2009). Because of the extensive role of freshwater tidal influence on Columbia River floodplain hydrology and ecology within wetland habitats on the Site, we are proposing the tidally-influenced portion of the Columbia River valley as the Columbia River Estuary extent of tidal influence portion of the proposed Service Area. Columbia River Estuary and mainstem-influenced floodplain wetland sites that are available and suitable for mitigation (and that also provide a high likelihood for success as well as benefits to multiple listed aquatic and terrestrial species) are rare, and the Site provides a practical solution to the gap in hydrologically connected mitigation opportunities. The proposed Bank location is unique among banks in the region in that we are proposing to re-establish floodplain processes and reconnect wetlands and waterbodies with Columbia River tidal/fluvial processes, including channel formation and maintenance, hydrology, sediment storage and transport, nutrient cycling, detritus export, organic matter flux, and increase floodplain live storage over a wider range of flows. This will be accomplished through direct surface water connections that will provide both high-flow refuge for aquatic species (e.g., ESA-listed juvenile salmonids and other native fishes) and year-round access to a diverse mosaic of floodplain wetland, fluvial, and freshwater tidal habitats and the functions these habitats provide. The relationship between Columbia River mainstem and floodplain is key to the success of habitat-forming processes and ecosystems functions for this Site, and also to our defined Service Area.

The proposed Service Area would address most water-dependent development projects requiring mitigation from impacts to mainstem Columbia River habitats that have the potential to impact some or all 13 Columbia River basin ESA-listed Evolutionarily Significant Units (ESUs) or Distinct Population Segments (DPSs) of salmon and steelhead and their designated critical habitat (DCH) at some level. The proposed Service Area covers the range of current and historical anadromy throughout the Columbia River basin, based in part on the analysis described in Section 5.6.5, which discusses the Proposed Service Area to include Columbia River basin ESA-listed salmon and steelhead, and related Designated Critical Habitats. Precedent has been set for "out-of-basin" salmonid habitat mitigation by the recent U.S. Bureau of Reclamation's Odessa Subarea Modified Partial Groundwater Replacement Project (located in south central Washington State). There, salmon recovery actions chosen for mitigation funding were in part based on outcomes of high biodiversity benefits, and some of the mitigation funds were dedicated to restoration actions located in the lower Columbia River (for chum salmon habitat projects) (USBR 2012, USBR 2013, NMFS 2013a). This is an example of a truly watershed-scale mitigation in the Columbia River, and is representative of a changing planning environment in the Columbia River basin, as demonstrated by regional, national, and international collaboration to address issues such as climate change and river management, the Federal Columbia River Power System (FCRPS), and the Columbia River Treaty.

5 CONSERVATION BANK RESOURCES

5.1 OVERVIEW OF FISH AND WILDLIFE HABITAT CONSERVATION GOALS AND OBJECTIVES

The intent of the Bank is to promote a dynamic landscape that provides a mosaic of diverse habitats through an ecosystem stewardship approach. Consideration of ecosystem needs at a broader scale allows the Bank Sponsor to balance the management and mitigation actions proposed so as to not inadvertently disrupt habitat for one at-risk species to benefit another. The goals of the proposed Bank in relation to conservation species and habitats are simultaneously to:

- Conserve an important landscape and the ecological processes that shape and define it, and
- Promote biodiversity of native flora and fauna through habitat restoration and protection.

Conservation Bank objectives include:

- Aid in recovery of at-risk species,
- Provide offsets for unavoidable adverse impacts to at-risk species and their habitats,
- Help prevent future status listings,
- Achieve landscape-level mitigation that is ecologically sustainable and meaningful, ans
- Provide opportunities for wildlife species re-introduction or recolonizing through translocation.

Specific objectives for each species and habitat will be developed in coordination with the IRT. The preliminary mitigation and conservation goals and objectives set forth in this prospectus are compatible with adjacent land uses on the Ridgefield NWR; the RNWR and USFWS' refuge system at large follows federal policies for Refuge Management that promote biological integrity, diversity and environmental health (USFWS 2001). Specific management and restoration goals for RNWR pertaining to biological integrity, diversity, and environmental health can be found in the Refuge's 2010 Comprehensive Conservation Plan (USFWS 2010). The proposed Bank goals and objectives also serve to further Lower Columbia Fish and Wildlife Recovery Plan goals, as described in detail for Fish in Section 5.6.6 and referenced for Wildlife in Section 5.7.4.

5.2 REGIONAL BIOGEOGRAPHY, GEOLOGY, AND ECOLOGY

The location of the Site is referenced in many ways; it is located in the Lower Columbia River Eco Province (IBIS 2008), in the Willamette-Lower Columbia Recovery Domain (for ESA-listed salmonids) (NMFS 2013b), and in the Columbia River Estuary and Lewis River watershed sub-basins (LCFRB 2010, NMFS 2011). The Site lies within the Willamette Valley-Puget Trough ecoregion, and is centrally located in the Pacific Flyway between nesting habitats in the Arctic and wintering habitats further south (Figure 13). The Site is situated within the Puget Trough physiographic province along the northern border of the Willamette Valley portion of this province. It is situated at the northern end of the Portland Basin where geomorphic processes provided conditions ideal for massive floodplain development and sediment accumulations to support large seasonal floodplain lakes and miles of tidal channels, wapato meadows, emergent marshes, and grasslands. The Site is unique in the lower Columbia River basin in that it still provides large-scale Columbia River floodplain habitats that have not been developed for human habitation and are not managed primarily for waterfowl hunting. This reach of the Columbia River is described by the U.S. Geological Survey (USGS) and others in terms of hydrogeomorphic characteristics divided into a hierarchical classification system. According to this Columbia River Estuary Ecosystem Classification system, the Site is located at the transition between Reaches E (Tidal Flood Plain Basin Constriction, roughly between Kalama, Washington, and St. Helens, Oregon) and F (Middle Tidal Flood Plain Basin, St. Helens, Oregon, to Vancouver, Washington, including the Lower Willamette) (USGS 2014) (Figure 13).

5.2.1 Geologic Context

The current Portland (Oregon) Basin (Figure 13) marks the northern terminus of the Willamette River lowland portion of the greater Puget-Willamette Trough of the Cascadia Subduction System (Evarts et al. 2009). While the Puget-Willamette Trough is bound by the Coast and Cascade ranges regionally, the Portland Basin is locally bound by the Portland Hills (Columbia River Basalt Group) to the southwest and older Paleogene volcanic rocks to the east. The Portland Basin is roughly 40 miles long, 20 miles wide, and is oriented with its long axis to the northwest.

Over the last 20 million years, the region around the Portland Basin has been subjected to local tectonic and volcanic activity as well as regional flood-basalt flows and extraordinary glacial-outburst floods. These events are captured in the sediment record because the Portland Basin is bisected by

the lower reaches of the Columbia River. The majority of the basin is filled with as much as 1,800 feet of Columbia River sediments, carried from the east, ranging in age from Miocene period to present. The present surface is underlain by as much as 400 feet of silt, sand, and gravel deposited by the late Pleistocene cataclysmic Missoula Floods.

The Site is located in the northern reach of the Portland Basin, and the formation of the Portland Basin was influenced during times of advanced glaciations by the deposition of voluminous glacial outwash events from the Lewis River (Evarts et al. 2009). Later periods of Mount St. Helens eruptions produced lahars and sediment that came down the Lewis River into the northern part of the Portland Basin, where extensive bottomlands were formed at the mouth of the Lewis River (present day Woodland, Woodland Bottoms, the proposed Bank Site, and Sauvie Island) (Evarts et al. 2009).

5.2.2 Ecological History

The proposed Bank Site is located in the area that Lewis and Clark mapped and described as Wapato[3] Valley (the lower Columbia River valley, including the Willamette River valley up to about modern Oregon City falls, between the Coast and Cascade mountain ranges) (Coues 1893, Moulton 1983) (Figure 13). The name Wapato Valley was given during their 1805–1806 expedition because of the dominance of wapato in the cultural and ecological landscape (Deur and Turner 2005, Coues 1893, Moulton 1983, Burroughs 1995). Portland Basin sedimentation patterns created the ideal hydrogeomorphic floodplain conditions to support vast wapato communities, and expanses of wapato-filled wetlands anchored Chinookan village sites, provided food security, were used as exchange networks for trade commodity, and were used in the development of specialized tools (Coues 1893, Darby 1996) all throughout the Portland Basin. The following passages from *Keeping it Living* (Deur and Turner 2005) describes a vision of ecological and economic sustainability that clearly demonstrates why we have chosen the name "Wapato Valley" to identify the proposed Bank:

> "In the late eighteenth and early nineteenth centuries, Wapato Valley was an ecologically complex and productive environment that provided the region's human inhabitants with numerous types of food, with many resources (most notably salmon runs) varying considerably over time and space. The Lower Columbia region fits the model put forward by D. R. Harris (1977) of an emergent stable agricultural system, characterized by an ecosystem with high species and pattern diversity, intensive management of some resources within the ecosystem, and plant ecology that was conducive to intensification."
>
> "The Columbia River's large discharge and low gradient created extensive wetlands in the meander floodplain of its lower reaches, which were also subject to daily tidal fluctuations and annual floods. Wapato was ubiquitous in slackwater bays, freshwater tidal mudflats, on marshy islands, and in myriad ponds, lakes, and sloughs, especially on the large, marshy island named "Wapato Island" by Lewis and Clark and today called Sauvie Island."
>
> "Wapato Valley is the broad, tidally influenced freshwater zone in the Lower Columbia River Valley, beginning at the mouth of the Columbia River gorge near the Sandy River confluence, and extending westward to the Kalama River valley. The Coast Range hems Wapato Valley in on the west, and the foothills of the Cascade Mountains form its eastern boundary. The same region is known today as the Portland Basin."

[3] For clarity and consistency in this document, we use the modern spelling of "wapato" to describe the plant species and the locales after which it was named. Multiple spellings were used historically including "wapto," "wappatoo," "wappetoe," "wappato," "wap-pa-too," "woppetoe," and "(w)appato."

5.3 CONCEPTUAL MODEL

The intent of the conceptual design is to address the on-site fundamental causes of environmental impacts that have altered physical conditions and produced biological consequences. In order to communicate the complexities of the relationships between watershed- and habitat-forming processes and ecosystem and habitat functions, a conceptual model is provided in Figure 14. The conceptual model is based on several other Columbia River conceptual models and research programs, and has been designed to represent on-site conditions only. In this model, the relationships are shown in terms of cause and effect, and illustrate how the impact of a given management or restoration action can initiate responses in a cascading manner within the ecosystem. When viewing the model from the top down, the deleterious consequences of various past and current land use management actions can be seen initiating a chain of impacts which cause specific, altered physical processes and, in turn, detrimental biological consequences. In contrast, when viewing the model from the bottom up, the proposed process-based restoration actions elicit a specific set of anticipated beneficial outcomes, and can easily identify how these outcomes will reverse the adverse effects of past and current management actions through the same physical and biological linkages. The model is not intended to be exhaustive, but to illustrate the complex interactions and linkages associated with restoring dynamism to a landscape.

5.4 PRELIMINARY BIOLOGICAL RESOURCES SURVEYS

Two (2) fish habitat types (Figure 15) and 6 existing broad-scale wildlife habitat types (Figure 16) have been delineated within the proposed Bank Site, as detailed in Section 5.6.3 and 5.7.3, respectively. These habitats support numerous resident and migratory wildlife species, and native fish species including state- and federally-protected species. In these areas, specific restoration actions are proposed to create, enhance, promote, maintain, and protect diverse habitats of high quality and complexity. These fish- and wildlife-specific mitigation actions will enhance and promote the habitat types and conditions that will encourage new use and expansion of current use by targeted species, resulting in more habitat area and improved habitat quality, complexity, and increased habitat diversity.

A number of protected species have been documented to occur within the Site, including species listed under the federal ESA, Washington State-listed species, and other special-status species. In some cases, suitable habitat is present for listed species that have not yet been documented to occur within the Site, but occurrence is suspected or is possible due to habitat suitability. A complete listing of fish and wildlife species observed within the PN Farm property prior to 13 October 2015 can be found in Appendix A, and preliminary biological and abiotic resources surveys to identify additional species and habitat usage are ongoing.

The USFWS has a relatively new program called Strategic Habitat Conservation (SHC), with guiding principles that have applicability to Conservation and Mitigation Banking, especially the management framework and use of surrogate species to represent habitat health (USFWS 2014a). On the proposed Bank Site, this surrogate species concept could be used to assess habitat health in existing conditions surveys as well as general biological response during post-project monitoring, in addition to the use of traditional monitoring approaches focused on species-specific biological response and vegetation communities or other structural or physical elements. In Oregon's Willamette Valley, which is located at the southern end of the Puget Trough-Willamette Valley EcoRegion in which the proposed Bank is located, an SHC pilot project is underway. USFWS and team partners selected a number of surrogate species (wildlife and plant species that can represent other wildlife and ecosystems) fitting into a variety of surrogate species categories, including keystone, iconic, and umbrella (USFWS 2014b). A number of these surrogate species and habitats they occupy or represent are present on the proposed Bank Site, and similarly also serve to signal habitat health.

Overlapping habitat types and their surrogate species are noted in bold text in the list below. The concept of surrogate species would need to be tailored to the Site for application and would be developed in partnership with the IRT. Potential Bank surrogates may include:

- Oak Woodland: Oregon white oak and Slender-billed white-breasted nuthatch,
- Native Grassland (including oak savanna): Western meadowlark and camas,
- Aquatic: Juvenile salmon and Oregon floater mussel,
- Riparian: Black cottonwood and Northern red-legged frog, and
- Wetland (including all freshwater wetland and wet prairie): American beaver and wapato.

5.5 OVERVIEW OF SPECIES GUILDS ON SITE

The location of the proposed Bank Site within the lower Columbia River watershed provides for a wide array of terrestrial, wetland, riparian, and aquatic habitats. The location in the Columbia River floodplain and confluence of the Lewis River and Gee Creek provides a diversity of habitats that supports a wide array of species, including some endemic to the lower Columbia River. Existing conditions surveys to determine a preliminary inventory and presence/absence sampling of fish and wildlife species in all habitat types were initiated in spring of 2014. No capture, trapping, or handling techniques were utilized. Visual and audio surveys, several brands of motion detection and time-lapse wildlife remote sensor cameras, and underwater video cameras were used. These techniques were found to be quite effective in identifying a wide range of species in a variety of habitats and had the benefit of providing a permanent record of the species, and in many cases, insights into behavior and interactions with other species. Additional techniques may be utilized at the request of the IRT after securing the appropriate recovery or scientific collection permits. Refer to Appendix A for a complete list of species that have been documented to occur on the PN Farm property. Wildlife are presented in faunal guilds at this time while habitat associations and finer scale habitat mapping is ongoing.

5.5.1 Mammals

A number of mammal species can be found throughout the Site in all habitat communities. Some species are year-round residents occupying habitats of the Site throughout their life cycle, while others may be seasonally or opportunistically transient. Species documented to occur on Site either through preliminary biological resource surveys or past observations or include Columbian white-tailed deer, Columbian black-tailed deer, black bear, coyote, beaver, bobcat, California ground squirrel, flying squirrel, Douglas' squirrel, raccoon, river otter, striped skunk, mink, several species of bats, and several rodent species. All of these species have the potential to breed within the Site given the large acreage, diversity of habitat types, and year-round access to water and cover. In addition, marine mammals including harbor seals and Stellar sea lion have been documented in the Columbia and Lewis rivers during anadromous fish returns. Introduced (non-native or naturalized) mammals recorded on site include nutria, Eastern cottontail rabbits, eastern gray squirrel, and opossum.

5.5.2 Birds

Over 100 resident and migratory bird species have been documented during several bird survey efforts including:

- a Christmas bird count by experienced volunteer birders affiliated with the local Audubon Society chapter in December 2014,
- spring–summer bird surveys in selected habitats in 2014,
- bird species captured on motion detection wildlife cameras in 2014 and 2015, and
- ongoing incidental observations.

The preliminary results of baseline species presence surveys and habitat inventory should not be viewed as exhaustive. It is likely that an even greater diversity of species utilize habitats of the Site. Seasonal and interannual variations in species assemblages of wintering and migratory birds are expected and documented to occur in the large open water and emergent wetland complexes. In upland, riparian and wetland forests, large-diameter trees and standing snags attract a diversity of resident and migratory nesting birds, including those that require large tracts of contiguous forested habitat. Proximity to open expanses of water and emergent vegetation provide foraging and hunting grounds for those birds that feed on the wing as well as numerous waterfowl species. The location of the Site on the Pacific Flyway is also important for migrating bird species. See Appendix A for a list of all fauna including birds observed within the Site as of 13 October 2015.

5.5.3 Herpetiles

The size of and proximity to seasonal and permanent wetlands and open water bodies, as well as the relative abundance of sandy shorelines, provides breeding grounds for a number of amphibians and reptiles. Surveys for amphibians and reptiles have identified 9 species, including the long-toed salamander, Northwestern salamander, red-legged frog, Pacific chorus frog, rough-skinned newt, western painted turtle, western pond turtle, and common garter snake. The non-native bullfrog is also present on Site.

5.5.4 Fish

Preliminary biological resources surveys of the Site have identified at least 25 species utilizing aquatic rearing and migration habitats in and adjacent to the proposed Bank; 5 native salmonids, 9 other native fishes and 11 non-native fishes. Detailed information for documented fish presence and habitat is provided in Section 5.6.1.

5.5.5 Invertebrates

A great number of terrestrial and freshwater invertebrates, including native freshwater mussels, are expected to occur on Site. Preliminary invertebrate surveys began in summer of 2015. Casual and opportunistic survey observations to date include sightings of monarch butterfly, Oregon floater mussel, signal crayfish, numerous dragonfly and damselfly species, yellow-bordered taildropper slugs, aquatic beetles, praying mantis, midges, stoneflies, caddisfly, and mosquitos.

5.6 FISH

5.6.1 Species

5.6.1.1 Special-status Species

There are 13 federally ESA-listed native salmonid ESUs and DPSs, and several more native fish species having other special-status designations and a potential distribution or designated critical habitat within or adjacent to the aquatic, riparian, floodplain, and upland habitats of the proposed Bank Site including the mainstem Columbia River, Lewis River, and Gee Creek (Table 9). ESA-listed fish species documented to date on the Site include juvenile chum salmon, juvenile Chinook salmon, juvenile coho salmon, steelhead, Pacific lamprey, and Pacific eulachon. Adult salmon and steelhead known to transit and spawn in the Lewis River are shown in Table 10.

Table 9. Special-status fish species within the Columbia River basin having a potential distribution or designated critical habitat within the proposed Bank Site and proposed for inclusion in the Conservation Bank.

Common name	ESU or DPS	Federal ESA status/ critical habitat	Washington State status
Chinook salmon	Lower Columbia River ESU	Threatened/Designated	Species of concern
	Snake River fall-run ESU	Threatened/Designated	Species of concern
	Snake River spring/summer ESU	Threatened/Designated	Species of concern
	Upper Columbia spring-run ESU	Endangered/Designated	Species of concern
Chum salmon	Columbia River ESU	Threatened/Designated	Species of concern
Sockeye salmon	Snake River ESU	Endangered/Designated	Species of concern
Coho salmon	Lower Columbia River ESU	Threatened/Proposed	None
Steelhead	Lower Columbia River DPS	Threatened/Designated	Species of concern
	Upper Columbia River DPS	Threatened/Designated	Species of concern
	Middle Columbia River DPS	Threatened/Designated	Species of concern
	Snake River DPS	Threatened/Designated	Species of concern
Bull trout	Columbia River DPS	Threatened/Designated	Species of concern
Coastal cutthroat trout	Southwestern Washington/ Columbia River ESU	Species of concern/None	None
Westslope cutthroat trout	N/A	Species of concern/None	None
Pacific eulachon	Southern DPS	Threatened/Designated	Species of concern
Pacific lamprey	N/A	Species of concern/None	None
Western brook lamprey	N/A	Species of concern/None	None

5.6.1.2 Non-listed Native Species

The Columbia River basin supports numerous species of native fishes including salmonids (salmon, steelhead, trout, char, and whitefish), lamprey, eulachon, sturgeon, minnows, suckers, sculpins, stickleback, burbot, and trout-perch (PNNL 2010, Sagar et al. 2013). Preliminary biological surveys at the Bank Site have identified 5 native salmonids (cutthroat trout, coho salmon, Chinook salmon, chum salmon, and steelhead/rainbow trout), at least 9 native fish species including Pacific lamprey, eulachon, peamouth, chiselmouth, three-spine stickleback, northern pikeminnow, long-nosed dace, starry flounder, and at least one sculpin species.

5.6.1.3 Non-native Species

The Columbia River basin has a large number of introduced, non-native fishes including a large number of warm-water fishery species and fish that originate from the aquarium pet trade (Dauble 2009 as cited in PNNL 2010). Preliminary biological surveys at the Bank Site have identified 11 non-native species including yellow bullhead, brown bullhead, channel catfish, common carp, banded killifish, western mosquitofish, pumpkinseed sunfish, warmouth, bluegill, white crappie, and black crappie.

5.6.2 Salmonid Habitat Classification Methodologies

Habitat classification for salmonids were delineated using primary constituent elements (PCEs) of critical habitat for Pacific salmonids identified in the 2005 NMFS critical habitat designations (70 CFR 52630). The proposed Bank Site, which is located in the floodplain of the Columbia River at RM 87 and at the confluence of the Lewis River and Gee Creek, provides two of the six types of

PCEs. The two types currently found on the Site include freshwater rearing habitat and freshwater migration corridors. The other four types (freshwater spawning, estuarine areas between fresh and salt water, and other marine habitats) do not occur on the Site. The Bank Site and proposed process-based conceptual restoration design provides for a high likelihood of success to increase both quantity and quality of freshwater rearing and migration corridor habitats.

Freshwater rearing habitats that provide the features inherent in the PCEs are those that support juvenile salmonid growth, development, and mobility:

- water quantity and floodplain connectivity to form and maintain physical habitat conditions;
- water quality and forage; and
- natural cover such as shade, submerged and overhanging large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting predator avoidance by juvenile salmon.

Freshwater migration habitat are those stream, river and freshwater tidal corridors free of obstruction that support juvenile and adult mobility and survival, providing the following PCEs:

- access and opportunity to life-stage appropriate habitats;
- suitable water quantity and quality conditions; and
- natural cover including submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

5.6.3 Existing Salmonid Habitat Conditions

5.6.3.1 Types and Locations

Migration corridors are located in the Lewis and Columbia Rivers, and to a lesser extent, Gee Creek. Rearing habitat is located in Lewis River and Columbia River shallow-water nearshore areas, and in deeper off-shore habitats for larger juvenile salmonids. Rearing habitat is also found in Gee Creek, and off-channel habitats of Gee Creek including floodplain wetlands influenced by Columbia River backwater and tidal influence. Rearing habitat is also located in side-channels of the Lewis River and in tidally influenced floodplain off-channel habitats.

Currently habitat conditions exist at a range of flows between Mean Low Water (MLW) and Mean High Water (MHW) as calculated during the time-period of estimated peak juvenile salmonid outmigration and mainstem estuary rearing (Figure 15). Existing conditions surveys have documented juvenile salmonids using the off-channel, stream, and nearshore riverine habitats on Site from approximately early February through mid-July. The temporal extent of habitat suitability (primarily driven by temperature) varies by year, depending upon Columbia River hydrology and river management, and surface flows. At MLW under existing conditions, approximately 63.28 acres of stream, floodplain, and off-channel rearing habitat is available (Lewis River nearshore areas are excluded from this analysis); however, 83.38 acres of impounded habitat is currently unavailable. Comparatively, at MWH under existing conditions, an estimated 100.70 acres of the stream, floodplain, and off-channel rearing habitat is accessible, with 219.43 acres of impounded habitat that is inaccessible. At low flow river stages and low tidal ranges, habitats of these types become isolated and fragmented by areas of fill, accumulated sand or sediments, and juvenile salmonid stranding of several species have been documented. Sometimes stranding is temporary as pools become isolated during lower tide cycles, and fish in pools with sufficient depth and cover can find refuge until the next high tide. In 2015, extreme low river flows compounded by a lack of precipitation, low groundwater recharge, and reduced hyporheic exchange created stranding on multiple occasions, both early and late in the migration season.

5.6.3.2 Functions

Rearing habitats found on the proposed Bank Site support juvenile salmonid growth, development, and mobility through the following habitat functions:

- sufficient water quantity and floodplain connectivity at a mid- to higher range of river stages and tidal cycles, to form and maintain physical habitat conditions;
- water quality suitable for juvenile rearing under most conditions from February through mid-July;
- forage in the form of primary productivity, algae production, zooplankton, wetland invertebrate production, and some stream and upland invertebrate production; and
- natural cover such as shade, submerged and overhanging large wood, log jams, beaver dams, aquatic vegetation, side channels, and undercut banks supporting predator avoidance by juvenile salmon.

Freshwater migration habitats in and adjacent to the Bank Site support juvenile and adult mobility and survival, by providing the following habitat functions:

- open access and opportunity to life-stage appropriate habitats;
- suitable water quantity and quality conditions; and
- natural cover including submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

5.6.4 Proposed Habitat Conditions

5.6.4.1 Types and Locations

Proposed restoration actions will increase both the quantity and quality of rearing habitats in stream, side-channel, off-channel, floodplain, and nearshore areas. As demonstrated in Section 3 *Conceptual Design* and in Figure 9, construction activities such as levee and fill removal will expand access opportunities for rearing habitat access by increasing hydrologic connectivity at a wider range of flows. Under proposed restored conditions, approximately 190.20 acres of rearing habitat including stream, side-channel, off-channel and floodplain wetland habitats (exclusive of nearshore mainstem habitats) at MLW as calculated between February and mid-July over the past 10 years of river stage data will be accessible. Under a restored condition at MHW calculated similarly, approximately 348.44 acres of stream, side-channel, off-channel, and floodplain rearing habitat are estimated to be accessible to rearing juvenile salmonids and other native fishes. Figure 17 demonstrates the proposed conditions and increases in habitat area.

5.6.4.2 Functions

In addition to habitat quantity gain, the following habitat functions will be improved as noted by the relevant construction actions:

- Levee and fill removal and channel regrading will allow for increased habitat diversity, increased floodplain connectivity, increased depth of cover, increased water quantity in the channels relative to mainstem river stages, and improved forage through surface water connections with large floodplain wetlands that export detritus, cycle nutrients, and produce large quantities of wetland invertebrate forage items. Restoring normative tidal hydrology will also create habitat conditions more suited to native species and less suited to non-native species that like impounded warm-water conditions, such as carp and bullhead catfish. Localized water temperatures will also improve as surface waters have more tidal circulation and flushing action and are reconnected with hyporheic exchange and spring-fed inputs.

- Installation of instream habitat structures including beaver enhancements will provide more immediate cover objects, opportunities for predator avoidance, and habitat complexity in the form of increased areas of flow diversity and low-flow refuge habitat, increased surface area for primary production, and food web support.
- Vegetation enhancements will increase native plant cover, increase the export of detritus, slow flood velocities, trap sediment on the floodplain and reduce suspended sediment, and provide shade, overhanging vegetation, aquatic vegetation, and future large wood inputs.

5.6.5 Proposed Service Area and Rationale

The proposed ESA-listed salmon and steelhead Bank Service Area is comprised of 3 Columbia River tributary sub-basin watersheds including all of WRIA 27 (Lewis), the extent of anadromy in WRIA 26 (Cowlitz), and WRIA 28 (Salmon-Washougal). The proposed Service Area also incorporates the Columbia River historical floodplain (defined here as the 100-year flood elevation using Columbia River datum (CRD) including eight hydrogeomorphic reaches (A through H, commonly accepted as the range of modern tidal influence) of the lower Columbia River between RM 0 at the mouth and RM 146 at Bonneville Dam (USGS 2014). These reaches cover all tidally influenced areas of Columbia River tributaries within Washington and Oregon, side channels, and sloughs as mapped by USGS (2014) (Figure 12). The proposed Service Area for listed salmonids also includes the Portland Basin and the lower Willamette River. A sound biological argument can be made to extend the Service Area to include the extent of anadromy in the Columbia River basin above Bonneville Dam for those species with DCH that occurs on or adjacent to the Bank Site (see note on extent of anadromy on Figure 12). The proposed Bank Site will provide direct and indirect ecosystem benefits to impacted aquatic resources (Johnson et al 2015). Recent out-of-basin salmonid mitigation examples, such as for the Odessa Subarea Modified Partial Groundwater Replacement Project previously discussed in Section 4.1.3, demonstrate that upstream Columbia River basin impacts are being considered at a basin-wide scale, and mitigation is being provided for lower Columbia River salmon stocks.

As part of our Service Area analysis, we considered the joint regulatory agency guidance requirement that aquatic mitigation activities providing benefits for native fish populations must benefit the same fish stocks that are potentially impacted within the Service Area (USACE et al. 2012). The proposed Bank Site supports or is in the current and historic range of a number of ESA-listed wildlife species that require floodplain habitats at some point in their life history. In addition to areas specified in ESA listing documents, we evaluated current and proposed DCH for all special-status fish species in the vicinity of the Site to best develop our proposed Service Area. As noted in Table 9, the Columbia River mainstem, riparian corridor, and floodplain area below Bonneville Dam provides suitable habitat and is DCH for all species of listed salmonids. Many of these designations are for salmon and steelhead species that originate above Bonneville Dam but must utilize the lower Columbia River mainstem and floodplain for rearing, refuge, and migration habitat during juvenile life stages and again as adults migrating upstream in the mainstem Columbia River system to spawn. The remaining ESUs and DPSs originate in the lower Columbia/Willamette River domain.

Recent research has shown that the more fit and larger in size juvenile salmonids are when they reach saltwater, the more likely they are to survive the saltwater transition and return as adults (Bottom et al. 2011; Sagar et al. 2013, 2014; Roni et al. 2014). Tidal wetland restoration is the focus of intense research and restoration planning (Diefenderfer et al. 2013a, 2013b). This Joint Bank will provide increased access and opportunity of approximately 500 acres of high-capacity/high-quality off-channel habitats where juvenile salmonids can rear, forage, and seek refuge. The proposed restoration actions will result in an increase in area of available off-channel habitat and will improve habitat quality and function (e.g., invertebrate prey and algal production, improved temperature

conditions, and structural characteristics) that will in turn promote juvenile salmonid fitness and survival. Off-channel habitats also provide a suite of ecosystem benefits (Thom et al. 2013; Johnson et al. 2013a, 2015) that indirectly contribute to the fitness of salmonids that do not directly access the site in the form of increased food web support (Sagar et al. 2013), primary productivity, organic matter flux and detritus export, (Thom et al. 2014), suspended sediment trapping and storage, flood attenuation, nutrient cycling, denitrification, and other attributes.

In addition to direct and indirect benefits to native salmonids, ecosystems and habitat-forming and influencing processes in mainstem and off-channel habitats are dynamic and complicated and provide many services and functions beyond fish habitat. This said, we expect the Joint Bank to be utilized for impacts to waters including wetlands that may not support ESA-listed fish. We also considered a large body of literature on the Columbia River basin and specifically the Columbia River estuary (see Section 13, References) including but not limited to the topics of hydrology, geomorphology, biology, ecology, restoration science, engineering, traditional ecological knowledge, Native American First Foods, and regulatory guidance and rules.

5.6.6 Compatibility with Watershed Management and Recovery Plans

5.6.6.1 Columbia River Basin Fish and Wildlife Recovery

The Columbia River basin is the focus of a tremendous effort to protect and enhance fish and wildlife species and habitats by a number of organizations including the Northwest Power and Conservation Council, who manage one of the largest fish and wildlife programs in the region. The council serves as a regional resource for fish and wildlife planning information and analysis, reviews and funds habitat restoration actions, and works on hatchery reform. The Columbia River basin was home to one of the largest Pacific salmon runs in the world (Weitkamp et al. 2012) and is the focus of major efforts by many Tribes, agencies, organizations, and participants to recover 13 federally-listed ESUs and DPSs of salmon and steelhead, as well as special-status species bull trout, coastal cutthroat trout, Pacific eulachon, Pacific lamprey, white sturgeon, and other native fishes of cultural relevance. Upstream of Bonneville Dam, Washington State salmon recovery regions are actively addressing fish and wildlife recovery in the middle and upper Columbia River, Snake River, and Pend Oreille areas. Together with Tribes, non-governmental organizations (NGOs), and federal, state, and local agency partners throughout the Columbia River basin, regional efforts are focused on increasing the production and survival of wild salmonids and other native fishes that then will migrate, feed, seek refuge, and actively rear in the Columbia River estuary on their way to the Pacific Ocean.

5.6.6.2 Lower Columbia River Region

In the Columbia River estuary, the Bonneville Power Administration and USACE jointly established a program known as the Columbia Estuary Ecosystem Restoration Program (CEERP) to implement ecosystem restoration actions and research, monitoring, and evaluation (RME) criteria in response to various requirements, mandates, and authorities. The goal of CEERP is to understand, conserve, and restore ecosystems in the lower Columbia River and estuary for the purpose of assisting in the recovery of ESA-listed salmon and steelhead, and to avoid jeopardy opinions for FCRPS hydropower operations in the region (Thom et al. 2013; Johnson et al. 2013a, 2015). The objectives of the CEERP program are to:

- Increase the capacity and quality of estuarine and tidal-fluvial ecosystems;
- Increase the opportunity for access by aquatic organisms to shallow-water habitats; and
- Improve realized functions for juvenile salmonids.

The CEERP program is significant in the context of the Bank because it shares a common set of objectives relative to ESA-listed salmonids, and the monitoring component of the program is

contributing to an emerging body of knowledge related to physical and biological responses to restoration actions in the Lower Columbia River that will help inform our project design and will provide information about juvenile salmonid species and their genetic origin from other lower Columbia River restoration sites. The CEERP program has a large geographic footprint, but is more narrowly focused on salmonids than is the Plas Newydd Conservation Program; however, the primary restoration actions of the CEERP program (restoring hydrologic connections between the Columbia River mainstem and floodplain, creating and/or enhancing shallow water habitats, and removing invasive plants and re-establishing native vegetation) overlap with proposed restoration actions on the Bank Site.

The benefits of habitat restoration efforts in the lower portion of the Columbia River watershed have far-reaching biological effects in part because of the large geographic range and biological influence of anadromous aquatic species. The ecological effects of protecting intact habitats and applying process-based restoration in the lower Columbia River are also broadly distributed, because ecosystem functions and processes (such as primary productivity, food web support, organic matter flux, nutrient processing, flood attenuation, and sediment trapping), through the complex processes of tidal-fluvial hydrology, affect all tidally influenced reaches as well as the Columbia River plume and nearshore ocean environment (Bottom et al. 2005, Fresh et al. 2005, Naiman et al. 2012, Thom et al. 2013, Sagar et al. 2013, Johnson et al 2015). The Site is strategically located in the floodplain of the Columbia River at RM 87, and along the lowest three miles of the Lewis River from the confluence with the Columbia River. The Site is tidally influenced, and experiences a daily tidal range of 2–4 feet on average. The restoration potential of the wetlands and aquatic habitats on the Site is significant because after restoration actions are implemented these aquatic resources will be directly hydrologically connected to and influenced by the Columbia River and to a lesser extent the Lewis River and contributing tributary Gee Creek.

As noted, the Site has excellent potential to provide a significant increase in access and opportunity for refuge, rearing, and foraging habitat for overwintering and outmigrating juvenile salmonids from both local lower Columbia River ESA-listed salmon and steelhead stocks (those originating from the Lower Columbia ESU), and "upriver" or out-of-basin ESA-listed salmon and steelhead populations (those salmon that originate from other ESU's including the Willamette, Middle Columbia, Snake, and Upper Columbia). Federally listed fish species within the Columbia River basin having a potential distribution or designated critical habitat within the Site (including the Columbia River mainstem) are presented in Table 9.

The Lower Columbia Fish Recovery Board (LCFRB) has assigned Population Recovery Classifications for all salmon and steelhead populations in their Lower Columbia River planning region (essentially the Washington watersheds draining into the Columbia River from the mouth of the Columbia River up to and including the Little White Salmon River subbasin) (LCFRB 2010). Primary populations are those salmon and steelhead stocks considered to have a high viability goal, representing a low or negligible risk of extinction with a high persistence probability. Other classifications include Contributing and Stabilizing. For evaluating LCFRB-funded habitat restoration projects preference is given to projects that: (1) support Primary salmon or steelhead populations; (2) are located in a high priority habitat area or reach; and (3) are deemed to have a high likelihood for success. The Population Recovery Classifications for the Lewis River basin are provided below in Section 5.6.6.3.

Collectively, the aforementioned "out-of-basin" salmon and steelhead populations are considered a Primary population under the LCFRB habitat restoration Project Evaluation Criteria (LCFRB 2015). The location of the proposed Bank is considered a high priority under the LCFRB project evaluation criteria for restoration because of (1) it is proximal to both tidal areas of the mainstem Columbia River and a priority tributary confluence (Lewis River), (2) the current and historical habitat

conditions in the reach provide excellent reference conditions and restoration potential is very good, (3) the potential to increase accessibility and connectivity with functional rearing habitat is excellent, and (4) the habitat potential for estuary-dependent species, including fall Chinook salmon and chum salmon is very high. Site-specific data we have collected and analyzed corroborate this high priority designation as we have observed and documented active rearing in off-channel and shoreline habitats by Chinook, chum, and coho salmon fry and Chinook salmon smolts as well as other Priority native fauna on various parts of the Site.

The proposed Bank is also compatible with and able to addresses a number of specific actions identified in the updated *Lower Columbia River Estuary Plan—Comprehensive Conservation and Management Plan* (LCEP 2011); the plan identifies actions necessary to restore the lower Columbia River, including habitat restoration, land use practices, water quality and contaminant reduction, education and stewardship, and regional coordination and synchronicity.

5.6.6.3 Lewis River Sub-basin (WRIA 27)

The Site is located in WRIA 27, the Lewis River watershed, and is downstream of two LCFRB designated salmonid recovery priority subbasins—the North Fork Lewis River (NF Lewis River) and the East Fork Lewis River (EF Lewis River). Combined, these subbasins cover area of almost 1,100 square miles within portions of Clark, Skamania, and Cowlitz counties, have a maximum elevation of 12,000 feet above sea level, and include over 280 miles of historical anadromous stream habitat (LCFRB 2010). The Lewis River basin has developed from volcanic, glacial, and erosional processes originating from Mt. St. Helens and Mt. Adams. The NF Lewis River is a high priority watershed for restoration because it is one of the few glacier-fed cold-water refuge systems in the Lower Columbia River basin and has the potential to be more resilient to climate change than rain-dominated systems, and to provide habitat for native fish and floodplain dependent fauna. Native ESA-listed fish species that spawn in the Lewis subbasins include fall Chinook salmon (two runs including Tule and Bright), spring Chinook salmon, chum salmon, coho salmon, winter and summer steelhead, bull trout (above Merwin Dam), Pacific eulachon, and Pacific lamprey. Other native fish species of interest include coastal cutthroat trout.

The restoration elements of the proposed Bank will help address several of the most immediate habitat priorities as identified in the NF Lewis River sub-basin plan for the lower mainstem Lewis (LCFRB 2010) including:

- *#2—Restore Floodplain Function, Riparian Function and Stream Habitat Diversity.*
  Impacts from agriculture, riparian forest removal, dike building and bank stabilization have occurred on site. Reconnecting floodplain habitats will restore normal habitat-forming processes to re-establish habitat complexity, off-channel habitats and conditions favorable to fish spawning and rearing. Restoring normal floodplain function to wetland and riparian habitats will benefit other native fish, wildlife and plant species. Protecting areas of existing floodplain function and riparian habitats is also a cost-effective priority action.
- *#5—Restore Passage at Culverts and Artificial Barriers*
  Barriers or obstructions take many forms including undersized and failing culverts, tide gates and fill. Removal of barriers allows access to critical spawning and rearing habitats.
- *#6—Address Immediate Risks with Short-term Habitat Fixes*
  To address temporal gaps between long-term habitat improvements through restoration of watershed processes and immediate habitat needs of imperiled species, short-term fixes can address some risks. Construction of coho salmon overwintering habitat and Chinook rearing habitat in the form of alcoves, side channels and engineered log jams can provide critical habitat functions while longer term habitat-forming processes respond to process-based restoration approaches.

Based on the salmon and steelhead populations that it supports, the Lewis River basin has been identified as critical to salmon recovery (Table 10) (LCFRB 2010).

Table 10. Salmon and steelhead populations in the Lewis River basin having a Recovery Priority status as detailed in LCFRB (2010).

Species	Population	Recovery priority
Fall Chinook salmon(Tule)	Lewis	Primary
Chum salmon		
Fall Chinook salmon(Bright)	NF Lewis	
Spring Chinook salmon		
Winter steelhead	EF Lewis	
Summer steelhead		
Coho salmon		
Summer steelhead	NF Lewis	Stabilizing
Winter steelhead	NF Lewis	Contributing
Coho salmon		

The proposed Bank also contributes to addressing several WRIA 27/28 Watershed Management Plan Implementation Actions and Recommendations including improving flow conditions and habitat conditions in Gee Creek, protecting floodplains from modifications that would impair hydrologic functions or habitat, implement floodplain restoration projects where substantial benefits to habitat factors are favorable, and monitor water temperatures in various streams and rivers (LCFRB 2006).

Aquatic and terrestrial habitat restoration is a priority for Native American Indian Tribes throughout the Columbia basin. Tribes tend to take a more holistic approach to ecological restoration, thinking and managing in terms of cultural connections, and commonly form a foundation based on Traditional Ecological Knowledge (TEK) and Tribal First Foods. As multi-generational landowners, managers, farmers, and ecologists, this seasonal knowledge is intuitive and makes sense to the Bank Sponsor; we works daily with seasonal and longer-term patterns on the landscape including patterns of water and river levels, the migrations and habitat use of fauna, and the budding, growing, and dormancy of flora. A combination of first-hand observations, empirical data collection, historical ecology techniques, and multi-generational farm experience were used to shape the goals and objectives of the Conservation Program, Bank, and restoration project components. The Bank Sponsor is looking forward to working with interested Tribes, including the local Cowlitz Indian Tribe, to integrate and apply guidance on TEK (from sources such as Freeman 1992, Usher 2000, USFWS 2011, EPA 2011, NMFS 2013c, Turner and Spalding 2013) as appropriate into the Joint Bank goals and objectives.

5.7 WILDLIFE

5.7.1 Species

5.7.1.1 Special-status Species

Preliminary biological resources surveys of the Site identified numerous native wildlife species on the Bank Site (Appendix A), including several special-status wildlife species, as noted below in Table 11.

Table 11. Special-status wildlife species and/or their habitats that have been observed within the Bank Site as of 13 October 2015.

Common name	Documented species occurrence on Site	Federal ESA status	WA State status
Northwestern pond turtle	Yes, possibly breeding	Species of Concern	Endangered
Oregon spotted frog	Not documented but suitable habitat present	Threatened[1]	Endangered
Bald eagle	Yes, nesting and year round resident	Species of Concern	Sensitive Species
Sandhill crane	Yes, wintering	None	Endangered
Streaked horned lark	Not documented but suitable habitat present	Threatened	Endangered
Slender-billed white-breasted nuthatch	Yes, nesting	None	Candidate
Yellow-billed cuckoo	Not documented, but suitable habitat present	Proposed Threatened	Candidate
Columbian white-tailed deer	Yes, fawning and year-round resident	Endangered	Endangered
Western gray squirrel	Not documented but suitable habitat present	Species of Concern	Threatened

[1] Designated critical habitat has been identified but does not occur on the Bank Site.

Bald eagle

The bald eagle has been federally delisted (USFWS 2007) and is once again a common breeding bird in lowland forests and riparian areas of Washington State; however, it remains a federal Species of Concern, is protected by The Bald and Golden Eagle Protection Act (16 U.S.C. 668–668d), the Migratory Bird Treaty Act (16 U.S.C 703–712), and is a Washington State Sensitive Species. Washington State's population is supplemented by many wintering eagles that breed in northern Canada. These birds winter within riparian areas along rivers in Washington with substantial salmon runs (Watson and Pierce 2001). In western Washington, the bald eagle builds large stick nests, typically within line of site of a large waterbody. An eagle pair may have and utilize multiple nests from year to year within the same vicinity. Typically nesting sites are located within mature trees, and often have broken or insubstantial tops with good visual range surrounding the nest. Their nesting season ranges from the beginning of January to mid-August. Bald eagles primarily prey on live fish and waterfowl, and are also known to feed on carcasses of various fish and wildlife species (WDFW 2013).

Multiple bald eagle nests have been documented within the Site, located primarily in Westside Riparian Hardwood/Cottonwood Forest habitat community. There are several pairs of eagles with territories on the Site, and each territory includes multiple nests. Bald eagles can also be seen preying on waterfowl populations within open water and wetland habitat communities throughout the Site. The bald eagle is a year-round resident of the Site, breeding, rearing young, and overwintering within the Site property. In winter months and during large runs of anadromous fish such as salmon and smelt, other eagles may occupy the site, overwintering or feeding for weeks in the same vicinity with resident pairs.

Streaked horned lark

The streaked horned lark, a Pacific Northwest sub-species of the horned lark, is a small year-round resident songbird with a total population of less than 1,000 individuals (USFWS 2015b). This ground-nesting species prefers a specific and narrow range of habitat conditions that typically

involves periodic disturbance (manmade or natural) in order to generate and maintain optimal early seral-stage floodplain habitat conditions (Anderson and Pearson 2015). Historically, suitable nesting habitat was found in prairies, along the coast of Washington, and along the Columbia River floodplain. Today, nesting occurs in native prairies, coastal dunes, fallow agricultural fields, seasonal wetlands, sparsely vegetated edges of grass fields, moderately- to heavily-grazed pastures, seasonal mudflats, port and airport properties, dredge spoil islands and other sand-dominated areas in and along the tidal reach of the Columbia River. Nesting begins in late March and continues into late August. Due to predation by coyotes, raccoons, and other predators, the streaked horned lark has a low nest success rate and will typically lay multiple egg clutches each year.

In the lower Columbia River, optimal habitat consists of large expanses of suitable habitat (land and water areas of 300 acres or more) (USFWS 2015b) adjacent to the Columbia River composed of a high percentage of exposed sand (>60%) and gravel interspersed with sparse coverage of low-structure vegetation including native and non-native grasses and forbs. Some patches with the appropriate characteristics (i.e., bare ground, low stature vegetation) may be smaller in size if adjacent fields provide the required open landscape context. For example, many of the sites used by larks on the islands in the Columbia River are small, but are adjacent to open water, which provides the open landscape context needed (USFWS 2015b). Actual defended nesting territories are in the 1–2 acre range (D. Greene, Natural Resources Manager, Port of Portland, pers. Comm. February 2015). Foraging for insects occurs within fallow, recently plowed, and sparsely vegetated fields, and along the wrack line and intertidal areas of Columbia River beaches including the intertidal area (Stinson 2005).

Streaked horned lark surveys within areas of suitable habitat were conducted within the proposed Bank Site in the spring and summer of 2014 over the course of three bird survey efforts. Suitable habitat was documented within two main areas of the Site; the expanse of beach on the Columbia River at the northwest corner of the Site south near the mouth of the Lewis River, and within the agricultural fields in the northeast corner of the Site adjacent to the Lewis River. While this species was not observed during these survey efforts, absence of occupation within suitable habitat is not predictive of future use (Jensen 2014). The presence and quality of existing suitable habitat indicates that this species may occupy the Site to nest and/or forage throughout the year. Given the very low total population numbers, transient availability of suitable habitat within the lower Columbia River, and suitable habitat on the Site, this species has a high likelihood to occur at the Site for breeding and foraging, and future occupation or reintroduction is possible.

Sandhill crane

Three subspecies of sandhill crane occur in Washington: a small number of greater sandhill cranes breed in Klickitat and Yakima counties; about 23,000 lesser sandhill cranes stop in eastern Washington during migration; and 3,000–4,000 Canadian sandhill cranes (and possibly some 44hermo and greaters) stop in the only migratory stopover in Western Washington, on the lower Columbia River bottomlands (Engler et al. 2003). Lower Columbia River floodplain habitat is the only major stopover site between northern breeding areas and wintering sites in California. In recent years, up to 1,000 sandhill cranes have wintered on lower Columbia bottomlands, primarily at the adjacent RNWR, Washington, Sauvie Island Wildlife Area, Oregon, (located across the Columbia River) and surrounding agricultural areas (Littlefield and Ivey 2002) including the proposed Bank Site. Sandhill cranes are omnivorous, feeding on grains, plant material, invertebrates, amphibians, and even small mammals (WDFW 2008).

Most of the sandhill cranes seen in Washington winter in California. The greater sandhill cranes that breed in Washington are part of the Central Valley population, so called because they winter in California's Central Valley. Other members of this population nest in Oregon, California, Nevada,

and interior British Columbia. Lesser sandhill cranes that stop in Washington during migration between their breeding grounds in Alaska and wintering areas in California are of the Pacific Flyway population. The subspecies composition of sandhill cranes that stage and winter along the lower Columbia River in northwest Oregon and southwest Washington is uncertain, but may include all 3 forms using the Pacific Flyway: lesser, Canadian, and greater (WDFW 2013). Several factors can affect Washington's sandhill cranes, particularly on private lands, including water availability and management, and incompatible grazing and haying practices (WDFW 2013). For migrant cranes, habitat on the lower Columbia River bottomlands between Vancouver and Woodland in Washington is threatened by industrial development and conversion of agricultural lands to incompatible uses, and crane habitat use is affected by disturbance from hunters and other recreationists (WDFW 2013).

Migratory sandhill cranes are locally common at the Site, and roosting and foraging habitat occurs along the edges of open water, in herbaceous wetlands, and in the open agricultural fields.

Yellow-billed cuckoo

The yellow-billed cuckoo is a rare, large passerine migratory bird, characterize by a large yellow bill and relatively long tail with distinct circular patterns. The western population of the yellow-billed cuckoo, an insect-eating bird found in riparian woodland habitats that winters in South America and breeds in western North America, has experienced a major decline in its breeding range since the 1800s and is now extirpated throughout most of its historical range. A few small and widely dispersed nesting populations remain in California, Arizona, and New Mexico as well as a few scattered nesting pairs in Idaho, Utah, Colorado, and Nevada (Reynolds and Hinckley 2005, Johnson 2009). Breeding no longer occurs in Washington, Oregon, and British Columbia (Campbell et al. 1992; Marshall et al. 2003, Tweit 2005). The western yellow-billed cuckoo historically bred in western Washington and was once recorded as abundant along the lower Columbia River at present-day Vancouver. This species is known to breed in deciduous riparian forest with cottonwood and willow, and occasionally riparian shrub communities, almost always near water (WDFW 2013). Breeding pairs in the Pacific Northwest are extremely rare. In western North America, western yellow-billed cuckoos begin arriving from migration in mid- to late May, making them one of the last migrants to return (WDFW 2013). Most nesting occurs between June and early August, but can extend from late May until late September. Unlike many species of cuckoos, western yellow-billed cuckoos often build their own nests and care for their own young.

Western yellow-billed cuckoos have not been observed within the Site, however suitable riparian forest habitat is relatively abundant and reintroduction of western yellow-billed cuckoos is possible on this Site.

Slender-billed white-breasted nuthatch

A sub-species of the white-breasted nuthatch, the slender-billed white-breasted nuthatch is a small resident passerine bird that occurs in a very limited range west of the Cascade Range in Oregon, Washington, and Northern California. This species is closely associated with mature stands of Oregon white oak and ponderosa pine, but may also utilize isolated oaks in agricultural settings and is considered locally rare. Oregon white oak and prairie habitats were once far more widespread from the southern Willamette Valley northwards to southern Puget Sound, but these habitat types have experienced a dramatic decline and are among the most threatened habitat types in the Pacific Northwest (Hanna and Dunn 1997, ABC 2006). White-breasted nuthatch densities are greater in areas with higher numbers of large trees, which provide more surface area for foraging and have more natural cavities for nesting and roosting (Hagar and Stern 2001, Viste-Sparkman 2006). Large, sprawling, open-grown oaks in woodlands with sparse understories are particularly important as habitat because these trees have more cavities for nesting and foraging substrate than oaks grown in

densely vegetated habitats of younger trees. Slender-billed white-breasted nuthatches are more abundant in relatively smaller (less than 30 acres) woodland patches, which by definition have more edge, than larger (greater than 62 acres) patches (Viste-Sparkman 2006). Slender-billed white-breasted nuthatches are locally abundant in lowland areas of Clark County, with numbers appearing to be highest in the vicinity of RNWR (WDFW 2013).

The slender-billed white-breasted nuthatch has been documented to occur throughout the Site in mature cottonwood stand and Oregon white oak communities, and nests have been recorded on the property in large mature Oregon white oak trees. This species would be expected to occur year-round throughout the Site in forested areas with mature Oregon white oak, Oregon ash, and cottonwoods.

Western pond turtle

The western pond turtle is one of two native turtle species in western Washington, and both are documented to occur on the Site (the other species present and breeding is the western painted turtle). The western pond turtle occupies habitats with components of slow moving streams, lakes, ponds and wetlands. The western pond turtle has declined throughout its range, but is still locally common in parts of California and Oregon. Recovery in Washington will require long-term efforts because the turtles grow slowly, requiring up to 10 years to produce their first offspring (WDFW 2013). Barriers to recovery include habitat fragmentation, barriers between upland nesting and aquatic habitats, and predation predominately by mammals but also including predation of hatchlings by birds and bullfrogs (Hays 1999).

Western pond turtles spend a considerable amount of time engaged in 46hermos-regulatory behavior. When out of water, turtles seek warmth from the sun in an activity known as emergent basking. Emergent basking has been noted in all months of the year in some areas, but generally increases in frequency through the spring to a peak in early to mid-June. Turtles normally forage along the bottom of water bodies, searching carefully in submerged leaf litter and other detritus. They may also forage on items on the surface or feed in the water column, preying heavily on aquatic macroinvertebrates such as the larvae of beetles, stoneflies, caddisflies, dragonflies, and other insects (Hays 1999). Western pond turtles use upland areas adjacent to water bodies for dispersal, nesting, overwintering, and aestivation. Other overland movements include spring and fall migrations to and from upland overwintering sites, in response to drying of the water body, or for other reasons not presently understood (Holland 1991, Hays 1999). Many turtles overwinter on land at sites up to approximately 1,650 feet from the water. Overwintering sites tend to have a deep layer of duff or leaf litter under trees or shrubs, and some turtles return to the same site each year (Holland 1994, Bury and Germano 2008).

Western pond turtles were reported by the landowner to be present on the Site at Lancaster Lake in the 1980s and 1990s. Recent survey efforts have identified both western pond turtles, and higher numbers of western painted turtles. Western painted turtle nesting sites were first found in spring of 2014 near the shore of Lake Rosannah (outside the proposed Bank location) through visible remains of predated nests (likely by raccoons). In spring of 2015, more formal turtle surveys were initiated throughout the property and both species of turtle were documented, including the locations of additional western painted turtle nests and preferred basking sites both within and outside the proposed Bank Site. All known nests were protected after eggs were laid with wire mesh and wood frame exclusion devices to prevent predation by raccoons and other predators. In addition to presence/absence surveys of suitable habitat, motion detection wildlife cameras were deployed to document turtle species on basking structures, female turtles on nesting sites, and hatchling emergence. In 2015, turtles were first observed on Site in mid-May with nesting attempts beginning

in early July. Hatchlings were first observed emerging in mid- to late August, approximately 2 months after nesting was initiated.

Oregon spotted frog

The Oregon spotted frog was once common throughout the western Pacific Northwest. In Washington it is currently known to occur in three locations, including three historic populations in Clark County (WDFW 2013). The most significant factor contributing to the decline of Oregon spotted frogs is the loss and alteration of wetland habitat. Oregon spotted frogs have life history traits, habitat requirements, and population characteristics that make them vulnerable to such loss and limit their distribution (WDFW 2013). Oregon spotted frogs are highly aquatic, inhabiting marshes and marshy edges of ponds, streams, and lakes and usually occur in shallow, slow moving waters with abundant emergent vegetation and a thick layer of dead and decaying vegetation on the bottom (Larsen 1997). Oregon spotted frogs are active in lowland habitats from February through October, and hibernate in muddy bottoms near their breeding sites in winter (Svihla 1935; Licht 1969, 1974). It is possible that overwintering sites are also used for breeding (Hays 1994).

Many of Washington's wetlands have been drained, filled, or otherwise altered, and continued development in the vicinity of current Oregon spotted frog habitat is expected (Corkran and Thoms 1996, McAllister and Leonard 1997). Small wetlands are particularly vulnerable because they are more difficult to maintain as functional communities and are less resistant to changes in hydrology and water quality than larger wetlands (Richter and Azous 1995). Changes in hydrology and plant communities resulting from development, as well as polluted run-off jeopardize the Oregon spotted frog (Larsen 1997). Reed canarygrass is particularly impacting documented Oregon spotted frog habitat sites that are occupied; active cattle grazing is used as a management tool to maintain low-growing emergent vegetation at breeding sites.

Amphibian surveys were initiated in early spring of 2015. Surveys identified long-toed salamander egg masses, northwestern salamander egg masses, rough skinned newts, Pacific treefrogs and their egg masses, and Northern red-legged frogs and their egg masses. Bullfrogs are also known to occupy the Site. Although no Oregon spotted frogs have yet been observed within the Site, there is suitable habitat for each life stage of this species and reintroduction is possible. Oregon spotted frogs were documented higher on the Salmon-Washougal terrace in Clark County, Washington prior to 1992.

Columbian white-tailed deer

The Columbian white-tailed deer is a larger-bodied subspecies of the white-tailed deer, occurring within the Columbia River floodplain, and the only white-tailed deer found west of the Cascades (Brookshier 2004). Lewis and Clark wrote of four subspecies of white-tailed deer in their journals, including what is now called the Columbian white-tailed deer that was observed along the Columbia River from present day The Dalles to Astoria, Oregon (Thwaites 1905). These deer utilize most floodplain habitats, preferring the edges of riparian forested environs, open meadows and agricultural fields, all within close proximity to the Columbia River. They are frequently observed swimming in sloughs and rivers, including regularly crossing larger rivers such as the mainstem Columbia River and the Lewis River (E. White, Wildlife Biologist, Cowlitz Indian Tribe, Longview, Washington, pers. Comm., April 2015). Columbian white-tailed deer utilize forested and scrub-shrub wetlands as cover, and prefer these areas for fawning as they tend to be isolated by spring freshet flooding, thus reducing coyote predation of fawns. Columbian white-tailed deer were once found in a contiguous area in southwestern Washington and western Oregon, but now exist in two distinct, geographically isolated populations: one in Douglas County, Oregon, and a second along the lower Columbia River (USFWS 1983, 2013a), where the proposed Bank is located. Aside from habitat loss and

fragmentation, coyote predation on young and mortality from roadkill on highways and roads are two primary factors challenging recovery of this species.

The USFWS began translocating Columbian white-tailed deer to the adjoining RNWR from the Julia Butler Hansen Refuge for the Columbian white-tailed deer near Cathlamet, Washington, in January of 2013 and continued translocation efforts occurred in 2014 and may possibly continue in 2015 (USFWS 2014c). Columbian white-tailed deer have been observed on the proposed Bank Site since immediately following the first translocation efforts. Now Columbian white-tailed deer have taken up year-round residence and they co-occur with Columbian black-tailed deer on the proposed Bank Site, and deer suspected of being hybrids have been observed. Pregnant does along with bucks are translocated; deer that are translocated are outfitted with identifying ear tags and in some cases radio collars for tracking purposes. Fawns born to these does are not tagged. Motion detection wildlife cameras have documented both tagged and untagged Columbian white-tailed bucks, and does with fawns on the proposed Bank Site in spring of 2015. Bank Sponsors are working with the Cowlitz Indian Tribe to assess the current Columbian white-tailed deer population and composition on the Bank Site and nearby occupied habitats through remote camera imagery.

Western gray squirrel

The western gray squirrel is the largest native tree squirrel in Washington. Western gray squirrels range from northcentral Washington southward through the western half of Oregon and into southern California (Carraway and Verts 1994). Arboreal and generally solitary in their habits, western gray squirrels forage mostly on the ground, but rarely stray far from trees. They use stick nests for resting and sleeping, and females use cavity nests for rearing of young. Western gray squirrel habitat is typically in transitional, conifer-dominated areas that merge with open patches of oak and other deciduous trees. Mature and large seeded mast-producing trees provide abundant food and sites for nest construction (Linders et al. 2010). In Washington, pine and oak are especially important for their ability to produce an abundance of large seeds. Pine nuts, acorns, seeds, green vegetation, hypogeous fungi (truffles and false truffles), and fruit are the main components of the western gray squirrel diet.

Historically, western gray squirrels were more widespread in Washington, but currently occur only in three geographically isolated populations: (1) Pierce County in the Puget Trough; (2) Klickitat, Yakima, and Skamania counties in the southeastern foothills of the Cascades; and (3) Chelan and Okanogan counties in north-central Washington (Linders and Stinson 2007). This species inhabits transitional forests of mature Oregon white oak, ponderosa pine, Douglas-fir, and various riparian tree species (Linders and Stinson 2007). Habitat quality in Washington is assumed to be relatively poor compared to other parts of the species' range due to the lower number of oak species and degradation of pine and oak habitats through fire suppression and urban development. Competition with the introduced eastern gray squirrel and other species of squirrels may also impact the remaining populations. The biggest threat at this time to western gray squirrels in Washington State appears to be genetic isolation, and low numbers resulting in a decline in genetic diversity and the negative effects of inbreeding (Linders and Stinson 2007, WDFW 2015a).

Historically, western gray squirrels in Washington were found throughout Clark County and along the lower Columbia River from Klickitat County to the east, north into Cowlitz County, potentially connecting with the Puget Sound population. Given the high quality and large tracts of their preferred habitat on the Site, it is possible that this species occupies the Site in low numbers or could potentially occupy the Site in the future through reintroduction efforts. Motion detection wildlife cameras were used starting in the fall of 2014 in forested areas of Oregon white oak and mixed Douglas-fir forests. Squirrel species detected to date include Douglas' squirrel, northern flying squirrel, eastern gray squirrel, and California ground squirrel.

5.7.1.2 Non-listed Native Species

Numerous resident and migratory non-listed native wildlife species occur within the Site. The location in the Lower Columbia River Eco Province, within the Pacific Flyway, and in the Columbia River floodplain and confluence of the Lewis River and Gee Creek provides a diversity of habitats that supports a wide array of species, including some endemic to the lower Columbia River. Species that have been documented to occur during existing conditions studies are listed in Appendix A.

5.7.1.3 Non-native Species

A number of non-native wildlife species common to western Washington and the lower Columbia River basin are present within the Site throughout the year. Most non-native wildlife species documented within the Site are ubiquitous to rural/residential and forested environs west of the Cascade Range and include opossums, eastern gray squirrel, nutria, house sparrow, ring-neck pheasant, starling, and bullfrog. There is no indication that these species occupy the Site in larger populations than current levels for western Washington. Refer to Appendix A for a complete list of native and non-native species that have been documented to occur on the PN Farm Property.

5.7.2 Habitat Classification Methodologies

A number of relevant methodologies exist that group, classify, and describe habitat types or habitat communities at varying scales. Methodologies are often based all or in part on wetland type or function, vegetation structure, or vegetation associations. Wildlife species presence can then be predicted or associated with specific habitats. There is no one system that serves to describe all habitat functions at all scales, as each methodology varies in how communities are delineated and described. For the purpose of describing and organizing the Site into distinct habitat communities, we utilize four complimentary classification systems to describe habitats, their functions and conditions, and predictive presence of both wildlife and vegetation species. Three of these methodologies are utilized to describe general habitat types within the Site, while the fourth is used specifically to classify wetland habitat on the Site:

1. **The Pacific Northwest Habitat Classification Systems (PhaCS) Database:** perhaps the most comprehensive habitat classification database in the Pacific Northwest, utilized extensively by state and federal agencies. PhaCS has been updated with a crosswalk between the Northwest Habitat Institute's Integrated Biodiversity Information System (IBIS), which classifies and describes larger-scale habitats in hierarchical order (including Eco Provinces, Sub-Basins, and Habitat Communities) with the purpose of identifying wildlife linkages within the Pacific Northwest, and the Bonneville Power Administration Integrated Status and Effectiveness Monitoring Program (NWHI 2015). The PhaCS database compiles different habitat classification systems into a single database and cross-walks these to a common system. This project, funded by the Northwest Environmental Data Network and the National Biological Information Infrastructure (NBII), is intended to improve communication between groups that may use different habitat classification systems. Utilizing IBIS along with on-site surveys and field observations, we are able to describe a number of distinct habitat communities within the Site. In order to identify habitats at a finer scale and because Site-specific knowledge is available, sub-communities are identified in order to capture unique wildlife communities at the Site scale.
2. **NatureServe:** a vegetation community alliance classification system utilizing widely accepted ecological community descriptions. This classification standard defines known vegetation community alliances delineated by documented vegetation species alliances and habitat structure characteristics, and are named for the dominant vegetation species within that community. These alliances make up in part the larger IBIS habitat community types. This

system is very useful at the Site-scale, providing detailed description of vegetation alliances from which additional delineation of suitable wildlife habitat can be identified and described. NatureServe alliance delineations, descriptions, and resulting map will be presented in a wildlife technical memorandum within the proposed Bank's Basis of Design Report.

3. **Washington Department of Fish and Wildlife Priority Habitats and Species (PHS):** WDFW maintains a database of PHS species and habitats. According to WDFW (2015a), "PHS is the principal means by which WDFW provides important fish, wildlife, and habitat information to local governments, state and federal agencies, private landowners and consultants, and tribal biologists for land use planning purposes. PHS is the agency's primary means of transferring fish and wildlife information from our resource experts to those who can protect habitat." The PHS database provides known occurrences of special-status species, species guilds, and habitats described as priority habitats by WDFW. PHS habitat descriptors and occurrences are often at a comparatively larger scale as the database provides information statewide, often obtained by remote-sensing or by WDFW biologists. The PHS database was queried on 23 February 2015, and the results of the database query indicated multiple occurrences of three WDFW priority habitats, including Oak Woodlands, Wetland Complexes, and Riparian Corridors. Wildlife species or assemblages that were documented include multiple occurrences of cavity-nesting ducks, waterfowl concentrations, and bald eagles (nesting, roosting, and wintering) (WDFW 2015b).
4. **Cowardin Wetland Habitat Classification:** based on Cowardin Classification system (Cowardin et al. 1979) combined with vegetation composition and structure present on the Site. For a complete description of wetland community mapping, please refer to Section 4.1.1.

5.7.3 Existing Habitat Types

Wildlife habitat types were broadly classified and their habitat types that occur within the Site were generally described (based on groupings of subtypes in Johnson and O'Neil 2001, IBIS, etc. as described in Section 5.7.2), largely for the purpose of identifying potential native breeding faunal guilds from the literature. These broad-scale habitat types are further broken down by native vegetation, or primary land use groupings to better represent the habitat and potential species at a site scale. First tier or broad-scale habitat types are provided in Figure 16. The hierarchy of wildlife habitats (organized starting at the highest elevation habitats and proceeding to the lowest elevation, acknowledging that there is overlap in elevation distribution across habitat types) is described as follows:

1. UPLAND FORESTS (286.15 acres)
    a. Westside Lowland Conifer-Hardwood Forest
        i. *Pseudotsuga menziesii-Alnus rubra-Acer macrophyllum*
    b. Westside Oak and Dry Douglas-fir Forest and Woodlands
        i. Westside *Quercus garryana* Forests and Woodlands
            1. Oregon white oak/Oval-leaf viburnum/Poison oak woodland
        ii. Westside *Quercus garryana-Pseudotsuga menziesii* Forests
        iii. Westside Dry *Pseudotsuga menziesii* Forests
2. WESTSIDE GRASSLANDS (also referred to as Native Grasslands) (occur in small isolated patches within other habitat types)
    a. Westside *Festuca idahoensis* var. *roemeri-Danthonia californica*

3. FLOODPLAIN FORESTS (292.23 acres)
    a. Westside Riparian—Wetlands
        i. Westside Riparian and Wetland Deciduous Forests
            1. Columbia River Black Cottonwood Gallery
            2. Oregon Ash Floodplain Forest
        ii. Westside Riparian/Wetland Shrublands
4. AGRICULTURE, PASTURE, AND MIXED ENVIRONS (286.15 acres)
    a. Improved Pasture
    b. Modified Grasslands
5. HERBACEOUS WETLANDS (64.41 acres)
    a. Graminoid Wet Meadow
    b. Herbaceous and Sedge Wetlands
        i. Tidal Wetlands
        ii. Freshwater Tidally Influenced Marshes
        iii. Impounded/Managed Wetlands
    c. Freshwater Aquatic Beds
        i. Columbia River Shoreline/Sandy Beach
        ii. Tidally Influenced Aquatic Beds
        iii. Impounded/Managed Aquatic Beds
6. OPEN WATER—LAKES, RIVERS, STREAMS (103.59 acres)
    a. Riverine
        i. Tidally Influenced Freshwater Riverine Mainstem Deepwater
        ii. Tidally Influenced Freshwater Riverine Mainstem Shoreline/Shallow
        iii. Tidally Influenced Freshwater Riverine Off-channel/Side-channel
    b. Lacustrine—Open Water
        i. Tidally Influenced Ponded and Lake
        ii. Impounded/Managed Ponded and Lake

Westside Lowlands Conifer-Hardwood Forest

This upland forest habitat occurs throughout low-elevation areas of western Washington, and is broken into two subgroups that occur on the Site: Westside Lowland Conifer Forest and Westside Riparian Hardwood/Cottonwood Forest.

Westside Lowland Conifer Forest

Restricted to the higher elevation areas of the Site above the Columbia River floodplain, the Westside Lowland Conifer Forest community is dominated by Douglas-fir with a lesser dominance of western red cedar and other native conifers, and a lower dominance of hardwood species including big-leaf maple and red alder. The understory is composed of a wide variety of native shrubs and forbs, including snowberry, low Oregon grape, sword fern in drier soil types, and red-osier dogwood and alder in wetter areas. This is a critical component for terrestrial wildlife of the Site, not only for species that are associated with mid- to late-successional conifer stands, but also serving as refugia during periods when the Columbia River inundates the Site. Columbian white-tailed deer and most terrestrial mammals would seek out higher ground during flooding events.

Westside Riparian Hardwood/Cottonwood Forest

Westside Riparian Hardwood/Cottonwood Forest is characterized by stands of cottonwoods in non-wetland soils with other subdominant hardwood species such as Oregon ash, red alder, and big-leaf maple. This habitat type occurs adjacent to the cottonwood-dominated Deciduous Forested Riparian

Floodplain Wetlands/Cottonwood Gallery (described below), and is characterized by slightly higher elevations that are subject to less frequent inundation. Wildlife species associated with this habitat subgroup include primary forage and rearing habitat for the Columbian white-tailed deer, nesting and foraging habitat for the slender-billed white-breasted nuthatch, foraging habitat for beaver, and nesting/roosting habitat for the bald eagle, osprey, and other raptors.

Westside Oak and Dry Douglas-Fir Forest and Woodlands

The Westside Oak and Dry Douglas-Fir Forest and Woodlands habitat type occurs dominantly throughout the uplands, generally above seasonal flooding elevation. Within the Site, this habitat type is dominated by Oregon white oak with a lesser occurrence of conifers including Douglas-fir. Historically, conifers would have had an even lower occurrence within these oak woodlands due to more frequent fire regimes. This is a particularly important habitat type as oak woodlands within the Willamette Valley and lower Columbia River watershed were once abundant but now occur in smaller fractured pockets as many of the larger oaks were removed. Within this larger community, we identified one main subgroup within the Site.

Oregon White Oak Woodlands

Oak-dominated stands characterized by large to medium-diameter Oregon white oak trees with an understory dominated by a wide variety of native shrubs, including the oval-leaved viburnum (a native shrub with a very limited range in Western Washington), poison oak, and other native shrubs and herbaceous species. This dry forested environment also contains important habitat features including snags and cavity trees. A number of wildlife species are found in this habitat community including the slender-billed white-breasted nuthatch and other cavity nesting birds such as woodpeckers and wood ducks when proximal to aquatic habitats, bobcats, black bears, arboreal squirrels, and many additional mammal species.

Westside Grasslands

Westside Grasslands are characterized by remnant native upland grassland plant assemblages, distinguished from the lower lying herbaceous wetlands or managed pastureland, and are found in small pockets primarily throughout higher elevations within the oak woodlands on thin mineral soils that have developed in place on open basalt outcroppings or knobs (also referred to as basalt balds) and other smaller clearings within the oak woodlands. These grassland communities contain a diverse assemblage of primarily native grasses and herbaceous species, moss and lichen, and a lower percentage of low-growing shrubs. Cryptobiotic crusts may also be present in small quantities. Species here can be miniaturized due to the shallow soil profile and represent species more commonly seen in the Columbia River gorge and other transition habitats between the montane and lowland areas.

Open Water—Lakes, Rivers, Streams, Side-channels, and Ponds

This habitat type is widespread and varied within the Site and includes the Columbia River, Lewis River, Lancaster Lake, Gee Creek, permanent and seasonal open waters/pond associated with Gee Creek, and groundwater/rainwater-fed permanent ponds within the Middle Lands. The acreage of open water, particularly in low-lying areas subject to inundation by higher flows in the Columbia River can vary greatly throughout the year. Open water habitats (both hydrologically connected through direct surface water flows and impounded habitats fed by rain, groundwater, and hyporheic exchange) range from just a few acres in the late summer/early fall period to well over 320 acres in the spring freshet/flood flow peak dominated by Columbia River backwater and high groundwater influence.

Columbia River Shoreline/Beach

Unique to the lower Columbia River shoreline and lower reaches of tidally influenced tributaries are large expanses of sandy beaches. Columbia River Shoreline/Beach habitats are subject to daily tidal fluctuations as well as seasonal flooding and annual depositions of sand and lesser quantities of silt. These sparsely vegetated communities provide ideal early seral stage habitat conditions for shorebirds, the federally threatened streaked horned lark, and the federally endangered Columbian white-tailed deer. This habitat is located at the northwest corner of the Site on the Columbia River south of the mouth of the Lewis River and extends to the mouth of Gee Creek and upstream the Lewis River past the railroad bridge where the rivers are dominated by bed having large rolling sand waves and a heavy mobile sand bedload.

Herbaceous Wetlands

Wetland vegetation communities are widespread throughout the Site, with heavy concentrations of herbaceous or emergent wetland habitats occurring within the southern half of the Site in low-lying inundated areas associated with Gee Creek and backwater areas of the Columbia River floodplain. Vegetation includes native species such as wapato and sedge and rush species. Non-native species include reed canarygrass and pasture grass. Herbaceous Wetlands support many life stages of numerous wildlife guilds. This important habitat type is critical for frogs, salamanders, breeding birds, and aquatic mammals such as vole, beaver, mink and river otter.

Westside Riparian Wetlands

Forested and shrub-dominated riparian wetland communities are also common throughout the Site, and are perhaps the most widespread habitat types, occurring along the Lewis and Columbia rivers and riparian areas associated with Lancaster Lake, Gee Creek, and backwater wetlands of the Columbia River floodplain. Dominant species include native deciduous trees and shrubs including Oregon ash, red alder, red-osier dogwood, willow species, and other deciduous native tree and shrub species. The larger habitat type of Westside Riparian Wetlands can be further subcategorized within the Site into two subgroups: Deciduous Forested Riparian Floodplain Wetlands/Cottonwood Gallery and Scrub-shrub Wetlands.

Deciduous Forested Riparian Floodplain Wetlands/Cottonwood Gallery

The Deciduous Forested Riparian Floodplain Wetlands/Cottonwood Gallery habitat subgroup is composed primarily of large black cottonwood and Oregon ash dominated canopies with an open shrub understory and occurs in lower floodplain areas for wetlands, and higher floodplain areas for cottonwood dominated forests. Riparian edges along Gee Creek, the Lewis River, and primary side channels of the Lewis River and Columbia River mainstems. Wildlife species associated with this habitat subgroup would be expected to be similar to the Westside Riparian Hardwood/Cottonwood Forest subgroup described previously, and includes primary forage and rearing habitat for the Columbian white-tailed deer, nesting and foraging habitat for the slender-billed white-breasted nuthatch, foraging habitat for beaver, and nesting/roosting habitat for the bald eagle, osprey, and other raptors.

Scrub-shrub Wetlands

The Scrub-shrub subtype is composed of a variety of wetland shrubs dominated by multiple willow species, red-osier dogwood, and other native shrub species with an understory of primarily wetland grass species. Wildlife species associated with this habitat subgroup include primary forage and rearing habitat for the Columbian white-tailed deer, foraging habitat for beaver, nesting habitat for multiple resident and migratory birds, and amphibian egg and rearing habitat when submerged habitat is present.

Agriculture, Pasture, and Mixed Environs

The Agriculture, Pasture, and Mixed Environs habitat type occurs throughout the Site. These pastures have been improved periodically, and in some cases annually, for decades. These practices have resulted in a dominant vegetation type of introduced pasture grasses and to a lesser degree native grasses that provide good forage, and weedy species. These areas are lower in elevation and are seasonally inundated with exception to the higher elevation areas adjacent to the Lewis River dike. All pasture areas are currently utilized as grazing land for cattle on a rotational basis. There are two habitat subgroups in this larger type with slight differences in grass and herbaceous species, influenced primarily by the presence of wetland soils: Agricultural/Pasture Wetlands and Agricultural/Pasture Uplands.

Agricultural/Pasture Wetlands

The Agricultural/Pasture Wetlands have slightly lower elevations with more frequent inundation and ephemeral pockets of standing water and are delineated by wetland soils and a higher percentage of wet-tolerant vegetation. Multiple amphibians have been documented to lay egg clusters in the vegetated ephemerally ponded areas. In addition to amphibians, many other species can be found in these areas year-round including Columbia white-tailed deer, bats and birds that hunt insect swarms that congregate above the fields such as swifts and swallows, foraging habitat for turtles, sandhill cranes, and multiple waterfowl species.

Agricultural/Pasture Uplands

The Agricultural/Pasture Uplands have slightly higher elevations with less frequent inundation and upland soils. Despite the lower diversity of non-native herbaceous vegetation, a number of native wildlife species can be found in these fields, including streaked horned lark in sparsely vegetated areas, Columbian white-tailed deer, bald eagles and other hunting raptors such as northern harriers, and American kestrel, bats and birds that hunt for insects on the wing, sandhill cranes, overwintering geese and other waterfowl, nesting and foraging habitat for turtles, and coyote and multiple other mammals hunting for small rodents.

5.7.4 Proposed Habitat Types

A wildlife habitat functions assessment and more detailed mapping is currently in progress; the results of this assessment are forthcoming. Appropriate habitat restoration prescriptions and species protection approaches, as well as species and habitat-specific service areas will be developed in close collaboration with the IRT. The intent is to increase native plant community cover, and to convert non-native managed pasture areas to native grasslands, wet meadow, and a variety of wetland cover types. Oak Woodland habitat values will be enhanced through removal of competing non-native understory species like Himalayan blackberry and competing species like Douglas-fir. Wet pasture areas currently behind dikes will be reconnected to tidal hydrology and consist of open water seasonal and permanent ponds and tidal channels, diverse wetland cover types, and floodplain forests. Early seral stage floodplain habitats suitable for streaked horned larks will be created using excavated sand material. Cover, browse, and fawning areas will be enhanced for Columbian white-tailed deer. Conceptual wildlife habitat types for initial IRT consideration are provided in Table 12 and illustrated in Figure 18.

Table 12. Conceptual wildlife habitat types for initial IRT consideration.

Habitat type	Acres
Open Water/Marsh/Side-channel	24.56
Mosaic of Open Water/Marsh/Wet Meadow	187.14
Wet Meadow and Native Grassland	41.51
Early Seral Stage Floodplain Habitat for Streaked Horned Lark	61.38
Mosaic of Native Grassland/Wet Meadow/Herbaceous Wetlands	173.02
Floodplain Forest	241.24
Herbaceous Wetlands	10.76
Upland Forest–Oak Woodland	136.64

6 SITE SELECTION RATIONALE

Plas Newydd Farm was purchased by the Morgan family in 1941 and has been a working farm since that time. This property was not sought out for purchase as a mitigation bank. Multiple generations of the Morgan family have been invested in the farm as a family business, conscientiously utilizing this property while protecting the land for its agricultural and natural resources values. This unique Columbia River floodplain (Figure 13) site offers a broad range of habitats and a great potential for improved watershed processes and ecological functions. The family has chosen mitigation and conservation banking as a tool for restoration, long-term conservation, maintenance, and stewardship.

6.1 WATERSHED APPROACH AND ECOLOGICAL SUITABILITY

While the Bank Site was not purchased for the sole intent of creating a wetland mitigation and habitat conservation bank, the Site meets the criteria and considerations that define selecting a mitigation site using a watershed approach as identified by Ecology, USACE, and EPA (Hruby et al. 2009). We have also evaluated the Site using other guidance for applying a watershed- or process-based restoration approach including guidance on siting and development of Conservation Banks and/or habitat restoration projects from USFWS (2003), NMFS (2013, Beechie et al. 2010), WDFW (Ecology and WDFW 2000, Cramer 2012), The Conservation Fund (2013), and others. As noted above, we are applying a watershed- or process-based restoration approach based on our detailed knowledge of the Site and understanding of four primary principles: (1) the mechanisms of ecological and watershed processes that determine the geomorphic, hydrologic, and ecological functions of a site in the context of the site location within the watershed; (2) the extent to which those processes and functions have been altered by land use or management actions; (3) where and how those processes can most effectively be restored and protected; and (4) the role of restoration and compensatory mitigation in repairing lost watershed and ecological processes and functions in the Columbia River basin landscape.

The following subsections provide additional context and supporting documentation that was used to shape the scale and type of bank proposed, the proposed mitigation action design concepts, and the proposed Service Area.

6.2 CLARK COUNTY

In order to improve the outcome of mitigation projects, Ecology took the lead on developing a framework for Clark County to guide the analysis and characterization of watersheds within its jurisdiction. By evaluating the geographical areas contributing surface/groundwater, their level of importance to watershed processes and the level of impairment, Clark County has divided and sub-divided watersheds to identify areas that are best suited for protection, restoration, and development.

Based on the Watershed Characterization and Analysis of Clark County, this Site has been evaluated as a high-priority zone for protection and restoration (Ecology 2009).

The proposed Bank Site is identified as part of the Cathlapotle sub-basin within the Columbia River landscape group. Hydrology in the Columbia River Unit is influenced in large part by the Columbia River. Groundwater recharge is produced by flow from upland watershed units and surface waters of the Lewis and Columbia rivers. This floodplain unit is tidally influenced and experiences 2–4 feet of daily surface water fluctuation. The proximity of the Site to the confluence of two major rivers has resulted in fluvial geomorphology shaped by silt and sand deposits. Clark County determined the proposed Bank location in the Cathlapotle subbasin to be a high priority for protection and restoration based on a high importance rating for floodplain and hydrologic processes and a relatively low impairment score (Ecology 2009). Presence of and proximity to the RNWR has resulted in a lowered impairment score for this sub-basin. It should be noted that significant alterations have been made to hydrologic processes on the Refuge (water control structures that impound water for waterfowl) and the Bank Site, and mitigation of the Bank Site alterations could result in vastly improved functionality and habitat (Ecology 2009).

6.3 LAND USE COMPATIBILITY

Washington Administrative Code (WAC) 173-700-303 (State of Washington 2009) outlines requirements for appropriate mitigation site selection. Site selection and rationale must meet the requirements of two sections: (1) banks must be sited, planned, and designed to be self-sustaining over time, and (2) banks must be compatible with Agricultural Lands of Long-term Commercial Significance (ALLCS).

The first section of WAC 173-700-303 (State of Washington 2009) was developed to ensure mitigation site stability, sustainability, and function. Requirements of this code include provisions for desired aquatic resource functions, ecological sustainability, and compatibility with surrounding land uses. The Site has not been designated as ALLCS (B. Davis, Environmental Permitting Manager, Clark County Environmental Services, pers. Comm., 12 January 2015).

As noted throughout, this Site has been designated a high priority location for restoration and protection in multiple federally authorized and state supported regional planning documents and by numerous natural resource agencies. Impacts to this Site include alterations to landform, hydrology, sediment dynamics, and vegetation communities, and in turn have served to adversely simplify habitat functions. These impacts can be attributed to management activities such as implementation of a system of dikes and levees, repeated dredging of adjacent rivers and disposal of dredge spoil sediments along shorelines, and agricultural practices. Though impacts to the Site have been significant, they have not been so great as to eliminate the opportunity to restore floodplain processes, re-establish and enhance a mosaic of aquatic and terrestrial habitats and provide a wide range of self-sustaining ecological functions.

7 PAST AND PRESENT LAND USE

7.1 RECENT HISTORY

The property claim was first established prior to Washington Territory or Statehood under the 1850 Donation Land Law (ODLL) for the Oregon Territory (Scott 2011). The original DLCs were in the names of Columbia and Rosannah Lancaster, and F. A. Fowler. Modern land use conversion impacts to this Site have persisted since the 1840s and continue to alter the landscape. Evidence of grazing, land clearing for agriculture, road and trail building, and home building is recorded in the General Land Office (GLO) plat as early as 1854 (GLO 2012). At the time of the GLO survey, the Lewis

River was referred to as the Cadapoodle River, and as the Chahwahnahiooks River[4] in the journals and maps of Lewis and Clark (Coues 1893). The GLO maps also show agricultural improvements and structures as required under the DLC rules, as well as a road/trail that went from the Hudson's Bay Company at Fort Vancouver to Woodland and other downriver locations in Washington. Basalt rock sources for Portland's growing network of cobblestone streets was also demarcated on these early maps.

The Northern Pacific Railroad bridge (now the BNSF Railway bridge) was established in the 1890s. In the 1920s, the railroad bridge was converted to a double track structure. During this decade, the current system of levees and dikes was instituted on the property. Dredging and large wood snag obstruction removal persisted as habitual practice on the Lewis River to maintain passage for steam and passenger boats through the 1920s (AINW, Inc. 2013). In 1941, the property was purchased by the Morgan family who began managing the Site for a dairy operation, later as an Angus cattle ranch, duck hunting leases, and forestry and selective harvest. Sustainable forestry harvesting, leased cattle grazing, and leased duck hunting continues today. The property is still owned by the Morgan family, now in its third generation of management.

7.2 CURRENT LAND OWNERSHIP

This property was purchased by the Morgan family in 1941, and the family has maintained ownership of the property since that time.

7.3 LAND USE AND ZONING DESIGNATION

7.3.1 Current Land Use

The Site is primarily zoned for forestry as Forest Tier I-80, with lesser amounts of Agriculture/Wildlife and Parks/Wildlife Refuge (an overflow from the RNWR) (Clark County 2015) (Figure 7) (Cowlitz County 2015).

Historic land use management actions that have impacted the Site include conversion of floodplain for agriculture through diking, ditching, dredging and placement of dredge material, filling, grading and diversion of water. Formerly, the property was managed as a year-round dairy farm, year-round cattle ranch, and then for extraction forestry. Current land use practices on the Site include sustainable timber harvest, seasonal leased cattle grazing, duck hunting leases, and NRCS funded farm activities (Figure 4). Historical maintenance of these areas has included plowing, ripping, and tilling the soil as well as seeding of forage species; however, no-till equipment has been used to prepare pastureland for spring grazing since the 1960s. NRCS-funded farm activities have included Oregon White Oak/Viburnum/Poison Oak community habitat restoration that occurred on and around the forestry area in the middle of the Bank where thinner soil, basalt dominated areas support an upland mixed forest community, waterfowl habitat enhancements in the impounded duck hunting ponds, invasive species treatment, and conversion to an off-channel watering systems for cattle.

7.3.1.1 Agriculture

Plas Newydd LLC takes an active role in the management of cattle grazing leases according to a formal grazing plan that has been developed between the Lessee, Farm Manager, and Managing Partner. The current lease includes yearling heifers, cow/calf pairs, and bulls, which are introduced and grazed at various times between approximately March and November, but can begin as early as February and go for as late as December, or shortened from the approximate timeframe. The initial date of when the cattle are first turned out in the spring is based on current grass condition, grass

[4] Multiple spellings for the Cadapoodle and Chahwahnahiooks rivers are used in historic and modern documents.

height, growth rate, near future weather outlook, river levels, ground conditions, and other factors with personnel and cattle. The rotational grazing approach is described below.

Stocking rates for the total amount of cattle to be grazed at Plas Newydd are based primarily on the amount of rest period days for grass to regrow, growing phase the grass is in, and total acres of grass available for cattle. Rest periods are the total days required once cattle are pulled off a certain paddock to regrow and have forage available to be grazed again and are used for the duration cattle are on the property to determine how long cattle can stay on certain paddocks, when to destock, when to add cattle, and when to start moving cattle more rapidly through paddocks or when to slow down rotations based on pasture growth. The goal with rest periods is to never regraze any paddock within the given rest period.

In order to keep the grass growing and the cattle growing at the same time, pastures are grazed according to 3 phases: a vegetative stage (rest phase) for which no grazing occurs and vegetation is able to regrow to minimize bare ground and rest periods, a transition phase (grazing period) where active grazing occurs and is the period with high feed value and which promotes healthy vegetative growth, and a reproduction phase where the cattle are either grazed down or the paddock skipped since at this phase the available feed has diminished and the grass seed has a chance to be naturally dispersed back into the ground for future regrowth.

For fields that have already been grazed, a calculation has been developed to map out future grazing areas available (available feed per acre) and rest periods needed, and to help form a plan of action if drought conditions occur (such as destocking). For assessing longer-term impacts (positive or negative) of grazing on the land and to help with future management decisions, transects are assessed at current and past grazing sites and data is collected for grass phase, plant height, abundance of seedlings, plant residue, and percent bare soil.

7.3.1.2 Forestry

Sustainable timber harvest is carried out on nearly all of the Plas Newydd property that is outside of the proposed Bank acreage, and forestry operations are based on the American Forest Foundation's American Tree Farm System (ATFS), which developed the Standards of Sustainability for Forest Certification (AFF 2015) through a "rigorous, multi-stakeholder process and based on international guidelines for sustainable forest management and conservation" (ATFS 2015). An Independent Standards Review Panel reviews these Standards every 5 years and makes recommendations based on an extensive public feedback process. The most current revised Standards became effective 1 January 2015 and will govern ATFS certification for the next 5 years. The revised Standards "include several core revisions to ensure long-term stewardship of America's forests, including expanding best management practices to encompass water, air and soil, and clarifying management needed to protect threatened and endangered species and forests of recognized importance" (ATFS 2015).

Plas Newydd has been an ATFS certified operation since 1988, and has developed and utilized forest management plans since 1947. These plans have all focused on maintaining a sustainable, small harvest operation that uses best available information on all aspects of timber operations from harvest to replanting to thinning to harvest and back again. Plas Newydd has been on the leading edge of diverse planting techniques and as evidence of this sustainable focus, the timber lands that have developed are diverse stands with interspersed habitat pockets of various tree types including Douglas-fir, Willamette Valley ponderosa pine, white pine, Oregon white oak, pacific yew, western red cedar, red alder, black cottonwood, and to a lesser extent western hemlock and other species. Plas Newydd strives to manage small harvests (10–20 acres) with quick replanting, and regularly consults with a diverse group in both the public and private sectors including Oregon State University and Washington State University forestry programs and NRCS.

There are no forestry operations proposed on the approximately 876 acre Bank Site. In the interior PN Farm property and adjacent to the Bank, but excluded from the Bank, lies the 152.19 acre Middle Lands timber management area (Figure 4). Throughout the forestry area, some stands will need thinning for forest health and fire fuel reduction in in the next 3–5 years. Part of the Middle Lands adjacent forestry area was thinned most recently in 2012 in cooperation with NRCS as part of their Environmental Quality Incentives Program (EQIP), and previously in cooperation with NRCS's WHIP (Wildlife Habitat Incentive Program). NRCS developed EQIP as "a voluntary program for conservation-minded landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Indian land" (NRCS 2015). In the next 30 years, some of the Middle Lands adjacent forestry area will likely need to be harvested due to environmental factors such as soil types that prevent a climax forest from naturally developing. The area has had issues with laminated root rot which has impacted some of the more mature Douglas-fir trees and has the potential to impact trees currently in rotation (Hagle 2010). To reduce this problem, Plas Newydd has been planting native resistant species such as Willamette Valley ponderosa pine, Sitka spruce, western red cedar, and white pine in all areas in order to increase diversity and to reduce the impacts of disease.

7.3.2 Adjacent Land Use

Zoned properties adjacent to the Site include Single Family Residential (R-5 and R-10) to the southeast separated by the BNSF Railway, Parks/Wildlife Refuge (P\WL) and Agriculture/Wildlife (AG-WL) to the south on RNWR, and the state managed Lewis River to the North (State Owned Aquatic Land) (Figure 4). Across the Lewis River in Cowlitz County, the zoning is Forestry-Recreation (FR), Heavy Manufacturing (MH) on Port of Woodland-owned property, and Agriculture-38 (AG-38) (Figure 7).

7.3.3 Adjacent Conserved Lands

The Ridgefield National Wildlife Refuge Carty Unit is located adjacent to the Bank Site, separated from the Site along most of its northern boundary by Gee Creek. The RNWR is protected from residential and commercial development, but does allow foot and non-motorized watercraft access. The RNWR is used for passive recreation in the form of walking, hiking, and birding, and also for waterfowl hunting and interpretive programs.

7.4 WATER RIGHTS

No water rights will need to be acquired as part of this project.

7.5 EXISTING STRUCTURES AND MITIGATION SITES

No buildings are located within the proposed Bank Site (Figure 3). There are existing structures that are part of the Plas Newydd property, and of which are located east of the BNSF Railway including several rental houses, the farmhouse/Conservation Program office building, outbuilding, and two dairy barns. The farmhouse/ Conservation Program office building and one barn are listed in the National Register of Historic Places. Though these structures are associated with the property and proposed Bank, they do not exist within the boundaries of the proposed Bank Site.

Existing structures within the boundaries of the proposed Bank Site include off-channel watering features, dikes, and water control structures (see Figure 4). The cattle watering features consist of groundwater pumps and containment cisterns.

The Site does not include any existing mitigation sites.

7.6 POTENTIAL ENCUMBRANCES AND SITE CONCERNS

There are no liens, right-of-ways, easements, or other encumbrances that could affect Bank development or function. There are no known Site constraints, conflicts, or known risks that could affect Bank development or function at the Site. Adjacent to the Site is the BNSF Railway that carries hazardous materials including chemicals and petroleum products. While several accounts of derailments and subsequent hazardous material leaks have been in the news lately, these occurrences are relatively rare and we feel the potential risk to the project can be managed with adequate buffers between the aquatic resources and the railway. The hydrology of the Site is constrained by FCRPS's and PacifiCorp's hydropower infrastructure and operations on the Columbia and Lewis rivers, respectively. These operations change the natural hydrograph, temperature regime, sediment transport, and other ecological factors that are outside the scope of the proposed Bank.

8 QUALIFICATIONS

8.1 SPONSOR

Plas Newydd LLC (PN Farm) is a private, family-owned business created as part of the long-term management plan for the property. PN Farm has a 74-year history of successful land management and stewardship of its ecologically diverse 1,600 acre property. During this span, PN Farm has established a strong record of effectively completing complex projects utilizing internal assets, professional contractors, and collaborators from numerous agencies, tribes, non-governmental organizations, and other interest groups. On an ongoing basis, PN Farm maintains and manages over 10 miles of roads and over a mile and a half of private levee infrastructure. PN Farm also maintains several historical buildings, including an 1850-era timber frame barn which was hand restored in 2010 and 2011 and the Columbia Lancaster House, which are both on the National Historic Register. PN Farm installed and manages over 4,000 feet of solar powered off-channel water system for cattle, which was installed to prevent the deleterious ecological effects of river watering. Aside from daily maintenance activities, we have successfully responded to stochastic events such as the damages and breaching caused by the 1996 100-year flood for which we rebuilt 300 feet of levee along the Lewis River, and restored damaged pasture, road, and wildlife habitat within a rapid 10-month period. Since the early 1970s, PN Farm has employed the most contemporary and environmentally sustainable best management practices to maintain the varied landscape for multiple uses and goals. PN Farm, has been a Certified American Tree Farm since the early 1980s (and has been awarded a Life Member award by the American Forestry Association) restoring and replanting its resources using a highly diverse species mix to better match historical species variety. Within our broad mix of managed grazing, forestry, and other extensively variable habitat, PN Farm has utilized all available tools for environmentally conscientious invasive species control from being part of test sites for approved biological controls for newly introduced invasive species to limited and targeted use of herbicides for must control species that require directed application.

In addition to maintenance-driven activities, PN Farm has partnered extensively with various organizations for both cost-share and grant-funded work to restore and protect areas such as Gee Creek, Allen Canyon, and the Lewis River shoreline. This work has also included voluntary restoration with the Cowlitz Tribe, Pacific Power, and the NRCS to co-manage for timber, pasture, and other habitat on PN Farm. PN Farm has also partnered with other restoration-oriented organizations such as the Cowlitz Tribe where we provided plant materials for the revegetation phase of a restoration project on North Fork Lewis River, and provided large wood and trees with rootwads for the second phase of that project which required us using controlled thinning to provide these materials. Plas Newydd has helped to custom grow native plant materials for other various local

restoration projects, and has donated Oregon white oak seedlings to the Ridgefield National Wildlife Refuge and to the Confederated Tribes of Warm Springs for their restoration actions. Additionally, PN Farm has worked extensively with the RNWR as well as local tribes, forestry groups, and agricultural groups to maintain and protect offsite habitat value and function within the region. PN Farm's licensed herbicide applicators have worked with the City of Ridgefield, Friends of the Ridgefield National Wildlife Refuge, Clark County Vegetation Management, and others to do extensive Japanese knotweed control along Gee Creek and the North Fork Lewis River.

8.2 DESIGN TEAM

The design team responsible for implementing the proposed Bank will be comprised of Plas Newydd Conservation Program staff and subcontractors as necessary where additional expertise is required. The full design team has not yet been designated; however, restoration engineer Tom Slocum will support the design efforts in close collaboration with Plas Newydd Conservation Manager and watershed restoration ecologist, Kelley Jorgensen. Brent Haddaway will provide wetland-specific expertise. Summaries of experience for current key Plas Newydd Conservation Program staff are given in the sections below. Plas Newydd staff also includes a number of full-time field scientists collecting physical and biological data, and numerous other support staff with a diverse array of on-the-ground and technical experience. Combined, the Conservation Program staff has extensive knowledge of the Site, Columbia River Basin dynamics and issues, potential subcontractors for design and implementation, local resources that can be utilized for implementation, and many years of applied experience in numerous fields that will directly benefit the success of the proposed Bank. In addition to staff, subcontractors from the region will be selected that understands the process-based foundation of the design, utilizes the most current and robust methodologies and strategies for project management and construction, is forward-thinking and able to adapt to the unique and dynamic nature of the Site landscape and resources therein.

8.2.1 Kelley Jorgensen—Conservation Program Manager/Watershed Restoration Ecologist

Ms. Jorgensen has over 25 years of experience in applied watershed science, field biology, watershed ecology, aquatic and terrestrial habitat restoration, mitigation services, and environmental permitting and regulatory compliance. The Columbia River basin has been her focus for over the last 20 years, working on numerous ecosystem mitigation and restoration projects since 1998. Since 2000, Kelley has reviewed and participated in selection for funding from hundreds of aquatic habitat restoration proposals as a member of the LCFRB Technical Advisory Committee. Since 2007 Kelley has been a member of the Salmon Recovery Funding Board interdisciplinary Technical Review Panel, which is responsible for vetting technically robust projects for hundreds of millions of dollars of federal and state salmon recovery funds; Kelley was chair of this panel from 2012 to 2014. From 2007 to 2015, Kelley was a volunteer Board of Director and Officer for River Restoration Northwest; a non-profit organization responsible for putting on the annual Stream Restoration Symposium that brings together an average of 400 interdisciplinary river restoration professionals to share lessons learned. Kelley manages the Plas Newydd Conservation Program including the development of the proposed Wetland Mitigation and Habitat Conservation Bank.

8.2.2 Tom Slocum, P.E.—Restoration Engineer

Mr. Slocum is a registered Professional Engineer and Principal of the Conservation Project Workshop, P.S. (CPW) The Conservation Project Workshop, P.S., is a Washington State-registered, non-profit professional services corporation that focuses on strengthening the capacity of staff from other non-profit organizations and tribal and local government agencies that plan and carry out environmental restoration and other natural resource conservation projects. Tom Slocum set up

CPW in 2007 as a structure for transferring engineering skills to colleagues in the environmental restoration field, with the hope of helping them complete more environmental restoration projects in a cost-effective and technically sound manner. Tom has expertise in engineering, permitting, grant writing, and project management related to salmon habitat restoration, water quality protection, and storm water management. He received his law degree from Seattle University Law School, his Master of Science degree in civil engineering from Northeastern University, and his Bachelor of Arts degree from Dartmouth College.

Tom is a Washington-licensed professional civil engineer and maintains an "inactive status" Washington attorney's license. His career focus has been working in the local, state, and international arenas to integrate environmental engineering with environmental policy. For the past 15 years he has run the engineering program of several conservation districts in northwest Washington and has served on the Washington Salmon Recovery Funding Board's technical review panel. In this work, he has had the opportunity to do design, permit, and provide engineering technical review of scores of environmental restoration projects for wetland, creek, river, and nearshore project sites.

8.2.3 Brent Haddaway—Consulting Lead Wetland Ecologist

Mr. Haddaway, PWS, is a wetland ecologist with over 20 years of experience in the Pacific Northwest. Brent has delineated hundreds of wetlands across Washington and Oregon in a range of ecological settings and site alterations. Brent has managed delineation projects exceeding 7,000 acres in size, and has developed project-specific methods to delineate boundaries on heavily altered sites. He was selected by USACE staff to instruct a wetland delineation short course to state and local government staff. Brent has served in a senior wetland role in the development of five mitigation bank projects in Washington and Oregon, numerous permittee-responsible mitigation projects, and a Natural Resource Damage Assessment Mitigation Bank in the Portland Harbor. Brent is a partner in a mitigation bank in Oregon that has approved stream mitigation credits and has completed its monitoring and accreditation process. In the development of these mitigation banks, he has developed project-specific functions assessment methods, negotiated stream crediting metrics, and authored several mitigation bank instruments. Brent is an owner and Partner of Cascade Environmental Group in Portland, Oregon.

8.2.4 David Morgan—Managing Partner of Plas Newydd LLC/Landowner

Mr. Morgan is the Managing Partner of Plas Newydd LLC and has 25 years of experience working in various capacities on the property. David took over management of the farm from his father, Rhidian Morgan, in 2014 after three years of transition management. As Managing Partner, David is responsible for daily operations of the approximately 1,625-acre property. David is the lead for long-term planning and implementation, coordination of the LLC Members, Forestry Program Management, cattle-grazing and pasture management, budget planning and financial compliance, human resources lead, and primary liaison for local community members and organizations wanting to form associations or conduct projects with Plas Newydd. From his many roles, David has had the opportunity to collaborate with a wide variety of local contractors, community interest groups and nearby landowners, consultants, non-profit organizations, Tribes, and staff from numerous local, state, and federal agencies. Prior to his full time transition at Plas Newydd Farm, David worked for the global leader in design and manufacturing stop/gauge and pusher systems as a design and test engineer where he was responsible for new product development as well as testing a broad range of equipment and technologies for functionality and design improvements.

8.2.5 Chris Watson—Geologist/GIS Analyst

Mr. Watson, a certified Geographic Information Systems (GIS) Professional, GIS analyst, field geologist, and Principal at Stellar Consulting Inc. In addition to being a small business owner, his background includes over 16 years in Pacific Northwest permitting and regulatory consulting environments. Chris provides the Plas Newydd Conservation Program team with hydrologic and other modeling as well as GIS analytical capabilities. Chris is adept at bringing to bear the correct spatial data and analyses to solve complex and often multifaceted problems. He has a skillset that includes project management, GIS analysis, geologic evaluation and exploration, technical writing, public education support, litigation support, computer simulations and modeling, and database design. Mr. Watson has spent the last six years working on river and habitat restoration projects in the lower Columbia River. This recent restoration work has required him to utilize his various skill sets to identify suitable project sites, model existing and proposed conditions, provide conceptual designs, and support various permitting efforts. Chris has been part of over 20 NEPA project teams in Oregon, Washington, Idaho, and Utah. His experience includes work for or on habitat restoration, wind, natural gas, storm water, watershed and basin delineation, federal highways and bridges, state and municipal infrastructure, hazardous waste, landfills, mines, ports, CERCLA, and North American Electric Reliability Corporation critical infrastructure protection.

8.2.6 Camille Aspittle—Conservation Program Assistant/Aquatic Ecologist

As Conservation Program Assistant, Ms. Aspittle works in numerous capacities including designing, coordinating, participating in, and managing field study projects; analyzing collected field data; researching, writing, and editing of technical documents; marketing; office administration; and management support. Prior to her engagement at Plas Newydd Farm, Camille worked for over a decade as a consultant for several large-scale habitat enhancement, river restoration, watershed assessment, and hydroelectric projects throughout the Pacific Northwest, which required extensive collaboration with subconsultants, private organizations, landowners, non-profit organizations, Tribes, and staff from numerous local, state, federal agencies. She has technical experience on a wide variety of interdisciplinary projects including limiting factors analysis, urban and wild land stream restoration, environmental impact assessment, endangered species consultation, and hydroelectric relicensing and compliance. Camille also served for 8 years as a Board Director and Treasurer for the Salmonid Restoration Federation, a non-profit organization aimed at helping stream restoration practitioners advance the art and science of restoration through education services for landowners, community-based restoration organizations, consultancies, and state and federal agencies.

9 REFERENCES

Note: The references provided below include both literature directly cited in this document as well as relevant literature that was reviewed and considered in developing this prospectus.

Abbott-Jamieson, S., and P. M. Clay. 2010. The long voyage to including sociocultural analysis in NOAA's National Marine Fisheries Service. Marine Fisheries Review 72(2) 14–33. http://spo.nmfs.noaa.gov/mfr722/mfr7222.pdf [Accessed 12 March 2015]

ABC (American Bird Conservancy). 2006. Top 20 most threatened bird habitats in the United States: Oak savannah. Bird Conservation (summer issue): 12–13. http://sfymkuy.abcbirds.org/newsandreports/birdconservation_pdf/MagSummer06.pdf [Accessed on 11 September 2015]

AFF (American Forest Foundation). 2015. American Forest Foundation (AFF) 2015–2020 Standards of Sustainability. American Tree Farm System, Washington, D.C. https://www.treefarmsystem.org/view-standards [Accessed 15 September 2015]

AINW, Inc. (Archaeological Investigations Northwest, Inc.) 2013. Cultural resource study for the Columbia-Lewis salmon recovery project, Clark County, Washington. AINW Report No. 2762. Prepared for Wildlands, Portland, Oregon by Archaeological Investigations Northwest, Inc., Portland, Oregon.

Anderson, H. E., and S. F. Pearson. 2015. Streaked horned lark habitat characteristics. Prepared by Center for Natural Lands Management and Washington Department of Fish and Wildlife. http://cascadiaprairieoak.org/wp-content/uploads/2015/04/Streaked-horned-lark-habitat-characteristics_April-2015.pdf [Accessed on 14 September 2015]

Armantrout, N. B. 1998. Glossary of aquatic habitat inventory terminology. American Fisheries Society, Western Division, Bethesda, Maryland.

ATFS (American Tree Farm System). 2015. American Forest Foundation announces improved tree farm certification standards. American Forest Foundation News Release. 6 January. https://www.forestfoundation.org/2015-aff-standards [Accessed 15 September 2015]

Bartell, S. M., and S. K. Nair. 2006. Columbia River channel improvement project adaptive environmental management plan. Prepared for U.S. Army Corps of Engineers by E2 Consulting Engineers, Maryville, Tennessee. http://www.nwp.usace.army.mil/Portals/24/docs/environment/aem/Entire.pdf [Accessed 2 March 2015]

Beechie, T. J., D. A. Sear, J. D. Olden, G. R. Pess, J. M. Buffington, H. Moir, P. Roni, and M. M. Pollock. 2010. Process-based Principles for Restoring River Ecosystems. BioScience 60(3): 209–222. http://www.salmonrecovery.gov/Files/Comprehensive%20Evaluation/Beechie%20et%20al%202010%20Process-based%20restoration.Mar2010.pdf [Accessed 10 March 2015]

Block, W. M., L. A. Brennan, and R. J. Gutiérrez. 1986. The use of guilds and guild-indicator species for assessing habitat suitability. Pages 109–114 *in* J. Verner, M. L. Morrison, and C. J. Ralph, editors. Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press, Madison, Wisconsin. http://fwcb.cfans.umn.edu/research/owls/lit%20folder/Block1986.pdf [Accessed 17 September 2015]

Borde, A. B., H. L. Diefenderfer, S. A. Zimmerman, V. I. Cullinan, R. M. Thom, and R. M. Kaufmann. 2010. Wetland inundation patterns and vegetation communities in the lower Columbia River and estuary. Presentation by Pacific Northwest National Laboratory for the Columbia River Estuary Conference, Astoria, Oregon. http://www.estuarypartnership.org/sites/default/files/Wetland%20Inundation%20Patterns%20and%20Vegetation%20Communities-Borde.pdf [Accessed on 25 August 2015]

Borde A. B., V. I. Cullinan, H. L. Diefenderfer, R. M. Thom, R. M. Kaufmann, S. A. Zimmerman, J. Sagar, K. E. Buenau, and C. Corbett. 2012. Lower Columbia River and estuary ecosystem restoration program reference site study: 2011 restoration analysis. PNNL-21433 Final Report. Prepared for the Lower Columbia River Estuary Partnership and the Bonneville Power Administration by Pacific Northwest National Laboratory, Richland, Washington. http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-21433.pdf [Accessed 12 March 2015]

Bottom, D. L., C. A. Simenstad, J. Burke, A. M. Baptista, D. A. Jay, K. K. Jones, E. Casillas, and M. H. Schiewe. 2005. Salmon at river's end: The role of the estuary in the decline and recovery of Columbia River salmon. NOAA Technical Memorandum NMFS-NWFSC-68. Northwest Fisheries Science Center, Fish Ecology Division, Seattle, Washington. http://noaa.ntis.gov/view.php?pid=NOAA:ocm61773737 [Accessed 12 March 2015]

Bottom D. L, A. Baptista, J. Burke, L. Campbell, E. Casillas, S. Hinton, D. A. Jay, M. A. Lott, G. McCabe, R. McNatt, M. Ramirez, G. Curtis Roegner, C. A. Simenstad, S. Spilseth, L. Stamatiou, D. Teel, and J. E. Zamon. 2011. Estuarine habitat and juvenile salmon: Current and historical linkages in the lower Columbia River and Estuary. Final Report 2002–2008. Prepared by National Oceanic and Atmospheric Administration, U.S. National Marine Fisheries Service, Northwest Fisheries Science Center, Fish Ecology Division, Seattle, Washington for U.S. Army Corps of Engineers, Portland District, Portland, Oregon.

Brookshire, J. 2004. Columbian white-tailed deer: *Odocoileus virginianus leucurus* in Management recommendations for Washington's priority species, Volume V: Mammals. Washington Department of Fish and Wildlife, Olympia, Washington. http://wdfw.wa.gov/publications/00027/cwtd.pdf [Accessed 15 October 2015]

Burroughs, R. D., editor. 1995. The natural history of the Lewis and Clark Expedition. Michigan State University Press, East Lansing, Michigan.

Bury, R. B. and D. J. Germano. 2008. *Actinemys marmorata* (Baird and Girard 1952)–Western pond turtle, Pacific pond turtle. Conservation Biology of Freshwater Turtles and Tortoises. Chelonian Research Monographs 5: 001.1–001.9. http://www.iucn-tftsg.org/wp-content/uploads/file/Accounts/crm_5_001_marmorata_v1_2008.pdf [Accessed on 14 September 2015]

Campbell, R. W., N. K. Dawe, I. McTaggart-Cowan, J. M. Cooper, G. W. Kaiser, and M. C. E. McNall,. 1992. The birds of British Columbia—Volume 2: Nonpasserines—Diurnal birds of prey through woodpeckers. UBC Press, Vancouver, British Columbia, Canada.

Caro, T. M. and G. O'Doherty. 1999. On the use of surrogate species in conservation biology. Conservation Biology 13(4): 805–814.

Carraway, L. N. and B. J. Verts. 1994. *Sciurus griseus*. Mammalian Species 474: 1–7.

CDFG (California Department of Fish and Wildlife). 2015. California conservation and mitigation banking. Report to the Legislature. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=102428&inline [Accessed on 26 August 2015]

CEG (Cascade Environmental Group). 2015. Plas Newydd Farm wetlands and other waters delineation report. Draft Report. Prepared for Plas Newydd Farm, LLC, Ridgefield, Washington by Cascade Environmental Group, LLC, Portland, Oregon.

CEQ (Council on Environmental Quality). 2011. Final guidance for federal departments and agencies on the appropriate use of mitigation and monitoring and clarifying the appropriate use of mitigated findings of no significant impact. Federal Register 76: 3843–3853. http://www.gpo.gov/fdsys/pkg/FR-2011-01-21/pdf/2011-1188.pdf [Accessed on 6 March 2015]

Chappell, C. B. 2006. Upland plant associations of the Puget Trough ecoregion. Washington. Natural Heritage Report 2006-01. Washington Department of Natural Resources, Natural Heritage Program, Olympia, Washington. http://www1.dnr.wa.gov/nhp/refdesk/communities/ [Accessed 18 September 2015]

Christy, J. A., and J. A. Putera. 1993. Lower Columbia River natural area inventory: 1992. Report to The Nature Conservancy, Seattle, Washington. http://library.state.or.us/repository/2008/200812221147561/index.pdf [Accessed on 3 September 2015]

Clark County. 2015. Maps online: Zoning and comprehensive plan. GIS data for Clark County, Washington. http://gis.clark.wa.gov/mapsonline/?site=ZoningCompPlan&ext=1 [Accessed 12 March 2015]

Clement, J. P., A d'A. Belin, M. J. Bean, T. A. Boling, and J. R. Lyons. 2014. A strategy for improving the mitigation policies and practices of the Department of the Interior. Report to the Secretary of the Interior from the Energy and Climate Change Task Force, Washington, D.C. https://www.doi.gov/sites/doi.gov/files/migrated/news/upload/Mitigation-Report-to-the-Secretary_FINAL_04_08_14.pdf [Accessed on 25 August 2015]

Clements, J. F. 2007. Checklist of birds of the world. Sixth Edition. Cornell University Press, Ithaca, New York.

Columbia Basin Bulletin. 2014. Pacific lamprey spawning surveys bring key information on ecology, population dynamics of species. Fish and Wildlife News. 5 December. http://www.cbbulletin.com/432725.aspx [Accessed 2 March 2015]

Columbia River Basin Biodiversity Atlas. 2010. Map of Columbia River basin in Canada and the U.S. NAD 83 Lambert Conformal Conic. http://biodiversityatlas.org/pdf/map_canada_us.pdf [Accessed on 2 March 2015]

Comer P. J., Faber-Langendoen D., Evans R., Gawler S. C., Josse C., Kittel G., Menard S., Pyne M., Reid M., Schulz K., Snow K., and Teague J. 2003. Ecological systems of the United States: A working classification of U.S. terrestrial systems. NatureServe, Arlington, Virginia.

Committee on Mitigating Wetland Losses, Board on Environmental Studies and Toxicology, Water Science and Technology Board, Division on Earth and Life Studies, and National Research Council. 2001. Compensating for wetland losses under the Clean Water Act. National Academy Press, Washington D.C.

Cooley, D. and L. Olander. 2011. Stacking ecosystem services payments: Risks and solutions. Working Paper NI WP 11-04. Duke University, Nicholas Institute for Environmental Policy Solutions, Durham, North Carolina. https://nicholasinstitute.duke.edu/sites/default/files/publications/stacking-ecosystem-services-payments-paper.pdf [Accessed on 15 October 2015]

Corbett, C. A. 1, C. Judd, K. Marcoe, G. Johnson, R. Thom, and E. Haas. 2010. Development of an ecosystem restoration strategy for the lower Columbia River using a multiple lines of evidence approach. Presentation by the Lower Columbia Estuary Partnership and Pacific Northwest National Laboratory for the Columbia River Estuary Conference, Astoria, Oregon. http://www.estuarypartnership.org/sites/default/files/Development%20of%20an%20Ecostystem%20Restoration%20Strategy%20using%20Multiple%20Lines%20of%20Evidence-Corbett.pdf [Accessed on 6 March 2015]

Corkran, C. C. and C. Thoms. 1996. Amphibians of Oregon, Washington, and British Columbia: A field identification guide. Lone Pine Publishing Company, Inc., Redmond, Washington.

Coues, E., editor. 1893. The History of the Lewis and Clark Expedition. Volumes I–III. Dover Publications, New York, New York.

Cowardin, L. M., V. Carter, Francis C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31. Prepared for the U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C. http://www.fws.gov/wetlands/documents/classification-of-wetlands-and-deepwater-habitats-of-the-united-states.pdf [Accessed on 13 March 2015

Cowlitz County. 2015. GIS data for Cowlitz County, Washington.

Cramer, M. L., editor. 2012. Stream habitat restoration guidelines. Final. Prepared for Washington State Aquatic Habitat Guidelines Program by Washington Department of Fish and Wildlife, Washington Department of Natural Resources, Washington Department of Transportation and Ecology, Washington State Recreation and Conservation Office, Puget Sound Partnership, and the U. S. Fish and Wildlife Service, Olympia, Washington. http://wdfw.wa.gov/publications/01374/wdfw01374.pdf [Accessed on 10 March 2015]

Craynon, J. R., editor. 2013. Environmental considerations in energy production. Society for Mining, Metallurgy, and Exploration, Inc., Englewood, Colorado

CRITFC (Columbia River Inter-Tribal Fish Commission). 2011. Tribal Pacific lamprey restoration plan for the Columbia River basin. Formal Draft. Nez Perce, Umatilla, Yakama, and Warm Springs tribes, Portland, Oregon. http://www.critfc.org/wp-content/uploads/2012/12/lamprey_plan.pdf [Accessed on 2 March 2015]

Darby, M. C. 1996. Wapato for the people: An ecological approach to understanding the Native American use of *Sagittaria latifolia* on the lower Columbia River. Masters of Arts Thesis, Anthropology. Portland State University, Portland, Oregon.

Dark, S., E. D. Stein, D. Bram, and J. Osuna. 2012. Historical ecology as a living resource for informing urban wetland restoration. Urban Coast 3: 54–60. ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/JournalArticles/697_HxEcol_UrbanCoast.pdf [Accessed on 26 August 2015]

Dauble, D. 2009. Fishes of the Columbia basin. Keokee Books, Sandpoint, Idaho.

Daw, S. 2014. Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*). USDI National Park Service, Southern Colorado Plateau Network I&M Program, Flagstaff, Arizona. http://www.nps.gov/articles/western-yellow-billed-cuckoo.htm [Accessed 17 September 2014]

Deur, D. E. and N. J. Turner, editors. 2005. Keeping It Living: Traditions of Plant Use and Cultivation on the Northwest Coast of North America. University of Washington Press, Seattle, Washington.

Diefenderfer, H. L., A. B. Borde, and V. I. Cullinan. 2013a. A synthesis of environmental and plant community data for tidal wetland restoration planning in the lower Columbia River and estuary. PNNL-22667 Final Report. Prepared for U.S. Army Corps of Engineers, Portland District, Portland, Oregon by Pacific Northwest National Laboratory, Marine Sciences Laboratory, Sequim, Washington. http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22667.pdf [Accessed on 2 March 2015]

Diefenderfer, H. L., G. E. Johnson, R. M. Thom, A. B. Borde, C. M. Woodley, L. A. Weitkamp, K. E. Buenau, and R. K. Kropp. 2013b. An evidence-based evaluation of the cumulative effects of tidal freshwater and estuarine ecosystem restoration on endangered juvenile salmon in the Columbia River. Final report, PNNL-23037. Prepared for the U.S. Army Corps of Engineers Portland District, Portland, Oregon, by Pacific Northwest National Laboratory and NOAA Fisheries. Richland, Washington. http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-23037.pdf [Accessed on 2 March 2015]

Diefenderfer, H., G. Johnson, R. Thom, K. Buenau, C. Woodley, L. Weitkamp, A. Borde, and R. Kropp. 2014. Evidence-based evaluation of the cumulative effects of tidal freshwater and estuarine ecosystem restoration on endangered juvenile salmon in the Columbia River. Presentation for the Conference on Ecological and Ecosystem Restoration, New Orleans, Louisiana. http://www.conference.ifas.ufl.edu/CEER2014/Speaker%20Presentations/July%2029,%20Tuesday_Sessions%2001%20-%2030/Salon%20K_sessions_10_20_30/1440_Gary%20Johnson.pdf [Accessed on 2 March 2015]

Eco-Analysts. 2009. Table Mountain conservation and mitigation bank prospectus. Prepared for U.S. Army Corps, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and California Department of Fish and Game by Eco-Analysts, Chico, California. http://elkhornslough.ucdavis.edu/files/elkhorn/TMCMB%20Prospectus%209-30-09.pdf [Accessed on 25 August 2015]

Ecology (Washington State Department of Ecology). 2008. Salmon-Washougal and Lewis detailed implementation plan: WRIA 27 and 28. Washington State Department of Ecology, Olympia, Washington.

Ecology (Washington State Department of Ecology). 2009. Summary of watershed characterization and analysis project for Clark County. Ecology Publication No. 09-06-003. Prepared by Aaland Planning Services, Inc. for Shorelands and Environmental Assistance Program, Washington State Department of Ecology, Olympia, Washington. https://fortress.wa.gov/ecy/publications/publications/0906003.pdf [Accessed on 1 March 2015]

Ecology. 2011. Clark County land use. GIS Technical Services map.

Ecology. 2014. Prospectus submittal procedures for federal and state wetland mitigation banks in Washington State. 25 November 2014 Revision.

Ecology and WDFW (Washington Department of Fish and Wildlife). 2000. State of Washington alternative mitigation policy guidance for aquatic permitting requirements from the Departments of Ecology and Fish and Wildlife. http://wdfw.wa.gov/publications/00972/wdfw00972.pdf [Accessed 15 October 2015]

Ecology, USACE (U.S. Army Corps of Engineers), and EPA (U.S. Environmental Protection Agency). 2006a. Wetland mitigation in Washington State—Part 1: Agency policies and guidance (Version 1: March 2006). Washington State Department of Ecology Publication #06-06-011a. Olympia, Washington. https://fortress.wa.gov/ecy/publications/publications/0606011a.pdf [Accessed on 25 February 2015]

Ecology, USACE (U.S. Army Corps of Engineers), and EPA (U.S. Environmental Protection Agency). 2006b. Wetland mitigation in Washington State—Part 2: Developing mitigation plans (Version 1: March 2006). Washington State Department of Ecology Publication #06-06-011b. Olympia, Washington. https://fortress.wa.gov/ecy/publications/publications/0606011b.pdf [Accessed on 25 February 2015]

Egan, D., and E. Howell. 2001. The historical ecology handbook: A restorationist's guide to reference ecosystems. Society for the Ecological Restoration International Publication. Island Press, Washington, D.C.

Engler, J. D., E. D. Anderson, and M. A. Stern. 2003. Population status of fall-migrant sandhill cranes along the lower Columbia River. Final Report. Prepared by U.S. Fish and Wildlife Service, Ridgefield National Wildlife Refuge Complex, Ridgefield, Washington and The Nature Conservancy of Oregon, Portland, Oregon.

EPA (U.S. Environmental Protection Agency). 2008. Compensatory mitigation for losses of aquatic resources; Final rule. Federal Register 73: 19594–19705. http://water.epa.gov/lawsregs/guidance/wetlands/upload/2008_04_10_wetlands_wetlands_mitigation_final_rule_4_10_08.pdf [Accessed on 12 March 2015]

EPA. 2010. Level III and IV ecoregions of Washington. Map scale: 1:250,000. http://www.epa.gov/wed/pages/ecoregions/wa_eco.htm [Accessed on 3 September 2015]

EPA. 2011. Integration of traditional ecological knowledge (TEK) in environmental science, policy and decision-making. Prepared by the Environmental Protection Agency Tribal Science Council. http://epa.gov/osp/tribes/pdf/Integration_TEK_EnvironmentalSciencePolicyDecisionMaking%20Tribal%20Priority_Final.pdf [Accessed on 25 February 2015]

EPA. 2012. Appropriate level of analysis required for evaluating compliance with the Section 404(b)(1) guidelines alternatives requirements. http://water.epa.gov/lawsregs/guidance/wetlands/flexible.cfm [Accessed on 25 February 2015]

Evans, N. R., R. M. Thom, G. D. Williams, J. Vavrinec, K. L. Sobocinski, L. M. Miller, A. B. Borde, V. I. Cullinan, V. I. Cullinan, J. A. Ward, C. W. May, and C. Allen. 2006. Lower Columbia River restoration prioritization framework. PNWD-3652. Prepared for Lower Columbia River Estuary Partnership by Battelle Memorial Institute, Pacific Northwest Division, Richland, Washington. http://www.estuarypartnership.org/sites/default/files/resource_files/LCEP%20Restoration%20Prioritization%20Framework.pdf [Accessed on 25 February 2015]

Evarts, R. C. 2004. Geologic map of the Saint Helens quadrangle, Columbia County, Oregon, and Clark and Cowlitz counties, Washington. Pamphlet to accompany Scientific Investigations Map 2834. Prepared by the U.S. Geological Survey. http://pubs.usgs.gov/sim/2004/2834/STH_geol_text.pdf [Accessed 15 October 2015]

Evarts, R. C., J. E. O'Connor, R. E. Wells, I. P. Madin. 2009. The Portland basin: A (big) river runs through it. Geological Survey of America (GSA) Today 19 (9): 4–10. http://www.geosociety.org/gsatoday/archive/19/9/pdf/i1052-5173-19-9-4.pdf [Accessed 13 March 2015]

FGDC (Federal Geographic Data Committee). 2008. National Vegetation Classification Standard (Version 2.0). Document number FGDC-STD-005-2008. http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/NVCS_V2_FINAL_2008-02.pdf [Accessed on 15 September 2015]

Ford M. J., editor. 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. NOAA Technical Memorandum NMFS-NWFSC-113. Prepared by the Northwest Fisheries Science Center, Seattle, Washington. http://www.westcoast.fisheries.noaa.gov/publications/status_reviews/salmon_steelhead/2011s_s_pnw_tm113webfinal.pdf [Accessed 12 March 2015]

Freeman, M. M. R. 1992. The nature and utility of traditional ecological knowledge. Northern Perspectives 20(1): 9–12.

Fresh, K. L., E. Casillas, L. L. Johnson, and D. L. Bottom. 2005. Role of the estuary in the recovery of Columbia River basin salmon and steelhead: An evaluation of the effects of selected factors on salmonid population viability. NOAA Technical Memorandum NMFS-NWFSC-69. Prepared by National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington. http://www.nwfsc.noaa.gov/assets/25/152_09262005_142538_EstuaryTM69WebFinal.pdf [Accessed 12 March 2015]

Gardner, C. K. 1854. Survey plat for Township No. 4 North, Range No. 1 West, Willamette Meridian. Surveyor General of Oregon, Oregon City, Oregon. 5 May. http://www.digitalarchives.wa.gov/Record/View/287F34F231CD425DD24DFF033E6BBF3C [accessed on 26 August 2015]

Gardner, R. C., and J. Fox. The legal status of environmental credit stacking. Stetson University College of Law Research Paper No. 2014-2. Ecology Law Quarterly 40(4): 101–144. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2375858 [Accessed 18 September 2015]

Gardner, R. C., J. Zedler, A. Redmond, R.E. Turner, C. A. Johnston, V. R. Alvarez, C. A. Simenstad, K. L. Prestegaard, and W. J. Mitsch. 2009. Compensating for wetland losses under the Clean Water Act (Redux): Evaluating the Federal compensatory mitigation regulation. Stetson Law Review, Volume 38: Number 2. Stetson University College of Law Research Paper #2009-24. http://www.stetson.edu/law/lawreview/media/38-2gardner-pdf.pdf [Accessed on 25 February 2015]

GLO (General Land Office). 2012. General Land Office Maps: Quadrant 1. Digital copies of the Cadastral survey maps for Oregon, University of Oregon, Eugene, Oregon. http://library.uoregon.edu/map/GIS/Data/Oregon/GLO/Quadrant_1.htm [Accessed 10 March 2015]

Hagar, J. C. and M. A. Stern. 2001. Avifauna in oak woodlands of the Willamette Valley, Oregon. Northwestern Naturalist 82: 12–25.

Hagle, S. K. 2009. Laminated root rot ecology and management. Chapter 11.2—Forest insect and disease management guide for the northern and central Rocky Mountains. USDA Forest Service, Northern Region, State and Private Forestry. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187461.pdf [Accessed on 15 September 2015]

Hallock, L. 2013. State of Washington Oregon spotted frog recovery plan. Draft .Washington Department of Fish and Wildlife, Olympia, Washington. http://wdfw.wa.gov/publications/01505/wdfw01505.pdf [Accessed 14 September 2015]

Halterman, M., M. J. Johnson, J. A. Holmes, and S. A. Laymon. A natural history summary and survey protocol for the western distinct population segment of the yellow-billed cuckoo. Final Draft. U.S. Fish and Wildlife Techniques and Methods. http://www.fws.gov/southwest/es/Documents/R2ES/YBCU_SurveyProtocol_FINAL_DRAFT_22Apr2015.pdf [Accessed on 14 September 2015]

Hanna, I., and P. Dunn. 1997. Restoration goals for Oregon white oak habitats in the South Puget Sound region. Pages 231–245 in P. Dunn and K. Ewing, editors. Ecology and conservation of the South Puget Sound prairie landscape. The Nature Conservancy, Seattle, Washington.

Harris, D. R. 1977. Alternative pathways toward agriculture. Pages 179–224 in C. A. Reed, editor. Origins of Agriculture. Mouton Publishers, The Hague, The Netherlands.

Harrison, J. 2008. Columbia River: Description, creation, and discovery. Northwest Power and Conservation Council, Portland, Oregon. http://www.nwcouncil.org/history/ColumbiaRiver [Accessed 10 March 2015]

Hasson, T. 2015. Improving mitigation policies and practices at the Department of the Interior. Presentation for the Regional Mitigation Workshop, NPR-A, Fairbanks, Alaska. http://www.blm.gov/style/medialib/blm/ak/aktest/planning/NPR-A_RMS.Par.57700.File.dat/DOI%20Mitigation%20Policies%20&%20Practices%203-31-2015.pdf [Accessed on 25 August 2015]

Hayes, D. 1999. Historical atlas of the Pacific Northwest: Maps of exploration and discovery. Sasquatch Books, Seattle, Washington.

Hays, D. W., K. R. McAllister, S. A. Richardson, and D. W. Stinson. 1999. Draft Washington State recovery plan for the western pond turtle. Washington Department of Fish and Wildlife, Olympia, Washington. http://wdfw.wa.gov/publications/00398/wdfw00398.pdf [Accessed on 11 September 2015]

Hayes, M. P. 1994. The spotted frog (*Rana pretiosa*) in western Oregon. Technical Report #94-1-01. Oregon Department of Fish and Wildlife, Wildlife Diversity Program, Portland, Oregon. http://soda.sou.edu/awdata/030728a1.pdf [Accessed 15 September 2015]

Holland, D. C. 1991. Status and reproductive dynamics of a population of western pond turtles (*Clemmys marmorata*) in Klickitat County, Washington in 1990. Unpublished report. Washington Department of Wildlife, Olympia, Washington.

Holland, D. C. 1994. The western pond turtle: Habitat and history. Final report. Prepared for U. S. Department of Energy, Bonneville Power Administration, Department of Environment, Fish, and Wildlife, Portland, Oregon. http://relicensing.pcwa.net/documents/Library/PCWA-L%20450.pdf [Accessed on 11 September 2015]

Houde, N. 2007. The six faces of traditional ecological knowledge: Challenges and opportunities for Canadian co-management arrangements. Ecology and Society 12(2): Article 34.

Hruby. T. K. 2014. Washington State wetland rating system for western Washington: 2014 update. Washington State Department of Ecology Publication no. 14-06-029. Olympia, Washington. https://fortress.wa.gov/ecy/publications/documents/1406029.pdf [Accessed 24 September 2015]

Hruby, T. K. Harper, and S. Stanley. 2009. Selecting wetland mitigation sites using a watershed approach. Washington State Department of Ecology Publication no. #09-06-032. Olympia, Washington. https://fortress.wa.gov/ecy/publications/publications/0906032.pdf [Accessed 12 March 2015]

IBIS. 2008. Interactive Biodiversity Information System. Northwest Habitat Institute, Corvallis, Oregon. http://www.nwhi.org/ibis

Independent Scientific Advisory Board. 2011. Columbia River food webs: Developing a broader scientific foundation for fish and wildlife restoration. Document ISAB 2011-1. Prepared by the Independent Scientific Advisory Board for the Northwest Power and Conservation Council, Columbia River Basin Indian Tribes, and NOAA Fisheries, Portland, Oregon.

Inter-Fluve Inc. 2013. Lake Rosannah water level and temperature study. Final Technical Memorandum. Prepared by Inter-Fluve Inc., Hood River, Oregon for Plas Newydd Farm, Ridgefield, Washington.

Jensen, S. 2014. Personal communication with Cat Brown, Wildlife Biologist, U.S. Fish and Wildlife Service, Oregon Fish and Wildlife Office, Portland, Oregon, regarding streaked horned lark potential for presence on two sites on the lower Columbia River. April.

Jewell, S. 2013. Improving mitigation policies and practices of the Department of the Interior. Secretarial Order Number 3330. U. S. Department of the Interior, Washington, D.C. 31 October. https://www.doi.gov/sites/doi.gov/files/migrated/news/upload/Secretarial-Order-Mitigation.pdf [Accessed on 25 August 2015]

Johnson, G., C. Corbett, J. Doumbia, M. Schwartz, R. Scranton, and C. Studebaker. 2013a. A programmatic plan for restoration action effectiveness monitoring and research in the lower Columbia River and estuary. AEMR Plan Final Draft. Prepared by Pacific Northwest National Laboratory, Lower Columbia Estuary Partnership, Bonneville Power Administration, and U.S. Army Corps of Engineers, Portland, Oregon. http://www.estuarypartnership.org/sites/default/files/resource_files/CEERP_2013_AEMR%20Programmatic_FinalDraft.pdf [Accessed 12 March 2015]

Johnson, G. E., N. K. Sather, A. J. Storch, J Johnson, R Skalski, D. J. Teel, T. Brewer, A. J. Bryson, E. M. Dawley, D. R. Kuligowski, T. Whitesel, and C. Mallette. 2013b. Multi-scale action effectiveness research in the lower Columbia River and estuary, 2012. PNNL-22481 Final Annual Report. Prepared for U.S. Army Corps of Engineers, Portland District by Pacific Northwest National Laboratory Richland, Washington.

Johnson, G. E., G. R. Ploskey, N. K. Sather, and D. J. Teel. 2015. Residence times of juvenile salmon and steelhead in off-channel tidal freshwater habitats, Columbia River, USA. Canadian Journal of Fisheries and Aquatic Sciences 72: 684–696. http://www.nrcresearchpress.com/doi/pdf/10.1139/cjfas-2014-0085 [Accessed 15 October 2015]

Johnson, M. J. 2009. Understanding the habitat needs of the declining western yellow-billed cuckoo. U.S. Geological Survey Fact Sheet 2009-3091. http://pubs.usgs.gov/fs/2009/3091/fs2009-3091.pdf [Accessed on 15 September 2015]

Kondolf, M. 2011. Setting goals in river restoration: When and where can the river "heal itself"? Pages 29–43 *in* A. Simon, S. J. Bennett, and J. M. Castro, editors. Stream restoration in dynamic fluvial systems: Scientific approaches, analyses, and tools. Geophysical Monograph Series 194. American Geophysical Union, Washington, D.C. https://institutbeaumont.files.wordpress.com/2007/09/kondolf2011-settinggoals.pdf [Accessed on 25 August 2015]

Kostow, K. 2002. Oregon lampreys: Natural history status and analysis of management issues. Information Reports Number 2002-01. Oregon Department of Fish and Wildlife, Portland, Oregon. https://nrimp.dfw.state.or.us/CRL/reports/info/2002-01.pdf [Accessed 2 March 2015]

LaRocco, G. L., and R. L. Deal .2011. Giving credit where credit is due: Increasing landowner compensation for ecosystem services. General Technical Report PNW-GTR-842. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, Oregon. http://www.fs.fed.us/pnw/pubs/pnw_gtr842.pdf [Accessed 15 October 2015]

Larsen, E. M., editor. 1997. Management recommendations for Washington's priority species. Volume III: Amphibians and reptiles. Washington Department of Fish and Wildlife, Olympia, Washington. http://wdfw.wa.gov/publications/00025/wdfw00025.pdf [Accessed on 11 August 2015]

Larsen, E. M., J. M. Azerrad, and N. Nordstrom, editors. 2004. Management recommendations for Washington's priority species—Volume IV: Birds. Washington Department of Fish and Wildlife, Olympia, Washington. http://wdfw.wa.gov/publications/00026/wdfw00026.pdf [Accessed on 15 September 2015]

Layman. W. D. 2006. River of memory: The everlasting Columbia. University of Washington Press, Seattle, Washington.

LCEP (Lower Columbia Estuary Partnership). 2011. Lower Columbia River estuary plan—Comprehensive Conservation and Management Plan. 2011 Update. Prepared by the Lower Columbia Estuary Partnership, Portland, Oregon. http://www.estuarypartnership.org/sites/default/files/CCMP%20Action%20Update%20Final%200212.pdf [Accessed 15 October 2015]

LCFRB (Lower Columbia Fish Recovery Board). 2006. Salmon-Washougal and Lewis Watershed Management Plan: WRIAs 27–28. Prepared by HDR Engineering, Inc. and Economic and Engineering Services, Inc. for the Lower Columbia Fish Recovery Board, Olympia, Washington.

LCFRB. 2010. Washington lower Columbia salmon recovery and fish & wildlife subbasin plan. Final Plan. Lower Columbia Fish Recovery Board, Olympia, Washington. http://www.lcfrb.gen.wa.us/#!library/c1tqm [Accessed on 25 February 2015]

LCFRB. 2015. Project evaluation criteria. 2015 Habitat project grant round—Call for projects. Lower Columbia Fish Recovery Board, Olympia, Washington. http://media.wix.com/ugd/810197_e7d820a8d6de48b8b7fcd21a123d4c4a.pdf [Accessed 6 March 2015]

Lewin, J. and P. J. Ashworth. 2013. The negative relief of large river floodplains. Earth-Science Reviews 129: 1–23. http://ac.els-cdn.com/S0012825213001864/1-s2.0-S0012825213001864-main.pdf?_tid=fd53c5d8-7847-11e5-8e60-00000aab0f27&acdnat=1445468809_93180787c561fc087b7eec76b7471eab [Accessed 15 October 2015]

Licht, L. E. 1969. Comparative breeding behavior of the red-legged frog (*Rana aurora aurora*) and the western spotted frog (*Rana pretiosa pretiosa*) in southwestern British Columbia. Canadian Journal of Zoology 47(6): 1287–1299.

Licht, L. E. 1974. Survival of embryos, tadpoles, and adults of the frogs *Rana aurora aurora* and *Rana pretiosa pretiosa* sympatric in southwestern British Columbia. Canadian Journal of Zoology 52(5): 613–627.

Linders, M. J., and D. W. Stinson. 2007. Western gray squirrel recovery plan. Washington Department of Fish and Wildlife, Olympia, Washington. http://wdfw.wa.gov/publications/00119/wdfw00119.pdf [Accessed on 11 September 2015]

Linders, M. J., W. M. Vander Haegen, J. M. Azerrad, R. Dobson, and T. Labbe. 2010. Management recommendations for Washington's priority species: Western gray squirrel. Washington Department of Fish and Wildlife, Olympia, Washington. http://wdfw.wa.gov/publications/00027/western_gray_squirrel_final.pdf [Accessed on 11 September 2015]

Littlefield, C. D., and G. L. Ivey. 2002. Sandhill crane recovery plan. Washington Department of Fish and Wildlife, Olympia, Washington. http://wdfw.wa.gov/publications/00396/wdfw00396.pdf [Accessed on 11 September 2015]

Madsen, B., J. Fox, and A Diamant. 2012. Offset credit stacking: Background paper for the EPRI greenhouse gas emissions offset policy dialogue workshop #13. Electric Power Research Institute, Inc. http://eea.epri.com/pdf/ghg-offset-policy-dialogue/workshop13/Background-Paper_EPRI-Offsets-W13_Credit-Stacking_Final_Locked.pdf [Accessed 18 September 2015]

Marcoe, K., and S. Pilson. 2013. Habitat change in the lower Columbia River and estuary, 1870–2011. Final Report. Prepared by the Lower Columbia Estuary Partnership, Portland, Oregon. http://www.estuarypartnership.org/sites/default/files/resource_files/Lower%20Columbia%20Estuary%20Historical%20Landcover%20Change%20final_2013_small.pdf [Accessed 12 March 2015]

Marshall, D. B., M. G. Hunter, and A. L. Contreras. 2003. Birds of Oregon: A general reference. First Edition. Oregon State University Press, Corvallis, Oregon.

McAllister, K. R. and W. P. Leonard. 1997. Oregon spotted frog. Washington State Status Report. Washington Department of Fish and Wildlife, Olympia, Washington.

Mills. L. S., M. E. Soule, and D. F. Doak 1993. The keystone-species concept in ecology and conservation. BioScience 43(4): 219–224.

Moulton, G. E., editor. 1983. Atlas of the Lewis and Clark expedition. Volume 1 *in* The journals of the Lewis and Clark expedition. University of Nebraska Press, Lincoln, Nebraska.

Multi-Agency Product Delivery Team. 2010. Mitigation banking proposal procedures. http://www.spd.usace.army.mil/Portals/13/docs/regulatory/banking/checklist.pdf [Accessed on 26 August 2015]

Naik, P. K. and D. A. Jay. 2005. Estimation of Columbia River virgin flow.: 1979 to 1928. Hydrological Processes 19: 1807–1824. http://www.researchgate.net/publictopics.PublicPostFileLoader.html?id=552024b7d767a6c34f8b4570&key=0fac5eea-48be-4926-8f9c-d4c44c468379 [Accessed on 1 September 2015]

Naiman, R, J., J. R. Alldredge, D. A. Beauchamp, P. A. Bisson, J. Congleton, C. J. Henny, N. Huntly, R. Lamberson, C. Levings, E. N. Merrill, W. G. Pearcy, B. E. Rieman, G. T. Ruggerone, D. Scarnecchia, P. E. Smouse, and C. C. Wood. 2012. Developing a broader scientific foundation for river restoration: Columbia River food webs. Proceedings of the National Academy of Sciences of the United States of America 109: 21201–21207. http://www.pnas.org/content/109/52/21201.full.pdf+html [Accessed 2 March 2015]

Native American Science Curriculum. 2010. The world of wolf and raven: TEK as scientific knowledge. PowerPoint Presentation. https://docs.google.com/presentation/d/17BoHGF2hXqTnPEizdJlBQJ-Qsi_0YkU623kHwzMPQ9U/present?slide=id.i0 [Accessed on 25 February 2015]

NMFS (National Marine Fisheries Service). 2011. Columbia River estuary ESA recovery plan module for salmon and steelhead. Prepared for NMFS by the Lower Columbia River Estuary Partnership and PC Trask & Associates, Inc. National Marine Fisheries Service Northwest Region, Portland, Oregon. http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/estuary-mod.pdf [Accessed on 25 February 2015]

NMFS. 2013a. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the U.S. Bureau of Reclamation's Odessa Subarea Modified Partial Groundwater Replacement Project. NWR-2012-9371. Prepared by the National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Portland, Oregon. http://www.usbr.gov/pn/programs/esa/wash/odessa/biopodessa.pdf [Accessed 15 October 2015]

NMFS. 2013b. ESA Recovery Plan for Lower Columbia River Coho Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead. Prepared by the National Marine Fisheries Service, Northwest Region. http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/willamette_lowercol/lower_columbia/final_plan_documents/final_lcr_plan_june_2013_-corrected.pdf [Accessed 15 October 2015]

NMFS. 2013c. Conservation banking guidance for the review, establishment, use and operation of conservation banks and in-lieu-fee arrangements for compensatory mitigation. Memorandum to Northwest Region Assistant Regional Administrators from William W. Stelle, Jr., Regional Administrator, NMFS, Seattle, Washington. 31 January.

NOAA (National Oceanic and Atmospheric Administration). 2010. Returning the tide: A tidal hydrology restoration guidance manual for the Southeastern United States. NOAA Restoration Center and NOAA Coastal Services Center, Silver Spring, Maryland. http://www.habitat.noaa.gov/toolkits/tidal_hydro/download_all_manual_chapters.pdf [Accessed 6 March 2015]

NOAA Fisheries (NOAA's National Marine Fisheries Service). 2014. Endangered Species Act Section 7(a)(2) Supplemental Biological Opinion: Consultation on remand for operation of the Federal Columbia River Power System. NOAA Fisheries Log Number NWR-2013-9562. http://www.westcoast.fisheries.noaa.gov/publications/hydropower/fcrps/2014_supplemental_fcrps_biop_final.pdf [Accessed 15 September 2015]

NPPC (Northwest Power and Conservation Council). 2014. Columbia River basin fish and wildlife program 2014. Pre-application version: Document 2014-12. Northwest Power and Conservation Council, Portland, Oregon. https://www.nwcouncil.org/media/7148624/2014-12.pdf [Accessed 2 March 2015]

NRCS (U.S. Department of Agriculture, Natural Resources Conservation Service). 2010. Field indicators of hydric soils in the United States. Version 7.0. L. M. Vasilas, G. W. Hurt, and C. V. Noble, editors. USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053171.pdf [Accessed 12 March 2015]

NRCS. 2011. Wildlife Habitat Incentive Program. Fact Sheet. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1041995.pdf [Accessed on 15 September 2015]

NRCS. 2015. Custom soil resource report for Clark County, Washington. Produced by the National Cooperative Soil Survey for Plas Newydd LLC, Ridgefield, Washington.

NSW (New South Wales) Department of Environment and Climate Change. 2007. BioBanking: Biodiversity banking and offsets scheme. Information booklet prepared by the Department of Environment and Climate Change, Sydney, Australia. http://www.environment.nsw.gov.au/resources/biobanking/biobankingoverview07528.pdf [Accessed 19 October 2015]

NWHI (Northwest Habitat Institute). 2015. NWHI website. http://nwhi.org/ [Accessed on 14 September 2015]

Opperman, J. J., R. L., B. A. McKenney, M. R., and A. W. Meadows. 2010. Ecologically functional floodplains: Connectivity, flow regime, and scale. Journal of the American Water Resources Association 46(2) 211–226.

Oregon Wildlife Institute. 2015. Species at risk website. http://www.oregonwildlife.org/species-at-risk [Accessed on 15 September 2015]

Pearson, S. F., and B. Altman. 2005. Range-wide streaked horned lark (*Eremophila alpestris strigata)* assessment and preliminary conservation strategy. Washington Department of Fish and Wildlife, Wildlife Program, Wildlife Science Division, Olympia, Washington.

Peterson, D. W., Becky K. Kerns, and Erich K. Dodson. 2014. Climate change effects on vegetation in the Pacific Northwest: A review and synthesis of the scientific literature and simulation model projections. General Technical Report PNW-GTR-900. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon. http://www.fs.fed.us/pnw/pubs/pnw_gtr900.pdf [Accessed 10 March 2015]

PNNL (Pacific Northwest National Laboratory. 2010. Fishes of the Columbia River. http://ecology.pnnl.gov/Fishes_Columbia_River.asp [Accessed 13 March 2015]
Pollock, M. M., J. M. Wheaton, N. Bouwes, C. Volk, N. Weber, and C. E. Jordan. 2012. Working with beaver to restore salmon habitat in the Bridge Creek intensively monitored watershed: Design rationale and hypotheses. NOAA Technical Memorandum NMFS-NWFSC-120. http://www.nwfsc.noaa.gov/research/divisions/fe/documents/NMFS-NWFSC-120.pdf [Accessed 12 March 2015]

Power, M. E., D. Tilman, J. A. Estes, B. A. Menge, W. J. Bond, L. S. Mils, G. Daily, J. C. Castilla, j. Lubchenco, and R. T. Paine. 1996. Challenges in the quest for keystones. BioScience 46(8): 609–620. http://cedarcreek.umn.edu/biblio/fulltext/t1117.pdf [Accessed 15 October 2015]

Prober, S. M., M. H. O'Connor, and F. J. Walsh. 2011. Australian Aboriginal people's seasonal knowledge: A potential basis for shared understanding in environmental management. Ecology and Society 16(2): Article 12. http://www.ecologyandsociety.org/vol16/iss2/art12/ [Accessed 25 February 2015]

Reed, P. B., Jr. 1988. National list of plant species that occur in wetlands: National summary. Biological Report 88(24). U. S. Fish and Wildlife Service, National Wetlands Inventory Project, Washington, D.C.
http://www.fws.gov/pacific/ecoservices/habcon/pdf/National%20List%20of%20Plant%20Species%201988.pdf [Accessed on 1 September 2015]

Reynolds, T. D. and C. I. Hinckley. 2005. A survey for yellow-billed cuckoo in recorded historic and other locations in Idaho. TREC, Inc., Rigby, Idaho.

Richter, K. O. and A. L. Azous. 1995. Amphibian occurrence and wetland characteristics in the Puget Sound Basin. Wetlands 15(3): 305–312.

Robertson, M. 2015. Stacking ecosystem services for sale: Can it be done? PowerPoint presentation for the 2015 National Mitigation & Ecosystem Banking Conference, Orlando, Florida.

Robertson, M.,T. K. BenDor, R. Lave, A. Riggsbee, J. B. Ruhl, and M. Doyle. Stacking ecosystem services. Frontiers in Environmental Ecology 12: 186–193. http://www.researchgate.net/publication/270065873_Stacking_ecosystem_services [Accessed 15 October 2015]

Rocchio, J. and R. Crawford, 2009. Field guide to Washington's ecological ecosystems Draft. Washington Department of Natural Resources, Asset Management and Protection Division, Washington Natural Heritage Program, Olympia, Washington.

Roegner, G. C., H. L. Diefenderfer, A. B. Borde, R. M. Thom, E. M. Dawley, A. H. Whiting, S. A. Zimmerman, and G. E. Johnson. 2008 Protocols for monitoring habitat restoration projects in the lower Columbia River and estuary. PNNL-15793 Final Report. Prepared for the U.S. Army Corps of Engineers Portland District, Portland, Oregon by Pacific Northwest National Laboratory, Richland, Washington. http://www.pnl.gov/main/publications/external/technical_reports/PNNL-15793.pdf [Accessed 12 March 2015]

Roni, P., G. R. Pess, T .J. Beechie, and K. M. Hanson. 2014. Fish-habitat relationships and the effectiveness of habitat restoration. NOAA Technical Memorandum NMFS-NWFSC-127. Prepared by Northwest Fisheries Science Center, Fish Ecology Division, Watershed Program, Seattle, Washington. http://www.nwfsc.noaa.gov/assets/25/7422_08122014_141405_FishHabRelationshipsTM127WebFinal.pdf [Accessed 12 March 2015]

Ryan, L. A., and M. Linders. 2003. The western gray squirrel and other squirrels in Washington. Washington Department of Fish and Wildlife, Olympia, Washington. http://wdfw.wa.gov/publications/01024/wdfw01024.pdf [Accessed 17 September 2015]

Sagar, J. P., A. B. Borde, K. L. Sobocinski, N. Sather, S. A. Zimmerman, C. M. Collins, S. Y. Sol, O. P.Olson, K. H. Macneale, P. M. Chittaro, L. L. Johnson, G. L. Kral, M. A. Rowe Soll, J. M. St. Pierre, R. M. Beaston, K. N. Norton, A. S. Cameron, M. Russell, A. Silva, D. Sigrist. 2010. Action effectiveness monitoring in the "Implement Habitat Restoration in the Lower Columbia River and Estuary" contract. Annual Report for 15 September 2007–14 September 2009. . Prepared by the Lower Columbia River Estuary Partnership, Portland, Oregon. http://www.estuarypartnership.org/sites/default/files/resource_files/2009%20AEM%20Report_072011.pdf [Accessed 15 October 2015]

Sagar, J. P., A. B. Borde, L. L. Johnson, C. A. Corbett, J. L. Morace, K. H. Macneale, W. B. Temple , J. Mason, R. M Kaufmann, V. I. Cullinan, S. A. Zimmerman, R. M. Thom, C. L. Wright, P. M. Chittaro, O. P. Olson, S. Y. Sol, D. J. Teel, G. M. Ylitalo, and N. D. Jahns. 2013. Juvenile salmon ecology in tidal freshwater wetlands of the lower Columbia River and estuary: Synthesis of the ecosystem monitoring program, 2005–2010. Prepared for the Bonneville Power Administration by the Lower Columbia Estuary Partnership, Portland, OR. http://www.estuarypartnership.org/sites/default/files/resource_files/EMP%20Synthesis%20Final_050913.pdf [Accessed 10 March 2015]

Sagar, J. P., A. B. Borde, L. L. Johnson, T. D. Peterson, J. A. Needoba, K. H. Macneale, M. Schwartz, A. Silva, C. A. Corbett, V. I. Cullinan, S. A. Zimmerman, R. M. Thom, P. M. Chittaro, O. P. Olson, S. Y. Sol, D. J. Teel, G. M. Ylitalo, M. A. Maier and C. E. Tausz. 2014. Juvenile salmon ecology in tidal freshwater wetlands of the lower Columbia River and estuary: Synthesis of the ecosystem monitoring program, trends (2005–2013) and food web dynamics (2011–2013). Draft Report. Prepared by the Lower Columbia Estuary Partnership for the Bonneville Power Administration, Portland, Oregon. http://www.estuarypartnership.org/sites/default/files/resource_files/EMP%20Synthesis%20Final_050913.pdf [Accessed 25 February 2015]

Scott. J. 2011. Oregon Donation Land Law (ODLL). Report of the Willamette Heritage Center. http://www.willametteheritage.org/LaRC/bios_histories/Oregon_Donation_and_Land_Law.pdf [Accessed 13 March 2015]

Simenstad, C. A., J. L. Burke, J. E. O'Connor, C. Cannon, D. W. Heatwole, M. F. Ramirez, I. R. Waite, T. D. Counihan, and K. L. Jones. 2011. Columbia River estuary ecosystem classification—Concept and application: U.S. Geological Survey Open-File Report 2011-1228. http://pubs.usgs.gov/of/2011/1228 [Accessed 2 March 2015]

Skidmore, P. B., C. R. Thorne, B. L. Cluer, G. R. Pess, J. M. Castro, T. J. Beechie, and C. C. Shea. 2011. Science base and tools for evaluating stream engineering, management, and restoration proposals. NOAA Technical Memorandum NMFS-NWFSC-112. Northwest Fisheries Science Center. Seattle, Washington. http://www.restorationreview.com/downloads/Science_and_Tools_for_Stream_Projects_2011.pdf [Accessed 12 March 2015]

Sprague, M., D. Ross, G. Mannina, and W. White. 2015. Universal principles of compensatory mitigation. National Mitigation Banking Association, Alexandria, Virginia. http://mitigationbanking.org/wp-content/uploads/2015/07/Universal-Principles-of-Compensatory-Mitigation-by-NMBA.pdf [Accessed on 25 August 2015]

State of Washington. 2009. Washington Administrative Code 173-700: Wetland Mitigation Banks. 3 September. http://apps.leg.wa.gov/wac/default.aspx?cite=173-700 [Accessed on 16 September 2015]

State of Washington. 2010. Revised Code of Washington Title 77.55.241: Off-site mitigation. http://apps.leg.wa.gov/rcw/default.aspx?cite=77.55.241 [Accessed 16 September 2015]

State of Washington. 2012. Washington Administrative Code 90.48.260: Federal Clean Water Act—Department designated as state agency, authority—Delegation of authority—Powers, duties, and functions. http://app.leg.wa.gov/rcw/default.aspx?cite=90.48&full=true#90.48.260 [Accessed 19 October 2015]

State of Washington. 2014. Washington Administrative Code 220-660: Hydraulic Code Rules. 30 December. http://apps.leg.wa.gov/wac/default.aspx?cite=220-660 [Accessed on 16 September 2015]

Stinson, D. W. 2005. Status Report for the Mazama pocket gopher, streaked horned lark, and Taylor's checkerspot. Washington Department of Fish and Wildlife, Olympia, Wasahington. http://wdfw.wa.gov/publications/00390/wdfw00390.pdf [Accessed on 11 September 2015]

Svihla, A. 1935. Notes on the Western Spotted Frog, *Rana pretiosa pretiosa*. Copeia 1935(3): 119–122.

The Conservation Fund. 2013. Pacific Northwest conservation banking training course. Notebook materials prepared for 26–28 February 2013 training, Water Resources Education Center, Vancouver, Washington Prepared by The Conservation Fund, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, NOAA National Marine Fisheries, U.S. Department of Defense, Parametrix, and The Watershed Company, for the Pacific Northwest conservation workshop, Vancouver, Washington.

The Nature Conservancy. 2015. Science resources on greater sage-grouse. http://www.nature.org/ourinitiatives/habitats/grasslands/greater-sage-grouse-science-resources.pdf [Accessed on 24 August 2015]

Thom, R. M., A. B. Borde, N. R. Evans, C. W. May, G. E. Johnson, and J. A. Ward. 2004. A conceptual model for the lower Columbia River estuary. Prepared for the U.S. Army Corps of Engineers, Portland, Oregon by Pacific Northwest National Laboratory, Richland, Washington. http://s458607291.onlinehome.us/FTP/Estuary_Model/html/index.htm [Accessed 25 February 2015]

Thom, R. M., N. K. Sather, G. C. Roegner, and D. L. Bottom. 2013. Columbia estuary ecosystem restoration program. 2012 Synthesis Memorandum. PNNL-21477 Final Report. Prepared for the Army Corps of Engineers, Portland, Oregon by Pacific Northwest National Laboratory, Sequim, Washington, and NOAA Fisheries, Seattle, Washington. https://www.nwcouncil.org/media/13615/CEERPSynthesis.pdf [Accessed 12 March 2015]

Thom, R. S. Breithaupt, C. Roegner, D. Woodruff, H. Diefenderfer, A. Borde, and G. Johnson. 2014. Particulate organic matter export from a restored tidal freshwater wetland in the Columbia River estuary. Presentation for the Columbia River Estuary Workshop, Astoria, Oregon. http://www.estuarypartnership.org/sites/default/files/resource_files/ThomR%20CREW%20May%202014.pdf [Accessed 12 March 2015]

Thorson, T. D., Bryce, S. A., Lammers, D. A., Woods, A. J., Omernik, J. M., Kagan, J., Pater, D. E., and Comstock, J. A., 2003. Ecoregions of Oregon. Map scale 1:1,500,000. U.S. Geological Survey, Reston, Virginia. http://www.epa.gov/wed/pages/ecoregions/or_eco.htm [Accessed on 3 September 2015]

Thwaites, R. G., editor. 1905. Original journals of the Lewis and Clark expedition, 1804–1806. Volume 4. Dodd, Mead, and Company, New York, New York.

Turner, N. P. R. Spalding. 2013. "We might go back to this"; Drawing on the past to meet the future in Northwestern North American indigenous communities. Ecology and Society 18(4): Article 29. http://www.ecologyandsociety.org/vol18/iss4/art29/ [Accessed 12 March 2015]

Turner, N. J., I. J. Davidson-Hunt, and M. O'Flaherty. 2003. Living on the edge: Ecological and cultural edges as sources of diversity for social–ecological resilience. Human Ecology 31(3):439–461. https://www.umanitoba.ca/institutes/natural_resources/canadaresearchchair/Turner,%20Dhunt%20and%20Ofalherty.pdf [Accessed 12 March 2015]

Tweit, B. 2005. Yellow-billed cuckoo *Coccyzus americanus*. Page 210 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow, editors. Birds of Washington: status and distribution. Oregon State University Press, Corvallis, Oregon.

USACE (U.S. Army Corps of Engineers). 2008a. Minimum monitoring requirements for compensatory mitigation projects involving the restoration, establishment, and/or enhancement of aquatic resources. Regulatory Guidance Letter No. 08-03. http://www.usace.army.mil/Portals/2/docs/civilworks/RGLS/rgl08_03.pdf [Accessed 2 March 2015]

USACE. 2008b. Navigable waters of the U.S. in Washington State. U.S. Spreadsheet produced by Army Corps of Engineers, Seattle District. 31 December http://www.nws.usace.army.mil/Portals/27/docs/regulatory/permit%20guidebook/Navigable_Waters_of_the_US_in_WA_State.pdf [Accessed 18 September 2015]

USACE. 2009. Columbia River estuary floodplain wetted area model: The evaluation of salmon habitat opportunity for restoration program planning, prioritization, design, assessment and reporting and other operations requirements. Version 3, HLD. http://cw-environment.usace.army.mil/restore/freshmarsh/pdfs/CRE%20Wetted%20Area%20Modeling%20051909.pdf [Accessed 2 March 2015]

USACE. 2014. National wetland plant list. Version 3.2. U.S. Army Corps of Engineers, Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire. http://rsgisias.crrel.usace.army.mil/NWPL/ [Accessed on 1 September 2015]

USACE and EPA. 2008. Compensatory mitigation for losses of aquatic resources. Federal Register 73: 19594–19705. http://www.gpo.gov/fdsys/pkg/FR-2008-04-10/html/E8-6918.htm [Accessed 25 February 2015]

USACE, Ecology, and WDFW. 2012. Interagency regulatory guide: Advance permittee-responsible mitigation. Ecology Publication #12-06-015. https://fortress.wa.gov/ecy/publications/publications/1206015.pdf [Accessed on 26 August 2015]

USBR (U.S. Bureau of Reclamation). 2012. Biological Assessment of effects to species and critical habitat for thirteen anadromous salmon ESUs, Pacific eulachon, green sturgeon, and killer whales in the Columbia River basin from implementation of the Modified Partial Groundwater Irrigation Replacement Alternative (Alternative 4A).: Odessa Subarea Special Study—Columbia Basin Project, Washington. Prepared by the U.S. Department of the Interior, Bureau of Reclamation, Pacific Northwest Region, Columbia-Cascades Area Office for the National Oceanic and Atmospheric Administration, National Marine Fisheries Service. http://www.usbr.gov/pn/programs/esa/wash/odessa/ba-odessa.pdf [Accessed 15 October 2015]

USBR. 2013. Record of decision for the Odessa Subarea special study final environmental impact statement—Columbia Basin Project, Washington. Prepared by the U.S. Department of the Interior, Bureau of Reclamation, Pacific Northwest Region, Columbia-Cascades Area Office. http://www.usbr.gov/pn/programs/eis/odessa/odessarod.pdf [Accessed 15 October 2015]

USFWS (U.S. Fish and Wildlife Service). No date. Pacific Flyway map. Pacific Flyway Council. http://pacificflyway.gov/Documents/Pacific_map.pdf [Accessed 18 September 2015]

USFWS. 1983. Revised Columbian white-tailed deer recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. http://www.fws.gov/ecos/ajax/docs/recovery_plan/830614.pdf [Accessed on 11 September 2015]

USFWS. 2001. National wildlife refuge system (Part 601): Chapter 3—Biological integrity, diversity, and environmental health. Fish and Wildlife Service Manual. 16 April. http://www.fws.gov/policy/601fw3.html [Accessed on 16 September 2015]

USFWS. 2003. Guidance for the establishment, use, and operation of conservation banks. Memorandum to Regional Directors of Regions 1–7 and Manager of California Nevada Operations from U. S. Fish and Wildlife Director, Washington, D. C. 2 May. https://www.fws.gov/endangered/esa-library/pdf/Conservation_Banking_Guidance.pdf [Accessed 10 March 2015]

USFWS. 2007. Endangered and threatened wildlife and plants; removing the bald eagle in the lower 48 states from the list of endangered and threatened wildlife. Final Rule. Federal Register 72: 37346–37372. http://www.fws.gov/pacific/ecoservices/documents/baldeaglefinaldelistingpublished.pdf [Accessed 18 September 2015]

USFWS. 2008. Strategic habitat conservation handbook: A guide to implementing the technical elements of strategic habitat conservation (Version 1.0). Report from the National Technical Assistance Team. http://www.fws.gov/landscape-conservation/pdf/SHCHandbook.pdf [Accessed 17 September 2015]

USFWS. 2010. Ridgefield National Wildlife Refuge comprehensive conservation plan. Final Plan. Prepared by Ridgefield National Wildlife Refuge Complex, Ridgefield, Washington and U.S. Fish and Wildlife Service, Pacific Northwest Planning Team, Portland, Oregon. http://www.fws.gov/pacific/planning/main/docs/wa/docsridgefield.htm [Accessed 18 September 2015]

USFWS. 2011. Traditional ecological knowledge for application by service scientists. U.S. Fish and Wildlife Service Fact Sheet. http://www.fws.gov/nativeamerican/pdf/tek-fact-sheet.pdf [Accessed 25 February 2015]

USFWS. 2013a. Columbia River Distinct Population Segment of the Columbian white-tailed deer (*Odocoileus virginianus leucurus*) 5-year review: Summary and evaluation. http://www.fws.gov/uploadedFiles/Region_1/NWRS/Zone_2/Willapa_Complex/Julia_Butler_Hansen/Documents/CWTD%205%20%20year%20Review.pdf [Accessed on 15 September 2015]

USFWS. 2013b. List of migratory bird species protected by the Migratory Bird Treaty Act as of December 2, 2013. http://www.fws.gov/migratorybirds/regulationspolicies/mbta/List%20of%20MBTA%20Protected%20Species%20December%202013.pdf [Accessed 18 September 2015]

USFWS. 2013c. General provisions; revised list of migratory birds. Final Rule. Federal Register 78: 65844–65864. http://www.gpo.gov/fdsys/pkg/FR-2013-11-01/pdf/2013-26061.pdf [Accessed 18 September 2013]

USFWS. 2014a. Strategic Habitat Conservation website. http://www.fws.gov/landscape-conservation/ [Accessed 17 September 2015]

USFWS. 2014b. Strategic conservation management in Oregon's Willamette Valley: Surrogate Species Pilot 1.0. Review Copy. U.S. Fish and Wildlife Service, Region 1, Portland, Oregon. http://www.fws.gov/oregonfwo/documents/SurrogateSpeciesPilot1.0.pdf [Accessed 16 September 2015]

USFWS. 2014c. Translocation—an effort to save Columbian white-tailed deer. Julia Butler Hansen Refuge website. http://www.fws.gov/jbh/translocation.html#progress [Accessed 16 October 2015]

USFWS. 2015a. Wetlands mapper. National Wetlands Inventory website. http://www.fws.gov/wetlands/Data/Mapper.html [Accessed 16 September 2015]

USFWS. 2015b. Streaked horned lark. Species fact sheet. Oregon Fish and Wildlife Office website. http://www.fws.gov/oregonfwo/Species/Data/StreakedHornedLark/ [Accessed 14 September 2015]

USFWS. 2015c. Eagles in the Pacific Northwest website. http://www.fws.gov/pacific/eagle/ [Accessed on 15 September 2015]

USGS (U.S. Geologic Survey). 2014. Columbia River estuary ecosystem classification hydrogeomorphic reach. U.S. Geologic Survey vector digital geospatial data, Reston, Virginia. http://water.usgs.gov/GIS/metadata/usgswrd/XML/creec_hydrogeomorphic_reach.xml [Accessed 10 March 2015]

Usher, P. J. 2000. Traditional ecological knowledge in environmental assessment and management. Arctic 53(2):183–193. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.474.5055&rep=rep1&type=pdf [Accessed 25 February 2015]

Viste-Sparkman, K. 2006. White-breasted nuthatch density and nesting ecology in oak woodlands of the Willamette Valley, Oregon. Fisheries and Wildlife Master's Thesis. Oregon State University, Corvallis, Oregon.

Ward E. J., J. H. Anderson , T. J. Beechie, G. R. Pess, and M. J. Ford. 2015. Increasing hydrologic variability threatens depleted anadromous fish populations. Global Change Biology 21(1): 1–10.

Washington State Department of Natural Resources. 2015. Washington Natural Heritage Program website. http://www.dnr.wa.gov/natural-heritage-program [Accessed on 15 September 2015]

Watson, J. W., and D. J. Pierce. 2001. Skagit River bald eagles: movements, origins, and breeding population status. Final Report. Washington Department of Fish and Wildlife, Olympia, Washington.

WDFW (Washington Department of Fish and Wildlife). 2000. State of Washington alternative mitigation policy guidance for aquatic permitting requirements from the Departments of Ecology and Fish and Wildlife. http://wdfw.wa.gov/publications/00972/ [Accessed 2 March 2015]

WDFW. 2008. Priority habitats and species list. Olympia, Washington. http://wdfw.wa.gov/publications/00165/wdfw00165.pdf [Accessed on 11 September 2015]

WDFW 2013. Threatened and endangered wildlife in Washington. 2012 Annual Report. Washington Department of Fish and Wildlife, Wildlife Program, Listing and Recovery Section, Olympia, Washington. http://wdfw.wa.gov/publications/01542/wdfw01542.pdf [Accessed on 11 September 2015]

WDFW. 2015a. Priority habitats and species (PHS). Conservation Program website. http://wdfw.wa.gov/conservation/phs/ [Accessed on 14 September 2015]

WDFW 2015b. Priority habitats and species in the vicinity of T04R01W Section 1. PHS Polygon Report and Map. State of Washington, Department of Fish and Wildlife, Olympia, Washington. 24 February.

WDNR (Washington Department of Natural Resources). 2015. Wetlands information available from the Washington Natural Heritage Program. Reference desk of the Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia, Washington. http://www1.dnr.wa.gov/nhp/refdesk/datasearch/index.html [Accessed 15 September 2015]

Weitkamp, L. A., P. J. Bentley, and M. N. C. Litz. 2012. Seasonal and interannual variation in juvenile salmonids and associated fish assemblage in open waters of the lower Columbia River estuary. Fishery Bulletin 110(4):426–450. http://fishbull.noaa.gov/1104/weitkamp.pdf [Accessed 12 March 2015]

Wells, G. and D. Anzinger. 2001. Lewis and Clark meet Oregon's Forests: Lessons from dynamic nature. Oregon State University Press, Corvallis, Oregon.
Western Governors' Association. 2014. Letter to United States Department of the Interior Secretary Sally Jewell, Washington, D.C. from John Hickenlooper, Governor, State of Colorado and WGA Chairman and Brian Sandoval, Governor, State of Nevada and WGA Vice Chairman. 21 January. http://webcache.googleusercontent.com/search?q=cache:OtV6pxNzGGUJ:www.westgov.org/component/docman/doc_download/1804-order-3330-letter%3FItemid%3D+&cd=1&hl=en&ct=clnk&gl=us [Accessed on 25 August 2015]

Wickersham, J., transcriber. 1887. List of donation land claims in Washington Territory. http://www.sos.wa.gov/legacy/publications_detail.aspx?p=43 [Accessed 10 March 2015]

Willamette Partnership. 2013. Ecosystem credit accounting system: General crediting protocol Version 2.0. Prepared by Willamette Partnership, Portland, Oregon. http://willamettepartnership.org/wp-content/uploads/2014/09/General-Crediting-Protocol-2.0.pdf [Accessed on 15 October 2015]

Witmer, G. W. and J. C. Lewis. 2001. Introduced wildlife of Oregon and Washington. USDA National Wildlife Research Center – Staff Publications. University of Nebraska, Lincoln, Nebraska. http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1652&context=icwdm_usdanwrc [Accessed on 25 August 2015]

FIGURES

THIS PAGE IS INTENTIONALLY LEFT BLANK

APPENDICES

APPENDIX A

List of scientific and common names for all biota observed within the PN Farm property

Table A-1. List of all vascular and non-vascular plants, fungi, and algae found within the PN Farm property as of 13 October 2015.

Scientific name	Common name
Acer circinatum	Vine maple
Acer macrophyllum	Big-leaf maple
Achillea millefolium	Common yarrow
Agrostis sp.	Bentgrass species
Agrostis stolonifera	Creeping bentgrass
Agrostis capillaris	Colonial bentrgrass
Aira caryophyllea	Silver hairgrass
Alopecurus aequalis	Shortawn foxtail
Alopecurus geniculatus	Water foxtail, marsh foxtail
Alopecurus pratensis	Meadow foxtail
Amelanchier alnifolia	Saskatoon serviceberry
Anthemis cotula	Stinking mayweed
Anthoxanthum odorata	Sweet vernal grass
Apocynum cannabinum	Hemp dogbane
Argentina anserina	Silverweed
Baptisia australis	Blue false indigo
Bidens cernua	Nodding beggarstick
Bidens frondosa	Devils beggartick
Callitriche heterophylla	Twoheaded water-starwort
Capsella bursa-pastoris	Shepherd's purse
Carex deweyana	Dewey's sedge
Carex macrocephala	Largehead sedge
Carex obnupta	Slough sedge
Carex utriculata	Swollen beaked sedge
Ceratophyllum demersum	Common hornwort, coontail
Chamerion angustifolium	Fireweed
Cirsium arvense	Canada thistle
Cirsium vulgare	Bull thistle
Claytonia sibirica	Siberian springbeauty
Conyza canadensis	Canadian horseweed
Coreopsis tentoria	Columbia coreopsis
Cornus sericea	Redosier dogwood
Corylus cornuta	Beaked hazelnut
Crataegus douglasii	Black hawthorn
Cuscuta salina	Marsh dodder
Cynodon dactylon	Bermuda grass
Cyperus strigosus	False nutsedge
Cytisus scoparius	Scotch broom
Daucus carota	Queen Anne's lace
Delphinium menziesii	Menzies' larkspur
Dianthus armeria	Deptford pink
Dichelostemma congestum	Forktooth ookow
Digitalis purpurea	Foxglove
Digitaria sanguinalis	Hairy crabgrass
Dipsacus fullonum	Fuller's teasel
Dryopteris sp.	Woodfern
Echinochloa crus galli	Barnyard grass
Eleocharis acicularis	Needle spikerush
Eleocharis palustris	Creeping spikerush
Elodea canadensis	American waterweed, broad waterweed
Elodea canadensis	Water weed

Scientific name	Common name
Epilobium ciliatum	Fringed willowherb
Equisetum arvense	Horsetail
Equisetum hyemale	Scouringrush horsetail
Eragrostis spp.	Lovegrass species
Erodium cicutarium	Storks bill
Festuca arundinacea	Tall fescue
Fontinalis antipyretica	Common water moss
Fragaria virginiana	Virginia strawberry
Frangula purshiana	Cascara buckthorn
Fraxinus latifolia	Oregon ash
Galium aparine	Cleavers bedstraw
Galium trifidum	Small bedstraw
Geranium dissectum	Cutleaf geranium
Geranium molle	Dovesfoot geranium
Geranium robertianum	Robert geranium
Gnaphalium uliginosum	Marsh cudweed
Helenium autumnale	Common sneezeweed
Hippuris vulgaris	Mare's tail
Holcus lanatus	Velvetgrass
Holodiscus discolor	Oceanspray
Hydrocotyle ranunculoides	Pennywort
Hypericum perforatum	St. Johnswort
Hypochaeris radicata	Hairy cat's ear
Impatiens ecornuta	Spurless touch-me-not
Iris pseudacorus	Yellow flag iris
Juncus acuminatus	Tufted rush
Juncus effusus	Common rush
Juncus tenuis	Poverty Rush
Lactuca serriola	Prickly lettuce
Leersia oryzoides	Rice cutgrass
Leucanthemum vulgare	Oxeye daisy
Lilaeopsis occidentalis	Western grasswort
Lilium occidentale	Western lily
Limosella aquatica	Water mudwort
Lindernia dubia	Moist bank pimpernel
Lolium perenne	Perennial ryegrass
Lomatium sp.	Desert parsley
Lonicera involucrata	Twinberry
Lotus corniculatus	Bird's foot trefoil
Ludwigia palustris	Water purslane
Lysimachia nummularia	Creeping jenny
Lythrum portula	Spatulaleaf loosestrife
Maianthemum racemosum	Feathery false lily of the valley
Malus fusca	Pacific crabapple
Marchantia polymorpha	Common liverwort
Marchantia spp.	Liverwort species
Mentha arvensis	Wild mint
Mentha pulegium	Pennyroyal
Mimulus ringens	Square-stemmed monkeyflower
Myriophyllum hippuroides	Western water milfoil
Myriophyllum spicatum	Eurasian milfoil
Nuphar lutea polysepala	Spatterdock, yellow pond lily
Oenothera biennis	Evening primerose
Panicum occidentale	Panic grass

Scientific name	Common name
Paspalum distichum	Knotgrass
Phalaris arundinacea	Reed canarygrass
Pinus ponderosa	Ponderosa pine
Plantago lanceolata	Narrowleaf plantain
Plantago major	broadleaf plantain
Polygonum amphibium	Water smartweed
Polygonum hydropiper	Water pepper
Polygonum hydropiperoides	Mild water pepper
Polygonum persicaria	Lady thumb
Polystichum munitum	Swordfern
Populus balsamifera trichocarpa	Black cottonwood
Potamogeton crispus	Curly pondweed
Prunella vulgaris	Common selfheal
Pseudohydnum gelatinosum	Jelly fungus
Pseudotsuga menziesii	Douglas-fir
Quercus garryana	Oregon white oak
Ranunculus repens	Creeping buttercup
Rorippa curvisiliqua	Western yellow cress
Rorippa palustris	Bog yellowcress
Rosa nutkana	Nootka rose
Rubus armeniacus	Himalayan blackberry
Rubus laciniatus	Cutleaf blackberry
Rubus leucodermis	Whitebark raspberry
Rubus parviflorus	Thimbleberry
Rubus ursinus	Trailing blackberry
Rumex acetosella	Common sheep sorrel
Rumex crispus	Curly dock
Rumex occidentalis	Western dock
Sagittaria latifolia	Wapato
Salix columbiana	Columbia River willow
Salix fluvatilis	Sand bar willow
Salix lucida lasiandra	Pacific willow
Salix sitchensis	Sitka willow
Salix spp.	Willow species
Sambucus nigra cerulea	Blue elderberry
Scirpus acutus	Hardstem bulrush
Scirpus atrocinctus	Woolsedge
Senecio riddellii	Riddell's ragwort
Solanum dulcamara	Bittersweet nightshade
Sparganium emersum	Narrowleaf bur-reed
Spiraea douglasii	Douglas' spiraea
Spirodela polyrrhiza	Duckweed, duckmeat
Symphoricarpos albus	Snowberry
Symphyotrichum subspicatum	Douglas aster
Taraxacum officinale	Dandylion
Thuja plicata	Western red cedar
Tolmiea menziesii	Piggyback plant
Toxicodendron diversilobum	Pacific poison oak
Trifolium arvense	Rabbitfoot clover
Trifolium pratense	Red clover
Trifolium repens	White clover
Trillium sp.	Trillium species
Typha latifolia	Giant cattail
Urtica dioica	Stinging nettle

Scientific name	Common name
Utricularia minor	Lesser bladderwort
Veronica americana	American speedwell
Veronica scutellata	Marsh speedwell
Viburnum ellipticum	Common viburnum
Viola glabella	Pioneer violet
Xanthium strumarium	Rough cocklebur

Table A-2. List of all fish and aquatic and terrestrial wildlife species found within the PN Farm property as of 13 October 2015.

Scientific name	Common name
Acrocheilus alutaceus	Chiselmouth
Actinemys marmorata	Western pond turtle
Actitis macularia	Spotted sandpiper
Agelaius phoeniceus	Red-winged blackbird
Aix sponsa	Wood duck
Ambystoma gracile	Northwestern salamander
Ambystoma macrodactylum	Long-toed salamander
Ameiurus natalis	Yellow bullhead
Ameiurus nebulosus	Brown bullhead
Anas americana	American wigeon
Anas clypeata	Northern shoveler
Anas platyrhynchos	Mallard
Anodonta sp.	Floater mussel species
Aphelocoma califorinica	Western scrub-jay
Ardea alba	Great egret
Ardea herodias	Great blue heron
Aythya collaris	Ring-necked duck
Bombycilla cedrorum	Cedar waxwing
Branta canadensis	Canada goose
Branta hutchinsii	Cackling goose
Bubo virginianus	Great horned owl
Bubulcus ibis	Cattle egret
Bucephala albeola	Bufflehead
Bucephala clangula	Common goldeneye
Buteo jamaicensis	Red tailed hawk
Calidris mauri	Western sandpiper
Calypte anna	Anna's hummingbird
Canis latrans	Coyote
Cardellina pusilla	Wilson's warbler
Castor canadensis	North American beaver
Cathartes aura	Turkey vulture
Catharus guttatus	Hermit thrush
Catharus ustulatus	Swainson's thrush
Certhia americana	Brown creeper
Chaetura vauxi	Vaux's swift
Charadrius vociferus	Killdeer
Chrysemys picta belli	Western painted turtle
Colaptes auratus	Northern flicker
Contopus sordidulus	Western wood-pewee
Corvus brachyrhynchos	American crow
Corvus corax	Common raven
Cottoidea sp.	Sculpin species

Scientific name	Common name
Cyanocitta stelleri	Steller's jay
Cygnus buccinator	Trumpeter swan
Cygnus columbianus	Tundra swan
Cyprinus carpio	Common carp
Danaus plexippus	Monarch butterfly
Didelphis virginianus	Opossum
Dryocopus pileatus	Pileated woodpecker
Empidonax difficilis	Pacific slope flycatcher
Empidonax traillii	Willow flycatcher
Entosphenus tridentatus	Pacific lamprey
Eumetopias jubatus	Stellar's sea lion
Euphagus cyanocephalus	Brewer's blackbird
Fundulus diaphanus	Banded killifish
Gallinago gallinago	Common snipe
Gambusia affinis	Western mosquitofish
Gasterosteus aculeatus	Three-spined stickleback
Glaucomys sabrinus	Northern flying squirrel
Grus canadensis	Sandhill crane
Haemorhous mexicanus	House finch
Haemorhous purpureus	Purple finch
Haliaeetus leucocephalus	Bald eagle
Hirundo rustica	Barn swallow
Icterus bullockii	Bullock's oriole
Ictalurus punctatus	Channel catfish
Ixoreus naevius	Varied thrush
Junco hyemalis	Dark-eyed junco
Laridae spp.	Gull species
Larus delawarensis	Ring-billed gull
Larus glaucescens	Glaucous-winged gull
Lepomis gibbosus	Pumpkinseed sunfish
Lepomis gulosus	Warmouth
Lepomis macochirus	Bluegill
Lithobates catesbeianus	American bullfrog
Lophodytes cucullatus	Hooded merganser
Lutra canadensis	River otter
Lynz rufus	Bobcat
Megaceryle alcyon	Belted kingfisher
Melospiza melodia	Song sparrow
Mephitis mephitis	Striped skunk
Mergus merganser	Common merganser
Molothrus ater	Brown-headed cowbird
Mustela vison	Mink
Mylochelius caurinus	Peamouth
Myocastro coypus	Nutria
Odocoileus hemionus columbianus	Black-tailed deer
Odocoileus virginianus leucurus	Columbian white-tailed deer
Oncorhynchus clarki	Cutthroat trout
Onocorhynchus kisutch	Coho salmon
Oncorhynchus mykiss	Steelhead, rainbow trout
Onocorhynchus tshawytscha	Chinook salmon
Onocorhynuchus keta	Chum salmon
Oreothlypis celata	Orange-crowned warbler
Otospermophilus beecheyi	California ground squirrel

Scientific name	Common name
Pacifastacus leniusculus	Signal crayfish
Pandion haliaetus	Osprey
Passer domesticus	House sparrow
Passerculus sandwichensis	Savannah sparrow
Passerella iliaca	Fox sparrow
Passerina amoena	Lazuli bunting
Patagioenas fasciata	Band-tailed pigeon
Pelecanus erythrorhynchos	American white pelican
Peromyscus maniculatus	Deer mouse
Petrochelidon pyrrhonota	Cliff swallow
Phalacrocorax auritus	Double-crested cormorant
Pheucticus melanocephalus	Black-headed grosbeak
Picoides pubescens	Downy woodpecker
Pipilo maculatus	Spotted towhee
Piranga ludoviciana	Western tananger
Platichthys stellatus	Starry flounder
Poecile atricapilla	Black-capped chickadee
Poecile rufescens	Chestnut-backed chickadee
Pomoxis annularis	White crappie
Pomoxis nigromaculatus	Black crappie
Procyon lotor	Common raccoon, northern raccoon
Progne subis	Purple martin
Pseudacris regilla	Pacific chorus frog
Ptychocheilus oregonensis	Northern pikeminnow
Rallus longirostris	Virginia rail
Rana aurora	Red-legged frog
Regulus calendula	Ruby-crowned kinglet
Regulus satrapa	Golden-crowned kinglet
Rhinichthys cataractae	Long-nosed dace
Sciurus carolinensis	Eastern grey squirrel
Selasphorus rufus	Rufous hummingbird
Setophaga coronata	Yellow-rumped warbler
Setophaga dominica	Common yellow throat warbler
Setophaga nigrescens	Black-throated gray warbler
Setophaga petechia	Yellow warbler
Setophaga townsendi	Townsend's warbler
Sitta canadensis	Red-breasted nuthatch
Sitta carolinensis	White-breasted nuthatch
Sphyrapicus ruber	Red-breasted sapsucker
Spinus tristis	American goldfinch
Spizella passerina	Chipping sparrow
Stelgidopteryx serripennis	Northern rough-winged swallow
Strix varia	Barred owl
Sturnus vulgaris	European starling
Sylvilagus floridanus	Eastern cottontail rabbit
Tachycineta bicolor	Tree swallow
Tamias semex	Allen's chipmunk
Tamias townsendi	Townsend's chipmunk
Taricha granulosa	Rough skinned newt
Thaleichthye pacificus	Eulachon, Columbia river smelt
Thamnophis sirtalis	Common garter snake
Thryomanes bewickii	Bewick's wren
Tringa melanoleuca	Greater yellowlegs

Scientific name	Common name
Tringa solitaria	Solitary sandpiper
Trochilidae sp.	Hummingbird species
Troglodytes aedon	House wren
Troglodytes pacificus	Pacific wren
Turdus migratorius	American robin
Tyto alba	Barn owl
Vireo Huttoni	Hutton's vireo
Zenaida macroura	Mourning dove
Zonotrichia atricapilla	Golden-crowned sparrow

APPENDIX B

Definitions of terminology, acronyms, and abbreviations

TERMINOLOGY

Term	Definition
At-risk species	Species listed by the National Marine Fisheries Service and U.S. Fish and Wildlife Service which as (1) endangered or threatened under the ESA; (2) proposed for listing under the ESA; (3) candidates for listing under the ESA; (4) likely to become candidates for listing in the near future; or species that are (5) listed as threatened or endangered (or similar classification) under Washington State law; and (6) Washington State species of conservation concern (USFWS 2003, The Conservation Fund 2013).
Biodiversity bank	Site used to offset the impacts of development leading to reductions in biodiversity values (NSW Department of Environment and Climate Change 2007).
Bundled credits	Credits representing a collection of spatially overlapping ecosystem services or resources as single commodities. Bundled credits are appropriate as mitigation for impacts that are also bundled.
Compensatory mitigation	The restoration, establishment (creation), enhancement, and/or preservation of aquatic resources to offset unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved (33 CFR Section 332.2).
Conservation bank	A site (or suite of sites) containing natural resource values that are conserved and managed in perpetuity for specified endangered, threatened, or other at-risk species and is used to offset impacts occurring elsewhere to the same resource values (i.e., in-kind, off-site compensatory offsets). Conservation banking should result in a net species conservation benefit (e.g., contributes to the recovery of federally listed species) (USFWS 2003, The Conservation Fund 2013).
Credit zones	Unique credits types adjacent to but spatially distinct from other credit types.
Double-dipping	Selling the same ecosystem service credit, however defined, multiple times. Also called double-selling.
Ecological lift	A net positive change in the biological communities or populations within a targeted area (Cranon 2013).
Ecosystem services (or environmental services	Economically valuable services provided by natural resource components of intact ecosystems such as habitat, water quality, water temperature, carbon sequestration, flood control, salinity reduction, pollination services, and a host of other such services that are beneficial to humans
Historical ecology	The interface between ecology and historical geography that undertakes studies of lost or degenerated historic ecosystems (Dirkx 1999 in Egan and Howell 2001).
Indicator species	USFWS surrogate species category (USFWS 2014b as adapted from Caro and O'Doherty 1999) used to "assess the magnitude of anthropogenic disturbance, to monitor population trends in other species, and to locate high areas of regional diversity."
Joint bank	A combined mitigation bank and conservation bank (as defined in this terminology table) that provides a more holistic approach to stewardship for aquatic resources (e.g., wetlands, streams, riparian areas) and endangered, threatened, or other at-risk species. (The Conservation Fund 2013)

Term	Definition
Keystone species	USFWS surrogate species category (USFWS 2014b as adapted from Mills et al. 1993 and Power et al. 1996) used to denote "species whose impact on community or ecosystem is disproportionately large relative to its abundance."
Mitigation	A process including Avoidance of the Resource Impact (a permit cannot be issued if there is a less damaging practicable alternative (40 CFR 230.10[a]), Minimization of adverse impacts through modification of the project and permit condition (40 CFR 230.10[d]), and finally Compensation (as defined above) for unavoidable adverse impacts.
Stacked credit	A credit representing two or more spatially overlapping ecosystem services as separate commodities, each compensating for different permitted impacts. Stacked credits are appropriate as mitigation for sites that have impacts to multiple ecosystem services or resources.
Succession	Changes in species composition of plants and animals in an ecosystem with time, often in a predictable order. More specifically, the gradual and natural progression of physical and biological changes, especially in trophic structure of an ecosystem, toward a climax condition or stage (Armantrout 1998).
TEK	Refers specifically to all types of knowledge about the environment derived from experience and traditions of a particular group of people (Usher 2000).
Umbrella species	USFWS surrogate species category (USFWS 2014b as adapted from Caro and O'Doherty 1999) used to "delineate the type of habitat or size of area for protection."
Wetland mitigation bank	A site (or suite of sites) where aquatic resources (e.g., wetlands, streams, riparian areas) are created, restored (re-established), established, enhanced, and/or preserved for the purpose of providing compensatory mitigation for impacts to similar aquatic resources authorized by permits issued by the Department of the Army Corps of Engineers.

ABBREVIATIONS AND ACRONYMS

Term	Definition
AFF	American Forest Foundation
ALLCS	Agricultural Lands of Long-term Significance
ATFS	American Tree Farm System
BLM	U.S. Department of Interior, Bureau of Land Management
BPA	Bonneville Power Administration
CEERP	Columbia Estuary Ecosystem Restoration Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
CRD	Columbia River datum
CPW	Conservation Project Workshop, P.S.
CRE	Columbia River estuary
CWA	Clean Water Act
DCH	Designated Critical Habitat
DLC	Donation Land Claim Act
DNR	Washington State Department of Natural Resources
DPS	Distinct Population Segment
Ecology	State of Washington's Department of Ecology
FCRPS	Federal Columbia River Power System
EFH	Essential Fish Habitat
EPA	United States Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ESA	Federal Endangered Species Act
ESU	Evolutionarily Significant Unit
FAC	facultative plants
FACU	facultative upland plants
FACW	facultative wetland plants
FWCA	Fish and Wildlife Coordination Act
GIS	Geographic Information System
GLO	USDI BLM's General Land Office
GMA	Washington State's Growth Management Act
HGM	hydrogeomorphic
IBIS	Integrated Biodiversity Information System
IRT	Interagency Review Team
LCFRB	Lower Columbia Fish Recovery Board
LCR	lower Columbia River
MBTA	Migratory Bird Treaty Act
MHW	Mean High Water
MHHW	Mean Higher High Water
MHWL	Mean High Water Line
MLW	Mean Low Water
MLLW	Mean Lower Low Water
MSA	Magnuson-Stevens Act
N/A	not applicable
NBII	National Biological Information Infrastructure

Term	Definition
NEPA	National Environmental Policy Act
NGO	Non-governmental organization
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRCS	U.S. Department of Agriculture, Natural Resources Conservation Service
NWI	National Wetlands Inventory
OBL	obligate wetland plant
ODLL	Oregon Donation Land Law
OHW	Ordinary High Water
OHWM	Ordinary High Water Mark
PHaCS	Pacific Northwest Habitat Classification System
PHS	Priority Habitats and Species
PNNL	Pacific Northwest National Laboratory
RCW	Revised Code of Washington
RM	river mile
RME	research, monitoring, and evaluation
RNWR	Ridgefield National Wildlife Refuge
SEPA	Washington State Environmental Policy Act
SHC	Strategic Habitat Conservation
SMA	Shoreline Management Act
TEK	Traditional Ecological Knowledge
USACE	U.S. Department of Defense, Army Corps of Engineers
USBR	U.S. Department of Interior, Bureau of Reclamation
USC	U.S. Government Code
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USFWS	U.S. Department of Interior, Fish and Wildlife Service
USGS	U.S. Department of Interior, Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WHCV	Wetlands of High Conservation Value
WHIP	Wildlife Habitat Incentives Program
WNHP	Washington Natural Heritage Program
WRIA	Water Resource Inventory Area